

1999
**Dry Bean
Grower Survey**

*of Pest Problems and Pesticide Use
in Minnesota and North Dakota*



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This is the twelfth annual survey of pest problems, pesticide use and grower practices of the Northharvest Bean Growers Association, an association of dry bean growers in Minnesota and North Dakota. Results of previous surveys dated 1987-1998 have been published (1,2,3,4,5,6,7,8,9,10,12). There was no survey in 1993.

The survey form (Figure 1, pages 3-4) was developed by research and extension faculty at North Dakota State University and the University of Minnesota and the directors of the Northharvest Bean Growers Association. The survey was completed by attendees at the Northharvest Bean Day in Fargo, ND on January 21, 2000. This was the third time that a survey was conducted at Bean Day. Surveys in previous years were mailed to all Northharvest growers. The surveys were anonymous.

Throughout this report, trade names of chemicals are often presented as an aid to clearer communication. Mention of trade names does not constitute endorsement or recommendation by NDSU or Northharvest Bean Growers.

Frequent comparisons are made in this report between the 1999 survey and the 1998 survey. Weather conditions varied between these years; June rainfall in 1999, although above normal, was less than in 1998. July rainfall was less than normal and less than in 1998. August and September rainfall was more than 50% above normal, and both months were higher than in 1998, especially September rainfall. September temperatures were below normal and both August and September temperatures were below the 1998 averages. The 1998 survey is listed in the references (10) and will not be referenced specifically each time it is mentioned in the text.

Figure 1. Survey form.

Please circle or fill in the requested information on pest problems and pesticide use on your 1999 dry bean crop.

Total acres planted in 1999		
Irrigated acres		Dryland acres
Total acres harvested		
Acres with hail damage		
Acres with water damage		
State	County	Acres
Minnesota		
North Dakota		
South Dakota		
DRY BEANS GROWN IN 1999		
Class	Variety	Acres
Pinto		
	1 Burke	
	2 Buster	
	3 Chase	
	4 Elizabeth	
	5 GTS 900	
	6 Maverick	
	7 Remington	
	8 Topaz	
	9 Winchester	
	10 Other Pinto (specify)	
Navy		
	21 Mayflower	
	22 Navigator	
	23 Norstar	
	24 Schooner	
	25 Vista	
	26 Other Navy (specify)	
Kidney		
	41 Montcalm (DRK)	
	42 Other Kidney (specify)	
Black		
	61 Onyx	
	62 Shadow	
	63 T-39	
	64 UI-911	
	65 Other Black (specify)	
Pink		
	81 (specify)	
Other		
	91 (specify class & variety)	
Seed source		
Seed source	Acres planted	
Western Grown		
Northharvest Grown (ND/MN)		
Bin run		
Biggest Production Problem in Dry Beans in 1999 (circle one)		
	Acres Affected	Bean Class
1 Applied herbicide injury		
2 Herbicide drift injury		
3 Delayed planting		
4 Emergence/stand		
Biggest Production Problem (continued from previous column)		

	Acres Affected	Bean Class	
5 Harvest			
6 Disease			
7 Insects			
8 Micronutrient deficiency			
9 Weeds			
10 None			
11 Other (specify)			
Insecticides Used on Dry Beans in 1999			
Insecticide	No. Acres Treated	No. of Sprays	
Lindane Seed Treatment	Yes No	Acres	
Lorsban Seed Treatment	Yes No	Acres	
Worst Insect/Mite Problem in 1999 (Rank 1-3; 1=worst)			
	Grasshoppers		
	Leafhoppers		
	Spider Mites		
	Seed Corn Maggot		
Crop Rotation (fields with dry beans in 1999) (crops in previous years)			
	Field #1 dry beans '99	Field #2 dry beans '99	Field #3
1998			
1997			
1996			
1995			
Micronutrient Use			
Acres treated with zinc		No. of sprays	
Other micronutrients		No. of sprays	
Worst Weed Problems in Dry Beans in 1999 (Rank 1-3; 1=worst)			
	Cocklebur	Ragweed	
	Nightshade	Lambsquarters	
	Foxtail (pigeon grass)	Redroot pigweed	
	Kochia	Biennial wormwood	
	Canada thistle	Wild oat	
	Volunteer grain	Other (specify)	
Non-Chemical Weed Management (double-pass counts as double acres)			
Practice	Acres treated	No. of passes	
Cultivation			
Rotary hoe/harrow			
No herbicide			
Worst Disease Problems in 1999 (Rank 1-3; 1=worst)			
	Alternaria		
	Bacterial Blight		
	Root Rot		
	Rust		
	White Mold		
	None		

Kidney beans were planted on 39% of Minnesota respondents' acres, navy beans on 31%, pinto beans on 14%, pink beans on 7% and black beans on 7%. Pinto beans were planted on 60% of North Dakota respondents' acres, navy beans on 30%, and black beans on 7%. The percentage of Minnesota respondents' acres planted to kidney beans was slightly less in 1999 than in 1998 and the percentage of navy beans planted increased from 22% in 1998 to 31% in 1999. The percentage of North Dakota respondents' acres planted to navy beans increased in 1999 (30% compared to 17% in 1998) and the percentage of acres planted to black beans decreased, from 17% in 1998 to 7% in 1999 (Table 4).

Varieties Grown

Maverick pinto was the most commonly grown dry bean variety, planted on 25% of Northharvest respondents' acres (Table 5). Norstar navy was the second most commonly grown dry bean variety, planted on 11% of Northharvest respondents' acres, followed by Montcalm dark red kidney on 9% of their acres, Winchester pinto on 4%, T-39 black on 4%, and Vista navy on 4%. In 1998, Maverick pinto also was the most commonly grown dry bean variety, followed by Montcalm dark red kidney. A major reduction in planted navy bean acres in 1998 may have affected these changes.

Maverick was the most commonly grown pinto variety, planted on 54% of Minnesota, 56% of North Dakota and 56% of Northharvest respondents' pinto acres. This is a significant increase over 1998, especially in Minnesota where Maverick acres doubled. Topaz was the second most commonly grown pinto variety, planted on 15% of Minnesota, 5% of North Dakota and 6% of Northharvest respondents' pinto acres (Table 6). These numbers show a dramatic switch from 1997, when Othello was the most commonly planted pinto in North Dakota. Almost no pinto acres were planted to varieties resistant to the common races of rust in 1996. The varieties Chase, Frontier, Maverick, Remington and Winchester accounted for 81% of Northharvest pinto acres in 1999; these varieties are resistant to current rust races.

Norstar was the leading navy variety, planted on 52% of Minnesota, 30% of North Dakota and 37% of Northharvest respondents' navy acres. Vista was the second most commonly planted navy, planted on 6% of Minnesota, 15% of North Dakota and 12% of Northharvest respondents' acres, followed by Mayflower, planted on <1% of Minnesota, 17% of North Dakota and 12% of Northharvest respondents' acres (Table 6). Norstar also was the leading navy variety in 1997 and 1998.

Table 5. Varieties grown in 1999 by Northharvest respondents in Minnesota and North Dakota.

Variety	Class ^b	Acres Planted ^a					
		MN	%	ND	%	Northharvest	%
Bill Z	P	0	0	1,480	1.9	1,480	1.3
Chase	P	185	0.5	3,050	3.8	3,235	2.8
Frontier	P	0	0	1,940	2.4	1,940	1.7
Maverick	P	2,859	7.6	26,860	33.6	29,719	25.3
Othello	P	75	0.2	1,185	1.5	1,260	1.1
Remington	P	90	0.2	3,030	3.8	3,120	2.7
Topaz	P	805	2.2	2,560	3.2	3,365	2.9
Winchester	P	345	0.9	4,272	5.3	4,617	3.9
Other Pinto	P	856	2.3	2,495	3.1	3,351	2.9
Envoy	N	970	2.6	651	0.8	1,621	1.4
Mayflower	N	35	0.1	4,110	5.1	4,145	3.5
Navigator	N	785	2.1	2,595	3.5	3,380	2.9
Norstar	N	6,050	16.2	7,205	9.0	13,255	11.3
Rogers 331	N	121	0.3	1,306	1.6	1,427	1.2
Schooner	N	960	2.6	1,365	1.7	2,325	2.0
Upland	N	655	1.8	765	1.0	1,420	1.2
Vista	N	675	1.8	3,610	4.5	4,285	3.7
Other Navy	N	1,196	3.2	2,123	2.7	3,319	2.8
Lt. Red Kidney	K	3,968	10.6	0	0	3,968	3.4
Montcalm	K	10,200	27.3	581	0.7	10,781	9.2
Shadow	B	0	0	1,880	2.4	1,880	1.6
T-39	B	1,350	3.6	3,105	3.9	4,455	3.8
Other Black	B	1,085	2.9	304	0.4	1,389	1.2
Pink	PK	2,730	7.3	650	0.8	3,380	2.9
Other	—	560	1.5	1,137	1.4	1,697	1.4

^a Includes varieties planted on more than 1% of respondents total acres.

^b P = pinto; N = navy; K = kidney; B = black; PK = pink

Montcalm dark red kidney continued to be the leading kidney variety, planted on 69% of Minnesota, 100% of North Dakota's very few kidney acres and 70% of Northharvest respondents' kidney acres (Table 6).

T-39 was the leading black variety, planted on 55% of Minnesota, 53% of North Dakota and 54% of Northharvest respondents' black acres, followed by Shadow, planted on none of Minnesota, 32% of North Dakota and 23% of Northharvest respondents' black acres (Table 6).

Production Problems

Harvest was reported as the worst production problem for 15% of Minnesota respondents on 11% of their acres, 12% of North Dakota respondents on 22% of their acres and 12% of Northharvest respondents on 19% of their acres. Weeds were the worst production problem for 22% of Minnesota respondents on 19% of their acres, 20% of North Dakota respondents on 16% of their acres and 19% of Northharvest respondents on 17% of their acres. Weather was the worst production problem for 19% of Minnesota respondents on 24% of their acres, 17% of North Dakota respondents on 14% of their acres, and 16% of Northharvest respondents on 17% of their acres. These values represent a slight reduction in weather-related problems from 1998 and a major reduction from 1997.

Delayed planting was the worst production problem for 12% of Minnesota respondents on 9% of their acres, 29% of North Dakota respondents on 20% of their acres and 21% of Northharvest respondents on 17% of their acres. Disease was the worst production problem for 16% of

Table 6: Leading varieties of dry bean, by market class, grown in Minnesota and North Dakota in 1999.

Class/Variety ^a	% of Respondents' Acres ^b		
	Minnesota	North Dakota	Northharvest
Pinto			
Maverick	53.7	56.4	56.1
Topaz	15.1	5.4	6.4
Navy			
Norstar	52.0	29.9	37.1
Vista	5.8	15.0	12.0
Mayflower	0.3	17.0	11.6
Kidney			
Montcalm (DRK)	69.3	100.0	70.4
Light Red Kidney	27.0	0	25.9
Black			
T-39	55.4	53.2	53.8
Shadow	0	32.2	22.7

^a Varieties grown on more than 10% of respondents' acres, for that class, in at least one state.

^b % of respondents' acres planted to that class of bean.

Minnesota respondents on 21% of their acres, 8% of North Dakota respondents on 6% of their acres and 10% of Northharvest respondents on 11% of their acres (Table 7). This is the lowest ranking for disease in many years.

Overall, weather was the worst production problem for Minnesota respondents, followed by disease, weeds and harvest. In contrast, harvest was the worst production problem for North Dakota respondents, followed by delayed planting, weeds and weather.

Weed Problems

Nightshade was the worst weed problem for 26% of Northharvest respondents on 28% of the acres reported (Table 8). These percentages are down slightly from 1998, but up considerably from 1997 and 1996. The nightshade problem has increased dramatically in recent years due to wetter weather, high seed production and dissemination, multiple flushes, and lack of control in row crops.

Table 7. Worst Production Problem in 1999 for respondents in Minnesota and North Dakota.

Worst Production Problem Reported	— Respondents —		— Acres Reported ^a —	
	Number	%	Number	%
Minnesota				
Weather	13	19.4	9,069	24.2
Disease	11	16.4	7,820	20.9
Weeds	15	22.4	7,165	19.2
Harvest	10	14.9	4,233	11.3
Delayed Planting	8	11.9	3,185	8.5
Insects	4	6.0	1,602	4.3
Emergence/Stand	3	4.5	850	2.3
Herbicide Injury	3	4.5	780	2.1
North Dakota				
Harvest	15	12.3	17,823	22.3
Delayed Planting	35	28.7	16,291	20.4
Weeds	24	19.7	13,151	16.4
Weather	21	17.2	10,980	13.7
Disease	10	8.2	4,880	6.1
Drift Injury	2	1.6	3,420	4.3
Herbicide Injury	4	3.3	2,250	2.8
Insects	3	2.5	2,000	2.5
Emergence/Stand	4	3.3	1,920	2.4
Micronutrient Deficiency	1	0.8	350	0.4
Northharvest				
Harvest	25	12.1	22,056	18.8
Weeds	39	18.8	20,316	17.3
Weather	34	16.4	20,049	17.1
Delayed Planting	43	20.8	19,476	16.6
Disease	21	10.1	12,700	10.8
Insects	7	3.4	3,602	3.1
Drift Injury	2	1.0	3,420	2.9
Herbicide Injury	7	3.4	3,030	2.6
Emergence/Stand	7	3.4	2,770	2.4
Micronutrient Deficiency	1	0.5	350	0.3

^a Respondents' acres only

Cocklebur was the worst weed for 12% of Northharvest respondents, representing 12% of the acres reported. Ragweed was the worst weed for 7% of respondents on 12% of the acres reported, and Canada thistle was the worst weed for 12% of respondents on 10% of their acres. Biennial wormwood was the worst weed for 7% of respondents on 6% of the acres reported, followed by kochia for 5% of respondents on 5% of their acres, foxtail for 6% of respondents on 4% of their acres, redroot pigweed for 6% of respondents on 4% of their acres and wild oat for 4% of respondents on 3% of their acres (Table 8). The ranking of weed problems changed considerably

Table 8. Worst weed problem in 1999 in Minnesota and North Dakota.

Worst Weed Problem ^a	Respondents		Acres reported ^b	
	Number	%	Number	%
Minnesota				
Ragweed	20	31.3	8,200	21.9
Nightshade	15	23.4	6,415	17.2
Cocklebur	7	10.9	5,720	15.3
Kochia	2	3.1	2,920	7.8
Wild Oat	4	6.3	1,660	4.4
Redroot Pigweed	5	7.8	1,560	4.2
Foxtail	2	3.1	1,400	3.7
Canada Thistle	2	3.1	1,350	3.6
Lambsquarters	3	4.7	1,228	3.3
Volunteer Grain	1	1.6	600	1.6
Biennial Wormwood	1	1.6	400	1.1
North Dakota				
Nightshade	33	26.8	26,138	32.7
Canada Thistle	21	17.1	10,705	13.4
Cocklebur	16	13.0	8,051	10.1
Biennial Wormwood	12	9.8	6,026	7.5
Ragweed	8	6.5	5,570	7.0
Foxtail	10	8.1	3,635	4.5
Kochia	7	5.7	3,340	4.2
Redroot Pigweed	6	4.9	3,270	4.1
Wild Oat	3	2.4	2,004	2.5
Lambsquarters	2	1.6	406	0.5
Northharvest				
Nightshade	48	25.7	32,553	27.7
Cocklebur	23	12.3	13,771	11.7
Ragweed	13	7.0	13,770	11.7
Canada Thistle	23	12.3	12,055	10.3
Biennial Wormwood	13	7.0	6,426	5.5
Kochia	9	4.8	6,260	5.3
Foxtail	12	6.4	5,036	4.3
Redroot Pigweed	11	5.9	4,830	4.1
Wild Oat	7	3.7	3,664	3.1
Lambsquarters	5	2.7	1,634	1.4
Volunteer Grain	1	0.5	600	0.5

^a Ranked as No. 1 weed problem on more than 0.5% of respondents' acres.

^b Respondents' acres only.

from 1998 to 1999: in 1998 the worst weeds, in order, were nightshade, redroot pigweed and Canada thistle, but in 1999 they were nightshade, cocklebur and ragweed. Successive wet years and tolerance to row crop herbicides have caused cocklebur and ragweed to increase.

In Minnesota, ragweed was the worst weed for 31% of survey respondents on 22% of the Minnesota acres reported, whereas in 1998 it was the third worst weed and was reported as the worst weed on 17% of respondents' acres. Nightshade was the worst weed for fewer respondents in 1999 than in 1998, a problem for 23% of respondents on 17% of their acres in 1999 compared to 37% of their acres in 1998. Cocklebur was the worst weed for 11% of respondents on 15% of their acres (Table 8).

In North Dakota, nightshade was the worst weed for 27% of respondents on 33% of the North Dakota acres reported, similar to 1998 but nearly double in 1997 when it was the worst weed for 14% of respondents' on 19% of their acres. Canada thistle was the worst weed for 17% of respondents on 13% of their acres, which is similar to 1998, 1997 and 1996. Cocklebur was the worst weed for 13% of respondents on 10% of their acres. Biennial wormwood was the worst weed for 10% of respondents on 8% of their acres (Table 8).

Nightshade was ranked most frequently as one of the three worst weed problems for Northharvest respondents, with 45% of respondents' acres affected, followed by cocklebur on 35%, Canada thistle on 31%, ragweed on 29%, redroot pigweed on 27%, kochia on 24%, lambsquarters on 19%, biennial wormwood on 16% and foxtail on 14% (Table 9). Nightshade was nearly as common a weed problem in 1999 as in 1998, and cocklebur was a slightly greater problem in 1999 than in 1998.

In Minnesota, ragweed was ranked most frequently as one of the three worst weed problems on 46% of respondents' acres, followed by redroot pigweed on 44%, nightshade on 36%, lambsquarters on 28%, kochia on 24%, cocklebur on 19%, Canada thistle on 19% and biennial wormwood on 12% (Table 9).

In North Dakota, nightshade was ranked most frequently as one of the three worst weeds on 49% of respondents' acres, followed by cocklebur on 43%, Canada thistle on 37%, kochia on 24%, ragweed on 22%, redroot pigweed on 20%, biennial wormwood on 18%, foxtail on 17% and lambsquarters on 15% (Table 9).

Table 9: Weeds ranked one of the three worst in 1999 in Minnesota and North Dakota.

No. 1, 2 or 3 Weed Problem ^a	— Respondents —		— Acres Reported ^b —	
	Number	%	Number	%
Minnesota				
Ragweed	35	47.9	17,133	45.8
Redroot Pigweed	33	45.2	16,343	43.7
Nightshade	32	43.8	13,615	36.4
Lambsquarters	23	31.5	10,493	28.1
Kochia	12	16.4	9,065	24.2
Cocklebur	13	17.8	7,190	19.2
Canada Thistle	13	17.8	7,065	18.9
Biennial Wormwood	5	6.8	4,500	12.0
North Dakota				
Nightshade	57	42.5	38,809	48.5
Cocklebur	47	35.1	34,209	42.8
Canada Thistle	56	41.8	29,696	37.1
Kochia	26	19.4	19,216	24.0
Ragweed	25	18.7	17,290	21.6
Redroot Pigweed	27	20.1	15,799	19.8
Biennial Wormwood	27	20.1	14,281	17.9
Foxtail	32	23.9	13,451	16.8
Lambquarters	20	14.9	12,037	15.1
Northharvest				
Nightshade	89	43.0	52,424	44.7
Cocklebur	60	29.0	41,399	35.3
Canada Thistle	69	33.3	36,761	31.3
Ragweed	60	29.0	34,423	29.3
Redroot Pigweed	60	29.0	32,142	27.4
Kochia	38	18.4	28,281	24.1
Lambsquarters	43	20.8	22,530	19.2
Biennial Wormwood	32	15.5	18,781	16.0
Foxtail	39	18.8	15,981	13.6

^a Ranked as No. 1, 2 or 3 weed problems or more than 10% of respondents' acres.

^b Respondents' acres only.

Weed Control Practices

The most common chemical weed control practices were post-applied bentazon (Basagran, others), used by 75% of respondents on 43% of Northharvest respondents' acres, followed by spring applied Sonalan, used on 41% of their acres, Poast on 22% of their acres, spring applied trifluralin on 21% of their acres, Raptor on 19% of their acres, and Pursuit on 18% of their acres. Other common weed control practices included use of Assure II, used on 8% of respondents' acres, Prowl on 7% of their acres, and Dual on 5% of their acres (Table 10).

The most common cultural weed control practice was inter-row cultivation, used by 82% of Northharvest respondents on 85% of their acres. Rotary hoe was used by 20% of respondents on 19% of their acres (Table 10).

In Minnesota, post-applied bentazon was applied by 60% of respondents on 37% of their acres, down from 55% of their acres in 1998 and 52% in 1997. Spring-applied Sonalan was applied on 33% of respondents' acres,

Table 10. Weed control practices in 1999 by all Northharvest respondents' in Minnesota and North Dakota.

Weed Control Practice ^a	Respondents		Acres Reported ^b	
	Number	%	Number	%
Cultivation	170	82.1	100,013	85.2
Bentazon				
(Basagran, others)	155	74.9	50,588	43.1
Sonalan, spring applied	129	62.3	47,549	40.5
Poast	59	28.5	26,118	22.3
Trifluralin, spring applied	84	40.6	24,111	20.5
Rotary hoe	42	20.3	22,403	19.1
Raptor	78	37.7	22,045	18.8
Pursuit	74	35.7	21,000	17.9
Assure II	36	17.4	9,200	7.8
Prowl	25	12.1	7,705	6.6
Dual	11	5.3	6,075	5.2
Eptam, spring applied	14	6.8	4,230	3.6
Sonalan, fall applied	12	5.8	4,108	3.5
Roundup, preplant	18	8.7	4,060	3.5
Frontier	14	6.8	4,020	3.4
Lasso	12	5.8	2,160	1.8
Trifluralin + Eptam	12	5.8	1,852	1.6
Trifluralin, fall applied	9	4.3	1,780	1.5

^a Includes all practices or herbicides used on more than 1,000 acres.

^b Respondents' acres only.

followed by Raptor, applied on 30% of respondents' acres. Use of Raptor is due to a greater nightshade infestation in dry bean acres. Herbicide use was different from that in 1998. Raptor use in 1999 dry beans was allowed through Section 18 registration and was the first year of use. Use of Raptor is due to excellent grass and broadleaf weed control, including nightshade, and fewer crop rotation restrictions due to faster breakdown than Pursuit. Both Pursuit and Raptor provide excellent nightshade control, but Pursuit has a 40-month crop rotation restriction to many crops. Inter-row cultivation was used by 81% of respondents on 81% of their acres, which is similar to previous years. Rotary hoe was used by 33% of respondents on 42% of their acres, up from 24% in 1998, 33% in 1997 and 30% in 1996 (Table 11). Wet weather early in the season may have reduced the use of rotary hoe in 1998.

In North Dakota, post-applied bentazon was applied by 83% of respondents on 46% of their acres, down from 58% in 1998. Spring applied Sonalan was applied on 44% of respondents' acres. Poast was applied on 24% of respondents' acres, up from 14% in 1998. Spring applied-trifluralin was applied on 22% of respondents' acres, Pursuit was applied on 22% of their acres and Raptor was applied on 13% of their acres. Inter-row cultivation was used by 83% of respondents on 87% of their acres, which is similar to 1998 and 1997. Rotary hoe was used by 13% of respondents on 9% of their acres, down from 17% in 1998 and 20% in 1997 (Table 11). There was a significant contrast in the use of rotary hoe in Minnesota, where it was

Table 11. Common weed control practices in 1999 in Minnesota and North Dakota

Weed Control Practice ^a	Respondents		Acres Reported ^b	
	Number	%	Number	%
Minnesota				
Cultivation	59	80.8	30,383	81.2
Rotary hoe	24	32.9	15,640	41.8
Bentazon (Basagran, others)	44	60.3	13,808	36.9
Sonalan, spring applied	35	47.9	12,240	32.7
Raptor	33	45.2	11,310	30.2
Poast	14	19.2	6,908	18.5
Trifluralin, spring applied	28	38.4	6,785	18.1
Dual	11	15.1	6,075	16.2
Prowl	15	20.5	4,940	13.2
Eptam, spring applied	11	15.1	4,000	10.7
Pursuit	21	28.8	3,820	10.2
North Dakota				
Cultivation	111	82.8	69,630	87.1
Bentazon (Basagran, others)	111	82.8	36,780	46.0
Sonalan, spring applied	94	70.1	35,309	44.2
Poast	45	33.6	19,210	24.0
Trifluralin, spring applied	56	41.8	17,326	21.7
Pursuit	53	39.6	17,180	21.5
Raptor	45	33.6	10,735	13.4
Rotary hoe	18	13.4	6,763	8.5

^a Practice or herbicides used on more than 10% of respondents' acres.

^b Respondents' acres only.

used on 42% of respondents' acres, and North Dakota, where it was used on only 9% of respondents' acres.

Gramoxone Extra desiccant was used by 6% of Minnesota, 5% of North Dakota and 5% of Northharvest respondents on 2%, 2% and 2% of their acres, respectively. Sodium chlorate desiccant was used by 1% of Minnesota, 2% of North Dakota and 2% of Northharvest respondents on <1%, <1% and <1% of their acres, respectively (Table 12). The low use of desiccants in 1999 and 1998 contrasts sharply with the high use in 1997, when 33% of Minnesota, 25% of North Dakota and 27% of Northharvest respondents' acres were treated.

Post-applied bentazon was the most commonly used herbicide on 25% of Minnesota respondents' black bean acres, 43% of their kidney, 37% of their navy, and 48% of their pinto bean acres. Spring-applied Sonalan was used on 11% of Minnesota respondents' black, 25% of their kidney, 43% of their navy, and 34% of their pinto acres. Raptor was used on 30% of respondents' black, 35% of their kidney, 26% of their navy, and 11% of their pinto acres. Poast was used on none of respondents' black, 22% of their kidney, 16% of their navy, and 36% of their pinto acres. Spring-applied trifluralin was used on 36% of respondents' black, 13% of their kidney, 10% of their navy, and 46% of their pinto acres. Dual was used on none of respondents'

Table 12. Desiccants used in 1999 in Minnesota and North Dakota.

Desiccant	Respondents		Acres Reported ^a	
	Number	%	Number	%
Minnesota				
Sodium Chlorate	1	1.4	160	0.4
Gramoxone Extra	4	5.5	730	2.0
North Dakota				
Sodium Chlorate	3	2.2	355	0.4
Gramoxone Extra	6	4.5	1,686	2.1
Northharvest				
Sodium Chlorate	4	1.9	515	0.4
Gramoxone Extra	10	4.8	2,416	2.1

^a Respondents' acres only.

black, 37% of their kidney, 5% of their navy and none of their pinto acres. Prowl was used on none of respondents' black, 14% of their kidney, 11% of their navy and 3% of their pinto acres. Spring-applied Eptam was used on none of respondents' black, 6% of their kidney, 19% of their navy and 16% of their pinto acres. Pursuit was used on <1% of respondents' black, 11% of their kidney, 11% of their navy and 16% of their pinto acres. Assure II was used on none of respondents' black, 14% of their kidney, 8% of their navy and 2% of their pinto acres (Table 13).

Post-applied bentazon was the most commonly used herbicide on 60% of North Dakota respondents' black bean acres, 74% of their kidney, 35% of their navy, and 49% of their pinto bean acres. Spring applied Sonalan was used on 52% of North Dakota respondents' black, 60% of their kidney, 38% of their navy and 42% of their pinto acres. Poast was used on 18% of respondents' black, 17% of their kidney, 12% of their navy and 30% of their pinto acres. Spring-applied trifluralin was used on 27% of respondents' black, none of their kidney, 22% of their navy and 21% of their pinto acres. Pursuit was used on 33% of respondents' black, 18% of their kidney, 22% of their navy and 19% of their pinto acres. Raptor was used on 10% of respondents' black, 31% of their kidney, 17% of their navy and 9% of their pinto acres. Assure II was used on none of respondents' black, 31% of their kidney, 8% of their navy and 8% of their pinto acres. Frontier was used on 1% of respondents black, 40% of their kidney, 3% of their navy and 5% of their pinto acres (Table 13).

Inter-row cultivation was used once by 39% of Minnesota respondents who answered the question, twice by 54%, three times by 3%, four times by 2% and five times by 2%. Inter-row cultivation was used once by 38% of North Dakota respondents who answered the question, twice by 50% and three times by 13% (Table 14). These data are similar to those for 1998 and 1997.

Table 13. Herbicide use by bean class in 1999 in Minnesota and North Dakota.

Herbicide	Black	Kidney	Navy	Pinto	State Total
	% of Acres Treated ^a				
Minnesota					
Bentazon (Basagran, others)	25.1	42.6	36.6	48.3	36.9
Sonalan, spring applied	10.7	24.9	43.1	34.4	32.7
Raptor	30.4	34.9	25.6	11.2	30.2
Poast	0	21.7	15.7	35.7	18.5
Trifluralin, spring applied	35.5	13.2	9.9	45.5	18.1
Dual	0	37.3	4.6	0	16.2
Prowl	0	14.0	11.3	3.1	13.2
Eptam, spring applied	0	5.9	19.4	16.3	10.7
Pursuit	0.4	11.3	11.4	15.5	10.2
Assure II	0	13.8	8.1	2.4	8.3
North Dakota					
Bentazon (Basagran, others)	60.0	74.0	34.7	48.6	46.0
Sonalan, spring applied	51.9	59.6	37.7	42.3	44.2
Poast	17.9	16.5	11.7	30.4	24.0
Trifluralin, spring applied	26.5	0	21.8	20.8	21.7
Pursuit	32.6	17.9	22.2	18.5	21.5
Raptor	9.6	31.0	17.0	9.2	13.4
Assure II	0	31.0	7.5	8.2	7.6
Frontier	0.9	39.6	3.0	5.3	4.4

^a % of respondents' acres for that class; includes herbicides used on over 10% of respondents' acres for one or more classes.

Rotary hoe was used once by 75% of Minnesota respondents who answered the question, twice by 17% and three times by 8%; fewer respondents answered this and the previous question than some of the other questions. Rotary hoe was used once by 89% of North Dakota respondents who answered the question and twice by 11% (Table 15). These data are similar to previous years (Table 11). Rotary hoe was used very little in North Dakota compared to Minnesota use.

Table 14. Number of cultivations of dry beans in 1999 in Minnesota and North Dakota.

	Number of Cultivations ^a				
	1	2	3	4	5
Minnesota	39.0	54.2	3.4	1.7	1.7
North Dakota	37.8	49.5	12.6	0	0

^a % of respondents answering questions; excludes respondents' who did not answer question.

Table 15. Number of times rotary hoe was used on dry beans in 1999 in Minnesota and North Dakota.

	Number of Times Rotary Hoe Used ^a		
	1	2	3
Minnesota	75.0	16.7	8.3
North Dakota	88.9	11.1	0

^a % of respondents answering questions; excludes respondents' who did not answer question.

Disease Problems

White mold was the worst disease problem for 36% of Northharvest respondents on 38% of their acres, followed by root rot for 20% of respondents on 17% of their acres, bacterial blight for 11% of respondents on 10% of their acres and rust for 4% of respondents on 3% of their acres (Table 16). White mold was a less common problem in 1999

Table 16. Worst disease problem in 1999 in Minnesota and North Dakota.

Worst Disease Problem ^a	Respondents		Acres reported ^b	
	Number	%	Number	%
Minnesota				
Root Rot	26	47.3	15,110	40.4
White Mold	20	36.4	9,168	24.5
Bacterial Blight	6	10.9	2,105	5.6
Rust	3	5.5	1,870	5.0
North Dakota				
White Mold	55	56.7	40,841	51.1
Bacterial Blight	17	17.5	10,620	13.3
Root Rot	15	15.5	7,470	9.3
Rust	5	5.2	2,120	2.7
Northharvest				
White Mold	75	36.2	50,009	37.8
Root Rot	41	19.8	22,580	17.0
Bacterial Blight	23	11.1	12,725	9.6
Rust	8	3.9	3,990	3.0

^a Ranked as No. 1 disease problem by respondents.

^b Respondents' acres only.

and 1998 than in 1997 and root rot was much more common in 1999 and 1998 than in 1997. More respondents reported having no serious disease problem ("none") in 1999 and 1998 than in 1997.

Root rot was the worst disease problem for 47% of Minnesota respondents on 40% of their acres. White mold was the worst disease problem for 36% of Minnesota respondents on 25% of their acres, followed by bacterial blight for 11% of Minnesota respondents on 6% of their acres and rust for 6% of Minnesota respondents on 5% of their acres (Table 16). Root rot was a much greater problem in Minnesota in 1999 and 1998 than in 1997 and white mold was less of a problem.

White mold was the worst disease problem for 57% of North Dakota respondents on 51% of their acres, followed by bacterial blight for 18% of North Dakota respondents on 13% of their acres, root rot for 16% of respondents on 9% of their acres and rust for 5% of respondents on 3% of their acres (Table 16). White mold was a less common problem in North Dakota in 1999 and 1998 than in 1997.

White mold was ranked as one of the three worst diseases by Northharvest respondents on 69% of their dry bean acres, slightly more than in 1998 and less than in 1997. Root rot was ranked as one of the three worst diseases by Northharvest respondents on 47% of respondents' acres, up considerably from 1997 and slightly from 1998. Bacterial blight was ranked as one of the three worst diseases by Northharvest respondents on 37% of their acres, slightly higher than in 1998. Rust was ranked as one of the three worst diseases by Northharvest respondents on 20% of their acres, lower than in 1998 or 1997 (Table 17).

Root rot was one of the three worst diseases on 58% of Minnesota respondents' acres and on 43% of North Dakota respondents' acres (Table 17); these figures represent substantial increases from 1997 in root rot ranking in both states. The data for all other diseases are fairly similar for both states and do not vary greatly from that of the combined data for both states (Northharvest total).

Table 17. Disease ranked as one of the three worst in 1999 in Minnesota and North Dakota.

No. 1,2 or 3 Disease Problem ^a	— Respondents —		— Acres reported ^b —	
	Number	%	Number	%
Minnesota				
White Mold	46	63.0	23,683	63.3
Root Rot	40	54.8	21,508	57.5
Rust	18	24.7	10,295	27.5
Bacterial Blight	18	24.7	9,105	24.3
Alternaria	4	5.5	2,605	7.0
North Dakota				
White Mold	83	61.9	56,815	71.1
Root Rot	45	33.6	34,155	42.7
Bacterial Blight	41	30.6	34,093	42.6
Rust	22	16.4	13,440	16.8
Alternaria	3	2.2	1,230	1.5
Northharvest				
White Mold	129	62.3	80,498	68.6
Root Rot	85	41.1	55,663	47.4
Bacterial Blight	59	28.5	43,198	36.8
Rust	40	19.3	23,735	20.2
Alternaria	7	3.4	3,835	3.3

^a Ranked as No. 1, 2 or 3 disease problem by respondents.

^b Respondents' acres only.

Disease Control Practices

Fungicides were used on 30% of Northharvest survey respondents' acres, up from 28% in 1998 but down from 43% in 1997 and 61% in 1996. Fungicides were used on 53% of Minnesota but only 20% of North Dakota respondents' acres, compared to 28% and 27%, respectively, in 1998, 59% and 37% in 1997 and 68% and 59% in 1996. Topsin M was the most widely used fungicide in Minnesota, applied on 27% of respondents acres, followed by Benlate, applied on 17% of their acres, Tilt, applied on 3%, and maneb, applied on 1%. Topsin M was the most widely used fungicide in North Dakota, applied on 10% of respondents' acres, followed by Benlate applied on 6% of their acres, and Tilt applied on 3% (Tables 18 and 19).

The percentage of acres treated by ground was over three times that treated by air for all Northharvest respondents. It was 4 ½ times as great for Minnesota respondents and twice as great for North Dakota respondents (Table 18). Although ground application was substantially greater than application by air, use of aerial application was greater in 1999 than in 1998; ground application was approximately the same in both years. The figures for aerial and ground broadcast application of Benlate do not add up to the total broadcast application in Minnesota, indicating that some respondents reported a broadcast application but did not report the method of application.

Table 18. Fungicides applied to dry beans in 1999 in Minnesota and North Dakota.

Fungicide ^a	Method of Appl. ^b	Total Acres Treated ^c		Acres Treated By Air ^c		Acres Treated By Ground ^c	
		Number	%	Number	%	Number	%
Minnesota							
Benlate	Banded	3,070	8.2	—	—	3,070	8.2
Benlate	Broadcast	3,388	9.1	400	1.1	1,688	4.5
Maneb	—	450	1.2	—	—	450	1.2
Tilt	—	1,240	3.3	550	1.5	690	1.8
Topsin M	Banded	2,020	5.4	—	—	2,020	5.4
Topsin M	Broadcast	8,090	21.6	1,000	2.7	7,090	18.9
Other	—	1,380	3.7	1,300	3.5	80	0.2
Total Fungicide	—	19,638	52.5	3,250	8.7	15,088	40.3
North Dakota							
Benlate	Banded	3,053	3.8	—	—	2,453	3.1
Benlate	Broadcast	2,021	2.5	536	0.6	1,485	1.9
Tilt	—	1,995	2.5	280	0.4	715	0.9
Topsin M	Banded	1,025	1.3	—	—	1,025	1.3
Topsin M	Broadcast	7,270	9.1	3,570	4.5	3,300	4.1
Other	—	540	0.7	—	—	540	0.7
Total Fungicide	—	15,904	19.9	4,386	5.5	9,518	11.9
Northharvest							
Benlate	Banded	6,123	5.2	—	—	5,523	4.7
Benlate	Broadcast	5,409	4.6	936	0.8	3,173	2.7
Maneb	—	450	0.4	—	—	450	0.4
Tilt	—	3,235	2.8	830	0.7	1,405	1.2
Topsin M	Banded	3,045	2.6	—	—	3,045	2.6
Topsin M	Broadcast	15,360	13.	4,570	3.9	10,390	8.9
Other	—	1,920	1.6	1,300	1.1	620	0.5
Total Fungicide	—	35,542	30.3	7,636	6.5	24,606	21.0

^a Mention of a trade name does not constitute endorsement of the product.

^b Respondents were not asked method of application for Bravo, Maneb or Tilt.

^c Respondents' acres only.

Minnesota respondents sprayed 44% of their acres with the benzimidazole fungicides Benlate and Topsin M for white mold control, compared to 27% in 1998, 52% in 1997, 44% in 1996 and 21% in 1995. North Dakota respondents sprayed 17% of their acres with the benzimidazole fungicides, compared to 22% in 1998, 28% in 1997, 22% in 1996 and 18% in 1995. In Minnesota 14% of respondents' acres were band sprayed (directed spray with drop nozzles between the rows) with benzimidazole fungicides and 31% were broadcast sprayed, a slightly higher percentage of band spraying than in previous years. In North Dakota, 5% of respondents' acres were band sprayed with benzimidazole fungicides and 12% were broadcast sprayed. Use of Topsin M was about 50% more than that of Benlate in both Minnesota and North Dakota (Table 19). This is the reverse of 1998, when Benlate use was 50-100% greater than that of Topsin M.

Rust fungicides were used on 3% of Northharvest respondents' acres, compared to 4% in 1998, 9% in 1997 and 34% in 1996. Tilt, available in both states under a specific exemption (section 18), was used on 3% of Northharvest

respondents' acres, followed by maneb on less than 1%. In Minnesota, Tilt was used on 3% of respondents' acres followed by maneb on 1%. In North Dakota, Tilt was used on

Table 19. Fungicides and application methods for white mold control in 1999 in Minnesota and North Dakota.

Fungicide	Band Applied		Broadcast		Total	
	Number	% ^a	Number	% ^a	Number	% ^a
Minnesota						
Benlate	3,070	8.2	3,388	9.1	6,458	17.3
Topsin M	2,020	5.4	8,090	21.6	10,110	27.0
Total ^b	5,090	13.6	11,478	30.7	16,568	44.3
North Dakota						
Benlate	3,053	3.8	2,021	2.5	5,074	6.3
Topsin M	1,025	1.3	7,270	9.1	8,295	10.4
Total ^b	4,078	5.1	9,291	11.6	13,369	16.7
Northharvest						
Benlate	6,123	5.2	5,409	4.6	11,532	9.8
Topsin M	3,045	2.6	15,360	13.1	18,405	15.7
Total ^b	9,168	7.8	20,769	17.7	29,937	25.5

^a Percent of respondents' acres.

^b Total of Benlate and Topsin M.

3% of respondents' acres (Table 20). The dramatic reduction in use of rust fungicides since 1996 is due at least partly to increased use of pinto varieties that have resistance to the current rust races, as discussed in the section on varieties grown.

Insect Problems

The potato leafhopper was the worst insect problem for 35% of Northharvest survey respondents representing 40% of the dry bean acres reported, up from 24% of acres in 1998, 9% in 1997 and 2% in 1996. Leafhoppers were a problem on 47% of Minnesota respondents' acres and 37% of North Dakota respondents' acres. Grasshoppers were a problem on 9% of North Dakota respondents' acres but none of Minnesota respondents' acres. Seed corn maggots were a problem on only 2% of Northharvest respondents' acres and spider mites were a problem on only 1% of their acres (Table 21).

Table 20. Fungicides used for rust control in 1999 in Minnesota and North Dakota.

State	Bravo		Maneb		Tilt		Total	
	Acres	% ^a						
Minn.	—	—	450	1.2	1,240	3.3	1,690	4.5
N.D.	—	—	—	—	1,995	2.5	1,995	2.5
Northharvest Total	—	—	450	0.4	3,235	2.8	3,685	3.1

^a Percent of respondents' acres.

^b Total of Bravo, Maneb and Tilt.

Table 21. Worst insect problem in 1999 in Minnesota and North Dakota

Worst Insect Problem ^a	Respondents		Acres Reported ^b	
	Number	%	Number	%
Minnesota				
Leafhopper	39	53.4	17,650	47.2
Seed Corn Maggot	2	2.7	290	0.8
Spider Mite	2	2.7	940	2.5
North Dakota				
Leafhopper	34	25.4	29,240	36.6
Grasshopper	14	10.4	7,400	9.3
Seed Corn Maggot	2	1.5	2,313	2.9
Spider Mite	1	0.7	450	0.6
Northharvest Total				
Leafhopper	73	35.3	46,890	40.0
Grasshopper	14	6.8	7,400	6.3
Seed Corn Maggot	4	1.9	2,603	2.2
Spider Mite	3	1.4	1,390	1.2

^a Insect problems reported on more than 1% of respondents' acres only.

^b Respondents' acres only.

Insect Control Practices

Asana was used on 7% of Northharvest respondents' acres, followed by dimethoate on 2% and malathion on less than 1%. Minnesota respondents treated 9% of their acres with Asana, 7% with dimethoate and 2% with malathion. In contrast, North Dakota respondents treated 6% of their acres with Asana and none with dimethoate or malathion (Table 22).

Lindane seed treatment was used on 13% of Northharvest respondents' acres and Lorsban was used on 8%. Both insecticidal seed treatments were used more commonly in North Dakota than in Minnesota, with 2% of Minnesota respondents' acres receiving lindane seed treatment and 3% receiving Lorsban seed treatment. This compares to 19% of North Dakota respondents' acres receiving lindane seed treatment and 11% receiving Lorsban seed treatment (Table 23).

Table 22. Use of insecticides in Minnesota and North Dakota in 1999.

Treatment	Respondents		Acres Reported	
	Number	%	Number	% ^a
Minnesota				
Asana	6	8.2	3,520	9.4
Dimethoate	6	8.2	2,733	7.3
Malathion	2	2.7	800	2.1
North Dakota				
Asana	10	7.5	5,000	6.3
Northharvest				
Asana	16	7.7	8,520	7.3
Dimethoate	6	2.9	2,733	2.3
Malathion	2	1.0	800	0.7

^a Percent of respondents' acres; over 1% of respondents' acres treated.

Table 23. Use of insecticidal seed treatment in Minnesota and North Dakota in 1999.

Treatment	Respondents		Acres Reported	
	Number	% ^a	Number	% ^b
Minnesota				
Lindane	2	20.0	700	1.9
Lorsban	3	27.3	1,090	2.9
North Dakota				
Lindane	21	47.7	14,815	18.5
Lorsban	15	42.9	8,820	11.0
Northharvest Total				
Lindane	23	42.6	15,515	13.2
Lorsban	18	39.1	9,910	8.4

^a Percent responding to question.

^b Percent of respondents' acres.

Micronutrient Usage

Zinc, a common micronutrient for dry beans, was applied to 55% of Northarvest respondents' acres, similar to 1998 and 1997. Zinc was applied to 58% of Minnesota and 54% of North Dakota respondents' acres. Other micronutrients were used on 8% of Northarvest, 13% of Minnesota and 6% of North Dakota respondents' acres (Table 24).

A single application of zinc was made by 95% of Minnesota and 96% of North Dakota respondents who answered the question. Two applications were made by 5% of respondents in each state. All Minnesota respondents and 78% of North Dakota respondents made a single application of other micronutrients (Table 25).

Crop Rotations

Crop rotations used by Northarvest respondents involved several years between dry bean crops. Nearly 40% of the dry beans planted in Minnesota followed wheat, 35% followed corn, 17% followed sugarbeets, and 4% followed barley. Over 64% of dry beans planted in North Dakota followed wheat, 13% followed corn, 10% followed barley and 8% followed sugarbeet (Table 26). The percentage of various crops that preceded dry beans in each state was similar to 1998, except that barley was less frequently the preceding crop.

Three, four and five year rotations were common in Minnesota, with 34%, 22% and 33% of respondents who answered the question citing these respective rotations. Only 7% of Minnesota respondents cited a two year rotation. In North Dakota, two, three, four and five year rotations were common, with 29%, 28%, 21% and 20% of respondents' citing these respective rotations (Table 27). The data indicate that fewer North Dakota respondents used a two year rotation and more used a five year rotation than in 1998.

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Table 24. Use of zinc and other micronutrients in 1999 in Minnesota and North Dakota.

Treatment	Acres Treated ^a	
	Number	%
Minnesota		
Zinc	21,608	57.8
Other Micronutrients	4,780	12.8
North Dakota		
Zinc	43,019	53.8
Other Micronutrients	4,841	6.1
Northarvest Total		
Zinc	64,627	55.1
Other Micronutrients	9,621	8.2

^a Insect problems reported on more than 1% of respondents' acres only.

^b Respondents' acres only.

Table 25. Number of applications of zinc and other micronutrients in 1999 by respondents in Minnesota and North Dakota.

	Number of Applications			
	Zinc		Other Micronutrients	
	% of Respondents ^a			
	1	2	1	2
Minnesota	94.7	5.3	100.0	0
North Dakota	95.5	4.5	77.8	22.2

^a Percent of those responding to question; includes only respondents who applied micronutrients.

Table 26. Crop grown the year prior to dry beans in 1999 by respondents in Minnesota and North Dakota.

Previous Crop	Minnesota	North Dakota
	% of Respondents ^a	
Barley	4.1	10.2
Corn	34.7	13.3
Fallow	0	0.4
Flax	0	0.8
Potato	2.5	1.6
Oats	0.8	1.2
Soybean	0.8	0.4
Sugarbeet	16.5	7.8
Wheat	39.7	64.1

^a Percent of those responding to question.

Table 27. Number of years in dry bean rotation in 1999 in Minnesota and North Dakota.

Number of Years in Rotation	Minnesota	North Dakota
	% of Respondents ^a	
1	2.5	1.2
2	6.6	29.1
3	34.4	28.3
4	22.1	20.9
5	32.8	20.2
9	1.6	0.4

^a Percent of those responding to question.

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