1998
NORTH DAKOTA
Weed Control Research

WEED SCIENCE

BIOLOGICAL

CULTURAL

CHEMICAL

NDSU

Weed Research Projects, Department of Plant Sciences
NORTH DAKOTA STATE UNIVERSITY
Fargo, N.D. 58105

NOT FOR PUBLICATION

SUMMARY OF 1998
WEED CONTROL EXPERIMENTS

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Alfalfa

Canola

Corn

Dry bean

Blue section cont.: **Weed control in Alfalfa, Canola, Corn, Dry Bean, Potato, Soybean, Sunflower, and Misc.**

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CLIMATIC DATA, 1998 Carrington

	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.09	0.18	0.00	0.00	0.00	51	31	54	36	81	42	84	54	83	66	75	44
2	0.00	0.00	0.06	0.00	0.28	0.00	56	28	63	36	45	35	82	61	72	66	82	44
3	0.00	0.00	0.00	0.00	0.01	0.00	57	30	72	31	60	33	76	57	78	63	90	50
4	0.00	0.00	0.00	0.00	0.02	0.00	56	29	68	40	57	35	78	51	80	60	92	51
5	0.35	0.00	0.00	0.82	0.00	0.00	47	36	74	35	58	38	70	62	86	55	82	55
6	0.07	0.00	0.00	0.14	0.00	0.00	44	35	59	34	61	35	79	62	84	57	77	46
7	0.02	0.28	0.00	0.04	0.00	0.00	38	33	54	34	65	32	78	58	85	53	74	39
8	0.00	0.53	0.00	0.00	0.00	0.00	48	31	52	46	69	36	82	58	89	55	74	44
9	0.00	0.07	0.04	0.00	0.00	0.00	56	29	62	49	65E	50E	87	58	87	55	82	59
10	0.00	0.17	0.13	0.00	0.00	0.00	61	36	68	52	68	49	87	64	92	56	96	63
11	0.00	0.01	0.01	0.00	0.00	0.00	70	32	67	46	70	46	86	67	86	60	82	61
12	0.16	0.00	0.02	0.13	0.02	0.44	58	48	69	44	75	53	83	63	91	67	70	53
13	0.02	0.00	0.00	0.00	0.04	0.03	59	40	74	39	83	52	88	62	90	61	74	57
14	0.00	0.00	0.12	0.23	0.00	0.00	46	29	70	55	66	56	88	61	76	51	76	50
15	0.00	0.01	0.00	0.00	0.00	0.00	46	25	72	55	72	51	76	52	75	47	78	43
16	0.00	0.00	0.00	0.01	0.00	0.00	52	24	75	50	72	47	76	48	86	58	89	64
17	0.00	0.00	0.03	0.00	0.00	0.00	58	31	83	49	68	62	80	58	78	49E	90	59
18	0.00	0.00	0.41	0.00	0.23	0.00	58	32	80	51	77	62	89	58	71	61	82	55
19	0.14	0.00	0.00	0.00	0.03	0.00	58	35	70	49	65	57	88	54	89	56	63	49
20	0.00	0.00	0.00	0.00	0.00	0.00	60	31	77	42	64	52	88	60	82	49	56	39
21	0.00	0.00	0.00	0.00	0.20	0.00	65	32	78	56	64	55	77	50	83	57	59	31
22	0.00	0.00	0.00	0.00	0.56	0.00	72	36	73	48	73	55	74	47	84	63	68	38
23	0.00	0.00	0.13	0.00	0.00	0.00	79	44	68	46	65	55	74	45	81	56	75	40
24	0.00	0.00	0.11	0.00	0.00	0.00	72	44	72	49	82	59	80	43	80	54	79	35
25	0.12	0.00	0.00	0.00	0.00	0.00	65	51	78	40	87	63	84	55	85	51	68	40
26	0.01	0.00	0.53	0.00	0.00	0.00	68	42	78	45	76	57	88	55	86	60	66	50
27	0.00	0.00	0.00	0.00	0.00	0.00	68	39	82	52	75	55	89	49	84	58	73	40
28	0.00	0.00	0.00	0.00	0.00	0.00	70	38	78	48	72	54	82	56	85	55	80	39
29	0.00	0.00	0.00	0.00	0.00	0.23	76	44	63	36	74	54	80	50	81	49	68	40
30	0.00	0.52	0.02	0.00	0.00	0.04	82	52	73	46	79	58	77	43	85	50	52	30
31		0.00		0.00	0.01				68	39			79	46	92	56		
Total	0.89	1.68	1.79	1.37	1.40	0.74	58	34	70	44	69	52	82	55	83	57	73	45

	CLIMATIC DATA, 1998 Casselton																	
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.00	0.00	0.00	0.19	46	32	79	50	66	54	81	57	81	51	89	51
2	0.00	0.00	0.15	0.00	0.00	0.00	55	29	65	43	85	42	86	57	85	63	76	45
3	0.00	0.00	0.05	1.08	0.15	0.00	56	28	70	39	51	36	80	63	75	63	85	49
4	0.00	0.00	0.00	0.00	0.00	0.00	58	32	72	47	64	37	75	55	70	62	83	48
5	0.00	0.00	0.00	0.66	0.03	0.00	56	35	71	40	61	44	79	58	86	60	89	57
6	0.37	0.00	0.00	0.00	0.00	0.00	47	43	79	43	62	41	78	63	87	58	84	49
7	0.07	0.06	0.00	0.78	0.00	0.00	48	39	74	38	64	37	81	62	88	58	76	46
8	0.06	0.07	0.00	0.00	0.00	0.00	43	33	55	47	70	40	84	63	87	55	75	40
9	0.00	0.62	0.00	0.00	0.00	0.00	44	38	54	48	75	48	85	63	88	58	75	42
10	0.00	0.20	0.00	0.00	0.00	0.00	54	33	72	50	73	49	87	65	86	55	83	58
11	0.00	0.62	0.51	0.00	0.00	0.00	64	36	73	52	71	52	88	67	90	58	94	58
12	0.00	1.12	0.00	0.00	0.00	0.00	73	39	67	49	75	56	88	70	90	58	86	56
13	0.07	0.58	0.02	0.00	0.01	0.43	64	46	64	47	76	50	88	65	88	66	78	60
14	0.00	0.04	0.00	0.01	0.00	0.22	58	31	72	47	81	58	92	70	92	64	68	56
15	0.00	0.16	0.15	0.00	0.00	0.00	42	27	83	60	79	59	95	61	79	48	82	44
16	0.00	1.60	0.00	0.00	0.00	0.00	48	24	74	58	69	55	86	51	80	56	77	49
17	0.00	0.00	0.06	0.02	0.00	0.00	54	28	75	51	79	61	76	57	93	54	89	49
18	0.00	0.00	0.66	0.00	0.00	0.00	60	28	83	59	79	63	82	59	80	56	95	61
19	0.00	0.00	0.10	0.40	0.55	0.00	60	32	73	53	80	60	88	61	77	63	78	46
20	0.00	0.00	0.82	0.00	0.00	0.00	59	34	73	45	70	54	90	62	86	58	72	54
21	0.00	0.00	0.00	0.00	0.00	0.00	61	32	77	56	73	54	94	58	83	55	65	36
22	0.00	0.00	0.00	0.00	1.75	0.00	63	32	80	50	69	53	82	52	88	55	64	35
23	0.00	0.00	0.00	0.00	0.00	0.00	75	39	74	50	72	53	77	51	83	63	70	37
24	0.00	0.11	0.04	0.00	0.00	0.08	81	43	70	54	78	57	76	47	86	58	73	38
25	0.00	0.00	0.52	0.00	0.00	0.00	82	47	71	48	86	53	80	53	81	54	78	41
26	0.11	0.00	0.00	0.00	0.00	0.64	72	40	82	52	85	53	86	53	86	60	78	44
27	0.00	0.00	1.65	0.08	0.04	0.00	72	34	79	53	87	58	91	55	88	61	65	44
28	0.00	0.02	0.00	0.00	0.00	0.00	70	35	81	59	76	56	87	63	86	58	72	43
29	0.00	0.00	0.01	0.00	0.00	0.00	72	36	83	39	77	57	84	55	84	53	79	43
30	0.00	0.00	0.00	0.00	0.00	0.37	75	39	64	44	81	60	83	49	84	52	69	44
31		0.77		0.68	0.00				70	41			79	51	86	56		
Total	0.68	6.60	4.74	3.71	2.89	1.93	58	34	73	49	71	50	84	59	85	58	77	46

CLIMATIC DATA, 1998 Crookston																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.15	0.00	0.00	0.00	44	28	69	42	78	41	84	62	84	65	74	42
2	0.00	0.82	0.00	0.100.00	0.00	0.00	55	30	67	38	50	37	83	62	78	64	73	46
3	0.00	0.00	0.00	0.00	0.00	0.00	60	31	70	46	61	42	79	54	81	58	82	49
4	0.00	0.00	0.00	0.00	0.06	0.00	59	36	67	37	59	45	78	59	86	58	88	59
5	0.25	0.00	0.00	0.52	0.00	0.00	56	40	70	44	55	44	69	61	87	56	83	48
6	0.12	0.16	0.00	0.00	0.00	0.00	47	39	73	40	62	35	74	62	87	55	77	46
7	0.00	0.29	0.00	0.12	0.00	0.00	44	35	59	41	68	41	82	61	85	59	72	40
8	0.02	0.10	0.00	0.00	0.00	0.00	45	35	64	49	73	45	85	62	85	63	74	44
9	0.00	0.05	0.00	0.00	0.00	0.00	51	31	71	46	74	51	88	67	86	54	80	58
10	0.00	0.00	0.93	0.00	0.00	T	62	31	75	56	69	54	88	69	86	56	93	63
11	0.00	0.48	0.00	0.00	0.00	T	71	39	66	49	72	56	89	71	90	63	83	50
12	0.00	0.92	0.01	0.00	0.02	0.20	65	47	61	41	74	50	88	65	88	65	75	54
13	0.33	0.00	0.00	0.00	0.00	0.00	55	34	69	52	82	55	89	64	90	61	73	56
14	0.00	0.12	0.08	1.14	0.00	0.00	46	28	81	57	82	57	90	59	77	47	80	40
15	0.00	2.50	0.02	0.00	0.00	0.00	48	27	80	56	70	56	78	48	78	59	76	45
16	0.00	0.46	0.08	T	0.00	0.00	50	32	72	47	75	58	71	54	89	50	85	57
17	0.00	0.00	T	0.00	0.00	0.00	58	30	80	59	75	63	79	62	77	54	90	55
18	0.00	0.00	0.38	0.22	0.22	0.05	61	33	82	57	80	58	86	61	71	61	92	57
19	0.21	0.00	1.51	0.00	0.18	0.00	60	32	70	47	63	57	85	60	86	57	79	45
20	0.00	0.00	0.00	0.00	0.00	0.02	60	31	78	49	70	60	91	59	83	55	55	35
21	0.00	0.00	0.00	0.00	0.00	0.00	65	32	72	44	67	55	75	55	84	60	62	36
22	0.00	0.00	0.00	0.00	0.30	0.00	72	34	71	43	70	51	75	51	80	60	70	39
23	0.00	0.00	0.00	0.00	0.03	0.00	75	42	73	53	73	60	74	48	83	55	73	33
24	0.00	0.00	0.85	0.00	0.02	0.00	76	41	73	49	81	63	77	49	80	51	72	37
25	0.00	0.00	0.00	0.00	0.00	0.00	75	40	80	48	84	63	82	60	84	57	68	46
26	0.00	0.00	1.75	0.00	0.00	0.10	69	29	81	54	85	63	87	56	88	63	71	46
27	0.00	0.00	0.00	0.00	0.25	0.00	69	39	83	56	78	56	84	60	81	54	73	36
28	0.00	0.00	0.00	0.02	0.00	0.00	72	39	80	38	73	60	82	53	83	55	78	40
29	0.00	0.00	0.00	0.00	0.00	0.00	77	44	58	39	76	60	80	51	78	47	67	41
30	0.00	0.14	0.00	0.00	0.00	0.10	80	43	74	38	81	60	77	48	83	56	53	24
31		0.00		0.00	0.28				63	44			80	58	90	50		
Total	0.93	6.04	5.76	0.24	1.36	0.47	59	34	70	46	70	51	79	57	81	55	73	44

CLIMATIC DATA, 1998 Fargo																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.03	0.00	0.08	0.00	0.00	0.00	42	30	67	50	82	47	84	58	84	63	75	50
2	0.00	0.00	0.01	0.57	0.01	0.00	52	28	69	44	50	41	80	64	77	66	76	46
3	0.00	0.00	0.00	0.01	0.01	0.00	57	31	75	37	62	37	78	62	70	65	85	54
4	0.00	0.00	0.00	0.00	0.00	0.00	56	36	70	44	60	36	78	58	84	63	91	60
5	0.16	0.00	0.00	0.38	0.00	0.00	53	42	73	35	58	45	75	64	86	62	84	64
6	0.10	0.00	0.00	0.00	0.00	0.00	49	42	76	41	59	42	78	64	86	62	78	50
7	0.00	0.26	0.00	0.92	0.00	0.00	44	38	55	38	68	36	81	66	83	57	72	45
8	0.06	1.06	0.00	0.00	0.00	0.00	47	36	55	48	72	45	83	65	86	62	76	46
9	0.00	0.00	0.00	0.00	0.00	0.00	53	36	70	50	69	56	87	65	84	64	81	59
10	0.00	0.00	0.79	0.00	0.00	0.00	63	34	74	49	72	52	88	68	87	59	95	64
11	0.00	0.90	0.00	0.00	0.00	0.00	72	34	66	55	72	55	87	70	90	64	84	63
12	0.01	1.72	0.25	0.00	0.00	0.08	70	54	60	49	72	56	87	71	86	67	79	56
13	0.05	0.00	0.00	0.00	0.00	0.44	61	41	72	49	81	54	90	68	92	67	68	62
14	0.00	0.05	0.00	0.13	0.00	0.00	47	34	83	61	79	61	92	71	77	56	80	51
15	0.00	1.52	0.24	0.00	0.00	0.00	48	30	75	58	65	58	83	58	80	50	78	43
16	0.00	0.00	0.00	0.01	0.00	0.00	52	26	74	55	78	59	73	51	93	65	88	54
17	0.00	0.00	0.01	0.00	0.00	0.00	61	33	84	56	79	64	80	58	79	56	90	57
18	0.00	0.00	3.45	0.21	0.02	0.00	62	30	82	58	80	60	85	63	77	64	94	56
19	0.00	0.00	0.69	0.00	0.03	0.00	63	36E	71	51	69	61	88	60	85	70	81	52
20	0.00	0.00	0.00	0.00	0.00	0.00	61	32	77	51	72	57	93	66	82	57	60	43
21	0.00	0.00	0.00	0.00	0.00	0.00	66	33	76	58	69	60	81	57	86	61	62	33
22	0.00	0.00	0.00	0.00	1.02	0.00	73	35	73	52	70	53	76	54	84	65	69	38
23	0.00	0.06	0.00	0.00	0.00	0.08	80	46	69	54	77	57	75	50	86	63	72	45
24	0.00	0.00	0.02	0.00	0.00	0.00	80	46	72	55	86	65	78	49	80	58	77	40
25	0.00	0.00	0.09	0.00	0.00	0.03	72	48	80	50	84	65	84	55	86	54	68	45
26	0.00	0.00	1.23	0.00	0.00	1.17	70	41	80	53	86	64	88	64	87	63	66	50
27	0.00	0.26	0.00	0.00	0.38	0.00	68	39	83	57	76	61	86	54	84	68	70	48
28	0.00	0.00	0.00	0.00	0.00	0.00	70	39	81	53	76	58	81	59	86	58	77	46
29	0.00	0.00	0.00	0.00	0.00	0.05	74	41	62	40	78	60	81	56	79	53	67	47
30	0.00	0.77	0.00	0.00	0.00	0.24	79	45	71	50	80	63	76	50	83	52	55	35
31		0.02		0.00	0.04				62	41			81	53	88	60		
Total	0.41	6.62	6.86	2.23	1.51	2.09	60	37	72	50	70	53	82	60	84	61	74	48

CLIMATIC DATA, 1998 Hettinger																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.00	0.00	0.00	0.00	56	25	54	32	78	47	81	54	91	62	79	47
2	0.00	0.00	0.00	0.23	0.00	0.00	58	27	65	24	49	30	80	59	82	63	95	56
3	0.00	0.00	0.00	0.00	0.11	0.00	60	27	79	37	60	29	76	60	76	63	96	55
4	0.00	0.00	0.00	0.25	0.04	0.00	55	27	66	39	60	29	81	62	73	59	99	52
5	0.00	0.00	0.10	0.01	0.00	0.00	62	34	75	30	57	43	86	63	84	52	84	64
6	0.01	0.00	0.00	0.01	0.00	0.00	46	35	60	32	62	40	85	58	87	57	78	56
7	0.00	0.00	0.00	0.00	0.00	0.00	37	30	42	32	61	42	85	55	87	58	80	52
8	0.00	0.02	0.94	0.41	0.00	0.00	46	27	52	35	51	44	88	54	93	56	83	56
9	0.00	0.00	0.10	0.00	0.00	0.00	60	23	57	33	61	49	86	61	90	62	97	63
10	0.00	0.84	0.12	0.00	0.00	0.11	64	28	63	44	76	52	90	64	93	63	94	64
11	0.00	0.00	0.00	0.29	0.00	0.01	79	40	63	36	71	50	90	63	88	61	81	60
12	0.09	0.00	0.00	0.00	0.13	0.25	62	39	68	40	77	43	86	57	93	54	67	61
13	0.00	0.00	0.13	0.00	0.00	0.01	58	32	79	50	78	54	89	58	94	61	68	55
14	0.00	0.00	0.18	0.08	0.00	0.00	56	24	75	50	66	53	89	60	78	60	76	51
15	0.00	0.00	0.00	0.00	0.00	0.00	49	24	69	44	72	42	86	56	90	60	86	56
16	0.00	0.00	0.06	0.00	0.00	0.00	51	17	76	39	67	52	90	58	93	58	88	52
17	0.00	0.00	0.42	0.00	0.17	0.00	54	31	88	52	59	54	96	62	84	58	91	53
18	0.11	0.00	0.47	0.00	0.11	0.00	56	28	74	45	60	54	96	64	94	66	94	54
19	0.01	0.00	0.00	0.00	0.01	0.13	42	28	74	40	72	51	97	59	88	62	70	47
20	0.00	0.00	0.00	0.00	0.00	0.00	58	24	75	48	65	50	91	60	86	58	58	42
21	0.00	0.00	0.00	0.00	0.00	0.00	66	28	65	51	66	48	84	50	90	61	59	36
22	0.00	0.00	0.08	0.00	0.00	0.00	73	28	70	50	78	43	79	50	91	62	68	36
23	0.00	0.16	0.51	0.00	0.00	0.00	76	41	55	47	72	57	82	49E	85	52	74	39
24	0.00	0.00	0.06	0.00	0.85	0.00	78	50	63	46	82	51	86	54	75	54	79	39
25	0.00	0.00	0.00	0.00	0.00	0.02	55	42	71	43	84	55	88	62	84	49	72	41
26	0.19	0.00	0.00	0.00	0.00	0.02	48	40	80	50	78	53	92	59	84	59	70	50
27	0.14	0.00	0.00	0.00	0.00	0.00	58	42	85	52	71	49	96	50	88	60	74	36
28	0.00	0.00	0.00	0.00	0.00	0.00	70	38	77	44	76	52	88	60	90	52	81	42
29	0.00	0.00	0.00	0.00	0.00	0.00	72	39	74	39	76	48	72	58	88	50	81	38
30	0.00	0.29	0.00	0.00	0.00	0.00	78	43	76	48	78	55	80	51	86	56	59	35
31		0.00		0.00	0.00				72	47			72	54	89	55		
Total	0.55	1.31	3.17	1.29	1.42	0.55	58	31	69	42	67	46	86	58	84	56	77	48

CLIMATIC DATA, 1998 McLeod

Date	Precipitation						April		May		June		July		August		Sept	
	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.02	0.00	0.00	0.00	47	32	66	46	84	49	86	61	84	63	74	48
2	0.00	0.00	0.00	0.02	0.12	0.00	57	27	68	45	49	40	80	65	74	64	80	43
3	0.00	0.00	0.00	0.01	0.27	0.00	59	32	73	40	63	36	79	64	70	64	83	50
4	0.00	0.00	0.00	0.00	0.00	0.00	56	30	70	46	60	38	79	58	83	64	90	55
5	0.24	0.00	0.00	1.09	0.00	0.00	53	38	74	39	58	46	80	64	84	61	84	57
6	0.00	0.00	0.00	0.00	0.00	0.03	51	44	71	40	62	41	82	66	84	61	76	47
7	0.00	0.14	0.00	0.01	0.00	0.00	45	39	55	39	68	37	83	66	84	57	78	44
8	0.07	0.37	0.00	0.00	0.00	0.00	45	37	55	48	70	48	84	66	86	60	74	41
9	0.00	0.36	0.05	0.00	0.00	0.00	54	37	67	49	65	54	89	68	85	62	82	56
10	0.00	0.11	1.20	0.00	0.00	0.00	67	36	75	52	70	54	90	69	91	57	93	58
11	0.00	1.31	0.00	0.00	0.00	0.00	72	37	65	54	73	54	89	71	90	61	83	60
12	0.25	1.59	0.01	0.00	0.00	0.00	75	54	65	49	75	55	88	68	87	64	81	56
13	0.01	0.00	0.00	0.00	0.00	0.37	64	45	74	48	82	53	92	66	94	66	68	62
14	0.00	0.14	0.08	0.00	0.00	0.00	49	36	84	63	78	60	93	70	78	56	80	49
15	0.00	1.04	0.32	0.00	0.00	0.00	49	32	74	58	67	57	84	60	78	51	78	42
16	0.00	0.00	0.00	0.00	0.00	0.00	54	26	76	56	78	56	76	55	91	63	87	46
17	0.00	0.00	0.05	0.02	0.00	0.00	62	32	83	57	77	63	81	60	80	57	89	47
18	0.00	0.00	0.70	0.77	M	0.00	64	32	81	60	79	63	88	63	76E	63E	93	53
19	0.13	0.00	0.05	0.00	M	0.00	63	42	73	51	74	60	91	62	84	67	81	48
20	0.00	0.00	0.00	0.40	0.00	0.00	62	38	77	52	75	57	94	64	81	56	59	38
21	0.00	0.00	0.00	0.00	0.00	0.00	68	33	78	62	71	58	81	59	84	56	61	34
22	0.00	0.00	0.00	0.00	0.69	0.00	73	37	70	54	74	55	77	54	86	64	68	32
23	0.00	0.41	0.00	0.00	0.00	0.00	80	43	65	55	78	57	75	54	85	59	73	37
24	0.00	0.00	0.05	0.00	0.00	0.00	82	45	70	54	89	65	79	51	79	57	78	38
25	0.65	0.00	0.78	0.00	0.00	0.08	70	51	79	49	85	63	83	58	85	53	69	40
26	0.00	0.00	2.44	0.00	0.00	0.28	69	41	78	53	84	62	87	61	86	59	73	49
27	0.00	0.04	0.00	0.00	0.04	0.00	66	38	83	56	78	59	86	56	84	61	70	43
28	0.00	0.00	0.00	0.00	0.00	0.00	68	39	81	57	77	59	81	62	88	57	79	41
29	0.00	0.00	0.00	0.00	0.00	0.00	72	40	64	42	79	58	77	59	79	52	68	46
30	0.00	0.14	0.00	0.00	0.00	0.27	77	43	69	52	80	64	77	53	84	50	56	32
31		0.00		0.00	0.00				65	44			80	53	86	56		
Total	1.35	5.65	5.75	2.32	1.23	1.03	60	37	72	51	71	52	84	61	84	59	74	45

CLIMATIC DATA, 1998 Minot																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.11	0.05	0.00	0.00	0.00	51	30	51	33	77	40	84	55	90	62	76	46
2	0.00	0.00	0.21	0.35	1.47	0.00	55	29	65	31	46	33	82	62	74	64	89	51
3	0.00	0.00	0.00	0.00	1.10	0.00	58	29	77	39	59	35	72	58	71	64	88	52
4	0.00	0.00	0.00	0.00	0.02	0.00	58	30	68	41	57	36	81	54	80	63	98	54
5	0.00	0.00	0.00	1.34	0.00	0.00	57	35	75	36	58	44	78	62	85	59	79	56
6	0.05	0.00	0.00	1.39	0.00	0.00	42	30	63	33	61	38	77	58	86	62	78	47
7	0.08	0.03	0.00	0.01	0.00	0.00	38	29	43	32	67	39	78	58	86	64	79	44
8	0.00	0.38	0.00	0.00	0.00	0.05	51	32	52	40	66	39	83	59	91	64	78	46
9	0.01	0.16	0.00	0.00	0.00	0.00	61	30	59	48	64	50	88	62	88	54	91	60
10	0.00	0.12	0.00	0.00	0.00	0.00	60	34	64	45	69	53	88	64	93	65	93	59
11	0.00	0.00	0.48	0.63	0.00	0.00	76	38	66	42	64	54	88	68	92	63	82	60
12	0.20	0.00	0.00	0.00	0.18	0.86	56	48	67	39	82	52	81	66	94	64	69	56
13	0.00	0.07	0.23	0.00	0.00	0.01	59	36	71	40	75	58	83	60	88	61	76	61
14	0.00	0.01	0.10	0.00	0.05	0.00	49	30	66	51	72	56	83	63	76	55	74	50
15	0.00	0.00	0.00	0.00	0.00	0.00	49	25	73	52	75	50	72	54	78	53	83	49
16	0.00	0.00	0.00	0.00	0.00	0.00	54	28	74	48	72	49	76	51	76	55	91	55
17	0.00	0.01	0.60	0.00	0.00	0.00	57	33	86	47	64	60	84	60	76	49	81	58
18	0.00	0.00	0.67	0.00	0.51	0.00	56	33	75	51	68	61	83	60	88	62	72	49
19	0.02	0.00	0.15	0.00	0.00	0.33	56	31	73	47	64	54	83	60	86	57	52	41
20	0.00	0.00	0.03	0.00	0.00	0.00	61	32	76	50	63	53	82	58	82	52	55	38
21	0.00	0.00	0.01	0.00	0.09	0.00	69	38	78	50	61	54	71	52	85	61	62	35
22	0.00	0.00	0.00	0.00	0.23	0.00	76	39	74	53	75	50	73	51	83	60	68	40
23	0.00	0.00	0.14	0.00	0.00	0.00	80	44	74	48	65	55	74	46	80	61	69	43
24	0.00	0.00	0.02	0.00	0.08	0.00	72	43	74	46	82	59	80	49	78	56	71	43
25	0.00	0.00	0.00	0.00	0.00	0.00	69	47	79	46	87	59	88	54	86	56	68	39
26	0.14	0.00	0.20	0.00	0.11	0.00	63	46	80	50	78	61	83	59	91	60	65	41
27	0.00	0.16	0.00	0.00	0.64	0.00	68	40	80	54	72	55	91	52	84	60	73	41
28	0.00	0.00	0.01	0.00	0.00	0.00	74	44	74	44	73	56	82	54	85	57	78	48
29	0.00	0.00	0.10	0.00	0.00	0.08	79	47	67	35	71	56	76	51	84	52	71	43
30	0.00	0.00	0.01	0.00	0.00	0.00	78	49	78	46	79	57	78	45	89	52	53	32
31		0.00		0.00	0.00	1.33			76	35			84	49	90	53		
Total	0.50	1.05	3.01	3.72	3.48	1.33	59	35	70	44	67	49	81	57	84	59	73	46

CLIMATIC DATA, 1998 Olivia

Date	Precipitation April	Precipitation May	Precipitation June	Precipitation July	Precipitation August	Precipitation Sept	April Max	April Min	May Max	May Min	June Max	June Min	July Max	July Min	August Max	August Min	Sept Max	Sept Min
1	0.92	0.00	0.00	0.00	0.00	0.00	34	32	78	44	61	46	80	59	79	61	74	53
2	T	0.00	0.10	0.22	0.00	0.00	38	32	73	35	71	51	84	61	80	59	77	45
3	0.00	T	0.00	0.00	0.33	0.00	44	33	70	39	63	40	81	52	72	62	75	48
4	0.00	0.00	0.00	0.34	0.05	0.00	51	32	78	48	63	42	83	57	69	61	83	54
5	0.00	0.00	0.00	0.00	0.00	0.00	55	32	90	45	63	41	77	58	72	61	87	54
6	0.00	0.00	0.00	0.34	0.00	0.00	55	40	75	45	64	44	75	57	76	59	92	60
7	0.09	0.00	0.00	T	T	0.00	68	43	83	43	64	41	78	60	83	60	77	44
8	0.39	0.37	0.00	0.00	T	0.00	50	37	73	43	69	52	83	64	71	63	77	44
9	0.00	0.36	0.18	0.00	0.00	0.00	49	35	73	48	63	52	85	65	80	65	78	55
10	0.00	0.00	T	0.00	0.00	0.00	56	33	74	46	63	52	86	69	88	55	77	58
11	0.00	0.44	0.00	0.00	0.00	0.00	64	37	76	46	72	55	86	66	83	58	92	61
12	0.00	0.22	1.08	0.00	0.00	0.00	72	48	77	55	73	53	85	65	84	61	92	61
13	0.05	0.00	0.18	0.00	0.00	0.00	66	45	61	44	71	54	86	66	79	61	91	59
14	0.00	0.00	0.00	0.00	T	0.19	63	40	80	49	80	61	93	71	85	65	94	62
15	0.00	0.00	0.36	2.34	0.00	0.00	63	38	89	54	78	61	90	63	87	50	77	58
16	0.00	0.41	0.11	0.00	0.00	0.00	49	32	81	56	78	55	79	60	87	61	81	53
17	0.00	T	0.00	T	0.00	0.00	55	29	81	55	79	56	84	61	86	68	86	57
18	0.00	0.00	0.82	0.00	0.00	0.00	62	41	92	64	81	64	80	61	85	63	87	57
19	0.00	T	2.00	0.78	0.00	0.00	59	36	100	57	81	56	77	63	75	63	93	58
20	0.09	T	0.11	0.00	0.85	0.00	64	38	84	55	78	62	87	63	90	64	95	53
21	0.00	T	0.00	T	0.00	0.00	68	34	79	58	81	56	86	61	86	62	73	39
22	0.00	0.00	0.00	0.00	0.44	0.00	69	43	78	53	78	57	78	60	83	62	58	36
23	0.00	0.00	0.00	0.00	0.02	0.00	71	70	78	53	79	56	76	52	85	54	68	41
24	0.00	1.02	0.28	0.00	0.00	0.22	77	45	73	52	80	63	75	52	86	62	65	46
25	0.00	0.10	0.70	0.00	0.00	T	84	48	57	52	87	60	78	55	81	57	79	53
26	0.09	0.00	0.00	0.00	0.00	0.15	65	43	78	58	82	64	79	58	82	56	80	53
27	0.00	0.00	0.45	0.00	0.00	0.00	67	33	73	52	85	61	81	59	83	62	84	50
28	0.00	0.12	0.13	0.00	0.35	0.00	61	35	87	62	82	60	83	51	83	62	71	46
29	0.00	0.00	T	0.00	0.00	0.10	70	37	88	54	83	56	84	54	85	58	83	52
30	0.00	0.00	T	0.00	0.00	0.00	73	41	79	59	83	59	74	53	82	52	79	51
31		0.79		0.00	0.00				90	49			79	51	82	54		
Total	1.63	3.83	6.50	4.02	2.04	0.66	59	37	77	49	72	53	79	58	79	58	78	50

CLIMATIC DATA, 1998 Prosper																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.11	0.00	0.00	0.00	42	32	67	50	82	46	84	58	85	61	76	46
2	0.00	0.00	0.00	0.52	0.04	0.00	54	31	71	44	50	40	79	60	76	64	78	43
3	0.00	0.00	0.00	0.01	0.02	0.00	57	32	76	39	62	37	77	60	71	64	85	47
4	0.00	0.00	0.00	0.00	0.06	0.00	55	32	70	46	60	38	77	56	85	60	92	54
5	0.26	0.00	0.00	0.43	0.00	0.00	51	40	75	36	60	46	76	60	86	60	84	60
6	0.04	0.02	0.00	0.00	0.00	0.00	48	42	75	40	61	41	79	64	88	56	79	49
7	0.00	0.14	0.00	0.23	0.00	0.00	43	38	52	39	67	36	82	62	85	54	74	45
8	0.03	0.76	0.00	0.00	0.00	0.00	46	36	54	48	71	41	84	62	86	58	76	40
9	0.00	0.00	0.00	0.00	0.00	0.00	51	35	68	49	69	53	88	62	85	59	83	58
10	0.00	0.22	0.39	0.00	0.00	0.00	63	34	72	50	73	49	88	65	87	56	95	61
11	0.00	0.27	0.00	0.00	0.00	0.00	71	34	66	56	73	53	87	68	91	57	85	62
12	0.01	1.42	0.04	0.00	0.00	0.02	69	54	60	48	74	57	87	64	88	62	76	55
13	0.03	0.01	0.00	0.00	0.00	0.24	60	42	71	47	82	49	90	62	92	66	68	60
14	0.00	0.06	0.05	0.13	0.00	0.01	46	35	82	57	80	57	92	66	77	52	81	48
15	0.00	1.05	0.16	0.00	0.00	0.00	47	31	75	58	65	58	83	56	80	47	78	43
16	0.00	0.00	0.00	0.03	0.00	0.00	52	31	75	53	77	58	73	50	93	62	90	49
17	0.00	0.00	0.02	0.00	0.00	0.00	61	31	84	51	77	61	80	59	80	54	92	50
18	0.00	0.00	0.55	0.28	0.43	0.00	62	31	82	57	79	61	85	58	75	62	94	57
19	0.00	0.00	0.40	0.00	0.24	0.00	63	37	72	53	69	60	88	60	84	68	80	50
20	0.00	0.00	0.00	0.05	0.00	0.00	62	37	78	47	72	54	93	62	82	56	61	40
21	0.00	0.00	0.00	0.00	0.00	0.00	66	34	78	56	71	60	81	58	86	56	63	32
22	0.00	0.00	0.00	0.00	1.29	0.00	73	38	74	49	70	53	76	72	82	64	70	34
23	0.00	0.03	0.00	0.00	0.00	0.09	81	40	72	51	76	54	75	50	84	60	73	38
24	0.00	0.00	0.02	0.00	0.00	0.00	81	43	73	54	85	60	79	48	80	57	78	37
25	0.00	0.00	0.68	0.00	0.00	0.02	73	49	80	48	84	63	84	51	86	54	69	41
26	0.00	0.00	1.89	0.00	0.00	0.26	71	39	80	51	84	64	91	59	88	58	65	49
27	0.00	0.00	0.00	0.00	0.28	0.00	70	34	84	52	76	59	86	53	84	61	72	44
28	0.00	0.00	0.00	0.00	0.00	0.00	71	32	83	54	75	56	81	56	85	56	78	40
29	0.00	0.00	0.00	0.00	0.00	0.04	76	35	63	40	78	57	82	52	79	53	68	46
30	0.00	1.22	0.00	0.00	0.00	0.11	81	37	69	50	80	62	76	50	83	50	55	31
31		0.01		0.00	0.09				62	41			80	48	88	54		
Total	0.37	5.21	4.31	1.68	2.45	0.79	60	35	72	49	70	51	83	58	84	58	75	45

CLIMATIC DATA, 1998 St Thomas																									
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.06	0.00	0.00	0.00	52	33	57	42	65	42	84	55	82	56	75	52
2	0.00	0.00	0.00	0.08	0.00	0.00	56	32	69	38	51	40	81	61	77	68	71	46
3	0.00	0.00	0.00	0.00	0.58	0.00	60	33	73	36	60	38	76	53	80	66	85	47
4	0.00	0.01	0.00	0.00	0.29	0.00	57	33	67	41	59	35	77	48	80	61	91	59
5	0.21	0.00	0.00	0.14	0.00	0.00	54	36	71	36	56	44	73	60	88	56	81	60
6	0.32	0.03	0.00	0.00	0.00	0.00	43	39	52	41	62	40	69	62	86	58	78	52
7	0.00	0.04	0.00	0.92	0.00	0.00	46	35	61	38	70	35	81	62	88	56	73	51
8	0.00	0.00	0.00	0.00	0.00	0.00	44	34	68	46	72	37	84	58	87	58	74	40
9	0.00	0.00	0.00	0.00	0.00	0.00	54	38	71	51	72	42	87	60	88	59	82	59
10	0.00	0.04	0.06	0.00	0.00	0.00	61	38	76	49	67	55	87	63	86	56	96	61
11	0.00	0.44	0.00	0.00	0.00	0.00	66	34	70	49	70	49	89	66	91	56	80	57
12	0.22	0.00	0.00	0.15	0.04	0.00	59	48	64	45	76	54	85	66	87	64	75	46
13	0.03	0.26	0.00	0.00	0.06	0.00	55	40	78	41	88	49	85	61	88	59	78	55
14	0.00	0.28	0.02	0.20	0.00	0.00	43	32	66	55	75	56	88	58	77	53	78	51
15	0.00	0.18	0.01	0.00	0.00	0.00	45	29	73	57	74	57	71	49	77	45	78	41
16	0.00	0.06	0.00	0.00	0.00	0.00	54	28	72	52	72	52	72	44	81	57	84	55
17	0.00	0.05	0.01	0.00	0.00	0.00	55	32	80	44	70	56	81	49	75	51	91	54
18	0.00	0.01	0.33	0.03	0.03	0.00	59	27	79	53	81	60	86	60	70	58	77	50
19	0.00	0.00	0.36	0.00	0.32	0.00	62	31	72	50	68	59	82	59	90	64	73	48
20	0.00	0.00	0.00	0.10	0.00	0.01	63	30	79	50	68	57	86	54	83	57	56	42
21	0.00	0.00	0.00	0.00	0.00	0.00	68	33	74	44	66	57	70	55	83	53	63	38
22	0.00	0.00	0.00	0.00	0.00	0.00	74	35	74	44	66	51	72	49	75	65	70	41
23	0.00	0.00	0.03	0.00	0.00	0.00	75	44	74	46	70	45	74	50	84	59	76	41
24	0.00	0.00	0.00	0.00	0.00	0.00	70	38	76	48	82	59	75	45	82	56	72	35
25	0.00	0.00	0.05	0.00	0.00	0.05	73	47	80	50	86	63	82	44	88	51	66	47
26	0.00	0.44	0.35	0.00	1.55	0.03	68	40	82	47	84	62	87	64	91	54	59	50
27	0.00	0.12	0.14	0.00	0.12	0.00	73	34	88	52	76	58	86	56	83	62	72	43
28	0.00	0.00	0.01	0.00	0.00	0.00	73	46	71	40	73	56	82	59	83	57	81	36
29	0.00	0.00	0.00	0.00	0.00	0.13	80	46	55	34	74	57	78	52	79	55	63	40
30	0.00	0.00	0.00	0.00	0.00	0.00	84	48	75	42	81	59	77	50	83	51	52	34
31		0.00		0.00	0.00				66	39			80	45	91	57		
Total	0.78	1.96	1.43	1.62	2.99	0.22	59	35	71	45	69	49	80	55	83	57	73	46

CLIMATIC DATA, 1998 Williston																		
	Precipitation						April		May		June		July		August		Sept	
Date	April	May	June	July	August	Sept	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	0.00	0.00	0.29	0.00	1.06	0.00	60	29	54	31	74	50	85	57	96	61	81	47
2	0.00	0.00	0.01	0.07	0.03	0.00	62	31	66	25	50	34	77	63	81	61	95	57
3	0.00	0.00	0.00	0.00	0.28	0.00	62	31	84	41	61	33	76	60	72	64	95	57
4	0.00	0.00	0.00	1.06	0.00	0.00	60	32	68	45	59	35	83	59	83	60	101	61
5	0.03	0.00	0.10	0.03	0.00	0.00	57	35	75	34	58	44	85	61	87	61	82	56
6	0.00	0.00	0.00	0.09	0.00	0.00	44	35	57	38	63	44	79	60	91	63	80	54
7	0.04	0.01	0.00	0.00	0.00	0.00	41	30	41	33	68	48	84	58	93	64	83	54
8	0.00	0.06	0.26	0.00	0.00	0.00	52	32	52	38	63	48	87	61	92	65	86	61
9	0.00	0.28	0.11	0.00	0.00	0.03	60	36	61	38	62	48	90	64	91	58	93	60
10	0.00	0.07	0.11	0.00	0.00	0.00	62	30	60	42	74	50	92	66	96	66	89	65
11	0.00	0.00	0.01	0.00	0.05	0.03	75	40	65	43	75	48	89	65	93	65	82	60
12	0.00	0.00	0.00	0.00	0.00	0.00	65	44	70	38	82	50	84	60	96	62	76	61
13	0.00	0.06	0.00	0.00	0.00	0.00	57	34	71	40	68	57	88	59	91	60	83	53
14	0.00	0.01	0.00	0.01	0.01	0.00	51	28	76	45	72	51	87	64	80	60	79	55
15	0.00	0.00	0.00	0.00	0.00	0.00	51	30	70	48	78	45	76	54	86	58	93	56
16	0.00	0.00	0.30	0.00	0.00	0.00	55	26	73	44	72	53	88	57	77	58	95	58
17	0.00	0.00	0.08	0.00	0.00	0.00	56	38	84	50	65	51	92	60	80	56	86	60
18	0.00	0.00	0.86	0.00	0.05	0.13	51	33	72	48	59	55	90	64	85	61	76	52
19	0.00	0.00	0.00	0.00	0.00	0.55	56	33	72	43	68	52	90	63	86	60	60	43
20	0.00	0.00	0.12	0.00	0.00	0.00	63	31	77	48	61	51	86	60	85	53	56	39
21	0.00	0.00	0.09	0.00	0.00	0.00	69	33	78	53	61	51	73	56	88	64	61	35
22	0.00	0.06	0.00	0.00	0.00	0.00	78	39	74	54	78	47	77	49	88	62	68	39
23	0.00	0.00	0.00	0.00	0.00	0.00	81	42	72	49	78	59	78	49	83	56	69	42
24	0.00	0.00	0.00	0.00	0.01	0.00	73	47	75	44	82	56	88	55	81	58	68	45
25	0.00	0.00	0.08	0.00	0.00	0.00	57	42	77	48	88	56	92	64	86	55	73	39
26	0.06	0.00	0.04	0.00	0.76	0.00	51	41	84	50	76	56	86	63	94	55	57	43
27	0.00	0.02	0.51	0.00	0.00	0.00	64	36	80	54	60	51	100	57	87	57	72	41
28	0.00	0.00	0.00	0.00	0.00	0.00	75	39	73	50	71	54	86	57	88	53	78	43
29	0.00	0.00	0.00	0.00	0.00	0.00	79	41	71	41	72	54	79	57	88	56	70	45
30	0.00	0.00	0.01	0.00	0.00	0.00	74	47	76	50	81	56	81	49	80	62	56	36
31		0.00		0.00	0.00				76	37			81	60	84	58		
Total	0.13	0.57	2.98	1.26	2.25	0.74	59	34	70	43	67	48	85	59	87	60	76	49

Soil Test Results At Various Weed Experiment Locations						
	Soil Texture	Organic matter	pH	lb/A N	PPM	
					P	K
A.K. Ere Grassland Preserve	Loamy sand	2.9	6.8	3	3	70
Angus, MN	Loam	6.1	7.7	147	26	550
Buxton	Loam	3.9	8.1			
Camp Grafton, ND	Loamy sand	2.8	7.0	3	3	98
Carrington, ND	Loam	3.6	7.2	Fertilized by test		
Casselton	Silty clay	4.4	7.8	Fertilized by test		
Crookston	Loam	4.7	8.1	113	60	390
Cuba, ND	Sandy loam	7.0	8.2	3	4	100
Fargo, ND (section 22)	Silty clay	4.5-6.0	7.5	190	26	1095
Fargo, ND (campus)	Silty clay	6.8	7.2	Fertilized by test		
Fargo, ND (sugarbeet experiments)	Silty clay	5.6	7.1	95	15	350
Glyndon	Loam	5.4	8.3	Fertilized by test		
Grand Forks, ND (English coulee)	Loam	5.1	8.3	17	14	225
Hatton	Sandy loam	2.4	7.8	Fertilized by test		
Hawley, MN	Loam	2.2	8.5	3	4	105
Hillsboro, ND	Silty clay	4.0	7.6	111	22	450
Jamestown, ND (Pipestem Dam)	Loam	6.8	6.8	28	5	290
McLeod	Sand	1.9	5.9	Fertilized by test		
Minot, ND	Loam	2.7	7.0	Fertilized by test		
Minto, ND	Silty clay	4.2	7.9	337	18	480
Oakes, ND	Sandy loam	2.1	7.1	24	Very high	VH
Oriska	Sily clay	5.3	6.8			
Prosper, ND	Silty clay loam	3.2	7.0	90	23	315
Prosper, ND (Zollinger)	Loam	4.0	7.2	Fertilized by test		
Sheyenne ND, Grasslands (Insect)	Loamy sand	2.5	6.9	3	7	125
St. Thomas, ND	Silt loam	3.4	8.1	81	7	175
Wahpeton	Silty clay	5.7	6.2	Fertilized by test		
West Fargo, ND	Silty clay	3.6	7.2	8	42	1460
Williston, ND	Loam	2.3	6.8	Fertilized by test		

KEY TO ABBREVIATIONS AND EVALUATIONS

Crop injury, crop stand and weed control ratings are based on a visual estimate using a scale of 0 = no effect to 100 = complete kill.

Alfa = Alfalfa
Amaz = Amaranth
Barl, Bar = Barley
Bdlf = Broadleaf
Biww = Biennial wormwood
Bubu = Buffalobur
Bygr = Barnyardgrass
Cath = Canada thistle
Cano = Canola
Cocb = Common cocklebur
Colq = Common lambsquarters
Coma = Common mallow
Copu = Common purslane
Corw = Common Ragweed
Cram = Crambe
Dali = Dandelion
Dobr = Downy brome
Drbe = Dry bean
Duru = Durum wheat
Ebns = Eastern black nightshade
Fach = False chamomile
Fibw = Field bindweed
Fipc = Field pennycress
Fisb = Field sandbur
Flwe = Flixweed
Foba = Foxtail barley
Fomi, Ftmi = Foxtail millet
Fota, Fxtl = Foxtail species
Grft = Green foxtail
Girw = Giant ragweed
HNS, Hans = Hairy nightshade
Howe = Horseweed
HRSW = Hard red spring wheat
KOCZ = Kochia
Lath = Ladysthumb
Lent = Lentils
Llsa = Lanceleaf sage
Mael = Marshelder
Mesa = Meadow salsify
Nabe = Navy bean
Nfcf = Nightflowering catchfly
Oats = Tame oats
Pest = Perennial sowthistle
Pesw = Pennsylvania smartweed
Pibe = Pinto bean
Pota = Potato
Powe = Pondweed
Prle = Prickly lettuce
Prmi = Proso millet (tame)
Prpw = Prostrate pigweed
Qugr = Quackgrass
Rrpw = Redroot pigweed
Ruth = Russian thistle
Safl, Saff = Safflower
Shpu = Shepherd's-purse
Smwe = Annual smartweed
Soyb, Sobe = Soybean
Spsp = Spotted spurge
Sugb, Sgbt = Sugarbeet
Snfl,Sufl = Sunflower
Swcl = Sweet clover
Tabw = Tame buckwheat
Tamu = Tansy mustard
Tumu = Tumble mustard
Tymu = Tame yellow mustard
Vowh = Volunteer wheat
Vele = Velvetleaf
Vema = Venice mallow
Wht = Volunteer wheat
Wibw = Wild buckwheat
Wimu = Wild mustard
Wioa = Wild oat
Wipm = Wild-proso millet
Yeft = Yellow foxtail

METHODS

PPI = Preplant incorporated
PEI = Preemergence incorporated
PRE, PE = Preemergence
EPOST = Early postemergence
MPOST = Mid postemergence
LPOST = Late postemergence
LLPOST = Late-late postemergence
P, PO, POST = Postemergence
POSTDIR = Postemergence directed

MISCELLANEOUS

DF = Dry flowable

EC = Emulsifiable concentrate

F = Fall

FL = F = Flowable

S = Spring

L = Liquid flowable

WP = Wettable powder

WDG = Water dispersible granules

G = Granules or gallon/A

SG = Soluble granules

Inc = I = Incorporation

%ir = inju = Percent injury rating

%sr = %std, strd = Percent stand reduction

HT = Plant height

SPK = Spike stage

Tswt = TW = Test weight

Yld = Yield

alk = alkanolamine salt

bee = butoxyethyl ester

dea = diethanolamine salt

dma = dimethylamine salt

SGF = sodium salt

ioe = isooctyl ester

MS, MVO = methylated vegetable oil

PO, OC = Petroleum oil concentrate (17% emulsifier)

SURF = S = Surfactant

NIS = nonionic surfactant

28N, UAN = 28% liquid nitrogen fertilizer

AMS = ammonium sulfate

AMN = ammonium nitrate

ADJUVANT	COMPANY
Esterified vegetable oils/fatty acid	
Class Destiny	Cenex
Dash	BASF
Dash HC	BASF
Hasten	WilFarm
MethOil	Terra
MSO	Loveland
Scoil	AGSCO
Sundance II	Rosens
Sun-It II3	AGSCO
W-4971	WilFarm
Esterified vegetable oils & organosilicone surfactant	
Dyne-Amic	Helena
Phase	Loveland
Rivet	Terra
W-1961	WilFarm
Fertilizer & drift retardant	
Array	Rosens
Nonionic surfactants	
Activate Plus	Terra
Activator 90	Loveland
AGPRO	AGPRO Systems
Agra-Wet	Loveland
Alfonic 12-14-80	Vista Chemical
Amway 80	Amway
Induce	Helena
Kinetic	Helena
L1-700	Loveland
Optima	Helena
Preference	Cenex
R-11	Wilbur-Ellis
R-900	WilFarm
Silwet L-77	Loveland
Spray Booster S	Cenex
TF-8036	Zeneca
Tergitol 15-5-9	Union Carbide
X-77	Loveland

ADJUVANT	COMPANY
Petroleum oil concentrates	
CL-9715	Cenex
Herbimax	Loveland
Mor-Act	Wilbur-Ellis
Ortech	Rosens
17% COC	Cenex
Prime Oil	Terra
Surfactant & fertilizer blends	
AMS Plus	Terra
Class Act	Cenex
Class Act II	Cenex
Class Act II DB	Cenex
Dispatch AMS	Loveland
Dispatch 2N	Loveland
Impressive HV	Rosen
Sensation	Rosens
Surfate	AGSCO
Quad 7	AGSCO
Water conditioning agent	
Choice	Loveland
Cayuse	Wilbur-Ellis
MSO/PO+fertilizer blends	
CL-9706	Cenex
CL-9711	Cenex
Eth-N-Gard	WilFarm
Unknown	
LI-105	Loveland
ND-4	NDSU
ND-72	NDSU
React	Loveland
Score	Novartis

LIST OF HERBICIDES TESTED IN 1998

Common Name or Code Name	Abbreviation	Company	Formulation	Trade Name
AC 263,222		American Cyanamid	2 lb/gal EC	Plateau
AC 299,263, Imazamox	Imam	American Cyanamid	1 lb/gal EC	Raptor/Motive
Acetochlor&Atrazine	Acet&Atra	Zeneca	2.4&1.6 L	FulTime
Acetochlor&Dichlormid	Acet&Dcmd	Zeneca	6.4 lb/gal EC 3.2 lb/gal ME	Surpass TopNotch
Acetochlor&MON EPTC	Acet&EPTC	Zeneca	1.4&5.6 E	Doubleplay
Acetochlor&MON 4660	Acet&4660	Monsanto	7 lb/gal EC	Harness
Acifluorfen	Acif, Blzr	BASF, American Cyanamid	2 lb/gal E,S	Blazer, Status
Acifluorfen&Bentazon	Acif&Bent	BASF	0.67+3 lb/gal EC, 1.33+2.67S	Galaxy, Storm
Alachlor	Alac	Monsanto	4 lb/gal MT	Several
Atrazine	Atra	Various	90% DF	Numerous
Atrazine+2,4-D		UAP	3.25 F	Shotgun
AzaFenidin	Azaf	DuPont	80% DF	Milestone, R6447
BAS 635	BAS 635	BASF	71.4 DF	BAS 635
Bay MKH 6562		Bayer	70% WG	
Bentazon	Bent, Bsgn	BASF	4 lb/gal S	Basagran
Bromoxynil	Brox	Rhône-Poulenc	2 lb/gal EC	Buctril/Broclean
CGA 248757, Fluthiacet	Actn, Flut	Novartis	75% SG	Action
CGA 277476, Oxasulfuron	Oxas, Expt	Novartis	75% SG	Expert
Chlorsulfuron		DuPont	75% WG	Telar
Clethodim	Clet, Slct	Valent	2 lb/gal 0.94 lb/gal	Select Prism
Clodinafop	Clod	Novartis		Discover
Clopyralid	Clpy	DowAgro Sciences	3 lb/gal S	Stinger
Clopyralid&2,4-D	Clpy&2,4-D	DowAgro Sciences	0.38 + 2 lb/gal S	Curtail
Cloransulam	Clor, FrstRt	DowAgro Sciences	84% DF	FirstRate
Cyanazine	Cyan	DuPont	90% DF	Bladex
Cycloate	Cycl	Zeneca	6 lb/gal EC	Ro-Neet
Desmedipham	Desm	AgrEvo	1.3 lb/gal EC	Betanex

Desmedipham & Phenmedipham	Desm&Phen	AgrEvo	0.65+0.65 lb/gal E	Betamix
Desmedipham & Phenmedipham & Ethofumesate	Desm&Phen&Etho	AgrEvo	0.6+0.6+0.6 lb/gal E	Betamix Progress
Diflufenzoypyr	BAS 664	BASF	70% WG	None
Dicamba	Dica	BASF	4 lb/gal S	Banvel, Clarity, Lab Services 122
Dicamba&nicosulfuron	Dica&Nico	BASF	67.3&7.5 DF	Celebrity
Dimethenamid	Dime, Frtr	BASF	6 lb/gal EC	Frontier
a-Dimethanamid	a-Dime	BASF	6lb/gal EC	Frontier-or isomer
Diclofop	Dcfp	AgrEvo	3 lb/gal EC	Hoelon
Difenzoquat	Dife	American Cyanamid	2 lb/gal S	Avenge
Diflufenzopyr Dicamba	BAS 662	BAS	2 lb/gal dicamba, 2.5:1(dic:d:stu)	Distinct
Diquat	Diqu	Zeneca	2 lb/gal S	Diquat
Endothall	Endo	Elf Atochem	3 lb/gal S	Herbicide 273
EPTC	EPTC	Zeneca	7 lb/gal EC 25% G	Eptam
EPTC&Dichlormid	EPTC&Dcmd	Zeneca	6.7 lb/gal EC 25% G	Eradicane
EPTC&Dichlormid& Acetochlor	EPTC&Dcmd& Acet	Zeneca	6.8 EC	DoublePlay
ET-751	pyraflufen		0.02 EC	
Ethalfluralin	Etha	DowAgro Sciences	3 lb/gal EC 10% G	Sonalan
Ethofumesate	Etho	AgrEvo	4 lb/gal F	Nortron
F8426 carfentrazone		FMC	50%	Aim/Affinity
Fenoxaprop-P	Fenx-P	AgrEvo	1 EC	Puma
Fenx-P&2,4-D&MCPA		AgrEvo	0.44+0.58+1.75 lb/gal EC	Tiller
Fenx-P&MCPA		AgrEvo	0.67+4 lb/gal EC	Dakota
Fenx-P&MCPA& Thifensulfuron& Tribenuron		AgrEvo	1.6:7.6:0.187:0.092	Cheyenne
Fluazifop-P	Flfp-P	Zeneca	2 lb/gal EC	Fusilade DX
Fluazifop-P& Fenoxaprop-P	Flfp&Fenx	Zeneca	2+0.66 lb/gal EC	Fusion
Flufenacet&Isoxaflutole	Fluf&Isox	Bayer	48&10% DF	EPTC/USA 1000

Flufenacet&Metribuzin		Bayer	54.4&13.6% DF	Axiom
Flumetsulam	Flms	DowAgro Sciences	80WG	Python
Flumetsulam& Metolachlor	Flms&Meto	DowAgro Sciences	0.2+7.47 lb/gal	Broadstrike+Dual
Flumetsulam& Trifluralin	Flms&Trif	DowAgro Sciences	0.25+3.4 lb/gal	Broadstrike+Treflan
Flumetsulam& Clopyralid	Flms & Clpy	DowAgro Sciences	23.1+62.3% DF	Hornet
Flumetsulam& Clpy&2,4-D	Flms&Clpy &2,4-D	DowAgro Sciences	84.3 % DF	Scorpion III
Flumiclorac	Flmc, Rsrc	Valent	0.86 lb/gal EC	Resource
Flumioxazin	V-53482	Valent	50 % WP	Valor
Fluroxypyr	Flur	UAP	1 lb/gal EC	Starane, PCC-140
Fosamine		DuPont	4 lb/gal SL	Krenite
Glufosinate	Gluf, Lbrty	AgrEvo	1 lb/gal EC	Liberty/Rely
Glufonsinate&Atrazine	Gluf&Atra	AgrEvo	1+3.3 L	Liberty ATZ
Glyphosate-ipa	Glyt	Monsanto	3 lb ae/gal S	Roundup Ultra/RT, Glyphos
Glyphosate-tms	Glyt	Zeneca	6 lb ai/gal S	Touchdown
Glyphosate&2,4-D		Monsanto	0.9 + 1.5 lb/gal	Landmaster BW
Glyphosate& dicamba		Monsanto	1 + 2.9 lb/gal	Weedmaster
Halosulfuron	Halo, Prmt	Monsanto	75% DF	Permit
Hexazinone	Hexa	DuPont	75% DF 90% SP	Velpar
HOE 1170		Agro	1.275 lb/gal	Puma
Imazamox	Imam	American Cyanamid	1 lb/gal S	Motive/Raptor
Imazaquin	Imqn	American Cyanamid	1.5 lb/gal S	Scepter
Imazethapyr	Imep, Prst	American Cyanamid	2 lb/gal S	Pursuit
Imazethapyr&Imazapyr	Imep&Impr	American Cyanamid	70 WDG	Lightning
Imazethapyr& Pendimethalin	Imep&Pend	American Cyanamid	2.9 EC	Pursuit Plus
Imazamethabenz	Immb	American Cyanamid	2.5 lb/gal EC	Assert
Isoxaflutole	RP 201772	Rhône-Poulenc	75 DF	Balance
Lactofen	Lact	Valent	2 lb/gal S	Cobra
MCPA	MCPA	Rhône-Poulenc	4 lb/gal EC, S	Several, Chiptox

Metolachlor& Benoxacor (active isomer)		Novartis	7.6 lb/gal E	Dual II Magnum
Metolachlor&Metribuzin	Meto&Metr	Bayer	6.55&1.45 F	Turbo
Metribuzin	Metr	Bayer DuPont	4 lb/gal F, 75% DF 4 lb/gal F, 75% DF	Sencor Lexone
Metsulfuron	Mets	DuPont	60% DF	Ally/Escort
MON-37500		Monsanto	75% DF	
Nicosulfuron	Nico	DuPont	75% DF	Accent
Nicosulfuron+ rimsulfuron+ atrazine		DuPont	89.46	Basis Gold
Nicosulfuron+ rimsulfuron+ clopyralid+ flumetsulam		DuPont	6.2+6.2+51.7 +19.3%	Accent Gold
Oxyfluorfen	Oxyf	Rohm & Haas	1.6 lb/gal EC	Goal
Paraquat	Para	Zeneca	2.5 lb/gal S 2 lb/gal S	Gramoxone Extra Cyclone
Pendimethalin	Pend	American Cyanamid	3.3 lb/gal EC	Prowl
Picloram		DowAgro Sciences	2 lb/gal S	Tordon 22K
Picioram&Triclopyr	Picl&Trcp	DowAgro Sciences	3 lb/gal	Access
Primisulfuron		Novartis	64.6 DF	Beacon
Propanil	Prnl	Rhom & Haas	80% DF	Stampede 80 EDF
Prosulfuron	Pros	Novartis	75 DF	Peak
Pyrazon	Pyzn	BASF	4.2 lb/gal F	Pyramin
Quinclorac		BASF	75% WP	Paramount
Quizalofop-P	Qufp-P	DuPont	0.88 lb/gal EC	Assure II
Rimsulfuron		DuPont	25% DF	Matrix
Rimsulfuron& Thifensulfuron	Rims&Thif, Bsis	DuPont	75% DF	Basis
Sethoxydim	Seth	BASF American Cyanamid	1.5 lb/gal EC	Poast, Prestige
Sulfentrazone	Snen	FMC	75% DF	Authority
Sulfometuron	Sume	DuPont	75% DF	Oust
Thifensulfuron	Thif, Pinn, Pncl	DuPont	25% DF	Pinnacle
Thifensulfuron& Tribenuron	Thif&Trib	DuPont	50%+25% DF	Harmony Extra

Tralkoxydim	Tral	Zeneca	80% DF	Achieve
Tribenuron	Trib	DuPont	75% DF	Express
Triallate	Tria	Monsanto	4 lb/gal EC, 10% G	Far-Go
Triflusulfuron	Tfsu	DuPont	50% DF	UpBeet
Triasulfuron	Trsu	Novartis	75% DF	Amber
Triclopyr	Trcp	DowAgro Sciences	4 lb/gal EC	Garlon
Trifluralin	Trif	DowAgro Sciences	4 lb/gal EC 10% G	Several
2,4-D	2,4-D	Various	Various EC, S, WSP	Numerous
2,4-DB	2,4-DB	Various	2 lb/gal	Numerous
V-10029		Valent	80 WP	

[a] Abbreviations in the tables may consist of only the first one, two, or three listed letters when space was limited. Abbreviations of numbered compounds vary with available space, but usually use the first letters and numbers.

Micro-rates of sugarbeet herbicides plus adjuvants, Angus, 1998. (Dexter) 'Hilleshog Horizon' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 24. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 8, May 15, May 22, and May 29. Sugarbeet injury and common lambsquarters, redroot pigweed, wild oats, green foxtail and wild buckwheat control were evaluated June 22.

Date	May 8	May 15	May 22	May 29
Time of Day	11:00 AM	3:00 PM	10:00 AM	10:30 AM
Air Temp. (°F)	64	78	61	48
6" Soil Temp. (°F)	53	62	64	66
Rel. Humidity (%)	70	60	54	22
Wind Velocity (mph)	0	10-15	10-12	7-12
Cloud Cover (%)	90	100	90	80
Soil Moisture	poor	good	good	fair
Sugarbeet Stage	v1.0	v1.0-v 2.0	v1.0-v4.0	v2.3-v8.5
Common Lambsquarters	cotyledon	cot – 4 leaf	4 leaf (1 inch tall)	3 – 6 inches tall
Redroot Pigweed	cot – 1 leaf	cot - 2 leaf	5 leaf (1 inch tall)	2-6 lf - 2 inches
Wild Oats	emerg – 1 leaf	emerg - 2 lf (4 in.)	4 lf (6 inches tall)	6 to 12 inches tall
Green Foxtail	emerg -2 lf (1.5 in)	emerg – 1 inch tall	1 to 3 inches tall	1 to 4 inches tall
Wild Buckwheat	cot – 1 leaf	cot – 2 leaf	4 leaf (3 inches)	3 to 5 inches tall

Treatment*	Rate	Sgbt inj	Colq cntl	Rrpw cntl	Wioa cntl	Grft cntl	Wibw cntl
	lb/A	%	%	%	%	%	%
Desmedipham	0.25	0	97	86	13	38	21
Desmedipham+Triflusulfuron	0.25+0.0156	0	100	100	68	76	73
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	0	100	100	48	61	100
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	0	100	99	26	61	96
Desm+Tfsu+MethOil	0.08+0.004+1.5%	0	89	96	89	70	85
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	0	96	97	76	68	83
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	0	97	96	84	79	90
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	0	98	98	85	60	96
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	0	99	100	63	68	96
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	0	98	99	78	76	92
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	0	98	100	79	68	95
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	0	95	96	45	85	98
Desm+Tfsu+Clpy+Clet+MOil	0.08+0.004+0.03+0.03+1.5%	0	98	99	100	100	95
Desm+Tfsu+Clpy+Clet+NH4+MO	0.08+.004+.03+.03+.02%+1.5%	0	96	98	100	100	96
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	0	96	98	100	100	96
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	0	99	96	88	76	97
Desm&Phen&Etho+Tfsu+Clpy+MOil	0.08+0.004+0.03+1.5%	0	100	99	80	81	98
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	97	100	100	79	96	98
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	0	96	98	99	96	96
C.V. %		8	4	4	14	12	10
LSD 5%		1	5	5	15	13	13
LSD 1%		1	NS	7	20	18	17
# OF REPS		4	4	4	4	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only the treatment that included diflufenzopyr caused significant sugarbeet injury. Desmedipham + triflusulfuron + MethOil at 0.08+0.004+1.5% gave less control of common lambsquarters than the other treatments. Desmedipham at 0.25 lb/A gave less control of redroot pigweed and wild buckwheat than the other treatments. Treatments that included clethodim or quizalofop gave or tended to give the best control of wild oats and green foxtail.

Micro-rates of sugarbeet herbicides plus additives, Clara City, 1998. (Dexter)
Sugarbeet was seeded April 25. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots

Date	May 6	May 13	May 20
Time of Day	1:15 PM	12:00 PM	1:00 PM
Sugarbeet Stage	cotyledon	2 to 3 leaf	4 to 6 leaf
Common Lambsquarters	cotyledon - 1 inch tall	cotyledon – 2 inch tall	cotyledon – 3 inch tall

May 6, May 13 and May 20. Sugarbeet injury and common lambsquarters control were evaluated June 19.

Treatment*	Rate	Colq cntl	Sgbt inj
	lb/A	%	%
Desmedipham	0.25	87	0
Desmedipham+Triflusulfuron	0.25+0.0156	92	0
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	97	0
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	96	0
Desm+Tfsu+MethOil	0.08+0.004+1.5%	83	0
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	87	0
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	93	0
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	86	0
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	84	0
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	89	0
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	79	0
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	65	0
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	95	0
Desm+Tfsu+Clpy+Clet+NH4+Moil	0.08+.004+.03+.03+.02%+1.5%	88	0
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	72	0
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	92	0
Desm&Phen&Etho+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	90	0
Desm+Tfsu+Clpy+Diflufenzopyr+Moil	0.08+0.004+0.03+0.05+1.5%	98	94
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	81	0
EXP MEAN		87	5
C.V. %		13	12
LSD 5%		17	1
LSD 1%		NS	1
# OF REPS		4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only desmedipham + triflusulfuron + clopyralid + diflufenzopyr + MethOil gave sugarbeet injury. Desmedipham + triflusulfuron + clopyralid + NH_4 + Quad 7 gave less control of common lambsquarters than other treatments.

Micro-rates of sugarbeet herbicides plus adjuvants, Fargo, 1998. (Dexter) 'Maribo 9581' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 28. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 26, June 2 and June 9. Sugarbeet injury and redroot pigweed and green foxtail control were evaluated June 24.

Date	May 26	June 2	June 9
Time of Day	12:00 AM	7:30 PM	2:30 PM
Air Temp. (°F)	90	52	68
6" Soil Temp. (°F)	68	61	66
Rel. Humidity (%)	22	37	46
Wind Velocity (mph)	5	15	4-6
Cloud Cover (%)	0	90	95
Soil Moisture	good	good	good
Sugarbeet Stage	v1.0-v2.5	v4.0-v5.2	v4.0-v6.5
Redroot Pigweed	1 to 2 leaf	2 to 4 leaf	3-5 leaf (2 inches tall)
Green Foxtail	emerg – 1 inch tall	0.5 to 2 inches tall	2 to 3 inches tall

Treatment*	Rate	Sgbt inj	Grft cntl	Rrpw cntl
	lb/A	%	%	%
Desmedipham	0.25	3	71	100
Desmedipham+Triflusulfuron	0.25+0.0156	3	93	100
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	3	89	100
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	1	86	100
Desm+Tfsu+MethOil	0.08+0.004+1.5%	0	79	100
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	4	88	100
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	4	90	100
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	5	89	100
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	1	84	100
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	5	91	100
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	6	88	100
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	5	84	100
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	1	99	99
Desm+Tfsu+Clpy+Clet+NH4+MOil	.08+.004+.03+.03+.02%+1.5%	3	99	100
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	3	99	100
Des&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	3	96	100
D&P&E+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	4	93	100
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	95	86	100
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	4	98	100
EXP MEAN		8	90	100
C.V. %		35	6	0
LSD 5%		4	8	0
LSD 1%		5	10	1
# OF REPS		4	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only the treatment that included diflufenzopyr caused important sugarbeet injury. Treatments that included clethodim or quizalofop gave or tended to give better control of foxtail than other treatments. All treatments gave excellent control of redroot pigweed.

Micro-rates of sugarbeet herbicides plus adjuvants, Crookston, 1998. (Dexter) 'Hilleshog Horizon' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 24. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 8, May 18, May 22 and May 29.

Date	May 8	May 18	May 22	May 29
Time of Day	1:45 PM	10:00 AM	1:00 PM	12:30 PM
Air Temp. (°F)	64	73	65	68
6" Soil Temp. (°F)	58	65	65	68
Rel. Humidity (%)	61	74	57	55
Wind Velocity (mph)	7	5-7	6-8	0
Cloud Cover (%)	100	0	90	5
Soil Moisture	good	good	good	good
Sugarbeet Stage	v1.0	v1.0-v3.5	v4.0	v5.0-v8.7
Common Lambsquarters	cotyledon - 2 leaf	cot - 6 leaf	1 inch tall	2 inches tall
Gr. and Yellow Foxtail	emerg – 2 lf (1 in.)	emerg – 2 in. tall	0.5 to 3 inches tall	3 to 5 inches tall
Wild Oats	emerg – 1 leaf	emerg – 2 lf (4 in.)	4 lf (4 – 6 inches)	3 to 6 inches tall
Redroot Pigweed	cotyledon – 1 leaf	cot – 2 leaf	4 leaf	2 inches tall
Common Mallow	cot – 1 leaf	cot – 4 leaf	8 leaf	4 to 8 leaf

Sugarbeet injury and common mallow, green and yellow foxtail, redroot pigweed, and common lambsquarters control were evaluated June 22. Green and yellow foxtail control was evaluated July 21.

		June 22					7-21
				Gr&Y			Gr&Y
Treatment*	Rate	Sgbt inj	Coma cntl	Fxtl cntl	Rrpw cntl	Colq cntl	Fxtl cntl
	lb/A	%	%	%	%	%	%
Desmedipham	0.25	0	0	68	97	99	64
Desmedipham+Triflusulfuron	0.25+0.0156	0	90	94	98	100	84
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	0	98	94	100	100	83
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	0	84	84	98	100	79
Desm+Tfsu+MethOil	0.08+0.004+1.5%	0	95	92	99	100	85
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	0	97	91	98	99	86
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	0	96	90	99	100	86
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	0	96	86	99	100	83
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	0	94	85	96	99	79
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	0	98	89	99	99	73
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	0	93	88	96	100	74
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	0	94	80	99	100	73
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	0	94	94	98	97	82
Desm+Tfsu+Clpy+Clet+NH4+MO	0.08+.004+.03+.03+.02%+1.5%	0	94	94	97	100	81
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	0	91	93	95	99	86
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	0	96	95	95	100	95
Desm&Phen&Etho+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	0	97	90	98	99	89
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	98	99	94	98	99	29
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	0	94	95	96	99	93
EXP MEAN		5	89	89	98	99	79
C.V. %		3	6	10	3	1	14
LSD 5%		0	8	13	NS	NS	16
LSD 1%		0	10	NS	NS	NS	21
# OF REPS		4	4	4	4	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

(Experiment continued on next page.)

Summary

Only the treatment that included diflufenzopyr caused sugarbeet injury. Desmedipham gave no control of common mallow. All the other treatments included triflusulfuron and all gave 90% or greater control of common mallow, except desmedipham + triflusulfuron + clopyralid at 0.16 + 0.008 + 0.06 lb/A. This treatment gave less control of common mallow than the same herbicides at half the rate plus methylated seed oil. So, the methylated seed oil more than doubled the activity of desmedipham + triflusulfuron + clopyralid on mallow. All treatments gave excellent control of redroot pigweed and common lambsquarters. The late evaluation of foxtail control generally showed less control than at the early evaluation. Foxtail control with desmedipham + triflusulfuron + clopyralid + diflufenzopyr + MethOil was especially poor at the late evaluation. Perhaps the diflufenzopyr antagonized foxtail control and more grass recovered in diflufenzopyr treated plots than in the other plots.

Micro-rates of sugarbeet herbicides plus adjuvants, Hillsboro, 1998. (Dexter) 'Hilleshog Horizon' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 28. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 14, May 20, May 27 and June 3. Sugarbeet injury

Date	May 14	May 20	May 27	June 3
Time of Day	11:00 AM	9:40 AM	9:30 AM	10:00 AM
Air Temp. (°F)	69	70	76	56
6" Soil Temp. (°F)	58	62	68	47
Rel. Humidity (%)	90	48	56	65
Wind Velocity (mph)	10-15	0-2	15	12-15
Cloud Cover (%)	100	0	40	20
Soil Moisture	good	good	good	good
Sugarbeet Stage	v1.0	v1.0-v2.1	v2.7-v4.7	v4.0-v8.0
Common Lambsquarters	cotyledon - 2 leaf	cot - 4 leaf	4 - 8 leaf	2 – 4 inches tall
Gr. and Yellow Foxtail	emerg – 1 lf(1 in.)	emerg – 2 in. tall	2 to 3 inches tall	2 to 5 inches tall
Wild Oats	emerg – 1 leaf	emerg – 2 lf (4 in.)	4 lf (6 – 8 inches)	6 to 12 inches tall
Redroot Pigweed	cotyledon	cot – 1 leaf	2 to 6 leaf	1 to 2 inches tall
Common Ragweed	cot – 2 leaf	cot – 2 leaf	2 to 4 leaf	1 to 3 inches tall

and redroot pigweed, volunteer wheat and green foxtail control were evaluated June 23.

Treatment*	Rate	Sgbt inj	Colq cntl	Gr&Y Fxtl cntl	Wioa cntl	Rrpw cntl	Cora cntl
	lb/A	%	%	%	%	%	%
Desmedipham	0.25	5	100	55	40	98	60
Desmedipham+Triflusulfuron	0.25+0.0156	5	100	85	79	100	100
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	5	100	80	69	100	100
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	5	100	75	43	100	100
Desm+Tfsu+MethOil	0.08+0.004+1.5%	5	94	78	73	100	100
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	3	99	80	75	100	100
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	5	99	81	80	100	100
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	5	99	81	80	100	100
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	3	99	76	65	100	100
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	4	99	79	70	100	100
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	10	100	79	75	100	100
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	5	99	79	61	100	100
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	5	99	100	100	100	100
Desm+Tfsu+Clpy+Clet+NH4+MOil	0.08+.004+.03+.03+.02%+1.5%	9	99	100	100	100	100
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	5	99	100	100	100	100
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	5	100	84	85	100	100
Desm&Phen&Etho+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	10	100	80	83	99	100
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	100	100	68	64	100	100
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	3	99	96	99	100	100
C.V. %		39	2	8	12	1	0
LSD 5%		6	3	9	13	1	NS
LSD 1%		8	NS	12	17	NS	NS
# OF REPS		4	4	4	4	4	2

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only the treatment that included diflufenzopyr caused severe sugarbeet injury. Desmedipham + triflusulfuron + MethOil at 0.08 + 0.004 + 1.5% gave less control of common lambsquarters than the other treatments. Treatments that included clethodim or quizalofop gave better grass control than other treatments. Redroot pigweed control was excellent with all treatments. Desmedipham at 0.25 lb/A gave less control of common ragweed than the other treatments.

Micro-rates of sugarbeet herbicides plus additives, Maynard, 1998. (Dexter) 'Hilleshog Viking' sugarbeet was seeded April 23. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 6, May 13 and May 20. Sugarbeet injury and wild proso millet, common lambsquarters and redroot pigweed control were evaluated June 18.

Date	May 6	May 13	May 20
Time of Day	3:00 PM	1:45 PM	11:00 AM
Sugarbeet Stage	cotyledon	2 leaf	4 leaf
Wild Proso Millet	0.25 inches tall	0.25 to 1 inch tall	2.5 inches tall
Common Lambsquarters	cotyledon	cotyledon – 1 inch tall	cotyledon – 2 inches tall
Redroot Pigweed	cotyledon	cotyledon – 1 inch tall	cotyledon – 2 inches tall

Treatment*	Rate	Wipm cntl	Colq cntl	Rrpw cntl	Sgbt inj
	lb/A	%	%	%	%
Desmedipham	0.25	41	84	74	0
Desmedipham+Triflusulfuron	0.25+0.0156	74	95	95	0
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	78	99	97	0
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	69	98	97	1
Desm+Tfsu+MethOil	0.08+0.004+1.5%	74	88	88	0
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	60	82	80	0
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	73	96	84	1
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	40	73	80	0
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	75	94	91	0
Desm+Tfsu+Clpy+Quad 7+MethOil	0.08+0.004+0.03+1%+1.5%	50	80	83	0
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	65	88	87	0
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	40	90	95	0
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	86	92	95	0
Desm+Tfsu+Clpy+Clet+NH4+MOil	.08+.004+.03+.03+.02%+1.5%	90	95	93	0
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	66	85	76	0
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	76	96	88	0
Desm&Phen&Etho+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	61	92	93	0
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	72	95	84	76
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	86	93	85	0
EXP MEAN		67	90	87	4
C.V. %		29	13	14	190
LSD 5%		27	NS	NS	11
LSD 1%		36	NS	NS	15
# OF REPS		4	4	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only desmedipham + triflusulfuron + clopyralid + diflufenzopyr + MethOil gave significant sugarbeet injury. Weed control was similar with all treatments.

Micro-rates of sugarbeet herbicides plus additives, St. Thomas, 1998. (Dexter) 'Hilleshog Horizon' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 27. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 13, May 20, May 27 and June 3. Sugarbeet injury and redroot pigweed, volunteer wheat and green foxtail control were evaluated June 23.

Date	May 13	May 20	May 27	June 3
Time of Day	11:45 AM	12:30 PM	1:00 PM	11:30 AM
Air Temp. (°F)	64	73	82	55
6" Soil Temp. (°F)	57	63	70	47
Rel. Humidity (%)	65	47	40	37
Wind Velocity (mph)	8	0-2	9	20
Cloud Cover (%)	95	5	25	0
Soil Moisture	good	good	good	good
Sugarbeet Stage	v1.0	v2.0	v5.2-v6.5	v5.2-v8.1
Redroot Pigweed	cotyledon	cot - 2 leaf	1 - 4 leaf	2 lf - 2 inches
Volunteer Wheat	emerg – 1 lf (4 in.)	emerg - 3 lf (5 in.)	4 to 7 inches	4 to 8 inches
Green Foxtail	emerg -2 lf (1.5 in.)	emerg – 1 inch	1 to 3 inches	1 to 4 inches

Treatment*	Rate	Sgbt inj	Rrpw cntl	Vowh cntl	Grft cntl
	lb/A	%	%	%	%
Desmedipham	0.25	0	93	70	80
Desmedipham+Triflusulfuron	0.25+0.0156	6	100	89	93
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	5	100	88	94
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	4	99	76	83
Desm+Tfsu+MethOil	0.08+0.004+1.5%	1	98	89	88
Desm+Tfsu+Clpy+MOil	0.08+0.004+0.03+1.5%	4	100	92	90
Desm+Tfsu+Clpy+MOil	0.08+0.004+0.03+3%	3	99	95	90
Desm+Tfsu+Clpy+NH4+MOil	0.08+0.004+0.03+0.02%+1.5%	3	100	90	87
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	0	100	88	89
Desm+Tfsu+Clpy+Quad7+MOil	0.08+0.004+0.03+1%+1.5%	1	100	91	88
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	1	100	90	86
Desm+Tfsu+Clpy+NH4+Quad7	0.08+0.004+0.03+0.02%+1%	0	100	92	88
Desm+Tfsu+Clpy+Clet+MOil	0.08+0.004+0.03+0.03+1.5%	1	100	98	100
Desm+Tfsu+Clpy+Clet+NH4+MOil	.08+.004+.03+.03+.02%+1.5%	1	100	98	100
Desm+Tfsu+Clpy+Clet+Quad7	0.08+0.004+0.03+0.03+1%	3	100	98	100
Des&Phen+Tfsu+Clpy+MOil	0.08+0.004+0.03+1.5%	5	99	91	96
D&P&E+Tfsu+Clpy+MOil	0.08+0.004+0.03+1.5%	0	99	94	96
Desm+Tfsu+Clpy+Diflufen+MOil	0.08+0.004+0.03+0.05+1.5%	97	100	85	99
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	3	100	96	99
C.V. %		54	1	5	6
LSD 5%		6	2	7	7
LSD 1%		7	2	9	10
# OF REPS		4	4	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

Summary

Only the treatments that included diflufenzopyr caused significant sugarbeet injury. Desmedipham at 0.25 lb/A and desmedipham + triflusulfuron + clopyralid at 0.16 + 0.008 + 0.06 lb/A gave less control of volunteer wheat than the other treatments. Treatments that included clethodim or quizalofop gave or tended to give better green foxtail control than other treatments. The treatments that included desmedipham and phenmedipham gave better control of green foxtail than when desmedipham was substituted for desmedipham and phenmedipham.

Micro-rates of sugarbeet herbicides plus adjuvants, Wahpeton, 1998. (Dexter) This experiment was established in a fallow field so no sugarbeet was present. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 19, May 25 and June 1. Common cocklebur, redroot pigweed and yellow foxtail control were evaluated June 24.

Date	May 19	May 25	June 1
Time of Day	4:00 PM	1:30 PM	1:30 PM
Air Temp. (°F)	75	73	82
6" Soil Temp. (°F)	68	64	65
Rel. Humidity (%)	55	48	37
Wind Velocity (mph)	14	5-10	15
Cloud Cover (%)	90	10	5
Soil Moisture	good	good	good
Common Cocklebur	cotyledon	cot – 2 leaf	2 leaf to 4 inches tall
Redroot Pigweed	cotyledon – 1 leaf	cotyledon – 2 leaf	cotyledon – 1.5 inches tall
Yellow Foxtail	emerg – 1 inch tall	0.5 to 1.5 inches tall	1 to 3 inches tall

Treatment*	Rate	Cocb cntl	Rrpw cntl	Yeft cntl
	lb/A	%	%	%
Desmedipham	0.25	85	88	75
Desmedipham+Triflusulfuron	0.25+0.0156	83	95	94
Desm+Tfsu+Clopyralid	0.25+0.0156+0.09	100	99	87
Desm+Tfsu+Clopyralid	0.16+0.008+0.06	100	98	84
Desm+Tfsu+MethOil	0.08+0.004+1.5%	73	88	84
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	100	95	91
Desm+Tfsu+Clpy+MethOil	0.08+0.004+0.03+3%	100	93	83
Desm+Tfsu+Clpy+NH4+MethOil	0.08+0.004+0.03+0.02%+1.5%	100	97	84
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+1%	100	97	91
Desm+Tfsu+Clpy+Quad7+MethOil	0.08+0.004+0.03+1%+1.5%	99	96	88
Desm+Tfsu+Clpy+Quad 7	0.08+0.004+0.03+2%	99	94	88
Desm+Tfsu+Clpy+NH4+Quad 7	0.08+0.004+0.03+0.02%+1%	100	96	88
Desm+Tfsu+Clpy+Clet+MethOil	0.08+0.004+0.03+0.03+1.5%	100	96	99
Desm+Tfsu+Clpy+Clet+NH4+MethOil	0.08+.004+.03+.03+.02%+1.5%	100	96	100
Desm+Tfsu+Clpy+Clet+Quad 7	0.08+0.004+0.03+0.03+1%	100	95	99
Desm&Phen+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	100	91	86
Desm&Phen&Etho+Tfsu+Clpy+MethOil	0.08+0.004+0.03+1.5%	100	88	83
Desm+Tfsu+Clpy+Diflufenzopyr+MOil	0.08+0.004+0.03+0.05+1.5%	100	99	93
Desm+Tfsu+Clpy+Qufp+MethOil	0.08+0.004+0.03+0.028+1.5%	99	95	97
C.V. %		6	3	11
LSD 5%		12	4	13
LSD 1%		16	5	NS
# OF REPS		2	4	4

*MethOil=methylated seed oil from Terra; Quad 7=basic blend adjuvant from AGSCO; NH_4=household ammonia(2% concentration) at 1 gallon/100 gallon water.

SUMMARY: Sugarbeet was not seeded at this location, an existing population of weeds was treated. Treatments that included clopyralid gave nearly total control of common cocklebur, more control than other treatments. Desmedipham, desmedipham + triflusulfuron + MethOil at 0.08 + 0.004 + 1.5% and desmedipham & phenmedipham & ethofumesate + triflusulfuron + clopyralid + MethOil at 0.08 + 0.004 + 0.03 + 1.5% gave less control of redroot pigweed than other treatments except desmedipham & phenmedipham + triflusulfuron + clopyralid + MethOil was similar. Treatments that included clethodim or quizalofop gave or tended to give better control of yellow foxtail than the other treatments.

Delayed preemergence herbicides plus micro-rate postemergence herbicides on sugarbeet, St. Thomas, 1998. (Dexter) 'Hilleshog Horizon' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 27. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 13, May 20 and May 27. Sugarbeet injury and volunteer wheat, redroot pigweed and green foxtail control were evaluated June 23.

Date	May 13	May 20	May 27
Time of Day	1:45 AM	12:30 PM	1:00 PM
Air Temp. (°F)	64	73	82
6" Soil Temp. (°F)	57	63	70
Rel. Humidity (%)	65	47	40
Wind Velocity (mph)	8	0 - 2	9
Cloud Cover (%)	95	5	25
Soil Moisture	good	good	good
Sugarbeet Stage	v 1.0	v 2.0	v5.2-v6.5
Volunteer Wheat	emerg-1 leaf(4 inches tall)	emerg-3 leaf(5 inches tall)	4 to 7 inches tall
Redroot Pigweed	cotyledon	cotyledon to 2 leaf	1 to 4 leaf
Green Foxtail	emerg–0.5 inch tall(2 lf)	emerg – 1 inch tall	1 to 3 inches tall

Treatment*	Rate	Sgbt inj	Wht cntl	Rrpw cntl	Grft cntl
	lb/A	%	%	%	%
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+MethOil	0.08+0.004+0.07+1.5%	0	97	98	100
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+Moil+Pyrazon/	0.08+0.004+0.07+1.5%+4				
Desm+Tfsu+Seth+MethOil	0.08+0.004+0.07+1.5%	0	99	100	100
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+Moil+Pyrazon/	0.08+0.004+0.07+1.5%+6				
Desm+Tfsu+Seth+MethOil	0.08+0.004+0.07+1.5%	3	99	100	100
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+Moil+Meto-M/	0.08+0.004+0.07+1.5%+1.9				
Desm+Tfsu+Seth+MethOil	0.08+0.004+0.07+1.5%	6	97	98	100
Desm+Tfsu+Seth+Methoil/	0.08+0.004+0.07+1.5%				
Desm+Tfsu+Seth+Moil+Dime/	0.08+0.004+0.07+1.5%+1.0				
Desm+Tfsu+Seth+MethOil	0.08+0.004+0.07+1.5%	8	95	97	100
EXP MEAN		3	97	99	100
C.V. %		155	3	1	0
LSD 5%		NS	NS	NS	0
LSD 1%		NS	NS	NS	0
# OF REPS		4	4	4	4

* MethOil=methylated seed oil from Terra.

Summary

Weed control from postemergence desmedipham + triflusulfuron + sethoxydim + MethOil applied three times was 97% or greater. The addition of pyrazon, metolachlor or dimethenamid in the second treatment could not improve weed control since the level of control was so high from postemergence herbicides alone. Sugarbeet was not significantly injured by any treatment.

Frontier on sugarbeet, Fargo, 1998. (Dexter) 'Seedex Monohikari' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 5. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots May 26, June 2 and June 10. Sugarbeet injury and redroot pigweed and green foxtail control were evaluated July 10.

Date	May 26	June 2	June 10
Time of Day	12:00 PM	7:30 PM	8:30 AM
Air Temp. (°F)	90	52	64
6" Soil Temp. (°F)	68	61	64
Rel. Humidity (%)	22	37	65
Wind Velocity (mph)	5	15	5-8
Cloud Cover (%)	0	90	100
Soil Moisture	good	good	good
Sugarbeet Stage	v1.0-v2.0	v2.0-v3.8	v4.0-v6.5
Redroot Pigweed	cotyledon - 4 leaf	4 to 8 leaf	1 to 3 inches tall
Green Foxtail	emerg – 1 inch tall	1 to 3 inches tall	2 to 4 inches tall

Treatment*	Date of Application	Rate	Sgbt inj	Rrpw cntl	Grft cntl
		lb/A	%	%	%
Dimethenamid	(June 2)	1.17	0	69	61
Dimethenamid	(June 2)	0.64	0	67	73
Desmedipham&Phenmedipham / Desm&Phen+Dimethenamid	(May 26) / (June 2)	0.25 / 0.25+0.64	3	96	83
Desmedipham&Phenmedipham / Desmedipham&Phenmedipham	(May 26) / (June 2)	0.25 / 0.25	0	90	58
Desmedipham&Phenmedipham / Desm&Phen+Tfsu+Dimethenamid	(May 26) / (June 2)	0.25 / 0.25+0.016+0.64	5	99	97
Desmedipham&Phenmedipham / Desm&Phen+Triflusulfuron	(May 26) / (June 2)	0.25 / 0.25+0.016	0	95	65
Desmedipham&Phenmedipham / Desmedipham&Phenmedipham / Dimethenamid+Seth+MethOil	(May 26) / (June 2) / (June 10)	0.25 / 0.25 / 0.64+0.19+1%	3	99	100
EXP MEAN			1	88	76
C.V. %			246	15	14
LSD 5%			NS	20	16
LSD 1%			NS	27	22
# OF REPS			4	4	4

*MethOil=methylated seed oil from Terra.

Summary

Postemergence dimethenamid gave less than 70% control of redroot pigweed and green foxtail. Adding dimethenamid to postemergence desmedipham & phenmedipham or desmedipham & phenmedipham + triflusulfuron resulted in improved green foxtail control compared to the herbicides used alone.

Grass control in sugarbeet, Fargo, 1998. (Dexter) 'Foster' barley at 95 lb/A, 'Paul' oats at 76 lb/A, 'Agri I' navy bean, 'Seedex Monohikari' sugarbeet, 'Interstate 6111' sunflower and 'Manta' Siberian foxtail millet at 47 lb/A were seeded in 4 foot strips across the herbicide plots May 5. The first portion of split applied treatments was applied 12:00 PM May 26 when the air temperature was 90F, relative humidity was 22%, wind velocity was 5 mph, cloud cover was 0%, soil temperature at six inches was 68F, soil moisture was good, sugarbeet was in the v1.0 to v2.0 stage, oats was in the 1 to 2 leaf stage (2 to 4 inches tall), barley was in the 1 to 2 leaf stage (2 to 3 inches tall), navy bean was in the cotyledon stage, sunflower was in the cotyledon to 2 leaf stage, foxtail millet was 0.5 to 1.5 inches tall and green and yellow foxtail was emerging to 1 inch tall. The second portion of split applied treatments was applied 7:30 PM June 2 when the air temperature was 52F, relative humidity was 37%, wind velocity was 15 mph, cloud cover was 90%, soil temperature at six inches was 61F, soil moisture was good, sugarbeet was in the v1.0 to v3.5 stage, oats was 4 to 6 inches tall, barley was 3 to 5 inches tall, navy bean was in the cotyledon to 1 trifoliolate stage, sunflower was in the 2 to 4 leaf stage, foxtail millet was 1 to 3 inches tall and green and yellow foxtail was 1 to 2 inches tall. The third portion of split applied treatments and all single application treatments were applied 8:15 AM June 10 when the air temperature was 64F, relative humidity was 65%, wind velocity was 5 to 8 mph, cloud cover was 100%, soil temperature at six inches was 64F, soil moisture was good, sugarbeet was in the v4.0 to v6.5 stage, oats was 6 to 7 inches tall, barley was 6 inches tall, navy bean was in the 1 trifoliolate stage, sunflower was in the 4 to 8 leaf stage, foxtail millet was 2 to 4 inches tall and green and yellow foxtail was 1 to 3 inches tall. All treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center 6.67 feet of 11 foot plots. Sugarbeet, sunflower, navy bean, green and yellow foxtail, barley, oats, and foxtail millet were evaluated July 3.

Summary

AgPro, Activator 90, Activator 90 + AMS, Silwet + 28%N, and Silwet + AMS, used as adjuvants with quizalofop, gave less control of one or more grass species than the best adjuvants tested. AMS and 28%N antagonized Silwet + quizalofop. Adding 28%N or AMS to Herbimax or Scoil had no significant effect on grass control from quizalofop. The micro-rate of desmedipham + triflusulfuron + clopyralid + MethOil + a grass herbicide gave 93% or greater grass control. Adding AMS to quizalofop + the micro-rate did not improve grass control. Treatments with Quad 7 gave grass control similar to treatments with MethOil. Adding NH_4 did not affect grass control.

(Experiment continued on next page.)

Grass control in sugarbeet, Fargo, 1998. (continued)

Treatment*	Rate	Sgbt inj	Sufl cntl	Nabe cntl	Gr&Y Fxtl cntl	Barl cntl	Oats cntl	Fomi cntl
	lb/A	%	%	%	%	%	%	%
Quizalofop+AgPro	0.0275+0.25%	0	0	0	89	96	94	85
Quizalofop+Activater90	0.0275+0.25%	0	0	0	87	97	97	84
Quizalofop+Activ90+28%N	0.0275+0.25%+1G	0	0	0	93	99	99	90
Quizalofop+Activ90+AMS	0.0275+0.25%+4	0	0	0	89	96	93	85
Quizalofop+Herbimax	0.0275+1%	0	0	0	96	99	99	94
Quizalofop+Herbimax	0.055+1%	0	0	0	94	99	99	93
Quizalofop+Herbimax+28%N	0.0275+1%+1G	0	0	0	95	99	99	94
Quizalofop+Herbimax+28%N	0.055+1%+1G	0	0	0	98	99	99	94
Quizalofop+Herbimax+AMS	0.0275+1%+4	0	0	0	96	99	99	94
Quizalofop+Herbimax+AMS	0.055+1%+4	0	0	0	93	99	99	93
Quizalofop+Scoil	0.0275+1%	0	0	0	97	99	99	93
Quizalofop+Scoil+28%N	0.0275+1%+1G	0	0	0	94	99	99	93
Quizalofop+Scoil+AMS	0.0275+1%+4	0	0	0	93	99	99	91
Quizalofop+Silwet	0.0275+0.1%	0	0	0	92	99	99	95
Quizalofop+Silwet+28%N	0.0275+0.1%+1G	0	0	0	84	93	93	76
Quizalofop+Silwet+AMS	0.0275+0.1%+4	0	0	0	89	99	99	85
Sethoxydim+Scoil	0.19+1%	0	0	0	100	99	99	99
Clethodim+Scoil	0.094+1%	0	0	0	93	83	80	86
Clethodim+Scoil	0.125+1%	0	0	0	97	86	86	94
Desm+Tfsu+Clpy+Clet+MethOil (3X)	0.08+0.004+0.03+0.031+1.5%	0	100	100	99	99	99	98
Desm+Tfsu+Clpy+Seth+MethOil (3X)	0.08+0.004+0.03+0.063+1.5%	0	100	100	97	99	99	96
Desm+Tfsu+Clpy+Qufp+MethOil (3X)	0.08+0.004+0.03+0.028+1.5%	0	100	100	95	99	99	93
Desm+Tfsu+Clpy+Qufp+AMS+MethOil (3X)	0.08+0.004+0.03+0.028+4+1.5%	0	100	100	97	99	99	96
Desm+Tfsu+Clpy+Clet+Quad 7 (3X)	0.08+0.004+0.03+0.031+1%	0	100	100	98	99	99	96
Desm+Tfsu+Clpy+Seth+Quad 7 (3X)	0.08+0.004+0.03+0.063+1%	0	100	100	92	98	98	93
Desm+Tfsu+Clpy+Qufp+Quad 7 (3X)	0.08+0.004+0.03+0.028+1%	0	100	100	99	99	99	97
Desm+Tfsu+Clpy+Clet+NH_4+MethOil (3X)	0.08+.004+.03+.031+.02%+1.5%	0	100	100	98	99	99	98
Desm+Tfsu+Clpy+Seth+NH_4+MethOil (3X)	0.08+.004+.03+.063+.02%+1.5%	0	100	100	94	97	99	95
Desm+Tfsu+Clpy+Qufp+NH_4+MethOil (3X)	0.08+.004+.03+.028+.02%+1.5%	0	100	100	97	99	99	95
Desm+Tfsu+Clpy+Qufp+AgPro (3X)	0.08+0.004+0.03+0.028+0.25%	0	100	100	89	99	99	93
C.V. %		0	0	0	5	3	4	7
LSD 5%		0	0	0	7	5	5	9
LSD 1%		0	0	0	9	6	7	12
# OF REPS		4	4	4	4	4	4	4

*Activator 90=non-ionic surfactant from Loveland; Herbimax=petroleum oil concentrate from Loveland; 28%N=28% nitrogen solution containing urea and NH_4NO_3; NH_4=household ammonia(2% concentration)at 1 gallon/100 gallon water; MethOil=methylated seed oil from AGSCO; Scoil=methylated seed oil from AGSCO; AMS=ammonium sulfate; Quad 7=basic blend adjuvant from AGSCO; Silwet=non-ionic surfactant from Loveland; AGPRO=non-ionic surfactant from AGPRO Systems.

Quizalofop and growth regulator on hand weeded sugarbeet, Fargo, 1998. (Dexter) 'Maribo 9581' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 28. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Desmedipham + triflusulfuron + clopyralid + MethOil at 0.08 + 0.004 + 0.03 + 0.03 + 1.5% was applied to the quizalofop treated plots May 26 and June 4. Desmedipham + triflusulfuron + clopyralid + clethodim + MethOil at 0.08 + 0.004 + 0.03 + 0.03 + 1.5% was applied to the control plots and the BAS13100W treated plots May 26 and June 4. Quizalofop treatments were applied June 9. BAS13100W treatments were applied July 22 and August 17. All treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet was hand thinned to an eight inch spacing June 26. Sugarbeet was hand weeded June 26 and maintained weed free throughout the growing season. Sugarbeet from the center two rows of 34 foot long plots was counted and harvested September 21.

Date	May 26	June 4	June 9	July 22	August 17
Time of Day	12:00 PM	3:00 PM	4:00 PM	9:30 AM	9:00 AM
Air Temp. (°F)	90	66	68	67	65
6" Soil Temp. (°F)	68	60	64	67	66
Rel. Humidity (%)	22	34	46	68	68
Wind Velocity (mph)	5	6	4-6	5-10	5-8
Cloud Cover (%)	0	90	95	0	0
Soil Moisture	good	good	good	good	poor
Sugarbeet Stage	v1.0-v2.5	v4.0-v5.5	v4.0-v6.5	14-22 leaf	closed canopy

Treatment*	Rate	Sgbt Popl	Sucr	Loss to Mol	Root Yield	Impur Index	Extract Sucrose
		plt/68'	%	%	ton/A		lb/A
Qufp+Activ.90+28%N	0.1375+0.25%+1G	80	14.5	2.1	13.1	1051	3217
Qufp+Herbimax+28%N	0.1375+1%+1G	81	14.5	2.1	13.7	1058	3357
Qufp+Scoil+28%N	0.1375+1%+1G	77	14.5	2.2	13.4	1117	3242
Qufp+Silwet+28%N	0.1375+0.1%+1G	79	14.2	2.2	13.2	1147	3135
Control	0	80	14.1	2.2	13.6	1168	3181
Diflufenzopyr+Dash(July 22)	0.003+1%	77	14.1	2.2	12.0	1131	2816
Diflufenzopyr+Dash(July 22)	0.007+1%	68	13.7	2.3	9.3	1227	2080
Diflufenzopyr+Dash(July 22)	0.015+1%	59	12.7	2.4	6.1	1384	1216
Diflufenzopyr+Dash(Aug. 17)	0.003+1%	71	14.0	2.2	10.6	1136	2490
Diflufenzopyr+Dash(Aug. 17)	0.007+1%	78	14.2	2.3	10.1	1163	2401
Diflufenzopyr+Dash(Aug. 17)	0.015+1%	75	14.3	2.3	10.1	1158	2388
Control	0	77	14.7	2.1	12.6	1051	3136
EXP MEAN		75	14.1	2.2	11.5	1149	2722
C.V. %		9	3.2	6.0	13.9	8	16
LSD 5%		8	0.5	0.2	1.9	113	499
LSD 1%		11	0.7	0.2	2.5	150	664
# OF REPS		6	6	6	6	6	6

*28%N=28% nitrogen solution containing urea and NH_4NO_3; Herbimax=petroleum oil from Loveland; Scoil=methylated seed oil from AGSCO; Silwet=non-ionic surfactant from Loveland; Dash=esterified vegetable oil from BASF; Activator 90=non-ionic surfactant from Loveland.

Summary

Quizalofop had no significant influence on sugarbeet yield or population. Diflufenzopyr reduced extractable sucrose per acre at all rates and application times.

Metolachlor on Liberty Link sugarbeet, Fargo, 1998. (Dexter) Preplant incorporated herbicides were applied 6:00 pm May 21 when the air temperature was 70F, soil temperature at six inches was 65F, wind velocity was 5-10 mph, cloud cover was 50% and soil moisture was good. A rototiller set 2 inches deep was used for incorporation. 'Liberty Link' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. The first portion of split applied postemergence herbicide treatments was applied 5:00 pm June 16 when the air temperature was 82F, relative humidity was 46%, soil temperature at six inches was 63F, wind velocity was 5 mph, cloud cover was 50%, soil moisture was good, sugarbeet was in the v2.0 to v4.5 leaf stage, redroot pigweed was in the 2 to 6 leaf stage and green and yellow foxtail was 1 to 2 inches tall. The second portion of split application postemergence herbicide treatments was applied 3:30 pm June 24 when the air temperature was 84F, relative humidity was 66%, soil temperature at six inches was 63F, wind velocity was 15-20 mph, cloud cover was 40%, soil moisture was good, sugarbeet was in the v3.5 to v8.0 leaf stage, redroot pigweed was in the 6 leaf stage to 2 inches tall and green and yellow foxtail was 2 to 5 inches tall. The third portion of split application postemergence herbicide treatments was applied 10:00 am July 2 when the air temperature was 78F, relative humidity was 75%, soil temperature at six inches was 67F, wind velocity was 5 mph, cloud cover was 100%, soil moisture was good, sugarbeet was in the v5.2 to v11.5 leaf stage, redroot pigweed was in the 4 leaf stage to 3 inches tall and green and yellow foxtail was 4 to 9 inches tall. All herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet was hand thinned to a twelve inch spacing June 26. Sugarbeet injury and green and yellow foxtail control were evaluated July 10 and August 2. Redroot pigweed control was evaluated August 2. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested October 1.

(Experiment continued on next page.)

Metolachlor on Liberty Link sugarbeet, Fargo, 1998. (continued)

Treatment*	Date of Application	Rate	July 10 Sgbt inj	July 10 Gr&Y Fxtl cntl	August 2 Sgbt inj	August 2 Rrpw cntl	August 2 Gr&Y Fxtl cntl
		lb/A	%	%	%	%	%
Metolachlor-M (PPI)		1.6	0	73	0	72	63
Metolachlor-M (PPI)		1.9	0	65	0	49	44
Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil	(June 16) (June 24) (July 2)	0.08+0.004+0.03+0.03+1.5%	0	100	0	62	94
Glufosinate/ Glufosinate/ Glufosinate	(June 16) (June 24) (July 2)	0.268	0	99	0	99	90
Metolachlor-M	(June 16)	1.9	0	52	0	3	23
Gluf+Metolachlor-M/ Glufosinate/ Glufosinate	(June 16) (June 24) (July 2)	0.268+1.9 0.268 0.268	0	100	0	100	100
Gluf+Metolachlor-M/ Glufosinate	(June 16) (June 24)	0.268+1.9 0.268	0	100	0	99	99
Gluf+Dime (BAS65607H)/ Glufosinate	(June 16) (June 24)	0.268+1 0.268	0	100	0	100	96
Desm+Tfsu+Clpy+Cley+MO+Meto-M/ Desm+Tfsu+Clpy+Clet+MethOil/ Desm+Tfsu+Clpy+Clet+MethOil	(June 16) (June 24) (July 2)	0.08+0.004+0.03+0.03+1.5%+1.9 0.08+0.004+0.03+0.03+1.5%	0	100	0	94	97
Glufosinate/ Gluf+Metolachlor-M	(June 16) (June 24)	0.268 0.268+1.9	0	100	0	100	100
EXP MEAN			0	89	0	78	80
C.V. %			0	13	0	27	18
LSD 5%			0	19	0	31	21
LSD 1%			0	27	0	42	28
# OF REPS			3	3	4	4	4

*MethOil=methylated seed oil from Terra.

(Experiment continued on next page.)

Metolachlor on Liberty Link sugarbeet, Fargo, 1998. (continued)

Treatment*	Date of (Application)	Rate	Sgbt Popl	Sucr	Root Yield	Impur Index	Extract Sucrose
		lb/A	plt/60'	%	ton/A		lb/A
Metolachlor-M	(PPI)	1.6	56	17.4	14.3	770	4370
Metolachlor-M	(PPI)	1.9	53	16.7	14.9	843	4317
Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil	(June 16) (June 24) (July 2)	0.08+0.004+0.03+0.03+1.5%	54	17.0	14.0	826	4163
Glufosinate/ Glufosinate/ Glufosinate	(June 16) (June 24) (July 2)	0.268	49	17.1	15.0	837	4490
Metolachlor-M	(June 16)	1.9	61	16.7	12.7	854	3705
Gluf+Metolachlor-M/ Glufosinate/ Glufosinate	(June 16) (June 24) (July 2)	0.268+1.9 0.268 0.268	56	16.5	15.6	889	4445
Gluf+Metolachlor-M/ Glufosinate	(June 16) (June 24)	0.268+1.9 0.268	56	16.7	17.3	874	4988
Gluf+Dime (BAS65607H)/ Glufosinate	(June 16) (June 24)	0.268+1 0.268	51	16.9	16.2	821	4825
Desm+Tfsu+Clpy+Cley+MO+Meto-M/ Desm+Tfsu+Clpy+Clet+MethOil/ Desm+Tfsu+Clpy+Clet+MethOil	(June 16) (June 24) (July 2)	0.08+.004+.03+.03+1.5%+1.9 0.08+.004+.03+.03+1.5%	59	17.3	13.6	770	4162
Glufosinate/ Gluf+Metolachlor-M	(June 16) (June 24)	0.268 0.268+1.9	65	17.0	17.1	806	5100
EXP MEAN			56	16.9	15.1	829	4457
C.V. %			17	3.1	12.8	9	14
LSD 5%			NS	NS	2.8	NS	NS
LSD 1%			NS	NS	NS	NS	NS
# OF REPS			4	4	4	4	4

*MethOil=methylated seed oil from Terra.

Summary

None of the treatments caused sugarbeet injury. PPI metolachlor gave better weed control than POST metolachlor applied June 16. All other POST treatments gave 90% or greater weed control. Foxtail spp. control on August 2 from glufosinate applied three times tended to be less than when metolachlor or dimethenamid was included in one postemergence treatment. Treatments had no significant effect or sugarbeet yield or population except plots treated with POST metolachlor alone yielded less tons per acre than several other treatments.

Liberty on sugarbeet at different weed stages, Fargo, 1998. (Dexter) 'Liberty Link' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. Herbicide application dates were determined by the size of weeds in the plots. Some treatments were applied June 16, July 2 and July 15 when weeds in the plots averaged 1 inch tall. Other treatments were applied June 24 and July 22 when weeds in the plots averaged 3 inches tall. The last treatment was applied at two week intervals regardless of weed size. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six

Date	June 16	June 24	July 2	July 15	July 22
Time of Day	5:00 PM	3:30 PM	10:00 AM	10:00 AM	9:30 AM
Air Temp. (°F)	82	84	78	76	67
6" Soil Temp. (°F)	63	63	67	74	67
Rel. Humidity (%)	46	66	75	56	68
Wind Velocity (mph)	5	15-20	5	0-5	5-10
Cloud Cover (%)	50	40	100	0	0
Soil Moisture	good	good	good	good	good
Sugarbeet Stage	v2.0-v4.5	v3.5-v8.0	v5.2-v11.5	12-18 leaf	12-20 leaf
Gr. and Yel. Foxtail	1-2 inches tall	2-5 inches tall	4-9 inches tall	4-20 inches	6-24 inches
Redroot Pigweed	2-6 leaf	6 leaf-2 inches	4 leaf-3 inches	3-7 inches tall	5-10 inches

row plots. Sugarbeet was hand thinned to a 14 inch spacing June 26. Sugarbeet injury and green and yellow foxtail control were evaluated July 10 and August 2. Redroot pigweed control was evaluated August 2. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested October 1.

			July 10		August 2		
Treatment*	Time of Application	Rate	Sgbt inj	Gr&Y Fxtl cntl	Sgbt inj	Rrpw cntl	Gr&Y Fxtl cntl
		lb/A	%	%	%	%	%
Glufosinate	(June 16, July 2, July 15)	0.268	0	98	0	100	93
Glufosinate	(June 16, July 2, July 15)	0.357	0	98	0	100	95
Glufos+AMS	(June 16, July 2, July 15)	0.268+3	0	98	0	100	94
Glufos+AMS	(June 16, July 2, July 15)	0.357+3	0	98	0	100	96
Glufosinate	(June 24, July 22)	0.268	0	95	0	100	97
Glufosinate	(June 24, July 22)	0.357	0	99	0	100	100
Glufosinate+AMS	(June 24, July 22)	0.268+3	0	99	0	100	99
Glufosinate+AMS	(June 24, July 22)	0.357+3	0	99	0	100	100
Desm&Phen&Etho+Sethoxydim	(June 16, July 2, July 15)	0.33+0.1	0	85	0	53	76
Desmedipham+Triflusulfuron+Clopyralid+Seth	(June 16, July 2, July 15)	0.33+0.0156+0.06+0.1	0	87	0	96	75
Glufosinate	(June 16, July 2, July 15)	0.268	0	98	0	100	94
EXP MEAN			0	96	0	95	93
C.V. %			0	6	0	7	5
LSD 5%			0	8	0	10	7
LSD 1%			0	11	0	14	9
# OF REPS			4	4	4	4	4

*AMS=ammonium sulfate

(Experiment continued on next page.)

Liberty on sugarbeet at different weed stages, Fargo, 1998. (continued)

Treatment	Date of Application	Rate	Sgbt popl	Sucr	Root Yield	Impur Index	Extrac Sucros
		lb/A	plt/60'	%	ton/A		lb/A
Glufosinate	(June 16, July 2, July 15)	0.268	52	16.8	14.8	812	4367
Glufosinate	(June 16, July 2, July 15)	0.357	48	16.4	16.1	851	4597
Glufos+AMS	(June 16, July 2, July 15)	0.268+3	49	16.0	13.2	883	3679
Glufos+AMS	(June 16, July 2, July 15)	0.357+3	51	16.7	13.6	819	4047
Glufosinate	(June 24, July 22)	0.268	45	16.5	11.5	822	3352
Glufosinate	(June 24, July 22)	0.357	59	16.6	14.8	893	4240
Glufosinate+AMS	(June 24, July 22)	0.268+3	54	16.8	13.4	846	3937
Glufosinate+AMS	(June 24, July 22)	0.357+3	52	16.4	14.5	853	4157
Desm&Phen&Etho+Sethoxydim	(June 16, July 2, July 15)	0.33+0.1	55	16.6	11.7	806	3415
Desmedipham+Triflusulfuron+Clopyralid+Seth	(June 16, July 2, July 15)	0.33+0.0156+0.06+0.1	50	16.7	12.3	809	3603
Glufosinate	(June 16, July 2, July 15)	0.268	51	17.0	13.2	791	3953
EXP MEAN			51	16.6	13.6	835	3941
C.V. %			16	3.2	12.8	7	13
LSD 5%			NS	NS	2.5	NS	727
LSD 1%			NS	NS	NS	NS	NS
# OF REPS			4	4	4	4	4

* AMS=ammonium sulfate

Summary

The first treatment is identical to the last treatment since treating one-inch weeds and treating every two weeks resulted in using the same treatment dates. None of the treatments caused sugarbeet injury. All glufosinate treatments gave over 90% weed control while the conventional herbicide treatments applied at a two-week interval gave less than 90% control of foxtail. Desmedipham + triflusulfuron + clopyralid + sethoxydim gave 96% control of redroot pigweed while desmedipham & phenmedipham & ethofumesate + sethoxydim gave only 53% control. Plots treated with glufosinate at 0.268 lb/A always had less extractable sucrose per acre than plots treated with the same timing but at 0.357 lb/A and in some comparisons, the differences were significant. The high yielding plots treated with glufosinate yielded more than the plots treated with conventional herbicides.

Liberty on sugarbeet at different weed stages, St. Thomas, 1998. (Dexter) 'Liberty Link' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 13. Counter 15G insecticide at 12 pounds product per acre was applied in a five inch band over the row at planting. Herbicide application dates were determined by the size of weeds in the plots. Some treatments were applied May 27, June 9, June 22 and July 2 when weeds in the plots averaged 1 inch tall. Other treatments were applied June 9 and July 2 when weeds in the plots averaged 3 inches tall. The last treatment was applied at two week intervals regardless of weed size. Herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet was hand thinned to an 18 inch spacing June 15. Sugarbeet injury and redroot pigweed, wild mustard and volunteer wheat control were evaluated August 2. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested September 28.

Date	May 27	June 9	June 22	July 2
Time of Day	1:00 PM	3:00 PM	11:30 AM	11:30 AM
Air Temp. (°F)	82	72	63	82
6" Soil Temp. (°F)	70	58	58	73
Rel. Humidity (%)	40	37	69	38
Wind Velocity (mph)	9	5-8	5	0
Cloud Cover (%)	25	90	100	100
Soil Moisture	good	fair	good	good
Sugarbeet Stage	v1.0-v2.0	v4.5-v5.5	v6.0-v9.5	10-14 leaf
Redroot Pigweed	cotyledon – 2 leaf	4 – 6 leaf	2-4 inches tall	--
Wild Mustard	cotyledon – 4 leaf	4 – 6 leaf	6-12 inches tall	--
Volunteer Wheat	1-2 leaf (3-4")	2-6 inches tall	8-12 inches tall	--

Treatment*	Date of Application	Rate	Sgbt inj	Rrpw cntl	Wimu cntl	Vowh cntl
		lb/A	%	%	%	%
Glufosinate	(May 27, June 9, June 22, July 2)	0.268	0	100	100	100
Glufosinate	(May 27, June 9, June 22, July 2)	0.357	0	100	100	100
Glufosinate+AMS	(May 27, June 9, June 22, July 2)	0.268+3	0	100	100	99
Glufosinate+AMS	(May 27, June 9, June 22, July 2)	0.357+3	0	100	100	99
Glufosinate	(June 9, July 2)	0.268	0	93	100	87
Glufosinate	(June 9, July 2)	0.357	0	99	100	98
Glufosinate+AMS	(June 9, July 2)	0.268+3	0	100	99	97
Glufosinate+AMS	(June 9, July 2)	0.357+3	0	100	100	97
Des&Phen&Etho+Seth	(May 27, June 9, June 22, July 2)	0.33+0.1	0	90	100	100
Desm+Tfsu+Clpy+Seth	(May 27, June 9, June 22, July 2)	0.33+0.0156+0.06+0.1	0	100	100	98
Glufosinate	(May 27, June 9, June 22)	0.268	0	100	99	98
EXP MEAN			0	98	100	97
C.V. %			0	3	1	3
LSD 5%			0	4	NS	4
LSD 1%			0	5	NS	6
# OF REPS			4	4	4	4

*AMS=ammonium sulfate.

(Experiment continued on next page.)

Liberty on sugarbeet at different weed stages, St. Thomas, 1998. (continued)

Treatment	Date of Application	Rate	Sgbt popl	Sucr	Root Yield	Impur Index	Extrac Sucros
		lb/A	plt/60'	%	ton/A		lb/A
Glufosinate	(May 27, June 9, June 22, July 2)	0.268	38	16.0	18.1	881	5044
Glufosinate	(May 27, June 9, June 22, July 2)	0.357	41	15.4	16.3	910	4356
Glufosinate+AMS	(May 27, June 9, June 22, July 2)	0.268+3	35	15.4	16.3	932	4317
Glufosinate+AMS	(May 27, June 9, June 22, July 2)	0.357+3	35	16.0	15.6	848	4363
Glufosinate	(June 9, July 2)	0.268	39	15.7	16.6	910	4497
Glufosinate	(June 9, July 2)	0.357	38	15.9	15.5	833	4310
Glufosinate+AMS	(June 9, July 2)	0.268+3	38	16.2	17.4	837	4923
Glufosinate+AMS	(June 9, July 2)	0.357+3	46	15.9	18.2	827	5027
Des&Phen&Etho+Seth	(May 27, June 9, June 22, July 2)	0.33+0.1	38	16.0	16.9	804	4782
Desm+Tfsu+Clpy+Seth	(May 27, June 9, June 22, July 2)	0.33+0.0156+0.06+0.1	36	15.6	15.6	916	4231
Glufosinate	(May 27, June 9, June 22)	0.268	40	16.2	16.8	852	4721
EXP MEAN			38	15.8	16.7	868	4597
C.V. %			16	3.2	13.3	9	15
LSD 5%			NS	NS	NS	NS	NS
LSD 1%			NS	NS	NS	NS	NS
# OF REPS			4	4	4	4	4

*AMS=ammonium sulfate.

Summary

None of the treatments caused sugarbeet injury. Glufosinate applied twice at 0.268 lb/A gave less control of volunteer wheat and redroot pigweed than other treatments except desmedipham & phenmedipham & ethofumesate + sethoxydim gave similar redroot pigweed control. Sugarbeet yield was similar among all treatments.

Cultivation of Liberty Link sugarbeet, Crookston, 1998. (Dexter) 'Liberty Link' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. Counter 15G insecticide at 12 pounds product per acre was applied in a 5 inch band over the row at planting. Glufosinate at 0.36 lb ai/A was applied to all plots June 12 and July 3. Plots receiving two cultivations were cultivated June 8 and June 22. Plots receiving five cultivations were cultivated June 8, June 22, June 29, July 6 and July 13. Sugarbeet was hand thinned to a ten inch spacing July 16. Sugarbeet was hand weeded June 12 and maintained weed free throughout the growing season. Sugarbeet from the center two rows of 35 foot long plots was counted and harvested October 9.

Number of Cultivations	Sugarbeet Population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/70ft	%	ton/A		lb/A
No Cultivation	90	16.8	23.4	655	7071
Two Cultivations	94	16.9	23.3	629	7110
Five Cultivations	90	16.8	22.5	636	6842
EXP MEAN	91	16.8	23.0	640	7008
C.V. %	7	2.4	7.6	9	7
LSD 5%	NS	NS	NS	NS	NS
LSD 1%	NS	NS	NS	NS	NS
# OF REPS	6	6	6	6	6

Summary

Cultivation had no effect on sugarbeet population or yield.

Cultivation of Liberty Link sugarbeet, Fargo, 1998. (Dexter) 'Liberty Link' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. Glufosinate at 0.36 lb ai/A was applied to all plots June 16 and July 15. Plots receiving two cultivations were cultivated June 26 and July 10. Plots receiving five cultivations were cultivated June 26, July 2, July 10, July 13 and July 20. Sugarbeet was hand thinned to a twelve inch spacing June 30. Sugarbeet was hand weeded June 30 and maintained weed free throughout the growing season. Sugarbeet from the center two rows of 35 foot long plots was counted and harvested October 1.

Number of Cultivations	Sugarbeet Population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/70ft	%	ton/A		lb/A
No Cultivation	53	16.5	17.7	909	5063
Two Cultivations	55	16.5	20.5	915	5873
Five Cultivations	54	16.9	22.8	821	6766
EXP MEAN	54	16.6	20.3	881	5900
C.V. %	14	5.1	13.1	12	18
LSD 5%	NS	NS	NS	NS	NS
LSD 1%	NS	NS	NS	NS	NS
# OF REPS	4	4	4	4	4

Summary

Cultivation had no effect on sugarbeet population or yield.

Metolachlor on Roundup Ready sugarbeet, Fargo, 1998. (Dexter) Preplant incorporated herbicides were applied 6:00 pm May 21 when the air temperature was 70F, soil temperature at six inches was 65F, wind velocity was 5-10 mph, cloud cover was 50% and soil moisture was good. A rototiller set 2 inches deep was used for incorporation. 'Roundup Ready' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. The first portion of split applied postemergence herbicide treatments was applied 5:00 pm June 16 when the air temperature was 82F, relative humidity was 46%, soil temperature at six inches was 63F, wind velocity was 5 mph, cloud cover was 50%, soil moisture was good, sugarbeet was in the v2.0 to v4.5 leaf stage, redroot pigweed was in the 2 to 6 leaf stage and green and yellow foxtail was 1 to 2 inches tall. The second portion of split application postemergence herbicide treatments was applied 3:30 pm June 24 when the air temperature was 84F, relative humidity was 66%, soil temperature at six inches was 63F, wind velocity was 15-20 mph, cloud cover was 40%, soil moisture was good, sugarbeet was in the v3.5 to v8.0 leaf stage, redroot pigweed was in the 6 leaf stage to 2 inches tall and green and yellow foxtail was 2 to 5 inches tall. The third portion of split application postemergence herbicide treatments was applied 10:00 am July 2 when the air temperature was 78F, relative humidity was 75%, soil temperature at six inches was 67F, wind velocity was 5 mph, cloud cover was 100%, soil moisture was good, sugarbeet was in the v5.2 to v11.5 leaf stage, redroot pigweed was in the 4 leaf stage to 3 inches tall and green and yellow foxtail was 4 to 9 inches tall. All herbicide treatments were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet was hand thinned to a twelve inch spacing June 26. Sugarbeet injury and green and yellow foxtail control were evaluated July 10 and August 2. Redroot pigweed control was evaluated August 2. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested October 1.

		July 10		August 2		
Treatment*	Rate	Sgbt inj	Gr&Y Fxtl cntl	Sgbt inj	Rrpw cntl	Gr&Y Fxtl cntl
	lb/A	%	%	%	%	%
Metolachlor-M (PPI)	1.6	0	70	0	79	70
Metolachlor-M (PPI)	1.9	0	88	0	95	69
Desm+Tfsu+Clpy+Clet+Moil/ (June 16) Desm+Tfsu+Clpy+Clet+Moil/(June 24) Desm+Tfsu+Clpy+Clet+Moil (July 2)	0.08+0.004+0.03+0.03+1.5% 0.08+0.004+0.03+0.03+1.5% 0.08+0.004+0.03+0.03+1.5%	0	100	0	88	92
Glyphosate (June 16, June 24, July 2)	0.268	0	100	0	96	78
Metolachlor-M (June 16)	1.9	0	68	0	15	40
Glyphosate+Metolachlor-M/ (June 16) Glyphosate/ (June 24) Glyphosate (July 2)	0.268+1.9 0.268 0.268	0	100	0	100	98
Glyphosate+Metolachlor-M/ (June 16) Glyphosate (June 24)	0.268+1.9 0.268	0	100	0	94	97
Glyphosate+Dimethenamid(BAS65607H)/ (June 16) Glyphosate (June 24)	0.268+1 0.268	0	100	0	93	93
Des+Tfs+Clp+Cle+MO+Meto-M/(June 16) Des+Tfs+Clp+Cle+MethOil/ (June 24) Des+Tfs+Clp+Cle+MethOil (July 2)	0.08+.004+.03+.03+1.5%+1.9 0.08+.004+.03+.03+1.5% 0.08+.004+.03+.03+1.5%	0	100	0	85	99
Glyphosate/ (June 16) Glyphosate+Metolachlor-M (June 24)	0.268 0.268+1.9	0	100	0	100	96
EXP MEAN		0	92	0	84	83
C.V. %		0	10	0	13	19
LSD 5%		0	14	0	16	22
LSD 1%		0	19	0	22	30
# OF REPS		4	4	4	4	4

*MethOil=methylated seed oil from Terra.

(Experiment continued on next page.)

Metolachlor on Roundup Ready sugarbeet, Fargo, 1998. (continued)

Treatment*	Date of (Application)	Rate lb/A	Sgbt Popl plt/60'	Sucr %	Root Yield ton/A	Impur Index	Extract Sucrose lb/A
Metolachlor-M (PPI)		1.6	67	14.3	16.9	1142	4007
Metolachlor-M (PPI)		1.9	60	14.4	15.4	1193	3631
Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil/ Desm+Tfsu+Clpy+Clet+MOil	(June 16) (June 24) (July 2)	0.08+0.004+0.03+0.03+1.5%	65	15.1	17.1	1120	4277
Glyphosate/ Glyphosate/ Glyphosate	(June 16) (June 24) (July 2)	0.75	69	14.8	18.1	1109	4458
Metolachlor-M	(June 16)	1.9	65	15.0	15.4	1105	3839
Glyt+Metolachlor-M/ Glyphosate/ Glyphosate	(June 16) (June 24) (July 2)	0.75+1.9 0.75 0.75	74	15.2	18.3	1073	4685
Glyt+Metolachlor-M/ Glyphosate	(June 16) (June 24)	0.75+1.9 0.75	68	15.4	17.1	1056	4422
Glyt+Dime (BAS65607H)/ Glyphosate	(June 16) (June 24)	0.75+1 0.75	72	14.6	18.8	1168	4493
Des+Tfs+Clp+Cle+MO+Meto-M/ 0.08+.004+.03+.03+1.5%+1.9 Desm+Tfsu+Clpy+Clet+MethOil/ Desm+Tfsu+Clpy+Clet+MethOil	(June 16) (June 24) (July 2)	0.08+.004+.03+.03+1.5%	71	15.6	16.4	1060	4306
Glyphosate/ Glyt+Metolachlor-M	(June 16) (June 24)	0.75 0.75+1.9	68	15.3	17.2	1033	4435
EXP MEAN			68	15.0	17.1	1106	4255
C.V. %			11	4.2	10.8	9	11
LSD 5%			NS	NS	NS	NS	NS
LSD 1%			NS	NS	NS	NS	NS
# OF REPS			4	4	4	4	4

*MethOil=methylated seed oil from Terra.

Summary

None of the treatments caused sugarbeet injury. PPI metolachlor gave better weed control than POST metolachlor applied June 16. Foxtail spp. control on August 2 from glyphosate applied three times tended to be less than when metolachlor or dimethenamid was included in one postemergence application. Treatments had no significant effect on sugarbeet yield or population.

Timing of Roundup application on sugarbeet, Fargo, 1998. (Dexter) 'Roundup Ready' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. The herbicide treatment was glyphosate at 0.75 lb ai/A applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet injury and redroot pigweed and green and yellow foxtail control were evaluated August 15. Sugarbeet was hand thinned to an 11 inch spacing June 26. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested October 1.

Date	June 16	June 24	July 2	July 9	July 15	July 22	July 27	July 31	August 8
Time of Day	5:00 PM	3:30 PM	10:00 AM	3:15 PM	10:00 AM	9:30 AM	9:00 AM	9:00 AM	11.45 AM
Air Temp. (°F)	82	84	78	91	76	67	77	70	87
6" Soil Temp. (°F)	63	63	67	73	74	67	68	69	67
Rel. Humidity (%)	46	66	75	45	56	68	41	64	48
Wind Veloc. (mph)	5	15-20	5	0	0-5	5-10	5	0	8
Cloud Cover (%)	50	40	100	20	0	0	0	0	40
Soil Moisture	good	good	good	good	good	good	good	fair	poor
Sugarbeet Stage	v2.0-v4.5	v3.5-v8.0	v5.2-v11.5	8-14 leaf	12-18 leaf	14-22 leaf	16-24 leaf	closed canopy	closed canopy
						--	--	--	--
Redroot Pigweed	2-6 leaf	6 lf-2"	4 lf-3"	2-6"	3-7"	--	--	--	--
Gr. and Ye. Foxtail	1-2 inch	2-5 inch	4-9 inch	2-12 inch	4-20 inch	--	--	--	--

Time of Application	Sugarbeet injury	Redroot Pigweed control	Grn&Yel Foxtail control
	%	%	%
June 16 / June 24 / July 2	3	100	97
June 16 / July 2 / July 15	3	100	97
June 16 / July 9 / July 27	3	100	100
June 24 / July 2 / July 9	0	100	98
June 24 / July 9 / July 22	3	100	100
June 24 / July 15 / July 31	0	100	100
July 2 / July 9 / July 15	5	100	100
July 2 / July 15 / July 27	1	100	100
July 2 / July 22	13	100	100
July 9 / July 22 / July 31	13	100	100
July 9 / July 27	10	100	100
July 15 / July 27 / August 8	14	100	100
July 15 / July 31	10	100	100
EXP MEAN	6	100	99
C.V. %	104	0	2
LSD 5%	9	0	NS
LSD 1%	12	0	NS
# OF REPS	4	4	4

Summary

All treatments gave nearly total weed control. Sugarbeet injury from treatments started late or treatments with only two applications was not due to glyphosate injury to the sugarbeet but was from weed competition prior to control by the treatments.

(Experiment continued on next page.)

Timing of Roundup application to sugarbeet, Fargo, 1998. (continued)

Date of Application	Sugarbeet Population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/60'	%	ton/A		lb/A
June 16 / June 24 / July 2	72	15.0	18.6	1064	4655
June 16 / July 2 / July 15	67	14.9	19.6	1112	4850
June 16 / July 9 / July 27	74	14.1	21.3	1261	4893
June 24 / July 2 / July 9	67	14.6	18.8	1237	4444
June 24 / July 9 / July 22	65	14.6	18.1	1145	4407
June 24 / July 15 / July 31	62	14.8	16.2	1178	3966
July 2 / July 9 / July 15	66	14.7	18.3	1135	4462
July 2 / July 15 / July 27	73	15.0	19.1	1125	4795
July 2 / July 22	58	14.2	15.1	1251	3489
July 9 / July 22 / July 31	65	14.8	18.1	1149	4423
July 9 / July 27	56	14.6	16.7	1169	4027
July 15 / July 27 / August 8	71	14.9	18.0	1135	4454
July 15 / July 31	58	14.8	15.9	1131	3924
EXP MEAN	65	14.7	18.0	1161	4368
C.V. %	14	3.3	13.0	6	15
LSD 5%	NS	NS	NS	105	NS
LSD 1%	NS	NS	NS	NS	NS
# OF REPS	4	4	4	4	4

Summary

Treatments had no significant effect on sugarbeet yield.

Timing of Roundup application to sugarbeet, St. Thomas, 1998. (Dexter) 'Roundup Ready' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 13. The herbicide treatment was glyphosate at 0.75 lb ai/A applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center four rows of six row plots. Sugarbeet injury and redroot pigweed, wild mustard, kochia and volunteer wheat control were evaluated July 2. Sugarbeet was hand thinned to an 11 inch spacing June 15. Sugarbeet from the center two rows of 30 foot long plots was counted and harvested September 28.

Date	May 27	June 3	June 9	June 16	June 22	July 2	July 8	July 14	July 21
Time of Day	1:00 PM	11:30 AM	3:00 PM	12:00 PM	11:30 AM	11:30 AM	12:45 PM	7:30 PM	8.45 AM
Air Temp. (°F)	82	55	72	70	63	82	81	88	67
6" Soil Temp. (°F)	70	47	58	62	58	73	66	68	68
Rel. Humidity (%)	40	37	37	63	69	38	76	69	67
Wind Veloc. (mph)	9	20	5-8	5-10	5	0	0	2-4	10-15
Cloud Cover (%)	25	0	90	100	100	100	30	0	35
Soil Moisture	good	good	fair	fair	good	good	good	good	poor
Sugarbeet Stage	v1.0-2.0	v1.0-2.5	v4.5-5.5	v4.0-7.5	v6.0-9.5	10-14 lf	16-20 lf	closed can	closed can
Redroot Pigweed	cot-2leaf	2-4 leaf	4-6 leaf	6 leaf-2"	2-4"	--	--	--	--
Wild Mustard	cot-2leaf	2-4 leaf	4-6 leaf	8 leaf-8"	6-12"	--	--	--	--
Kochia	emer-1"ros	1-1.5"ros.	2-3" tall	2-6" tall	4-7" tall	--	--	--	--
Volunteer Wheat	3-4"	3-5"	2-6"	6-10"	8-12"	--	--	--	--

Time of Application	Sgbt inj	Rrpw cntl	Wimu cntl	Kocz cntl	Vowh cntl
	%	%	%	%	%
May 27 / June 3 / June 16	5	100	100	100	85
May 27 / June 16 / July 8	1	100	100	100	100
May 27 / June 9/ June 22	4	100	100	100	95
June 3 / June 9 / June 16	4	100	100	99	78
June 3 / June 9 / July 2	3	100	100	100	100
June 3 / June 16 / July 2	5	100	100	100	100
June 9 / June 16 / June 22	5	100	100	96	92
June 16 / July 2 / July 14	19	100	100	100	100
June 16 / July 8	9	100	100	100	99
June 9 / June 22 / July 8	3	100	100	100	100
June 9 / July 2	6	100	100	100	100
June 22 / July 8 / July 21	18	100	100	100	100
June 22 / July 14	14	100	100	100	100
EXP MEAN	7	100	100	100	96
C.V. %	116	0	0	1	9
LSD 5%	NS	0	0	2	12
LSD 1%	NS	0	0	NS	17
# OF REPS	4	4	4	4	4

Summary

All treatments gave excellent control of redroot pigweed, wild mustard and kochia. Volunteer wheat germinated and emerged late in the season so volunteer wheat was present in plots when the last treatment was on June 22 or earlier. The observed sugarbeet injury was not from glyphosate injury but was due to weed competition prior to control.

(Experiment continued on next page.)

Timing of Roundup application to sugarbeet, St. Thomas, 1998. (continued)

Date of Application	Sugarbeet Population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/60'	%	ton/A		lb/A
May 27 / June 3 / June 16	57	15.5	21.7	820	5875
May 27 / June 16 / July 8	58	14.7	22.8	987	5670
May 27 / June 9 / June 22	58	15.2	22.5	903	5927
June 3 / June 9 / June 16	57	14.7	21.5	1010	5328
June 3 / June 9 / July 2	60	15.0	22.5	934	5805
June 3 / June 16 / July 2	61	14.9	22.6	971	5760
June 9 / June 16 / June 22	58	14.8	23.2	1044	5773
June 16 / July 2 / July 14	73	14.8	18.8	944	4763
June 16 / July 8	67	13.9	21.5	1133	4990
June 9 / June 22 / July 8	60	15.3	22.0	917	5840
June 9 / July 2	60	14.4	21.7	1035	5262
June 22 / July 8 / July 21	73	13.6	17.9	1155	4010
June 22 / July 14	66	14.0	20.7	1131	4853
EXP MEAN	62	14.7	21.5	999	5374
C.V. %	10	4.5	13.6	11	13
LSD 5%	9	0.9	NS	161	1014
LSD 1%	12	1.3	NS	216	NS
# OF REPS	4	4	4	4	4

Summary

Plots treated with glyphosate for the first time on June 16 or June 22 yielded less than 5000 lb/A of extractable sucrose. All other plots were treated earlier and all yielded more than 5000 lb/A.

Cultivation of Roundup Ready sugarbeet, Crookston, 1998. (Dexter) 'Roundup Ready' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. Counter 15G insecticide at 12 pounds product per acre was applied in a 5 inch band over the row at planting. Glyphosate at 0.75 lb ai/A was applied to all plots June 12 and July 3. Plots receiving two cultivations were cultivated June 8 and June 22. Plots receiving five cultivations were cultivated June 8, June 22, June 29, July 6 and July 13. Sugarbeet was hand thinned to a ten inch spacing July 16. Sugarbeet was hand weeded June 12 and maintained weed free throughout the growing season. Sugarbeet from the center two rows of 35 foot plots was counted and harvested October 9.

Number of Cultivations	Sugarbeet population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/70ft	%	ton/A		lb/A
No Cultivation	97	15.7	26.6	879	7230
Two Cultivations	106	15.8	29.5	854	8082
Five Cultivations	97	15.4	28.4	856	7578
EXP MEAN	100	15.6	28.2	863	7630
C.V. %	4	4.7	7.5	18	7
LSD 5%	5	NS	NS	NS	NS
LSD 1%	7	NS	NS	NS	NS
# OF REPS	6	6	6	6	6

Summary

Plots cultivated twice had a higher harvested sugarbeet population than uncultivated plots or plots cultivated five times. The reason is not known. Cultivation had no effect on sugarbeet yield.

Cultivation of Roundup Ready sugarbeet, Fargo, 1998. (Dexter) 'Roundup Ready' sugarbeet was seeded 1.25 inches deep in 22 inch rows May 22. Glyphosate at 0.75 lb ai/A was applied to all plots June 16 and July 15. Plots receiving two cultivations were cultivated June 26 and July 10. Plots receiving five cultivations were cultivated June 26, July 2, July 10, July 13 and July 20. Sugarbeet was hand thinned to a twelve inch spacing June 30. Sugarbeet was hand weeded June 30 and maintained weed free throughout the growing season. Sugarbeet from the center two rows of 35 foot long plots was counted and harvested October 1.

Number of Cultivations	Sugarbeet population	Sucrose	Root Yield	Impurity Index	Extract Sucrose
	plants/70ft	%	ton/A		lb/A
No Cultivation	62	15.1	18.8	1039	4793
Two Cultivations	60	14.8	18.8	1113	4643
Five Cultivations	62	15.0	19.1	1091	4772
EXP MEAN	61	14.9	18.9	1081	4736
C.V. %	5	2.7	9.3	7	10
LSD 5%	NS	NS	NS	NS	NS
LSD 1%	NS	NS	NS	NS	NS
# OF REPS	4	4	4	4	4

Summary

Cultivation had no effect on sugarbeet population or yield.

Herbicide carryover, Fargo, 1996-1998. (Dexter) Preplant incorporated herbicides were applied 11:00 am May 23, 1996 when the air temperature was 59F, relative humidity was 60%, soil temperature at six inches was 50F, wind velocity was 10-16 mph, cloud cover was 100% and soil moisture was good. PPI treatments were incorporated with a rototiller set 3 to 4 inches deep. 'Ozzie' soybean was solid seeded in seven inch rows at 60 pounds per acre May 23. Postemergence treatments were applied 11:00 am June 26, 1996 when the air temperature was 86F, relative humidity was 74%, soil temperature at six inches was 67F, wind velocity was 8 mph, cloud cover was 50%, soil moisture was good and soybean was in the 1 to 2 trifoliolate stage. All herbicides were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center 13 feet of 20 foot wide by 60 foot long plots. Basagran + Ultima + Dash HC at 1 + 0.5 lb ai/A + 1 pint/A was applied to all plots July 1, 1996. Soybean was chopped in September of 1996. Fall 1996 and 1997 tillage was one pass with a 'Conser-Till' chisel plow at a slow speed and parallel with the direction herbicides were applied. Spring tillage in 1997 and 1998 was one pass with a 'Kongskilde Triple K' field cultivator operated parallel with the herbicide application direction. '2371' wheat at 90 lb/A, 'Foster' barley at 90 lb/A, 'Beta 3712' sugarbeet, 'Westar' canola at 8 lb/A, 'Interstate 6111' sunflower, 'Agri 1' navy bean at 50 lb/A, and 'NK 2555' corn were seeded in 4 foot wide drill strips across herbicide plots June 9, 1997. Wheat, barley, sugarbeet, canola, sunflower, navy bean, and corn injury was evaluated July 5 and July 23, 1997. 'Maribo 9581' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 30, 1998. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Desmedipham + triflusulfuron + clopyralid + clethodim + MethOil at 0.08 + 0.004 + 0.03 + 0.03 lb ai/A + 1.5% v/v was applied to all plots May 20, 1998. The same herbicide treatment was applied June 10 with sethoxydim at 0.063 lb ai/A instead of clethodim. Desmedipham + triflusulfuron + clopyralid + sethoxydim + MethOil at 0.16 + 0.008 + 0.06 + 0.126 lb ai/A + 1.5% v/v was applied to all plots July 15, 1998. Sugarbeet injury was evaluated June 23 and July 3, 1998.

Treatment (trade name)	Method of Applic	Rate	July 5, 1997 Wht	Barl	Sgbt	Cano	Sufl	Nabe	Corn
		lb/A	% injury						
CGA-277476 (Expert)	POST	0.0705	0	0	0	0	0	6	0
CGA-277476 (Expert)	POST	0.141	0	0	8	5	13	0	0
Picloram (Tordon)	POST	0.0234	0	0	3	0	0	36	3
Cloransulam (First Rate)	PPI	0.03125	29	39	90	89	79	18	33
Sulfentrazone (Authority)	PPI	0.375	0	0	95	0	6	6	0
Isoxaflutole RPA201772 (Balance)	PPI	0.14	0	0	96	36	18	70	0
MON-37500	POST	0.022	9	18	90	15	91	9	31
Rimsulfuron (Matrix)	POST	0.0156	3	3	3	0	0	8	0
Rimsulfuron (Matrix)	POST	0.0234	0	0	3	0	0	3	3
Rimsulfuron (Matrix)	POST	0.0469	3	0	8	4	0	10	0
EXP MEAN			4	6	39	15	21	17	7
C.V. %			118	105	19	92	56	60	112
LSD 5%			7	9	11	20	17	14	11
LSD 1%			10	12	15	27	23	20	15
# OF REPS			4	4	4	4	4	4	4

(Experiment continued on next page.)

Herbicide carryover, Fargo, 1996-1998. (continued)

Treatment (trade name)	Method of Applic	Rate	July 23, 1997 Wht	Barl	Sgbt	Cano	Sufl	Nabe	Corn	1998 June 23 Sugarbeet	1998 July 3 Sugarbeet
		lb/A	% injury								
CGA-277476 (Expert)	POST	0.0705	0	0	0	0	0	5	5	5	8
CGA-277476 (Expert)	POST	0.141	3	6	10	10	0	5	0	10	0
Picloram (Tordon)	POST	0.0234	0	0	16	8	0	68	0	8	0
Cloransulam (First Rate)	PPI	0.03125	30	56	95	93	93	33	36	33	31
Sulfentrazone (Authority)	PPI	0.375	3	4	98	19	0	0	0	48	38
Isoxaflutole RPA201772 (Balance)	PPI	0.14	0	0	97	30	33	88	0	8	3
MON-37500	POST	0.022	6	15	80	28	88	3	11	35	29
Rimsulfuron (Matrix)	POST	0.0156	0	0	5	0	0	0	0	18	0
Rimsulfuron (Matrix)	POST	0.0234	4	3	20	0	0	0	0	15	8
Rimsulfuron (Matrix)	POST	0.0469	1	6	10	3	0	0	0	0	3
EXP MEAN			5	9	43	19	21	20	5	18	12
C.V. %			139	104	33	88	44	47	151	113	131
LSD 5%			9	14	20	24	14	14	12	29	22
LSD 1%			13	18	28	32	19	19	16	NS	30
# OF REPS			4	4	4	4	4	4	4	4	4

Summary

Picloram, cloransulam, sulfentrazone, isoxaflutole and MON-37500 applied in 1996 injured one or more species seeded in 1997. CGA-277476 and rimsulfuron caused no significant injury. On July 23, picloram only injured navy bean, cloransulam injured all crops, sulfentrazone only injured sugarbeet, isoxaflutole injured all broadleaf crops and MON-37500 injured all crops except wheat, navy bean and corn.

Chloransulam, sulfentrazone and MON-37500 applied in 1996 caused significant sugarbeet injury in 1998.

Carryover of corn herbicides, Fargo, 1998. (Dexter) Preplant incorporated herbicides were applied 11:30 am May 5, 1998 when the air temperature was 70F, relative humidity was 30%, soil temperature at six inches was 56F, wind velocity was 7 mph, sky was clear and soil moisture was poor. PPI treatments were incorporated with a rototiller set 3 inches deep. 'Liberty Link' corn was solid seeded in seven inch rows May 5. Postemergence treatments were applied 12:00 pm July 2, 1998 when the air temperature was 80F, relative humidity was 61%, soil temperature at six inches was 70F, wind velocity was 5 mph, cloud cover was 100%, soil moisture was good and corn was 5 to 9 inches tall. All herbicides were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center 13 feet of 20 foot wide by 50 foot long plots. Corn stand was poor so all plots were tilled once with a 'Kongskilde Triple K' field cultivator and corn was replanted June 4. Liberty herbicide at 28 fluid ounces per acre was applied to all plots July 13, 1998. Corn was flail shredded August 25, 1998. The plot area was tilled twice with a tandem disk and once with an 'Alloway Seed Better' cultivator August 25. Tillage was parallel with the direction herbicides were applied. 'Beta 3712' sugarbeet was seeded 1.25 inches deep in 22 inch rows August 25. Sugarbeet injury was evaluated October 2.

Treatment*	Trade Name	Time of Application	Rate	Sugarbeet injury
			lb/A	%
Isoxaflutole	(Balance-75%)	PPI	0.047	13
Isoxaflutole	(Balance-75%)	PPI	0.094	38
Isoxaflutole	(Balance-75%)	PPI	0.186	89
Isoxaflutole	(Balance-75%)	PRE	0.047	18
Isoxaflutole	(Balance-75%)	PRE	0.094	35
Isoxaflutole	(Balance-75%)	PRE	0.186	83
BAS635+X-77	(71.4%)	POST	0.027+0.25%	38
BAS635+X-77	(71.4%)	POST	0.045+0.25%	68
R6447	(Raft-80%)	POST	0.067	45
R6447	(Raft-80%)	POST	0.134	35
R6447	(Raft-80%)	POST	0.268	28
EXP MEAN				44
C.V. %				69
LSD 5%				44
LSD 1%				NS
# OF REPS				4

*X-77=non-ionic surfactant from Loveland.

Summary

Herbicides were applied in the spring and sugarbeet was seeded in August of 1998. Isoxaflutole at 0.186 lb/A and BAS635 at 0.045 lb/A gave significant sugarbeet injury. Several crops will be seeded across these plots in 1999.

Carryover of soybean herbicides, Fargo, 1998. (Dexter) Preplant incorporated herbicides were applied 11:30 am May 5, 1998 when the air temperature was 70F, relative humidity was 30%, soil temperature at six inches was 56F, wind velocity was 7 mph, sky was clear and soil moisture was poor. PPI treatments were incorporated with a rototiller set 3 inches deep. 'Roundup Ready' soybean was solid seeded in seven inch rows at 70 pounds per acre May 5. Postemergence treatments were applied 12:00 pm July 2, 1998 when the air temperature was 80F, relative humidity was 61%, soil temperature at six inches was 70F, wind velocity was 5 mph, cloud cover was 100%, soil moisture was good and soybean was in the 3 to 4 trifoliolate stage. All herbicides were applied in 8.5 gpa water at 40 psi through 8001 nozzles to the center 13 feet of 20 foot wide by 50 foot long plots. Roundup Ultra at 1 quart per acre was applied to all plots June 4 and July 13, 1998. Soybean was flail shredded August 25, 1998. The plot area was tilled twice with a tandem disk and once with an 'Alloway Seed Better' cultivator August 25. Tillage was parallel with the direction herbicides were applied. 'Beta 3712' sugarbeet was seeded 1.25 inches deep in 22 inch rows August 25. Sugarbeet injury was evaluated October 2.

Treatment*	Trade Name	Time of Application	Rate	Sugarbeet injury
			lb/A	%
CGA-277476+X-77	(Expert-57%)	POST	0.036+0.25%	38
CGA-277476+X-77	(Expert-57%)	POST	0.071+0.25%	13
CGA-277476+X-77	(Expert-57%)	POST	0.142+0.25%	3
Cloransulam	(FirstRate-84%)	PPI	0.031	69
Cloransulam	(FirstRate-84%)	PRE	0.031	89
Cloransulam+X-77	(FirstRate-84%)	POST	0.016+0.25%	100
Imazethapyr+X-77	(Pursuit-2lb/G)	POST	0.063+0.25%	100
Sulfentrazone	(Authority-75%)	PPI	0.375	88
Isoxaflutole	(Balance-75%)	PPI	0.094	85
EXP MEAN				65
C.V. %				27
LSD 5%				26
LSD 1%				35
# OF REPS				4

*X-77=non-ionic surfactant from Loveland.

Summary

Herbicides were applied in the spring and sugarbeet was seeded in August of 1998. All herbicides except CGA-277476 caused severe sugarbeet injury.

Herbicide carryover, Fargo, 1997-98. (Dexter and Zollinger) An experiment was conducted to evaluate small grain safety to V-53482 herbicide applied PRE. 'ND-2371' wheat, 'Foster' barley, and 'Valley' oat were seeded June 9 and PRE treatments were applied June 11 at 5:30 pm with 85F air, 101F soil, 43% RH, 20% clouds, and 3-5 mph wind. Treatments were applied to the entire area of the 20 X 60 ft plots with a bicycle-wheel-type plot sprayer equipped with a shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment. This experiment was continued in 1998 to evaluate carryover of V-53482 and Lightning to sugarbeet. Fall tillage in 1997 was one pass with a 'Conser-Till' chisel plow operated at a slow speed parallel to the direction herbicides were applied. Spring tillage in 1998 was one pass with a 'Kongskilde Triple K' field cultivator. 'Maribo 9581' sugarbeet was seeded 1.25 inches deep in 22 inch rows April 30, 1998. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Desmedipham+triflusulfuron+clopyralid+clethodim+MethOil at 0.08 + 0.004 + 0.03 + 0.03 lb ai/A + 1.5% v/v was applied to all plots May 20, 1998. The same herbicide treatment was applied June 10 with sethoxydim at 0.063 lb ai/A instead of clethodim. Desmedipham + triflusulfuron + clopyralid + sethoxydim + MethOil at 0.16 + 0.008 + 0.06 + 0.126 lb ai/A + 1.5% v/v was applied to all plots July 15, 1998. Sugarbeet injury was evaluated July 3, 1998.

1997 Treatment	Rate	July 5, 1998 Wheat	Barley	Oats	Green Foxtail	1998 Sgbt
	lb/A	-------- percent control				--------
V-53482	0.094	19	16	24	86	0
V-53482	0.188	58	48	60	95	0
V-53482	0.376	75	74	85	98	0
Imazethapyr&Imazapyr (Lightning)	0.056	92	83	90	92	0
Untreated Check	0	0	0	0	0	0
EXP MEAN		49	44	52	74	0
C.V. %		21	20	19	5	0
LSD 5%		15	14	15	6	0
LSD 1%		22	19	21	8	0
# OF REPS		4	4	4	4	0

Summary

V-53482 is a contact type, cell membrane disrupter (PPO inhibitor) herbicide. This experiment was conducted to determine small grain crop safety to V-53482 PRE for potential labeling in small grains for grass and broadleaf weed control. All rates of V-53482 and Lightning resulted in excessive wheat, barley and oat injury but 86 to 98% green and yellow foxtail control. None of the treatments caused sugarbeet injury in 1998.

Wild oat control in wheat, Fargo 1998. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments (0d) were applied to 1.5- to 4-leaf wheat, 1- to 4.5-leaf wild oat, cotyledon- to 2-leaf wild buckwheat, and cotyledon-to 4-leaf wild mustard on May 21 with 70 F, 50% RH, partly cloudy sky, and 5- to 10-mph wind. The treatments (6d) were applied to 3 to 6-leaf wheat, 3- to 7-leaf wild oats, 2-to 4-leaf wild buckwheat, and 2- to 6-leaf wild mustard on May 27 with 65F, 65% RH, partly cloudy sky, and 5- to 10-mph wind. All Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	June 8 Wht	June 8 Wioa	July 21 Wht	July 21 Wioa	Aug 12 Yield
	oz/A	%				bu/A
Diclofop+Bromoxynil+PO(0d)	16+4+.12G	0	90	0	85	30
Difp+PO(0d)/Difp+Brox+PO(6d)	8+.12G/8+4+.12G	3	93	0	92	26
Imazamethabenz+Thif&Trib+Act90(0d)	5+.22+.25%	0	76	5	73	22
Imazamethabenz+Thif&Trib+Act90(0d)	2.5+.22+.25%	0	60	0	43	10
Immb+Act90(0d)	2.5+.25%					
/Immb+Thf&Trb+Act90(6d)	/2.5+.22+.25%	0	84	0	76	22
Difenzoquat+Thif&Trib(0d)	12+.22	0	82	0	82	21
Tralkoxydim+Brox&MCPA+Tf8436+AMS(0d)	2.9+8+.5%+24	0	93	0	95	35
Clodinafop+Brox&MCPA+Score(PO)	0.8+8+.8%	1	97	1	98	34
HOE1170+Thif&Trib(0d)	1.7+.22	0	98	0	97	33
MON37500+ND72(0d)	.37+1%	0	90	0	90	37
MON37500+ND72(0d)/MON37500+ND72(6d)	.18+1%/.18+1%	0	93	1	98	34
Tiller(0d)	9.3	1	95	0	89	30
Cheyenne+Thif&Trib(0d)	7.3+.22	0	91	0	86	33
Bay MKH6562+ND72(0d)	.25+1%	5	76	1	96	25
Propanil+MCPA-ioe+PO(0d)	8+4+.18G					
/Propanil+PO(6d)	/8+.18G	3	20	0	0	4
Propanil+MCPA-ioe+PO(0d)	16+4+.18G	0	0	0	0	20
Untreated	0	0	0	0	0	19
C.V. %		259	9	533	6	47
LSD 5%		3	9	NS	6	17
# OF REPS		4	4	4	4	4

Summary

Diclofop, imazamethabenz, and MON 37500 were applied both as one full rate or as two split applications each at one-half the full rate. In general split applications increased efficacy of these wild oat control herbicides and never reduced efficacy. Thus, split applications could provide a potential for increased wild oat control without risk of reduced control.

Propanil was included in the experiment to evaluate efficacy for foxtail control, which in 1997 occurred with wild oat. However foxtail was not present at a density for good evaluation in 1998. The lack of foxtail occurred because the early seeding and cool conditions early in the 1998 season were not favorable for foxtail establishment.

All of the wild oat control herbicides alone, in mixture with broadleaf control herbicides or as split applications gave excellent wild oat control. Wild oat density exceeded 150 plants/yd^2, and wheat yield was increased about 25% from effective wild oat control. Imazamethabenz and difenzoquat were the only wild oat control herbicides giving less than 85% control. Cool conditions at and after application probably accounted for the reduced efficacy of imazamethabenz and difenzoquat. These results indicate that many herbicides can effectively control wild oat, and split application has potential to increase control.

Wild oat control in wheat, Carrington 1998. (Harbour) 'Verde' hard red spring wheat was seeded May 12. Treatments (0d) were applied to 3.5-leaf wheat, 5.5-leaf wild oat, 2- to 6-inch (rosette) wild mustard. 5-inch common lambsquarters, and 1-to 2-inch pigweed on June 5 with 57F, 45% RH, clear sky, and 0- to 10-mph wind. Treatments following / were applied to 4.5-leaf wheat, 6.5-leaf wild oat, 5- to 10-inch flowering wild mustard, 8-inch common lambsquarters, and 2-ingh pigweed on June 12 with 70F, 58% RH, clear sky, and 10-to 15-mph wind. All treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with 4 replicates.

		6/30				7/14	8/6	8/13
Treatment[a]	Rate	Wht	Wioa	Wimu	Colq	Wioa	Wioa	Yield
	oz/A			%				bu/A
Diclofop+Bromoxynil+PO	16+4+.12G	0	75	76	77	89	85	34
Difp+PO/Difp+Brox+PO	8+.12G/8+4+.12G	1	79	70	93	93	81	34
Imazamethabenz+Thif&Trib+Act90	5+.22+.25%	1	88	98	97	94	93	34
Imazamethabenz+Thif&Trib+Act90	2.5+.22+.25%	5	88	98	98	92	86	31
Immb+Act90	2.5+.25%							
/Immb+Thif&Trib+Act90	/2.5+.22+.25%	4	92	98	95	99	98	35
Difenzoquat+Thif&Trib	12+.22	14	96	97	96	97	93	31
Tralkoxydim+Brox&MCPA+Tf8436+AMS	2.9+8+.5%+24	4	97	96	98	94	92	35
Clodinafop+Brox&MCPA+Score(PO)	0.8+8+.8%	0	97	98	98	99	98	39
HOE1170+Thif&Trib	1.7+.22	2	97	98	98	97	89	36
MON37500+ND72	.37+1%	1	74	74	73	97	92	36
MON37500+ND72/MON37500+ND72	.18+1%/.18+1%	5	96	98	95	97	97	38
Tiller	9.3	0	95	97	97	86	68	32
Cheyenne+Thif&Trib	7.3+.22	0	84	98	98	74	52	30
Bay MKH6562+ND72	.25+1%	9	97	97	94	99	99	35
Propanil+MCPA-ioe+PO/Propanil+PO	8+4+.18G/8+.18G	0	47	98	98	34	38	31
Propanil+MCPA-ioe+PO	16+4+.18G	1	24	75	75	15	27	24
Untreated	0	0	0	0	0	0	0	26
C.V. %		152	28	22	21	17	22	16
LSD 5%		6	31	27	26	20	24	8
# OF REPS		4	4	4	4	4	4	4

[a]Treatments following the / were applied six days after initial treatments.

Summary

Wheat injury on June 30, was minimal although injury appeared greater when treated with difenzoquat+thifensulfruon&tribenuron than any other herbicide. Early wheat injury did not influence wheat yield. Common lambsquarters was nearly controlled by all treatments except the single application of diclofop+bromoxynil&MCPA. Wild oat controlled better by tralkoxydim+bromoxynil&MCPA, clodinofop+bromoxynil&MCPA, HOE1170+ thifensulfuron&tribenuron, and single application of MON k37500 than Cheyenne+thifensulfuron&tribenuron, and split and single application of propanil+MCPA-ioe. Herbicide split applications did not always increase wild oat control because control was high with the single application. However, split herbicide applications never reduced control. Thus, may provide a means of increasing consistency in wild oat control.

Wild oat control from split applications of diclofop, imazamethabenz, MON 37500, and propanil was similar to their respective, single application at twice the rate. Wheat yields generally were 10 bu/A greater with effective wild oat control than the untreated check.

All of the wild oat control herbicides as one single application, except Cheyenne or as split applications gave good (>85%) wild oat control at the late evaluation. Wild oat infestation was moderate (about 150 plants/yd^2). Difenzoquat injured 'Verde' wheat. These results indicate that many herbicides can effectively control wild oat, and split application has potential to increase control.

Wild oat and foxtail control in wheat, Hettinger 1998. (Ericksmoen) 'Grandin' hard red spring wheat was seeded on April 29. Treatments were applied to 4-leaf wheat, 1-to 4-leaf wild oats and 2-to 4-leaf foxtail on May 25 with 75 F, 38% RH, sunny sky and 5 mph wind. The second application of the split treatments were applied to 5.5 leaf wheat, 3-to 5-leaf wild oats and 3-to 5-leaf foxtail on May 31 with 65 F, 29% RH, sunny sky and 2 mph wind. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 17 gpa at 40 psi through 8001 flat fan nozzles to a 5 foot wide area the length of 10 by 28 ft plots. The experiment was randomized complete block design with four replicates. Wild oat and foxtail populations were 1.5 and 26 plants/ft^2 respectively. Evaluations were on June 4 for crop injury and on July 21 for wild oat and foxtail control. Harvest for grain yield was on August 7.

Treatment	Rate	Jun 4	Jul 7				Jul 21		Aug 7
		Wht	Wht	Wioa	KOCZ	Grft	Wioa	Grft	Yield
	oz/A				%				bu/A
Diclofop+Bromoxynil+PO(0d)	16+4+.12G	0	0	94	83	97	99	72	25
Diclofop+PO(0d)/Diclofop+Brox+PO(6d)	8+.12G+8+4+.12G	0	3	97	79	98	94	88	26
Imazamethabenz+Thif&Trib+Act90(0d)	5+.22+.25%	0	1	77	25	44	99	47	24
Imazamethabenz+Thif&Trib+Act90(0d)	2.5+.22+.25%	0	1	82	40	38	99	36	24
Immb+Act90(0d) /Immb+Thif&Trib+Act90(6d)	2.5+.25% /2.5+.22+.25%	0	4	99	60	48	99	48	29
Difenzoquat+Thif&Trib(6d)	12+.22	8	5	95	30	0	99	45	23
Tralkoxydim+Brox&MCPA+Tf8436+AMS(0d)	2.9+8+.5%+24	1	0	99	88	90	99	74	28
Clodinafop+Brox&MCPA+Score(0d)	0.8+8+.8%	0	0	99	99	99	99	93	29
HOE1170+Thif&Trib(0d)	1.7+.22	0	3	99	90	99	99	94	26
MON37500+ND72(0d)	.37+1%	0	3	99	10	79	99	22	23
MON37500+ND72(0d)/MON37500+ND72(6d)	0.18+1%/0.18+1%	1	5	99	23	92	99	37	22
Tiller(0d)	9.3	5	3	88	58	89	93	90	25
Cheyenne+Thif&Trib(0d)	7.3+.22	0	3	94	83	97	94	91	27
Bay MKH6562+ND72(0d)	.25+1%	4	10	99	35	96	99	97	24
Propanil+MCPA-ioe+PO/Propanil+PO(6d)	8+4+.18G/8+.18G	1	1	35	80	60	12	35	22
Propanil+MCPA-ioe+PO(0d)	16+4+.18G	0	1	15	68	63	37	49	21
Untreated	0	0	0	0	0	0	0	0	24
C.V. %		17	101	23	36	14	17	57	12
LSD 5%		1	3	26	42	14	20	48	4
# OF REPS		4	4	4	2	4	4	4	4

Summary

None of the herbicides caused important injury to wheat. Bay MKH6562 and difenzoquat appeared to injure wheat at evaluations, but the injury did not relate to any wheat yield reduction. The most effective treatments for green foxtail control were: clodinafop, HOE1170, Cheyenne, Tiller, and split applied diclofop. These treatments were also effective for wild oat control. Diclofop, imazamethabenz, and MON 37500 applied as spilt application often tended to increas efficacy for wild oat and foxtail. Wild oat density was light at < 5 plants per square yard therefore yields were not generally increased form wild oat control

Wild oat control in wheat, Minot 1998. (Jenks) 'Amidon' hard red spring wheat was seeded April 23. Treatments were applied to 4-leaf wheat and wild oat,and less than 1-inch common lambsquarters,on May 19 with 69 F and 29% RH. Treatments (6d) were applied May 25 with 73 F and 35% RH. All treatments were applied with a bicycle wheel type plot sprayer delivering 10 gpa at 40 psi at 3 mph through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with 3 replicates. Weed densities were wild oat 30/sq^2 and common lambsquarters 21/ft^2.

Treatment	Rate	May 19 Wioa	May 19 Colq	May 25 Wioa	May 25 Colq
	oz/A	%			
Difp+Brox+PO(0d)	16+4+.12G	62	47	25	90
Difp+PO(0d)/Difp+Brox+PO(6d)	8+.12G/8+4+.12G	62	75	33	80
Immb+Thif&Trib+Act90(0d)	5+.22+.25%	77	68	38	92
Immb+Thif&Trib+Act90(0d)	2.5+.22+.25%	63	70	30	99
Immb+Act90(0d)	2.5+.25%				
/Immb+Thif&Trib+Act90(6d)	/2.5+.22+.25%	70	43	65	89
Difenzoquat+Thif&Trib(6d)	12+.22	28	62	23	99
Tral+Brox&MCPA+Tf8436+AMS(0d)	2.9+8+.5%+24	92	98	80	99
Clodinafop+Brox&MCPA+Score(0d)	0.8+8+.8%	90	98	78	99
HOE1170+Thif&Trib(0d)	1.7+.22	89	98	80	99
MON37500+ND72(0d)	0.37+1%	80	20	68	10
MON37500+ND72(0d)/MON37500+ND72(6d)	0.18+1%+0.18+1%	85	10	63	0
Tiller(0d)	9.3	73	95	53	99
Cheyenne+Thif&Trib(0d)	7.3+.22	68	96	73	99
Bay MKH6562+ND72(0d)	0.25+1%	80	48	60	0
Propanil+MCPA-ioe+PO/Propanil+PO(6d)	8+4+.18G+8+.18G	13	94	5	99
Propanil+MCPA-ioe+PO(0d)	16+4+.18G	8	94	33	99
Untreated	0	0	0	0	0
C.V. %		12	19	22	12
LSD 5%		12	20	22	19
# OF REPS		3	3	2	2

Summary

Diclofop, imazamethabenz, and MON 37500 were applied both as one full rate or as two split applications each at one-half the full rate. Split applications did not increase efficacy of the wild oat control herbicides. However, split application never reduced efficacy. Thus, split applications could provide a potential for increased wild oat control without risk of reduced control. Propanil was included in the experiment to evaluate efficacy for foxtail control, which in 1997 occurred with wild oat. However foxtail was not present at a density for good evaluation in 1998. The lack of foxtail occurred because the early seeding and cool conditions early in the 1998 season was not favorable for foxtail establishment.

HOE-1170, tralkoxydim, and clodinafop gave more than 75% control at the later evaluation. The extremely dense infestations(>500/yd^2) and drought conditions may have contributed to the generally less wild oat control at Minot than the other locations in 1998.

Wild oat control in hard red spring wheat, Williston 1998. (Riveland) 'Keene' hard red sping wheat was seeded May 23. Treatments (0d) were applied to 3- to 4-leaf wheat and 2- to 4-leaf wild oat on May 24 with 68 F, 40% RH, clear sky, 7-mph wind. Treatments (6d) were applied to 4.5-to 5-leaf wheat and 3- to 5-leaf wild oats on May 29 with 57 F, 55% RH, clear sky, and 5-mph wind. All treatments were applied with a bicycle type sprayer with wind cones mounted on a G-Allis Chalmers tractor delivering 8.6 gpa at 30 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 24 ft plots. The experiment was a randomized complete block design with 4 replicates.

Treatment[a]	Rate	Jul 9 Wht	Jul 9 Wioa	Aug 10 Wht	Aug 10 Wioa	TEST weight	Aug 17 Yield
	oz/A	%				lbs/bu	bu/A
Difp+Brox+PO	16+4+.12G	0	90	0	63	60	31
Difp+PO/Difp+Brox+PO	8+.12G/8+4+.12G	1	94	0	85	61	30
Immb+Thif&Trib+Act90	5+.22+.25%	0	92	0	90	59	32
Immb+Thif&Trib+Act90	2.5+.22+.25%	1	84	0	75	60	27
Immb+Act90 /Immb+Thif&Trib+Act90	2.5+.25% /2.5+.22+.25%	0	97	1	94	61	31
Difenzoquat+Thif&Trib	12+.22	0	71	0	36	60	25
Tral+Brox&MCPA+Tf8436+AMS	2.9+8+.5%+24	0	94	0	88	60	33
Clodinafop+Brox&MCPA+Score	0.8+8+.8%	2	99	0	96	60	35
HOE1170+Thif&Trib	1.7+.22	2	98	1	90	61	34
MON37500+ND72	0.37+1%	2	89	0	66	61	27
MON37500+ND72/MON37500+ND72	0.18+1%/.18+1%	1	99	0	95	60	35
Tiller	9.3	1	94	5	88	61	32
Cheyenne+Thif&Trib	7.3+.22	0	92	0	87	61	32
Bayer1+ND72	0.25+1%	7	99	8	97	61	30
Propanil+MCPA-ioe+PO /Propanil+PO	8+4+.18G /8+.18G	0	13	0	13	61	21
Propanil+MCPA-ioe+PO	16+4+.18G	0	0	0	13	61	16
Untreated	0	0	0	0	0	60	16
C.V. %		139	9	240	26	1	13
LSD 5%		2	10	3	26	NS	5
# OF REPS		4	4	4	4	4	4

[a]Treatments after / were applied 6 days after initial treatments.

Summary

Diclofop, imazamethabenz, and MON 37500 were applied both, as one full rate or as two split applications each at one-half the full rate. The largest response to split application was with MON 37500. In general split applications increased efficacy of these wild oat control herbicides. Split application never reduced efficacy of these herbicides. Thus, split applications could provide a potential for increased wild oat control without risk of reduced control. Propanil was included in the experiment to evaluate efficacy for foxtail control, which in 1997 occurred with wild oat at most locations. However foxtail was not present at a density for good evaluation in 1998. The lack of foxtail occurred because the early seeding and cool conditions early in the 1998 season was not favorable for foxtail establishment. All of the wild oat control herbicides alone, in mixture with broadleaf control herbicides or as split applications gave excellent (>90%) wild oat control. Wild oat infestation was moderate (about 150 plants/yd^2) and wheat yield increased about 15 bu/A from herbicides that effectively controlled wild oat. Diclofop as a single treatment, difenzoquat, and MON 37500 applied once were the only treatments giving less than 70% wild oat control at harvest. Imazamethabenz and difenzoquat were the only wild oat control herbicides giving less than 85% control. These results indicate that many herbicides can effectively control wild oat and split application has potential to increase control in many environments.

Summary Of Uniform Wild Oat Control Experiments

All of the wild oat control herbicides alone, in mixture with broadleaf control herbicides or as split applications gave excellent (>90%) wild oat control at most locations. However at **Minot** with extremely dense infestations(>500/yd^2) and drought conditions, only HOE-1170, tralkoxydim, and clodinafop gave more than 75% control at the later evaluation. At **Hettinger** wild oat density was low (<25/yd^2) and all wild oat control herbicides were highly effective, but with the low infestation effective control of wild oat did not increase wheat yield. At **Williston** wild oat infestation was moderate (about 150 plants/yd^2) and wheat yield increased about 15 bu/A from herbicides that effectively controlled wild oat. Diclofop as a single treatment, difenzoquat, and MON 37500 applied once were the only treatments giving less than 70% wild oat control at harvest. At **Carrington** wild oat infestation was moderate (about 150 plants/yd^2), and the only treatments giving less than 90% wild oat control were diclofop applied once and fenoxaprop formulated mixtures with broadleaf control herbicides. Difenzoquat injured 'Verde' wheat used at Carrington. At **Fargo** wild oat density exceeded 150 plants/yd^2, and wheat yield was increased about 25% from effective wild oat control. Imazamethabenz and difenzoquat were the only wild oat control herbicides giving less than 85% control. Cool conditions at and after application probably accounted for the reduced efficacy of imazamethabenz and difenzoquat at Fargo. These results indicate that many herbicides can effectively control wild oat, split application has potential to increase control in many environments, and the relative effectiveness of wild oat control herbicides varies with environment.

Tralkoxydim plus adjuvant with $NaHCO_3$ (1.8 g/L) for wild oat control. (Nalewaja). 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 2- to 4-leaf wheat and wild oat, and cotyledon-to 4-leaf wild mustard and wild buckwheat on May 22 at 9:30 AM with 62 F, 56% RH, cloudy sky, and 3-to 5-mph wind. Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	RATE	June 8			July 16	
		Wht	Wioa	Wimu	Wht	Wioa
	oz/A			%		
Tralkoxydim+TF8035+AMS	2+.5%+24	3	89	10	0	87
Tralkoxydim+ND191C5	2+1%	2	89	25	0	92
Tralkoxydim+ND191C5	2+2%	1	92	20	0	96
Tralkoxydim+Scoil	2+2%	1	89	35	0	94
Tralkoxydim+Scoil+AMS	2+2%+24	0	96	36	0	98
Tralkoxydim+Scoil+AMS	2+2%+12	1	89	30	0	94
Tralkoxydim+Scoil+ND4	2+2%+1%	1	94	35	0	98
Tralkoxydim+ND4	2+1%	0	80	15	0	77
Tralkoxydim+ND72	2+1%	0	48	15	0	39
Tralkoxydim+React	2+.18G	1	89	20	0	93
Tralkoxydim+ND192c5	2+1%	3	86	30	0	87
Tralkoxydim+ND192c5	2+2%	0	94	18	0	98
Untreated	0	0	0	0	0	0
C.V. %		214	7	109	0	11
LSD 5%		NS	8	NS	NS	13
# OF REPS		4		4	4	4

Summary

Tralkoxydim gave excellent wild oat control without injury to wheat applied with various adjuvants, except ND4 and ND72 which reduced wild oat control. ND72 was much less effective than ND4. All adjuvants were oil type except ND4 and ND72 were surfactant basic blends. The inclusion of ammonium sulfate (AMS) with Scoil tended to increase efficacy. However, only when at 24 oz/A. The substitution of ND4 for AMS with Scoil was equally as effective as AMS. Sodium bicarbonate was included with all treatments so its influence on efficacy could not be determined. AMS has in the past overcome sodium bicarbonate antagonism of tralkoxydim phytotoxicity to wild oat and the ND191c5 and ND192c5 adjuvants directly overcome the antagonism. Thus, it may be assumed that the sodium bicarbonate was antagonistic and the high levels of control were because antagonism was overcome.

Wild Oat Control with Bay MKH6562. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 1.5- to 4-leaf wheat, 1- to 4.5-leaf wild oat, cotyledon-to 2-leaf wild buckwheat, and cotyledon-to 4-leaf wild mustard on May 21 with 70 F, 50% RH, partly cloudy sky, and 5- to 10-mph wind. Treatments (/) were applied to 4- to 7-leaf wheat, 5- to 7-leaf wild oat, 3- to 5-leaf wild buckwheat, and 3- to 7-leaf wild mustard on May 29 with 65 F, 40% RH, partly cloudy sky, and 5- to 10-mph wind. All treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

		June 8			July 16	
Treatment	Rate	Wht	Wioa	Wimu	Wht	Wioa
	oz/A	%				
Bay MKH6562+X-77	0.1+.25%	0	83	99	1	83
Bay MKH6562+X-77	0.2+.25%	1	84	99	1	92
Bay MKH6562+X-77	0.35+.25%	3	96	99	0	98
Bay MKH6562+ND72	0.1+1%	1	92	99	2	93
Bay MKH6562+ND72	0.2+1%	0	91	98	1	96
Bay MKH6562+24-Ddma+X-77	0.2+8+.25%	2	87	99	0	96
Bay MKH6562+24-Ddma+ND72	0.2+8+1%	0	93	99	1	97
Bay MKH6562+X-77(0d) /Bay MKH6562+X-77(8d)	0.1+.25% /.1+.25%	4	88	99	2	92
Bay MKH6562+ND72(0d)/Bay1+ND72(8d)	0.1+1%/.1+1%	2	81	99	8	78
Bay MKH6562+Fluroxypyr+2,4-Dioe+ND72	0.1+1.5+6+1%	1	88	99	1	90
HOE1170+Bromoxynil&MCPA	1.7+8	0	92	99	0	88
Untreated	0	0	15	0	0	0
C.V. %		170	13	1	186	11
LSD 5%		NS	16	1	4	13
# OF REPS		4	4	4	4	4

Summary

Bay MKH6562 did not injure wheat regardless of rate or adjuvant. ND72 was more effective than X-77 in enhancing Bay MKH6562 phytotoxicity to wild oats. Bay MHK 6562 at 0.1 oz/A with ND72 was equally as effective as Bay MHK 6562 at 0.3 oz/A when with X-77. Split application of Bay MKH6562 appeared less effective than a single application when applied with ND72. However, with X-77 the split and single application were similarly effective. Fluroxypyr+2,4-Dioe and 2,4-Ddma, applied with Bay MKH6562, did not reduce wild oat control by Bay MKH 6562.

Wild Oat Control With V-10029, Fargo. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 2- to 4-leaf wheat and wild oat, and cotyledon- to 4-leaf wild mustard and wild buckwheat on May 22 with 62 F,56% RH, cloudy sky, and 3-to 5-mph wind. Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	June 17			July	
		Wht	Wioa	Wimu	Wht	Wioa
	oz/A	%				
V-10029+Kenetic	0.32+0.125%	0	44	99	0	0
V-10029+Kenetic	0.42+0.125%	0	63	99	0	7
V-10029+Kenetic	0.53+0.125%	0	54	74	0	8
V-10029+ND4	0.32+1%	3	83	95	0	26
V-10029+Scoil	0.32+0.18G	0	69	99	0	34
V-10029+ND72	0.32+1%	0	56	99	0	10
HOE1170	0.8	5	90	0	0	92
Untreated	0	0	0	0	0	0
C.V. %		235	19	25	0	67
LSD 5%		3	16	26	NS	22
# OF REPS		4	4	4	4	4

Summary

V-10029 regardless of rate or adjuvant did not adequately control wild oat.

Wild Oat Control With Tralkoxydim. (Nalewaja). 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 2- to 4-leaf wheat and wild oat and cotyledon -wild mustard and wild buckwheat on May 22 with 62 F, 56% RH, cloudy sky and 3- to 5-mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	June 8			July 16		Aug 12
		Wht	Wioa	Wimu	Wht	Wioa	Yield
	oz/A	%					bu/A
Tralkoxydim+TF8035	2.88+0.5%	0	86	0	0	83	37
Tralkoxydim+TF8035+AMS	2.88+0.5%+24	0	85	8	0	87	38
Tral+TF8035+Brox&MCPA	2.88+0.5%+12	1	87	99	0	88	41
Tral+TF8035+Brox&MCPA+AMS	2.88+0.5%+12+24	0	92	99	0	97	50
Tral+TF8035+Flur+2,4-Dioe	2.88+5%+2+8	1	87	99	0	84	37
Tral+TF8035+Flur+2,4Dioe+AMS	2.88+.5%+2+8+24	1	88	99	0	89	45
Tral+TF8035+2,4-Dioe	2.88+0.5%+8	0	90	99	0	84	39
Tral+TF8035+2,4-Dioe+AMS	2.88+0.5%+8+24	0	86	96	0	85	42
Tral+TF8035+Clpy&MCPA	2.88+0.5%+5.54	2	85	99	0	91	45
Tral+TF8035+Clpy&MCPA+AMS	2.88+0.5%+8+24	3	93	99	0	96	46
Tral+TF8035+MCPA-ioe	2.88+0.5%+8	0	92	99	0	93	43
Tral+TF8035+MCPA-ioe+AMS	2.88+0.5%+8+24	0	93	99	1	98	44
HOE1170	1.7	0	98	0	0	99	43
Untreated	0	0	0	0	0	0	6
C.V. %		308	5	6	748	4	16
LSD 5%		NS	6	6	NS	4	9
# OF REPS		4	4	4	4	4	4

Summary

Wild oat control exceeded 80% with all treatments and increased wheat yield by more than 30 bu/A. Wild oat density exceeded 300 plants/yd^2. The wild mustard was controlled by MCPA applied shortly after the June 8 evaluation. Ammonium sulfate increased or tended to increase wild oat control from tralkoxydim when with bromoxynil&MCPA or clopyralid&MCPA. Otherwise the inclusion of ammonium sulfate did not have any impact on efficacy. Broadleaf control herbicides in general were not greatly antagonistic to wild oat control from tralkoxydim.

Split Treatments for Wild Oat Control. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 1.5-to 4-13 leaf wheat, 1- to 4.5-leaf wild oat, cotyledon-to 2-leaf wild buckwheat, and cotyledon-to 4-leaf wild mustard on May 21 with 70 F, 50% RH, partly cloudy sky, and 5- to 10-mph wind. Treatments (/) were applied to 3- to 6-leaf wheat, 3- to 7-leaf wild oat, 2- to 4-leaf wild buckwheat, and 2- to 6-leaf wild mustard on May 27 with 65 F, 65% RH, partly cloudy sky, a d 5- to 10-mph wind. All treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to an area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	June 23		July 16	
		Wht	Wioa	Wht	Wioa
	oz/A	%			
Imazamethabenz+Act90	5+.25%	0	66	0	78
Immb+Act90/Immb+Act90	1.8+.25%/.18+.25%	0	69	0	71
Bay MKH6562+X-77	.2+.25%	1	97	0	99
Bay MKH6562+X-77/Bay MKH6562+X-77	.075+.25%/.075+.25%	1	95	2	98
Bay MKH6562+ND72	.2+1%	1	99	0	99
Bay MKH6562+ND72/Bay MKH6562+ND72	.075+1%/.075+1%	1	96	4	94
HOE1170	1.7	1	97	0	97
HOE1170/HOE1170[a]	**0.63/0.63**	**1**	**94**	**0**	**94**
Difenzoquat[a]	**12**	**2**	**91**	**3**	**86**
Difenzoquat+Difenzoquat	4.5/4.5	0	65	0	81
Untreated	0	0	0	0	0
C.V. %		232	11	264	8
LSD 5%		NS	13	NS	10
# OF REPS		4	4	4	4

[a] Treatment HOE1170/HOE1170 reps 2, 3, and 4 did not receive the second HOE1170 treatment, but were applied over the difenzoquat replication 2,3, and 4.

Summary

Split application of imazamethabenz or Bay MKH6562 did not influence efficacy. Bay MKH 6562 was highly effective in controlling wild oat limiting any expression of increased control form split application. However, imazamethabenz was only 60 to 70% which would allow for expression of any benefit form split treatment. The split HOE1170 treatment gave 94% wild oat control even though three replications were only treated with 0.63 oz/A. The apparent greater efficacy of a single difenzoquat application is from the three replications receiving a treatment of HOE1170 at 0.63 oz/A in addition to difenzoquat.

Wild oat and foxtail control with HOE-1170, Fargo. Nalewaja, John D., Ronald F. Roach and Janet D. Davidson. The experiment was established at two different locations to determine wild oat and foxtail control in wheat. All treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates per treatment. Information for the various experiments is as follows:

Experiment	Wild oat	Foxtail
Wheat variety	'Oxen'	'Oxen'
Seeding date	Apr 23	Apr 27
Treatment date	May 21	May 27
crop stage (leaf)	1.5 to 4	4 to 6
temperature (F)	73	65
Harvest date	Aug 12	-

Wild oat (>300 plants/yd^2) and foxtail infestations were dense. Foxtail consisted of both green and yellow species. Moisture and growing conditions at herbicide application were excellent for wheat growth, which was highly competitive with the foxtail. Pre-harvest evaluations of foxtail control were not taken because of wheat lodging and an absence of visible foxtail in or above the wheat, regardless of treatment. Wheat in the foxtail experiment was not harvested because of head blight and lodging.

HOE-1170 effectively controlled wild oat in mixture with broadleaf control herbicides (Table 1). In this experiment HOE-1170 applied alone was less effective than in mixture, which is contrary to all other reports and other experiments conducted in the same field and treated on the same day. These considerations indicate an application error. However, comparison among other treatments indicates that HOE-1170 effectively controlled wild oat without visible injury to wheat regardless of the broadleaf control herbicide in the spray mixture. Wild oat control tended to be greater from HOE-1170 than imazamethabenz, but equal to that from tralkoxydim. The generally cool temperatures at and following treatment probably favored HOE-1170 and tralkoxydim more than imazamethabenz. Wheat yield generally reflected wild oat control. All herbicide treatments increased yield 30 to 40 bu/A when compared to the untreated control.

All broadleaf control herbicides, when tank mixed with HOE-1170, reduced or tended to reduce foxtail (mixture of green and yellow species) control, except for clopyralid&MCPA (Table 2). The antagonism of HOE-1170 for foxtail control from tribenuron+MCPA, dicamba+MCPA, tribenuron+MCPA, dicamba+MCPA, and tribenuron+ dicamba+MCPA generally was reduced but not overcome by increasing the rate of HOE-1170 from 0.8 to 1 oz/A. However, the increased rate of HOE-1170 did not increase foxtail control when with tribenuron+MCPA+dicamba. HOE-1170 was equally as effective for foxtail control when with dicamba sodium (Na) or diglycolamine (dga) both plus MCPA (isooctyl ester, ioe). In this experiment, even though foxtail control differed among treatments, foxtail did not visibly compete with the wheat. The growing conditions were cool which favored wheat over foxtail.

Results of these experiments indicate that mixtures of HOE-1170 with certain broadleaf control herbicides have potential of controlling both grass and broadleaf weeds. However, HOE-1170 rate may need to be increased to overcome antagonism from some broadleaf control herbicides. The conditions of these experiments were positive for wheat growth. Wild oat responds to environment similarly as wheat which may account for the excellent wild oat control and lack of antagonism of HOE-1170 from broadleaf herbicides. Those same environmental conditions are stressful to foxtail, which may account for the large antagonism of foxtail control from broadleaf control herbicides observed.

Table 1. Wild oat and wild mustard control with HOE-1170, Fargo, ND. (Nalewaja, Roach, and Davidson).

Treatment[a]	Rate	6/28 Wht	6/28 Wioa	6/28 Wimu	7/21 Wht	7/21 Wioa	8/12 Yield
	oz/A	%					bu/A
HOE-1170	1.7	1	88	0	0	82	35
HOE-1170+Thif&Trib	1.7+0.2&0.1	1	98	99	0	95	45
HOE-1170+Brox&MCPA	1.7+4&4	3	93	99	0	92	41
HOE-1170+Bromoxynil	1.7+4	2	97	87	0	93	50
HOE-1170+MCPA-ioe	1.7+6	2	96	99	0	96	48
HOE-1170+F8426+MCPAioe	0.13+0.13+4	0	95	99	0	95	48
Fenx&MCPA+MCPA+Brox	1.3&2&6+4	2	92	99	0	89	40
HOE-1170+Flur+Thif&Trib	1.7+2+0.1&0.04	2	98	99	0	94	45
HOE-1170+Clpy&MCPA+Flur	1.7+1.43&8.01+2	1	98	99	0	96	48
HOE-1170+Flur+2,4-Dioe	1.7+1.5+6	2	95	99	1	96	49
Immb+Brox&MCPA+Scoil	6+4&4+0.18G	3	81	99	0	84	32
Tral+TF8035+Brox&MCPA	2.88+0.5%+4&4	3	91	99	0	94	43
Untreated	0	0	0	0	0	0	5
C.V. %		140	5	8	721	8	16
LSD 5%		NS	7	10	NS	10	9
# OF REPS		4	4	4	4	4	4

aTF8035=surfactant, Zeneca, Wilmington, DE.; Scoil=adjuvant, AGSCO, Grand Forks, ND; Commercial formulation of Fenx&MCPA&2,4-D=Tiller at 9.3 oz ai/A; Brox&MCPA =Bronate at 8 oz ai/A; Thif & Trib=Harmony at 0.14- or 0.3-oz ai/A; Clpy&MCPA =Curtail M at 9.44 oz ai/A.

Table 2. Foxtail and broadleaf weed control with HOE-1170, Fargo, ND. (Nalewaja, Roach, and Davidson).

Treatment[a]	Rate	June 8 Wht	Fota[b]	Wibw	Rrpw	Wimu
	oz/A	%				
HOE-1170	0.8	0	98	0	0	0
HOE-1170	1	0	96	0	0	0
HOE-1170+Clpy&MCPA	0.8+1.44&8.06	3	98	83	89	99
HOE-1170+Clpy&MCPA	1+1.44&8.06	0	98	47	84	99
HOE-1170+Trib+MCPA-ioe	0.8+0.125+4	2	55	62	68	68
HOE-1170+Trib+MCPA-ioe	1+0.125+4	3	81	95	95	99
HOE-1170+Dica-Na+MCPA-ioe	0.8+1+4	3	80	62	84	99
HOE-1170+Dica-Na+MCPA-ioe	1+1+4	1	94	58	95	98
HOE-1170+MCPA-ioe	0.8+4	3	89	42	87	99
HOE-1170+MCPA-ioe	1+4	2	91	47	73	99
HOE-1170+Trib+Dica-Na+MCPA-ioe	0.8+0.125+1+4	5	78	75	97	99
HOE-1170+Trib+Dica-Na+MCPA-ioe	1+0.125+1+4	3	79	87	99	99
Fenx&MCPA&2,4-D+Dica-Na	0.76&3.51&1.13+4+1	4	91	23	77	99
HOE-1170+Dica-dga+MCPA-ioe	1+1.6+6.3	0	93	17	93	66
Tral+TF8035+Brox&MCPA	2.9+.5%+4&4	4	95	99	99	99
Untreated	0	0	0	0	0	0
C.V. %		120	8	40	14	18
LSD 5%		NS	11	35	16	24
# OF REPS		3	3	3	3	3

aTF8436=surfactant, Zeneca, Wilmington, DE; Commercial formulation of Fenx&MCPA& 2,4-D=Tiller at 5.4 oz ai/A; Brox&MCPA=Bronate at 8 oz ai/A; Clpy&MCPA= clopyralid acid&MCPAioe=Curtail M at 9.5 oz ai/A.
[b]Fota=green and yellow foxtail.

Wild oat and foxtail control with clodinafop, Fargo, ND. Nalewaja, John D., Ronald F. Roach, and Janet D. Davidson. The experiment was established at two sites to determine wild oat and foxtail control in wheat. All treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with three and four replicates per treatment. Information for the various experiments is as follows:

Experiment	Wild oat	Foxtail
Wheat variety	'Oxen'	'Oxen'
Seeding date	Apr 23	Apr 27
Treatment date	May 21	May 27
crop stage (leaf)	1.5 to 4	4 to 6
temperature (F)	73	65
Harvest date	Aug 12	-

Wheat was tolerant to clodinafop, HOE-1170, and tralkoxydim when applied alone or in combination with various herbicides for broadleaf weed control (Table 1). The inclusion of broadleaf control herbicides, bromoxynil or dicamba, tended to or reduced wild oat control from clodinafop. However, clodinafop gave greater than 90% wild oat control when mixed with the broadleaf herbicides, except some antagonism was observed from thifensulfuron&tribenuron+dicamba. The greatest wild oat control was from clodinafop alone and with fluroxypyr which were equally effective as HOE-1170 alone. Tralkoxydim alone or with bromxynil&MCPA were equally as effective in controlling wild oat, but were or tended to be less effective than clodinafop or HOE-1170 alone. Wild oat infestation was dense at >300 plants/yd^2, and all herbicide treatments at the rates used gave more than adequate wild oat control. Wheat yield generally reflected the level of wild oat control and was highest with clodinafop alone, clodinafop+thifensulfuron&tribenuron, and clodinafop+fluroxypyr.

Clodinafop for foxtail control was at a higher rate and HOE-1170 at a lower rate than in the wild oat control experiment (Table 2). Yellow foxtail control exceeded 95% and was similar from these herbicides and tralkoxydim when applied without a broadleaf control herbicide. Thifensulfuron&tribenuron alone or with dicamba were highly antagonistic to clodinafop and HOE-1170 control of yellow foxtail. Dicamba only tended to antagonize yellow foxtail control by clodinafop. Foxtail infestations were dense, but the wheat was highly competitive and the foxtail probably would not have greatly reduced yield. Wheat was not harvested because of a severe head blight infection. Head blight appeared to differ with herbicide treatment, which probably was due to delayed flowering from some herbicide treatments that increased or decreased susceptibility to head blight depending upon moisture conditions for disease infections at flowering.

Environmental conditions for both experiments were wet with excellent plant growth at herbicide application and throughout the season. Clodinafop was most effective for control of both wild oat and yellow foxtail when applied alone or with fluroxypyr. Thifensulfuron&tribenuron was most antagonistic to clodinafop for yellow foxtail, but dicamba at the rates used was most antagonistic for wild oat control (Tables 1 and 2). Thifensulfuron&tribenuron antagonized HOE-1170 similarly to clodinafop. Bromoxymil&MCPA reduced or only tended to reduce efficacy of tralkoxydim or clodinafop. The wild oat and foxtail control were excellent with the prevailing conditions, but antagonism from the broadleaf control herbicides might be greater with less favorable environmental conditions.

Table 1. Wild oat and wild mustard control with clodinafop, Fargo. ND. (Nalewaja, Roach, Davidson).

Treatment[a]	Rate	June 8			July 20		8/12
		Wht	Wioa	Wimu	Wht	Wioa	Yield
	oz/A	%					bu/A
Clodinafop+Score	0.8+0.8%	0	95	0	1	98	36
Clodinafop+Brox&MCPA+Score	8+4&4+0.8%	0	91	99	0	92	29
Clodinafop+Dicamba+Score	0.8+1.5+0.8%	2	92	85	3	92	29
Clod+Thif&Trib+Score	8+0.15&0.08+0.8%	1	93	99	0	98	36
Clod+Thif&Trib+Dica+Score	0.8+0.15&0.08+1+0.8%	2	81	99	0	93	22
Clodinafop+Fluroxypyr+Score	8+2+0.8%	1	95	99	1	99	36
HOE-1170	1.3	3	97	0	2	97	31
HOE-1170+Thif&Trib	1.3+0.15&0.08	5	97	99	3	93	33
Tralkoxydim+TF8035	2.9+0.5%	1	88	25	2	91	27
Tralkoxydim+Brox&MCPA+TF8035	2.9+4&4+0.5%	1	86	0	1	90	25
C.V. %		250	6	11	240	3	24
LSD 5%		NS	7	9	NS	4	10
# OF REPS		4	4	4	4	4	4

[a]Score petroleum oil, Novartis, Greensboro, NC; TF8035, surfactant, Zeneca, Wilmington, DE; Commercial formulation Thif&Trib=Harmony Extra at 0.23 oz ai/A; Brox&MCPA, Bronate at 8 oz ai/A.

Table 2. Foxtail and broadleaf weed control with clodinafop, Fargo, ND. (Nalewaja, Roach, and Davidson).

Treatment[a]	Rate	June 5					July 31		
		Wht	Fota[b]	Wibu	Rrpw	Wimu	Wht	Yeft	Wibu
	oz/A	%							
Clodinafop+Score	1+1%	1	99	0	0	0	0	98	0
Clodinafop+Brox&MCPA	1+4&4+1%	0	99	99	99	99	0	96	93
Clodinafop+Dica-Na+Score	1+1.5+1%	3	98	80	99	86	3	90	90
Clodinafop+Thif&Trib+Score	1+0.15&0.08+1%	2	89	98	99	99	1	55	95
Clodinafop+MCPA-ioe+Score	1+4+1	0	98	27	60	98	2	94	30
Clodinafop+Flur+2,4-Dioe+Score	1+1.5+4+1%	1	97	98	98	99	0	96	97
Clod+Thif&Trib+Dica-Na+Score	1+0.15&0.08+1+1%	2	91	99	99	99	2	54	98
HOE-1170	0.8	0	99	0	0	0	0	97	0
HOE-1170+Thif&Trib	0.8+0.15&0.08	2	93	99	99	99	0	73	93
Tralkoxydim+TF8035	2.9+0.5%	0	99	0	0	0	0	99	0
Tral+Brox&MCPA+TF8035	9+4&4+0.5%	6	99	99	99	99	3	93	93
C.V. %		124	2	18	9	7	197	14	15
LSD 5%		3	3	18	10	7	NS	19	15
# OF REPS		3	3	3	3	3	3	3	3

[a] Score, petroleum oil, Novartis, Greensboro, NC; TF8035,surfactant, Zeneca, Wilmington, DE; Commercial formulation Thif&Trib, Harmony Extra at 0.23 oz ai/A; Brox&MCPA, Bronate at 8 oz ai/A.
[b]Fota=green and yellow foxtail.

Foxtail Control with Imazamethabenz, 1998. (Nalewaja) Oxen hard red spring wheat was seeded May 27. Treatments were applied to 4- to 6-leaf wheat, 1- to 4-inch foxtail, 2- to 6-leaf wild mustard, and 2- to 4-leaf redroot pigweed and wild buckwheat on June 30 with 75F, 60% RH, clear sky and 5- to 10-mph wind. Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with 3 replicates.

Treatment	Rate	7/29 Yeft
	oz/A	%
Imazamethabenz+Diclofop+Act90+PO	5+9+.25%+.12G	60
Imazamethabenz+Diclofop+Act90+PO	5+12+.25%+.12G	63
Imazamethabenz+Tiller+Act90	5+4.62+.25%	99
Imazamethabenz+Tiller+Act90	5+6.16+.25%	99
Imazamethabenz+Tral+TF8036	5+2.11+.5%	33
Imazamethabenz+Tral+TF8036	5+2.88+.5%	10
Imazamethabenz+HOE1170+Act90	5+0.644+.25%	99
Imazamethabenz+HOE1170+Act90	5+0.78+.25%	98
Imazamethabenz+HOE1170+Act90	3+0.4+.25%	99
Imazamethabenz+Act90	3+.25%	8
Imazamethabenz+Act90	5+.25%	5
Imazamethabenz+Act90	7.5+.25%	7
Diclofop+PO	12+.12G	93
Tiller	7.4	98
Tral+TF8036	2.88+0.5%	74
HOE1170	0.64	99
HOE1170	0.78	98
Untreated	0	0
C.V. %		14
LSD 5%		15
# OF REPS		3

*Treatments 5 and 6 were not fully dissolved.

Summary

Foxtail and wheat were highly stressed from excess water prior to treatment. All treatment containing fenoxaprop (Tiller and HOE1170) controlled yellow foxtail. Imazamethabenz antagonized yellow foxtail control from diclofop and tralkoxydim. Fenoxaprop formulation in mixture with imazamethabenz would provide foxtail control. Wild oat was not present in the experiment so any benefit from these mixtures on wild oat control was not determined. It is believed that imazamethabenz is most effective with warm and fenoxaprop with cool conditions so such mixtures potentially could increase efficacy over various environments.

Clodinafop with adjuvants for foxtail control in wheat. (Nalewaja) 'Oxen' hard red spring wheat was seeded on April 27. Treatments were applied to 4- to 6-leaf wheat, 1- to 4-inch foxtail, 2- to 6-leaf wild mustard, and 2- to 4-leaf redroot pigweed, and wild buckwheat on June 30 with 75F, 60% RH, clear sky, and 5- to 10-mph wind. Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Foxtail
	oz/A	%
Clodinafop+Score	1+1%	99
Clodinafop+Score	0.5+1%	85
Clodinafop+ND4	0.5+1%	88
Clodinafop+ND72	0.5+1%	87
Clodinafop+Scoil	0.5+.18G	95
Clodinafop+React	0.5+0.18G	95
Untreated	0	0
C.V. %		5
SD 5%		7
# OF REPS		4

Summary

Foxtail consisted of mainly yellow foxtail. The ND adjuvants were equally as effective as Score with clodinafop, but less effective than Scoil or React.

HOE-1170 for Foxtail Control, Fargo 1998. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 27. Treatments were applied to 4- to 6-leaf wheat and foxtail, 3-leaf redroot pigweed, 2- to 5-leaf wild buckwheat, and 1.5" kochia on May 27 with 65F, 40% RH, partly cloudy sky, and 5- to 10-mph wind. Treatments were applied with a bicycle wheel type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with three replicates.

		June 8				
Treatment	Rate	Wht	Fota	Wibu	Rrpw	Wimu
	oz/A	%				
HOE-1170	0.8	0	98	0	0	0
HOE-1170	1	0	96	0	0	0
HOE-1170+Clpy&MCPA	0.8+9.5	3	98	83	89	99
HOE-1170+Clpy&MCPA	1+9.5	0	98	47	84	99
HOE-1170+Trib+MCPA-ioe	0.8+0.125+4	2	55	62	68	68
HOE-1170+Trib+MCPA-ioe	1+0.125+4	3	81	95	95	99
HOE-1170+Dica-Na+MCPA-ioe	0.8+1+4	3	80	62	84	99
HOE-1170+Dica-Na+MCPA-ioe	1+1+4	1	94	58	95	98
HOE-1170+MCPA-ioe	0.8+4	3	89	42	87	99
HOE-1170+MCPA-ioe	1+4	2	91	47	73	99
HOE-1170+Trib+Dica-Na+MCPA-ioe	0.8+0.125+1+4	5	78	75	97	99
HOE-1170+Trib+Dica-Na+MCPA-ioe	1+0.125+1+4	3	79	87	99	99
Tiller+Dica-Na	5.4+1	4	91	23	77	99
HOE-1170+Dica-dga+MCPA-ioe	1+1+4	0	93	17	93	66
Tral+TF8035+Brox&MCPA	2.9+0.5%+8	4	95	99	99	99
Untreated	0	0	0	0	0	0
C.V. %		120	8	40	14	18
LSD 5%		NS	11	35	16	24
# OF REPS		3	3	3	3	3

Summary

Foxtail infestations were dense. Foxtail consisted of both green and yellow species. Moïsture and growing conditions at herbicide application were excellent for wheat growth, which was highly competitive with the foxtail. Pre-harvest evaluations of foxtail control were not taken because of wheat lodging and an absence of visible foxtail in or above the wheat, regardless of treatment. Wheat in the foxtail experiment was not harvested because of head blight and lodging.

All broadleaf control herbicides, when tank mixed with HOE-1170, reduced or tended to reduce foxtail (mixture of green and yellow species) control, except for clopyralid&MCPA (Table 2). The antagonism of HOE-1170 for foxtail control from tribenuron+MCPA, dicamba+MCPA, tribenuron+MCPA, dicamba+MCPA, and tribenuron+dicamba+MCPA generally was reduced but not overcome by increasing the rate of HOE-1170 from 0.8 to 1 oz/A. However, the increased rate of HOE-1170 did not increase foxtail control when with tribenuron+MCPA+dicamba. HOE-1170 was equally as effective for foxtail control when with dicamba sodium (Na) or diglycolamine (dga) both plus MCPA (isooctyl ester, ioe). In this experiment, even though foxtail control differed among treatments, foxtail did not visibly compete with the wheat. The growing conditions were cool which favored wheat over foxtail.

Results indicate that mixtures of HOE-1170 with certain broadleaf control herbicides have potential of controlling both grass and broadleaf weeds. However, HOE-1170 rate may need to be increased to overcome antagonism from some broadleaf control herbicides. Environmental conditions are stressful to foxtail, which may account for the large antagonism of foxtail control from broadleaf control herbicides observed.

HOE1170 plus adjuvants for foxtail control in wheat, Fargo. (Nalewaja) 'Oxen' hard red spring wheat was seeded May 27. Treatments were applied to 4- to 6-leaf wheat, 1- to 4-inch green and yellow foxtail, 2- to 6-leaf wild mustard, and 2- to 4-leaf redroot pigweed and wild buckwheat on June 30 with 75 F, 60% RH, clear sky, and 5- to 10 -mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Yeft
	oz/A	%
HOE1170	0.8	99
HOE1170+Scoil	0.8+0.18G	99
HOE1170+ND4	0.8+1%	98
HOE1170+ND4	0.8+1%	99
HOE1170+Tergitol-7	8+0.25%	99
HOE1170+28N	0.8+2%	96
HOE1170+PO(Clean crop)	0.8+0.25G	98
HOE1170+ND72	0.8+0.1%	99
HOE1170+SilwetL77	0.8+0.25%	99
HOE1170+Li105	0.8+.5%	99
Untreated	0	0
C.V. %		2
LSD 5%		2
# OF Reps		4

Summary

Hoe1170 gave excellent control of foxtail (mainly yellow foxtail in the experiment) so the influence of adjuvant on efficacy was undeterminable. the wheat and foxtail plants were highly stressed from excessive moisture prior to treatment.

Quinclorac for Foxtail Control in Wheat (2-3LF), Fargo 1998. (Nalewaja)
'Oxen' hard red spring wheat was seeded April 27. Treatments were applied to 4- to 6-leaf wheat, 2- to 4-leaf green and yellow foxtail, 3- to 5-leaf wild mustard, 1- to 4-leaf wild buckwheat, 0.5- to 1-inch kochia, and cotyledon- to 3-leaf redroot pigweed on May 26 with 80F, 39% RH, and 5- to 10-mph wind. Treatments were applied with a bicycle-wheel-type-plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with 3 replicates.

Treatment[a]	Rate	June 8				
		Wht	Fota	Wibw	Rrpw	Wimu
	oz/A			%		
Quin+Scoil(FgoH20)	2+.18G	0	76	0	50	0
Quin+Scoil+Cacl2	2+.18G+1.1	2	94	0	58	0
Quin+ND4(FgoH20)	2+1%	0	72	0	52	0
Quin+ND4+Cacl2	2+1%+1.1	0	71	0	38	0
Quin+ND4+Cacl2+AMS	2+1%+1.1+11.3	0	45	0	35	0
Quin+ND72(FgoH20)	2+1%	3	73	7	48	0
Quin+ND72+Cacl2	2+1%+1.1	0	43	0	43	0
Quin+ND72+SBC	2+1%+2	3	78	7	52	0
Quin+ND72+Cacl2+AMS	2+1%+1.1+11.3	0	82	0	52	0
Quin+ND72[a](FgoH20)	2+1%	0	95	0	53	0
Quin+ND72[a]+Cacl2	2+1%+1.1	1	86	0	42	0
Quin+ND72[a]+Cacl2+AMS	2+1%+1.1+11.3	0	73	0	36	0
Quin+Act90(FgoH2O)	2+.25%	1	65	0	43	0
Quin+Act90+Cacl2	2+.25%+1.1	0	49	0	32	0
Quin+React+Cacl2	2+.18G+1.1	1	38	0	18	0
Untreated	0	0	0	0	0	0
C.V. %		211	11	473	34	0
LSD 5%		NS	12	NS	23	NS
# OF REPS		3	3	3	3	3

[a]Fgo=Fargo water and $CaCl_2$=1 g/L, $CaCl_2$ water=1%, SBC=sodium bicarbonate 1.8g/L, and AMS=1%

Summary

Experiment represents a dense foxtail infestation of > 100 plants/yd^2 and favorable growing conditions. Late season rating were not taken because of lodging and vigorous wheat growth that suppressed foxtail. Conditions were wet before and after treatment. Scoil was highly effective when the spray carrier contained $CaCl_2$. However, $CaCl_2$ reduced efficacy of quinchlorac for foxtail when applied with ND72, but ammonium sulfate overcame the $CaCl_2$ antagonism. $CaCl_2$ was not antagonistic when with ND4, but the inclusion of ammonium sulfate was antagonistic. These results indicate that $CaCl_2$ antagonized ND72 but not ND4. The main difference between ND4 and ND72 is in surfactant, thus, surfactant characteristic is more important to efficacy than any calcium-quinchlorac complexes. ND72 was more effective than ND72a, except they were similar when with $CaCl_2$ and AMS. These results indicate that many factors are involved in adjuvant efficacy with quinchlorac.

Quinclorac for foxtail control in wheat, Fargo NW-22. (Nalewaja) 'Oxen' hard red spring wheat was seeded May 27. Treatments were applied to 4- to 6-leaf wheat, 1- to 4-inch green and yellow foxtail, 2- to 6-leaf wild mustard, and 2- to 4-leaf redroot pigweed and wild buckwheat on June 30 with 75 F, 60% RH, clear sky, and 5- to 10 mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	July 29 Yeft
	oz/A	%
Quinclorac+Scoil(FgoH20)	2+.18G	84
Quinclorac+Scoil+Cacl2	2+.18G+1.1	75
Quinclorac+ND4(FgoH2O)	2+1%	73
Quinclorac+ND4+Cacl2	2+1%+1.1	71
Quinclorac+ND4+Cacl2+AMS	2+1%+1.1+11.3	66
Quinclorac+ND72(FgoH20)	2+1%	61
Quinclorac+ND72+Cacl2	2+1%+1.1	43
Quinclorac+ND72+SBC	2+1%+2	71
Quinclorac+ND72+Cacl2+AMS	2+1%+1.1+11.3	58
Quinclorac+ND72a(FgoH2O)	2+1%	65
Quinclorac+ND72a+Cacl2	2+1%+1.1	61
Quinclorac+ND72a+Cacl2+AMS	2+1%+1.1+11.3	58
Quinclorac+Act90(FgoH20)	2+.25%	56
Quinclorac+Act90+Cacl2	2+.25%+1.1	49
Quinclorac+React+Cacl2	2+.18G+1.1	78
Untreated	0	0
C.V. %		19
LSD 5%		16
# OF REPS		4

Fgo=Fargo water and CaCl=1g/L, CaCl2 water=1%, SBC=sodium bicarbonate at 1.8g/L, and AMS+1%

Summary

Plants were severely stressed from excessive moisture prior to treatment. Scoil and React were the most effective adjuvants with Quinclorac for yellow foxtail control. Contrary to the previous experiment ND4 tended to be more effective than ND72. However, the salt interaction of reduced efficacy from AMS with ND4 and $CaCl_2$ withND72 are similar to in the other experiment. The generally greater efficacy of ND72a than ND72 is also similar to the other experiment (Quinclorac for Foxtail Control in Wheat (2-31f), Fargo 1998).

Foxtail and broadleaf control with quinclorac. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 3- to 5-leaf wheat, 2- to 5-leaf green and yellow foxtail, 2- to 4-leaf wild buckwheat, and 2- to 5-leaf wild mustard on May 26 with 75 F, 50% RH, sunny sky, and 0-mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Jun 5				Aug 4	
		Wht	Fota	Wimu	Wibu	Wht	Yeft
	oz/A	%					
Quinclorac+Quad 7	2+1%	0	60	5	16	18	69
Quinclorac+ND72	2+1%	1	83	19	5	0	57
Quinclorac+Scoil	2+.18G	2	93	5	28	1	76
Quinclorac+Dica-dga+Quad 7	2+1.5+1%	26	68	62	91	0	74
Quinclorac+Dica-dga+ND72	2+3+1%	11	73	66	97	0	61
Quinclorac+Dica-dga+Scoil	2+3+.18G	17	80	60	96	1	85
Quinclorac+BAS635+Quad 7	2+.2+1%	1	66	99	96	1	19
Quinclorac+BAS635+ND72	2+.2+1%	1	80	99	95	0	29
Quinclorac+BAS635+Scoil	2+.2+.18G	11	67	99	92	0	49
Quinclorac+Dica-dga+BAS635+Quad 7	2+2+.2+1%	2	94	99	96	0	76
Quinclorac+Dica-dga+BAS635+ND72	2+2+.2+1%	7	58	99	85	0	36
Quinclorac+Dica-dga+BAS635+Scoil	2+2+1+.18G	13	85	99	90	1	60
BAS635+Quad 7	0.2+1%	0	11	99	93	0	46
BAS635+Dica-dga+ND4	0.2+2+1%	8	40	99	97	0	28
Untreated	0	0	0	0	0	0	0
C.V. %		94	11	18	13	605	43
LSD 5%		9	10	17	13	NS	31
# OF REPS		4	4	4	4	4	4

Summary

The August 4 evaluations were variable because of lodging of the wheat in parts of the experiment. Discussion will be limited to the June 5 evaluation. Quinclorac control of foxtail was greatest when applied with Scoil, except when the treatment also contained BAS 635. Quinclorac applied with BAS 635 gave the greatest foxtail control with ND72 adjuvant. However Quad 7 adjuvant was most effective when quinclorac was with dicamba. Quinclorac did not control wild buckwheat except when in combination with dicamba or BAS 635.

Foxtail control in wheat, Fargo 1998. (Nalewaja) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 4- to 5-leaf wheat, 3- to 5-leaf foxtail, 2-leaf redroot pigweed, 1- to 4-leaf wild buckwheat, and 1 inch kochia on May 27 with 65 F, 55% RH, hazy sky, and 5- to 10 mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to an area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	June 8					July 16		
		Wht	Fota	Wibw	Rrpw	Wimu	Wht	Yeft	Wibu
	oz/A					%			
MON37500+Bay MKH6562+ND72	0.1+.1+1%	4	94	93	99	99	2	91	95
MON37500+Bay MKH6562+X-77	0.1+.1+.25%	4	92	83	96	99	0	91	90
Bay MKH6562+HOE1170	0.1+.4	0	94	27	97	99	0	98	40
Bay MKH6562+HOE1170+ND72	0.1+.4+1%	0	96	82	99	99	0	95	95
Bay MKH6562+Clod+Score	0.1+.4+1%	0	88	52	99	99	0	90	77
Bay MKH6562+Clod+ND72	0.1+.4+1%	0	87	71	99	99	2	93	95
MON37500+HOE1170+ND72	0.1+.4+1%	1	84	75	99	99	0	87	83
MON37500+ND72	0.2+1%	3	88	82	98	99	0	93	92
Bay MKH6562+ND72	0.1+1%	4	98	72	99	99	0	99	93
Bay MKH6562+ND72	0.2+1%	6	97	96	99	99	2	96	92
C.V. %		96	4	28	2	0	321	7	20
LSD 5%		4	7	35	NS	NS	NS	10	28
# OF REPS		3	3	3	3	3	3	3	3

Summary

MON 37500 and Bay MKH6562 completely controlled redroot pigweed and wild mustard, regardless of rate or herbicide combination. Wild buckwheat control exceeded 90% only when Bay MHK6562 was at 0.2 oz/A or Bay MHK6562 + MON 37500, both when with ND72. Green and yellow foxtail control was excellent with Bay MHK6562 alone, or in mixture with MON 37500 or HOE1170, but not in mixture with clodinafop. HOE1170 applied with MON 37500 did not increase foxtail control beyond that of MON 37500 alone. Clodinafop tended to be antagonistic to Bay MKH6562.

Kochia Resistance Management Study. (Nandula) 'Oxen ' hard red spring wheat was seeded April 23. Treatments were applied to 4- to 4.5-leaf wheat, 1- to 1.5-inch kochia, and 4-to 5-leaf wild mustard on May 27 with 72 F, 57% RH, clear sky, and 15 mph wind. Treatments were applied with a shielded bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Jun 13 Kochia	Jul 24 Kochia
	oz/A	%	%
2,4-Dioe	8	59	75
2,4-Dioe	12	61	83
Dicamba-dga	2	69	86
Dicamba-SGF	2	55	89
Dicamba-dga+MCPA	2+6	49	97
Dicamba-SGF+ND4	2+1%	71	94
Fluroypyr	2	71	97
Fluroxypyr	4	78	97
Fluroxypyr+ND4	2+1%	78	96
Brox&MCPA	8	97	99
Tribenuron(Express)+Act90	0.2+0.25%	85	95
BAS635+Act90	0.22+0.25%	51	64
Quinclorac+Quad 7	0.2+1%	0	0
F8426+Act90	0.26+0.25%	86	97
Untreated	0	0	0
C.V. %		13	5
LSD 5%		12	6
# OF REPS		4	4

Summary

Although injury to wheat was not evaluated, visual observation indicated that the dicamba treatments injured wheat up to 20% 4 wk after treatment. discussion of results is based on the July 24 evaluation only. Reduced control of kochia from 2,4-D indicates possible presence of resistant kochia plants. Dicamba-SGF was slightly more efficient than the dga salt in controlling kochia. Kochia control was increased by addition of MCPA to dicamba. Quinclorac was totally ineffective in controlling kochia. BAS 635 gave inadequate control of kochia. Fluroxypyr, tribenuron, bromoxynil+MCPA, and F8426 (carfentrazone) provided 95% or more control of kochia.

Resistant wild oat study. Ada MN, 1998. (Nandula) 'Russ' hard red spring wheat was seeded April 24. Treatments were applied to 4-leaf wheat and 3- to 4.5-leaf wild oat on May 21 with 67 F, 50% RH sunny sky, and 7-to 10-mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Jun 11 Wioa	Jul 22 Wioa
	oz/A	%	%
Tralkoxydim(Achieve)+TF8035+AMS[a]	2.9+.5%+24	23	54
Clodinafop(Discover)+Score[b]	0.8+1.0%	50	65
HOE1170(Puma)	1.7	80	95
Bay MKH6562+ND72	0.2+1.0%	59	97
Difp(Hoelon)+PO	32+0.12G	31	71
Difp(Hoelon)+PO	16+0.12G	25	55
Dife(Avenge)	16	75	81
V-10029+Kinetic	0.33+0.125%	31	0
Immb(Assert)+Act90	6.0+0.25%	15	50
Untreated	0	0	0
C.V. %		26	17
LSD 5%		15	14
# OF REPS		4	4

[a]Treatment was not fully dissolved causing obstruction of nozzles.
[b]Treatment sprayed without pressure.

Summary

None of the treatments seemed to injure wheat by the July 22 evaluation (data not shown). Due to cool temperatures at and after application, treatments did not influence wild oat control by June 11 evaluation. Discussion of results is limited to the July 22 evaluation. Poor wild oat control with tralkoxydim and clodinafop was, in part, due to improper application. V 10029 was totally ineffective in controlling wild oat. Inadequate control with diclofop and imazamethabenz was probably due to resistance. HOE 1170 and BAY MKH 6562 gave more than 90% control. Cool temperatures at and after treatment could have resulted in inadequate wild oat control from difenzoquat. Wild oat seed collected from the diclofop-, imazamethabenz-, difenzoquat-treated, and untreated plots is being tested in the greenhouse for resistance.

Small grain variety response to trifluralin, Prosper ND 1998. Peel, Michael. Released and experimental varieties of hard spring wheat, durum, and barley were evaluated for their response to spring-applied, PPI trifluralin granules. Treflan granules were applied, at 0.4 and 0.8 lb/A, and incorporated on April 24, a second incorporation was made on April 29. The trial, planted on April 30, was a split plot design, with treatments as the whole plot and varieties the sub plot. At the time of treflan application soil temperature was 52 F, wind was ~10 mph, and soil moisture was adequate for small grain stand establishment. At the 5 leaf stage Puma was applied across the entire trial to control annual grasses in the untreated plots.

Visual injury and plant stand were determined at the 1.5 to 2.0 leaf stage, head number was determined at the soft dough stage. Visual rating was on a scale of 0 to 10, 0=no injury, and 10-complete stand loss. Heading date, height and yield were also measured.

Soil temperature six days after planting fell to 51 F, 14 days later it was above 60 F where remained the rest of the season. Ten days following planting 1.14 inches of rain accumulated and five days later an additional 2.81 for a total of 3.95 within the first 15 days. Crop emergence had not occurred before the first rain.

Overall significant visual injury and stand reduction occurred at both levels of treatment for all crops, while lower head number and yield reduction occurred only for wheat and durum (Table 1). Overall stand reductions of 50 and 31% for wheat and durum resulted in no yield reduction at 0.4 lb/A, the recommended rate. Stand reductions of 90 and 73% in wheat and durum at the 0.8 lb/A were correlated with 33 and 12 % lower head numbers in these crops respectively. Furthermore, at the 0.8 lb/A treatment wheat and durum yields were reduced 20 and 6% respectively. Reduced stands and head number was observed in barley but did not result in a yield reduction. Favorable conditions during most of the growing season allowed component compensation to reduce the impact of trifuralin injury on yield. Under adverse environmental stress component compensation would likely be less and these low stands would result greater yield loss.

All durum and barley varieties showed visual injury and had lower stands at the 0.8 lb/A level and most at the 0.4 lb/A level (Table 2). Only one durum variety had fewer heads at the 0.8 lb/A. Neither level of treatment resulted in significantly lower yield of any barley or durum variety. Significant injury at both levels of treatment for the three traits, stand, head number and visual injury, was observed for most wheat varieties (Table 3). Of the 16 wheat varieties yield was significantly reduced in seven varieties, 2375, Gunner, Hamer, Lars, Butte86, Kulm and ND695.

Table 1. Mean response of HRSW, durum and barley to trifluralin at 0.4 & 0.8 lb ai/A, Prosper ND 1998.

	Treatment	Heading Date	Height	Stand	Head Number	Injury	Yield
	lb ai/A	June 1	(cm)	Plants/ft^2	Heads/ft^2	0-10	(bu/A)
			-----Hard Red Spring Wheat-----				
Trtmnt means	0	29	84	21	33	0.0	45.4
	0.4	29	87	10	30	2.9	46.6
	0.8	29	87	2	22	8.1	36.2
Treatment LSD (0.05)			3.1	2.1	3.1	0.4	3.9
R square			.87	.94	.67	.97	.69
			-----Durum-----				
Trtmnt means	0	31	94	14.2	26	0.0	38.8
	0.4	31	95	9.8	27	2.7	40.8
	0.8	31	95	3.7	23	6.5	36.5
Treatment LSD (0.05)			3.7	1.0	2.7	1.1	4.8
R square		.72	.81	.89	.49	.96	.59
			-----Barley-----				
Trtmnt means	0	27	80	17	23	0.0	45.1
	0.4	27	81	12	29	2.5	46.8
	0.8	27	79	5	34	6.1	45.3
Treatment LSD (0.05)			1.6	2.7	4.7	0.9	NS
R square		.85	.57	.89	.95	.68	.61

Table 2. Durum and barley variety response to PPI trifluralin at 0.4 and 0.8 lb ai/A, Prosper ND 1998.

Variety	Treatment (lb ai/A)	Heading Date (June 1)	Height (cm)	Stand (plants/ft^2)	Head Number (Heads/ft^2)	Injury (0-10)	Yield (bu/A)
			--Durum--				
Ben	0	31	94	15	26	0.0	39.2
	0.4	31	97	9	26	3.0	41.3
	0.8	31	98	4	19	6.5	39.3
Munich	0	30	85	16	26	0.0	40.3
	0.4	30	86	11	28	2.3	41.3
	0.8	30	84	4	25	6.0	33.2
Renville	0	30	101	14	27	0.0	36.6
	0.4	30	102	12	25	2.3	38.4
	0.8	30	104	4	23	6.3	40.5
D87240	0	31	100	12	22	0.0	38.5
	0.4	31	100	9	22	2.8	38.9
	0.8	31	97	5	24	6.3	33.8
D89135	0	32	90	15	27	0.0	35.5
	0.4	32	91	9	28	3.3	36.8
	0.8	32	90	3	19	7.8	31.9
D901313	0	31	93	13	28	0.0	42.7
	0.4	31	95	10	29	2.5	49.1
	0.8	31	95	4	26	6.5	40.2
Entry LSD (0.05)			7.3	3.9	8.9	1.5	8.9
			--Barley--				
Robust	0	28	80	19	26	0.0	42.2
	0.4	28	84	15	29	2.3	51.0
	0.8	28	80	7	34	5.5	47.6
Excel	0	28	80	16	19	0.0	41.7
	0.4	28	78	14	31	2.0	51.8
	0.8	28	77	5	37	6.5	44.1
Stander	0	27	80	17	21	0.0	49.8
	0.4	27	78	10	29	3.0	42.2
	0.8	27	76	4	33	7.0	41.6
Foster	0	26	77	15	26	0.0	47.2
	0.4	26	83	12	29	2.5	42.6
	0.8	26	82	5	31	6.0	47.6
MNBrite	0	27	83	21	24	0.0	44.4
	0.4	27	83	13	26	2.5	46.2
	0.8	27	78	6	37	5.3	45.6
Entry LSD (0.05)			6.1	4.9	10.7	1.5	NS

Table 3. HRSW variety response to PPI trifluralin at 0.4 and 0.8 lb ai/A, Prosper ND 1998.

Variety	Treatment lb ai/A	Heading Date From June 1	Height (cm)	Stand Plants/ft^2	Head Number Heads/ft^2	Injury 0-10	Yield (bu/A)
2375	0	28	80	21	29	0.0	51.8
	0.4	28	81	10	27	3.0	53.0
	0.8	28	80	3	19	8.5	39.4
AC_Barrie	0	30	88	28	32	0.0	40.8
	0.4	30	91	12	30	2.3	48.0
	0.8	30	89	4	23	7.5	37.3
AC_Cora	0	30	90	21	31	0.0	38.8
	0.4	30	96	11	26	2.8	41.0
	0.8	30	98	3	20	7.5	35.9
Gunner	0	30	88	20	34	0.0	40.3
	0.4	30	90	9	30	3.0	45.8
	0.8	30	89	2	23	8.8	28.5
Hamer	0	29	81	18	33	0.0	48.2
	0.4	29	81	9	34	3.5	49.7
	0.8	29	80	2	21	8.5	32.8
Lars	0	31	76	19	40	0.0	48.1
	0.4	31	74	10	34	3.3	48.8
	0.8	31	71	2	16	8.5	31.8
Butte86	0	29	81	20	37	0.0	42.8
	0.4	29	85	9	30	2.5	49.4
	0.8	29	86	3	22	8.0	34.5
Kulm	0	26	85	21	32	0.0	52.1
	0.4	26	92	10	30	3.3	49.0
	0.8	26	92	2	18	8.8	35.2
Keene	0	28	89	22	33	0.0	45.5
	0.4	28	96	13	30	3.3	45.5
	0.8	28	96	3	23	7.8	38.2
Oxen	0	29	75	19	36	0.0	48.0
	0.4	29	77	11	32	2.0	48.0
	0.8	29	79	2	24	7.8	42.2
Russ	0	29	80	19	38	0.0	45.3
	0.4	29	83	9	28	3.5	44.8
	0.8	29	82	2	22	8.3	36.1
Trenton	0	29	91	25	30	0.0	45.6
	0.4	29	95	11	29	3.0	45.5
	0.8	29	98	2	20	8.3	37.0
Verde	0	30	81	21	34	0.0	48.2
	0.4	30	81	11	37	2.5	47.6
	0.8	30	81	2	24	7.8	39.3
Argent	0	29	83	17	30	0.0	37.8
	0.4	29	88	11	28	3.0	39.9
	0.8	29	87	2	25	8.0	35.4
ND_694	0	29	89	23	32	0.0	46.7
	0.4	29	94	11	32	2.5	47.7
	0.8	29	96	3	27	7.8	39.1
ND_695	0	29	83	19	30	0.0	46.4
	0.4	29	86	11	28	2.8	42.4
	0.8	29	83	2	24	8.5	36.3
Entry LSD (0.05)			5.0 28	4.5	9.8	1.4	9.9

Response of durum and spring wheat cultivars to Avenge, Prosper ND, 1998.
Peel, Michael D. Richard K. Zollinger. Released and experimental varieties of hard red spring wheat and durum were evaluated for their response to Avenge and Avenge plus Assert. The trial, planted on April 30, was a split plot design. Herbicide treatment was the whole plot and varieties sub plots. All plots were rated for visual injury (a rating of 0 to 100 where 0 = no injury), percent stunted plants and head number. Heading date, height and yield were also recorded.

Treatments were applied on May 26 when the crop was in the 4 to 5 leaf stage. Treatments included avenge 4 pt/A, avenge 6 pt/A and avenge 2 pt/A + assert 0.75 pt/A. Average wind speed was 7 mph, and air temp was 75° F. The ten days following the treatment were typified by daily high temperatures of 60° to 80° F and daily low temperatures of 37° to 54° F. Four days following the treatment 1.22 inches of rain fall were received. Favorable growing conditions prior to the treatment resulted in plant stands of 1.1 million plants/A or greater. At the time the treatments were applied all varieties were healthy.

Five to seven days following the treatment visible injury to some varieties was easily detected. Injury was typified by stunted plants and leaf burn, most injured varieties produced new leaf tissue, severely stunted varieties did not recover.

On average all treatments resulted in significant injury which included stunted plants, lower head number and lower yield of hard red spring wheat (Table 1). The average yield reduction of all wheat varieties was 15% at 4 pt/A avenge, 25% at 6 pt/A avenge and 10% at 2 pt/A avenge plus 0.75 pt/A assert. Durum was similarly impacted although the only significant yield reduction was 39% at 6 pt/A avenge (Table 2).

On an individual variety basis 13 of the 25 wheat varieties showed significant yield reductions (Table 1). In 1997 many of the same wheat varieties were tested in the same manner at the same location, but injury was virtually non-existent, indicating injury from avenge or avenge plus assert is dependent on environmental conditions. Based on visual injury, stunted plants and yield reduction, severely injured wheat varieties include 2375, Hamer, Trenton, Verde, Argent, Ingot, Gunner, and Grandin. The greatest yield reduction was 63% (Verde).

Of the six durum varieties tested injury to Renville, Munich, Belzer and Mountrail resulted in reduced yield compared with checks (Table 2). Injury was the greatest on Belzer, stunting made it easy distinguish from the other varieties in the trial.

Table 1. Response of hard red spring wheat to Avenge and Avenge plus Assert, Prosper, ND 1998.

Variety	Trtmnt[1]	Heading Date	Height	Visual injury 1998	Visual injury 1997	Stunted Plants	Head Number	Yield 1998	Yield 1997
		(June 1)	(cm)	(0-100)	(0-100)	(%)	(heads/ft^2)	(bu/A)	(bu/A)
Keene	1	29	90	0	0	0	36	47.9	40.5
	2	30	93	17	0	7	33	54.4	34.7
	3	31	87	15	0	30	30	46.2	48.8
	4	30	90	9	0	8	37	47.3	41.5
Russ	1	28	80	0	0	0	31	46.1	31.3
	2	29	82	20	0	35	32	42.1	35.0
	3	33	80	28	0	57	30	38.0	39.0
	4	29	81	12	10	27	34	47.6	37.1
Oxen	1	28	76	0	0	0	36	54.9	33.6
	2	28	75	10	0	8	40	49.2	36.2
	3	28	76	8	3	7	35	46.8	39.7
	4	29	74	5	3	5	38	49.4	40.9
2375	1	27	80	0	0	0	33	44.8	35.4
	2	30	78	32	0	65	29	46.0	41.9
	3	29	73	23	0	28	23	34.1	41.9
	4	30	77	15	0	20	31	54.2	43.6
Marshall	1	32	80	0	0	0	39	48.5	28.8
	2	31	77	18	10	7	37	41.2	30.5
	3	32	78	20	3	2	40	40.0	34.0
	4	31	79	7	13	3	40	38.6	32.5
Forge	1	25	82	0	0	0	41	58.2	37.7
	2	26	81	9	0	3	38	54.7	38.3
	3	28	82	15	0	5	40	42.4	46.9
	4	25	78	5	7	3	37	44.2	33.6
Sharp	1	27	83	0	--	0	37	52.8	--
	2	28	82	14	--	10	33	47.6	--
	3	29	77	12	--	9	26	41.4	--
	4	28	78	7	--	15	39	50.0	--
Sharpshooter	1	27	81	0	0	0	33	46.9	45.8
	2	27	80	15	7	7	36	37.8	42.8
	3	29	79	17	0	25	34	37.7	43.5
	4	29	79	5	0	8	34	38.0	35.3
Kulm	1	26	88	0	0	0	36	55.5	42.7
	2	28	88	9	0	12	29	45.0	42.4
	3	28	89	15	3	13	37	52.9	44.0
	4	28	86	7	3	15	31	54.7	38.3
Hamer	1	29	80	0	0	0	37	55.9	34.9
	2	30	78	19	0	17	36	43.5	35.3
	3	30	73	22	13	18	30	33.9	33.0
	4	31	77	14	10	13	40	50.3	37.1
Lars	1	29	74	0	0	0	46	45.2	36.8
	2	30	72	15	3	18	42	47.3	29.4
	3	32	73	23	0	10	39	42.0	30.9
	4	30	74	9	10	2	38	44.1	39.5
Trenton	1	28	91	0	0	0	31	47.1	40.8
	2	32	94	28	0	67	31	37.9	46.0
	3	36	92	37	0	96	22	28.8	45.8
	4	36	94	20	7	87	32	46.6	42.0
Verde	1	29	79	0	0	0	42	56.2	42.0
	2	37	77	37	10	66	28	30.6	34.9
	3	42	72	50	7	98	18	20.8	39.2
	4	36	77	30	18	85	31	37.2	30.3
Argent	1	28	82	0	0	0	30	47.7	33.6
	2	32	85	22	3	58	25	36.0	33.6
	3	34	83	28	0	68	20	31.1	36.9
	4	30	86	17	5	50	34	43.6	31.5

Table 1. Continued.

Variety	Trtmnt[1]	Heading Date	Height	Visual injury 1998	Visual injury 1997	Stunted Plants	Head Number	Yield 1998	Yield 1997
		(June 1)	(cm)	(0-10)	(0-10)	(%)	(heads/ft^2)	(bu/A)	(bu/A)
ND694	1	27	88	0	0	0	34	59.6	42.0
	2	29	88	19	0	42	33	45.8	40.5
	3	29	88	22	0	33	27	38.3	43.8
	4	28	91	11	0	18	38	54.4	40.6
ND695	1	28	81	0	0	0	30	51.1	32.4
	2	36	74	31	0	66	22	24.0	37.5
	3	40	76	45	0	96	9	19.7	39.4
	4	38	79	27	7	87	28	30.1	36.6
Ingot	1	24	85	0	0	0	33	58.8	38.2
	2	25	85	11	0	27	27	54.5	38.8
	3	26	86	13	3	30	33	47.1	43.1
	4	26	88	12	0	12	34	51.2	35.4
MN93413	1	31	79	0	0	0	39	51.3	30.5
	2	32	79	20	7	10	30	51.0	32.4
	3	32	78	23	0	8	34	44.1	39.2
	4	31	80	10	3	7	32	51.7	27.1
MN92043	1	31	78	0	0	0	34	44.5	36.5
	2	31	81	27	13	15	33	33.8	34.7
	3	32	75	37	0	22	21	29.8	35.7
	4	32	82	13	10	9	30	40.0	38.8
Gunner	1	30	82	0	0	0	38	48.1	32.0
	2	36	88	42	20	68	39	38.2	32.0
	3	40	77	60	0	96	28	25.1	34.6
	4	35	84	30	20	80	37	36.3	31.5
Bacup	1	25	84	0	--	0	31	48.9	--
	2	27	82	14	--	10	37	43.5	--
	3	27	77	18	--	22	27	33.1	--
	4	27	79	7	--	10	31	46.8	--
Grandin	1	28	80	0	--	0	35	47.9	--
	2	31	83	27	--	53	31	38.6	--
	3	30	82	23	--	67	19	27.7	--
	4	30	84	14	--	37	23	32.7	--
AC Majestic	1	30	84	0	--	0	39	45.3	--
	2	32	83	8	--	13	39	40.2	--
	3	32	82	10	--	8	41	42.0	--
	4	30	86	4	--	7	38	41.3	--
AC Barrie	1	30	86	0	--	0	34	38.2	--
	2	31	83	13	--	8	37	38.2	--
	3	30	83	7	--	3	31	45.1	--
	4	31	84	7	--	7	32	43.9	--
HJ98	1	29	81	0	--	0	35	46.7	--
	2	31	77	15	--	18	35	44.1	--
	3	31	76	19	--	17	36	41.1	--
	4	29	75	8	--	12	37	50.1	--
Entry LSD (0.05)		4	6	15	9	29	10	11.2	9.0
Trtmnt means	1	28	82	0	0	0	36	39.3	37.3
	2	30	82	20	3.3	28	33	33.5	37.2
	3	32	82	24	1.5	35	29	29.3	39.4
	4	30	80	12	5.8	25	34	35.4	36.3
Treatment LSD (0.05)		2	4	12	--	21	6	6.6	--
R square		0.86	0.85	0.90	--	0.86	0.71	0.72	--

1 Treatments: 1=unteated check; 2=avenge 4 pt/A; 3=avenge 6 pt/A; 4=avenge 2 pt/A + assert 0.75 pt/A.

Table 2. Response of durum cultivars to avenge and avenge plus assert, Prosper, ND 1998.

Variety	Trtmnt[1]	Heading Date (June 1)	Height (cm)	Visual Injury (0-100)	Stunted Plants (%)	Head Number (heads/ft^2)	Yield (bu/A)
Ben	1	30	94	0	0	29	36.5
	2	31	93	8	12	27	42.5
	3	32	90	8	13	24	30.1
	4	31	93	3	4	25	38.1
Renville	1	30	97	0	0	29	38.7
	2	31	98	13	25	22	32.6
	3	31	97	13	28	23	26.1
	4	31	97	5	9	24	35.0
Munich	1	29	81	0	0	37	35.8
	2	29	82	8	7	29	30.7
	3	29	81	7	8	28	18.6
	4	30	80	3	6	31	35.3
Belzer	1	31	94	0	0	27	40.0
	2	42	76	27	69	13	22.6
	3	43	74	30	96	7	10.8
	4	40	85	13	87	16	20.7
Maier	1	30	87	0	0	24	31.2
	2	31	87	25	18	22	30.4
	3	31	87	5	3	21	24.6
	4	31	88	3	6	31	27.6
Mountrail	1	31	91	0	0	28	32.4
	2	33	88	22	58	21	28.5
	3	33	89	27	72	16	20.1
	4	31	95	10	10	31	35.0
Entry LSD (0.05)		3	7	18	52	10	10.1
	1	30	91	0	0	29	28.2
	2	33	87	17	32	22	24.6
	3	33	86	15	37	20	17.1
Trtmnt means	1	32	87	6	20	26	25.1
Treatment LSD (0.05)		2	4	15	32	6	7.4
R square		0.86	0.85	0.82	0.92	0.78	0.77

1 Treatments: 1=unteated check; 2=avenge 4 pt/A; 3=avenge 6 pt/A; 4=avenge 2 pt/A + assert 0.75 pt/A.

Weed Response to Harmony Extra Rates and Adjuvants, Carrington, 1998. (Harbour, Gehlhar, and Nalewaja).

'Verde' hard red spring wheat was planted on May 5 at 1.2 million PLS on last year's camelina ground. Activator 90 (Act90) and ND72 adjuvants were added to spray treatments at 0.25% (v/v). Treatments were applied to 5.5 leaf wheat, 3- to 6-inch wild mustard, 2- to 4-inch volunteer camelina, 1- to 6-inch common lambsquarters and 6- to 8-inch kochia on June 12 at 3:15 pm with 72F, 52% RH, partly cloudy sky, and 10- to 20-mph wind. Treatments were applied using a bicycle-wheel-plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles to a 6.67 ft wide area of 10- by 30-ft plots. The experiment was a randomized complete block design with four replicates.

			6-29					8-6		8-14
Treatment	Adjuvant	Rate	Wheat	Wimu	Cmla□	Colq	KOCZ	Colq	KOCZ	Yield
		oz ai/A	% inj	% control						bu/A
Thif&Trib	Act90	0.2	2	98	94	86	68	94	62	35
Thif&Trib	ND72	0.2	0	94	93	91	68	93	65	31
Thif&Trib	Act90	0.1	0	96	96	88	73	90	74	36
Thif&Trib	ND72	0.1	0	94	94	89	76	76	59	33
Thif&Trib	Act90	0.05	0	88	97	78	56	68	69	37
Thif&Trib	ND72	0.05	0	92	96	86	50	82	97	35
Thif&Trib	Act90	0.025	0	83	92	78	66	84	62	34
Thif&Trib	ND72	0.025	0	89	97	88	62	76	55	34
Thif&Trib+2,4-De	–	0.2+4	3	95	97	93	81	95	77	34
Thif&Trib+dica	–	0.2+2	1	97	97	90	89	97	89	24
Untreated			0	0	0	0	0	0	0	27
LSD (0.05)			NS	8	7	9	20	14	31	5

□ Volunteer camelina

Herbicide treatments did not injure wheat to contribute to yield reduction when evaluated 17 DAT. All treatments except Thif&Trib at 0.025 oz plus Activator 90 provided greater than 85% wild mustard control. All treatments controlled volunteer camelina at greater than 90%. Herbicide treatments significantly increased weed control compared to the untreated check. Thif&Trib plus 2,4-De and Thif&Trib plus dicamba provided excellent common lambsquarters control and good kochia control. Thif&Trib-sprayed kochia were slightly stunted compared to the untreated check and likely due to unconfirmed ALS resistance. 2,4-De or dicamba tankmixed with Thif&Trib generally improved kochia control, and demonstrated the need for tankmixing herbicides to better manage ALS-herbicide resistant weeds. At 55 DAT, common lambsquarters control generally decreased as Thif&Trib rates decreased. Kochia control was erratic, ranging from poor to good with any Thif&Trib rate plus adjuvant, and likely due to herbicide resistance. Thif&Trib plus dicamba tended to provide the greatest kochia control. All Thif&Trib plus adjuvant treated-wheat yields were similar, and greater than the untreated check (27 bu/A) or Thif&Trib plus dicamba (24 bu/A). Poor Thif&Trib plus dicamba-treated wheat yields were partially attributed to the very late application stage (5.5 leaf) compared to the recommended 4-leaf stage.

Broadleaf weed control in wheat, Carrington, 1998. (Harbour and Gehlhar) 'Verde' wheat was planted on May 5 at 1.2 million PLS on last year's camelina ground. Treatments were applied to 5.5-leaf wheat, 6- to 8-inch kochia, 1- to 6-inch common lambsquaters, 2- to 4-inch volunteer camelina, and 3- to 6-inch wild mustard on June 12 with 72 F, 46% RH, partly cloudy sky, and 10- to 18-mph wind. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10- by 30-ft plots. The experiment was a randomized complete block design with four replicates.

		6-29					8-6		8-14
Treatment	Rate	Wht	Cmla[†]	Wimu	KOCZ	Colq	KOCZ	Colq	Yield
	oz ai/A	% inj	%				%		bu/A
Starane	1.5	0	92	95	86	61	96	21	36
Starane	4	0	97	97	85	85	95	38	34
Starane + 2,4-D amine	1.5 + 6	0	98	98	93	95	97	97	36
Bronate	12	0	96	97	63	87	63	90	32
2,4-D amine	6	0	96	95	74	86	19	96	37
MCPA amine	6	0.5	98	98	65	88	22	96	36
Harmony Extra	0.23	0	94	97	73	81	36	48	36
Express	0.13	0	94	95	66	66	63	21	35
Distinct	1.3	0	95	94	46	53	13	40	17
Clarity	1.4	0	95	93	55	62	75	94	18
BAS 635	0.41	0	95	94	58	64	69	53	34
Untreated		0	0	0	0	0	0	0	30
LSD (0.05)		NS	6	4	25	22	27	26	4

[†]Cmla = Volunteer camelina

Wheat was not injured by herbicides when evaluated at 17 DAT. All treatments provided greater than 90% control of volunteer camelina and wild mustard. Starane + 2,4-D amine controlled kochia better than Bronate, MCPA amine, Express, Distinct, Clarity, and BAS 635 at 17 DAT. Common lambsquaters was controlled better by Starane + 2,4-D amine than by the low rate of Starane, Express, Distinct, Clarity, and BAS 635 at 17 DAT. At 55 DAT, Starane, at either rate, and Starane + 2,4-D amine provided ≥95% kochia control, and Starane + 2,4-D amine, Bronate, 2,4-D amine, MCPA amine, and Clarity gave >90% control of common lambsquarters. Poor kochia control by ALS herbicides may be partially due to unconfirmed ALS-herbicide resistant plants. Wheat yields were greater when treated with 2,4-D amine than Starane (4 oz/A), Bronate, Distinct, Clarity, BAS 635, and the untreated check. The untreated check yielded more than Distinct- or Clarity-treated wheat, and was likely due to later-developed wheat injury from the late application (5.5- to 6-leaf) and poor weed control.

Green foxtail control with clodinafop in HRSW. (Brian Jenks, Minot) Clodinafop was evaluated for green foxtail control compared to other products. Amidon hard red spring wheat was seeded May 5. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 13.

Clodinafop and fenoxaprop provided good to excellent green foxtail control. Some antagonism was observed (10% lower weed control) in the 3-way mix of clodinafop, thifensulfuron + tribenuron, and dicamba. Little or no antagonism was observed when clodinafop was tankmixed with dicamba alone, thifensulfuron + tribenuron alone, or bromoxynil + MCPA ester alone. Tralkoxydim was inadvertently mixed and applied at one-half the normal use rate.

Application date	June 6
Application timing	POST
Temperature (°F)	
Air	56
Soil	56
Relative humidity (%)	43
Wheat stage	4 to 5-leaf
Green foxtail	1-2" tall / 125 per sq ft
Common lambsquarters	< 1" tall / 2 per sq ft

Table. Green foxtail control with clodinafop in HRSW.

Treatment	Rate	July 3		August 7		Aug 13
		Grft	Colq	Grft	Colq	Yield
	lb/A	------------------	% Control	------------------		bu/A
untreated		0	0	0	0	23
clodinafop + Score[a]	0.063 + 1%	95	0	97	0	25
clodinafop + bromoxynil-MCPA ester + Score[b]	0.063 + 0.5 + 1%	88	100	92	100	30
clodinafop + dicamba + Score	0.063 + 0.094 + 1%	95	100	94	100	32
clodinafop + thifensulfuron-tribenuron + Score[c]	0.063 + 0.014 + 1%	90	100	94	100	31
clodinafop + thifensulfuron-tribenuron + dicamba + Score	0.063 + 0.014 + 0.063 + 1%	86	100	83	100	31
fenoxaprop	0.05	92	0	92	0	30
fenoxaprop + thifensulfuron-tribenuron	0.05 + 0.014	96	100	95	100	31
tralkoxydim + Supercharge[d]	0.09 + 0.5%	85	0	73	0	26
tralkoxydim + bromoxynil-MCPA ester + Supercharge[e]	0.09 + 0.5 + 0.5%	72	100	63	100	33
CV		13	0	13	0	10
LSD (0.05)		17	0	17	0	5

[a] Score = spray additive by Novartis
[b] bromoxynil-MCPA ester applied as commercial premix
[c] thifensulfuron-tribenuron applied as commercial premix
[d] tralkoxydim inadvertently mixed at ½ rate
[e] Supercharge = spray additive by Zeneca

Wild oat control with clodinafop in HRSW. (Brian Jenks, Minot) Clodinafop was evaluated for wild oat control compared to other products. Amidon hard red spring wheat was seeded April 23. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 10.

Soil conditions were very dry from mid-April through mid-June. We received only one inch of rainfall from planting to the first herbicide application and one additional inch through the first month after the herbicide application. Clodinafop alone or in combination with thifensulfuron-tribenuron provided good to excellent wild oat control. Wild oat control was reduced 10-20% when clodinafop was tankmixed with dicamba in a two-way or three-way mix. Wild oat control with clodinafop alone was 10-20% better than fenoxaprop or tralkoxydim applied alone.

Application date	May 19
Application timing	POST
Temperature (°F)	
Air	69
Soil	70
Relative humidity (%)	29
Soil moisture	dry
Wheat stage	4-leaf
Wild oat	3-leaf / 19 per sq ft
Common lambsquarters	< 1" tall / 2 per sq ft

Table. Wild Oat control with clodinafop in HRSW.

Treatment Name	Rate	June 9 Wioa	June 9 Colq	July 24 Wioa	July 24 Colq	Aug 10 Yield
	lb/A	--% Control--				bu/A
untreated		0	0	0	0	19
clodinafop + Score[a]	0.05 + 0.8%	87	0	89	0	28
clodinafop + dicamba + Score	0.05 + 0.094 + 0.8%	82	91	66	99	26
clodinafop + thifensulfuron-tribenuron + Score[b]	0.05 + 0.014 + 0.8%	88	91	93	97	34
clodinafop + thifensulfuron-tribenuron + dicamba + Score	0.05 + 0.014 + 0.063 + 0.8%	78	98	78	99	26
fenoxaprop	0.08	73	0	77	0	24
fenoxaprop + thifensulfuron-tribenuron	0.08 + 0.014	73	98	70	100	22
tralkoxydim + Supercharge[c]	0.18 + 0.5%	70	0	55	0	17
tralkoxydim + bromoxynil-MCPA ester + Supercharge[d]	0.18 + 0.5 + 0.5%	75	93	66	93	20
CV		9	10	10	5	22
LSD (0.05)		11	8	16	6	9

[a] Score = spray additive by Novartis
[b] thifensulfuron-tribenuron applied as commercial premix
[c] Supercharge = spray additive by Zeneca
[d] bromoxynil-MCPA ester applied as commercial premix

Tralkoxydim tank mix compatibility and efficacy. (Brian Jenks, Minot) Tralkoxydim was evaluated for wild oat control compared to other products. Amidon hard red spring wheat was seeded April 23. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 11.

Soil conditions were very dry from mid-April through mid-June. We received only one inch of rainfall from planting to the first herbicide application and one additional inch through the first month after the herbicide application. Wild oat control with tralkoxydim was better (20-30%) when tankmixed with certain broadleaf herbicides compared to tralkoxydim applied alone. Severe antagonism was observed when tralkoxydim was tankmixed with prosulfuron. Weed control was generally as good or better when AMS was included in the tankmix.

Application date	May 19
Temperature (°F)	
Air	71
Soil	68
Soil moisture	dry
Relative humidity (%)	25
Wheat stage	3-leaf
Wild oat size / density	3-leaf / 17 per sq ft
Common lambsquarters size / density	<1" tall / 20 per sq ft

Table. Tralkoxydim tank mix compatibility and efficacy

Treatment	Rate	June 9		July 24		Aug 11
		Wioa	Colq	Wioa	Colq	Yield
	lb/A	-------------% Control			------------	bu/A
tralkoxydim + TF8035[a]	0.18 + 0.5%	63	0	53	0	16
tralkoxydim + TF8035 + AMS	0.18 + 0.5% + 1.5	75	0	60	0	18
tralkoxydim + TF8035 + bromoxynil-MCPA ester[b]	0.18 + 0.5% + 0.75	85	95	83	100	30
tralkoxydim + TF8035 + bromoxynil-MCPA ester + AMS	0.18 + 0.5% + 0.75 + 1.5	85	95	91	97	35
tralkoxydim + TF8035 + fluroxypyr + 2,4-D ester	0.18 + 0.5% + 0.167 + 0.5	87	95	88	99	32
tralkoxydim + TF8035 + fluroxypyr + 2,4-D ester + AMS	0.18 + 0.5% + 0.167 + 0.5 + 1.5	85	95	82	100	26
tralkoxydim + TF8035 + 2,4-D ester	0.18 + 0.5% + 0.5	83	95	68	100	18
tralkoxydim + TF8035 + 2,4-D ester + AMS	0.18 + 0.5% + 0.5 + 1.5	88	94	88	99	34
tralkoxydim + TF8035 + clopyralid-MCPA ester[c]	0.18 + 0.5% + 0.346	85	94	84	100	29
tralkoxydim + TF8035 + clopyralid-MCPA ester + AMS	0.18 + 0.5% + 0.346 + 1.5	90	93	80	99	25
tralkoxydim + TF8035 + prosulfuron	0.18 + 0.5% + 0.018	77	82	50	100	22
tralkoxydim + TF8035 + prosulfuron + AMS	0.18 + 0.5% + 0.018 + 1.5	48	77	38	90	15
tralkoxydim + TF8035 + MCPA ester	0.18 + 0.5% + 0.5	87	93	77	99	23
tralkoxydim + TF8035 + MCPA ester + AMS	0.18 + 0.5% + 0.25 + 1.5	89	85	75	100	24
Untreated		0	0	0	0	11
CV		13	8	18	5	32
LSD (0.05)		16	10	26	8	13

[a] TF8035 = Spray additive by Zeneca
[b] bromoxynil-MCPA ester applied as commercial premix
[c] clopyralid-MCPA ester applied as commercial premix

Evaluation of fluroxypyr and other broadleaf herbicides for ALS-resistant kochia control in HRSW. (Brian Jenks and Kent McKay, Minot). A series of herbicide combinations were evaluated for broadleaf weed control, but with particular emphasis on possible low populations of ALS-resistant kochia. Amidon hard red spring wheat was seeded May 5 in Minot, ND. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Weeds present included kochia, Russian thistle, common lambsquarters, and prostrate pigweed. Wheat was harvested with a small plot combine on August 24.

The 1X or 2X rate of tribenuron did not control kochia more than 78%. Visual evaluations of treated kochia plants indicate that the field has about 20% ALS-resistant kochia present. When we combined tribenuron with bromoxynil + MCPA ester, fluroxypyr, or 2,4-D + dicamba, kochia control was greater than 90%. Tribenuron did provide good control of the other weeds present. Kochia control was excellent with any treatment that included fluroxypyr or bromoxynil + MCPA ester. Unfortunately, fluroxypyr by itself at 0.5 pt/A or 0.67 pt/A controlled only kochia and did not control the other broadleaf weeds. Whereas, bromoxynil + MCPA ester provided good control of all weeds present. Combinations that included propanil or thifensulfuron + tribenuron did not control kochia unless bromoxynil was present in the mixture. General broadleaf control with 2,4-D ester was better than with MCPA ester.

Application date	June 12
Air / Soil Temperature (°F)	72 / 62
Relative humidity (%)	41
Wheat stage	5-leaf
Weed size / density	
Kochia	5" / 32 per sq ft
Russian thistle	2" / 3 per sq ft
Common lambsquarters	2" / 3 per sq ft
Prostrate pigweed	2" / 3 per sq ft

Table. Evaluation of fluroxypyr and other broadleaf herbicides for ALS-resistant kochia control in HRSW.

Treatment	Rate	July 3				August 10				Aug 24
		Kocz	Ruth	Colq	Prpw	Kocz	Ruth	Colq	Prpw	Yield
	lb/A	% Control								bu/A
untreated		0	0	0	0	0	0	0	0	37
tribenuron + NIS	0.0078 + 0.25%	80	100	99	85	78	100	100	92	38
tribenuron + NIS	0.016 + 0.25%	77	100	100	87	73	100	100	96	41
tribenuron + 2,4-D ester + dicamba + NIS	0.0078 + 0.25 + 0.125 + 0.125%	92	99	99	90	95	100	100	98	44
tribenuron + bromoxynil-MCPA ester[a] + NIS	0.0078 + 0.375 + 0.25%	93	97	99	92	92	100	100	95	42
bromoxynil-MCPA ester	0.5	96	98	98	92	97	100	100	95	33
fluroxypyr + bromoxynil-MCPA ester	0.083 + 0.375	99	98	100	91	100	98	100	97	44
fluroxypyr	0.0625	93	20	20	17	98	33	23	30	39
fluroxypyr	0.083	95	37	23	17	99	35	23	33	42
fluroxypyr + 2,4-D ester	0.083 + 0.25	94	84	92	90	100	99	100	92	42
fluroxypyr + MCPA ester	0.083 + 0.25	94	53	60	50	96	82	91	85	38
tribenuron + fluroxypyr + 2,4-D ester + NIS	0.0078 + 0.083 + 0.25 + 0.25%	96	95	97	87	98	98	100	95	42
fluroxypyr + dicamba + 2,4-D ester + NIS	0.083 + 0.063 + 0.25 + 0.25%	92	84	90	82	97	96	96	94	42
tribenuron + fluroxypyr + 2,4-D ester + NIS	0.0078 + 0.0625 + 0.25 + 0.25%	97	98	99	91	99	100	100	97	42
fluroxypyr + dicamba + 2,4-D ester + NIS	0.0625 + 0.063 + 0.25 + 0.25%	90	86	93	83	100	100	100	96	39
propanil + MCPA ester + COC	1.4 + 0.25 + 1%	28	17	72	71	41	52	100	77	31
propanil + MCPA ester + COC + bromoxynil	1.4 + 0.25 + 1% + 0.187	96	96	100	93	95	97	100	96	35
propanil + thifensulfuron-tribenuron[b] + NIS	1.4 + 0.011 + 0.25%	65	96	98	95	59	98	100	100	25
dicamba	0.125	82	75	72	73	92	100	100	92	40
CV		6	16	23	23	7	16	13	13	16
LSD (0.05)		8	20	30	28	9	23	18	20	10

[a] bromoxynil-MCPA ester was applied as a commercial premix
[b] thifensulfuron-tribenuron was applied as a commercial premix
COC = Class 17% Concentrate by Cenex
NIS = Class Preference by Cenex

Foxtail control with Achieve herbicide in wheat, Carrington 1998. (Endres, Harbour, and Zwinger) The experiment was conducted to evaluate weed control and wheat response with Achieve herbicide. Irrigated 'Grandin' HRS wheat was planted in 6-inch rows at the rate of 1.25 million PLS/A on May 7. Treatments were applied June 1 with 60 F, 65% RH, clear sky, and 15-mph wind to 4.5- to 5.5-leaf wheat and 3.5- to 5-leaf green and yellow foxtail. Treatments were applied to a 6.67 ft wide area the length of 10 by 25 ft plots with a hooded bicycle-wheel-type plot sprayer delivering 10.4 gal/A at 40 psi through 8001 flat fan nozzles. Wheat was machine harvested on August 17. Bronate was applied at 0.75 lb/ac on June 6 for broadleaf weed control to treatments previously treated with Achieve without a broadleaf herbicide tank mixture. The experiment was a randomized complete block design with four replications.

Treatment[a]	Rate	Foxtail control 6/12	Foxtail control 7/28	Wheat Injury 6/12	Wheat Injury 7/28	Wheat Grain yield	Wheat Test weight
	lb/A	%	%	%	%	bu/A	lb/bu
Achieve + TF8035	0.18	79	72	9	0	28.2	53.7
Achieve + TF8035 + AS	0.18	80	79	8	0	27.5	53.6
Achieve + TF8035 + Bronate	0.18 + 0.75	88	76	9	0	30.6	54.1
Achieve + TF8035 + Bronate + AS	0.18 + 0.75	91	81	26	0	30.8	55.4
Achieve + TF8035 + Starane + 2,4-De	0.18 + 0.125 + 0.5	63	79	3	0	28.0	54.0
Achieve + TF8035 + Starane + 2,4-De + AS	0.18 + 0.125 + 0.5	72	94	12	0	30.0	54.8
Achieve + TF8035 + 2,4-De	0.18 + 0.5	69	76	4	0	28.7	54.1
Achieve + TF8035 + 2,4-De + AS	0.18 + 0.5	69	93	12	0	28.5	54.4
Achieve + TF8035 + Curtail M	0.18 + 0.35	56	74	1	0	31.8	55.7
Achieve + TF8035 + Curtail M + AS	0.18 + 0.35	71	92	8	0	32.5	56.0
Untreated		0	0	0	0	29.3	54.4
LSD (0.05)		9	10	4	NS	NS	1.1
C.V. %		9	10	35	-	8	1

[a]TF8035 applied at 0.5% v/v. AS=Ammonium sulfate applied as Bronc (Wilbur-Ellis)at 1.5 lb ai/A.

Foxtail density was primarily yellow foxtail. Foxtail control ranged from 72 to 94% with all Achieve treatments when visually evaluated near wheat maturity. Bronate tank-mixed with Achieve did not antagonize foxtail control. However, Starane + 2,4-De, 2,4-De, and Curtail M tank mixtures generally reduced early-season foxtail control. The addition of ammonium sulfate generally improved foxtail control with Achieve tank mixtures of Starane + 2,4-De, 2,4-De, and Curtail M. Wheat injury, including stand and biomass reduction, ranged from 1 to 26% when evaluated 12 days after herbicide application. The greatest injury was with Achieve + TF8035 + Bronate + AS. Injury was not detected near crop maturity. No differences in grain yield were detected among treatments.

Small grain cultivar response to trifluralin, Carrington 1998. (Endres and Zwinger) The trial was conducted to evaluate response of recently-released hard red spring (HRS) wheat, durum, and barley cultivars to spring-applied, PPI trifluralin granules. The trial was established on a conventionally-tilled Heimdal-Emrick loam soil with 3.4% organic matter and pH of 6.3. Plot size was 5.25 by 16 ft. Treflan granules were applied at 0.4 and 0.8 lb/A on April 28 with a Gandy air-flow applicator with 69 F, 23% RH, 65% sunny sky, and 9 mph wind. Granules were incorporated on April 28 and May 6 with a Melroe culti-harrow set to till at 3- to 4-inch depth at a speed of 5- to 6-mph. The small grain was planted in 7-inch rows at the rate of 1.2 million PLS/A and a depth of 1.5 inches on May 13. Bronate at 1 pt/A + Puma at 0.67 pt/A were applied across the trial on June 6 for grass and broadleaf weed control. Visual evaluation of plant injury and plant counts were taken on May 26 with the crop in the 1.5- to 2-leaf stage. Head density was measured on July 23 and plant height on August 7. The trial was machine harvested on August 11. The experiment was a randomized complete block design with a split-plot arrangement and four replicates per treatment.

Across trifluralin rates, Butte 86 and Verde HRS wheat had the highest plant injury ratings, ranging from 7 to 9%. Also, Butte 86, Keene, Kulm, and Verde HRS; all durum varieties; and Stander barley had the lowest plant densities. Russ had the highest yield among HRS varieties, Ben and Renville were the highest yielding durum varieties, and Robust and Stander were the highest yielding barley varieties when averaged across trifluralin rates. Across varieties, plant injury increased with trifluralin at 0.8 lb/A and plant density declined at both trifluralin rates but grain yield increased.

Butte 86 had the highest injury (6%) among varieties with trifluralin at 0.4 lb/A. Butte 86 and Verde had 19% injury with trifluralin at 0.8 lb/A. Other varieties with 10% or more injury with trifluralin applied at the high rate include 2375, Hamer, Keene, Kulm, and Lars HRS and Stander barley. However, varieties did not differ in their response to the trifluralin treatments as measured by plant and head density, plant height, grain yield, and test weight. A combination of dry topsoil at trifluralin granule application time and delay of substantial rainfall (0.86 inches) until eight days after trifluralin application may have slowed herbicide release and likely reduced injury during crop germination and emergence.

Small grain cultivar	Trif rate	Plant Injury	Plant Density	Heading date	Head density	Plant height	Grain yield	Test weight
	lb/A	%	plt/A (x1000)	Jday	head/A (x1000)	inches	bu/A	lb/bu
<u>Wheat</u>								
2375	0	0						
	0.4	0	996.0	1872.5	32.1	58.7	59.0	
	0.8	10	705.8	1662.0	31.2	60.1	59.3	
AC Barrie	0	0	1058.6	2288.0	34.5	43.7	58.5	
	0.4	2	1013.1	2259.6	34.3	53.5	58.5	
	0.8	7	785.4	2088.8	34.7	52.2	58.3	
AC Cora	0	0	1064.3	2117.3	37.0	38.2	57.0	
	0.4	1	1001.7	2191.3	36.8	53.2	58.3	
	0.8	5	779.8	2202.7	38.0	48.3	56.5	
Argent	0	0	1081.4	2253.9	32.3	50.0	60.0	
	0.4	6	757.0	2009.1	32.1	56.9	58.8	
	0.8	19	643.2	2037.6	31.6	54.1	59.3	
Butte 86	0	0	1081.4	2253.9	32.3	50.0	60.0	
	0.4	6	757.0	2009.1	32.1	56.9	58.8	
	0.8	19	643.2	2037.6	31.6	54.1	59.3	
Gunner	0	0	1235.1	2151.4	33.1	42.8	60.0	
	0.4	2	973.3	2373.4	32.7	54.8	59.8	
	0.8	8	961.9	2447.4	33.6	53.5	58.8	
HJ98	0	0	996.0	2123.0	30.6	47.7	58.8	
	0.4	0	933.4	1707.5	29.8	54.5	58.8	
	0.8	13	683.0	1827.0	30.2	58.3	58.0	
Hamer	0	0	996.0	2123.0	30.6	47.7	58.8	
	0.4	0	933.4	1707.5	29.8	54.5	58.8	
	0.8	13	683.0	1827.0	30.2	58.3	58.0	
Keene	0	0	887.9	2066.1	37.2	49.2	58.5	
	0.4	4	734.2	2111.6	36.0	56.9	57.8	
	0.8	12	671.6	2060.4	36.5	60.2	58.5	
Kulm	0	0	1030.2	1895.3	31.2	44.3	59.0	
	0.4	2	836.7	1775.8	31.9	65.7	58.3	
	0.8	13	614.7	1679.0	32.4	57.6	59.3	
Lars	0	0	876.5	1975.0	25.7	43.6	55.0	
	0.4	3	916.4	2123.0	26.7	57.8	56.0	
	0.8	12	779.8	1656.3	26.1	49.8	56.0	
Oxen	0	0	916.4	2271.0	28.7	48.3	58.0	
	0.4	1	996.0	2401.9	29.6	59.0	57.5	
	0.8	6	711.5	2071.8	27.6	58.8	58.8	
Russ	0	0	1024.5	1952.2	32.5	58.8	59.5	
	0.4	1	1024.5	2111.6	30.7	69.3	59.5	
	0.8	4	859.4	1992.1	32.6	68.2	59.5	
Trenton	0	0	1183.9	1952.2	35.5	51.9	59.3	
	0.4	1	916.4	1952.2	34.9	60.0	58.8	
	0.8	4	927.7	1997.8	35.1	60.8	58.8	
Verde	0	0	899.3	2242.5	30.9	43.5	58.0	
	0.4	2	717.1	2060.4	28.7	46.8	57.5	
	0.8	19	677.3	2083.1	28.6	49.8	58.7	
Trif*var LSD (0.05)								
Trif means	0							
	0.4							
	0.8							
Trif LSD (0.05)								

Small grain cultivar	Trif rate	Plant Injury	Plant Density	Heading date	Head density	Plant height	Grain yield	Test weight
	lb/A	%	plt/A (x1000)	Jday	head/A (x1000)	inches	bu/A	lb/bu
Durum								
Belzer	0	0	813.9	1309.1	34.4	32.1	55.8	
	0.4	1	791.1	1354.6	35.1	45.2	56.0	
	0.8	3	694.4	1343.2	33.4	45.4	55.8	
Ben	0	0	779.8	1536.7	32.9	39.7	59.0	
	0.4	0	757.0	1673.3	33.7	53.3	59.0	
	0.8	2	683.0	1218.0	34.0	49.9	59.3	
Maier	0	0	779.8	1582.3	28.9	36.6	57.3	
	0.4	2	774.1	1428.6	29.6	48.8	57.5	
	0.8	7	591.9	1428.6	28.4	46.5	56.3	
Mountrail	0	0	779.8	1582.3	28.9	36.6	57.3	
	0.4	2	774.1	1428.6	29.6	48.8	57.5	
	0.8	7	591.9	1428.6	28.4	46.5	56.3	
Munich	0	0	779.8	1582.3	28.9	36.6	57.3	
	0.4	2	774.1	1428.6	29.6	48.8	57.5	
	0.8	7	591.9	1428.6	28.4	46.5	56.3	
Renville	0	0	956.2	1644.9	36.4	45.2	57.0	
	0.4	1	791.1	1724.6	35.5	52.9	57.4	
	0.8	3	739.9	1502.6	34.7	53.0	57.8	
Trif*var LSD (0.05)								
Trif means	0							
	0.4							
	0.8							
Trif LSD (0.05)								
Barley								
Foster	0	0	1126.9	1576.6	27.2	83.4	44.8	
	0.4	0	825.3	1570.9	28.7	84.0	45.8	
	0.8	1	956.2	1895.3	28.7	84.2	44.8	
Robust	0	0	1200.9	1514.0	28.6	83.1	46.3	
	0.4	0	910.7	1815.6	29.4	89.5	46.3	
	0.8	1	996.0	1599.3	31.0	92.4	46.3	
Stander	0	0	967.6	1519.7	26.7	92.5	45.7	
	0.4	1	717.1	1371.7	27.3	84.4	45.3	
	0.8	10	791.1	1371.7	27.5	91.5	46.0	
Trif*var LSD (0.05)								
Trif means	0							
	0.4							
	0.8							
Trif LSD (0.05)								

Achieve for weed control in recrop hrs wheat, Williston 1998. (Riveland, Jessen and Bradbury) The experiment was conducted to evaluate weed control and wheat response to Achieve herbicide. 'Keene' hrs wheat was planted in 7 inch rows at 80 lbs/a on April 28. Treatments were applied on May 29 to 3- to 3.5 -leaf wheat, 2 - 5-leaf wioa (85% were 4- to 5-leaf), 2 - 5-leaf grft, and 1-2 inch Ruth with 63 F, 50% RH, partly cloudy sky, and 5- to 10 mph SE wind. Treatments were applied with a bicycle type plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 8.6 gals/a at 30 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with four replications. Wheat was machine harvested on August 17.

		7-11						
		Crop	Control			Test	Grain	
Treatment[a]	Rate	Inj	Wioa	Grft	Ruth	Weight	Prot.	Yield
	lbs/a ai	%				lbs/b	%	bus/a
Achieve + TF8035	0.18	1	94	26	0	62	8.4	23.1
Achieve + TF8035 + AMS	0.18	1	90	20	0	62	8.0	22.8
Achieve + TF8035 + Bronate	0.18 + 0.375	2	94	6	83	62	8.1	30.4
Achieve + TF8035 + Bronate + AMS	0.18 + 0.375	3	96	0	97	62	8.3	28.1
Achieve + TF8035 + 2,4-Dioe	0.18 + 0.5	3	96	26	95	63	7.9	24.2
Achieve + TF8035 + 2,4-Dioe + AMS	0.18 + 0.5	3	96	8	89	62	8.1	22.2
Achieve + TF8035 + 2,4-DSalvo	0.18 + 0.5	4	95	8	87	62	7.8	22.7
Achieve + TF8035 + 2,4DSalvo	0.18 + 0.4	3	92	53	81	62	8.3	21.1
Achieve + TF8035 + Curtail-M	0.18 + 0.3463	1	97	26	50	63	8.8	24.6
Achieve + TF8035 + Curtail-M + AMS	0.18 + 0.3463	4	96	9	78	63	8.0	23.9
Achieve + TF8035 + Starane+2,4-De	0.18 +0.125+0.5	4	98	10	97	63	8.5	23.0
Achieve + TF8035 + Star+2,4-De+AMS	0.18 +0.125+0.5	2	97	44	94	63	8.3	22.9
Achieve + TF8035 + Peak	0.18 + 0.0178	2	76	18	96	63	8.3	23.3
Achieve + TF8035 +Peak+AMS	0.18 + 0.0178	3	59	15	96	62	7.9	22.1
Untreated	0	0	0	0	0	62	7.9	15.5
C.V. %		113	13	74	13	1	6.3	11.4
LSD 5%		NS	15	19	13	NS	NS	3.8
# OF REPS		4	4	4	4	2	2	4

a - TF8035 applied at 0.5% v/v. AMS = Ammonium sulfate applied at 1.5 lbs/a
2,4-Dioe was a 5.6 lb/gal formulation. 2,4-De was a 3.8 lb/gal formulation.
2,4-DSalvo is a 5.0 lb/gal ester formulation sold by United Ag Products.

Wheat was not injured by any Achieve treatment. Addition of AMS did not increase wild oat control. Peak appears to be antagonistic to Achieve and its ability to control wild oats. No treatment adequately controlled green foxtail. Populations of Ruth were variable.

Achieve for wild oat in hrs wheat, Williston 1998. (Riveland, Jessen and Bradbury) The experiment was conducted to evaluate weed control and wheat response to Achieve herbicide. 'Keene' hrs wheat was planted on fallow in 7 inch rows at 80 lbs/a on April 27. Treatments were applied on May 29 to 4- to 5-leaf wheat, and 2 - 5-leaf wild oats (85% were 4- to 5-leaf) with 46 F, 70% RH, partly cloudy sky, and 5- to 10 mph SE wind. Treatments were applied with a bicycle type plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 8.6 gals/a at 30 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with four replications. Wheat was machine harvested on August 17.

Treatment[a]	Rate	7-11 Crop Inj	7-11 Contrl Wioa	8-16 Crop Inj	Test Weight	Grain Protein	Yield
	lbs/a ai	%	%	%	lbs/b	%	bus/a
Achieve + TF8035	0.18	0	64	0	57	13.7	26.6
Achieve + TF8035 + AMS	0.18	0	66	0	59	12.4	26.9
Achieve + TF8035 + Bronate	0.18 + 0.375	2	94	4	59	13.2	32.5
Achieve + TF8035 + Bronate + AMS	0.18 + 0.375	4	92	4	59	13.3	30.6
Achieve + TF8035 + 2,4-Dioe	0.18 + 0.5	1	91	1	59	13.0	32.1
Achieve + TF8035 + 2,4-Dioe + AMS	0.18 + 0.5	1	82	1	59	12.2	21.4
Achieve + TF8035 + 2,4-DSalvo	0.18 + 0.5	0	77	0	59	13.1	30.0
Achieve + TF8035 + 2,4DSalvo	0.18 + 0.4	4	90	3	59	12.6	30.0
Achieve + TF8035 + Curtail-M	0.18 + 0.3463	1	92	1	60	12.6	33.9
Achieve + TF8035 + Curtail-M + AMS	0.18 + 0.3463	1	96	3	60	12.8	32.6
Achieve + TF8035 + Starane+2,4-De	0.18 +0.125+0.5	2	87	4	60	13.0	33.0
Achieve + TF8035 + Star+2,4-De+AMS	0.18 +0.125+0.5	1	88	6	60	13.0	30.4
Achieve + TF8035 + Peak	0.18 + 0.0178	0	54	0	58	13.7	27.1
Achieve + TF8035 +Peak+AMS	0.18 + 0.0178	0	49	0	60	12.1	25.8
Untreated	0	0	0	0	58	13.3	14.4
C.V. %		141	13	132	2	3.2	12.2
LSD 5%		2	14	3	NS	.9	5.0

a - TF8035 applied at 0.5% v/v. AMS = Ammonium sulfate applied at 1.5 lbs/a 2,4-Dioe was a 5.6 lb/gal formulation. 2,4-De was a 3.8 lb/gal formulation. 2,4-DSalvo is a 5.0 lb/gal ester formulation sold by United Ag Products.

Wheat was not seriously injured by any Achieve treatment. Addition of AMS did not increase wild oat control, but adding several broadleaf herbicides in combination with Achieve did increase wild oat control and corresponding yield, with the exception of Peak and two 2,4-D combinations. The yield reduction associated with the addition of AMS to Achieve + 2,4-Dioe has no apparent explanation.

Weed Control with BAS 635 in Wheat. Zollinger and Fitterer. An experiment was conducted in Fargo, ND, to evaluate weed control from herbicides applied postemergence. 'Oxen' hard red spring wheat was seeded April 23, 1998. POST treatments were applied to 4 leaf wheat on May 20, 1998, at 4:00 to 6:00 pm with 77 F air, 69 F soil surface, 65% RH, 20% clouds, and 0 mph wind; 0.5 to 1 inch, 1 to 2 leaf, green and yellow foxtail at 10 to 30 plants/ft^2;1 inch, cotyledon to 4 leaf, rosette wild mustard at 1 to 5 plants/ft^2; 1 inch, cotyledon redroot pigweed at 2 to 3 plants/ft^2; 3 to 5 leaf wild oat at 1 to 5 plants/ft^2; 2 to 4 inch diameter rosette Canada thistle at 1 to 7 shoots/yd^2; and 1 inch, 2 leaf wild buckwheat at 1 plant yd/^{2}. Treatments were applied to the center 8 feet of the 10 by 30 foot plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

Treatment [a]	Rate	May 29			June 13		June 26	
		Wimu	Wibw	Cath	Wibw	Cath	Wibw	Cath
	lb ai/A	% control						
BAS 635+NIS	0.027+0.25%	97	36	29	53	40	48	53
BAS 635+NIS	0.045+0.25%	99	38	30	50	35	65	55
BAS 635+Dicamba+NIS	0.027+0.094+0.25%	99	71	33	75	63	78	84
BAS 635+Dicamba+NIS	0.045+0.062+0.25%	98	71	30	65	40	60	61
BAS 635+Dicamba+NIS	0.045+0.094+0.25%	99	80	35	75	65	86	73
BAS 635+2,4-D	0.045+0.25+0.094+0.	97	85	58	85	73	92	83
BAS 635+2,4-D amine+NIS	0.045+0.25+0.25%	99	70	38	73	40	63	71
BAS 635+Buctrill+NIS	0.027+0.25+0.25%	99	65	35	70	33	78	75
Dicamba+2,4-D amine+NIS	0.094+0.25+0.25%	92	80	31	58	15	41	45
Harmony Extra+Dicamba+NIS	0.026+0.094+0.025%	94	76	28	81	55	75	68
Harmony Extra+2,4-D	0.026+0.25+0.094+0.	94	81	48	75	55	90	88
Harmony Extra+Buctril+NIS	0.026+0.25+0.25%	97	88	30	78	20	80	61
Harmony Extra+2,4-D amine+NIS	0.026+0.25+0.25%	97	85	30	65	30	59	69
Harmony Extra+NIS	0.013+0.25%	97	88	33	35	28	48	55
Harmony Extra+NIS	0.026+0.25%	97	79	25	68	15	53	55
Clarity	0.094	97	86	28	75	30	74	53
Clarity+MCPA amine	0.094+0.25	97	79	25	75	14	83	60
Clarity+Bronàte	0.094+0.25&0.25	97	89	28	86	23	87	75
Harmony Extra+Clarity+NIS	0.25+0.094+0.25%	97	90	30	73	50	70	70
Distinct+NIS	0.063&0.025+0.25%	97	86	40	80	58	86	65
Distinct+NIS	0.094&0.038+0.25%	97	89	53	90	65	90	73
Untreated		0	0	0	0	0	0	0
LSD (0.05)		5	15	13	13	14	14	14

[a]Wimu = wild mustard, Wibw = wild buckwheat, Cath = Canada thistle, dicamba-Na = sodium salt formulation, dicamba-dga = diglycolamine salt formulation, &=formulated premix, NIS = nonionic surfactant (Preference).

All treatments gave complete redroot pigweed and common lambsquarters control, complete control of wild mustard at the June 13 and 26 ratings, and less than 10% foxtail and wild oat control. No wheat injury was observed on May 29. Distinct at 0.063 and 0.094 lb/A showed 30 and 50% wheat injury on June 13 and 13 and 14% wheat injury on June 26, respectively. A treatment containing Buctril, Dicamba/Clarity at 0.094 lb ai/A, or Distinct was required to give above 80% wild buckwheat control. Three-way combinations of either BAS 635 or Harmony Extra with 2,4-D and Dicamba/Clarity gave greater than 80% Canada thistle control. A reduction in wild buckwheat control at the June 26 evaluation may be due to seedlings that emerged after treatment.

Weed Control with V-10029 in Wheat. Zollinger and Fitterer. An experiment was conducted in Fargo, ND, to evaluate weed control from herbicides applied to wheat in the 3- to 6-leaf stage. 'Oxen' hard red spring wheat was planted April, 23, 1998. Early postemergence treatments were applied to 3- to 4-leaf wheat on May 20, 1998, at 4:00 to 6:00 pm with 77 F air, 69 F soil surface, 65% RH, 20% clouds, and no wind to 3- to 5-leaf wild oat at 1 to 5 plants/ft^2; and 0.5 to 1 inch, 1 leaf green and yellow foxtail at 5 to 10 plants/ft^2. Mid postemergence treatments were applied to 6-leaf wheat on June 2, 1998, at 9:30 to 10:00 am with 50 F air, 54 F soil surface, 55% RH, 95% clouds, and 2 to 5 mph NW wind; to 6 to 10 inch, 5- to 6-leaf wild at 1 to 5 plants/ft^2; 1 to 2 inch, 1- to 3-leaf green and yellow foxtail at 15 to 30 plants/ft^2; 4 to 6 inch, 4- to 6-leaf, rosette wild mustard at 2 to 5 plants/ft^2; and 2- to 4-inch, 2 to 4 leaf wild buckwheat at 4 plants/ft^2. Treatments were applied to the center 8 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		Wheat injury				14 DAT		28 DAT	
Treatment [a]	Rate	May 2	June 8	June 22	July 2	Fxtl	Wioa	Fxtl	Wioa
	lb ai/A	%				% control			
3 to 4 leaf wheat stage									
V-10029+Kinetic	0.19+0.125%	7	3	0	0	20	10	15	20
V-10029+Kinetic	0.38+0.125%	11	7	3	0	18	8	30	23
V-10029+Kinetic	0.56+0.125%	15	13	3	3	27	15	35	13
V-10029+Kinetic	0.75+0.125%	14	20	8	5	32	23	33	43
V-10029+Kinetic	0.94+0.125%	15	22	10	2	32	23	37	37
V-10029+Kinetic	1.13+0.125%	17	18	13	3	43	28	32	43
Achieve+Supercharge+AMS	0.24+1qt+15lb/100gal	28	27	3	0	85	92	77	97
Puma	0.08	2	3	0	0	94	91	65	95
6 leaf wheat stage									
V-10029+Kinetic	0.19+0.125%		5	8	2	37	27	47	53
V-10029+Kinetic	0.38+0.125%		8	10	4	20	28	40	63
V-10029+Kinetic	0.56+0.125%		17	10	7	18	40	33	48
V-10029+Kinetic	0.75+0.125%		25	13	7	15	30	23	32
V-10029+Kinetic	0.94+0.125%		35	25	13	37	47	50	55
V-10029+Kinetic	1.13+0.125%		45	32	20	32	35	57	60
Achieve+Supercharge+AMS	0.24+1qt+15lb/100gal		7	12	6	72	88	90	80
Puma	0.08		5	2	6	92	97	96	95
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		5	10	9	7	13	15	14	16

[a] Fxtl = green and yellow foxtail, Wioa = wild oat, Kinetic = surfactant with silicone, Supercharge = methylated seed oil, AMS = ammonium sulfate.

Wheat injury from treatments applied at the 3- to 4-leaf stage was highest from Achieve on May 2 and June 8. Wheat injury from Achieve was less than 30% when applied during the 3-leaf stage of wheat but was less than 15% when applied during the 6-leaf stage of wheat. V-10029 did not cause wheat injury greater than 25% at any evaluation. Small differences in wheat injury were observed from V-10029 applied at 0.19 to 0.75 lb/A to 3- or 6-leaf wheat. However, V-10029 at 0.94 or 1.1 lb/A and applied at the 6-leaf stage caused 25 to 45% injury, which was more than when applied during the 3- to 4-leaf stage. Wheat by July 2 had recovered from all treatments applied at the 3-leaf stage by July 2. However, wheat injury from V-10029 applied during the 6-leaf ranged from 2 to 20%. Wheat injury from Puma was minimal. V-10029 gave less than 60% foxtail and less than 63% wild oat control at any rate or application timings. V-10029 gave complete wild mustard control and less than 20% wild buckwheat control. Achieve and Puma did affect broadleaf weeds.

Weed control with dicamba in Wheat. Zollinger and Fitterer. An experiment was conducted in Fargo, ND to evaluate weed control from herbicides applied POST. 'Oxen' wheat was planted April 23, 1998. POST treatments were applied to 5 lf wheat on May 29, 1998 at 2:00-3:00 pm with 69 F air, 75 F soil surface, 60% RH, 0% clouds, and 3-7 mph N wind. Weed species present were: 1-1.5" (10-20/ft^2) foxtail; 1-4" (3-5/ft^2) rosette wild mustard; 0.5-1", cot, (5-10/yd^2) venice mallow; 4-8", (1/yd^2) rosette Canada thistle, and 0.5-2 (1/ft^2) wild buckwheat. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		June 16					June 26			
Treatment	Rate	Wimu	Wibw	Vema	Cath	Wheat Injury	Wimu	Wibw	Cath	Wheat Injury
	Product/A	%								
LABS 122	2 oz	20	20	17	10	0	72	68	18	0
Banvel	2 oz	20	12	10	10	0	73	70	23	0
LABS 122	4 oz	40	20	17	30	0	90	87	35	0
Banvel	4 oz	37	20	20	27	2	95	90	43	0
LABS 122+MCPA-Amine	2oz+0.75pt	67	57	37	33	0	98	95	38	0
Harmony Extra+LABS 122+ Activator 90	0.3oz+2oz+ 0.25%	92	67	83	43	0	99	99	70	0
Harmony Extra+LABS 122+ MCPA-Amine	0.3oz+2oz+ 0.5pt	93	93	83	73	0	99	99	82	0
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		11	10	14	11	NS	3	5	13	NS

LABS 122 is a dicamba from another source other than BASF. Little differences were observed between Banvel and LABS 122 at the June 16 or June 26 rating and either herbicides did not cause crop injury.

Preharvest Weed Control In Wheat. Zollinger and Fitterer. An experiment was conducted at Fargo, ND to evaluate preharvest weed control in wheat. Ten days before harvest treatments were applied on July 29, 1998 at 8:30 am with 72 F air, 72 F soil surface, 61% RH, 0-3 mph NW wind, 100% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and the crop stage was hard dough. Weeds present at the hard dough stage were: headed, (30-50/ft^2), foxtail; flowering, (5-10/ft^2), venice mallow. Three days before harvest treatments were applied on August 4, 1998 at 8:00 am with 68 F air, 68 F soil surface, 78% RH, 3-5 mph SW wind, 50% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and the crop was at the harvest stage. Weeds present at the harvest stage were: headed, (30-50/ft^2), foxtail; flowering, (5-10/ft^2), venice mallow. The treatments were applied to the center 8 ft of the 10 by 40 ft plots with a CO2 backpack sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table 1. Weed control data.

		2 DAT		5 DAT		7 DAT		10 DAT		12 DAT	
Treatment	Rate	Fxtl	Vema	Fxtl	Vema	Fxtl	Vema	Fxtl	Vema	Fxtl	Vema
	Product/A	% control									
Hard dough stage											
Roundup Ultra	2 pt	0	0	45	33	68	60	96	82	98	85
Touchdown + NIS	1.6 pt	0	0	32	22	62	43	92	95	95	85
Landmaster BW	5.2 pt	0	0	42	32	72	63	93	97	97	85
Roundup Ultra + Banvel	2 pt + 0.5 pt	0	0	37	32	63	57	88	93	93	82
3-5 days before harvest											
Gramoxone Extra + NIS	0.8 pt	53	48	78	75	-	-	-	-	-	-
Gramoxone Extra + NIS	1.2 pt	58	70	77	85	-	-	-	-	-	-
Gramoxone Extra + NIS	1.6 pt	63	72	82	83	-	-	-	-	-	-
Untreated		0	0	0	0	0	0	0	0	0	0
LSD (0.05)		12	11	11	11	10	8	9	13	6	10

Table 2. Durum quality data.

			Kernel			
Treatment	Rate	TWT	Vit	Large	Small	1000
	Product/A	lb/bu	%			g
Hard dough stage						
Roundup Ultra	2 pt	60.7	88	65	2	38
Touchdown + NIS	1.6 pt	60.4	89	56	6	34
Landmaster BW	5.2 pt	60.6	90	62	4	36
Roundup Ultra + Banvel	2 pt + 0.5 pt	60.2	85	60	4	34
3-5 days before harvest						
Gramoxone Extra + NIS	0.8 pt	59.2	86	60	3	36
Gramoxone Extra + NIS	1.2 pt	60.0	85	65	3	38
Gramoxone Extra + NIS	1.6 pt	59.0	88	61	5	36
Untreated		60.1	90	65	3	37
LSD (0.05)		1.0	NS	NS	NS	NS

Most treatments provided excellent foxtail control and good venice mallow control with no affect on grain quality.

Preharvest Small Grain Dry Down. Zollinger, Fitterer, and Manthey. An experiment was conducted at Fargo, ND, to evaluate herbicides applied preharvest in wheat. 'Ben' durum wheat was planted April 28, 1998. Plots were kept weed free by applying Achieve + Scoil at 0.18 lb/A + 1.5% v/v + Bronate at 0.5 lb/A to small weeds. The 50% grain moisture treatments were applied on July 23, 1998, at 8:30 am with 64 F air, 61 F soil surface, 70% RH, 0 to 2 mph NW wind, no clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the soft dough crop wheat stage. The 30% grain moisture treatments were applied on July 29, 1998, at 7:30 am with 72 F air, 72 F soil surface, 61% RH, 0 to 3 mph NW wind, 100% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the hard dough wheat stage. The 9 days before harvest treatments were applied on July 9, 1998, at 8:00 am with 72 F air, 72 F soil surface, 61% RH, 0 to 3 mph NW wind, 100% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and hard dough crop stage. The 3 days before harvest treatments were applied on August 4, 1998, at 8:00 am with 68 F air, 68 F soil surface, 78% RH, 3 to 5 mph SW wind, 50% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the harvest ripe wheat kernel stage. The treatments were applied to the center 8 feet of the 10 by 40 foot plots with a CO_2 pressurized backpack sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. Plots were harvested August 9, 1998.

Treatments applied at 50% grain moisture wheat stage reduced test weight, 1000 kernel weight, percent large kernels, percent normal seedlings, but increased percent injured seedlings, micro-sedimentation, relative yellow color, gluten content, and protein. Treatments applied 9 days before harvest or 30% grain moisture or later generally did not have different measurements than grain from untreated plots. Measurements and their range that were not significantly different from grain of untreated plots (data not shown) were: vitreous kernels (82 to 93%); protein of whole kernel (12.3 to 13.4% dry basis); falling number, value indicates no sprout damage (390 to 428 seconds); yield (10.5 to 14.7 bu/A); total germination, sum of normal and injured seedlings (71.7 to 82.5%); semolina extracted from grain (66.6 to 68.6%); brightness of semolina, the higher the value the more bright (83.6 to 84.7); green to red reading of semolina, negative number is green reading a positive number is red (-1.6 to +2.0); yellow reading of semolina, the higher the number the more yellow (21.5 to 23.0); wet gluten content, a measure of desirable protein in semolina (26.5 to 29.9%); ash content (0.87 to 0.91% dry basis); medium kernels (7 to 12%); and small kernels (3 to 6%).

Table. Preharvest small grain dry down.

Treatment	Rate	Kernel[a]			Seedling[b]		Mst[c]	Yel[d]	Gluten index[e]	Protein[f]
		Twt	1000	L/K	Norm	Inj				
	Product/A	lb/bu	g	%	%	%	mm		%	%
50% grain moisture										
Roundup Ultra	2 pt	60.7	34.2	44	60	23	29	22.5	86	11.9
Touchdown+NIS	1.6 pt+0.25%	60.8	33.4	45	62	19	30	22.8	81	11.9
Landmaster BW	5.25 pt	61.2	33.9	50	52	20	31	23.0	80	12.1
Roundup Ultra+Banvel	2 pt+0.5 pt	60.8	33.2	44	56	22	30	23.0	77	12.2
9 days before harvest										
Gramoxone Extra+NIS	0.8 pt+0.25%	61.6	38.1	63	73	2	27	21.9	69	11.6
Gramoxone Extra+NIS	1.2 pt+0.25%	61.7	36.0	62	73	4	29	22.1	61	11.6
Gramoxone Extra+NIS	1.6 pt+0.25%	61.8	36.8	64	72	5	27	21.8	63	11.9
30% grain moisture										
Roundup Ultra	2 pt	62.0	36.3	64	66	5	28	22.1	63	11.6
Touchdown	1.6 pt+0.25%	62.1	36.4	63	75	4	29	22.0	67	11.4
Landmaster BW	5.25 pt	62.1	36.2	62	75	2	28	22.1	56	11.5
Roundup Ultra+Banvel	2 pt+0.5 pt	61.8	36.1	63	72	5	28	21.9	52	11.5
3 days before harvest										
Gramoxone Extra+NIS	0.8 pt+0.25%	61.5	35.7	64	69	3	28	21.7	66	11.8
Gramoxone Extra+NIS	1.2 pt+0.25%	60.8	35.6	62	72	2	29	21.5	69	11.2
Gramoxone Extra+NIS	1.6 pt+0.25%	61.2	36.6	64	75	3	27	21.5	47	11.6
Untreated		61.1	35.6	65	78	0	28	22.1	63	11.7
LSD (0.05)		0.7	1.9	7	9	5	2	0.7	14	0.4

[a]Twt = kernel test weight, 1000 = 1000 kernel weight, L/K = large kernels.
[b]norm = normal germinating seedlings, inj = injured seedlings (roots thick and stunted).
[c]Mst = micro-sedimentation test (higher the value, the better the protein quality).
[d]Yel = yellow reading (higher the number, the more yellow).
[e]Gluten index = measure of gluten quality.
[f]Protein = protein content of semolina on dry basis

PPS and PRE Finesse on hrs wheat, Williston 1998. (Riveland, Bradbury and Ulrich) The experiment was conducted to evaluate wheat response to Finesse herbicide applied preplant on the soil surface and preemergence, prior to crop and weed emergence. 'Keene' hrs wheat was planted on fallow in 6 inch rows at 80 lbs/A on .April 30. PPS treatments were applied on April 17 to a dry soil surface with 53 F, 23% RH, clear sky, and 8 to 10 mph NW wind. PRE treatments were applied to a dry soil surface on May 2 with 60 F, 37% RH, partly cloudy sky, and 6 to 6 mph ESE wind. Treatments were applied with a bicycle-type-plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 10 Gals/A at 40 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. Bronate at 5 oz/A was applied to all plots on May 24 when the wheat was in the 3 to 3.5-leaf stage. Soil test showed soil in the plot area with a pH of 6.3 and OM content of 2.1%. the experiment was a randomized complete block design with four replications. Wheat was machine harvested on August 15.

Finesse treatment[a]	Rate	Rating date 5-14	6-8	7-11	Test weight	Yield
	oz ai/A	% crop injury			lbs/bu	bu/A
14-day PPS	0.4	0	0	0	59.1	36.49
14-day PPS	0.8	0	0	0	60.0	37.72
0-3 day PRE	0.4	0	0	0	59.3	39.42
0-3 day PRE	0.8	0	0	0	59.6	35.94
Untreated Ck	0.0	0	0	0	5.85	35.21
High Mean		0	0	0	60.0	39.42
Low Mean		0	0	0	58.5	35.21
Exp Mean		0	0	0	59.3	36.96
C.V.%		0	0	0	1.4	7.24
LSD 5%		-	-	-	NS	NS
LSD 1%		-	-	-	NS	NS
# of Reps		4	4	4	4	4
F-TRT		-	-	-	2.0	1.53

The crop was 95% emerged on May 8. No discernible differences in emergence were noted. Injury ratings made on May 14 showed no crop injury that could be distinguished by color or stand establishment. Wheat at this time was in the 1.1 to 1.3-leaf growth stage. Ratings made on June 8 and July 11 were all negative for crop injury. No significant yield or test weight differences were detected among treatments.

Imazamethabenz (Assert) spray volume in wheat, 1998. (Nalewaja and Ciernia) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 4.5-to 5-leaf wheat and 3-leaf wild oat on May 22 with 71 F, 38% RH, hazy sky, and 7 mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed, nozzles, and pressure. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	PSI	Gpa	Mph	Tip	Jun 23 Wht	Jun 23 Wioa
	oz/A					%	%
Imazamethabenz+X77	3+0.25%	28	2.5	10	8001	0	52
Imazamethabenz+SunitII	3+0.18G	28	2.5	10	8001	0	72
Imazamethabenz+X77	3+0.25%	28	5	10	8002	0	59
Imazamethabenz+SunitII	3+0.18G	28	5	10	8002	0	83
Imazamethabenz+X77	3+0.25%	28	10	10	8004	0	53
Imazamethabenz+SunitII	3+0.18G	28	10	10	8004	0	75
Imazamethabenz+X77	3+0.25%	28	20	10	8008	0	65
Imazamethabenz+SunitII	3+0.18G	28	20	10	8008	0	75
Imazamethabenz+X77	3+0.25%	15	2.5	12	LP8001	0	66
Imazamethabenz+SunitII	3+0.18G	15	2.5	12	LP8001	0	82
Imazamethabenz+X77	3+0.25%	28	5	5	8001	0	73
Imazamethabenz+SunitII	3+0.18G	28	5	5	8001	0	79
Imazamethabenz+X77	3+0.25%	28	10	5	8002	0	62
Imazamethabenz+SunitII	3+0.18G	28	10	5	8002	0	79
Imazamethabenz+X77	3+0.25%	28	20	5	8004	0	67
Imazamethabenz+SunitII	3+0.18G	28	20	5	8004	0	69
C.V. %						0	10
LSD 5%						NS	11
# OF REPS						3	3

Summary

Plants were growing with excessive moisture and showing stress symptoms. Plants in the fourth replication were not evaluated because of standing water. In addition to moisture stress plants appeared stressed for nitrogen as the experiment was in an area not fertilized for the 1998 crop. The most striking result was that Sun-it oil adjuvant was more effective than surfactant X-77 in enhancement of imazamethabenz, regardless of spray volume, pressure, or nozzle. However, the enhancement difference was more at high sprayer speed (10 mph) than low (5 mph). This was mainly because the surfactant used on a percentage basis was more effective in the higher volume spray per acre (greater amount of surfactant per area). Spray volume did not influence imazamethabenz efficacy when with the oil adjuvant Sun-it applied on an area basis. Imazamethabenz applied at 2.5 gpa with the oil adjuvant was equally as effective as in 10 or 20 gpa. The results clearly indicate that low spray volumes are efficacious with imazamethabenz applied with an oil adjuvant (Sunit II) on an area basis.

Imazamethabenz with adjuvant concentrations, Fargo 1998. (Nalewaja and Ciernia) 'Paul' oat, Siberian foxtail millet, and White proso millet were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 6-to 7-leaf oat and 5-to 7-leaf millets on July 2 with 78 F, 41% RH, and 3-to 6-mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

						Jul 15			Jul 23
Treatment	Rate	Psi	Gpa	Mph	Tip	Prmi	Fomi	Oat	Oat
	oz/A					%			
Immb+X77	3+0.25%	28	2.5	10	8001	0	0	48	55
Immb+X77	3+0.5%	28	2.5	10	8001	0	0	54	73
Immb+X77	3+1%	28	2.5	10	8001	0	0	53	75
Immb+SunitII	3+2%	28	2.5	10	8001	0	0	51	68
Immb+SunitII	3+4%	28	2.5	10	8001	0	0	53	79
Immb+SunitII	3+8%	28	2.5	10	8001	0	0	54	80
Immb+X77	3+0.25%	28	10	2.5	8001	0	0	50	66
Immb+X77	3+0.5%	28	10	2.5	8001	0	0	54	68
Immb+X77	3+1%	28	10	2.5	8001	0	0	53	79
Immb+SunitII	3+2%	28	10	2.5	8001	0	0	58	79
Immb+SunitII	3+4%	28	10	2.5	8001	0	0	56	83
Immb+SunitII	3+8%	28	10	2.5	8001	0	0	64	92
C.V. %						0	0	8	10
LSD 5%						NS	NS	6	11
OF REPS						4	4	4	4

Summary

Imazamethabenz was more effective when applied with Sun-it than surfactant X-77 at a given spray volume and efficacy increased as concentration of either adjuvant increased. Imazamethabenz applied at low, 2.5 gpa, was equally or more effective than at high, 10 gpa, if the amount of surfactant or oil adjuvant were the same as an area basis. For example, oat control from imazamethabenz was 80% with Sun-it at 8% in 2.5 gpa and 79% at 2% in 10 gpa (equal amounts on an area basis). Further, oat control was 75% with 1% X-77 in 2.5 gpa and only 66% with 0.25% X-77 in 10 gpa (again equal amounts on an area basis). The greatest oat control was with the most Sun-it on an area basis, 92% for 8% in 10 gpa. These data again demonstrate that low spray volumes are effective with imazamethabenz provided the amount of surfactant percentage is increased so that the amount per area are equal to that in the high volume.

Imazamethabenz with adjuvants and spray volume, Fargo 1998. (Nalewaja and Ciernia) 'Paul' oat was seeded August 4. Treatments were applied to 5-leaf oat on September 2 with 79 F, 40% RH, overcast sky and 5 mph wind. Treatments were applied with a 4-wheeled all terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Sep 28 Oat
	oz/A					%
Immb+X77	1+0.25%	28	2.5	10	8001	14
Immb+X77	2.5+0.25%	28	2.5	10	8001	63
Immb+X77	5+0.25%	28	2.5	10	8001	82
Immb+SunitII	1+0.18G	28	2.5	10	8001	73
Immb+SunitII	2.5+0.18G	28	2.5	10	8001	88
Immb+SunitII	5+0.18G	28	2.5	10	8001	91
Immb+X77	1+0.25%	28	5	5	8001	68
Immb+X77	2.5+0.25%	28	5	5	8001	79
Immb+X77	5+0.25%	28	5	5	8001	86
Immb+SunitII	1+0.18G	28	5	5	8001	75
Immb+SunitII	2.5+0.18G	28	5	5	8001	82
Immb+SunitII	5+0.18G	28	5	5	8001	91
Immb+X77	1+0.25%	28	10	2.5	8001	68
Immb+X77	2.5+0.25%	28	10	2.5	8001	87
Immb+X77	5+0.25%	28	10	2.5	8001	88
Immb+SunitII	1+0.18G	28	10	2.5	8001	64
Immb+SunitII	2.5+0.18G	28	10	2.5	8001	79
Immb+SunitII	5+0.18G	28	10	2.5	8001	91
C.V. %						5
LSD 5%						5
# OF REPS						4

Summary

Imazamethabenz at all rates was equally as effective in 2.5 as 5 or 10 gpa when applied with SunitII at 1.5 pt/A. However when applied with X-77 at 0.25% imazamethabenz efficacy generally increased with spray volume. Imazamethabenz at 1 or 2.5 oz/A was more effective applied with SunitII at 1.5 pt/A in 2.5 gpa than 10 gpa. This probably reflects the higher concentration of adjuvant and imazamethabenz in the spray solution.

Tralkoxydim spray volume in wheat. (Nalewaja and Ciernia) 'Oxen' hard red spring wheat was seeded April 23. Treatments were applied to 6-leaf wheat and wild oat on June 4 with 58 F, 27% RH, mostly cloudy sky, and 6- to 8-mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed, nozzles, and pressure. The experiment was a randomized complete block design with four replicates. Treatments were to the same plots that were previously treated (5/20/98)in error with 0.24 oz/A tralkoxydim. No injury symptoms were evident from any of the earlier treatments.

Treatment	Rate	Psi	Gpa	Mph	Tip	June 23	
						Wht	Wioa
	oz/A					%	
Tralkoxydim+TF8035	2.4+0.5%	28	2.5	10	8001	0	68
Tralkoxydim+Scoil	2.4+1%	28	2.5	10	8001	0	75
Tralkoxydim+Scoil	2.4+0.188G	28	2.5	10	8001	0	92
Tralkoxydim+TF8035	2.4+0.5%	28	5	5	8001	0	79
Tralkoxydim+Scoil	2.4+1%	28	5	5	8001	0	86
Tralkoxydim+Scoil	2.4+0.188G	28	5	5	8001	1	96
Tralkoxydim+TF8035	2.4+0.5%	28	5	10	8002	0	78
Tralkoxydim+Scoil	2.4+1%	28	5	10	8002	0	87
Tralkoxydim+Scoil	2.4+0.188G	28	5	10	8002	2	95
Tralkoxydim+TF8035	2.4+0.5%	28	10	10	8004	1	87
Tralkoxydim+Scoil	2.4+1%	28	10	10	8004	0	92
Tralkoxydim+Scoil	2.4+0.188G	28	10	10	8004	1	97
C.V. %						238	5
LSD 5%						1	7
# OF REPS						4	4

Summary

Tralkoxydim was equally as effective in controlling wild oat when applied at 2.5, 5, or 10 gpa when with Scoil used at 1.5 pt/A (0.188G). However, control increased with spray volume when tralkoxydim was applied with adjuvants on a percentage basis. These results indicate that tralkoxydim is equally effective applied at 2.5 as 10 gpa when the amount of adjuvant is equal to an area basis for both volumes. Nozzle size (droplet size) did not influence the efficacy of tralkoxydim applied at 5 gpa, the only volume applied in two droplet sizes.

Low volume comparisons with Imazethapyr, Fargo. (Nalewaja and Ciernia) 'Paul' oat, Siberian foxtail millet, and white proso millet were seeded in adjacent strips as bioassay species on August 4. Treatments were applied to 5-leaf oat and 4-leaf millets on September 3 with 70 F, 32% RH, sunny sky and 3- to 4-mph wind. Treatments were applied with a 4-wheeled all terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in pressure, speed, and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Sept 28 Oat	Sept 28 Fomi	Sept 28 Prmi
	oz/A					%	%	%
Imep+Act90	0.37+0.25%	28	2.5	10	8001	44	56	48
Imep+Sunit	0.37+0.188G	28	2.5	10	8001	81	83	82
Imep+Quad7	0.37+1%	28	2.5	10	8001	65	72	66
Imep+Quad7	0.37+2%	28	2.5	10	8001	78	73	81
Imep+Act90	0.37+0.25%	28	5	5	8001	18	39	43
Imep+Sunit II	0.37+0.188G	28	5	5	8001	81	78	82
Imep+Quad7	0.37+1%	28	5	5	8001	80	79	59
Imep+Quad7	0.37+2%	28	5	5	8001	84	78	80
Imep+Act90	0.37+0.25%	15	2.5	12	LP8001	6	30	24
Imep+Sunit II	0.37+0.188G	15	2.5	12	LP8001	45	54	49
Imep+Quad7	0.37+1%	15	2.5	12	LP8001	48	48	48
Imep+Quad7	0.37+2%	15	2.5	12	LP8001	64	48	51
Imep+Sunit II	0.37+0.188G	15	2.5	14.2	8002	68	68	69
Imep+Act90	0.37+0.25%	28	5	10	8002	18	36	31
Imep+Sunit II	0.37+0.188G	28	5	10	8002	81	78	77
Imep+Quad7	0.37+1%	28	5	10	8002	68	68	65
Imep+Quad7	0.37+2%	28	5	10	8002	88	81	84
C.V. %						10	22	27
LSD 5%						8	20	23
# OF REPS						4	4	4

Summary

The error associated with foxtail millet and proso millet data was high because of variable emergence and will not be discussed. Imazethapyr with Activator 90 without 28%N was not effective enough in this experiment to differentiate among spray volumes. Imazethapyr applied with Sunit II was equally effective in 2.5 gpa from 8001 nozzles as 5 gpa from 8002 nozzles, but not 2.5 gpa from LP8001 nozzle. The larger droplets from the LP nozzles may have reduced spray retention or coverage needed for efficacy. At both 2.5 and 5 gpa using Quad 7 at 2% always tended to r increased imazethapyr efficacy compared at 1%.

Imazethapyr spray volumes with adjuvants, Fargo. (Nalewaja and Ciernia). 'Paul' oat, Siberian foxtail millet and white proso millet were seeded in adjacent strips as bioassay species on August 4. Treatments were applied to 7-leaf oat and 5-leaf millets on September 10 with 77 F, 25% RH, sunny sky, and 12-mph wind. Treatments were applied with a 4-wheeled all terrain sprayer equipped with a side mounted boom with 4 nozzle spaced at 20 inches and spray cones to shield wind. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Oct 2		
						Oat	Fomi	Prmi
	oz/A						%	
Imep+Act90+28%	0.37+0.25%+0.25G	28	2.5	10	8001	67	49	71
Imep+Act90+28%	0.37+0.5%+0.25G	28	2.5	10	8001	68	48	66
Imep+Act90+28%	0.37+1%+0.25G	28	2.5	10	8001	72	60	75
Imep+Sunit	0.37+2%	28	2.5	10	8001	68	64	68
Imep+Sunit	0.37+4%	28	2.5	10	8001	80	66	77
Imep+Sunit	0.37+8%	28	2.5	10	8001	77	60	66
Imep+Quad7	0.37+1%	28	2.5	10	8001	59	59	72
Imep+Quad7	0.37+2%	28	2.5	10	8001	63	59	69
Imep+Act90+28%	0.37+0.25%+0.25G	28	10	10	8004	70	48	66
Imep+Act90+28%	0.37+0.5%+0.25G	28	10	10	8004	64	53	76
Imep+Act90+28%	0.37+1%+0.25G	28	10	10	8004	66	54	73
Imep+Sunit	0.37+2%	28	10	10	8004	63	53	71
Imep+Sunit	0.37+4%	28	10	10	8004	68	56	78
Imep+Sunit	0.37+8%	28	10	10	8004	72	60	76
Imep+Quad7	0.37+1%	28	10	10	8004	68	56	62
Imep+Quad7	0.37+2%	28	10	10	8004	75	57	74
C.V. %						7	17	15
LSD 5%						7	NS	NS
# OF REPS						4	4	4

Summary

Oats was the main species considered, because emergence of foxtail millet and proso millet was too variable for good evaluation. Differences among treatments were small, but imazethapyr with SunitII at 1.5 pt/A again tended or was more effective when applied in 2.5 than 10 gpa. Imazethapyr efficacy tended to increase as X-77 percentage increased when in 2.5 gpa, but not in 10 gpa indicating amount of adjuvant on an area basis was more important than the percentage in the spray. The higher spray volumes and percentages of Quad 7 were positive to efficacy.

Imazamox with volume and adjuvant. (Nalewaja and Ciernia) 'Paul' oat, Siberian foxtail millet, and white proso millet were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 7-to 8-leaf oat, 6- to 8-leaf foxtail and proso millet on July 10 with 87 F, 51% RH, mostly sunny sky, and 3- to 6-mph wind. Treatments were applied with a 4-wheeled all terrain sprayer equipped with a side mounted boom with four nozzles space at 20 inches. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Jul-23 Prmi	Jul-23 Fomi	Jul-23 Oat	Aug 4 Prmi	Aug 4 Fomi	Aug 4 Oat
	oz/A					%					
Imam+Act90+28%	0.25+0.25%+2%	28	2.5	10	8001	43	67	78	51	72	90
Imam+Sunit	0.25+0.188G	28	2.5	10	8001	57	75	69	76	81	90
Imam+Quad 7	0.25+1%	28	2.5	10	8001	33	45	43	74	79	92
Imam+Quad 7	0.25+2%	28	2.5	10	8001	62	62	68	80	83	90
Imam+Act90+28N	**0.25+0.25%+2%**	**28**	**5**	**5**	**8001**	**45**	**48**	**59**	**35**	**60**	**81**
Imam+Sunit	0.25+0.188G	28	5	5	8001	58	72	75	79	86	92
Imam+Quad 7	0.25+1%	28	5	5	8001	70	83	83	81	88	94
Imam+Act90+28N	0.25+0.25%+2%	28	5	10	8002	53	70	73	61	71	86
Imam+Sunit	0.25+0.188G	28	5	10	8002	73	83	67	81	85	89
Imam+Quad 7	0.25+1%	28	5	10	8002	65	73	75	78	82	93
Imam+Act90+28N	0.25+0.25%+2%	28	10	10	8004	52	65	65	53	71	87
Imam+Sunit	0.25+0.188G	28	10	10	8004	58	68	75	59	75	89
Imam+Quad 7*	**0.25+1%**	**28**	**10**	**10**	**8004**	**22**	**48**	**27**	**23**	**53**	**21**
C.V. %						23	21	22	8	7	6
LSD 5%						21	23	24	8	8	7
# OF REPS						3	3	3	4	4	4

Bold indicates a known application at twice the desired speed (= ½ rate). *The low control with an adjuvant positive to spray retention indicates a possible application error.

Summary

Only three replications were evaluated because of flooding in the area at the first evaluation. The error means square was large so significant difference among treatments are limited. In general, Imazamox was equally effective when applied in 2.5 to 10 gpa especially when the adjuvant was Sun-it used on an area basis. Imazamox generally gave less millet control when applied with Activator 90 + 28% N than Sun-it, except control was similar when applied in 10 gpa using 8004 nozzles. Control of all species was greatest when Imazamox was applied in 5 gpa, regardless of adjuvant.

Bentazon with adjuvants on broadleaf species. (Nalewaja and Ciernia) 'Omega' flax, birdseed sunflower, and amaranth were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 4- to 5-inch flax, 6-leaf sunflower and 6-inch amaranth on July 1 with 79 F, 39% RH, sunny sky and 0-to 3-mph wind. Treatments were applied with a 4-wheeled all terrain sprayer with a side mounted boom with four nozzles spaced 20 inches apart. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Jul 8		
						Flax	Amar	Sufl
	oz/A						%	
Bent+Scoil	8+0.188G	28	2.5	10	8001	5	60	78
Bent+Act90	8+0.25%	28	2.5	10	8001	3	53	71
Bent+SilwetL77	8+0.25%	28	2.5	10	8001	1	30	68
Bent+Quad 7	8+1%	28	2.5	10	8001	0	25	79
Bent+Quad 7	8+2%	28	2.5	10	8001	3	41	78
Bent+Scoil	8+0.188G	28	10	10	8004	5	36	86
Bent+Act90	8+0.25%	28	10	10	8004	3	63	85
Bent+SilwetL77	8+0.25%	28	10	10	8004	5	28	80
Bent+Quad 7	8+1%	28	10	10	8004	6	55	89
Bent+Quad 7	8+2%	28	10	10	8004	6	29	90
C.V. %						94	19	11
LSD 5%						NS	11	13
# OF REPS						4	4	4

Summary

Bentazon phytotoxicity to sunflower was generally greater when applied in 10 gpa using 8004 nozzles than 2.5 gpa using 8001 nozzles. Silwet L77 was or tended to be less effective than the other adjuvants with bentazon for sunflower control. Bentazon control of amaranth varied greatly with adjuvants, but did not follow a clear pattern relative to spray volume (nozzle size). Amaranth is easily wet and the high wetting characteristic of Silwet L77 and Quad 7 at 2% may account for the poor control at 10 gpa. The greater amaranth control for bentazon with Scoil when in 2.5 than 10 gpa may relate to the high oil concentration when 0.18G is applied in 2.5 gpa.

Thifensulfuron & tribenuron with adjuvants on broadleaf species. 'Omega' flax, birdseed sunflower, and amaranth were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 4- to 5-inch flax, 6-leaf sunflower, and 8-leaf amaranth on July 1 with 79 F, 39% RH, sunny sky and 0-to 3-mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Jul 9 Flax	Jul 9 Amar	Jul 9 Sufl
	oz/A					%	%	%
Thif&Trib+X77	0.05+0.25%	28	2.5	10	8001	31	88	69
Thif&Trib+X77	0.1+0.25%	28	2.5	10	8001	26	90	71
Thif&Trib+Quad 7	0.05+1%	28	2.5	10	8001	28	89	76
Thif&Trib+Quad 7	0.1+1%	28	2.5	10	8001	31	89	78
Thif&Trib+X77	0.05+0.25%	28	5	5	8001	31	89	70
Thif&Trib+X77	0.1+0.25%	28	5	5	8001	31	91	75
Thif&Trib+Quad 7	0.05+1%	28	5	5	8001	29	82	76
Thif&Trib+Quad 7	0.1+1%	28	5	5	8001	31	90	79
Thif&Trib+X77	0.05+0.25%	28	5	10	8002	26	84	74
Thif&Trib+X77	0.1+0.25%	28	5	10	8002	26	89	76
Thif&Trib+Quad 7	0.05+1%	28	5	10	8002	30	89	75
Thif&Trib+Quad 7	0.1+1%	28	5	10	8002	31	91	86
C.V. %						15	8	7
LSD 5%						NS	NS	7
# OF REPS						4	4	4

Summary

Thifensulfuron and tribenuron gave similar flax and redroot pigweed control regardless of adjuvant spray mixture or rate applied. Thifensulfuron and tribenuron rate did not influence sunflower control, except when applied with 8002 nozzles in 5 gpa at 10 mph with Quad 7. These data indicate that 2.5 or 5 gpa spray volumes and thifensulfuron&tribenuron rates of 0.05 or 1.0 oz/A did not greatly influence efficacy.

2,4-D amine with adjuvants for broadleaf control. (Nalewaja and Ciernia) 'Omega' flax, amaranth, and birdseed sunflower were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 4- to 5-inch flax, 8-leaf amaranth, and 6-leaf sunflower on July 1 with 79 F, 39% RH, sunny sky and 0 to 3-mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer with a side mounted boom having four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Jul 9 Flax	Jul 9 Rrpw	Jul 9 Sufl
	oz/A					%	%	%
2,4-Ddma	3	28	2.5	10	8001	21	30	38
2,4-Ddma+Act90	3+0.25%	28	2.5	10	8001	20	36	41
2,4-Ddma+Quad 7	3+1%	28	2.5	10	8001	21	38	48
2,4-Ddma	3	28	10	2.5	8001	23	30	41
2,4-Ddma+Act90	3+0.25%	28	10	2.5	8001	24	38	45
2,4-Ddma+Quad 7	3+1%	28	10	2.5	8001	26	48	51
2,4-Ddma	3	28	10	5	8004	23	51	58
2,4-Ddma+Act90	3+0.25%	28	10	5	8004	25	36	53
2,4-Ddma+Quad 7	3+1%	28	10	5	8004	25	38	49
C.V. %						16	18	14
LSD 5%						NS	10	9
# OF REPS						4	4	4

Summary

Adjuvants did not appear important to 2,4-D efficacy. The large spray droplets from 8004 nozzles appeared positive to 2,4-D efficacy. Redroot pigweed and sunflower probably retained the large droplets equally as well as the smaller droplets from 8001 nozzles.

Quizalofop (Assure II) with adjuvants for grass control. (Nalewaja and Ciernia) 'Paul' oat was seeded August 4. Treatments were applied to 5-leaf oat on September 4 with 80 F, 30% RH, sunny sky, and 5-mph wind. Treatments were applied with a 4-wheeled all terrain sprayer with a side mounted boom having four nozzles spaced 20 inches apart. Various spray volumes were obtained by changes in speed, nozzles, and pressure. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	Sep 2 Oat
	oz/A					%
Quizalofop+PO	0.4+1%	28	2.5	10	8001	49
Quizalofop+PO	4+0.18G	28	2.5	10	8001	82
Quizalofop+Quad7	0.4+1%	28	2.5	10	8001	87
Quizalofop+PO	0.4+1%	28	10	2.5	8001	70
Quizalofop+PO	0.4+0.18G	28	10	2.5	8001	76
Quizalofop+Quad7	0.4+1%	28	10	2.5	8001	88
Quizalofop+PO	0.4+1%	28	5	10	8002	62
Quizalofop+PO	0.4+0.18G	28	5	10	8002	82
Quizalofop+Quad7	0.4+1%	28	5	10	8002	87
Quizalofop+PO	0.4+1%	28	10	10	8004	60
Quizalofop+PO	0.4+0.18G	28	10	10	8004	75
Quizalofop+Quad7	0.4+1%	28	10	10	8004	89
Quizalofop+PO	0.4+1%	15	2.5	12	LP8001	56
Quizalofop+PO	0.4+.18G	15	2.5	12	LP8001	73
C.V. %						8
LSD 5%						8
# OF REPS						4

Summary

Quizalofop was most phytotoxic to oat when applied with Quad 7 and spray volume or droplet size did not influence efficacy when with Quad 7. Spray volume form 2.5 to 10 gpa were equally effective for quizalofop applied with a petroleum oil (Herbimax) adjuvant at 1.5 pt/A (0.18G. However, quizalofop efficacy increase with spray volume using 8001 or 8002 nozzles when applied with petroleum oil adjuvant at 1% of the spray carrier. The reduced efficacy at 10 gpa using 8004 nozzles and 1% (0.8 pt/A) petroleum adjuvant, but not with 1.5 pt/A indicates that the higher percentage of oil in the spray probably was required for retention of the large droplets. These data further support the concept that low spray volumes are efficacious when the adjuvant percentage is increased to equal the amount of the high spray volume. Further, large spray droplets, as from LP8001 at 2.5 gpa or 8004 at 10 gpa are efficacious with proper adjuvant and adjuvant concentration.

Nicosulfuron (Accent) plus adjuvants for grass control. (Nalewaja and Ciernia) 'Paul' oat, white proso millet, and Siberian foxtail millet were seeded in adjacent strips as bioassay species on May 29. Treatments were applied to 7-to 8-leaf oat and 6- to 8-leaf millets on July 10 with 87 F, 51% RH, sunny sky, and 3- to 6-mph wind. Treatments were applied with a 4-wheel all-terrain sprayer with a side mounted boom having four nozzles spaced 20 inches apart. Various spray volumes were obtained by changes in speed, and nozzles. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Psi	Gpa	Mph	Tip	July 29		
						Prmi	Ftmi	Oat
	oz/A						%	
Nicosulfuron+Act90	0.25+0.25%	28	2.5	10	8001	33	40	38
Nicosulfuron+Quad7	0.25+1%	28	2.5	10	8001	75	79	78
Nicosulfuron+Quad7	0.25+2%	28	2.5	10	8001	78	88	87
Nicosulfuron+Scoil	0.25+1%	28	2.5	10	8001	56	58	61
Nicosulfuron+Scoil	0.25+0.188G	28	2.5	10	8001	78	84	87
Nicosulfuron+Act90	0.25+0.25%	28	10	10	8004	51	57	69
Nicosulfuron+Quad7	0.25+1%	28	10	10	8004	75	77	85
Nicosulfuron+Quad7	0.25+2%	28	10	10	8004	79	83	85
Nicosulfuron+Scoil	0.25+1%	28	10	10	8004	71	76	80
Nicosulfuron+Scoil	0.25+0.188G	28	10	10	8004	78	84	83
C.V. %						9	11	8
LSD 5%						9	12	9
# OF REPS						4	4	4

Summary

Nicosulfuron phytotoxicity to all species was equally as great when applied in 2.5 or 10 gpa when with Scoil at 1.5 pt/A (0.188G) or Quad 7 at 1 or 2%. However, Quad 7 was more effective for oat control at 2% when in 2.5 gpa. Nicosulfuron was less effective in 2.5 than 10 gpa when Activator 90 or Scoil were used on a percentage of the spray.

Spray volume with glyphosate (Roundup Ultra), Fargo,ND. (Nalewaja, John D and Mark G. Ciernia). An experiment was established to determine the efficacy of glyphosate (Roundup Ultra) applied in different spray volumes. 'Paul' oat, 'Siberian' foxtail millet, and 'White' proso millet were seeded in adjacent strips as bioassay species on August 4. Treatments were applied to 7-leaf oat and 5-leaf millets on September 11, 1998, with 80 F, 30% RH, and 9 mph wind. Treatments were applied with a 4-wheeled all-terrain sprayer equipped with a side mounted boom with four nozzles spaced at 20 inches. Various spray volumes were obtained by changes in speed, nozzles, and pressure. The experiment was a randomized complete block design with four replicates. Control was evaluated on September 21, 1998.

Treatment[a]	Rate	Psi	Gpa	Mph	Tip	Sept 21 Oat	Sept 21 Fomi	Sept 21 Prmi
	oz/A					%	%	%
Glyphosate	0.5	28	2.5	10	8001	30	24	27
Glyphosate+12-14-80	0.5+0.5%	28	2.5	10	8001	69	80	74
Glyphosate	0.5	28	5	5	8001	34	54	38
Glyphosate+12-14-80	0.5+0.5%	28	5	5	8001	70	78	69
Glyphosate	0.5	15	2.5	12	LP8001	38	51	44
Glyphosate+12-14-80	0.5+0.5%	15	2.5	12	LP8001	74	78	64
Glyphosate	0.5	28	5	10	8002	15	35	5
Glyphosate+12-14-80	0.5+0.5%	28	5	10	8002	76	80	69
Glyphosate	0.5	28	10	10	8004	3	28	5
Glyphosate+12-14-80	0.5+0.5%	28	10	10	8004	61	74	56
C.V. %						15	9	13
LSD 5%						10	8	8
# OF REPS						4	4	4

[a] 12-14-80=Alfonic 12-14-80 ethoxylate surfactant from Vista Chemical Co., Austin, TX.

Summary

Oat was the most uniform species and rating for oat should best indicate response to treatments, even though the LSD is larger for oat. Surfactant greatly increased Roundup Ultra phytotoxicity regardless of spray volume, nozzles, travel speed, or pressure. Roundup Ultra with or without surfactant (12-14-80) was less phytotoxic to oat when applied at 10 gpa using 8004 nozzles than any other treatment. It cannot be determined from the experiment if the reduced Roundup Ultra efficacy at 10 gpa was because of the high volume or the large droplets produced by the 8004 nozzles. The results clearly indicate that additional adjuvants are required with Roundup Ultra at low use rates.

Alfalfa Response to Velpar. Zollinger and Fitterer. An experiment was conducted at NW-22 to evaluate the response of alfalfa to Velpar. POST applications were applied to alfalfa breaking dormancy with ¼" growth on April 9, 1998 at 3:00 pm with 52 F air, 45 F soil surface, 38% RH, 0-5 mph NW wind, 60% clouds, moist soil surface, wet subsoil, no dew and alfalfa breaking dormancy with ¼" growth. Treatments were applied to the center 8 ft of the 10 X 30 ft plots with a CO_2 backpack sprayer delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

Treatment	Rate	Yield
	(lb/A)	(tons dry matter/A)
Velpar DF (1X rate)	1	2.44
Velpar DF (2X rate)	2	2.25
Untreated check		2.58
LSD (0.05)		NS

Rainfall occurred on April 12 and 13 in the amount of 0.01" and 0.05" respectively. No alfalfa injury was detectable throughout the season. Harvest was taken June 3, 1998 with alfalfa in 7% bloom and an average height of 27".

Imi Canola. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from herbicides applied at the PPI and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 4, 1998 at 1:00 pm with 66 F air, 58 F soil 2-4" depth, 32% RH, 100% clouds, and 25 NW mph wind, dry soil surface, and moist subsoil. Pioneer '45A71' canola was planted May 4, 1998. POST treatments were applied May 29, 1998 at 3:10 pm with 66 F air, 87 F soil surface, 36% RH, 0% clouds, and 10-12 mph N wind, dry soil surface, moist subsoil, good crop vigor, no dew present, and crop stage was cotyledon-2 lf. Weed species present were: 1-2", (30-40/ft^2) foxtail; 1-2", 1-3 lf, (5-10/ft^2) rosette wild mustard; 2-4", 2 lf, (5-12/ft^2) common cocklebur. LPOST treatments were applied June 23, 1998 at 12.00 pm with 79 F air, 68 F soil surface, 68% RH, 50% clouds, and 6-8 mph SE wind, moist soil surface, wet subsoil, good crop vigor, no dew present, and crop stage was bolting. Weed species present were: 1-4", 1-4 lf, (30-40/ft^2) foxtail; 3-6", bolting, (5-10/ft^2) wild mustard; and 2-6", 4-6 lf, (5-12/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 30 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for soil applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for the POST treatments. The experiment had a randomized complete block design with four replicates per treatment.

		May 29			14 DAT			28DAT		
Treatment	Rate	Fxtl	Wimu	Cocb	Fxtl	Wimu	Cocb	Fxtl	Wimu	Cocb
	Product/A	%								
PPI										
Treflan	1.5pt	89	53	50	90	15	16	86	45	15
PPI fb POST										
Treflan/Herbicide 273	1.5pt/1.5pt	95	41	43	93	99	73	90	20	0
Treflan/Pinnacle+Herbimax	1.5pt/0.25oz+1.25%	96	43	39	96	61	40	84	99	35
Treflan/Motive+Herb+28%	1.5pt/2oz+1.25%+1.25%	97	56	50	96	56	65	79	98	63
Treflan/Motive+Herb+28%	1.5pt/4oz+1.25%+1.25%	92	34	39	98	99	88	90	99	88
Treflan/Motive+Herb+28%	1.5pt/4oz+1.25%+1.25%	96	49	55	99	99	90	97	99	84
POST										
Motive+Herb+28% UAN	2oz+1.25%+1.25%	-	-	-	88	94	73	79	99	75
Motive+Activator 90+28%	2oz+0.25%+1.25%	-	-	-	93	97	81	75	99	81
Motive+Herb+28% UAN	4oz+1.25%+1.25%	-	-	-	95	97	81	84	99	84
Motive+Act 90+28% UAN	4oz+0.25%+1.25%	-	-	-	95	98	91	83	99	86
Motive+Herb+28% UAN	5oz+1.25%+1.25%	-	-	-	94	99	79	86	99	86
Motive+Act 90+28% UAN	5oz+0.25%+1.25%	-	-	-	94	99	86	88	99	89
Motive+Herb+28% UAN	5oz+1.25%+1.25%	-	-	-	93	98	86	88	99	89
Motive+Act 90+28% UAN	5oz+0.25%+1.25%	-	-	-	93	98	80	81	99	88
Assure II+Pinnacle+Act 90	8oz+0.25oz+0.25%	-	-	-	66	58	30	80	99	35
Poast+Motive+Herb+28%	1pt+2oz+1.25%+1.25%	-	-	-	94	94	58	90	99	78
Poast+Motive+Herb+28%	1pt+4oz+1.25%+1.25%	-	-	-	96	96	86	90	99	88
Poast+Stinger+Herb+28%	1pt+0.33oz+1.25%+1.25%	-	-	-	92	28	21	91	30	50
LPOST										
Motive+Herb+28% UAN	4oz+1.25%+1.25%	-	-	-	59	99	40	75	99	65
Motive+Act 90+28% UAN	4oz+0.25%+1.25%	-	-	-	79	75	40	81	99	73
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		2	5	8	11	18	18	11	5	13

Excessive rainfall cause canola damage particularly to the second replicate. The study was not harvested for yield due to crop injury from rainfall. All treatments except Poast + Stinger gave complete pigweed and common lambsquarters control. At 28 DAT most POST treatments containing Motive showed little difference in foxtail, wild mustard, and common cocklebur control regardless of rate.

Wild oat control in imidazolinone-tolerant canola. (Brian Jenks, Minot) Canola was seeded May 15 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, early-post (June 8), and late-post (June 22) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. At planting, soil temperature was 56°F and soil was dry. Canola was harvested with a small plot combine on August 19.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. Postemergence treatments were delayed due to cold temperatures and high winds. No crop injury or maturity differences were observed. All imazamox treatments provided good wild oat control. However, yields were much higher when imazamox was applied to smaller wild oat compared to larger wild oat. Canola yields were much higher when early-season wild oat competition was reduced with trifluralin, trifluralin + imazamox, or imazamox applied early-post. Although they appeared less competitive, a light population of ALS-resistant kochia was present in the plots and were standing above the crop at the end of the season.

Application date	May 12	June 8	June 22
Application timing	PPI	POST I	POST II
Temperature (°F)			
Air	65	60	67
Soil	62	57	65
Soil moisture	dry	dry	moderate
Relative humidity (%)	35	40	57
Canola stage		2 to 3-leaf	4 to 5-leaf
Wild oat stage		4-leaf	6-leaf

Table. Wild oat control in imidazolinone-tolerant canola.

Treatment	Rate	7-5 Wioa	8-12 Wioa	8-19 Yield
	lb/A	--% Control--		lb/A
trifluralin	0.75	75	68	1025
trifluralin / endothall	0.75 / 0.56	80	68	1182
trifluralin / imazamox + COC + 28% N	0.75 / 0.016 + 1.25% +1.25%	99	96	1553
trifluralin / imazamox + COC + 28% N	0.75 / 0.032 + 1.25% + 1.25%	98	99	1472
trifluralin / thifensulfuron + COC	0.75 / 0.023 + 1.25%	72	73	1068
imazamox + COC + 28% N	0.016 + 1.25% + 1.25%	95	98	1509
imazamox + NIS + 28% N	0.016 + 0.25% + 1.25%	89	88	1264
imazamox + COC + 28% N	0.032 + 1.25% + 1.25%	94	96	1299
imazamox + NIS + 28% N	0.032 + 0.25% + 1.25%	95	95	1441
imazamox + COC + 28% N	0.04 + 1.25% + 1.25%	96	99	1359
imazamox + NIS + 28% N	0.04 + 0.25% + 1.25%	97	98	1524
sethoxydim + imazamox + COC + 28% N	0.2 + 0.016 + 1.25% + 1.25%	95	98	1376
sethoxydim + imazamox + COC + 28% N	0.2 + 0.032 + 1.25% + 1.25%	96	99	1180
sethoxydim + clopyralid + COC + 28% N	0.2 + 0.125 + 1.25% + 1.25%	95	97	1471
quizalofop + thifensulfuron + NIS	0.055 + 0.023 + 0.25%	89	88	1182
imazamox + COC + 28% N (Post II)	0.032 + 1.25% + 1.25%	88	99	1164
imazamox + NIS + 28% N (Post II)	0.032 + 0.25% + 1.25%	85	98	1005
imazamox + COC + 28% N (Post II)	0.04 + 1.25% + 1.25%	90	99	1151
imazamox + NIS + 28% N (Post II)	0.04 + 0.25% + 1.25%	89	99	1042
hand-weeded + / trifluralin + / imazamox + NIS + 28% N	0.75 + / 0.032 + 0.25% + 1.25%	98	98	1649
weedy check		0	0	596
weedy check		0	0	585
CV		6	6	17
LSD (0.05)		8	8	333

COC= Class 17% Concentrate by Cenex
NIS= Class Preference by Cenex

Efficacy and crop tolerance to quizalofop/ethametsulfuron combinations in canola. (Brian Jenks, Minot) Canola was seeded May 15 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of a single application timing for grass control in canola. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. Postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 18.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. No crop injury or maturity differences due to herbicide treatments were observed. Wild oat control with quizalofop alone was excellent (>96%) at both evaluations. Wild oat control was reduced slightly (5-10%) when quizalofop was tankmixed with ethametsulfuron. Increasing the quizalofop rate to overcome antagonism did not significantly raise percent weed control or canola yields in this study.

Application date	June 8
Application timing	POST
Temperature (°F)	
Air	60
Soil	57
Soil moisture	dry
Relative humidity (%)	60
Canola stage	3-leaf
Wild oat stage	4-leaf

Table. Efficacy and crop tolerance to quizalofop/ethametsulfuron combinations in canola.

Treatment	Rate	July 7 Wioa	August 10 Wioa	Aug 18 Yield
	lb/A	------------ % Control	-----------	lb/A
quizalofop + COC	0.055 + 1%	96	99	1381
quizalofop + COC	0.07 + 1%	97	99	1364
ethametsulfuron + COC	0.014 + 1%	66	73	1284
quizalofop + ethametsulfuron + COC	0.055 + 0.014 + 1%	86	95	1345
quizalofop + ethametsulfuron + COC	0.07 + 0.014 + 1%	89	92	1413
untreated		0	0	488
CV		11	8	14
LSD (0.05)		14	12	305

COC = Herbimax by Loveland

Optimum rate and application timing in glyphosate-tolerant canola. (Brian Jenks, Minot) The objective was to evaluate the effect of different rates and application timings on crop tolerance and weed control. Canola was seeded May 15 into 7.5-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of early-post (June 6), mid-post (June 15), and late-post (June 22) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 18.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high in surrounding fields, but there was little or no damage to the glyphosate-tolerant canola which had been treated with Gaucho. Wild oat control was excellent with all herbicide treatments. Any treatments receiving the late-post application caused lower leaves to turn a purplish color and also delayed flowering. Delayed flowering was not observed with the early- or mid-post applications. Yield decreased with later applications when glyphosate was applied at 16 or 32 fl oz alone. Weed competition and/or crop injury may have contributed to the yield decrease. A decreasing yield trend was not observed in the split applications of glyphosate.

Application date	June 6	June 15	June 22
Application timing	POST I	POST II	POST III
Temperature (°F)			
Air	56	58	65
Soil	58	65	61
Relative humidity (%)	42	38	66
Canola stage	2 to 3-leaf	4-leaf	6-leaf
Wild oat stage	3-leaf	4-leaf	6-leaf

Table. Optimum rate and application timing in glyphosate-tolerant canola.

Treatment	Rate	Timing	7-4 Wioa	8-11 Wioa	8-18 Yield
	lb/A		-----% Control-----		lb/A
untreated			0	0	1020
glyphosate + AMS	0.38 + 1%	Early	93	96	1655
glyphosate + AMS	0.38 + 1%	Mid	96	98	1587
glyphosate + AMS	0.38 + 1%	Late	97	99	1396
glyphosate + AMS	0.75 + 1%	Early	96	96	1761
glyphosate + AMS	0.75 + 1%	Mid	96	97	1618
glyphosate + AMS	0.75 + 1%	Late	98	99	1556
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Early / Mid	95	97	1605
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Early / Late	99	99	1585
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Mid / Late	98	99	1617
sethoxydim + clopyralid + MSO	0.2 + 0.188 + 2.5%	Mid	97	99	1719
quizalofop + NIS	0.055 + 0.25%	Early	91	93	1832
quizalofop + NIS	0.055 + 0.25%	Mid	94	96	1681
CV			2	1	22
LSD (0.05)			3	1	347

MSO = DASH from BASF
NIS = Class Preference from Cenex

Weed control in glufosinate-tolerant canola. (Brian Jenks, Minot) Canola was seeded May 12 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, early-post (June 6), and late-post (June 15) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 17.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. No crop injury or maturity differences were observed with any herbicide treatment. All PPI or early-post treatments provided good wild oat control. However, control and yields were much higher when glufosinate was applied to 3-lf wild oat compared to 5-lf wild oat. Wild oat control was slightly higher with the split application of glufosinate compared to single applications. Canola yields were much higher by reducing early-season wild oat competition with either trifluralin, trifluralin + glufosinate, or glufosinate applied early-post. The addition of sethoxydim did increase wild oat control and canola yield. Kochia was present in the experimental area, but populations were not uniform and therefore not rated; however, kochia was controlled in glufosinate-treated plots.

Application date	May 5	June 6	June 15
Application timing	PPI	POST I	POST II
Temperature (°F)			
Air	61	59	72
Soil	64	62	70
Soil moisture	Dry	Dry	Moderate
Relative humidity (%)	33	38	34
Canola stage		2 to 3-leaf	4-leaf
Wild oat stage		3-leaf	5-leaf

Table. Weed control in glufosinate-tolerant canola.

Treatment	Rate	7-4 Wioa	8-11 Wioa	8-17 Yield
	lb/A	---------% Control	----------	lb/A
trifluralin	0.75	94	93	1380
trifluralin / endothall	0.75 / 0.56	89	90	1467
trifluralin / glufosinate	0.75 / 0.27	96	97	1801
trifluralin / glufosinate (Post II)	0.75 / 0.27	91	97	1754
glufosinate	0.27	79	87	1443
glufosinate + AMS	0.27 + 3	82	90	1438
glufosinate + sethoxydim + MSO	0.27 + 0.2 + 1.25%	94	93	1657
glufosinate	0.36	79	86	1474
glufosinate + AMS	0.36 + 3	88	83	1377
glufosinate	0.45	94	94	1720
glufosinate	0.89	94	94	1720
glufosinate / glufosinate (Post II)	0.27 / 0.27	96	95	1618
glufosinate (Post II)	0.27	68	67	842
glufosinate + MSO (Post II)	0.27 + 1.25%	77	70	1068
glufosinate (Post II)	0.36	65	55	999
glufosinate + AMS (Post II)	0.36 + 3	82	74	1306
glufosinate (Post II)	0.45	78	69	1059
glufosinate (Post II)	0.89	86	78	1400
hand-weeded +		98	99	1710
trifluralin /	0.75			
glufosinate	0.27			
weedy check		0	0	452
CV		9	8	24
LSD (0.05)		12	11	548

MSO = Class Destiny from Cenex

Canola herbicide screening trial at Minot, ND - 1998. (Brian Jenks, Minot) The objective of this trial was to evaluate weed control in imidazolinone-tolerant canola. Treatments consisted of combinations of PPI's, PRE's, and two postemergence applications. All treatments were applied with a bicycle sprayer using CO_2 as the propellant. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. The PPI's and PRE's were applied with 80015 flat fan nozzles, 20 gpa at 30 psi. All post treatments were applied with 8001 flat fan nozzles, 10 gpa at 40 psi. Canola variety 45A71 was seeded May 13 at 700,000 seeds per acre. Seed bed preparation was conventional with 6-inch row spacing. At planting, soil temperature was 56°F and soil was dry. Application information is listed below:

Application date	May 12	May 14	June 10	June 22
Application timing	PPI	PRE	POST I	POST II
Temperature (°F)				
Air	66	63	65	65
Soil	61	57	63	59
Soil moisture	Dry	Dry	Dry	Moist
Relative humidity (%)	35	87	74	66
Wind (mph)	8	5-8	6	4
Time of day	4 pm	4 pm	7 pm	10 am
Canola				
leaf no.			3	6
Wild oat				
leaf no.			3	4-5
tiller no.			1	2
density (ft^2)			7	10

Soil conditions were very dry for the first 30 d after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. The canola crop was not as competitive as normally expected early in the growing season due to the dry conditions and flea beetle damage. Severe crop injury was observed with carfentrazone (60%). Dicamba and quinclorac caused stunting early but the crop appeared to recover as the season progressed. Endothall caused slight stunting and delayed maturity in all treatments. Wild oat control with trifluralin combinations ranged from 52-73% with most treatments. Control was slightly higher (85%) when mixed with ethametsulfuron, which was also observed in a separate study (data not shown) indicating that ethametsulfuron may have some activity on wild oat. PPI treatments alone provided poor to fair wild oat control. PRE treatments did not control wild oat. Postemergence grass herbicides generally provided excellent wild oat control. The most effective treatment was probably trifluralin (PPI) followed by an early postemergence grass herbicide. Notes were taken on control of low populations of wild buckwheat and kochia, but are not presented here. In general, following POST applications, wild buckwheat populations were lower in endothall and clopyralid plots and highest in the PRE treatments or with products containing grass herbicides only. Imazamox did not control wild buckwheat as well as endothall or clopyralid. Kochia populations were also higher in the PRE and grass-herbicide treatments. There were fewer kochia in the ethalfluralin, trifluralin, pendimethalin, F-8426, and quinclorac treatments. Imazamox appeared to control some of the kochia, but a few plants did stand above the canola. These plants exhibited excessive branching (or shortened distance between branches) at the base, which is typical of ALS-resistant kochia.

Table. Canola herbicide screening trial at Minot, ND - 1998

Treatment[a]	Rate	7-5 Wioa	8-10 Wioa	8-20 Yield
	(lb ai/A)	(% control)		(lb/A)
PPI Treatments				
ethalfluralin	0.95	83	74	1041
pendimethalin	1.24	57	53	940
trifluralin	0.75	70	62	1235
trifluralin	1.0	88	67	953
metolachlor	1.5	37	23	580
dimethenamid	1.5	40	30	768
acetochlor + safener	2.4	42	25	739
PRE treatments				
metolachlor	1.5	43	40	911
dimethenamid	1.5	52	35	865
acetochlor + safener	2.4	55	48	680
PPI / POST I treatments				
trifluralin / clopyralid	0.75 / 0.125	65	63	1251
trifluralin / dicamba	0.75 / 0.063	83	72	1114
trifluralin / endothall	0.75 / 0.375	69	52	879
trifluralin / endothall	0.75 / 0.56	75	73	1205
trifluralin / endothall	0.75 / 0.75	80	72	1087
trifluralin / ethametsulfuron + COC	0.75 / 0.019 + 1%	80	85	1161
trifluralin / thifensulfuron + COC	0.75 / 0.004 + 1%	68	60	1044
trifluralin / imazamox + COC + 28%N	0.75 / 0.016 + 1.25% + 1.25%	99	99	1480
trifluralin / imazamox + COC + 28%N	0.75 / 0.032 + 1.25% + 1.25%	99	99	1330
PPI / POST II treatments				
trifluralin / endothall (Post II)	0.75 / 0.56	73	64	1086
trifluralin / imazamox + COC + 28% N (Post II)	0.75 / 0.016 + 1.25% + 1.25%	88	99	1345
trifluralin / imazamox + COC + 28% N (Post II)	0.75 / 0.032 + 1.25% + 1.25%	85	99	1186

(continued)

Table. Canola herbicide screening trial at Minot, ND -1998 (continued)

Treatment[a]	Rate	7-5 Wioa	8-10 Wioa	8-20 Yield
	(lb ai/A)	(% control)		(lb/A)
POST I treatments				
quizalofop + COC	0.055 + 1%	98	99	1416
nicosulfuron + COC	0.031 + 1%	95	98	1089
endothall	0.56	0	0	762
sethoxydim + COC	0.2 + 1.25%	80	99	1148
quizalofop + thifensulfuron + COC	0.055 + 0.004 + 1%	95	99	1072
quizalofop + ethametsulfuron + COC	0.055 + 0.019 + 1%	95	95	1192
quizalofop + clopyralid + COC	0.055 + 0.125 + 1%	98	99	1282
nicosulfuron + thifensulfuron + COC	0.016 + 0.004 + 1%	95	99	1291
nicosulfuron + thifensulfuron + COC	0.031 + 0.004 + 1%	95	91	1256
imazamox + COC + 28% N	0.016 + 1.25% + 1.25%	96	99	1361
imazamox + COC + 28% N	0.032 + 1.25% + 1.25%	99	99	1448
sethoxydim + carfentrazone + NIS	0.2 + 0.004 + 0.25%	94	98	982
sethoxydim + carfentrazone + NIS	0.2 + 0.008 + 0.25%	79	78	971
sethoxydim + endothall + NIS	0.2 + 0.375 + 0.25%	95	98	998
quinclorac + MSO	0.125 + 1.25%	27	32	921
quinclorac + MSO	0.25 + 1.25%	33	50	902
POST I / POST II treatments				
sethoxydim + COC / endothall (Post II)	0.2 + 1.25% / 0.375	99	99	1105
quizalofop + COC / thifensulfuron + COC (Post II)	0.055 + 1.0% / 0.004 + 1.0%	98	99	1449
quizalofop + COC / imazamox + COC + 28% N (Post II)	0.055 + 1.0% / 0.016 + 1.25% + 1.25%	98	99	1326
POST II treatment				
imazamox + COC + 28% N (Post II)	0.032 + 1.25% + 1.25%	85	99	1086
Checks				
hand-weeded + trifluralin / imazamox + COC + 28% N	0.75 / 0.032 + 1.25% + 1.25%	99	99	1564
weedy check		0	0	749
CV		16	15	22
LSD (0.05)		19	18	395

[a] Additives: NIS is Class Preference, COC is Class 17% Concentrate, and MSO is Class Destiny.

Weed managment in Roundup-Ready canola, Carrington 1998. (Endres and Zwinger) The experiment was conducted to evaluate canola injury and weed control with selected rates and application timing of Roundup Ultra. Roundup-ready and Liberty-link canola was seeded in 7-inch rows at a rate to establish 17 plants/ft^2 on June 4, 1998. Herbicide treatments were applied to a 6.67 ft wide area the length of 10 by 25 ft plots with a hand-held sprayer through 8001 flat-fan nozzles delivering 10.3 gal/A at 40 psi. Treatments on 3-leaf canola were applied June 27 with 63 F, 78% RH, sunny sky, and 8 mph wind to 0.5- to 6-inch tall redroot and prostrate pigweed, 1- to 2-inch tall common lambsquarters, and 2- to 5-leaf yellow and green foxtail. Treatments on 4- to 5-leaf canola were applied July 1 with 66 F, 86% RH, sunny sky, and 1 mph wind to 0.5- to 6-inch tall pigweed, 1- to 2-inch tall common lambsquarters, and 2- to 5-leaf foxtail. Treatments on 5- to 6-leaf canola were applied July 3 with 64 F, 96% RH, 100% cloudy sky, and 9 mph wind to 0.5- to 8-inch tall pigweed, 1- to 2-inch tall common lambsquarters, and 3- to 5-leaf foxtail. Crop tolerance was visually evaluated July 9 and August 24. The canola was machine harvested on August 26. The experiment was a randomized complete block design with three replications.

Herbicide			Canola	Weed control				Canola	
				Pigweed		Colq	Fxtl	Seed	Test
No.	Treatment	Rate	stage	7/16	8/27	8/27	8/27	yield	weight
		oz/A	leaf	%				lb/A	lb/bu
1.	Untreated			0	0	0	0	844.8	51.0
2.	Roundup Ultra	16	3	95	93	99	87	984.2	51.5
3.	Roundup Ultra	16	4-5	97	95	98	85	1004.3	52.1
4.	Roundup Ultra	16	5-6	95	96	97	83	1071.2	51.4
5.	Roundup Ultra	32	3	96	96	94	75	874.3	51.6
6.	Roundup Ultra	32	4-5	97	97	97	78	820.1	51.9
7.	Roundup Ultra	32	5-6	98	96	98	83	763.3	52.4
8.	Roundup Ultra	16/16	3/4-5	98	97	99	78	878.7	51.4
9.	Roundup Ultra	16/16	3/5-6	99	98	99	82	957.4	52.4
10.	Roundup Ultra	16/16	4-5/5-6	98	98	99	96	1046.1	51.1
11.	Poast + Stinger + COC	29 + 8 + 0.125%	4-5	50	43	50	97	696.0	51.1
12.	Hand-weeded			99	93	88	85	1035.5	50.6
13.	Hand-weeded + Roundup Ultra	32	3	99	95	98	88	896.0	52.4
Mean				86	84	86	78	913.2	51.6
C.V. %				14	13	18	16	15	2
LSD (0.05)				21	18	26	22	230.9	NS
14.	Liberty	32	4-5	94	92	92	68	458.7	48.9

Canola injury or development delay were not observed. Generally, all Roundup Ultra treatments provided good to excellent weed control. The low rate of Roundup Ultra provided similar weed control and similar or greater seed yield compared to the higher rate applied once or as a sequential treatment. Roundup Ultra provided greater control of pigweed and common lambsquarters compared to Poast + Stinger. Seed yield was similar between the hand-weeded check and the hand-weeded check plus Roundup Ultra.

PPI Weed Control in Corn. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from herbicides applied at the PPI and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 7, 1998 at 12:00 pm with 58 F air, 55 F soil at 2-4" depth, 38% RH, 75% clouds, and 0-2 mph NW wind, dry soil surface, and moist subsoil. Interstate PayCo '4X85' corn was planted on May 7, 1998. POST treatments were applied May 29, 1998 at 3:00-3:30 pm with 66 F air, 87 F soil surface, 36% RH, 0% clouds, and 8-10 N mph wind. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for PPI applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST applied treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	May 26			June 12		
		Fxtl	Wimu	Cocb	Fxtl	Wimu	Cocb
	Product/A	%					
PPI							
Axiom	21oz	83	57	13	80	88	0
Axiom	23oz	95	70	25	93	95	20
Axiom+Hornet	21oz+4.8oz	88	98	28	79	99	85
DoublePlay	5pt	99	47	17	97	67	15
Surpass	2.5pt	93	70	35	91	77	23
USA 1000	0.725lb	95	95	23	96	96	60
Axiom+Balance	10.5oz+1.5oz	87	95	23	94	98	53
Surpass+Sencor	2.5pt+3oz	95	95	32	95	93	23
PPI fb POST							
Axiom/Banvel	21oz/1oz	93	99	23	92	92	23
Surpass/Shotgun+Sencor	2.5pt/1.5pt+2oz	90	99	87	95	99	92
Untreated		0	0	0	0	0	0
LSD (0.05)		9	5	11	14	16	23

Cold/wet weather after planting caused little corn to emerge. Most treatments except Axiom at 21 oz/A and Axiom + Hornet gave greater than 90% foxtail control. Most treatments except Axiom at 21 oz/A, DoublePlay, and Surpass gave greater than 90% wild mustard control. Only Hornet or the treatment containing Shotgun gave adequate common cocklebur control.

PRE Weed Control in Corn. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from herbicides applied at the PRE stage. Interstate PayCo '4X85' corn was planted and PRE treatments were applied on May 7, 1998 at 1:30 pm with 62 F air, 55 F soil at 2-4" depth, 38% RH, 100% clouds, and 1-4 mph NW wind, dry soil surface, and moist subsoil. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		May 26			June 12		
Treatment	Rate	Fxtl	Wimu	Cocb	Fxtl	Wimu	Cocb
	Product/A	%					
Balance	1.5oz	77	77	20	86	95	52
Balance	2oz	80	80	25	91	99	60
Harness	2.3pt	95	83	15	93	92	18
Surpass	2.5pt	92	85	17	93	85	10
Balance+Atrazine	1.5oz+0.5lb ai	95	95	25	96	99	72
Balance+FulTime	1.5oz+2.5pt	97	95	22	93	99	77
Balance+Harness	1.5oz+1.125pt	97	95	22	93	98	62
Balance+Harness Xtra	1.5oz+1.63pt	97	96	23	93	99	87
Balance+TopNotch	1.5oz+2pt	97	90	13	88	99	63
Surpass+Hornet	2.5pt+4.8oz	99	99	47	90	98	78
Surpass+Python	2.5pt+1oz	97	97	37	93	95	47
Surpass+Python	2.5pt+1.25oz	99	99	48	88	99	63
Untreated		0	0	0	0	0	0
LSD (0.05)		6	5	10	10	4	10

Rainfall occurred prior to weed emergence to activate herbicides. Cold/wet weather after planting caused little corn to emerge. Most treatments gave greater than 85% foxtail and wild mustard control. Only Balance + Harness Xtra gave greater than 85% common cocklebur control.

PRE/POST Weed Control in Corn. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from herbicides applied at the PRE and POST stages. Interstate PayCo '4X85' corn was planted and PRE treatments were applied May 7, 1998 at 2:00 pm with 64 F air, 55 F soil at a depth of 2-4", 38% RH, 100% clouds, and 1-4 NW mph wind, dry soil surface, and moist subsoil. POST treatments were applied June 5, 1998 at 11:00 am with 56 F air, 62 F soil surface, 43% RH, 100% clouds, and 0-3 NW mph, dry soil surface, and moist subsoil. Weed species present were: 1-3", 2-4 lf, (10-40/ft^2) foxtail; 1-3", 2-4 lf, (10-20/ft^2) rosette wild mustard; 1", cot-1lf, (5-10/ft^2) venice mallow; 2-4", 2-4 lf, (10-30/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for PRE treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 23		July 10	
		Fxtl	Cocb	Fxtl	Cocb
	Product/A	%			
PRE fb POST					
Balance/Buctril	1.5oz/1.5pt	93	98	82	85
Balance/Clarity	1.5oz/0.5pt	82	98	77	95
Frontier/Buctril	20oz/1.5pt	72	90	52	80
Frontier/Shotgun	16oz/3pt	99	98	98	95
Frontier/Shotgun	16oz/2pt	98	97	97	94
Surpass/Shotgun	2.5oz/2pt	96	97	88	96
Frontier/Aim+NIS	20oz/0.32oz+0.25%	87	63	58	53
Frontier/Clarity+28% UAN	20oz/1pt+1qt	81	91	67	96
Frontier/Hornet+Impressive DB	20oz/1.6oz+2.25lb	87	50	67	82
Frontier/Shotgun+Broclean	16oz/1.5pt+0.75pt	99	98	72	93
Frontier/Shotgun+Clarity	16oz/1.5pt+2pt	98	97	93	92
Frontier/Shotgun+PCC-140	16oz/1.5pt+0.33pt	97	98	96	93
Frontier/Distinct+NIS+28% UAN	20oz/4oz+0.25%+2.5qt	87	88	70	93
Frontier/Distinct+NIS+28% UAN	20oz/6oz+0.25%+2.5qt	89	96	70	98
Frontier/Hornet+Herbimax+AMS	20oz/1.6oz+1qt+2lb	92	57	80	78
Frontier/Hornet+NIS+28% UAN	20oz/2.4oz+0.25%+2.5qt	82	60	70	89
Frontier/Aim+Hornet+NIS+28% UAN	20oz/0.32oz+2.4oz+0.25%+2.5qt	95	65	83	90
Untreated		0	0	0	0
LSD (0.05)		16	5	24	11

Cold/wet weather after planting caused little corn to emerge. Balance and Frontier were applied PRE at reduced rates to partially control foxtail and allow evaluation of broadleaf herbicides. Rainfall occurred prior to weed emergence to activate PRE herbicides. All treatments gave complete wild mustard control. Redroot pigweed and common lambsquarters were not uniform at this location and were not evaluated. Most treatments except Frontier followed by Aim gave near 80% common cocklebur control or greater.

POST(1) Weed Control in Corn . Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from POST applied herbicides. Interstate PayCo '4X85' corn was planted on May 7, 1998. POST treatments were applied June 5, 1998 at 12:00-1:00 pm with 56 F air, 62 F soil surface, 43% RH, 100% clouds, and 0-3 mph NW wind, dry soil surface, moist subsoil, poor crop vigor, no dew present, and crop stage was 3-4"/3 lf. Weed species present were: 1-3", 2-4 lf, (10-40/ft^2) foxtail; 1-3", 2-4 lf, (10-20/ft^2) rosette wild mustard; 1", cot-1lf, (5-10/ft^2) venice mallow; 2-4", 2-4 lf, (10-30/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 23		July 10	
		Fxtl	Cocb	Fxtl	Cocb
	Product/A	%			
Accent+Atrazine+Scoil	0.5oz+0.42lb+1.5pt	87	30	92	0
Accent+Clarity+Quad 7	0.33oz+4oz+1%	80	55	68	95
Accent+Clarity+Scoil	0.33oz+4oz+1.5pt	84	53	68	94
Accent+Distinct+Quad 7	0.5oz+4oz+1%	83	68	77	90
Accent+Herbimax+28% UAN	0.67oz+1%+2qt	87	53	83	50
Accent+Hornet+Quad 7	0.5oz+2.4oz+1%	86	60	89	96
Basis+Clarity+Quad 7	0.33oz+4oz+1%	73	63	68	95
Basis+Herbimax+28% UAN	0.33oz+1%+2qt	75	63	65	63
Accent+Atrazine+Aim+NIS	0.67oz+0.42lb+0.32oz+0.25%	53	67	37	50
Accent+Atrazine+Clarity+Scoil	0.33oz+0.42lb+4oz+1.5pt	92	90	90	93
Accent+Distinct+NIS+28% UAN	0.67oz+6oz+0.25%+2qt	82	84	82	95
Accent+Hornet+NIS+28% UAN	0.67oz+2.4oz+0.25%+2qt	82	57	72	96
Accent+Scorpion III+NIS+28% UAN	0.67oz+4oz+0.25%+2qt	85	95	80	93
Accent+Shotgun+NIS+28% UAN	0.67oz+2pt+0.25%+2qt	78	97	78	93
Basis+Atrazine+Herbimax+28% UAN	0.33oz+0.42lb+1%+2qt	83	53	60	33
Untreated		0	0	0	0
LSD (0.05)		12	9	19	18

Cold/wet weather after planting caused little corn to emerge. Accent + Atrazine + Scoil with or without Clarity gave 90% foxtail control. A higher proportion of yellow foxtail was present. All treatments gave complete wild mustard control. Most treatments including a plant growth regulator herbicide controlled common cocklebur.

POST(2) Weed Control in Corn . Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from POST applied herbicides. Interstate PayCo '4X85' corn was planted on May 7, 1998. POST treatments were applied June 5, 1998 at 12:00-1:00 pm with 56 F air, 62 F soil surface, 43% RH, 100% clouds, and 0-3 mph NW wind, dry soil surface, moist subsoil, poor crop vigor, no dew present, and crop stage was 3-4"/3 lf. Weed species present were: 1-3", 2-4 lf, (10-40/ft^2) foxtail; 1-3", 2-4 lf, (10-20/ft^2) rosette wild mustard; 1", cot-1lf, (5-10/ft^2) venice mallow; 2-4", 2-4 lf, (10-30/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		June 23		July 10	
Treatment	Rate	Fxtl	Cocb	Fxtl	Cocb
	Product/A	%			
Accent Gold+Quad 7	2oz+1%	83	72	88	93
Accent Gold+Quad 7	2.5oz+1%	78	77	90	96
Accent Gold+Quad 7	2.7oz+1%	83	75	93	95
Accent Gold+Scoil	2oz+1.5pt	80	73	87	95
Accent Gold+Scoil	2.5oz+1.5pt	68	72	87	95
Basis Gold+Scoil	10oz+1.5pt	87	43	80	50
Accent Gold+Atrazine+Scoil	2oz+0.42lb+1.5pt	73	75	82	95
Accent Gold+Clarity+Scoil	2oz+4oz+1.5pt	75	72	81	95
Accent Gold+Distinct+Scoil	1.5oz+3oz+1.5pt	67	67	65	95
Accent Gold+Distinct+Scoil	1.5oz+4oz+1.5pt	67	70	67	95
Accent Gold+Distinct+Scoil	2oz+3oz+1.5pt	75	72	75	95
Accent Gold+Distinct+Scoil	2oz+4oz+1.5pt	70	73	82	95
Accent Gold+Herbimax+28% UAN	2.9oz+1%+2lb	75	72	92	95
Basis Gold+Accent+Scoil	7oz+0.2oz+1.5pt	85	32	90	40
Basis Gold+Herbimax+28% UAN	14oz+1%+2qt	82	53	78	60
Untreated		0	0	0	0
LSD (0.05)		16	11	12	6

Study objectives were to evaluate weed control from Accent Gold at label and reduced rates alone or with tank-mix products. Cold/wet weather after planting caused little corn to emerge. All treatments gave 100% wild mustard control. Most treatments except Accent Gold at 1.5 oz/A gave greater than 80% foxtail control. Basis Gold did not control common cocklebur. No adjuvant enhancement of Accent Gold was observed.

Weed Control in Imi Corn. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from POST applied herbicides. Garst '8972IT' Imi corn was planted May 7, 1998. POST treatments were applied June 5, 1998 at 2:00 pm with 56 F air, 62 F soil surface, 43% RH, 100% clouds, and 5-7 mph NW wind, dry soil surface, moist subsoil, poor crop vigor, no dew present, and crop stage was 3-4"/3 lf. Weed species present were: 1-3", 2-4 lf, (10-40/ft^2) foxtail; 1-3", 2-4 lf, (10-20/ft^2) rosette wild mustard; 2-4", 2-4 lf, (5-15/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 23		July 10	
		Fxtl	Cocb	Fxtl	Cocb
	Product/A	%			
Lightning+Quad 7	0.75oz+1%	67	50	83	70
Lightning+Scoil	1oz+1.5pt	85	70	90	82
Lightning+Scoil	0.75oz+1.5pt	65	57	85	72
Lightning+NIS+28% UAN	1oz+0.25%+2qt	82	72	90	83
Lightning+NIS+28% UAN	0.75oz+0.25%+2qt	66	63	80	73
Lightning+NIS+28% UAN	1.28oz+0.25%+2qt	85	75	92	87
Lightning+Clarity+Quad 7	1oz+4oz+1%	71	62	83	88
Lightning+Atrazine+Scoil	1oz+0.42lb+1.5pt	87	72	93	93
Lightning+Atrazine+Quad 7	1.28oz+0.42lb+1%	86	57	95	90
Lightning+Shotgun+NIS+28% UAN	1oz+1.5pt+0.25%+2qt	83	99	95	93
Lightning+Hornet+NIS+28% UAN	1oz+2.4pt+0.25%+2qt	72	75	95	95
Lightning+Clarity+NIS+28% UAN	1oz+4oz+0.25%+2qt	82	73	93	93
Lightning+Clarity+NIS+28% UAN	1.28oz+4oz+0.25%+2qt	91	68	95	95
Accent+Atrazine+Clarity+Scoil	0.67oz+0.42lb+4oz+1.5pt	87	85	83	93
Accent+Prowl+Clarity+NIS+28% UAN	0.67oz+3pt+6oz+0.25%+2qt	86	65	87	95
Untreated		0	0	0	0
LSD (0.05)		13	15	9	6

Cold/wet weather after planting caused little corn to emerge. The objectives of this study were to evaluate weed control from Lightning at label and reduced rates and with adjuvants. At July 10 evaluation most tank-mix treatments with Lightning gave 90% foxtail and common cocklebur control. However, weed control was reduced with all treatments of Lightning at 0.75 oz/A regardless of adjuvant.

Weed Control in Liberty Link Corn. Zollinger and Fitterer. An experiment was conducted in Casselton, ND to evaluate weed control from herbicides applied at the PRE and POST stages to Liberty Link corn. Croplan Genetics 'N2555BT' Liberty Link corn was planted May 7, 1998. The PRE treatments were applied May 26, 1998 at 11:00-12:00 am with 78 F air, 67 F soil at a depth of 2-4", 30% RH, 10% clouds, and 10-15 SW mph wind, dry soil surface, and moist subsoil. The POST treatments were applied May 29, 1998 at 3:30-4:30 pm with 66 F air, 87 F soil surface, 36% RH, 0% clouds, and 8-10 N mph, dry soil surface, moist subsoil, poor crop vigor, no dew present, and crop stage was one leaf. Weed species present were: 1", (10-40/ft^2) foxtail; 1-2", 2 lf, (15-20/ft^2) wild mustard; 2-3", 2 lf, (10-20/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for PRE treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 12			June 23		July 10	
		Fxtl	Wimu	Cocb	Fxtl	Cocb	Fxtl	Cocb
	Product/A	%						
PRE fb EPOST								
Dual II Magnum/Liberty+AMS	2pt+20oz+3lb	98	97	93	87	75	88	70
Frontier/Liberty+AMS	28oz+20oz+3lb	97	96	93	86	73	85	63
Surpass/Liberty+AMS	2pt+20oz+3lb	98	96	92	89	70	88	65
Balance/Liberty+AMS	1.5oz+20oz+3lb	98	99	95	95	90	95	87
Prowl/Liberty+AMS	3pt+20oz+3lb	94	96	93	67	67	60	57
EPOST								
Liberty+Prowl+AMS	20oz+3pt+3lb	88	87	88	50	70	57	53
Liberty+Atrazine+AMS	20oz+0.42lb+3lb	65	96	92	18	73	23	57
Liberty+Atrazine+AMS	20oz+0.55lb+3lb	73	90	92	35	67	30	57
Liberty ATZ+AMS	40oz+3lb	90	98	95	45	63	57	77
Liberty+Atrazine+AMS	16oz+0.42lb+3lb	75	95	90	40	67	30	40
Liberty+Aim+NIS+AMS	16oz+0.32oz+0.25%+3lb	58	85	90	18	63	23	57
Liberty+Atrazine+Aim+NIS+AMS	16oz+0.42lb+0.32oz+0.25%+3lb	70	93	93	40	72	23	53
Liberty+Atrazine+AMS	12oz+0.42lb+3lb	48	88	77	17	57	20	50
Liberty+Aim+NIS+AMS	12oz+0.32oz+0.25%+3lb	65	80	89	17	50	23	67
Liberty+Atrazine+Aim+NIS+AMS	12oz+0.42lb+0.32oz+0.25%+3lb	70	95	80	15	57	20	50
Accent+Buctril&Atrazine+NIS+28%	0.67oz+2pt+0.25%+2qt	92	98	96	57	85	57	73
Untreated		0	0	0	0	0	0	0
LSD (0.05)		13	9	6	17	15	13	14

Rainfall occurred prior to weed emergence to activate herbicides. Cold/wet weather after planting caused little corn to emerge. At July 10 evaluation, PRE fb POST treatments gave greater than 85% foxtail control. POST treatments of Liberty with Prowl, Atrazine, or Aim gave poor foxtail control. Only Balance PRE fb Liberty POST gave greater than 85% common cocklebur control.

Dry Bean Tolerance to Soil-applied Herbicides. Zollinger and Fitterer. An experiment was conducted, at Hatton, ND, to evaluate dry bean tolerance to herbicides applied PPI, PRE, and POST. PPI treatments were applied and incorporated with a rototiller operated 2 inches deep on June 4, 1998, at 2:30 pm with 60 F air, 60 F soil, 31% RH, 4 to 7 mph N to NW wind, 50% clouds, dry soil surface, and moist subsoil. 'Winchester' and 'Maverick' pinto and 'Norstar' and 'Navigator' navy dry beans were planted and PRE treatments were applied on June 4, 1998, at 3:45 pm with 60 F air, and 60 F soil, 31% RH, 4 to 7 mph NW wind, 50% clouds, dry soil surface, and moist subsoil. POST treatments were applied on June 30, 1998, at 12:30 with 78 F air, 91 F soil surface, 54% RH, 3 to 5 mph N wind, 5% clouds, moist soil surface, wet subsoil, excellent crop vigor, no dew present, to dry beans at the first trifoliolate stage. Treatments were applied to the center 6.67 ft of 10 by 40 ft plots with a bicycle type plot sprayer equipped with drift cones delivering 17 gpa at 40 psi through 8002 flat fan nozzles for the soil applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST applied treatments. The experiment had a randomized complete block design with three replicates per treatment.

		June 25				July 13				July 28			
Treatment[a]	Rate	Nav[b]	Nor[b]	Mav[b]	Win[b]	Nav	Nor	Mav	Win	Nav	Nor	Mav	Win
	(oz product/A)	%											
PPI													
Sonalan+Python	24+1	2	3	0	0	20	30	12	13	33	55	28	25
Sonalan+Python	24+1.26	3	5	0	2	25	32	20	30	40	53	40	40
Sonalan+Python	24+1.88	3	5	0	2	28	40	26	25	47	63	50	35
Sonalan+Python	64+1	8	13	3	3	20	43	25	27	50	67	50	47
Sonalan+Python	64+1.26	11	13	7	3	30	43	32	27	37	60	47	40
Sonalan+Python	64+1.88	7	14	7	10	33	50	25	33	43	67	50	50
Sonalan+Authority	40+0.44 lb	5	7	5	6	7	7	17	10	13	27	20	32
PRE													
Frontier+Python	20+1.08	0	2	0	0	7	13	17	15	27	45	27	25
Frontier+Authority	20+0.44 lb	2	4	1	0	12	8	12	13	18	25	17	22
Frontier+FirstRate	20+0.3	2	3	0	0	14	25	20	11	23	48	27	25
Authority+FirstRate	0.33 lb +0.3	5	9	7	7	15	33	23	11	27	57	40	23
PPI fb POST													
Sonalan+Python/ Pursuit+Act 90	16+1.26/ 0.72+0.25% v/v	2	2	0	0	27	30	22	15	47	53	50	40
PRE fb POST													
Frontier/Assure II+ Act 90+28% UAN	32/20+ 0.25% v/v+128	0	0	0	0	8	10	9	7	13	10	8	8
Frontier/Assure II+ Herbimax+28% UAN	32/20+ 16+128	0	0	0	0	12	17	17	9	10	25	10	10
Frontier/Assure II+ Scoil+28% UAN	32/20+ 24+128	0	0	0	0	7	9	13	9	17	23	17	8
Frontier/Assure II+ Silwet L-77+28% UAN	32/20+ 0.1% v/v+128	0	0	0	0	11	12	13	13	13	20	10	17
LSD (0.05)		4	7	2	3	11	13	10	9	12	16	14	15

[a]Act 90 = Activator 90 = nonionic surfactant, Herbimax = petroleum oil, Scoil = methylated seed oil, Silwet L-77 = surfactant with silicone.

[b]Nav = Navigator, Nor = Norstar, Mav = Maverick, Win = Winchester.

All soil applied herbicides gave unacceptable dry bean injury. Sonalan + Python severely injured dry bean varieties tested. Dry beans showed little response to Sonalan + Authority early but injury increased over time. PRE applied herbicides caused less dry bean injury than herbicides applied PPI. 'Norstar' navy bean was injured more by soil-applied herbicides than other dry bean varieties. Pursuit applied after Sonalan + Python did not injury dry bean more than when no Pursuit was applied. Assure II at 20 oz/A is twice the maximum label rate. Injury from treatments containing Frontier followed by Assure II is attributed to Frontier based on symptoms observed.

Dry Bean Tolerance to POST-applied Herbicides. Zollinger and Fitterer. An experiment was conducted, at Hatton, ND, to evaluate dry bean tolerance from POST applied herbicides. 'Winchester' and 'Maverick' pinto and 'Norstar' and 'Navigator' navy beans were planted June 4, 1998. POST treatments were applied on June 30, 1998, at 1:00 to 2:00 p.m. with 78 F air, 91 F soil surfaces, 54% RH, 5 to 7 mph N wind, 5% clouds, moist soil surface, wet subsoil, excellent crop vigor, no dew present, and the crop was at the first trifoliolate stage. Treatments were applied to the center 6.67 ft of 10 by 40 ft plots with a bicycle type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table 1. Dry bean injury ratings.

Treatment[a]	Rate	July 13				July 28			
		Nav[b]	Nor[b]	Mav[b]	Win[b]	Nav	Nor	Mav	Win
	(oz product/A)	(% injury)							
Select+Basagran+Herbimax	8+24+16	7	6	0	4	8	5	2	0
Select+FirstRate+Act 90	8+0.3+0.25% v/v	25	23	23	25	30	32	15	17
Select+Expert+Act 90	8+2+0.25% v/v	43	50	47	42	50	50	57	40
Pursuit+Act 90	0.72+0.25% v/v	3	6	3	0	3	3	3	3
Pursuit+Herbimax	0.72+16	2	3	2	0	0	2	0	0
Pursuit+Quad 7	0.72+1% v/v	3	5	3	3	7	8	3	3
Pursuit+Scoil	0.72+24	3	2	3	5	3	3	0	2
Raptor+Act 90	2+0.25% v/v	3	10	6	7	8	13	3	3
Raptor+Act 90	3+0.25% v/v	5	10	8	5	12	15	3	7
Raptor+Act 90	4+0.25% v/v	5	8	7	8	0	5	0	3
Raptor+Act 90+28% UAN	2+0.25%+1% v/v	5	12	5	3	12	12	13	10
Raptor+Act 90+28% UAN	3+0.25%+1% v/v	2	2	5	2	5	10	8	8
Raptor+Act 90+28% UAN	4+0.25%+1% v/v	0	5	2	3	0	3	0	3
Raptor+Quad 7	2+1% v/v	3	5	5	3	3	8	3	2
Raptor+Quad 7	3+1% v/v	2	5	6	2	2	3	0	0
Raptor+Quad 7	4+1% v/v	3	3	2	2	0	7	0	3
Raptor+Scoil	2+24	2	3	3	3	2	3	0	3
Raptor+Scoil	3+24	2	2	2	0	2	3	3	2
Raptor+Scoil	4+24	7	8	7	5	2	3	3	0
Raptor+Basagran+Act 90	4+16+0.25% v/v	0	3	3	3	0	2	0	0
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		8	9	7	8	12	16	10	10

Table 2. Yields of selected dry bean treatments.

Treatment[a]	Rate	Yield			
		Nav[b]	Nor[b]	Mav[b]	Win[b]
	Product/A	lb/A			
Raptor + Act 90	4 oz + 0.25%	2310	2526	2274	2196
Raptor + Act 90 + UAN	4 oz + 0.25% + 1%	2734	2619	2809	2529
Raptor + Quad 7	4 oz + 1%	2560	2663	2604	2561
Raptor + Scoil	3 oz + 1.5 pt	2409	2656	2671	2230
Raptor + Scoil	4 oz + 1.5 pt	2770	2703	2507	2504
Untreated		2851	3140	2820	2330
LSD (0.05)		NS	NS	NS	215

[a]Act 90 = Activator 90 = nonionic surfactant, Herbimax = petroleum oil, Scoil = methylated seed oil, Quad 7 = ammonium nitrate + nonionic surfactant + buffer.

[b]Nav = Navigator, Nor = Norstar, Mav = Maverick, Win = Winchester.

FirstRate and Expert injured dry bean varieties tested and dry beans did not recover. Pursuit at 4 oz/A with different classes of adjuvants did not injure dry beans. Dry bean injury was less than 14% from Raptor at different rates and with different adjuvants. At the last rating, dry beans recovered from most treatments causing injury. Raptor with Scoil or Quad 7 did not cause greater injury than surfactant or surfactant + UAN fertilizer. No yield losses were found, compared to the untreated check, for selected treatments harvested.

Dry Bean Weed Control and Tolerance(1). Zollinger and Fitterer. An experiment was conducted at NW-22, to evaluate dry bean tolerance and weed control from herbicides applied at the PPI, PRE, and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 27, 1998 at 4:00-5:00 pm with 84 F air, 68 F soil 2-4" depth, 52% RH, 40% clouds, and 3-7 mph SE wind, dry soil surface, and wet subsoil. Pinto (Winchester and Maverick) and Navy (Norstar and Navigator) dry beans were planted and PRE treatments were applied May 29, 1998 at 3:00-4:00 pm with 71 F air, 77 F soil 2-4" depth, 60% RH, 3-5 mph N wind, and 0% clouds, dry soil surface, and moist subsoil. POST treatments were applied on July 1, 1998 at 2:00-4:00 pm with 78 F air, 87 F soil surface, 72% RH, NW 0-5 mph wind, 20% clouds, dry soil surface, moist subsoil, poor-fair crop vigor, no dew present, crop stage was 1-2 trifoliate (V1-V2). Weeds present at the POST stage were: 2-4", (2-10/ft2), foxtail; 1-3", (5-20/ft2), redroot pigweed; 5-30", (patchy), Canada thistle. Treatments were applied to the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with drift cones delivering 17 gpa at 40 psi through 8002 flat fan nozzles for soil applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST applied treatments. The experiment had a randomized complete block design with three replicates per treatment.

		July 13			
Treatment	Rate	Win	Mav	Nor	Nav
	Product/A	%			
PPI					
Sonalan+Python	2.5pt+1oz	15	3	10	10
Sonalan+Python	2.5pt+1.26oz	32	13	10	15
Sonalan+Python	2.5pt+1.88oz	32	27	32	32
Sonalan+Python	4pt+1oz	40	27	30	35
Sonalan+Python	4pt+1.26oz	25	20	20	25
Sonalan+Python	4pt+1.88oz	38	28	32	38
PPI fb POST					
Sonalan+Python/Pursuit+NIS	1pt+1.26oz/0.72oz+0.25%	40	27	22	27
Sonalan+Authority	2.5pt+0.44lb	33	28	15	35
PPI fb 1-tri fb 10 DAA					
Frontier/Basagran+Herbimax/Basagran+Poast+Herbimax	2pt/1pt+2pt/1pt+1pt+2pt	30	15	10	30
Frontier+Sonalan/Basagran+Herbimax/ Basagran+Poast+Herbimax	2pt+1.5pt/1pt+2pt/ 1pt+1pt+2pt	25	15	10	18
Frontier+Eptam/Basagran+Herbimax/ Basagran+Poast+Herbimax	2pt+2pt/1pt+2pt/ 1pt+1pt+2pt	13	0	0	0
PRE					
Frontier+Python	20oz+1.88oz	33	30	27	35
Frontier+Authority	20oz+0.44lb	32	17	5	48
Frontier+FirstRate	20oz+0.3oz	35	32	30	38
Authority+FirstRate	0.33lb+0.3oz	43	40	37	42
PRE fb 1-tri fb 10 DAA					
Frontier/Basagran+Herbimax/Basagran+Poast+Herbimax	2pt/1pt+2pt/1pt+1pt+2pt	47	22	18	27
Frontier/Basagran+Herbimax/ Basagran+Frontier+Poast+Herbimax	1.25pt/1pt+2pt/ 1pt+0.75pt+1pt+2pt	28	17	17	28
Untreated		0	0	0	0
LSD (0.05)		4	8	3	4

Most of the study was affected by excessive rainfall and standing water. Unaffected areas in each plot were evaluated if available. However , excessive water may have confounded injury from herbicides.

Dry Bean Weed Control and Tolerance(2). Zollinger and Fitterer. An experiment was conducted at NW-22, to evaluate dry bean tolerance and weed control from POST applied herbicides. Pinto (Winchester and Maverick) and Navy (Norstar and Navigator) dry beans were planted on May 27, 1998. POST treatments were applied May 29, 1998 at 2:00-4:00 pm with 78 F air, 87 F soil surface, 72% RH, 0-5 mph NW wind, 20% clouds, dry soil surface, moist subsoil, poor-fair crop vigor, no dew present, and crop stage was 1-2 trifoliate (V1-V2). Weeds present at the POST stage were: 2-4", (2-10/ft^2), foxtail; 1-3", (5-20/ft^2), redroot pigweed; 5-30", (patchy), Canada thistle. Treatments were applied to the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Portions of the study were affected by excessive rainfall and standing water. Unaffected areas in each plot were evaluated if available. However, excessive water may have confounded weed control from herbicides. Generally, small difference in dry bean response were observed between varieties with most treatments. Dry bean response did not differ with adjuvant type used with Raptor applied alone but injury usually increased as Raptor rate increased. Addition of UAN to Raptor + NIS increased dry bean injury at the 2 and 3 fl oz/A of Raptor rates. Addition of Basagran to Raptor at 4 fl oz/A + NIS tended to reduced dry bean injury as compared to Raptor + NIS applied alone. Select in tank-mix with broadleaf herbicides used gave greater than 90% foxtail control.

Table. Dry bean weed control and tolerance(2).

Treatment	Rate	July 13							July 29						
		Injury*				Control			Injury				Control		
		Win	Mav	Nor	Nav	Fxtl	Rrpw	Colq	Win	Mav	Nor	Nav	Fxtl	Rrpw	Colq
	Product/A	%													
Raptor+Activator 90	2oz+0.25%	3	3	7	8	99	99	99	7	7	3	3	90	96	98
Raptor+Activator 90	3oz+0.25%	10	5	7	12	99	99	99	7	0	7	7	92	90	95
Raptor+Activator 90	4oz+0.25%	10	8	18	12	99	99	99	10	13	13	3	90	95	99
Raptor+Quad 7	2oz+1%	0	0	0	6	99	99	99	3	0	0	5	92	90	99
Raptor+Quad 7	3oz+1%	7	5	8	10	99	99	99	17	13	7	7	92	96	99
Raptor+Quad 7	4oz+1%	7	7	7	7	99	99	99	10	17	18	15	90	90	99
Raptor+Scoil	2oz+1.5pt	8	10	5	10	99	99	99	0	0	0	0	95	95	99
Raptor+Scoil	3oz+1.5pt	7	3	5	5	99	99	99	0	0	0	0	96	96	99
Raptor+Scoil	4oz+1.5pt	10	5	5	8	99	99	99	5	3	5	0	93	90	99
Select+Herbimax	6oz+1pt	0	0	0	0	99	0	0	0	0	0	0	96	0	0
Select+Herbimax	8oz+1pt	0	0	0	0	99	0	0	0	0	0	0	98	0	0
Raptor+Activator 90+28% UAN	2oz+0.25%+1qt	3	3	3	7	99	99	99	13	13	13	12	96	93	99
Raptor+Activator 90+28% UAN	3oz+0.25%+1qt	17	3	13	13	99	99	99	12	15	15	15	95	90	99
Raptor+Activator 90+28% UAN	4oz+0.25%+1qt	13	13	18	12	99	99	99	8	12	3	7	92	99	99
Raptor+Basagran+Activator 90	4oz+1pt+0.25%	0	0	0	0	99	99	99	3	8	8	5	92	90	93
Select+Basagran+Herbimax	8oz+1.5pt+1pt	0	0	0	2	99	20	33	0	0	0	0	95	20	10
Select+FirstRate+Activator 90	8oz+0.3oz+0.25%	10	8	7	8	99	20	17	50	50	50	50	93	37	53
Select+Pursuit+Activator 90	8oz+0.72oz+0.25%	0	0	0	2	99	99	99	0	0	0	0	92	85	96
Select+Pursuit+Herbimax	8oz+0.72oz+1pt	7	3	10	10	99	99	99	8	0	0	0	92	82	96
Select+Pursuit+Quad 7	8oz+0.72oz+1%	7	3	7	10	99	99	99	7	10	8	8	92	92	96
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		6	5	8	6	0	6	11	12	11	10	9	4	15	10

*Win = Winchester, Mav = Maverick, Nor = Norstar, Nav = Navigator.

Green foxtail control with imazamox in dry beans. (Brian Jenks and Kent McKay, Minot) The objective of the study was to evaluate weed control in dry beans with imazamox compared to standard treatments. Maverick dry beans were planted May 19 in Washburn, ND. Seedbed preparation was conventional with 30-inch row spacing and 60 lb/A seeding rate. Herbicide treatments consisted of preplant incorporated and postemergence applications. Individual plots were 10 by 30 feet and were arranged in a RCBD design and replicated four times. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Postemergence applications were made on June 25 with the exception of one split treatment applied on July 1. On June 25 dry beans were 1-2 trifoliate, while green foxtail was approximately 1-inch tall and 175 plants/ft^2. The dry beans were harvested September 2.

Green foxtail populations were very high as indicated by the extremely low dry bean yield in the untreated plot. Ethalfluralin, pendimethalin, and dimethenamid applied PPI did not control green foxtail. Dimethenamid looked good initially, but control was poor later in the season. We collected green foxtail from the ethalfluralin-treated area and sent it to a laboratory for testing. It was determined that the green foxtail was completely tolerant to dinitroaniline herbicides. Green foxtail control with imazamox, sethoxydim, or quizalofop was good to excellent in all treatments. Even though much of the green foxtail was resistant to DNA herbicides, control was slightly better with a soil-applied herbicide followed by imazamox postemergence. Control with imazamox + NIS was 5-10% lower compared to other adjuvants. Some antagonism may have occurred with imazamox + quizalofop as green foxtail control was also 5-10% lower than imazamox applied alone.

Table. Green foxtail control with imazamox in dry beans.

Treatment	Rate	7-8 Grft	8-26 Grft	9-2 Yield
	lb/A	---% Control---		lb/A
ethalfluralin	0.94	26	15	308
ethalfluralin / imazamox + MSO + 28% N	0.56 / 0.016 + 1.5% + 1 qt	92	98	1428
pendimethalin	1.25	0	3	158
pendimethalin / imazamox + MSO + 28% N	1.0 / 0.016 + 1.5% + 1 qt	87	93	1053
dimethenamid	0.94	66	48	802
dimethenamid / imazamox + MSO + 28% N	0.75 / 0.016 + 1.5% + 1 qt	95	97	1385
imazamox + MSO + 28% N	0.016 + 1.5% + 1 qt	88	94	1302
imazamox + MSO + 28% N	0.024 + 1.5% + 1 qt	88	98	1201
bentazon + COC / sethoxydim + COC (Post II)	0.75 + 2 pt / 0.055 + 2 pt	94	90	1375
bentazon + sethoxydim + COC / bentazon + COC (Post II)	0.375 + 1.5 pt + 2 pt / 0.375 + 2 pt	95	91	1631
bentazon + quizalofop + COC	0.75 + 0.055 + 2 pt	97	88	1314
imazamox + Quad 7 + 28% N	0.016 + 1% + 2 pt	83	92	1334
imazamox + NIS + 28% N	0.016 + 0.25% + 1 qt	80	86	1164
imazamox + quizalofop + COC + 28% N	0.016 + 0.055 + 2 pt + 1 qt	82	85	1101
untreated		0	0	124
CV		12	7	25
LSD (0.05)		13	8	372

COC= Herbimax by Loveland
MSO= Scoil by AGSCO
NIS= Activator 90 by Loveland
Quad 7= Surfactant blend by AGSCO

Navy bean herbicide trial, Carrington 1998. (Endres and Zwinger)
The objective of the trial was to evaluate crop injury and weed control with herbicides including Authority, Frontier, Python, Basagran, and Raptor. The trial was established on soil with 3.5% organic matter and 7.0 pH. Treatments were applied to a 6.67 ft wide area the length of 10 by 25 ft plots. Soil-applied treatments were applied with a hooded bicycle-wheel-type plot sprayer delivering 17.3 gal/A at 40 psi through 8002 flat fan nozzles. PPI treatments were applied May 28 with 58 F, 86% RH, clear sky, and 12-mph wind and incorporated at a 3-inch depth with a rototiller. 'Mayflower' navy bean was planted in 30-inch rows at the rate of 90,000 PLS/A on May 28. PRE treatments were applied May 29 with 38 F, 73% RH, clear sky, and 11-mph wind. Treatments 8 and 9 were incorporated at a 1-inch depth with a harrow. POST1 and 3 treatments were applied with a hand-held sprayer delivering 20.8 gal/A at 40 PSI through 8002 flat fan nozzles. POST2 treatments were applied with a hand-held sprayer delivering 10.3 gal/A at 40 PSI through 8001 flat fan nozzles. POST1 treatments were applied June 27 with 65 F, 70% RH, 5% clouds, and 6-mph wind to 1-trifoliolate leaf bean, 1- to 3-inch tall green and yellow foxtail, 1-to 2-inch tall common lambsquarters, 1- to 2-inch tall redroot and prostrate pigweed, and 1- to 2-inch tall wild buckwheat. POST2 treatments were applied July 2 with 64 F, 91% RH, 100% clouds, and 2-mph wind to 2- to 3-trifoliolate leaf bean, 1- to 6-inch tall green and yellow foxtail, 1-to 4-inch tall common lambsquarters, 1- to 4-inch tall redroot and prostrate pigweed, and 1- to 4-inch tall wild buckwheat. POST3 treatments were applied July 6 with 78 F, 70% RH, 33% clouds, and 3-mph wind to 3-trifoliolate leaf bean, 1- to 12-inch tall green and yellow foxtail, 1-to 4-inch tall common lambsquarters, 1- to 5-inch tall redroot and prostrate pigweed, and 1- to 5-inch tall wild buckwheat. Visual estimates of percentage crop injury and weed control were taken 28 days after treatments (DAT) and preharvest weed control on September 2. The experiment was a randomized complete block design with three replications.

Navy bean injury was observed with the Raptor treatments but generally at low levels. Weed control was good to excellent with treatments 2-9 except for wild buckwheat. However, Sonalan + Authority provided 91% control of wild buckwheat. Foxtail and pigweed control was generally excellent with all Raptor treatments. Weed control with Raptor at 2 fl oz generally improved with the addition of AMS.

Treatment[a]			28 DAT				Preharvest			
No.	Name	Rate	Drbe	Fxtl	Colq	Pigw	Fxtl	Colq	Pigw	Wibw
		Prod/A	%inj	- %	control –		----	% control		----
1	untreated	----	0	0	0	0	0	0	0	0
PPI:										
2	Sonalan + Python	2.5 pt + 1 oz	0	99	96	95	92	90	93	79
3	Sonalan + Authority	2.5 pt + 0.33 oz	0	96	95	96	97	87	95	91
PPI/POST1/POST3:										
4	Frontier/ Basagran + COC/ Basagran + Poast + COC	2 pt/ 1 pt/ 1 + 1 pt	0	99	99	98	99	94	95	75
5	Frontier + Sonalan/ Basagran + COC/ Basagran + Poast + COC	1 + 1.5 pt/ 1 pt/ 1 + 1 pt	0	99	99	98	99	99	95	75
6	Frontier + Authority/ Basagran + COC/ Basagran + Poast + COC	1 pt + 0.33 oz/ 1 pt/ 1 + 1 pt	0	99	98	96	99	97	93	62
PRE/POST1/POST3:										
7	Frontier/ Basagran + COC/ Basagran + Poast + COC	2 pt/ 1 pt/ 1 + 1 pt	0	99	98	96	99	91	91	23
8	Frontier/ Basagran + COC/ Basagran + Poast + COC	2 pt/ 1 pt/ 1 + 1 pt	0	99	99	98	98	95	97	76
9	Frontier/ Basagran + COC/ Basagran + Frontier + Poast + COC	2 pt/ 1 pt/ 1 + 0.75 pt + 1 pt	0	98	97	84	94	93	96	24
10	Frontier + Authority	20 fl oz + 0.33 oz	0	93	88	90	68	38	79	13
POST2:										
11	Raptor + NIS	2 fl oz	6	95	58	94	93	38	73	0
12	Raptor + NIS	3 fl oz	5	99	70	98	96	50	95	53
13	Raptor + NIS	4 fl oz	13	98	79	99	98	53	97	67
14	Raptor + NIS + AMS	2 fl oz	2	98	79	98	89	66	99	22
15	Raptor + NIS + AMS	3 fl oz	2	98	93	99	96	74	98	42
16	Raptor + NIS + AMS	4 fl oz	3	98	95	99	97	72	98	66
LSD (0.05)			7	3	7	4	7	19	8	33
CV %			67	2	5	3	4	16	5	41

[a] COC=Destiny at 32 fl oz/A;NIS=Preference at 0.25% v/v;AMS=Bronc at 1% v/v.

Potato Weed Control. Zollinger and Fitterer. An experiment was conducted at McLeod, ND to evaluate weed control in potato from herbicides applied at the PPI, PRE, and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 21, 1998 at 1:00-3:00 pm with 82 F air, 76 F soil, 50% RH, 0-3 mph E wind, 50% clouds, dry soil surface, and moist subsoil. 'Russet Burbank' potato was planted May 22, 1998. PRE treatments were applied on June 9, 1998 at 11:00-12 noon, with 65 F air, 70 F soil, 65 % RH, 5-7 mph NE wind, 95% clouds, wet soil surface, and wet subsoil. Plots were hilled on June 6, 1998. POST treatments were applied on July 1, 1998 at 10:00 with 76 F air, 71 F soil, 69% RH, 5-10 mph SE wind, 30% clouds, dry soil surface, moist subsoil, excellent crop vigor, no dew present, and crop stage was 8-10". Soil applied treatments were applied to the center eight feet of the 10 by 25 ft plots with a bicycle wheel type plot sprayer equipped with wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. POST applied treatments were applied with a CO2 backpack sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	July 16		
		Fxtl	Rrpw	Colq
	Product/A	(%)		
PPI fb PRE				
Eptam/Sencor	3.5 pt/0.67 lb	97	95	93
PRE				
Matrix	1.5 oz	88	98	95
Matrix+Sencor	1 oz + 5.33 lb	96	99	99
Frontier+Sencor	20 oz + 0.67 lb	94	89	93
Frontier a-isomer+Sencor	14 oz + 0.67 lb	99	99	99
Frontier a-isomer+Matrix	14 oz + 0.75 lb	99	99	99
Prowl+Sencor	1.2 pt + 0.67 lb	90	90	95
Eptam+Matrix	3.5 pt + 0.75 oz	96	99	99
Sencor	0.67 lb	83	85	93
POST				
Matrix+NIS	1 oz + 0.25 %	99	99	99
Matrix+NIS	1.5 oz + 0.25 %	99	99	99
Matrix+Sencor+NIS	1.5 oz + 5.33 lb + 0.25 %	99	99	99
Matrix+Sencor+NIS	1.5 oz + 5.33 lb + 0.25 %	99	99	99
Untreated		0	0	0
LSD (0.05)		6	8	6

NIS = nonionic surfactant (Preference)

The study was established on an irrigation site with light sandy soil but with a heavy weed pressure. Herbicides were activated by irrigation water within 2 to 3 days after application which may explain generally good to excellent weed control.

Rhizoctonia/Herbicide Interaction. Fitterer, Zollinger, Gudmestad, and Secor. An experiment was conducted at McLeod, ND to evaluate rhizoctonia/herbicide interaction in potatoes from herbicides applied at the PPI, PRE, and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 21, 1998 at 1:00-3:00 pm with 82 F air, 76 F soil, 50% RH, 0-3 mph E wind, 50% clouds, dry soil surface, and moist subsoil. Russet Burbank potato was planted May 22, 1998 and hilled on June 6, 1998. PRE treatments were applied on June 9, 1998 at 11:00-12 noon, with 65 F air, 70 F soil, 65% RH, 5-7 mph NE wind, 95% clouds, wet soil surface, and wet subsoil. POST treatments were applied on June 24, 1998 at 10:00 am with 75 F air, 77 F soil, 64% RH, 3-8 mph SE wind, 5% clouds, dry soil surface, wet subsoil, excellent crop vigor, no dew present, crop stage was 10-12". PPI Treatments were applied to the center eight feet of the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. PRE treatments were applied with a CO2 backpack sprayer delivering 17 gpa at 40 psi through 8002 flat fan nozzles. POST treatments were applied with a CO2 backpack sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

No potato injury was observed throughout the season. Weed control, for all treatments, was complete for foxtail, common lambsquarters and redroot pigweed on June 24. Foxtail control was 89% or higher except for Lorox; and redroot pigweed, and common lambsquarters control was 80% or higher for all treatments except Lorox, Treflan, and Poast (a grass herbicide) on July 16. Herbicides did not increase potato stem and stolon rhizoctonia or injury ratings early in the season (June 16, 23, and 30). Treflan and Prowl applied (PPI) increased stem rhizoctonia incidence while Prowl (PRE) increased stolon rhizoctonia incidence on July 7. On July 14, Treflan (PPI) increased the incidence of stem rhizoctonia and stolon girdling, Dual Magnum (PPI) and Poast (POST) increased the incidence of stem and stolon girdling, Matrix (Pre) and Frontier a-isomer (PRE) increased the incidence of stolon rhizoctonia and girdling, and Lorox (PRE) increased incidence of stolon girdling.

Table 1. Potato and weed control ratings.

Treatment	Rate	June 24	July 16		
		Injury	Fxtl	Rrpw	Colq
	Product/A	%			
PPI					
Eptam	5.0 pt	0	98	82	87
Treflan	1.5 pt	0	87	73	78
Prowl	3.0 pt	0	93	97	97
Dual Magnum	2.0 pt	0	99	96	96
Frontier a-isomer	14 oz	0	96	95	95
PRE					
Treflan	1.5 pt	0	89	80	83
Prowl	3.0 pt	0	89	94	95
Dual Magnum	1.67 pt	0	99	99	99
Lorox	2.5 lb	0	74	60	70
Sencor	1.0 lb	0	90	94	96
Matrix	1.25 oz	0	93	94	95
Turbo	3.5 pt	0	99	99	99
Frontier a-isomer	14 oz	0	98	98	98
POST					
Sencor	0.5 lb	0	95	98	98
Matrix + NIS	1.25 oz + 0.25%	0	99	99	99
Poast + Herbimax	1.0 pt + 1.0 qt	0	99	0	0
Untreated		0	0	0	0
LSD (0.05)		NS	10	15	13

Table 2. Potato stem and stolon rhizoctonia and injury ratings.

Treatment	Rate	June 16				June 23				June 30				July 7				July 14			
		Stems		Stolons		Stems		Stolons		Stems		Stolons		Stems		Stolons		Stems		Stolons	
		R*	G*	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G
	Product/A	%																			
PPI																					
Eptam	5.0 pt	39	28	3	0	51	19	13	8	67	39	27	22	49	26	16	14	48	34	21	15
Treflan	1.5 pt	45	13	3	3	53	30	16	10	68	34	19	19	83	45	31	24	78	39	27	13
Prowl	3.0 pt	23	8	3	3	62	25	13	10	64	41	16	15	83	41	26	19	89	45	23	19
Dual Magnum	2.0 pt	33	15	1	0	67	33	22	19	60	30	24	20	66	24	22	16	78	62	27	23
Frontier a-isomer	14 oz	30	20	3	3	53	24	9	5	44	37	21	17	46	28	21	18	64	33	31	17
PRE																					
Treflan	1.5 pt	40	12	3	3	56	30	14	12	60	28	21	19	60	32	25	24	58	22	14	6
Prowl	3.0 pt	41	27	1	0	56	30	16	13	58	33	24	20	51	27	64	22	61	39	25	16
Dual Magnum	1.67 pt	30	18	3	1	52	33	14	11	56	31	20	18	63	34	22	16	74	32	18	12
Lorox	2.5 lb	21	16	1	1	63	30	19	18	58	40	23	21	66	27	46	43	69	44	22	17
Sencor	1.0 lb	39	23	2	0	69	45	23	19	63	30	22	18	57	35	23	20	55	42	23	16
Matrix	1.25 oz	31	25	5	5	61	31	17	13	59	40	20	17	73	41	32	25	77	38	33	21
Turbo	3.5 pt	31	24	6	3	74	33	22	20	64	25	21	18	52	25	18	15	72	41	20	10
Frontier a-isomer	14 oz	37	26	4	1	50	21	12	11	59	30	18	14	46	28	21	18	64	33	31	17
POST																					
Sencor	0.5 lb	20	12	0	0	52	22	6	6	71	43	25	24	70	33	24	21	61	33	17	11
Matrix + NIS	1.25 oz + 0.25%	35	21	4	4	59	36	17	17	65	38	22	17	56	35	19	15	71	48	23	16
Poast + Herbimax	1.0 pt + 1.0 qt	24	24	1	0	58	30	19	17	70	41	25	22	65	37	26	23	78	66	28	20
Untreated		31	10	2	0	59	37	18	16	66	40	31	22	62	31	24	23	67	35	19	8
LSD (0.05)		NS	NS	NS	NS	NS	NS	NS	10	NS	NS	NS	NS	18	NS	22	NS	17	19	11	9

*R = with rhizoctonia, G = girdled.

Potato Tolerance to Frontier. Zollinger and Fitterer. An experiment was conducted, at McLeod, ND, to evaluate potato tolerance to Frontier herbicide in potato. Russet Burbank potato was planted on May 22 and hilled on June 6, 1998. PRE treatments were applied on June 9, 1998 at 11:00-12 noon with 65 F air, 70 F soil, 65% RH, 5-7 mph NE wind, 95% clouds, wet soil surface, and wet subsoil. Treatments were applied to the center eight feet of the 10 by 25 ft plots with a CO2 pack back sprayer delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Potato injury June 4	Potato injury July 16	Yield
	lb ai/A	%	%	cwt/A
Frontier	2.34	0	0	469
Frontier a-isomer	0.64	0	0	479
Frontier a-isomer	1.29	0	0	479
Frontier a-isomer	2.58	0	0	474
Dual II Magnum	5.2	0	0	523
Turbo	3.5	0	0	517
Untreated		0	0	505
LSD (0.05)		NS	NS	43

No potato injury was observed though out the season. Potato harvest occurred on October 13. Frontier a-isomer did not cause a significant decrease in yield when compared to the untreated check.

Potato tolerance to Assure II. Zollinger and Fitterer. An experiment was conducted, at McLeod, ND, to evaluate potato tolerance to Assure II. 'Red Pontiac' potato was planted May 22, and hilled on June 6, 1998. POST treatments were applied on June 24, 1998 at 10:00 am with 75 F air, 77 F soil surface, 64% RH, 3 to 8 mph SE wind, 5% clouds, dry soil surface, moist subsoil, excellent crop vigor, no dew present to 10-12" potato. Treatments were applied to the center eight feet of the 10 by 25 ft plots with a CO2 backpack sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate
	Product/A
Assure II + Herbimax	10 fl oz + 1% v/v
Assure II + Herbimax	20 fl oz + 1% v/v
Assure II + Herbimax	40 fl oz + 1% v/v
Untreated	

No injury was observed throughout the season.

Potato Vine Desiccation. Zollinger and Fitterer. An experiment was conducted, in McLeod, ND, to evaluate potato vine desiccation from labeled and experimental desiccants. 'Red Pontiac' potato was planted May 22, 1998, and one cultivation was performed on June 6. Vine kill chemicals were applied at beginning of natural senescence (BNS), September 9 at 10:30 am with 73 F, 25% RH, 70% clouds, 5 to 12 mph SE wind, and no dew present. An additional diquat treatment was applied only on September 16 which was 7 days after the initial treatments, at 6:00 pm with 83 F, 41% RH, 60% clouds, 5 to 8 mph NE wind, and no dew present. Treatments were applied to the 12 by 25 foot plots with a back-pack sprayer delivering 26 gpa at 40 psi through 8003 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. Tubers were evaluated four times for skin set, prior to application, at 7 and 14 days after treatment (DAT), and one day following harvest. Skin set values are ounces per inch at 17 lb of pressure. Stem end discoloration was measured after harvest by comparing untreated and treated tubers.

		Vine desiccation (DAT)							Yield	Skin set		
									Oct	Sept	Sept	Oct
Treatment[a]	Rate	2	5	7	10	14	16	21	13	16	23	14
	lb ai/A	(%)							(cwt/A)	(oz/in)		
<u>BNS</u>												
Rely	0.28	13	43	50	61	81	91	97	419	40	45	52
Rely	0.38	21	48	64	76	92	92	97	348	42	45	51
Rely+AMS	0.28+3 lb	21	53	64	73	86	94	97	367	43	45	53
Rely+AMS	0.38+3 lb	26	54	65	76	90	94	98	386	43	44	51
Diquat+NIS	0.25+0.25%	23	31	40	54	74	85	97	383	42	47	52
ET-751+Agri-Dex	0.009+1%	19	39	53	63	85	93	97	368	43	45	53
ET-751+Agri-Dex	0.018+1%	24	40	54	65	88	94	97	382	42	46	52
ET-751+Agri-Dex	0.027+1%	25	48	55	68	90	95	98	359	43	43	52
<u>7 days after BNS</u>												
Diquat+NIS	0.25+0.25%	10	63	97	99	-	-	-	394	45	45	52
Untreated		0	0	0	0	0	0	0	380	44	43	52
LSD (0.05)		8	12	14	14	9	6	1	47	NS	NS	NS

[a]AMS = ammonium sulfate, NIS = nonionic surfactant (Preference), Agri-Dex = petroleum oil concentrate.

Initially, ammonium sulfate improved speed of potato desiccation but no longer enhanced effectiveness by 14 days after application. Most treatments gave greater potato desiccation than diquat until 14 days after application. ET-751 gave equal potato desiccation to Rely but greater than diquat at 14 days after application. Potato senescence was initially lower with diquat applied 7 days after beginning of natural potato senescence than treatments applied at beginning of natural senescence but speed of desiccation surpassed earlier applied treatments by 5 days after treatment. With the exception of greater potato yield with Rely at 0.28 lb/A, there were no differences in potato yield. Skin set of potatoes from treated plants did not differ from tubers of potatoes from untreated plots. No significant stem end discoloration was found after harvest.

Potato Vine Desiccation with Desicate II. Zollinger and Fitterer. An experiment was conducted, in McLeod, ND, to evaluate potato vine desiccation. 'Russet Burbank' potato was seeded May 22, 1998, and one cultivation was performed on June 6. The first treatments of vine kill desiccants were applied at beginning of natural senescence (BNS), September 9 at 10:30 am with 73 F, 25% RH, 70% clouds, 5 to 12 mph SE wind, and no dew present. The sequential treatments were applied 7 days following the first application on September 16 at 6:00 pm with 83 F, 41% RH, 60% clouds, 5 to 8 mph NE wind, and no dew present. Treatments were applied to the center 8 feet of 12 by 25 foot plots with a back-pack sprayer delivering 26 gpa at 40 psi through 8003 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		First treatment date						Second treatment date			
		2 DAT		5 DAT		7 DAT		2 DAT		7 DAT	
Treatment[a]	Rate	leaf	stem	leaf	stem	leaf	stem	leaf	stem	leaf	stem
	Product/A	(% desiccation)									
Desicate II+LI 700/ Diquat	3 pt+0.125%/ 1 pt	20	7	50	33	60	40	68	53	92	85
Desicate II+AMS/ Diquat+NIS	3 pt+5 lb/ 1 pt+0.25%	28	12	82	53	92	75	95	82	98	94
Desicate II+LI 700/ Diquat+NIS	3 pt+0.125%/ 1 pt +0.25%	17	7	47	30	57	45	67	53	85	75
Desicate II+LI 700+AMS/ Diquat+NIS	3 pt+0.125%+5 lb/ 1 pt+0.25%	33	15	75	53	83	70	88	78	93	87
Desicate II/ Diquat+NIS	3 pt/ 1 pt+0.25%	13	3	60	43	82	70	86	77	93	85
Desicate II+LI 700/ Desicate II+LI 700	2 pt+0.125%/ 2 pt+0.125%	8	3	30	30	42	37	57	48	88	78
Diquat+NIS/ Diquat+NIS	1 pt+0.25%/ 1 pt+0.25%	52	23	82	53	87	68	93	77	98	96
Untreated		0	0	0	0	0	0	0	0	0	0
LSD (0.05)		11	6	14	10	9	18	10	9	10	15

[a] LI-700 = surfactant, AMS = ammonium sulfate, NIS = Preference (nonionic surfactant).

Two days after first treatment date, only Diquat gave greater than 50% potato leaf and greater than 20% stem desiccation. Generally, ammonium sulfate enhanced potato leaf and stem desiccation from Desicate II more than LI-700 until 7 days after the sequential treatment. Potato stems were slower to desiccate than leaves. Effective stem desiccation did not match leaf desiccation until 14 DAT. Desicate II applied as a split treatment was slow to desiccate potato leaves and stems. Diquat was needed as a second treatment to effectively dessicate potato leaves and stems. Evaluations were taken 9 and 14 days after the second treatment (data not shown), and potato leaves and stems were completely desiccated by 9 days after second application for all treatments.

Soil and Post Treatments in Soybeans. Zollinger and Fitterer. An experiment was conducted at NW-22, to evaluate weed control from herbicides applied at the PPI, PRE, and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on June 8, 1998 at 4:00-5:00 pm with 74 F air, 63 F soil 2-4" depth, 32% RH, 60% clouds, and 8-10 E mph wind, dry soil surface, wet subsoil. Stine '1284' (7-23-2233RR) soybean was planted and PRE treatments were applied June 9, 1998 at 3:15 pm with 70 F air, 60 F soil 2-4" depth, 60% RH, 3-7 mph NE wind, and 95% clouds, dry soil surface, moist subsoil. Post treatments were applied on July 15, 1998 at 10:00 am with 73 F air, 68 F soil, (2-4" depth), 72 % RH, 1-2 mph N wind, and 10% clouds, dry soil surface, moist subsoil, crop vigor was fair, no dew present, crop stage was V2-V7. Weeds present at the POST application were: 4-8", (10-30/ft^2), foxtail; 2-12", (5-10/ft^2), redroot pigweed; 2-10", (1-5/ft^2), wild mustard. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for soil applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST applications. The experiment had a randomized complete block design with three replicates per treatment.

		July 29				Aug 11			
Treatment	Rate	Fxtl	Rrpw	Colq	Wibw	Fxtl	Rrpw	Colq	Wibw
	Product/A	%							
PPI									
Sonalan+Python	2.5pt+1oz	94	95	99	99	94	92	93	95
Sonalan+Python	2.5pt+1.26oz	93	99	99	99	98	99	99	99
PRE									
Frontier+Python	26oz+1oz	92	92	99	63	91	81	82	50
Frontier+Python	26oz+1.26oz	91	97	99	75	91	99	99	38
PPI fb POST									
Authority/Roundup Ultra+AMS	0.33lb/1.5pt+3lb	96	99	99	99	97	99	99	99
Authority/Roundup Ultra+AMS	0.5lb/1.5pt+3lb	96	99	99	99	97	99	99	99
Treflan/FirstRate+Activator 90+28% UAN	2pt/0.3oz+0.25%+2.5%	95	86	96	99	91	90	94	98
Prowl/Pursuit+Activator 90+28% UAN	3pt/1.08oz+0.25%+1%	96	98	99	99	99	99	99	99
Prowl/Raptor+Activator 90+28% UAN	3pt/4oz+0.25%+1%	95	99	99	99	98	99	99	99
PRE fb POST									
Authority/Roundup Ultra+AMS	0.33oz/1.5pt+3lb	96	99	99	99	98	99	99	99
Authority/Roundup Ultra+AMS	0.5oz/1.5pt+3lb	98	99	99	99	98	99	99	99
POST									
Flexstar HL+Sun-It II+28% UAN	0.75pt+1%+2.5%	11	95	91	50	0	97	95	60
Flexstar HL+Basagran+Sun-It II+28% UAN	0.75pt+1.5pt+1%+2.5%	6	48	58	61	0	92	38	33
Flexstar HL+Raptor+Sun-It II+28% UAN	0.75pt+3oz+1%+2.5%	54	89	92	52	50	87	87	57
Pursuit+Sun-It II	1.08oz+1.5%	75	77	65	45	74	80	80	57
Pursuit+Sun-It II	0.72oz+1.5%	66	77	75	30	71	75	71	45
Pursuit+Quad 7	0.72oz+1%	65	84	82	38	71	83	84	45
Pursuit+Blazer+Activator 90+28% UAN	1.08oz+10oz+0.25%+1%	53	79	60	38	55	68	63	38
Raptor+Activator 90+28% UAN	5oz+0.25%+1%	75	81	86	47	79	85	86	45
Raptor+Sun-It II	4oz+1.5%	78	89	92	28	88	86	76	50
Raptor+Quad 7	4oz+1%	69	86	90	20	80	83	79	45
Raptor+Sun-It II	3oz+1.5%	68	96	98	55	81	79	83	43
Raptor+Quad 7	3oz+1%	70	89	92	65	83	84	80	63
Raptor+Sun-It II	2oz+1.5%	65	97	89	43	70	69	73	50
Roundup Ultra+AMS	2pt+2.5lb	96	99	99	99	97	96	86	87
Roundup Ultra+AMS	1.5pt+2.5lb	98	99	99	99	97	95	85	87
Roundup Ultra+AMS	1pt+2.5lb	95	98	99	99	92	72	76	75
Roundup Ultra+Pursuit+Activator 90+AMS	1pt+0.72oz+0.25%+2.5lb	97	99	99	99	94	92	87	87
Roundup Ultra+Raptor+Activator 90+AMS	1pt+2oz+0.25%+2.5lb	99	98	98	77	98	97	97	94
Roundup Ultra+FirstRate+Activator 90+AMS	1pt+0.3oz+0.25%+2.5%	97	99	99	99	98	97	99	99
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		9	16	15	32	9	13	17	26

Wild mustard was completely controlled throughout the growing season. The study received excessive moisture during early to mid season which may explain high weed control ratings and lack of additional weed flushes.

Pursuit with Adjuvants. Zollinger and Fitterer. An experiment was conducted in Casselton, ND, to evaluate weed control from Pursuit applied with different adjuvants. POST treatments were applied June 23, 1998, at 10:00 pm with 78 F air, 68 F soil surface, 68% RH, 50% clouds, and 6 to 8 mph SE wind, moist soil surface, wet subsoil, with no dew present. Weed species present were 1 to 4 inch, 2 to 4 lf, (10 to 20/ft^2) foxtail; 6 to 8 inch, flowering, (5 to 15/ft^2) wild mustard; and 2 to 6 inch, 4 to 8 lf, (15 to 30/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment[a]	Rate	July 10		July 21	
		Fxtl[b]	Cocb	Fxtl	Cocb
	(Product/A)	(% control)			
Pursuit+Preference+AMS	0.72 oz+0.25%+2.5 lb	90	50	67	57
Pursuit+Herbimax+AMS	0.72 oz+1 qt+2 lb	77	60	73	60
Pursuit+Scoil	0.72 oz+1.5 pt	90	62	75	68
Pursuit+Destiny	0.72 oz+1.5 pt	90	53	80	57
Pursuit+Preference+Destiny+AMS	0.72 oz+0.25%+0.25%+2.5 lb	87	63	73	57
Pursuit+Impressive DB	0.72 oz+2.25 lb	90	53	67	43
Pursuit+Dispatch 2N	0.72 oz+2.5 qt	80	70	75	82
Pursuit+Class APM-28	0.72 oz+5% v/v	87	65	57	57
Pursuit+React	0.72 oz+1.5 pt	82	62	63	70
Pursuit+CL 9605+AMS	0.72 oz+0.5%+2.5 lb	89	65	63	75
Pursuit+CL 9706	0.72 oz+4 pt	87	75	75	80
Pursuit+CL 9808	0.72 oz+1% v/v	88	50	53	60
Pursuit+CL 9809	0.72 oz+1% v/v	87	57	60	67
Pursuit+Quad 7	0.72 oz+1% v/v	90	67	67	68
Untreated		0	0	0	0
LSD (0.05)		11	11	13	18

[a]AMS = ammonium sulfate, CL9605 = surfactant + ammonium sulfate, CL9706 = methylated seed oil + 28% UAN, CL9808 = nitrogen fertilizer + nonionic surfactant, CL9809 = nitrogen fertilizer + nonionic surfactant, Class APM-28 = surfactant + fertilizer, Destiny = methylated seed oil, Dispatch 2N = surfactant + fertilizer, Herbimax = petroleum oil concentrate, Impressive DB = surfactant + fertilizer, Preference = surfactant, React = methylated seed oil + water conditioning agent, Scoil = methylated seed oil, Quad 7 = basic blend (ammonium nitrate + nonionic surfactant + buffer).
[b]Fxtl = Grft and Yeft.

Pursuit at 0.72 oz/A is registered for use on dry beans in North Dakota or half of the full registered rate on soybean. Few differences in weed control were observed at the July 10 evaluation. However, at the July 21 evaluation, green and yellow foxtail control ranged from 53 to 80% and common cocklebur control ranged from 43 to 82%. Adjuvants are herbicide and weed specific.

Raptor with adjuvants. Zollinger and Fitterer. An experiment was conducted in Casselton, ND, to evaluate weed control from Raptor applied with different adjuvants. POST treatments were applied June 23, 1998, at 10:00 pm with 78 F air, 68 F soil surface, 68% RH, 50% clouds, and 6 to 8 mph SE wind, moist soil surface, wet subsoil, with no dew present. Weed species present were: 1 to 4 inch, 2 to 4 lf, (10 to 20/ft^2) foxtail; 6 to 8 inch, flowering, (5 to 15/ft^2) wild mustard; and 2 to 6 inch, 4 to 8 lf, (15 to 30/ft^2) common cocklebur. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment[a]	Rate	July 10		July 21	
		Fxtl[b]	Cocb	Fxtl	Cocb
	(Product/A)	(% control)			
Raptor+Preference+AMS	3 oz+0.25% v/v+2.5	80	53	60	68
Raptor+Herbimax+AMS	3 oz+1 qt+2	87	62	72	72
Raptor+Scoil	3 oz+1.5 pt	90	50	73	65
Raptor+Destiny	3 oz+1.5 pt	87	53	70	63
Raptor+Preference+Destiny+AMS	3 oz+0.25% v/v+0.25% v/v+2.5	89	62	70	67
Raptor+Impressive DB	3 oz+2.25	85	47	53	60
Raptor+Dispatch 2N	3 oz+2.5 qt	84	72	77	80
Raptor+Class APM-28	3 oz+5% v/v	82	53	47	53
Raptor+React	3 oz+1.5 pt	80	47	50	50
Raptor+CL 9605+AMS	3 oz+0.5% v/v+2.5	84	57	53	58
Raptor+CL 9706	3 oz+4 pt	85	68	80	82
Raptor+CL 9808	3 oz+1% v/v	86	40	53	50
Raptor+CL 9809	3 oz+1% v/v	87	53	78	62
Raptor+Quad 7	3 oz+1% v/v	90	43	57	53
Untreated		0	0	0	0
LSD (0.05)		0	14	10	10

[a]AMS = ammonium sulfate, CL9605 = surfactant + ammonium sulfate, CL9706 = methylated seed oil + 28% UAN, CL9808 = nitrogen fertilizer + nonionic surfactant, CL9809 = nitrogen fertilizer + nonionic surfactant, Class APM-28 = surfactant + fertilizer, Destiny = methylated seed oil, Dispatch 2N = surfactant + fertilizer, Herbimax = petroleum oil concentrate, Impressive DB = surfactant + fertilizer, Preference = surfactant, React = methylated seed oil + water conditioning agent, Scoil = methylated seed oil, Quad 7 = basic blend (ammonium nitrate + nonionic surfactant + buffer).
[b]Fxtl = Grft and Yeft.

Raptor at 3 oz/A is below the lowest registered rate of 4 to 5 oz/A. Few differences in green and yellow foxtail control was observed at the July 10 evaluation. However, at the July 21 rating, green and yellow foxtail control ranged from 47 to 80% and common cocklebur control ranged from 50 to 82% control. Adjuvants were herbicide and weed specific.

Common Ragweed Control In Soybean. Zollinger and Fitterer. An experiment was conducted at Wahpeton, ND to evaluate ragweed control in soybean at the PPI, EPOST, MPOST, and LPOST stages. PPI treatments were incorporated with a rototiller at a depth of 2" and applied on May 4, 1998 at 10:00 am with 72 F air, 60 F soil, 31% RH, 3-5mph NW wind, 5% clouds, dry soil surface, and moist subsoil. EPOST treatments were applied on June 10, 1998 at 3:00 pm with 72 F air, 73 F soil surface, 59 RH, 7-12 mph S wind, 80% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and the crop stage was at the cotyledon stage. Weeds present at the EPOST stage were: 2-4", 2-3 lf, (10/ft^2), foxtail; 2-4", 2-4 lf, (10/ft^2), barnyard grass; 2-3", 2 lf, (1/yd^2), common lambsquarters; 2-4", 4 lf, (1/yd^2), common cocklebur; 2-3", (1/ft^2), common ragweed. MPOST treatments were applied on June 25, 1998 at 2:30 pm with 76 F air, 78 F soil surface, 72% RH, 3-7 mph SW wind, 20% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and the crop stage was (V1) 1st trifoliate. Weeds present at the MPOST stage were: 4-8", (10-30/ft^2), foxtail; 4-8", (10/ft^2), barnyardgrass; 3-6", (1/yd^2), common lambsquarters; 4-10", (1-5/yd^2), common cocklebur; 4-10", (1-3/yd^2), common ragweed. LPOST treatments were applied on July 10, 1998 at 11:00 am with 85 F air, 93 F soil surface, 67% RH, 2-4 mph S wind, 10% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and the crop stage was 3rd trifoliate. Weeds present at the LPOST stage were: 6-10", (10-30/ft^2), foxtail; 6-10", (10/ft^2), barnyardgrass; 5-8", (1/yd^2), common lambsquarters; 6-12", (1-5/yd^2), common cocklebur; 6-12", (1-3/yd^2), common ragweed. Treatments were applied to the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a windshield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for the PPI treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for the POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 24					July 10			July 20			
		Fxtl	Bygr	Colq	Cocb	Corw	Fxtl	Corw	Cocb	Fxtl	Colq	Cocb	Corw
	Product/A	%											
PPI fb EPOST													
Prowl/Raptor+ Activator 90+AMS	2.4pt/4oz+ 0.25%+2.5lb	95	95	99	82	67	98	85	92	96	99	68	73
Prowl/Status+Raptor+ Activator 90+AMS	2.4pt/10oz+4oz+ 0.25%+2.5lb	95	95	99	98	98	96	98	98	95	99	96	98
Prowl/Roundup Ultra+Raptor +Activator 90+AMS	2.4pt/1pt+4oz+ 0.25%+2.5lb	99	99	99	98	99	99	98	98	97	99	98	98
EPOST													
Raptor+Activator 90+AMS	5oz+0.25%+2.5lb	93	93	93	82	50	95	88	97	96	95	91	78
Roundup Ultra+Raptor+ Activator 90+AMS	1pt+4oz+ 0.25%+2.5lb	98	98	96	98	97	98	98	98	95	98	95	98
Roundup Ultra+Raptor+ Activator 90+AMS	1pt+5oz+ 0.25%+2.5lb	97	97	99	98	97	98	99	98	96	99	95	99
MPOST													
Roundup Ultra	2pt	-	-	-	-	-	99	98	98	96	99	95	92
MPOST fb LPOST													
Roundup Ultra/Roundup Ultra	2pt/2pt	-	-	-	-	-	99	96	99	99	99	99	98
Untreated		0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		5	5	8	7	21	3	4	3	3	3	12	16

Complete common lambsquarters control was observed on July 10 and complete redroot pigweed control was observed on July 10. Generally, most treatments gave 90% weed control except control of common ragweed with the PPI fb EPOST or EPOST treatment of Raptor + NIS.

Soybean Ragweed II. Zollinger and Fitterer. An experiment was conducted at Wahpeton, ND to evaluate ragweed control in soybean at the POST stage. POST treatments were applied on July 10, 1998 at 12:00 pm with 85 F air, 93 F soil surface, 67% RH, 3-5 mph S wind, 30% clouds, dry soil surface, moist subsoil, excellent crop vigor, no dew present, and the crop stage was 3-4 trifoliate (V3). Weeds present at the POST stage were: 1-6", (1-4/ft^2), common ragweed; 2-12", (5-20/ft^2), foxtail. Treatments were applied to the center 8 ft of the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a windshield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Common ragweed	
		July 20	Aug 11
	Product/A	%	
Cobra+Herbimax (2EC)	8oz+1pt	75	73
Cobra+Herbimax (25WP)	8oz+1pt	60	75
Cobra+Pursuit+Herbimax (2EC)	6oz+1.08oz+1pt	83	72
Cobra+Pursuit+Herbimax (25WP)	6oz+1.08oz+1pt	91	72
Cobra+FirstRate+Herbimax (2EC)	6oz+0.3oz+1pt	94	90
Cobra+FirstRate+Herbimax (25WP)	6oz+0.3oz+1pt	94	95
Cobra+Expert+Herbimax (2EC)	6oz+1.25oz+1pt	89	88
Cobra+Expert+Herbimax (25WP)	6oz+1.25oz+1pt	87	87
Cobra+Raptor+Herbimax (2EC)	6oz+4oz+1pt	92	93
Flexstar HL+Scoil+28% UAN	12oz+1%+2.5%	96	92
Flexstar HL+Basagran+Scoil+28% UAN	12oz+1.5pt+1%+2.5%	97	92
Flexstar HL+Raptor+Scoil+28% UAN	12oz+3oz+1%+2.5%	95	89
Untreated		0	0
LSD (0.05)		10	18

An excellent common ragweed population (5 to 20 plants/sq ft) was present at application. Most treatments except Cobra applied alone or in tank-mix combination with Pursuit, gave 87% to 95 % common ragweed control.

Kochia Control in Roundup Ready Soybean. Zollinger and Fitterer. An experiment was conducted at Glyndon, MN to evaluate kochia control in Roundup Ready soybean from herbicides applied at the POST stage. POST treatments were applied on July 10, 1998 at 2:00 pm with 90 F air, 93 F soil surface, 80% RH, 0-3 mph SW wind, 50% clouds, dry soil surface, wet subsoil, good crop vigor, no dew present, and the crop was at the V-2 stage at the time of application. Weeds present were: 2-8", (5-15/ft^2), kochia. Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with a windshield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiments had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Kochia	
		July 20	Aug 11
	Product/A	%	%
Cobra+Herbimax	12oz+1pt	42	75
Cobra+Herbimax	8oz+1pt	37	77
Cobra+Raptor+Herbimax	8oz+4oz+1pt	85	77
Cobra+Raptor+Herbimax	5.5oz+4oz+1pt	78	78
Galaxy+Herbimax	2pt+1pt	37	88
Untreated		0	0
LSD (0.05)		10	13

Kochia size was larger (2 to 8 inches tall) than when broadleaf herbicides are normally applied in soybean. Kochia control ranged from 75% to 88% control. Galaxy + additive gave 88% kochia control.

Soybean Grass. Zollinger and Fitterer. An experiment was conducted at Wahpeton, ND to evaluate grass control in soybean at the POST stage. POST treatments were applied on July 10, 1998 at 12:00 pm with 85 F air, 93 F soil surface, 67% RH, 3-5 mph S wind, 30% clouds, dry soil surface, moist subsoil, excellent crop vigor, no dew present, and the crop stage was 3-4 trifoliate (V3). Weeds present at the POST stage were: 1-6", (1-4/ft^2), common ragweed; 2-12", (5-20/ft^2), foxtail. Treatments were applied to the center 8 ft of the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a windshield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		Foxtail	
Treatment	Rate	July 20	Aug 11
	Product/A	%	
Select+Herbimax	6oz+1qt	57	87
Fusion+Herbimax	5oz+1qt	53	90
Poast Plus+Herbimax	1.5pt+1qt	53	88
Assure II+Herbimax	8oz+1qt	70	95
Select+Pinnacle+Herbimax	6oz+0.125oz+1pt	50	85
Select+Pinnacle+Resource+Herbimax	6oz+0.125oz+4oz+1qt	63	88
Select+FirstRate+Herbimax	6oz+0.3oz+1qt	63	87
Poast Plus+FirstRate+Herbimax	1.5oz+0.3oz+1qt	60	88
Assure II+Pinnacle+Herbimax	8oz+0.125oz+1qt	57	57
Raptor+Herbimax	4oz+1qt	50	80
Untreated		0	0
LSD (0.05)		11	13

Purpose of this study was to compare foxtail control from grass herbicides applied alone and in tank-mix combination with broadleaf herbicides. Foxtail control was lower when Assure II was tank-mixed with Pinnacle as compared foxtail control from Assure II without Pinnacle. Most treatments provided 85% foxtail control or better.

Roundup Ready Soybean. Zollinger and Fitterer. An experiment was conducted at NW 22, to evaluate weed control from herbicides applied at the PPI, PRE and POST stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 27, 1998 at 4:00-5:00 pm with 84 F air, 68 F soil 2-4" depth, 52% RH, 40% clouds, and 3-7 mph SE wind. Stine 1284 (7-23-2233RR) Roundup Ready soybean was planted and PRE treatments were applied May 29, 1998 at 3:00-4:00 pm with 71 F air, 77 F soil 2-4" depth, 60% RH, 3-5 mph N wind, and 0% clouds. Early POST treatments were applied on July 1, 1998 at 2:00-4:00 pm with 78 F air, 87 F soil 2-4" depth, 72% RH, 0-5 mph NW wind, and 20% clouds, soil surface was dry-moist, subsoil was moist-wet, crop vigor was poor-fair, there was no dew present, and crop stage was 1-2 trifoliate (V1-V2). Weeds present at the early POST stage were: 2-4", (2-10/ft^2), foxtail; 1-3", (5-20/ft^2), redroot pigweed; 5-30", (patchy), Canada thistle. Mid POST treatments were applied on July 15, 1998 at 9:00 am with 71 F air, 67.8 soil 2-4" depth, 72% RH, 1-2 mph N wind, 10% clouds, dry soil surface, moist subsoil, fair crop vigor, no dew present, and crop stage was V2-V3. Weeds present at the mid POST stage were: 6-10", (2-10/ft^2), foxtail; 4-18", (5-20/ft^2), redroot pigweed; 9-30", (patchy), Canada thistle. Bloom treatments were applied on July 29, 1998 at 8:45 am with 72 F air, 72 F soil, 61% RH, 0-3 mph NW wind, 100 % clouds, dry soil surface, moist subsoil, good crop vigor, no dew was present, and crop stage was V3-V6. Weeds present at the BLOOM stage were: 10-14", (2-10/ft^2), foxtail; 10-30", (5-20/ft^2), redroot pigweed; 20-36", (patchy), Canada thistle. Treatments were applied to the center 8 feet of the 10 by 30 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles for soil applied treatments and 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST applied treatments. The experiment had a randomized complete block design with four reps per treatment.

Treatment	Rate	Aug 11			Aug 26			
		Fxtl	Rrpw	Wibw	Fxtl	Rrpw	Colq	Wibw
	Product/A				%			
PPI fb MPOST								
Prowl/Pursuit+Activator 90+28% UAN	3pt/1.44oz+0.25%+2.5%	97	91	60	98	87	92	96
Prowl/Raptor+Activator 90+28% UAN	3pt/4oz+0.25%+2.5%	95	95	60	99	92	90	80
PRE fb MPOST								
Frontier/Galaxy+Poast+Herbimax+AMS	20oz/2pt+1.5pt+1qt+2.5lb	98	93	45	99	94	96	62
Frontier/Roundup Ultra+AMS	20oz/2pt+2.5lb	99	96	92	99	92	95	95
PRE fb EPOST fb MPOST fb LPOST								
Roundup Ultra+AMS/RU Ultra+AMS/ Roundup Ultra+AMS/RU Ultra+AMS	2pt+2.5lb/2pt+2.5lb/ 2pt+2.5lb/2pt+2.5lb	99	98	97	98	99	99	99
EPOST								
Roundup Ultra+AMS	2pt+2.5lb	94	61	45	95	69	75	65
EPOST fb MPOST								
Roundup Ultra+AMS/RU Ultra+AMS	2pt+2.5lb/2pt+2.5lb	95	95	98	99	95	97	93
EPOST fb MPOST fb LPOST								
Roundup Ultra+AMS/RU Ultra+AMS/ Roundup Ultra+AMS	2pt+2.5lb/2pt+2.5lb/ 2pt+2.5lb	98	99	98	99	99	99	99
EPOST fb MPOSTfbLPOSTfbBLOOM								
Roundup Ultra+AMS/RU Ultra+AMS/ Roundup Ultra+AMS/RU Ultra+AMS	2pt+2.5lb/2pt+2.5lb/ 2pt+2.5lb/2pt+2.5lb	99	99	99	99	99	99	99
MPOST								
Raptor+Activator 90+28% UAN	5oz+0.25%+2.5%	95	85	38	94	89	90	62
Frontier+Roundup Ultra+AMS	16oz+2pt+2.5lb	98	98	91	99	98	98	94
Frontier+Roundup Ultra+AMS	20oz+2pt+2.5lb	98	95	89	97	95	96	95
Galaxy+Poast+Herbimax+AMS	2pt+1.5pt+1pt+2.5lb	91	58	35	93	53	64	38
Galaxy+Roundup Ultra+AMS	2pt+1pt+2.5lb	96	80	50	89	78	85	58
Pursuit+RU Ultra+Act. 90+AMS	1.44oz+2pt+0.25%+2.5lb	98	95	94	97	92	93	92
Roundup Ultra+AMS	2pt+2.5lb	99	99	88	98	97	98	94
MPOST fb LPOST fb BLOOM								
Roundup Ultra+AMS/RU Ultra+AMS/ Roundup Ultra+AMS	2pt+2.5lb/2pt+2.5lb/ 2pt+2.5lb	99	99	98	99	99	99	99
LPOST								
Roundup Ultra+AMS	2pt+2.5lb	99	70	69	98	98	92	91
LPOST fb BLOOM								
Roundup Ultra+AMS/RU Ultra+AMS	2pt+2.5lb/2pt+2.5lb	99	89	70	99	99	99	92
BLOOM								
Roundup Ultra+AMS	2pt+2.5lb	97	50	40	96	87	96	68
ALL SEASON								
Handweed		99	99	99	99	99	99	99
Handweed+Roundup Ultra	2pt	99	99	97	99	99	99	99
Untreated		0	0	0	0	0	0	0
LSD (0.05)		3	16	21	4	11	10	20

Soybean Iron Chlorosis/Herbicide Interaction - Arthur, ND. Zollinger and Fitterer. An experiment was conducted at Arthur, ND to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on July 1, 1998 at 4:30 pm with 78 F air, 83 F soil surface, 65% RH, 0-5 NW wind, 5% clouds, dry soil surface, wet subsoil, crop was chlorotic, no dew present, and the crop stage was 1st-2nd trifoliate. Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	July 17			July 28		
		Stunt	Yellow	Burn	Stunt	Yellow	Burn
	Product/A	%					
Basagran+Herbimax	2pt+2pt	28	23	15	12	14	0
Blazer+Activator 90	1.5pt+0.25%	34	27	18	10	12	0
Galaxy+Herbimax	2pt+2pt	28	20	17	12	11	0
Storm+Herbimax	1.5pt+2pt	31	22	18	15	14	0
Cobra+Herbimax	10oz+1.5pt	42	27	23	14	13	0
Flexstar HL+Herbimax	0.75pt+2pt	31	25	20	8	7	0
Pinnacle+Activator 90	0.25oz+0.25%	23	18	13	11	19	0
FirstRate+Activator 90+28%UAN	0.3oz+0.125%+2.5%	31	28	15	14	11	0
Pursuit+Herbimax+28% UAN	3oz+2pt+2.5%	26	25	12	10	28	0
Raptor+Herbimax+28% UAN	4oz+2pt+2.5%	29	24	18	11	10	0
Untreated		0	0	0	0	0	0
LSD (0.05)		14	NS	8	NS	14	NS

The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10 wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

Soybean Iron Chlorosis/Herbicide Interaction - Fairmount, ND. Zollinger and Fitterer. An experiment was conducted at Fairmount, ND to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on June 16, 1998 at 8:00-9:00 am with 74 F air, 72 F soil surface, 68% RH, 0 wind, 40% clouds, dry soil surface, moist subsoil, crop vigor was chlorotic, no dew present, and the crop stage was unifoliate-1st trifoliate. Weeds present at the POST stage were: 4-12",(1/ft^2), wild mustard; 3-4", (1/yd^2), common ragweed; 3-6", (5-10/ft^2), marshelder. Treatments were applied to the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	June 30				July 16							
		Stunt	Yellow	Burn	Corw	Stunt	Yellow	Burn	Corw	Mael	Colq	Rrpw	Cocb
	Product/A	— % injury —			% control	— % injury —			— % control —				
Basagran+Herbimax	2pt+2pt	28	22	12	98	13	16	4	67	99	99	94	94
Blazer+Activator 90	1.5pt+0.25%	36	34	28	98	16	13	2	98	99	99	99	89
Galaxy+Herbimax	2pt+2pt	25	25	22	98	24	24	8	99	99	91	91	83
Storm+Herbimax	1.5pt+2pt	28	33	20	98	17	20	7	89	98	89	93	81
Cobra+Herbimax	10oz+1.5pt	45	54	38	98	36	34	20	99	98	83	99	94
Flexstar HL+ Herbimax	0.75pt+ 2pt	28	28	14	98	19	16	7	88	91	85	89	60
Pinnacle+ Activator 90	0.25oz+ 0.25%	18	17	7	98	2	2	2	55	81	99	99	15
FirstRate+Activator 90+ 28%UAN	0.3oz+0.125%+ 2.5%	17	21	11	99	13	11	2	96	99	70	65	99
Pursuit+Herbimax+ 28% UAN	3oz+2pt+ 2.5%	28	28	15	99	11	10	3	85	67	99	98	96
Raptor+Herbimax+ 28% UAN	4oz+2pt+ 2.5%	23	23	15	99	13	8	0	83	72	99	99	84
Untreated		0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		13	16	10	2	14	19	11	21	13	19	17	21

Marshelder was completely controlled at the June 30 evaluation. The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10ft wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

Soybean Iron Chlorosis/Herbicide Interaction - Galchutt, ND. Zollinger and Fitterer. An experiment was conducted at Galchutt, ND to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on June 30, 1998 at 6:00-7:00 pm with 76 F air, 82 F soil surface, 76% RH, 0-3 mph NW wind, 25% clouds, moist soil surface, wet subsoil, crop was chlorotic, no dew present, and the crop stage was 1st -- 2nd trifoliate (V1-V2). Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		July 16			July 29		
Treatment	Rate	Stunt	Yellow	Burn	Stunt	Yellow	Burn
	Product/A	%					
Basagran+Herbimax	2pt+2pt	19	25	17	21	16	0
Blazer+Activator 90	1.5pt+0.25%	27	23	27	27	21	0
Galaxy+Herbimax	2pt+2pt	17	13	15	22	13	0
Storm+Herbimax	1.5pt+2pt	24	25	23	29	20	0
Cobra+Herbimax	10oz+1.5pt	28	28	26	26	15	0
Flexstar HL+Herbimax	0.75pt+2pt	23	23	22	18	16	0
Pinnacle+Activator 90	0.25oz+0.25%	19	25	17	19	13	0
FirstRate+Activator 90+28%UAN	0.3oz+0.125%+2.5%	20	29	15	19	16	0
Pursuit+Herbimax+28% UAN	3oz+2pt+2.5%	21	29	12	18	13	0
Raptor+Herbimax+28% UAN	4oz+2pt+2.5%	28	38	18	28	28	0
Untreated		0	0	0	0	0	0
LSD (0.05)		13	16	12	15	16	NS

The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10 wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

Soybean Iron Chlorosis/Herbicide Interaction - Horace, ND. Zollinger and Fitterer. An experiment was conducted at Horace, ND to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on July 1, 1998 at 9:30 am with 72 F air, 79 F soil surface, 55% RH, 0-2 mph S wind, no clouds, dry-moist surface, moist-wet subsoil, crop vigor was chlorotic, no dew present, and the crop stage was 1st trifoliate (V1). Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	July 16			July 29		
		Stunt	Yellow	Burn	Stunt	Yellow	Burn
	Product/A	%					
Basagran+Herbimax	2pt+2pt	23	22	15	18	12	0
Blazer+Activator 90	1.5pt+0.25%	22	23	22	13	11	0
Galaxy+Herbimax	2pt+2pt	25	19	23	16	11	0
Storm+Herbimax	1.5pt+2pt	28	19	21	22	14	0
Cobra+Herbimax	10oz+1.5pt	33	21	32	27	12	0
Flexstar HL+Herbimax	0.75pt+2pt	21	19	22	13	7	0
Pinnacle+Activator 90	0.25oz+0.25%	20	22	18	11	9	0
FirstRate+Activator 90+28% UAN	0.3oz+0.125%+2.5%	19	22	13	12	11	0
Pursuit+Herbimax+28% UAN	3oz+2pt+2.5%	21	22	14	13	10	0
Raptor+Herbimax+28% UAN	4oz+2pt+2.5%	22	21	18	13	8	0
Untreated		0	0	0	0	0	0
LSD (0.05)		12	13	9	12	11	NS

The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10 wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

<u>Soybean Iron Chlorosis/Herbicide Interaction</u> - Kent, MN. Zollinger and Fitterer. An experiment was conducted at Kent, MN to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on June 18, 1998 at 9:30 am with 63 F air, 65.5 F soil surface, 80% RH, 2-3 mph S wind, 100% clouds, moist soil surface, moist subsoil, crop was chlorotic, no dew present, and the crop stage was 1st trifoliate. Weeds present at the POST stage were: 1-5" (20-50/ft^2), foxtail; 3-5", (1-5/ft^2), common cocklebur; 2-5", (1/yd^2), kochia; 3-8", (1/ft^2), common lambsquarter; 2-4", (1/ft^2), redroot pigweed. Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		July 1							July 16						
Treatment	Rate	Stunt	Yellow	Burn	Kocz	Cocb	Rrpw	Colq	Stunt	Yellow	Burn	Cocb	Kocz	Rrpw	Colq
	Product/A	% injury			% control				% injury			% control			
Basagran+Herbimax	2pt+2pt	8	10	2	76	99	88	78	11	3	0	73	93	85	83
Blazer+Activator 90	1.5pt+0.25%	19	26	17	69	71	91	80	8	0	0	48	56	98	79
Galaxy+Herbimax	2pt+2pt	15	19	11	96	98	98	78	12	1	0	70	80	89	65
Storm+Herbimax	1.5pt+2pt	23	26	18	93	89	96	81	8	2	0	83	70	88	74
Cobra+Herbimax	10oz+1.5pt	43	32	45	99	99	99	81	26	8	2	98	98	99	50
Flexstar HL +Herbimax	0.75pt+ 2pt	23	33	21	99	99	99	93	9	2	0	81	95	98	84
Pinnacle+ Activator 90	0.25oz+ 0.25%	8	12	3	96	73	99	90	12	4	0	47	82	94	75
FirstRate+Act 90+ 28% UAN	0.3oz+0.125%+ 2.5%	8	9	2	52	99	20	33	11	3	0	98	68	20	30
Pursuit+Herbimax+ 28% UAN	3oz+2pt+ 2.5%	18	28	11	98	99	99	66	6	4	0	99	90	96	76
Raptor+Herbimax+ 28% UAN	4oz+2pt+ 2.5%	19	29	5	96	86	96	93	7	0	0	69	89	99	94
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		11	13	9	15	19	11	16	10	5	NS	20	19	13	15

Wild mustard was completely controlled through out growing season. The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10 wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

Soybean Iron Chlorosis/Herbicide Interaction - Moorhead, MN. Zollinger and Fitterer. An experiment was conducted at Moorhead, MN to evaluate iron chlorosis herbicide interactions in soybean at the POST stage. POST treatments were applied on July 1, 1998 at 6:00 pm with 81 F air, 90 F soil surface, 56% RH, 0-3 mph NW wind, 25% clouds, moist soil surface, wet subsoil, crop was chlorotic, no dew present, and the crop stage was 2nd - 3rd trifoliate (V2-V3). Treatments were applied to the entire area of the 10 by 20 ft plots with a bicycle wheel type plot sprayer equipped with drift cones delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Soybean (July 17)			Soybean (July 29)		
		Stunt	Yellow	Burn	Stunt	Yellow	Burn
	Product/A	%					
Basagran+Herbimax	2pt+2pt	10	12	14	0	0	0
Blazer+Activator 90	1.5pt+0.25%	3	9	16	0	0	0
Galaxy+Herbimax	2pt+2pt	7	8	14	0	0	0
Storm+Herbimax	1.5pt+2pt	18	20	27	0	0	0
Cobra+Herbimax	10oz+1.5pt	16	13	23	13	11	0
Flexstar HL+Herbimax	0.75pt+2pt	12	12	22	3	3	0
Pinnacle+Activator 90	0.25oz+0.25%	0	3	4	0	0	0
FirstRate+Activator 90+28%UAN	0.3oz+0.125%+2.5%	0	5	9	0	0	0
Pursuit+Herbimax+28% UAN	3oz+2pt+2.5%	5	12	8	0	0	0
Raptor+Herbimax+28% UAN	4oz+2pt+2.5%	6	12	8	0	0	0
Untreated		0	0	0	0	0	0
LSD (0.05)		17	16	15	4	5	NS

The study was established in a location planted to soybean exhibiting iron chlorosis. All evaluations were performed without knowing treatment number or herbicide used. Evaluating soybean response to herbicide treatments were difficult because stunting and chlorosis caused by iron deficiency, in many plots, could not be differentiated from soybean response to herbicides. In other words, iron deficiency caused injury ratings that were incorrectly attributed to the herbicide. In many cases, symptoms of iron chlorosis did not observe plot borders and ran the entire length of the study causing injury ratings to be taken from herbicides that normally do not cause injury (Basagran, Flexstar, Pinnacle, Pursuit). The entire 10 wide area was treated at the growers request to minimize weeds infestation and weed seed rain. Grower cooperators, in all cases, sprayed the remainder of the field with a herbicide for weed control not allowing a true untreated area to observe differences. Without an untreated area or border in each plot to determine herbicide effects, evaluating differences between iron chlorosis and herbicide injury was very difficult.

A few conclusion are generally consistent throughout all six sites. Injury rating were less at the second evaluation compared to the first. Cobra and sometimes other herbicides that have a contact mode of action and cause burning or speckling of soybean leaves may increase injury symptoms from iron chlorosis. Soybeans may recover or the higher injury ratings may be observed at the second evaluation. Stress conditions on soybeans may add to the stress from iron chlorosis and herbicides to induce greater injury symptoms.

Sunflower Weed Control. Zollinger and Fitterer. An experiment was conducted at Oriska, ND, to evaluate weed control and sunflower tolerance to PPI and PRE herbicides. PPI treatments were incorporated with a rototiller at a depth of 2 inches and applied on May 6, 1998, at 10:00 am with 60 F air, 53 F soil, 43% RH, 5 to 7 mph NW wind, 100% clouds, dry soil surface, and moist subsoil. 'Cargill SF 120' sunflower was planted and PRE treatments were applied on May 6, 1998, at 11:00 am with 58 F air, 53 F soil, 45% RH, 0 to 3 mph NW wind, 100% clouds, moist soil surface, and moist subsoil. The treatments were applied to the center 8 ft of the 10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		June 3					June 22						July 7
Treatment	Rate	Sufl injury	Fxtl	Wimu	Mael	Kocz	Sufl injury	Fxtl	Wimu	Kocz	Mael	Biww	Sufl injury
	(lb ai/A)	(%)	(% control)				(%)	(% control)					(%)
PPI													
Dual Magnum	1.67	2	95	80	30	83	0	87	20	10	7	13	0
Prowl	1.25	0	50	68	30	93	0	45	50	30	13	20	0
Sonalan	1.15	3	87	67	37	99	0	75	18	53	7	17	0
Treflan	1.0	0	65	47	50	99	0	45	43	43	13	13	0
PRE													
Dual Magnum	2.0	0	96	77	75	96	0	90	66	60	52	70	0
V-53482+Prowl	0.094+1.25	7	68	93	77	96	8	43	93	88	60	95	0
V-53482	0.063	8	58	96	83	99	12	37	88	99	68	99	2
V-53482	0.094	18	62	99	87	99	17	28	94	89	83	99	15
V-53482	0.188	50	82	96	96	96	30	66	93	99	90	99	30
Authority	0.25	3	82	93	87	99	5	53	76	99	70	99	3
Authority+Prowl	0.25+1.25	3	81	98	82	99	2	48	81	99	62	99	0
Authority+Prowl	0.25+1.5	5	73	96	83	99	0	48	71	99	57	99	2
Untreated		0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		13	10	10	13	11	15	19	15	13	15	17	18

[a]Fxtl = Grft and Yeft.

All treatments gave complete redroot pigweed and common lambsquarters control. Dual Magnum provided greater weed control PRE than PPI. DNA herbicides applied PPI generally gave poor weed control and did not control late flushes of marshelder or biennial wormwood. V-53482 and Authority are PPO inhibitors and are of the same chemistry. Sunflower injury was reduced when V-53482 was applied with Prowl as compared to V-53482 applied alone. Authority gave 5% or less sunflower injury. V-53482 injured sunflower more but gave equal or greater broadleaf weed control than Authority. V-53482 and Authority generally gave greater than 80% broadleaf weed control and were the only herbicides to give complete control of biennial wormwood.

Sunflower Response to Herbicides. Zollinger and Fitterer. An experiment was conducted in Prosper, ND to evaluate sunflower response to herbicides applied at the PPI and PRE stages. PPI treatments were applied and incorporated with a rototiller to a depth of 2" on May 19, 1998 at 1:00-4:00 pm with 78 F air, 67 F soil 2-4" depth, 42% RH, 10% clouds, and 7-15 NW mph wind, dry soil surface, and moist subsoil. Thirteen Cargill hybrid and inbred sunflower lines were planted and PRE treatments were applied May 26, 1998 at 1:00-2:00 pm with 75 F air, 90 F soil 2-4" depth, 30% RH, 10-15 mph NW wind, and 25% clouds, dry soil surface, and moist subsoil. Treatments were applied to the 10 by 85 ft plots with a bicycle-wheel-type plot sprayer equipped with drift cones delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

This study was established in an area where herbicide carryover was suspected. Some plants exhibited yellowing and crooking at the base of the stem. In addition, excessive rainfall severely affected plants in the second rep of the study and affected the rest of the study. Sunflower types used were composed of inbred and hybrid lines. High injury ratings may be due to herbicide residue, excessive rains and possible line sensitivity.

Table 1. Hybrid and inbred sunflower line injury ratings - July 2.

Treatment	Rate	Line (July 2)												
		12	2	1	13	8	7	6	3	11	10	9	5	4
	ai/A	% injury												
PPI														
Dual Magnum	2.0 lb	10	13	8	8	13	3	8	8	18	8	5	5	25
R6447	1 oz	15	15	18	8	15	13	10	18	18	15	10	23	20
R6447	2 oz	43	78	30	48	18	28	10	18	38	48	18	28	30
Treflan	0.75 lb	15	18	13	5	13	8	23	60	8	3	5	10	5
PRE														
Prowl	1.25 lb	23	10	20	23	0	0	3	3	18	3	10	3	5
V-53482	0.063 lb	0	8	10	5	8	13	10	8	13	5	3	13	5
V-53482	0.094 lb	8	5	3	8	5	15	30	8	15	13	8	8	15
V-53482	0.188 lb	28	45	10	20	20	15	15	40	50	60	30	10	50
R6447	1 oz	13	13	20	15	8	43	8	25	10	5	10	15	15
R6447	2 oz	18	13	8	8	10	28	15	5	20	13	5	15	8
Authority	0.25 lb	15	15	20	15	8	18	8	8	8	5	5	10	15
Authority	0.38 lb	38	33	20	30	23	48	20	23	23	15	8	8	8
Authority+Prowl	0.25 lb+1.25 lb	28	15	10	13	13	18	8	8	10	15	10	8	10
Authority+Prowl	0.38 lb+1.25 lb	23	20	18	20	18	30	13	10	18	5	15	13	25
PPI fb PRE														
Treflan/Authority	0.75 lb/0.25 lb	18	20	15	8	15	23	18	33	15	8	5	5	20
Treflan/Authority	0.75 lb/0.38 lb	15	13	13	8	13	18	18	23	23	23	10	20	25
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		19	19	19	22	12	38	23	23	34	18	16	14	29

Table 2. Hybrid and inbred sunflower line injury ratings - July 17.

Treatment	Rate	Line (July 17)												
		12	2	1	13	8	7	6	3	11	10	9	5	4
	ai/A	% injury												
PPI														
Dual Magnum	2.0 lb	7	10	7	7	12	13	12	12	5	7	3	7	10
R6447	1 oz	8	15	8	3	7	3	12	13	8	13	8	17	8
R6447	2 oz	27	32	7	12	7	8	12	13	22	27	12	20	17
Treflan	0.75 lb	8	17	3	5	10	5	7	12	8	2	5	10	3
PRE														
Prowl	1.25 lb	12	12	5	3	7	5	2	7	5	5	3	8	5
V-53482	0.063 lb	3	10	10	7	5	10	5	15	5	8	7	17	0
V-53482	0.094 lb	2	5	3	12	0	3	7	8	5	12	13	13	18
V-53482	0.188 lb	17	23	15	18	10	18	8	17	27	30	22	20	27
R6447	1 oz	13	18	5	3	0	10	5	7	3	5	8	8	7
R6447	2 oz	15	12	7	3	7	10	10	10	8	5	2	8	5
Authority	0.25 lb	13	10	2	2	5	7	2	8	5	5	3	8	5
Authority	0.38 lb	15	17	13	22	5	17	12	12	12	10	12	7	5
Authority+Prowl	0.25 lb+1.25 lb	15	10	5	12	7	12	2	7	5	7	8	8	5
Authority+Prowl	0.38 lb+1.25 lb	17	10	13	17	10	13	8	8	10	8	13	15	10
PPI fb PRE														
Treflan/Authority	0.75 lb/0.25 lb	10	17	3	5	8	8	8	10	3	5	5	7	5
Treflan/Authority	0.75 lb/0.38 lb	7	13	5	2	8	7	12	5	7	12	10	5	8
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		14	14	10	13	8	10	8	8	11	12	8	10	10

Sunflower Tolerance to R6447. Zollinger and Fitterer. An experiment was conducted at Oriska, ND to evaluate tolerance, in sunflower, to R6447 applied at the PPI and PRE stages. PPI treatments were incorporated with a rototiller at a depth of 2" and applied on May 6, 1998 at 10:00 am with 60 F air, 53 F soil, 43% RH, 5-7 mph NW wind, 100% clouds, dry soil surface, and moist subsoil. Cargill 'SF 120' sunflower was planted and PRE treatments were applied on May 6, 1998 at 11:00 am with 58 F air, 53 F soil, 45% RH, 0-3 mph NW wind, 100% clouds, moist soil surface, and moist subsoil. The treatments were applied to the center 8 ft of the10 by 40 ft plots with a bicycle wheel type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Sunflower injury			
		May 20	June 3	June 22	July 7
	lb ai/A	%			
PPI					
R6447	0.71	22	72	40	52
R6447	1.065	27	73	60	68
R6447	1.42	33	84	60	78
R6447	2.13	52	96	87	92
PRE					
R6447	0.71	27	43	20	20
R6447	1.065	45	63	33	28
R6447	1.42	35	65	27	32
R6447	2.13	70	93	82	83
R6447+Prowl	1.065+1.25	3	57	27	18
Untreated		0	0	0	0
LSD (0.05)		11	13	8	18

Rates were accidently applied in lb ai/A instead of oz ai/A that resulted in rates 16 times greater than intended. Considering such high application rates, sunflower tolerance was good at the lowest rates of R6447 at the July 7 rating. Only 20% injury was observed from R6447 applied PRE at 0.71 lb/A, 28% injury at 1.065 lb/A applied PRE, and 18% injury when Prowl was tank-mixed and applied PRE with R6447 at the July 7 evaluation. DNA herbicides may safen R6447.

Mechanical weed control in sunflower, Carrington 1998. (Endres, Henson, and Zwinger) The experiment was conducted to determine if a harrow or rotary hoe may be effectively substituted for herbicides for weed control in 14- and 30-inch sunflower. The experiment was established on a loam soil with 7 pH and 3.9% organic matter. Plot size was 10 by 25 ft. The PPI herbicide component of the herbicide check was applied to a 6.67 by 25 ft area with a hooded bicycle-wheel-type plot sprayer. Sonalan was applied at 1.15 lb/A with the sprayer delivering 10.5 gal/A at 35 psi through 8002 flat fan nozzles on May 19 with 54 F, 73% RH, and 14 mph wind. Sonalan was immediately incorporated using a tractor mounted roto-tiller set to till at a 3-inch depth. Tillage for final seedbed preparation was made June 1 using a Melroe culti-harrow set to till at a 2- to 3-inch depth. Northrup King 231 oilseed sunflower was planted on June 1 in 14- and 30-inch rows at 2.5-inch depth and approximately 2 to 3 times the normal seeding rate. POST-plant tillage treatments were applied perpendicular to the sunflower rows to a 8.3- by 25-ft area with a harrow and a 7- by 25-ft area with a rotary hoe. The tillage implements were set to till at a depth of 0.5-1 inch. The harrow was operated at 4 mph and the rotary hoe tilled at 8 mph. The initial tillage treatments were made on June 6 with 56 F, 25% sunny sky, 8 mph wind, and dry soil surface with no emerged weeds present and sunflower not germinated. The second tillage passes were performed on June 15 with 71 F, 50% sunny sky, 9 mph wind, and dry soil surface to emerging- to VC-stage sunflower, emerging- to 2-leaf yellow foxtail and emerging redroot pigweed and wild mustard. The third tillage passes were performed on June 22 with 63 F, 20% sunny sky, 6 mph wind, and dry soil surface to V2-stage sunflower, emerging- to 3-leaf yellow foxtail and emerging- to cotyledon-stage redroot pigweed and wild mustard. Assert was applied as the POST herbicide component of the herbicide check at 0.25 lb/A with a hand-held plot sprayer delivering 10.5 gal/A at 40 psi through 8001 flat fan nozzles on July 1 with 60 F, 94% RH, clear sky, and 3 mph wind. Between-row cultivation of the 30-inch row sunflower was performed on June 30 and July 9. Sunflower were hand thinned to a population of approximately 24,000 plants/A on June 30. Sparse densities of other annual weeds existed in the trial including common lambsquarters and wild buckwheat. Weed control and sunflower injury was evaluated by plant counts on June 29 and visually evaluated on June 30. Weed control also was visually evaluated on July 17. The crop was hand harvested and machine threshed on October 15 to determine seed yield. The experiment was a randomized complete block design with four replications.

Excellent weed control was achieved with Sonalan/Assert (Table 1). Three tillage passes with the harrow or rotary hoe improved weed control compared to two passes, but control generally was less than the herbicide check. Greater weed control was achieved with the harrow versus the rotary hoe. Between-row tillage in the 30-inch row sunflower with the harrow or rotary hoe operations provided 73 to 85% weed control. The crop canopy in the 14-inch row sunflower did not shade the ground rapidly enough to adequately suppress weed growth.

Visual evaluation of sunflower biomass or stand reduction indicated 26 to 32% injury with the rotary hoe and 41 to 50% injury with the harrow (Table 2). Injury was similar when comparing two or three passes with either implement. Sunflower plant density was reduced 0 to 46% with tillage passes compared to the untreated checks. Increased sunflower seeding rates are needed to achieve the recommended plant density if a harrow or rotary hoe are used for weed control.

Sunflower yield generally correlated with weed control (Table 2). Thirty-inch rowed sunflower seed yield associated with the harrow or rotary hoe plus between-row tillage were similar to the yield with the herbicide check except with the treatment of two passes with the rotary hoe. Yield with all tillage treatments were less than the yield with the herbicide check in the 14-inch rowed sunflower. These data indicate that weed control will not be satisfactory with use of only a harrow or rotary hoe in narrow-rowed sunflower.

Table 1. Weed control with a harrow or rotary hoe in sunflower (Endres, Henson, and Zwinger).

Treatment	Grasses[a] Control 6/30	Grasses[a] Control 7/17	Grasses[a] Density 6/29	Broadleaves[b] Control 6/30	Broadleaves[b] Control 7/17	Broadleaves[b] Density 6/29
	--- % ---		plt/0.25 m^2	--- % ---		plt/0.25 m^2
30-inch rows:						
Weedy check	0	70	74	0	75	10
Herbicide check	95	98	16	88	98	15
Harrow x 2	76	75	49	73	77	13
Harrow x 3	85	81	26	85	85	7
Rotary hoe x 2	23	73	92	21	75	17
Rotary hoe x 3	60	75	63	55	76	13
14-inch rows:						
Weedy check	0	0	71	0	0	15
Herbicide check	96	95	8	88	97	7
Harrow x 2	68	23	61	74	27	12
Harrow x 3	84	44	27	85	52	5
Rotary hoe x 2	34	5	64	29	10	17
Rotary hoe x 3	60	13	43	65	28	9
C.V. %	12	13	31	19	14	53
LSD (0.05)	10	10	22	15	12	9

[a]Grasses=yellow foxtail.
[b]Broadleaves=redroot pigweed, wild mustard, common lambsquarters, and wild buckwheat.

Table 2. Sunflower performance with mechanical weed control (Endres, Henson, and Zwinger).

Treatment	Sunflower Density 6/29	Sunflower Injury 6/30	Seed yield
	plants/A	- % -	lb/A
30-inch rows:			
Weedy check	63165	0	1190
Herbicide check	65825	0	1310
Harrow x 2	43885	45	1125
Harrow x 3	40560	50	1170
Rotary hoe x 2	63830	28	965
Rotary hoe x 3	50530	29	1060
14-inch rows:			
Weedy check	31250	0	765
Herbicide check	38565	0	1325
Harrow x 2	27925	41	870
Harrow x 3	19945	50	795
Rotary hoe x 2	26595	26	590
Rotary hoe x 3	26595	32	600
C.V. %	30	52	20
LSD (0.05)	17895	19	275

Glyphosate with adjuvants. Zollinger and Fitterer. An experiment was conducted at Fargo, ND, to evaluate weed control from Roundup Ultra (glyphosate-isopropylamine) and Touchdown (glyphosate-trimethylsulfonium) applied with different adjuvants. Treatments were applied June 16, 1998 at 4:00 to 5:00 pm with 80 F air, 86 F soil surface, 65% RH, 70% clouds, and 3 to 5 mph NE wind, wet soil surface, wet subsoil, with no dew present. Weed species present were: 1 to 8 inch, (10 to 20/ft^2) foxtail; 6 to 14 inch, (10 to 12/ft^2) volunteer grain; 10 to 14 inch, (1 to 3/ft^2) wild oat; 8 to 10 inch, rosette to flowering, (5 to 10/ft^2) wild mustard; and 1 to 6 inch, (10 to 20/ft^2) common mallow. Treatments were applied to the center 8 feet of the 10 by 30 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

		July 2			July 13		
Treatment[a]	Rate	Fxtl[b]	Wioa	Wimu	Fxtl	Wioa	Wimu
	(Product/A)	(% control)					
Roundup Ultra+AMS	0.5 pt+8.5/100 gal	96	78	92	90	70	95
Roundup Ultra+AMS Arrow	0.5 pt+9/100 gal	83	73	88	88	77	17
Roundup Ultra+AMS Solution	0.5 pt+2.5% v/v	90	82	88	88	80	57
Roundup Ultra+Class Act	0.5 pt+2.5% v/v	94	88	90	93	90	53
Roundup Ultra+CL 9808	0.5 pt+1% v/v	93	90	88	90	85	17
Roundup Ultra+CL 9804	0.5 pt+2.5% v/v	94	91	92	91	93	73
Roundup Ultra+CL 9607	0.5 pt+17/100 gal	93	83	90	83	75	17
Roundup Ultra+Surfate	0.5 pt+1% v/v	93	83	87	93	93	67
Touchdown+Preference+AMS	0.4 pt+0.25% v/v +8.5/100 gal	95	87	87	95	92	28
Touchdown+CL9804	0.4 pt+2.5% v/v	88	78	85	88	82	30
Touchdown+CL9813	0.4 pt+2.5% v/v	92	85	88	90	83	57
Touchdown+CL 9607	0.4 pt+17/100 gal	83	67	88	80	67	37
Touchdown+Surfate	0.4 pt+1% v/v	92	70	92	87	77	35
Untreated		0	0	0	0	0	0
LSD (0.05)		8	15	6	6	10	19

[a]AMS = ammonium sulfate, AMS Arrow = ammonium sulfate + drift retardant, AMS Solution = liquid ammonium sulfate, CL9607 = drift retardant + ammonium sulfate, CL9804 = ammonium sulfate + nonionic surfactant, CL9808 = nitrogen fertilizer + nonionic surfactant, CL9813 = ammonium sulfate + nonionic surfactant, Class Act = surfactant + fertlizer, Preference = surfactant, Surfate = ammonium sulfate + nonionic surfactant.
[b]Fxtl = Grft and Yeft.

Roundup Ultra and Touchdown formulation generally gave good to excellent grass and wild mustard control at the July 2 evaluation. However, at the July 13 evaluation, foxtail control ranged from 80 to 93%, wild oat from 67 to 93%, and wild mustard from 17 to 95%. Adjuvants with glyphosate appear weed specific.

Wild Buckwheat Control with Glyphosate. Zollinger and Fitterer. An experiment was conducted at NW-22, to evaluate weed control from herbicides applied at the POST stage. POST treatments were applied May 29, 1998 at 3:00-4:00 pm with 71 F air, 77 F soil surface, 60% RH, 0% clouds, and 3-5 mph N wind, dry soil surface and moist subsoil. Weed species present were 6-10" (1-5/ft^2) volunteer grain; 2-4" (1-5/ft^2) foxtail; 2-6" (2-8/yd^2) wild buckwheat; 10-14" (1-3/yd^2) prickly lettuce; (2-8/yd^2) Canada thistle. Treatments were applied to the center 8 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate*	June 13				June 26			
		Wibw	Prle	Cath	Corw	Wibw	Prle	Cath	Biww
	Product/A	%							
Touchdown+AMS	1.6 pt	57	73	47	76	40	92	78	47
Touchdown+AMS	2.4 pt	67	88	77	93	57	96	88	60
Touchdown+AMS	3.2 pt	95	92	89	90	63	99	95	70
Roundup Ultra+AMS	2 pt	70	90	60	93	33	90	78	47
Roundup Ultra+AMS	3 pt	78	95	80	99	55	98	85	57
Roundup Ultra+AMS	4 pt	92	96	86	99	68	99	95	67
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		15	10	17	17	11	3	8	7

*AMS was added to all treatments at 8.5 lb pr/100gal. Control of volunteer grain, foxtail, and common cocklebur was complete.

Increasing the rates of Touchdown and Roundup Ultra increased weed control. However, at the June 26 evaluation the highest rates of either herbicide gave only 68% wild buckwheat control and 70% biennial wormwood control.

Herbicide efficacy and crop tolerance in Chickpeas. (Brian Jenks and Kent McKay, Minot) 'Sanford' chickpeas were planted May 23 into 7.5-inch rows at 140,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, preemergence, and postemergence applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI and PRE treatments were applied (May 22 and May 25) with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied June 25 with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Chickpeas were approximately 7-inches tall at the POST application. Foxtail pressure was initially light and erratic, but emergence continued through the season. Foxtail populations in some areas were about 5 per square foot and 1-2 inches tall at POST application. Yellow foxtail was the most common species, but green foxtail was also present. Chickpeas were harvested with a small plot combine on September 29.

Treatment[a]	Rate	July 14 Injury	July 14 Fxtl	Sept 14 Injury	Sept 14 Fxtl	Yield
		-------% injury or control			-------	lb/A
Untreated		0	0	0	0	1562
Prowl / Motive + NIS	3 pt / 2 fl oz + 0.25%	63	93	33	100	2061
Prowl / Motive + NIS	3 pt / 3 fl oz + 0.25%	77	92	50	100	1393
Motive + NIS	2 fl oz + 0.25%	70	84	50	83	1646
Motive + NIS	3 fl oz + 0.25%	75	93	57	95	1325
Balance	1.25 oz	1	48	0	40	1738
Balance	2 oz	2	52	0	55	1724
Authority	0.25 lb ai	3	50	0	40	1974
Axiom	15 oz	1	65	0	83	2272
Resource + NIS	0.027 lb ai + 0.25%	15	0	8	0	1403
V-53482	0.078 lb ai	0	72	0	88	2417
Frontier	20 fl oz	0	65	0	73	2151
Sonalan	2 pt	0	80	0	83	2247
Sencor	0.25 lb ai	3	55	0	32	1299
Broadstrike + Treflan	2 pt	19	67	17	80	1906
Treflan	1.5 pt	0	82	0	73	2531
Prowl	3 pt	0	60	0	65	1862
Tough + NIS	2 pt + 0.25%	0	0	0	0	2084
Treflan / Tough + NIS	1.5 pt / 2 pt + 0.25%	0	85	0	90	2247
CV		27	12	45	19	23
LSD (0.05)		8	12	8	20	700

[a] Applied PPI: Prowl, Sonalan, Broadstrike + Treflan, and Treflan
Applied PRE: Balance, Authority, Axiom, V-53482, Frontier, Sencor
Applied POST: Motive, Resource, and Tough

Motive, Resource, and Broadstrike + Treflan caused moderate to severe injury to chickpeas. No injury was observed with the other treatments. Prowl/Motive, Motive, Axiom, V-53482, Sonalan, Broadstrike + Treflan, and Treflan/Tough provided good to excellent foxtail control. Foxtail control with Motive alone at 2 fl oz/A was 12% less than 3 fl oz/A.

Herbicide efficacy and crop tolerance in Lentils. (Brian Jenks and Kent McKay, Minot) 'Laird' lentils were planted May 23 into 7.5-inch rows at 550,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, preemergence, and postemergence applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI and PRE treatments were applied (May 22 and May 25) with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied June 25 with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Lentils were approximately 6-inches tall at the POST application. Foxtail pressure was initially light and erratic, but emergence continued through the season. Foxtail populations in some areas were about 4 per square foot and 1-2 inches tall at POST application. Yellow foxtail was the most common species, but green foxtail was also present. Lentils were harvested with a small plot combine on September 10.

Treatment[a]	Rate	July 14		September 9		
		Injury	Fxtl	Injury	Fxtl	Yield
		-------% injury or control -------				lb/A
Untreated		0	0	0	0	1326
Prowl / Motive + NIS	2.4 pt / 2 fl oz + 0.25%	50	94	40	94	660
Prowl / Motive + NIS	2.4 pt / 3 fl oz + 0.25%	83	98	72	99	283
Motive + NIS	2 fl oz + 0.25%	53	87	35	80	731
Motive + NIS	3 fl oz + 0.25%	72	95	53	97	561
Balance	1.25 oz	33	57	23	40	971
Balance	2 oz	47	58	28	40	912
Python	1 oz	0	0	0	0	1352
Authority	0.25 lb ai	2	67	0	73	1173
Axiom	15 oz	2	72	0	80	1389
Resource + NIS	0.027 lb ai + 0.25%	30	0	15	0	490
V-53482	0.078 lb ai	5	67	0	90	1411
Frontier	20 fl oz	1	75	0	82	1351
Sonalan	2 pt	1	77	0	79	1110
Sencor	0.25 lb ai	0	42	0	35	874
Broadstrike + Treflan	2 pt	3	67	0	55	1292
Treflan	1.5 pt	0	72	0	67	1048
Prowl	3 pt	0	72	0	59	1227
Sencor + Treflan	0.25 lb ai + 1 pt	0	79	0	62	1059
CV		46	19	59	31	27
LSD (0.05)		15	19	13	30	455

[a] Applied PPI: Prowl, Sonalan, Broadstrike + Treflan, Treflan, and Sencor + Treflan
Applied PRE: Balance, Python, Authority, Axiom, V-53482, Frontier, and Sencor
Applied POST: Motive and Resource

Motive, Balance, and Resource caused moderate to severe injury to lentils. Very slight or no injury was observed with the other treatments. Prowl/Motive, Motive, Axiom, V-53482, Frontier, and Sonalan provided good to excellent foxtail control. Foxtail control with Motive alone at 2 fl oz/A was 17% less than 3 fl oz/A.

Field pea response to herbicides, Carrington, 1998. (Endres, Schatz, and Zwinger) The experiment was conducted to evaluate weed control and field pea tolerance to selected soil- and POST-applied herbicides. The experiment was conducted on a Heimdahl loam soil with 6.9 pH and 3.5% organic matter at the NDSU Carrington Research Extension Center. Plot size was 10 by 25 ft. Herbicide treatments were applied to a 6.67 by 25 ft area with a hooded bicycle-wheel-type plot sprayer. PPI treatments were applied at 17.2 gal/A at 40 psi through 8002 flat fan nozzles on April 29 with 75 F, 24% RH, clear sky, and 8 mph wind. PPI treatments were immediately incorporated twice using a field cultivator with a rolling basket set at a 3- to 4-inch depth and operated at a speed of 4 mph. On May 6, 'Profi' field pea was planted in 7-inch rows at a pure live seed rate of 300,000 seeds/A. PRE treatments were applied at 17.2 gal/A at 40 psi through 8002 flat fan nozzles on May 7 with 36 F, 88% RH, 100% cloudy sky, and 12 mph wind. POST cloransulam and imazamox treatments were applied at 10.3 gal/A and metribuzin and bentazon treatments were applied at 20.7 gal/A at 40 psi through 8001 flat fan nozzles on May 22 with 68 F, 40% RH, 50% cloudy sky, and 11 mph wind to 3-inch tall field pea, 1- to 2-inch tall common lambsquarters, 2-leaf redroot and prostrate pigweed, and 3- to 4-leaf yellow and green foxtail. Soil-applied treatments were visually evaluated for weed control and field pea injury (stand and/or biomass reduction) on May 20 and June 5, and POST treatments on June 5 and 22. Field pea were harvested with a plot combine on July 29 to determine seed yield. The experiment was a randomized complete block design with four replicates.

PPI treatments and sulfentrazone provided excellent control of foxtail, pigweed, and common lambsquarters (Table 1). Weed control was poor with cloransulam. Foxtail and pigweed control was 91 to 97% with imazamox. Imazamox + NIS+UAN or Quad 7 improved common lambsquarters control compared to imazamox + NIS. Bentazon control of pigweed and commom lambsquarters was greatly improved by adjuvants. Increasing the rate of COC or MSO from one to two pints with bentazon did not improve broadleaf weed control.

Field pea was injured 18 to 81% with ethalfluralin + flumetsulam and dimethenamid (Table 2). Imazamox + Quad 7 injured pea 13 to 25% compared to only 0 to 3% injury from imazamox + NIS or NIS+UAN. Pea injury generally did not increase with the addition of adjuvants to bentazon.

Field pea seed yield was highest with ethalfluralin/imazethapyr + NIS (POST), sulfentrazone, and imazamox (Table 2). These treatments generally provided excellent weed control and low pea injury (0 to 9%), except imazamox + Quad 7 injured pea.

Table 1. Weed control in field pea (Endres and Zwinger).

Treatment[a]	Rate	2 wk after treatment Foxtail[b]	2 wk after treatment Pigweed[c]	4 wk after treatment Foxtail[b]	4 wk after treatment Colq	4 wk after treatment Pigweed[c]
	(lb/A)	(% control)				
Untreated		0	0	0	0	0
PPI						
Ethalfluralin/ Imazethapyr + NIS (POST)	0.75/ 0.031 + 0.25%	98	98	99	98	98
Ethalfluralin + Flumetsulam	0.75 + 1	98	99	99	99	99
Dimethenamid	0.95	96	97	97	90	95
PRE						
Isoxaflutole	0.1	82	99	74	99	82
Sulfentrazone	0.35	91	99	93	99	99
POST						
Metribuzin	0.19	58	88	15	81	79
Cloransulam + NIS+UAN	0.016 + 2.5%	26	34	0	0	20
Imazamox + NIS	0.031 + 0.25%	93	92	94	72	91
Imazamox + + NIS+UAN	0.031 + 2 pt	95	94	97	92	95
Imazamox + Quad 7	0.031 + 1%	95	97	97	95	96
Bentazon	0.75	0	51	0	31	56
Bentazon + COC	0.75 + 1 pt	0	88	0	89	83
Bentazon + COC	0.75 + 2 pt	0	89	0	91	85
Bentazon + MSO	0.75 + 1 pt	0	90	0	93	89
Bentazon + MSO	0.75 + 2 pt	0	91	0	93	89
LSD (0.05)		12	16	11	15	13

[a]NIS=Class Preference, a nonionic surfactant from Cenex, St. Paul, MN; NIS+UAN=Class APM 28, a surfactant + fertilizer from Cenex; Quad 7= a surfactant blend from AGSCO, Grand Forks ND; COC=Herbimax, an oil-surfactant from Loveland Industries, Greeley CO; MSO=Scoil, a methylated vegetable oil from AGSCO.
[b]Foxtail=Yellow and green.
[c]Pigweed=Redroot and prostrate.

Table 2. Field pea response to herbicide treatments (Endres and Zwinger).

Treatment[a]	Rate	Field pea Injury 2 WAT	4 WAT	Seed yield	Test weight
	(lb/A)	------ (%)	------	(bu/A)	(lb/bu)
Untreated		0	0	40.2	64.4
PPI					
Ethalfluralin/ Imazethapyr + NIS (POST)	0.75/ 0.031 + 0.25%	3	0	54.3	64.2
Ethalfluralin + Flumetsulam	0.75 + 1	81	63	42.4	64.0
Dimethenamid	0.95	25	18	49.0	64.6
PRE					
Isoxaflutole	0.1	0	0	46.2	64.4
Sulfentrazone	0.35	0	9	51.6	63.9
POST					
Metribuzin	0.19	0	0	48.8	64.3
Cloransulam + NIS+UAN	0.016 + 2.5%	8	6	43.8	64.1
Imazamox + NIS	0.031 + 0.25%	3	0	50.2	64.3
Imazamox + + NIS+UAN	0.031 + 2 pt	0	0	52.5	64.2
Imazamox + Quad 7	0.031 + 1%	25	13	51.3	65.1
Bentazon	0.75	1	0	44.1	63.8
Bentazon + COC	0.75 + 1 pt	1	0	46.5	64.3
Bentazon + COC	0.75 + 2 pt	6	2	45.7	64.0
Bentazon + MSO	0.75 + 1 pt	6	4	42.8	64.4
Bentazon + MSO	0.75 + 2 pt	9	8	46.9	64.1
LSD (0.05)		8	11	4.8	NS

[a]NIS=Class Preference,a nonionic surfactant from Cenex, St. Paul, MN; NIS+UAN=Class APM 28, a surfactant + fertilizer from Cenex; Quad 7= a surfactant blend from AGSCO, Grand Forks ND; COC=Herbimax, an oil-surfactant from Loveland Industries, Greeley CO; MSO=Scoil, a methylated vegetable oil from AGSCO.

Tank mixture grass control antagonism trial, Carrington 1998. (Endres and Schatz) The objective of the trial was to evaluate foxtail and wild oat control with selected tank mixtures of grass and broadleaf herbicides. Treatments were applied to a 6.67 ft wide area the length of 10 by 25 ft plots with a hand-held sprayer delivering 21.6 gal/A with treatments containing Basagran and 12.9 gal/A for all other treatments at 40 psi through 8002 flat fan nozzles. Treatments were applied May 30 with 71 F, 62% RH, 30% clouds, and 6-mph wind to 3- to 5-leaf green and yellow foxtail, 4- to 5.5-leaf wild oat, 4- to 5-inch tall common lambsquarters, and 1- to 5-inch tall wild buckwheat. The experiment was a randomized complete block design with four replications.

Treatment[a]		June 13				June 26			
Name	Rate	Wioa	Fxtl	Colq	Wibw	Wioa	Fxtl	Colq	Wibw
	Prod/A	----	% control		----	----	% control		----
Poast + COC	1 pt	86	86	0	0	99	97	0	0
Assure II + PO	0.5 pt	80	81	0	0	98	95	0	0
Pursuit + NIS + UAN	2 fl oz	73	80	43	76	79	79	57	84
Basagran + COC	1.5 pt	0	0	93	65	0	0	91	60
Bronate	0.9 pt	0	0	95	85	0	0	95	93
Poast + Pursuit + NIS + UAN	1 pt + 2 fl oz	73	82	43	75	91	89	49	86
Poast + Basagran + COC	1 + 1.5 pt	68	72	92	70	74	87	90	66
Poast + Bronate + COC	1 + 0.9 pt	85	88	83	89	98	93	93	81
Assure II + Pursuit + NIS + UAN	0.5 pt + 2 fl oz	65	74	52	77	78	84	62	81
Assure II + Basagran + PO	0.5 + 1.5 pt	79	84	94	80	95	86	87	69
Assure II + Bronate + PO	0.5 + 0.9 pt	77	73	95	87	93	59	93	83
LSD (0.05)		9	7	11	10	8	6	11	6
CV %		10	8	11	9	8	6	12	9

[a]COC=Destiny at 32 fl oz/A; PO=Herbimax at 1% v/v; NIS=Preference at 0.25% v/v; UAN=AMP-28 at 4% v/v.

Poast + Bronate did not antagonize wild oat and foxtail control compared to Poast. Assure II + Basagran or Bronate did not antagonize wild oat control compared to Assure II. Assure II + Bronate reduced foxtail control 38%, when evaluated June 26, compared to Assure II. Wild oat and foxtail control was generally antagonized with Poast + Pursuit, Poast + Basagran, and Assure II + Pursuit compared to control with the grass herbicides. Reduction in grass control from these tank mixtures ranged from 5 to 21%.

Borage and camelina herbicide screening trial, Carrington 1998. (Endres, Henson, and Zwinger) The trial was conducted to evaluate the tolerance of borage and camelina to selected herbicides, as no herbicides currently are labeled for these specialty oilseed crops. Treatments were applied to a 6.67 ft wide area the length of 10 by 15 ft plots with a hand boom sprayer. PPI herbicide treatments were applied on June 4 with 56 F, 47% RH, 95% cloudy sky, and 10-mph wind with the sprayer delivering 14.8 gal/A at 40 psi through 8002 flat fan nozzles and immediately incorporated with a rototiller at a 4-inch depth. Borage was planted at 20 lb PLS/A and 'Robinson' camelina was planted at 5 lb PLS/A in 7-inch rows on June 5. POST treatments were applied July 7 with 77 F, 68% RH, 35% clouds, and 10-mph wind with the sprayer delivering 10 gal/A at 40 psi through 8001 flat fan nozzles to 4- to 6-leaf borage, 4- to 10-inch height camelina, 1- to 12-inch height green and yellow foxtail, 1- to 3-inch height prostrate and redroot pigweed, and 1- to 4-inch height common lambsquarters. Foxtail density was high and common lamsquarters and pigweed densities were low to moderate. Injury was estimated by visually evaluating biomass and stand reduction. Crop injury and weed control with trifluralin were evaluated June 27 and July 3, and the POST treatments were evaluated July 21 and August 6. Borage was swathed on August 24 with a sickle mower and the seed threshed with a plot combine on August 31. Camelina was direct harvested with a plot combine on August 26. The experiment was a randomized complete block design with four replications.

Green and yellow foxtail control generally was excellent with trifluralin, sethoxydim, and quizalofop (Table 1). Trifluralin also provided excellent control of common lambsquarters and prostrate and redroot pigweed. Trifluralin at 0.5 lb/A provided similar control of common lambsquarters and pigweed as the high rate. MCPA amine at 0.12 lb/A was required to provide fair to good control (64 to 86%) of common lambsquarters and pigweed.

At 4 weeks after treatment(WAT), borage injury ranged from 0 to 13% with sethoxydim, quizalofop, and imazamethabenz (Table 2). The remaining herbicide treatments caused excessive crop injury. Borage yield among herbicide treatments was similar to the hand-weeded check except with trifluralin at 1 lb/A and clopyralid. These data indicate that borage may tolerate substantial herbicide injury and weed pressure. Camelina injury was not detected with sethoxydim, quizalofop, and the low rate of clopyralid. Excessive injury occurred with other herbicide treatments. Camelina injury and/or poor weed control with herbicides resulted in yield generally less than the hand-weeded check.

Table 1. Weed control in borage and camelina, Carrington, 1998.

Herbicide Treatment	Rate	2 wk after treatment Foxtail	Colq	Pigweed	4 wk after treatment Foxtail	Colq	Pigweed
	(lb/A)	(% control)					
Untreated check	--	0	0	0	0	0	0
Hand-weeded check	--	95	99	99	92	99	96
PPI							
Trifluralin	0.5	88	-	95	85	93	94
Trifluralin	1	95	-	95	92	96	95
POST							
Sethoxydim + MSO[a]	0.19	91	0	0	97	0	0
Sethoxydim + MSO[a]	0.38	96	0	0	97	0	0
Quizalofop + PO[b]	0.88	93	0	0	96	0	0
Quizalofop + PO[b]	1.76	95	0	0	97	0	0
MCPA amine	0.06	0	55	31	0	43	26
MCPA amine	0.12	0	76	66	0	86	64
Imazamethabenz + MSO[c]	0.19	31	0	10	[illegible]	0	10
Imazamethabenz + MSO[c]	0.38	35	9	48	[illegible]	15	20
Clopyralid	0.09	0	0	0	[illegible]	0	0
Clopyralid	0.18	0	10	0	[illegible]	11	0
mean		51	18	25	47	32	29
C. V. %		5	50	51	7	42	43
LSD (0.05)		3	15	19	5	19	18

[a]MSO=Sun-It II at 32 fl oz/A.
[B]PO=Herbimax at 1% v/v.
[c]MSO=Sun-It II at 24 fl oz/A.

Table 2. Borage and camelina performance with herbicides, Carrington, 1998.

Herbicide Treatment	Rate	Borage Injury(WAT) 2	4	Seed yield	Camelina Injury(WAT) 2	4	Seed yield
	lb/A	%		lb/A	%		lb/A
Untreated check	--	0	0	36.9	0	0	332
Hand-weeded check	--	0	0	61.4	0	0	748
PPI							
Trifluralin	0.5	90	90	36.3	[illegible]0	68	426
Trifluralin	1	97	96	11.5	[illegible]3	74	620
POST							
Sethoxydim + MSO[a]	0.19	0	0	39.8	0	0	447
Sethoxydim + MSO[a]	0.38	14	0	39.4	0	0	354
Quizalofop + PO[b]	0.88	13	9	47.7	0	0	463
Quizalofop + PO[b]	1.76	23	8	64.9	0	0	558
MCPA amine	0.06	46	38	44.6	[illegible]0	78	37
MCPA amine	0.12	37	48	36.2	[illegible]5	87	7
Imazamethabenz + MSO[c]	0.19	0	0	55.7	[illegible]5	93	0
Imazamethabenz + MSO[c]	0.38	18	13	41.5	[illegible]8	91	0
Clopyralid	0.09	0	26	6.4	0	0	2
Clopyralid	0.18	0	31	1.6	[illegible]4	28	4
mean		24	26	37.4	34	37	279
C. V. %		36	55	58	27	31	52
LSD (0.05)		13	20	31.2	13	16	207

[a]MSO=Sun-It II at 32 fl oz/A.
[B]PO=Herbimax at 1% v/v.
[c]MSO=Sun-It II at 24 fl oz/A.

Authority for weed control in safflower, Williston 1998. (Riveland and Bradbury) The experiment was conducted to evaluate weed control and safflower response to Authority. 'Montola 2000' safflower was planted in 7 inch rows at 30 lbs/a on May 14. PPI treatments were applied to dry soil on May 12 with 69 F, 19 % RH, party cloudy sky and 5-8 mph NW wind. The whole plot area was then worked with a three point hitch cultivator with 9 inch shovels perpendicular to the application direction at a depth of 3-4 inches. A second incorporation was accomplished using a multi-weeder (narrow tines and harrows) set to work at a depth of 2-2.5 inches at a speed of 6mph. PE treatments were applied to dry soil on May 14 with 64 F, 64% RH, clear sky, and 5-7 mph SE wind. Treatments were applied with a bicycle type plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 10.0 gals/a at 40 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with four replications. The plots were harvested for yield on September 25.

Treatment[a]	Rate	Crop Inj	Std Red.	Wioa	Grft	Test Weight	Oil	Yield
	lbs/a ai	----%----		-% control--		lbs/b	%	lbs/a
PRE								
Authority	0.188	1	0	0	8	39	37.1	342
Authority	0.2	1	5	0	10	38	37.2	400
Authority	0.25	1	3	11	23	39	37.5	390
Prowl	1.0	0	0	36	50	38	37.5	350
Authority+Prowl	0.2+1.0	1	6	43	43	39	38.2	518
Authority	0.2	0	3	0	13	39	38.0	399
Authority	0.2	0	6	0	6	38	37.5	276
PPI								
Treflan	1.0	0	6	93	90	39	37.2	1004
Sonalan	1.0	0	4	97	98	41	38.2	1263
Authority+Sonalan	0.2+0.5	1	9	90	94	40	38.0	1112
Authority+Treflan	0.2+0.5	0	9	82	78	40	37.3	928
Authority+Sonalan	0.2+0.75	1	10	95	97	41	38.4	1274
Authority+Treflan	0.2+0.75	0	13	91	88	40	38.2	1036
Untreated Check	0	0	0	0	0	39	38.6	301
C.V. %		294	122	15	26	3	2.1	16
LSD 5%		NS	NS	10	18	2	NS	160
# OF REPS		4	4	4	4	4	4	4

No crop injury occurred. Authoriy in combination with Sonalan or Trelan tended to reduce crop stands. Wild oat population was heavy so only those treatments able to adequately control wild oat exhibited significant yield increases.

<u>Wild Oat control in safflower, Williston 1998.</u> (Riveland and Bradbury) The experiment was conducted to evaluate wild oat control and safflower response to Assure II and other grass herbicides. 'Montola 2000' safflower was planted in 7 inch rows at 30 lbs/a on May 2. Treatments were applied on June 10 to 3- to 4 - leaf safflower, 4 - 5-leaf wild oat, 2 - 6-leaf green foxtail, and 1-3 inch Russian thistle with 63 F, 75% RH, partly cloudy sky, and 6 mph SE wind. Treatments were applied with a bicycle type plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 8.6 gals/a at 30 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with four replications. Safflower was machine harvested on September 25.

		7-11						
		Crop	Control			Test	Grain	
Treatment[a]	Rate	Inj	Wioa	Grft	Ruth	Weight	Prot.	Yield
	oz/a ai	%				lbs/b	%	lbs/a
Assure II + COC	0.55+1%v/v	0	73	89	0	40	38.7	865
Assure II + COC	0.77+1%v/v	0	93	96	0	40	38.8	1137
Assure II + COC	1.1+1%v/v	0	89	97	0	39	39.0	964
Assure II + NIS	0.77+0.5%v/v	0	79	94	0	39	38.4	858
Assure II + Pinnacle + NIS	0.77 + 0.25+0.5%v/v	0	75	91	95	41	38.3	925
Poast + MSO	1.6+0.25G	2	85	85	0	40	38.9	932
Poast + MSO	3.2+0.25G	0	74	85	0	39	38.5	785
Poast + MSO	4.8+0.25G	0	85	91	0	40	38.6	939
Poast + Pinnacle + MSO	3.2 + 0.25+0.25G	3	79	83	70	40	38.3	921
Puma	0.96	0	54	90	0	39	38.3	688
Achieve + T8035 + AMS	2.88 + 0.5%v/v+24lb	0	66	94	0	40	38.2	887
Control	0	0	0	0	0	35	37.7	258
C.V. %		399	20	6	98	4	1.9	20
LSD 5%		NS	20	8	19	2	NS	241
# OF REPS		4	4	4	4	4	4	4

a - COC - Class 17% Concentrate; Cenex NIS - Activator 90; Loveland, UAP
MSO - Destiny; Cenex G = gallon

Safflower was not injured by any treatment. Russian thistle population was light. Puma and Achieve adequately controlled green foxtail but not wild oats. All treatments increased safflower yields from 2 to 4 times the untreated safflower yields.

Broadleaf weed control in safflower, Williston 1998. (Riveland and Bradbury) The experiment was conducted to broadleaf weed control and safflower response to Ally and other herbicides. 'Finch' safflower was planted in 7 inch rows at 30 lbs/a on April 28. Treatments were applied on June 6 to 4 - 6 -leaf safflower, 3 - 6 -leaf green foxtail, 2 inch Russian thistle and Horseweed, and 3-8 inch Kochia with 58 F, 50% RH, cloudy sky, and 3 to 5 mph SE wind. Treatments were applied with a bicycle type plot sprayer with wind cones mounted on a G-Allis Chalmers tractor and delivering 8.6 gals/a at 30 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. The experiment was a randomized complete block design with four replications. The plots were not harvested for yield.

Treatment[a]	Rate	Crop Inj	Grft	Kocz	Howe	Ruth
	oz/a ai	%	-------% control-------			
Pinnacle + NIS	0.12+0.25%v/v	1	0	15	72	97
Ally + NIS	0.03+0.25%v/v	1	0	18	96	97
Ally + NIS	0.04+0.25%v/v	1	0	6	96	96
Ally + NIS	0.05+0.25%v/v	5	13	33	96	98
Ally + NIS	0.06+0.25%v/v	10	25	40	96	98
Assert	6	0	8	0	0	0
Assert + Ally + Sunit II	6+0.03+0.25G	7	48	46	93	96
Assert + Finesse + Sunit II	6+0.125 +0.25G	14	86	20	89	90
BAS-514 + Sunit II	4+0.25G	99	91	38	96	48
BAS-514 + Sunit II	2.4+0.25G	100	80	39	86	58
Finesse + NIS	0.075+0.25%v/v	1	54	5	94	93
Finesse + NIS	0.125+0.25%v/v	4	80	20	94	96
Poast + Finesse + COC	3.2+0.125+0.25G	19	87	35	94	97
Poast + Ally + Destiny	3.2+0.04+0.25G	8	93	43	95	97
Poast + Destiny	3.2 +0.25G	1	93	0	0	0
Assure II + Ally + COC	0.77+0.04+0.25G	11	85	54	95	96
Pinnacle + Ally + NIS	0.06+0.04+0.25%v/v	28	64	35	95	94
Untreated Control	0	0	0	0	0	0
C.V. %		36	39	70	15	11
LSD 5%		9	28	25	17	12
# OF REPS		4	4	4	4	4

a - COC - Class 17% Concentrate; Cenex NIS - Activator 90; Loveland, UAP
G = gallon

Safflower was completely destroyed by BAS-514 and was also injured by Finesse in combination with Poast and Assert. Finesse alone did not cause significant crop injury. Some combinations of herbicides that control both broadleaf and grassy weeds did not cause significant crop injury. No treatment controlled Kochia adequately, perhaps because the kochia was too large when treatments were applied. Horsewweed was controlled by all bl herbicides while only BAS-514 and Assert failed to control Russian thistle adequately. Finesse surpressed green foxtail at the higher rate of application.

Evaluation of diflufenzopyr with auxin herbicides for leafy spurge control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Diflufenzopyr is an auxin transport inhibitor (ATI), which suppresses the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. In general, diflufenzopyr interferes with the auxin balance needed for plant growth. The purpose of this research was to evaluate diflufenzopyr applied with various auxin herbicides for leafy spurge control.

BAS-662 (formally known as SAN-1269) is a combination of dicamba plus diflufenzopyr (SAN-836) in a ratio of 2.5:1 dicamba:diflufenzopyr. In the first experiment this pre-mixed treatment was compared to diflufenzopyr applied with other auxin herbicides in the same ratio of 2.5:1. The application rate for all herbicides was reduced approximately 50% from the normal use rate for season-long control to more quickly determine if diflufenzopyr caused increased leafy spurge control when applied with an auxin herbicide. The experiment was established at the Ekre Research Station, near Walcott, ND, on June 12, 1997. The leafy spurge was in the true-flower growth stage and 18 to 36 inches tall. The herbicides were applied using a hand-boom sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and replicated four times in a randomized complete block design. All treatments were applied with the surfactant X-77 plus 28% N at 0.25% + 1.25% (v/v), respectively. Leafy spurge foliage injury was visually evaluated 1 MAT (month after treatment) and control based on percent stand reduction compared to the untreated check was evaluated 3 and 12 MAT.

Leafy spurge foliage injury increased dramatically when diflufenzopyr was applied with an auxin herbicide compared to the herbicide applied alone (Table 1). For example, foliage injury increased from 76 to 93% when diflufenzopyr was applied with dicamba and from 56 to 99% when diflufenzopyr was applied with picloram compared to the herbicides applied alone. The largest increase in foliage injury (38 to 95%) occurred when quinclorac was applied with diflufenzopyr compared to quinclorac applied alone.

Leafy spurge control with dicamba, picloram, and fluroxypyr was better 3 MAT when the herbicides were applied with diflufenzopyr compared to the herbicides applied alone (Table 1). For instance, leafy spurge control with fluroxypyr increased from 28 to 76% 3 MAT when diflufenzopyr was added and from 10 to 47% when diflufenzopyr was applied with picloram. Since the herbicides were applied at below the normal use rate, leafy spurge control declined rapidly the following growing season. However, control 12 MAT was increased when diflufenzopyr was applied with dicamba and quinclorac and tended to be increased with picloram plus 2,4-D compared to the herbicides applied alone 3 MAT.

The second experiment evaluated leafy spurge control with dicamba applied in mid-summer or fall alone or with diflufenzopyr in a commercial mixture. The experiment was established near Fargo in 1997 and herbicides were applied as previously described on July 22 (summer) or September 15 (fall) when leafy spurge was in the true-flower to seed-set or fall regrowth growth stages, respectively. All treatments were applied with surfactant X-77 and 28% N at 0.25% plus 1.25%, respectively. Leafy spurge growth had been delayed in the spring because of flooding in the area.

Leafy spurge foliage injury 1 MAT increased when diflufenzopyr was applied with dicamba compared to dicamba alone, similar to the first study (Tables 1 and 2). Leafy spurge control the following growing season was much better when dicamba was applied with diflufenzopyr compared to dicamba alone, especially for the fall applied treatments (Table 2). For instance, leafy spurge control averaged 96% 11 MAT with dicamba plus diflufenzopyr at 16 plus 6.4 oz/A compared to only 20% with dicamba applied alone and was similar to the standard treatment of picloram plus 2,4-D. Control 13 MAT was or tended to be increased with all dicamba plus diflufenzopyr treatments compared to dicamba alone. Again, dicamba plus diflufenzopyr at 16 plus 6.4 oz/A provided similar control (61%) to the standard picloram plus 2,4-D treatment.

The third experiment was established near Valley City, ND on September 17, 1997 when leafy spurge was in the fall regrowth growth stage to evaluate the effect of diflufenzopyr applied with auxin herbicides and imazapic at recommended rates. As observed in the previous studies leafy spurge control increased or tended to increase when diflufenzopyr was applied with an auxin herbicide, especially dicamba and picloram (Table 3). Leafy spurge control averaged 54% 12 MAT when diflufenzopyr was applied with dicamba compared to only 20% when dicamba was applied alone. Control increased from 66 to 90% when diflufenzopyr was applied with picloram compared to the herbicide alone. Leafy spurge control also tended to increase when diflufenzopyr was applied with imazapic even though that herbicide is classified as a ALS inhibitor.

The fourth experiment was established to evaluate the optimum ratio of diflufenzopyr with various herbicides. The diflufenzopyr ratio was varied from the standard ratio of 2.5:1 herbicide:ATI to 5:1 and 10:1. The experiment was established near Jamestown and Valley City, North Dakota, in early June 1998 when leafy spurge was in the true-flower growth stage. Both initial foliage injury 1 MAT and top growth control 3 MAT were higher when diflufenzopyr was applied with dicamba and quinclorac compared to the herbicide alone (Table 4). However, injury and control were similar regardless of the diflufenzopyr rate. For instance, leafy spurge control with dicamba applied alone averaged 84% 3 MAT but increased to an average of 97% when applied with diflufenzopyr. Control with quinclorac alone averaged 78% but increased to an average of 97% when applied with diflufenzopyr. Control was also increased to 78% when diflufenzopyr was applied with glyphosate plus 2,4-D compared to 44% with the herbicides alone.

In summary, both initial and long-term leafy spurge control increased when diflufenzopyr was applied with auxin herbicides and with imazapic. Leafy spurge control 3 MAT was similar regardless of the ratio of diflufenzopyr to herbicide. Diflufenzopyr could be used to increase long-term leafy spurge control with herbicides or allow the use of reduced herbicide rates without a subsequent loss in control.

Table 1. Leafy spurge control with auxin herbicides applied alone and with diflufenzopyr in June 1997.

Treatment	Rate	Foliage inj[a] 1 MAT[b]	Control 3 MAT[b]	Control 12 MAT[b]
	— oz/A —	%		
Dicamba	4	76	5	0
Dicamba + diflufenzopyr[c]	4 + 1.6	93	43	38
Picloram	2	56	10	0
Picloram + diflufenzopyr	2 + 0.8	99	47	6
2,4-D	4	81	40	4
2,4-D + diflufenzopyr	4 + 1.6	98	45	5
Picloram + 2,4-D	2 + 4	68	64	3
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	95	71	25
Quinclorac	8	38	88	71
Quinclorac + diflufenzopyr	8 + 3.2	95	96	90
Fluroxypyr	4	78	28	4
Fluroxypyr + diflufenzopyr	4 + 1.6	100	76	16
LSD (0.05)		9	34	23

[a]Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b]Months after treatment.
[c]Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).

Table 2. Dicamba applied in mid-summer or fall alone and with diflufenzopyr for leafy spurge control.

Time applied and treatment	Rate	Foliage inj[a]. 1 MAT[b]	Control 11 MAT[b]	Control 13 MAT[b]
	– oz/A –	%		
Mid-summer				
Dicamba + diflufenzopyr[c]	4+1.6	36	38	8
Dicamba + diflufenzopyr[c]	8+3.2	80	38	23
Dicamba	4	10	6	3
Dicamba	8	66	23	6
Picloram + 2,4-D	4 + 16	97	34	18
Fall applied				
Dicamba + diflufenzopyr[c] fall	8+3.2		77	23
Dicamba + diflufenzopyr[c] fall	16+6.4		96	61
Dicamba fall	8		28	8
Dicamba fall	16		20	5
Picloram + 2,4-D fall	8 + 16		94	63
LSD (0.05)		22	26	20

[a]Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b]Months after treatment.
[c] Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).

Table 3. Diflufenzopyr applied with various herbicides in the fall for leafy spurge control.

Treatment	Rate	Control	
		9 MAT[a]	12 MAT[a]
	—— oz/A ——	—— % ——	
Dicamba + X-77 + 28% N	32 + 0.25% + 1.25%	65	20
Dicamba + diflufenzopyr[b] + X-77 + 28% N	32 + 12.8 + 0.25% + 1.25%	78	54
Picloram	8	89	66
Picloram + diflufenzopyr	8 + 3.2	100	90
Picloram + 2,4-D	8 + 16	95	78
Picloram + 2,4-D + diflufenzopyr	8 + 16 + 3.2	99	88
Quinclorac + Scoil[c]	16 + 1 qt	99	89
Quinclorac + diflufenzopyr + Scoil[c]	16 + 6.4 + 1 qt	100	95
Imazapic + Sunit[c] + 28% N	2 + 1 qt + 1 qt	95	84
Imazapic + diflufenzopyr + Sunit[c] + 28% N	2 + 0.8 + 1 qt + 1 qt	99	96
LSD (0.05)		14	16

[a] Months after treatment.
[b] Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).
[c] Methylated seed-oil by AGSCO.

Table 4. Diflufenzopyr applied at various ratios with herbicides for leafy spurge control averaged over two locations in North Dakota.

Treatment	Rate	Foliage injury	Control
		1 MAT[a]	3 MAT[a]
	—— oz/A ——	—— % ——	
Dicamba + X-77 + 28% N	2 + 0.25% + 1 qt	64	84
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 3.2 + 0.25% + 1 qt	67	94
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 6.4 + 0.25% + 1 qt	78	99
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 12.8 + 0.25% + 1 qt	70	98
Quinclorac + Scoil[b]	12 + 1 qt	47	78
Quinclorac + diflufenzopyr + Scoil[b]	12 + 1.6 + 1 qt	61	96
Quinclorac + diflufenzopyr + Scoil[b]	12 + 3.2 + 1 qt	60	97
Quinclorac + diflufenzopyr + Scoil[b]	12 + 4.8 + 1 qt	66	98
Glyphosate + 2,4-D[c]	6 + 10	88	44
Glyphosate + 2,4-D[c] + diflufenzopyr	6 + 10 + 6.4	84	78
LSD (0.05)		8	8

[a] Months after treatment.
[b] Methylated seed-oil by AGSCO.
[c] Commercial formulation - Landmaster BW.

Evaluation of diflufenzopyr with auxin herbicides for Canada thistle and spotted knapweed control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). The auxin transport inhibitor (ATI) diflufenzopyr suppresses the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. The purpose of this research was to evaluate Canada thistle and spotted knapweed control by auxin herbicides applied with diflufenzopyr.

In the first experiment auxin herbicides were applied at approximately 50% below the normal use rate for season-long control to more quickly determine if diflufenzopyr caused increased weed control compared to the herbicides applied alone. The experiment was established near Fargo on June 13, 1997, with an air temperature of 82 F and a dew point of 66 F. Canada thistle was in the early bud growth stage and 4 to 16 inches tall. The herbicides were applied using a hand-boom sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and treatments were replicated four times in a randomized complete block design. All treatments were applied with the surfactant X-77 at 0.25% plus 28% N at 1.25%, (v/v). Canada thistle foliage injury was visually evaluated 1 MAT (month after treatment) and control based on percent stand reduction compared to the control was evaluated 3 and 12 MAT.

Canada thistle foliage injury was increased when diflufenzopyr was applied with any of the herbicides evaluated (Table 1). Plants treated with diflufenzopyr plus an herbicide desiccated faster and tended to turn black in color rather than brown for plants treated with only a herbicide. The greatest increase in foliage injury occurred when diflufenzopyr was applied with picloram, 2,4-D, or quinclorac, which averaged 77% foliage injury 1 MAT compared to only 34% when the herbicides were applied alone.

Canada thistle control 3 MAT increased when diflufenzopyr was applied with dicamba, 2,4-D, quinclorac, and clopyralid compared to the herbicides applied alone (Table 1). The most dramatic increase occurred when diflufenzopyr was applied with quinclorac. Quinclorac generally is not toxic to Canada thistle, yet when applied with diflufenzopyr control 3 MAT averaged 67% compared to only 6% when the herbicide was applied alone. Control increased from 37 to 70% with dicamba and from 44 to 83% with 2,4-D when the herbicides were applied with diflufenzopyr compared to alone. No treatment provided satisfactory control 12 MAT.

The second experiment evaluated Canada thistle control with dicamba, quinclorac, and clopyralid plus 2,4-D at standard use rates alone and with diflufenzopyr at various ratios (herbicide:ATI) (Table 2). Treatments were applied on June 9,1998, near Fargo as previously described. Canada thistle plants were beginning to bolt and were 4 to 10 inches tall. Canada thistle control with quinclorac was greatly improved when the herbicide was applied with diflufenzopyr. However, control was similar regardless of the ratio of the ATI in the mixture. Initial control with dicamba and clopyralid plus 2,4-D was similar whether the herbicides were applied alone or with the ATI.

The third experiment evaluated diflufenzopyr applied with various herbicides for spotted knapweed control. The experiment was established near Hawley, MN, on June 12, 1997, and treatments were applied as previously described. The spotted knapweed was in the early bolt growth stage and 4 to 6 inches tall and had been mowed in August 1996. Spotted knapweed control was similar regardless of herbicide or the addition of diflufenzopyr (Table 3). Spotted knapweed control was quite variable over the entire experiment.

In summary, Canada thistle but not spotted knapweed control improved when diflufenzopyr was applied with an auxin herbicide compared to the herbicide alone. Control 12 MAT was similar regardless of the ratio of herbicide to diflufenzopyr.

Table 1. Canada thistle control with auxin herbicides applied In June 1997 either alone or with diflufenzopyr in June 1997.

Treatment	Rate	Foliage inj[a] 1 MAT[b]	Control 3 MAT[b]	Control 12 MAT[b]
	— oz/A —	%	%	%
Dicamba	4	54	37	15
Dicamba + diflufenzopyr[c]	4 + 1.6	76	70	11
Picloram	2	46	94	24
Picloram + diflufenzopyr	2 + 0.8	89	88	13
2,4-D	4	36	44	18
2,4-D + diflufenzopyr	4 + 1.6	65	83	18
Picloram + 2,4-D	2 + 4	63	93	24
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	84	94	34
Quinclorac	8	19	6	1
Quinclorac + diflufenzopyr	8 + 3.2	76	67	11
Clopyralid	1.6	65	83	19
Clopyralid + diflufenzopyr	1.6 + 0.6	88	97	34
LSD (0.05)		13	21	NS

[a] Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b] Months after treatment.
[c] Commercial mixture of dicamba plus diflufenzopyr - Distinct.

Table 2. Diflufenzopyr at various ratios with herbicides for Canada thistle control applied in June 1998.

Treatment	Rate	Control 2 MAT[a]
	—— oz/A ——	— % —
Dicamba + X-77 + 28% N	8 + 0.25% + 1 qt	81
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 0.8 + 0.25% + 1 qt	84
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 1.6 + 0.25% + 1 qt	84
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 3.2 + 0.25% + 1 qt	96
Quinclorac + Scoil[b]	12 + 1 qt	5
Quinclorac + diflufenzopyr + Scoil[b]	12 + 1.6 + 1 qt	68
Quinclorac + diflufenzopyr + Scoil[b]	12 + 3.2 + 1 qt	51
Quinclorac + diflufenzopyr + Scoil[b]	12 + 4.8 + 1 qt	73
Clopyralid + 2,4-D[c]	4 + 16	94
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 2	97
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 4	100
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 8	100
LSD (0.05)		24

[a] Months after treatment.
[b] Methylated seed-oil by AGSCO.
[c] Commercial formulation-Curtail

Table 3. Diflufenzopyr with various herbicides for spotted knapweed control applied in June 1997.

Treatment[a]	Rate	Foliage injury 1 MAT[b]	Control 3 MAT[b]	Control 12 MAT[b]	Control 15 MAT[b]
	—— oz/A ——	——	——	%	——
Dicamba	4	68	69	84	78
Dicamba + diflufenzopyr	4 + 1.6	63	48	48	51
Picloram	2	55	28	40	34
Picloram + diflufenzopyr	2 + 0.8	61	42	83	68
2,4-D	4	61	48	40	44
2,4-D + diflufenzopyr	4 + 1.6	70	71	79	76
Picloram + 2,4-D	2 + 4	40	25	36	33
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	51	55	65	59
Quinclorac	8	46	50	50	66
Quinclorac + diflufenzopyr	8 + 3.2	57	68	85	82
Clopyralid	1.6	49	26	45	33
Clopyralid + diflufenzopyr	1.6 + 0.6	70	68	79	68
LSD (0.05)		NS	NS	NS	NS

[a] All treatments were applied with X-77 + 28% N at 0.25% + 1.25%, respectively.
[b] Months after treatment.

<u>Evaluation of imazapic for leafy spurge control.</u> Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Imazapic (Plateau) has been registered for leafy spurge control in non-cropland. The label states that imazapic should be applied with a methylated seed oil (MSO) adjuvant plus 28% urea nitrogen. Also, the manufacturer recommends imazapic be applied in the fall prior to a killing frost or as a split application in the fall and the following spring. The purpose of these experiments was to evaluate imazapic for leafy spurge control and grass injury applied alone or with a MSO adjuvant in the spring or fall for 3 years, or for leafy spurge control under trees.

The first experiment evaluated leafy spurge control with imazapic applied in mid-summer or fall for 3 years at two locations in North Dakota. The herbicide treatments were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and replicated four times with the herbicide treatments in a randomized complete block design. Herbicides were applied near Valley City or Jamestown on July 3, 1996, when the leafy spurge was in the flowering to seed-set growth stage. The air temperature was approximately 80 F and the soil temperature at the 4 inch depth was 57 F at Valley City and 69 F at Jamestown. The fall treatments were applied at both locations on September 9 when the leafy spurge was in the fall regrowth growth stage and the air temperature was in the mid 80s. Treatments were reapplied in 1997 and 1998 on similar dates.

Imazapic applied in mid-summer at Valley City did not control leafy spurge when visually evaluated the year of treatment (Table 1). However, control by imazapic at 2 and 4 oz/A averaged 94 and 99%, respectively in May 1997. Imazapic at 4 oz/A provided 93% leafy spurge control in September 1997 with minimal grass injury, but 4 oz/A is above the maximum labeled use rate of 3 oz/A. Imazapic fall-applied at 2 or 4 oz/A provided excellent leafy spurge control the following spring but grass injury was very noticeable and averaged 43%. Imazapic applied at 1 or 2 oz/A with MSO provided 92% leafy spurge control when evaluated in the fall 12 MAT, which was higher than the standard picloram plus 2,4-D treatment which averaged 47%.

Imazapic applied in July for 3 yr averaged >90% leafy spurge control 1 month after the last August treatment date (Table 1), with no visible grass injury. The grasses had recovered from the injury observed following the initial treatment and were not injured by the subsequent treatments. Leafy spurge control from imazapic fall-applied averaged above 80% following two annual applications and was similar to the standard treatment of picloram plus 2,4-D.

Leafy spurge control with imazapic applied in mid-summer tended to be less at Jamestown than Valley City (Tables 1 and 2). Only imazapic at 4 oz/A provided greater than 90% control in May 1997 at Jamestown (Table 2). Control averaged 99% in September following a second application of picloram plus 2,4-D, but only was 71% or less with a second application of imazapic. Grass injury could not be evaluated in September 1997 because of severe hail damage at the research location.

Imazapic applied in the fall at Jamestown provided excellent (99%) leafy spurge control in May 1997 regardless of application rate (Table 2). In contrast to the high grass injury at Valley City (Table 1), imazapic at 4 oz/A fall-applied averaged 18% grass injury and was the only treatment to injure grass at Jamestown (Table 2). Leafy spurge control averaged 97% 12 and 24 MAT with both imazapic applied alone at 4 oz/A or at 2 oz/A with MSO compared to 26% with picloram plus 2,4-D.

The second experiment evaluated leafy spurge control with imazapic on a sandy soil at Camp Grafton South, near McHenry, North Dakota, under full-grown ash trees (Table 3). The experiment was established on August 29, 1996, when leafy spurge was in the fall regrowth stage. The air temperature was 79 F and the soil temperature was 72 F at the 4 inch soil depth.

Leafy spurge control in June 1997 averaged 100% with imazapic applied at 2 and 3 oz/A compared to 89% with picloram plus 2,4-D (Table 3). There was 23% grass injury with imazapic applied at 3 oz/A. Control remained high 12 MAT with both imazapic treatments and averaged 95% control compared to 48% with picloram plus 2,4-D, and the grass had recovered. Control 15 MAT with imazapic applied at 3 oz/A averaged 84% and was the only treatment to maintain good control. There was no visible injury to the ash trees regardless of application rate.

In general, imazapic applied in the fall provided better leafy spurge control than the mid-summer treatment and control was sometimes improved when the herbicide was applied with a MSO or MSO plus 28% N compared to imazapic applied alone. Grass injury to cool season species tended to be higher when imazapic was applied in July compared to fall-applied, but the grasses recovered by 12 MAT.

Table 1. Imazapic for leafy spurge control annually applied in mid-summer or fall for 3 yr at Valley City, ND.

		Evaluation/year							
		Sept 1996		May 1997		Sept 1997		June 98	Aug 98
Treatment[a]	Rate	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Control
	— oz/A —	%							
Applied annually in July									
Imazapic	2	0	0	94	10	74	5	90	95
Imazapic	4	0	0	99	28	93	5	50	93
Imazapic + MSO[b]	1 + 1 qt	0	0	0	8	87	3	82	96
Imazapic + MSO[b]	2 + 1 qt	0	0	99	28	73	16	59	96
Picloram + 2,4-D	4 + 16	74	4	75	0	38	0	26	96
Applied annually in Sept.									
Imazapic	2			100	36	71	0	99	85
Imazapic	4			100	53	99	0	100	98
Imazapic + MSO[b]	1 + 1 qt			100	20	92	0	99	82
Imazapic + MSO[b]	2 + 1 qt			100	40	92	0	99	85
Picloram + 2,4-D	8 + 16			99	13	47	0	95	86
LSD (0.05)		34	NS	20	25	25	NS	26	10

[a]Initial treatments applied July 2 (summer) and September 9, 1996 (fall). All treatments were reapplied in 1997 and 1998.
[b]Methylated seed oil was SunIt by AGSCO.

Table 2. Imazapic for leafy spurge control annually applied in mid-summer or fall for 3 yr at Jamestown, ND.

Treatment[a]	Rate	Sept 1996		May 1997		Sept 1997	June 1998		Aug 1998
		Control	Grass inj.	Control	Grass inj.	Control	Control	Grass inj.	Control
	— oz/A —	— % —							
Applied annually in July									
Imazapic	2	0	0	0	0	0	34	0	22
Imazapic	4	13	14	92	1	71	96	2	99
Imazapic + MSO[b]	1 + 1 qt	28	0	33	0	13	58	0	36
Imazapic + MSO[b]	2 + 1 qt	17	0	72	0	45	85	0	82
Picloram + 2,4-D	4 + 16	46	0	15	0	99	42	0	87
Applied annually in Sept.									
Imazapic	2			99	5	28	97	0	45
Imazapic	4			100	18	97	100	23	99
Imazapic + MSO[b]	1 + 1 qt			99	6	70	99	0	29
Imazapic + MSO[b]	2 + 1 qt			100	6	96	100	6	96
Picloram + 2,4-D	8 + 16			95	0	26	97	0	26
LSD (0.05)		14	10	19	6	18	10	5	17

[a]Intial treatments applied July 2 (summer) and September 9, 1996 (fall). All treatments were reapplied at a similar date in 1997 and 1998.

[b]Methylated seed oil was Sun-It by AGSCO.

Table 3. Imazapic for leafy spurge control near trees established on Camp Grafton South near McHenry, ND.

Treatment[a]	Rate	June 1997		Sept 1997		June 98
		Control	Grass injury	Control	Grass injury	Control
	— oz/A —	— % —				
Imazapic + MSO[b] + 28% N	2 + 1 qt + 1 qt	100	11	93	0	56
Imazapic + MSO[b] + 28% N	3 + 1 qt +1 qt	100	23	96	3	84
Picloram + 2,4-D	8 + 16	89	0	48	0	6
LSD (0.05)		8	9	14	NS	32

[a]Treatments applied August 29, 1996.

[b]Methylated seed oil was Sun-It by AGSCO.

Screening imazapic for spotted knapweed, Canada thistle, and perennial sowthistle control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Imazapic has been used for rangeland renovation including leafy spurge control and has a narrower weed control spectrum than the more commonly used picloram plus 2,4-D. The purpose of this research was to evaluate imazapic for broadleaf weed control in pastures infested with spotted knapweed, Canada thistle, and perennial sowthistle.

An experiment to evaluate imazapic applied alone or with picloram for spotted knapweed control was established on a moderate infestation of spotted knapweed near Hawley, MN. Herbicides were applied on June 13, 1997 (spring) or September 18, 1997 (fall) using a hand-boom sprayer delivering 8.5 gpa at 35 psi. All treatments containing imazapic were applied with a methylated seed oil (MSO) at 1 qt/A. The experiment was in a randomized complete block design with four replications and each plot was 10 by 30 feet. Evaluations were based on visible percent stand reduction compared to an untreated control.

Imazapic applied alone in the spring or fall did not control spotted knapweed (Table 1). Control averaged less than 30% and some grass injury was observed following the spring applied treatments. Picloram at 4 oz/A applied alone or with imazapic provided nearly complete spotted knapweed control.

The second experiment evaluated imazapic applied alone or with clopyralid plus 2,4-D for Canada thistle and perennial sowthistle control. The experiment was established near Fargo, ND, in a dense stand of both weed species. Herbicides were applied as previously described except the application equipment was a tractor mounted sprayer. Treatments were applied on May 29 to weeds in the vegetative growth stage or September 15, 1997 to weeds rosette growth stage. respectively. All imazapic treatments were applied with an MSO at 1 qt/A.

Imazapic spring applied alone provided short-term control of Canada thistle but not perennial sowthistle (Table 2). For instance, imazapic applied at 3 oz/A provided 79% Canada thistle control in July but control declined to 6% by October 1997. The same treatment averaged less than 50% perennial sowthistle control even 1 MAT (month after treatment). Clopyralid plus 2,4-D at 3 plus 16 oz/A provided approximately 90% control of both species 1 MAT when applied in the spring or fall and control was similar whether applied alone or with imazapic. Clopyralid plus 2,4-D spring applied provided season-long Canada thistle and perennial sowthistle control and fall-applied provided good perennial sowthistle but not Canada thistle control in the spring following spring.

In general, imazapic provided poor spotted knapweed, Canada thistle, and perennial sowthistle control when applied alone regardless of application date. The addition of imazapic to picloram or clopyralid plus 2,4-D did not result in improved weed control compared to the pyridinecarboxylic acid herbicides applied alone.

Table 1. Imazapic applied alone and with picloram in June or September for spotted knapweed control.

Treatment	Rate	August 1997 Control	August 1997 Grass inj.	May 1998 Control	May 1998 Grass inj.	Aug 1998 Control
	— oz/A —	—	—	%	—	—
Spring applied						
Imazapic + MSO[a]	2 + 1 qt	28	5	23	0	10
Imazapic + MSO[a]	2.5 + 1 qt	5	11	0	0	0
Imazapic + MSO[a]	3 + 1 qt	13	16	13	0	0
Imazapic + picloram + MSO[a]	2 + 4 + 1 qt	100	20	99	0	100
Imazapic + picloram + MSO[a]	2.5 + 4 + 1 qt	100	27	97	0	99
Picloram	4	100	5	99	0	99
Fall applied						
Imazapic + MSO[a]	2 + 1 qt			21	0	5
Imazapic + MSO[a]	2.5 + 1 qt			24	0	5
Imazapic + MSO[a]	3 + 1 qt			11	0	13
Imazapic + picloram + MSO[a]	2 + 4 + 1 qt			99	13	100
Imazapic + picloram + MSO[a]	2.5 + 4 + 1 qt			100	18	99
Picloram	4			99	7	100
LSD (0.05)		21	22[b]	30	7	11

[a]Methylated seed oil was Sun-It by AGSCO.

[b]LSD = (0.10).

Table 2. Imazapic applied alone or with clopyralid plus 2,4-D in May or September 1997 for Canada thistle and perennial sowthistle control.

Treatment	Rate	Canada thistle 1997 July	Canada thistle 1997 Aug	Canada thistle 1997 Oct	Canada thistle 1998 May	Perennial sowthistle 1997 July	Perennial sowthistle 1997 Aug	Perennial sowthistle 1997 Oct	Perennial sowthistle 1998 May
Spring applied	oz/A	% control							
Imazapic + MSO[a]	2 + 1 qt	73	53	18	..	20	9	18	..
Imazapic + MSO[a]	2.5 + 1 qt	76	42	6	..	23	35	26	..
Imazapic + MSO[a]	3 + 1 qt	79	68	6	..	40	34	44	..
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2 + 3 +16 + 1 qt	91	84	10	..	97	95	79	..
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2.5 + 3 + 16 + 1 qt	90	84	34	..	85	88	51	..
Clopyralid + 2,4-D[b]	3 + 16	96	91	63	..	90	84	65	..
LSD (0.05)		8	23	27		26	39	34[c]	
Fall applied									
Imazapic + MSO[a]	2 + 1 qt	..	..	19	25	..	..	19	51
Imazapic + MSO[a]	2.5 + 1 qt	..	..	17	49	..	..	14	61
Imazapic + MSO[a]	3 + 1 qt	..	..	18	58	..	..	19	68
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2 + 3 + 16 + 1 qt	..	..	86	33	..	..	93	60
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2.5 + 3 +16 + 1 qt	..	..	96	35	..	..	96	71
Clopyralid + 2,4-D[b]	3 + 16	..	..	87	15	..	..	87	89
LSD (0.05)				11	23			10	27

[a]Methylated seed oil was Sun-It by AGSCO
[b]Commercial formulation - Curtail.
[c]LSD = 0.10.

Evaluation of imazapic and quinclorac for spotted knapweed control. Rodney G. Lym. Imazapic (formerly known as imazameth) has been labeled for control of several perennial weeds in non-cropland. Imazapic may be a more cost-effective treatment than the widely used herbicide combination of picloram plus 2,4-D for spotted knapweed control. Quinclorac is a systemic herbicide registered to control annual grass and broadleaf weeds in rice. Quinclorac also controls leafy spurge in pasture and rangeland with minimal or no impact on desirable forbs. The purpose of this research was to evaluate imazapic and quinclorac for spotted knapweed control.

The experiment was established on September 19, 1996, on a sandy/gravely site near the Hawley Airport, Hawley, MN. Spotted knapweed was in the rosette growth stage and had been mowed in mid-summer. The air temperature was 61 F, and the soil temperature at the 4 inch depth was 61 F. Frost did not occur in the area until October 3 when the low temperature was 27 F. Herbicides were applied using a hand-held sprayer delivering 8.5 gpa at 35 psi. The grass species present were generally bluegrass and smooth bromegrass. Initial control of bolted spotted knapweed plants and grass injury was evaluated on June 12 and August 22, 1997, and control of spotted knapweed rosettes on August 22. Visual evaluations were repeated on similar dates in 1998 and were based on percent stand reduction as compared to the control.

		Evaluation						
		9 MAT[a]		12 MAT[a]			21 MAT[a]	24 MAT[a]
Treatment	Rate	Bolted	Grass inj.	Bolted	Rosette	Grass inj.	Bolted	Bolted
	oz/A	%						
Imazapic	2	21	0	4	0	22	7	5
Imazapic + MSO[b] + 28% N	1 + 1 qt + 1 qt	18	0	25	0	12	0	5
Imazapic + MSO[b] + 28% N	2 + 1 qt + 1 qt	8	0	0	0	71	0	0
Imazapic + MSO[b] + 28% N	4 + 1 qt + 1 qt	33	5	7	0	48	13	7
Quinclorac	8	55	0	51	8	6	12	10
Quinclorac + MSO[b]	4 + 1 qt	60	0	65	46	3	45	25
Quinclorac + MSO[b]	8 + 1 qt	61	0	58	36	0	45	30
Quinclorac + MSO[b]	16 + 1 qt	93	0	91	86	0	68	70
Picloram + 2,4-D	4 + 16	100	0	100	100	0	97	99
Clopyralid + 2,4-D[c]	3 + 16	98	0	99	71	0	73	65
LSD (0.05)		28	3	30	33	30	34	28

[a]Months after treatment.
[b]Methylated seed oil was Sun-It by AGSCO.
[c]Commercial formulation - Curtail.

Imazapic did not provide adequate spotted knapweed control regardless of application rate (Table). However, the growth of cool season grass species was reduced. Grass injury averaged 22 and 71% 12 MAT (months after treatment) when imazapic was applied at 2 oz/A alone or with a MSO plus 28% N, respectively.

Quinclorac at 16 oz/A plus a MSO provided 91 and 86% bolted and rosette spotted knapweed control, respectively, 12 MAT with no visible grass injury (Table). Quinclorac at 8 or 4 oz/A did not control spotted knapweed. Picloram plus 2,4-D averaged 100% control of both bolted and rosette spotted knapweed 12 MAT with no grass injury. Clopyralid plus 2,4-D also provided excellent bolted spotted knapweed control, but only 71% rosette control 12 MAT. Picloram plus 2,4-D continued to provide nearly 100% control 24 MAT compared to 70% with quinclorac at 16 oz/A and 65% with clopyralid plus 2,4-D. Thus, picloram plus 2,4-D would be the treatment of choice for long-term spotted knapweed control in many situations, but quinclorac (if labeled in the future) would be useful in areas where picloram cannot be used, or where removal of all broadleaf species would be undesirable.

Quackgrass control with quizalofop and glyphosate. Katheryn M. Christianson and Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Quackgrass is an aggressive, rapidly spreading weed that competes with crops. It grows in a wide range of temperate environments from cultivated fields to pastures and is difficult to control once established. The purpose of this experiment was to evaluate quizalofop and glyphosate alone and in combination for quackgrass control

The experiment was established in a dense stand of quackgrass at the North Dakota State University experiment station at Fargo, ND. The soil was a Fargo silty clay with 3.5% organic matter and a 8.0 pH. The quackgrass was 8 to10 inches tall and had 4 to 6 leaves. Herbicides were applied using a hand-held sprayer delivering 8.5 gpa at 35 psi. Quackgrass control was visually evaluated on June 17, 1998, 21 DAT (days after treatment) and July 10, 1998, 45 DAT. Control was based on percent stand reduction as compared to the untreated check.

Table. Quackgrass control with quizalofop and glyphosate[a].

Treatment	Rate	Control 21 DAT	Control 45 DAT
	oz/A	%	%
Quizalofop + glyphosate + AMS	1.1 + 8 + 40	87	93
Quizalofop + glyphosate + AMS	1.1 + 12 + 40	83	94
Quizalofop + glyphosate + AMS + COC	1.1 + 8 + 40 + 1%	86	93
Quizalofop + AMS + COC	1.1 + 40 + 1%	53	52
Glyphosate + AMS	8 + 40	81	90
Glyphosate + AMS	12 + 40	88	97
Untreated check		0	0
LSD (0.05)		10	4

[a]AMS, ammonium sulfate; COC, crop oil concentrate - Herbimax; DAT, days after treatment; glyphosate, commercial formulation Roundup Ultra.

Quackgrass control 21 DAT was greater than 80% with all glyphosate treatments regardless of application rate or if tank mixed with quizalofop. Quackgrass control 45 DAT increased to greater than 90% for all treatments applied with glyphosate. Glyphosate at 12 oz/A applied alone provided almost complete quackgrass control (97%) 45 DAT. Quizalofop at 1.1 oz/A applied alone provided approximately 52% control of quackgrass regardless of evaluation date. The addition of quizalofop did not increase quackgrass control compared to glyphosate alone.

Plumeless thistle (*Carduus acanthoides*) and Canada thistle control in pasture and rangeland. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, 58105). Plumeless thistle is seldom found in cultivated fields even when there are infestations in nearby roadsides or pastures. Plumeless thistle tends to be shorter than other noxious biennial thistles; it typically is 2 to 4 feet tall but can be 6 feet or more in ideal growing conditions. The purpose of these experiments was to evaluate plumeless thistle control using various herbicides including imazapic, metsulfuron, and chlorsulfuron.

The experiments were established on a fallow field along the Sheyenne River near Fargo, ND on June 4, 1998. Plumeless thistle plants were beginning to bolt and were 18 to 24 inches tall. Treatments for both experiments were applied with a hand-held sprayer delivering 8.5 gpa at 35 psi. The experiments were in a randomized complete block design with three replications. The plots were 9 by 25 feet. Treatments were visually evaluated in July approximately 1 month after treatment for percent control or height reduction compared to the untreated control.

All plumeless thistle treatments provided rapid topgrowth control and prevented plants from flowering (Tables 1 and 2). Most treatments provided near 100% control 8 WAT (weeks after treatment). The most cost-effective treatment was 2,4-D at 1 lb/A applied alone which provided 97% or greater control. Although plumeless thistle has been increasing in North Dakota following several seasons of above or much above average precipitation, it is easily controlled by inexpensive herbicides. Previous research at North Dakota State University has shown that when treatments are not applied until after plumeless thistle has bolted, dicamba at 0.5 lb/A or picloram at 0.25 lb/A were required to prevent flowering.

Imazapic applied alone did not provide satisfactory control of plumeless thistle and averaged less than 50% even when applied at the maximum labeled use rate of 3 oz/A (Table 1). Plumeless thistle control improved when 2,4-D was applied with imazapic but was independent of application rate. For instance, control averaged 90% when imazapic plus 2,4-D was applied at 2 + 4 oz/A, but only 50% when the imazapic rate was increased to 3 oz/A. Clopyralid at 4 oz/A provided complete control of plumeless thistle.

Chlorsulfuron, clopyralid plus 2,4-D, and dicamba plus 2,4-D provided excellent plumeless thistle control (Table 2). Metsulfuron applied alone from 0.6 to 1.2 oz/A provided an average of 85% plumeless thistle control. Dicamba alone at 4 oz/A only averaged 30% plumeless thistle control, but control improved to 98% when dicamba was applied with 2,4-D.

Table 1. Plumeless thistle control with imazapic applied on June 4, 1998.

Treatment	Rate	Control July 1998
	oz/A	—— % ——
Imazapic + MSO[a]	2 + 1 qt	16
Imazapic + MSO[a]	3 + 1 qt	43
Imazapic + 2,4-D + MSO[a]	2 + 4 + 1 qt	90
Imazapic + 2,4-D + MSO[a]	3 + 4 + 1 qt	52
Imazapic + 2,4-D + MSO[a]	2 + 8 + 1 qt	75
Imazapic + 2,4-D + MSO[a]	3 + 8 + 1 qt	97
2,4-D	4	0
2,4-D	8	40
Clopyralid	4	100
LSD (0.05)		10

[a]Methylated seed oil was Scoil by AGSCO.

Table 2. Plumeless thistle control with chlorsulfuron and metsulfuron applied on June 4, 1998.

Treatment	Rate	Control July 1998
	oz/A	—— % ——
Chlorsulfuron + Silwet L-77[a]	0.75 + 0.25%	91
Chlorsulfuron + Silwett L-77[a]	1.5 + 0.25%	91
Chlorsulfuron + Silwett L-77[a]	2.25 + 0.25%	100
Clopyralid + 2,4-D + Silwett L-77[a]	4 + 24 + 0.25%	99
Metsulfuron + Silwett L-77[a]	0.6 + 0.25%	80
Metsulfuron + Silwett L-77[a]	1.2 + 0.25%	90
Dicamba + Silwett L-77[a]	4 + 0.25%	30
Metsulfuron + 2,4-D + dicamba + Silwett L-77[a]	0.6 + 16 + 4 + 0.25%	100
Metsulfuron + 2,4-D + dicamba + Silwett L-77[a]	1.2 + 16 + 4 + 0.25%	100
2,4-D + dicamba + Silwett L-77[a]	16 + 4 + 0.25%	98
LSD (0.05)		11

[a]Silicone surfactant.

Comparison of various formulations of 2,4-D applied alone or with clopyralid, sulfentrazone, or dikegulac for Canada thistle control. Rodney G. Lym and Katheryn M. Christianson. (Plant Sciences Department, North Dakota State University, Fargo, 58105). 2,4-D remains one of the most widely used herbicides for Canada thistle control in cropland due to its low cost and no soil residue limiting crop rotations. However, 2,4-D generally only provides short-term Canada thistle topgrowth control and does not reduce the original stand density. The purpose of this research was to evaluate various 2,4-D formulations applied alone or with other herbicides or a plant growth regulator for Canada thistle control in cropland.

The first experiment evaluated various ester and amine 2,4-D formulations applied in the spring or fall for Canada thistle control. The experiment was established on a dense stand of Canada thistle at the North Dakota State University Experiment Station at Fargo. The soil was Fargo silty clay with 3.5% organic matter and 7.8 pH. Herbicides were applied on May 29, 1997 when the plants were in the rosette to early bolting growth stage or on September 5, 1997, when the plants were in the rosette growth stage. The experimental area had been mowed 1 month prior to treatment. The treatments were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet arranged in a randomized complete block design with four replications. Treatments were visually evaluated for height reduction 1 WAT (week after treatment), stem reduction 3 WAT, and top growth control 3 MAT (months after treatment) compared to the untreated control. In general, Canada thistle height and stem reduction was similar regardless of the 2,4-D formulation (Table 1). All treatments provided approximately 70% or more stem reduction 3 WAT but only the treatment containing clopyralid gave Canada thistle control throughout the growing season. The area was flooded from frequent heavy rains in 1998 and could not be reevaluated.

The second experiment evaluated 2,4-D applied with clopyralid, sulfentrazone (an aryl triazinone herbicide), or the plant growth regulator dikegulac for Canada thistle control. The experiment was established on September 5, 1997 at the same location and evaluated as described for the first experiment. The area was also flooded the following spring and Canada thistle regrowth was variable and somewhat independent of the herbicide treatment. Clopyralid applied with 2,4-D mixed amine (2:1dimethylamine:diethanolamine) tended to provide better Canada thistle control then clopyralid applied alone or as the manufacturers premix (Table 2). Control was similar when sulfentrazone or dikegulac were applied with 2,4-D compared to 2,4-D applied alone.

In summary, Canada thistle control was similar regardless of the 2,4-D formulation applied and provided short-term control only when applied with clopyralid. Control tended to be better when clopyralid was applied with the mixed amine 2,4-D formulation compared the manufacturers pre-mix or 2,4-D acid.

Table 1. Comparison of various 2,4-D formulations for Canada thistle control.

Treatment/application timing	Rate	Height reduction 1 WAT[a]	Stem reduction 3 WAT[a]	Control 3 MAT[b]
	– lb/A –	————	%	————
Spring				
2,4-D ethylhexyl ester[c]	1	66	85	15
2,4-D dimethylamine[d]	1	54	75	12
2,4-D butoxyethyl ester[e]	1	59	83	11
2,4-D butoxyethyl ester[f]	1	41	75	8
2,4-D mixed amine[g]	1	53	71	15
Clopyralid + 2,4-D[h]	1	57	88	51
LSD (0.05)		14	11	22
Fall				
2,4-D ethylhexyl ester[c]	1	56	68	
2,4-D dimethylamine[d]	1	63	66	
2,4-D butoxyethyl ester[e]	1	59	70	
2,4-D butoxyethyl ester[f]	1	68	69	
2,4-D mixed amine[g]	1	57	75	
Clopyralid + 2,4-D[h]	0.18 + 1	79	86	
LSD (0.05)		NS	NS	

[a] Weeks after treatment.
[b] Months after treatment.
[c] Riverside ester - Terra
[d] Riverside amine - Terra
[e] Phenoxy 088 - Terra.
[f] Weedone 638 - Rhone-Poulenc.
[g] 2:1 dimethylamine:diethanolamine - Hi-Dep - PBI-Gordon.
[h] Commercial formulation - Curtail.

Table 2. Evaluation of 2,4-D applied in the fall with clopyralid and plant growth regulators for Canada thistle control.

Treatment	Rate	9 MAT[a]
	lb/A	— % control —
2,4-D[b]	1	78
2,4-D[b] + clopyralid	1 + 0.19	92
Clopyralid	0.375	71
Clopyralid + 2,4-D[c]	0.19 + 1	78
2,4-D[b] + clopyralid + 2,4-D[c]	1 + 0.05 + 0.25	89
2,4-D acid + clopyralid (NB206546)	0.5 + 0.05	63
2,4-D + sulfentrazone (NB20663)	0.25 + 0.015	23
2,4-D acid (NB20652)	1	72
2,4-D + dikegulac (NB20830)	1 + 0.25	62
Clopyralid	0.19	69
LSD (0.05)		40

[a] Months after treatment
[b] Mixed amine salts (2:1dimethylamine:diethanolamine) - Hi-Dep.
[c] Commercial formulation - Curtail.

Picloram plus 2,4-D applied annually for 13 years to control leafy spurge. Rodney G. Lym and Calvin G. Messersmith. Picloram is an effective herbicide for leafy spurge control, especially when applied at rates from 1 to 2 lb/A. However, the high cost of picloram at 1 to 2 lb/A makes it uneconomical to treat large acreages in pasture and rangeland weed control programs. Research by North Dakota State University has suggested that picloram at 0.25 to 0.5 lb/A applied annually will give satisfactory leafy spurge control after 3 to 5 yr. The purposes of this experiment were to establish the number of annual applications of picloram needed to provide 90 to 100% control of leafy spurge and to investigate possible synergism between picloram and 2,4-D.

The experiment was established at three locations in North Dakota and began on August 25, 1981 at Dickinson, September 1, 1982 at Sheldon, and on June 11, 1982 at Valley City. Dickinson had a loamy fine sand soil with pH 6.6 and 3.6% organic matter, Sheldon had a fine sandy loam with pH 7.7 and 2.1% organic matter, and Valley City had a loam with pH 6.7 and 9.4% organic matter. Dickinson, located in western North Dakota, generally receives much less precipitation than the other two sites located in eastern North Dakota. All treatments were applied annually except 2,4-D alone which was applied biannually (both spring and fall). Picloram and picloram plus 2,4-D were applied in late August 1981 and in June of 1982 through 1986. The Sheldon and Dickinson locations were discontinued following the fall evaluations in 1985 and spring evaluations in 1989, respectively. The Valley City site has received ten picloram and picloram plus 2,4-D treatments and 20 2,4-D treatments prior to the evaluation in June 1992. The plots were 10 by 30 ft and each treatment was replicated four times in a randomized complete block design. Evaluations were a visual estimate of percent stand reduction as compared to the control.

Leafy spurge control averaged 79% across all treatments 48 MAFT (months after first treatment) and declined slightly to 71% following the 1988 drought (60 and 72 MAFT) before increasing to 87% in 1990 (84 MAFT) (Table). Leafy spurge control 96 MAFT (June 1991) increased by an average of 24, 12, and 9% when 2,4-D at 1 to 2 lb/A was applied with picloram at 0.25, 0.38 or 0.5 lb/A, respectively, as compared to picloram alone. However, by 108 MAFT (June 1992) only control with picloram at 0.25 lb/A was increased by 2,4-D and averaged 68 and 85%, respectively. In general, the 2,4-D rate did not influence control when applied with picloram. Leafy spurge control averaged 80% with 2,4-D alone following 10 yr of biannual treatments.

Picloram at 0.5 lb/A alone and all picloram at 0.38 or 0.5 lb/A plus 2,4-D treatments provided or nearly provided the target of 90% leafy spurge control following four annual applications (Table). Control did not increase or increased only slightly with subsequent retreatments in these small plot experiments which have a constant pressure for reinfestation from plants in the plot borders. Since control had not or only slightly changed since 1987, the retreatments were discontinued after 1995. The only leafy spurge topgrowth observed in 1995 was in the control plots and from encroachment from plot borders.

To evaluate the longevity of control after the annual and biannual treatments had been discontinued, picloram at 2 lb/A was applied to the control plots and all borders in

September 1995. Leafy spurge control averaged over 97% in June 1996 12 months after the treatments had been discontinued (data not shown). However, by September control had declined to an average of 51% in the 2,4-D only plots. Thus, even after 13 yr of biannual treatments of 2,4-D, leafy spurge regrew rapidly the year after treatments had been discontinued. Leafy spurge control from the 2,4-D only treatments began to decline rapidly in 1997, 2 yr after treatments were stopped and averaged 73 and 40%, in June and August 1997, respectively (data not shown). By August 1998, leafy spurge control from the 2,4-D only treatments had declined to less than 30% (Table). In contrast, the average control for picloram at 0.25, 0.38 or 0.5 lb/A applied with 2,4-D averaged 91, 98, and 99%, respectively, in August 1997 (data not shown) and 68, 89, and 94% in August 1998 (Table). Long-term control has only slightly declined with any treatment that contained picloram at 0.5 lb/A 3 yr following the last application.

Table. Leafy spurge control with annual picloram or picloram plus 2,4-D treatments and biannual 2,4-D treatments from 1982 to 1995 in North Dakota.

		1998		Months after first treatment										
Herbicide	Rate	June	Aug	12	24	36	48	60	72	84	96	108	120
	— lb/A—	% control[a]											
Picloram	0.25	88	87	39	48	48	58	49	38	64	56	68	96
Picloram	0.38	93	90	65	62	52	77	69	67	96	72	91	99
Picloram	0.5	95	88	65	71	81	86	77	71	92	81	91	99
2,4-D biannually	1	37	26	22	30	38	50	39	55	70	69	74	82
2,4-D biannually	1.5	23	18	22	24	26	45	49	49	62	57	66	74
2,4-D biannually	2	36	29	19	30	26	54	54	62	75	67	78	83
Picloram+2,4-D	0.25+1	75	66	52	66	63	85	73	76	92	80	85	95
Picloram+2,4-D	0.25+1.5	84	68	58	66	70	85	77	62	88	73	82	99
Picloram+2,4-D	0.25+2	88	68	57	62	66	83	76	77	91	88	88	99
Picloram+2,4-D	0.38+1	94	87	69	72	70	90	84	76	96	82	89	97
Picloram+2,4-D	0.38+1.5	93	83	68	74	76	93	84	79	88	83	92	99
Picloram+2,4-D	0.38+2	98	96	68	59	76	91	86	82	96	86	95	99
Picloram+2,4-D	0.5+1	98	92	71	75	84	94	87	82	96	84	97	99
Picloram+2,4-D	0.5+1.5	99	98	64	73	80	97	91	88	99	95	98	99
Picloram+2,4-D	0.5+2	98	93	76	75	81	95	91	88	99	90	96	99
LSD (0.05)		26	29	18	14	19	14	14	15	19	17	14	10
Mean of treatments		93	73	52	55	63	79	72	70	87	78	86	94

[a]Mean values through 48 and 72 months after first treatment include data from the Sheldon and Dickinson locations which were discontinued after 1985 and 1989, respectively.

Leafy spurge control with *Aphthona nigriscutis* alone or combined with herbicides. Rodney G. Lym, Don A. Mundal, and Robert B. Carlson. An experiment to evaluate the effect of herbicide application timing on biocontrol insect population and leafy spurge control was established on a private farm near Cuba, North Dakota. Approximately 500 *Aphthona nigriscutis* were released in July 1989 in a moderately dense patch of leafy spurge. The insects established and began to spread to other patches of leafy spurge within the pasture prior to the beginning of this experiment.

The experiment was established in two patches of leafy spurge approximately 5000 square feet each and about 100 yards apart. The treatments included picloram plus 2,4-D at 0.5 plus 1 lb/A fall applied, picloram plus 2,4-D at 0.25 plus 1 lb/A spring applied, and an untreated control. Herbicides were applied annually beginning with the initial spring treatment on June 5, 1992, and the first fall treatment on September 10, 1992. Herbicides were reapplied at similar dates from 1993 to 1995. The plots were 15 by 50 feet, and treatments were replicated four times (two per patch). *A. nigriscutis* population was evaluated by sweep counts with a standard insect collection net and are reported as a mean of three square meters (five sweeps equals 1 m^2).

Leafy spurge stem density declined rapidly when herbicides were fall applied to plants infested with *A. nigriscutis* (Table 1). The leafy spurge stand declined from 164 stems/m^2 in 1992 to 12 stems/m^2 the following year. Leafy spurge gradually declined with the insect alone treatment from 188 stems/m^2 in June 1992 to 6 stems/m^2 by May 1995. Both the insect alone and fall-applied herbicide plus insect treatments provided more rapid leafy spurge stem reduction than the spring-applied herbicides plus insects treatment. Herbicides applied in June prevent the adult flea beetles from feeding on those plants, and thus probably reduce egg laying and subsequent larvae feeding.

Leafy spurge stem density recovered more rapidly from the insect alone treatment than from either herbicide plus insect treatment (Tables 1 and 2). For example, leafy spurge control averaged 73% with the insect alone treatment in May 1995, but declined rapidly once the adult flea beetles emerged (i.e., larvae that had fed on roots pupated and then emerged) and only averaged 47 and 31% control in July and September 1995, respectively (Table 2). Leafy spurge control with the fall-applied herbicide plus insect treatment averaged slightly over 80% in May and July 1995 before declining to 60% in September.

Leafy spurge stem density was lower in 1996 than 1995 regardless of treatment, but the combination treatment of insects plus herbicides provided better control then the insects alone (Table 1). Leafy spurge control remained high in 1996 and declined only slightly from the June to September evaluation dates compared to the same time in 1995. Control averaged 91% in September 1996 with the two combination treatments compared to 79% control with the insects alone (Table 2). Since herbicide application was stopped after 1995, the decline is due to the insects alone. Control was similar regardless of treatment and averaged 11 stems/m^2 1997, 2 yr after the last herbicide application (Table 1). Stem density continued to decline in 1998 and averaged 3.5 stems/m^2 regardless of treatment.

The *A. nigriscutis* population gradually increased over time and generally reached peak numbers in the first week of July each year (Table 3). Beetle population gradually increased from 1993 to 1996 and averaged 90 adults/m^2 in 1997 and 1998 regardless of treatment. Flea beetle population began to decline in 1997 as the leafy spurge density decreased (Tables 1 and 3). There was an average of only 23 beetles/m^2 in 1998 regardless of the initial treatment. Thus, 9 yr after the initial release flea beetles, the population appeared to be in equilibrium with the leafy spurge population. It took 4 yr less for this equilibrium to be reached when herbicides were used in conjunction with the biocontrol agents compared to the insects alone.

Table 1. Leafy spurge stem density after treatment with *Aphthona nigriscutis* alone or combined with herbicide treatments near Cuba, ND.

		Stem density/evaluation date									
Treatment[a]	Rate	June 1992	May 1993	May 1994	Sept 1994	May 1995	Sept 1995	June 1996	Sept 1996	June 1997	June 1998
	lb/A	No./m^2									
Picloram + 2,4-D (Spring)	0.25+1	220	208	136	76	16	40	24	8	12	4
Picloram + 2,4-D (Fall)	0.5+1	164	12	12	92	0.5	52	0.5	12	12	3
Insect only	. .	188	152	100	120	6	68	12	36	8	4
LSD (0.05)		28	28	20	20	8	12	8	8	NS	NS

[a]Herbicides annually applied in June or September from 1992 to 1995.

Table 2. Leafy spurge control after treatment with *Aphthona nigriscutis* alone or combined with herbicides.

Treatment[a]	Rate	May 1993	May 1994	May 1995	July 1995	Sept 1995	June 1996	Sept 1996	June 1997
		Visible control							
	- lb/A-	%							
Picloram + 2,4-D (Spring)	0.25+1	6	35	91	60	73	88	93	90
Picloram + 2,4-D (Fall)	0.5+1	93	94	81	84	60	99	90	93
Insect only	. .	19	45	73	47	31	90	79	86
LSD (0.05)		11	10	NS	35	23	11[b]	7	NS

[a]Herbicides applied in June or September annually from 1992 to 1995.
[b]LSD = (0.10).

Table 3. Effect of herbicide application on *Aphthona nigriscutis* population 3 yr after the biocontrol insect had established.

Treatment[a]	Rate	1992	1993	1994	1995	1996	1997	1998
		A. nigriscutis counts[b]/year						
	lb/A	no./m^2						
Picloram + 2,4-D (Spring)	0.25+1	1	0	19	76	25	12	17
Picloram + 2,4-D (Fall)	0.5+1	21	52	40	30	18	8	26
Insects only	. .	12	28	132	70	96	23	27
LSD (0.05)		5	16	63	26	29	6	NS

[a]Herbicides annually applied in June or September from 1992 through 1995.
[b]Highest number collected during sampling from June through September.

Biological control of purple loosestrife in North Dakota. Jeffrey A. Nelson, Rodney G. Lym, and Katheryn M. Christianson. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Purple loosestrife was added to the North Dakota Noxious Weed List in 1996. Purple loosestrife is found in 11 North Dakota counties with the largest infestations in urban areas. Biological control of purple loosestrife fits well in urban areas considering public apprehension of herbicides sprayed in close proximity to residential areas. Three species of purple loosestrife biological agents were introduced in North Dakota in 1997 and 1998. The objective of this research was to evaluate purple loosestrife control with biological agents.

Experiments were established along a water way at Sertoma Park (park site) and along a walking trial (channel site) in Grand Forks, North Dakota. Approximately 5,000 leaf beetle adults, *Galerucella calmariensis* and *G. pusilla*, were released at a single release point at both locations in June 1997. *Galerucella* spp. overwinter as adults and begin to lay eggs soon after emergence. The number of *Galerucella* spp. adults and egg masses, and purple loosestrife stems, plant height, and spike length were recorded at 50 foot increments from and including the release point. A second experiment was established at Sertoma Park to evaluate the effect of *Hylobius transversevittatus* on purple loosestrife in July 1997. Approximately 1,000 *H. transversevittatus* eggs were placed into cut purple loosestrife stems or on the roots. This biological agent is nocturnal so evaluations of population density were not conducted. However, the effect of *H. transversevittatus* on purple loosestrife was evaluated by estimating stem density, plant height, and spike length in four square meter quadrats within the experiment.

Galerucella spp. successfully established at both the channel and park sites (*Table 1*). Adults and egg masses were observed on purple loosestrife plants at both sites on June 11, 1998. Egg masses were removed and introduced into an artificial enclosure with purple loosestrife plants to evaluate egg viability. Eggs hatched, larvae increased in size, pupated, and emerged as adults within the enclosure confirming *Galerucella* spp. life cycle could be completed in North Dakota. Few adult *Galerucella* spp. were observed in the field at either the channel or park locations. The reason few adults were observed in the field is unknown; however, adults will drop from foliage when disturbed and readily disperse from the experiment location so the population density may have been underestimated. Changes in purple loosestrife stem density and percent cover between 1997 and 1998 were likely due to natural fluctuations in plant population. To date, the density of *Galerucella* spp. is not high enough to significantly impact purple loosestrife.

Purple loosestrife stems that had been infested with *H. transversevittatus* eggs were harvested in September 1997 and dissected to determine egg viability and larval feeding. Over 50% of the harvested stems contained *H. transversevittatus* larvae. Larvae were allowed to feed but failed to develop into adults under artificial conditions. There was little reduction in stem density, stem height, and spike length from the *H. transversevittatus* release site the first year following release (*Table 2*). However, numerous purple loosestrife plants appeared stunted and flowered later than plants outside the release area. Delayed flowering maybe an indication of *H. transversevittatus* larval feeding.

North Dakota State University initiated an outreach program for biological control of purple loosestrife in 1998. An implementation grant from the National Biological Control Institute provided funds to release *G. calmariensis* and *G. pusilla* at locations in Minot and Valley City, North Dakota. These locations will be used for demonstration and field tours in the summer of 1999.

Table 1. Purple loosestrife control with *Galerucella* spp. released in 1997 at two locations in Grand Forks, ND.

	Purple loosestrife						*Galerucella* spp.	
	Stem		Stem height		Cover			
Treatment[1]	1997	1998	1997	1998	1997	1998	Adult	Egg masses
Channel site	No./m²		m		%		No./m²	
Release	25	60	1.3	1.7	100	75	0	12
50 ft	10	8	1.3	1.7	33	18	0	2
100 ft	15	26	1.2	1.8	38	34	0	1
150 ft	12	0	1.2	0	10	0	0	0
Park site								
Release	19	10	1.5	1.1	60	25	2	21
50 ft	27	19	1.3	1.1	45	19	0	3
100 ft	20	13	1.3	1.1	33	28	0	0
150 ft	17	16	1.3	1.3	55	15	0	1

[1]Estimates of purple loosestrife control and *Galerucella* spp. population were made on July 17, 1997 and July 16, 1998.

Table 2. Purple loosestrife control with *Hylobius transversovittatus* introduced as eggs in 1997 in Grand Forks, ND.

Stem		Flower stem		Stem height		Spike length	
1997	1998	1997	1998	1997	1998	1997	1998
No./m²				m			
85	24	25	24	1.9	1.5	0.6	0.4

Evaluation of diflufenzopyr applied with various herbicides for milkweed control. Rodney G. Lym. Milkweed has been increasing in recent years on both pasture and rangeland and crop land. While milkweed is a native species, it is sometimes desirable to control this plant. The purpose of this research was to evaluate various herbicides applied with diflufenzopyr for milkweed control.

Herbicides were applied on August 13, 1997 when milkweed was in the seed-set growth stage and 3 to 5 feet tall growing in rangeland. The plots were 10 by 50 feet and treatments were replicated twice. Herbicides were applied with a hand-boom sprayer delivering 8.5 gpa at 35 psi. The air temperature was 75 F with a dew point of 59 F and the sky was clear. Milkweed control was visually evaluated in June and September 1998 and is based on percent stand reduction compared to the untreated control.

Treatment	Rate	Control	
		June	Sept.
	——— oz/A ———	— % —	
Dicamba + diflufenzopyr + X-77 + 28%N	8 + 3.2 + 1.25%	63	15
Dicamba + X-77 + 28%N	8 + 0.25% + 1.25%	40	20
Picloram + 2,4-D + diflufenzopyr + X-77 + 28%N	4 + 8 + 1.6 + 0.25% + 1.25%	85	25
Picloram + 2,4-D + X-77 + 28%N	4 + 8 + 0.25% + 1.25%	55	18
Quinclorac + diflufenzopyr + X-77 + 28%N	8 + 3.2 + 0.25% + 1.25%	65	5
Quinclorac + X-77 + 28%N	8 + 0.25% 1.25%	50	0
Imazapyr + X-77 + 28%N	2 + 0.25% + 1.25%	85	23
Imazapic + X-77 + 28%N	2 + 0.25% + 1.25%	23	0
LSD (0.05)		NS	NS

Control varied greatly between treatments and replications. No statistically significant differences occurred between treatments even though the means ranged from 85 to 23% control. However, control was always evaluated higher when diflufenzopyr was applied with an auxin herbicide compared to the herbicide applied alone in June. Also, imazapyr tended to provided better milkweed control than imazapic. No treatment provided milkweed control 12 months after treatment.

Milkweed Control. Zollinger and Fitterer. An experiment was conducted at Buxton, ND to evaluate milkweed control from POST applied herbicides. MPOST treatments were applied to 1-14"(bud), (1-15/yd2), common milkweed on June 10, 1998 10:15 am with 64 F air, 68 F soil, 62% RH, 4-9 mph S wind, 100% clouds, dry soil surface, moist subsoil, milkweed vigor was excellent, and there was no dew present at the time of application. Late POST treatments were applied to 1-14", (bud), (1-15/yd2), common milkweed in which the growing point was dead on June 25, 1998 at 1:00 pm with 72 F air, 74 F soil surface, 70% RH, 3-5 mph SW wind, 70% clouds, wet soil surface, wet subsoil, and there was no dew present at the time of application. Treatments were applied to the center eight feet of the 10 by 40 ft plots with a bicycle wheel type sprayer equipped with drift cones delivering 8.5 gpa at 40psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatment	Rate	Common milkweed		
		June 25	July 6	Aug 5
	pr/A		%	
Prebud				
Roundup Ultra+AMS	3qt+17lb	75	77	58
Touchdown+NIS+AMS	2.4qt+0.25%+17lb	75	80	65
Distinct+NIS+UAN 28%	8oz+0.25%+1qt	40	55	62
Starane	0.67oz	10	15	13
Starane	1.33oz	22	20	23
Distinct+Starane+NIS+UAN 28%	6oz+0.67pt+0.25%+1qt	42	50	58
Distinct+Starane+NIS+UAN 28%	6oz+1.33pt+0.25%+1qt	50	58	62
Distinct+NIS+UAN 28%	6oz+0.25%+1qt	42	48	48
Prebud fb 10 DAA				
Distinct+NIS+UAN 28%/Distinct+NIS+UAN 28%	4oz+0.25%+1qt/4oz+0.25%+1qt	32	47	78
Distinct+NIS+UAN 28%/Distinct+NIS+UAN 28%	3oz+0.25%+1qt/3oz+0.25%+1qt	33	48	67
LSD (0.05)		13	9	8

Distinct contains dicamba plus diflufenzopyr (synergist or auxin transport inhibitor). Distinct and Starane has shown to improve control of perennial weed other than milkweed. Research objectives were to evaluate milkweed control from Distinct and Starane. Prebud treatments containing Distinct and Starane provided poor milkweed control but Roundup and Touchdown gave fair to good milkweed control at June 25 and July 6 evaluations. At August 5, no single Distinct treatment gave greater than 62% control. Distinct applied twice gave greater milkweed control than any single treatments or when compared to the single treatment at the equivalent amount of product per acre. All treatments prevented additional milkweed shoots from emerging during the entire growing season. Treatments will be evaluated in the spring of 1999 for control.

Canada thistle control, Carrington, 1998. (Endres) The trial was conducted to evaluate Canada thistle with selected POST herbicides. Treatments were applied September 15, 1997 with 59 F, 66% RH, 0% clouds, and 14-mph wind with a hand-boom sprayer delivering 8.5 gal/A at 40 psi through 8001 flat fan nozzles to 1- to 12-inch tall Canada thistle rosettes. Treatments were applied to a 6.67 ft wide area the length of 10 by 20 ft plots. Weed density was moderate and variable. The experiment was a randomized complete block design with three replications.

Herbicide		Canada thistle control	
Treatment	Rate	6/16	8/17
	product/A	------ % -----	
2,4-Da + Roundup Ultra + AMS	1.25 pt + 1 pt + 5% v/v	41	72
Fallowmaster	44 fl oz	27	19
Roundup Ultra + AMS	2 pt + 5% v/v	69	71
Curtail	4 pt	78	79
Harmony Extra + 2,4-Da + Banvel + NIS	0.5 oz + 0.5 pt + 3 fl oz + 1 pt	19	0
LSD (0.05)		NS	24

Canada thistle control ranged from 71 to 79% with 2,4-Da + Roundup Ultra + AMS, Roundup Ultra + AMS, and Curtail eleven months after application. Fallowmaster and Harmony Extra + 2,4-Da + Banvel + NIS treatments were not effective.

Canada thistle and perennial sowthistle control, Cathay, 1998. (Endres) The trial was conducted to evaluate Canada thistle and perennial sowthistle control with selected POST herbicides. Treatments were applied September 26, 1997 with 78 F, 44% RH, 80% clouds, and 6-mph wind with a hooded bicycle-wheel-type plot sprayer delivering 11.5 gal/A at 40 psi through 8001 flat fan nozzles to 1- to 12-inch tall Canada thistle and 2- to 12-inch wide perennial sowthistle rosettes. Treatments were applied to a 6.67 ft wide area the length of 10 by 30 ft plots. Weed density was moderate to high and variable. The experiment was a randomized complete block design with three replications.

Herbicide		Weed control			
		Canada thistle		Perennial sowthistle	
Treatment	Rate	7/19	9/3	7/19	9/3
	product/A	%			
Banvel	2 pt	77	74	82	79
Fallowmaster	44 fl oz	88	84	73	74
Curtail	2 pt	74	68	66	62
Distinct + NIS + UAN	0.5 oz + 0.25% v/v + 4 pt	13	48	52	47
Facet + MSO + UAN	0.67 oz + 1 pt + 4 pt	23	22	21	13
LSD (0.05)		42	37	NS	40

Canada thistle and perennial sowthistle control ranged from 62 to 84% with Banvel, Fallowmaster, and Curtail about one year after application. Distinct and Facet treatments were poor (13-48%).