Soybean Response to Intensive Management, Carrington, 2008

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A field study consisting of a dryland and irrigated trial was conducted at the NDSU Carrington Research Extension Center to examine soybean seed yield and quality based on individual or combinations of selected management inputs that may increase net return for producers. Experimental design was a randomized complete block with split-split plot arrangement with four replications. Whole plots were planting dates (May 16 and 24), and split plots consisted of a factorial combination of cultivars (relative maturity of 0.4 and 0.8), row spacing (14 and 28 inches), planting rate (150,000 and 200,000 pure live seeds (pls) /A), and special foliar inputs versus untreated check. The conventional-till study was established with soybean and spring wheat as the previous crops in 2006 and 2007, respectively, on a Heimdal Emrick loam soil with 75 lbs./A (0-24") nitrate-N, 22 ppm P, 151 ppm K, 3.0% organic matter and 7.5 pH. Roundup Ready® cultivars Dairyland Seeds 'DSR0401' (medium canopy) and Northrup King 'S08C3' (row width flexibility) were grown in the study. Foliar treatments were applied with a CO_2-pressurized hand-boom sprayer delivering 14 gal/A at 35 psi with 8001 flat-fan nozzles. The V2 (second trifoliate) growth stage treatments (TJ Technologies 'Sunflower/Canola/Soybean Mix' at 48 fl oz/A plus an experimental EMD Crop BioScience 'LCO promoter' at 32 fl oz/A) were applied on July 3 and R2 (full bloom) growth stage treatment (Headline fungicide at 6 fl oz/A + NIS at 0.25% v/v) was applied on July 31. Plant disease was evaluated but notes were not taken due to very low and non-variable incidence. Rainfall totaled 13.4 inches (NDAWN) from May 1 to September 30, including 3.4 inches received during July and August. Supplemental irrigation totaled 6.75 inches, including 4.75 inches in July and August. The trials were harvested with a plot combine on October 9 (dryland) and 17 (irrigated).

Dryland trial

Plant emergence required three additional days with the early planting date compared to the later date (Table 1). Plant stand was greater with 14-inch rows and 200,000 pls/A compared to wide rows and the low planting rate. Time from planting to canopy closure, first flower, and physiological maturity was less with the later planting date. Seed yield increased with narrow rows and application of special foliar inputs. Seed protein was slightly higher with the normal planting date and 14-inch rows versus the later planting date and wide rows.

Dryland soybean intensive management trial, September 2008.

Table 1. Soybean response to main factors in intensive management study, CREC, 2008.

Dryland													
		Plant							Seed				
Main factor	Sub factor	Emergence	Stand	Canopy closure	Flowering	PM[1]	Height	Pod Height	Yield	Test Weight	Number /lb	Oil	Protein
		DAP[2]	plt/A	DAP			inch	cm	bu/A	lb/bu		%	%
	DSR0401	19	156074	65	56	124	27	6	40.4	57.1	3508	17.3	36.0
Variety	NK S08C3	19	150560	64	56	127	28	7	40.1	57.9	3571	17.2	34.7
	16-May	20	154473	71	60	130	27	6	39.9	57.5	3560	17.4	35.5
Planting date	24-May	17	152161	59	52	120	28	7	40.6	57.5	3520	17.2	35.1
Row spacing	14	19	163855	65	56	125	27	7	41.0	57.6	3573	17.2	35.5
(inches)	28	19	142778	.	56	126	28	6	39.5	57.5	3506	17.3	35.2
Planting rate	150	19	143534	65	56	126	28	6	40.3	57.5	3526	17.2	35.2
(x1000 pls/acre)	200	19	163099	64	56	125	27	7	40.2	57.5	3554	17.2	35.4
	Foliar	19	154896	65	56	126	28	6	41.2	57.5	3501	17.3	35.1
Special inputs[3]	UTC	19	151739	65	45	125	27	7	39.3	57.5	3579	17.2	35.5
Mean		19	153317	65	56	126	27	7	40.3	57.5	3540	17.2	35.3
CV %		2.6	20.3	2.4	1.8	0.9	6.8	22.6	7.8	0.7	3.1	1.7	2.1
Irrigated													
	DSR0401	20	162099	82	57	127	29	6	48.2	57.2	3359	16.5	37.7
Variety	NK S08C3	21	161855	79	56	132	30	7	46.0	57.8	3473	16.2	36.7
	16-May	23	165412	86	60	135	29	6	46.0	57.5	3435	16.4	37.3
Planting date	24-May	18	158542	75	52	124	30	8	48.1	57.6	3398	16.3	37.2
Row spacing	14	20	164256	65	56	129	30	7	47.5	57.6	3441	16.3	37.3
(inches)	28	21	159698	103	56	130	29	7	46.7	57.5	3389	16.4	37.1
Planting rate	150	21	141667	80	56	130	30	7	46.7	57.5	3409	16.3	37.1
(x1000 pls/acre)	200	20	182286	81	56	129	30	7	47.5	57.6	3422	16.3	37.3
	Foliar	21	165790	83	56	130	29	7	48.5	57.5	3352	16.4	37.0
Special inputs	UTC	20	158164	78	56	129	30	7	45.6	57.6	3482	16.2	37.4
Mean		20	161977	81	56	129	30	7	47.1	57.5	3415	16.3	37.2
CV %		40.7	17.3	5	1.5	1.1	3.7	21.4	5.4	0.6	2.9	1.5	1.4

LSD (0.05): highlighted pairs of data = significantly different.

[1]PM=physiological maturity.

[2]DAP=days after planting.

[3]Foliar=V2 stage aplication of micro-nutrient blend + LCO promoter, followed by R2 application of Headline fungicide; UTC=untreated check.

Irrigated trial

Plant emergence required five additional days with the early planting date compared to the later date (Table 1). Plant stand was greater with seeding 200,000 pls/A compared to the low planting rate. Time from planting to canopy closure, first flower, and physiological maturity was less with the late planting date. Narrow row soybean had canopy closure 38 days sooner than wide rows. Pod height was nearly one inch higher with the later planting date. Seed yield increased with the later planting date and application of special foliar inputs. Seed protein was slightly higher with narrow rows and foliar inputs.

Economic analysis was applied to main factors that had statistical yield differences. Assumptions include soybean market price of $8/bu, ground application costs of $5/acre, and total cost of the three foliar products of $20 /acre. Dryland results indicated a yield increase of 1.5 bu/acre with 14-inch rows

compared to 28-inch rows, which provided an advantage of $12/acre. In the irrigated trial, later-planted soybean yielded 2.1 bu/acre more and increased income by $15.20/acre compared to the earlier planting. Application of special foliar inputs increased yield by 1.9 and 2.9 bu/acre in the dryland and irrigated trials, respectively. However, product and application costs exceeded the soybean value in both trials, resulting in net loss of about $2/acre (irrigated) or $10/acre (dryland).

Analysis of variance (AOV) P values of factor interactions for the dryland and irrigated environments are provided in Tables 2 and 3, respectively. Factor interactions will be discussed after more site-years are added to the study database.

Table 2. AOV P values of factor interactions for dryland soybean intensive management study, CREC, 2008.

	Plant							Seed				
Factors[1]	Emergence	Stand	Canopy Closure	Flowering	PM[2]	Height	Pod Height	Yield	Test Weight	Number /lb	Oil	Protein
	DAP[3]	plt/A	DAP			inch	cm	bu/A	lb/bu		%	%
rep	0.44	0.01	0.38	0.62	0.04	0.12	0.19	0.46	<.0001	0.10	0.85	0.46
VAR	0.18	0.38	0.33	0.97	<.0001	0.01	0.07	0.42	<.0001	0.00	0.16	<.0001
rep*VAR	0.15	0.91	0.30	0.25	0.01	0.62	0.95	0.46	0.68	0.03	0.62	0.01
DATE	<.0001	0.65	<.0001	<.0001	<.0001	0.14	0.00	0.13	0.90	0.03	0.32	0.01
ROW	0.01	0.00	.	0.60	0.13	0.22	0.44	0.02	0.02	0.00	0.05	0.04
SEED	0.02	0.00	0.05	0.95	0.01	0.57	0.21	0.77	0.87	0.12	0.26	0.25
MGMT	0.62	0.65	0.52	0.97	0.13	0.24	0.24	0.00	0.61	0.00	0.19	0.06
VAR*DATE	0.18	0.18	0.21	0.78	0.00	0.38	0.14	0.56	0.54	0.69	0.69	0.10
VAR*ROW	0.05	0.62	.	0.48	0.25	0.08	0.20	0.57	0.12	0.59	0.14	0.27
VAR*SEED	0.70	0.48	0.39	0.30	0.66	0.51	0.21	1.00	0.15	0.49	0.39	0.40
VAR*MGMT	0.29	0.75	0.63	0.48	0.74	0.09	0.83	0.58	0.36	0.20	0.57	0.16
DATE*ROW	0.25	0.93	.	0.79	0.79	0.39	0.30	0.69	0.28	0.52	0.50	0.26
DATE*SEED	0.03	0.60	0.20	0.50	0.80	0.43	0.58	0.97	0.71	0.49	0.33	0.27
DATE*MGMT	0.46	0.17	0.40	0.95	0.75	0.27	0.62	0.97	0.45	0.57	0.78	0.73
ROW*SEED	0.73	0.57	.	0.06	0.61	0.88	0.86	0.98	0.05	0.41	0.44	0.75
ROW*MGMT	0.08	0.58	.	0.28	0.61	0.10	0.76	0.50	0.34	0.02	0.25	0.60
SEED*MGMT	0.05	0.92	0.07	0.71	0.22	0.09	0.44	0.61	0.12	0.91	0.18	0.21
VAR*DATE*ROW	0.75	0.12	.	0.39	0.51	0.47	0.27	0.92	0.36	0.04	0.64	0.80
VAR*DATE*SEED	0.34	0.39	0.17	0.03	0.07	0.81	0.16	0.14	0.60	0.13	0.56	0.16
VAR*DATE*MGMT	0.39	0.91	0.99	0.73	0.22	0.40	0.19	0.55	0.86	0.18	0.98	0.68
VAR*ROW*SEED	0.08	0.79	.	0.34	0.07	0.33	0.72	0.39	0.92	0.61	0.41	0.20
VAR*ROW*MGMT	0.40	0.06	.	0.50	0.34	0.91	0.63	0.82	0.60	0.73	0.15	0.55
VAR*SEED*MGMT	0.22	0.72	0.71	0.23	0.96	0.53	0.25	0.71	0.41	0.86	0.21	0.47
DATE*ROW*SEED	0.82	0.19	.	0.03	0.58	0.22	0.36	0.53	0.44	0.53	0.47	0.97
DATE*ROW*MGMT	0.89	0.05	.	0.59	0.15	0.52	0.55	0.93	0.31	0.49	0.32	0.17
ROW*SEED*MGMT	0.15	0.94	.	0.56	0.81	0.20	0.12	0.39	0.66	0.81	0.90	0.43
VAR*DATE*ROW*SEED	0.34	0.37	.	0.80	0.03	0.33	0.59	0.92	0.08	0.10	0.65	0.15
VAR*DATE*ROW*MGMT	0.71	0.24	.	0.68	0.82	0.18	0.68	0.13	0.97	0.01	0.18	0.18
DATE*ROW*SEED*MGMT	1.00	0.50	0.67	0.77	0.89	0.64	0.07	0.37	0.20	0.78	0.81	0.84
VAR*DAT*ROW*SEE*MGMT	0.04	0.23	0.53	0.01	0.96	0.87	0.43	0.92	0.40	0.47	0.84	0.88

[1]VAR=varieties; DATE=planting dates; ROW=row spacings; SEED=planting rates; and MGMT=special foliar inputs.

[2]PM=physiological maturity.

[3]DAP=days after planting.

Table 3. AOV P values of factor interactions for irrigated soybean intensive management study, CREC, 2008.

	Plant							Seed				
Factors[1]	Emergence	Stand	Canopy Closure	Flowering	PM[2]	Height	Pod Height	Yield	Test Weight	Number /lb	Oil	Protein
	DAP[3]	plt/A	DAP			inch	cm	bu/A	lb/bu		%	%
rep	0.41	0.95	0.01	0.02	0.01	0.04	0.08	0.20	<.0001	0.03	<.0001	0.03
VAR	0.24	0.60	0.02	<.0001	<.0001	<.0001	0.00	<.0001	<.0001	<.0001	<.0001	<.0001
rep*VAR	0.42	0.28	0.00	0.13	0.35	0.03	0.07	0.37	0.53	0.38	0.34	0.55
DATE	0.00	0.20	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.51	0.11	0.05	0.32
ROW	0.14	0.45	<.0001	0.63	0.00	<.0001	0.25	0.08	0.08	0.01	0.02	0.02
SEED	0.14	<.0001	0.48	0.56	0.05	0.99	0.37	0.13	0.19	0.39	0.46	0.22
MGMT	0.16	0.18	0.44	0.59	0.04	0.70	0.05	<.0001	0.10	<.0001	0.00	0.00
VAR*DATE	0.17	0.95	0.71	<.0001	0.99	0.49	0.00	0.02	0.49	0.20	0.96	0.14
VAR*ROW	0.20	0.74	0.11	0.12	0.58	0.61	0.98	0.40	0.19	0.03	0.68	0.07
VAR*SEED	0.19	0.81	0.95	0.04	0.25	0.65	0.44	0.96	0.56	0.38	0.08	0.06
VAR*MGMT	0.17	0.18	0.65	0.01	0.07	0.43	0.25	0.69	0.55	0.12	0.49	0.20
DATE*ROW	0.16	0.60	0.47	0.95	0.83	0.04	0.58	0.80	0.63	0.15	0.31	0.23
DATE*SEED	0.18	0.69	0.14	0.76	0.81	0.00	0.03	0.30	0.95	0.15	0.81	0.56
DATE*MGMT	0.21	0.13	0.53	0.80	0.39	0.28	0.30	0.87	0.64	0.81	0.34	0.54
ROW*SEED	0.21	0.71	0.75	0.34	0.53	0.90	0.07	0.55	0.14	0.72	0.74	0.82
ROW*MGMT	0.15	0.85	1.00	0.74	0.92	0.37	0.13	0.67	0.82	0.15	0.03	0.04
SEED*MGMT	0.11	0.36	0.59	0.62	0.70	0.19	0.26	0.39	0.72	0.99	0.84	0.90
VAR*DATE*ROW	0.15	0.87	0.71	0.09	0.46	0.29	0.44	0.05	0.07	0.59	0.63	0.22
VAR*DATE*SEED	0.19	0.55	0.65	0.33	0.80	0.51	0.17	0.33	0.53	0.56	0.13	0.93
VAR*DATE*MGMT	0.16	0.42	0.71	0.11	0.64	0.88	0.96	0.64	0.87	0.69	0.90	0.33
VAR*ROW*SEED	0.21	0.60	0.81	0.27	0.85	0.69	0.11	0.63	0.43	0.86	0.92	0.42
VAR*ROW*MGMT	0.16	0.40	0.71	0.27	0.77	0.70	0.03	0.91	0.41	0.41	0.84	0.08
VAR*SEED*MGMT	0.12	0.30	0.69	0.25	0.36	0.40	0.58	0.36	0.71	0.44	0.76	0.86
DATE*ROW*SEED	0.16	0.72	0.07	0.09	0.10	0.73	0.91	0.73	0.74	0.95	0.70	0.47
DATE*ROW*MGMT	0.25	0.84	0.33	0.29	0.17	0.62	0.13	0.56	0.54	0.63	0.35	0.12
ROW*SEED*MGMT	0.22	0.69	0.57	0.47	0.55	0.20	0.66	0.86	0.96	0.96	0.48	0.91
VAR*DATE*ROW*SEED	0.15	0.24	0.33	0.26	0.99	0.93	0.04	0.16	0.58	0.06	0.97	0.24
VAR*DATE*ROW*MGMT	0.28	0.81	0.95	0.28	0.77	0.80	0.98	0.13	0.83	0.18	0.87	0.74
DATE*ROW*SEED*MGMT	0.24	0.45	0.35	0.63	0.87	0.43	0.41	0.27	0.32	0.46	0.85	0.55
VAR*DAT*ROW*SEE*MGMT	0.20	0.89	0.06	0.28	0.88	0.75	0.36	0.76	0.96	0.62	0.73	0.61

[1]VAR=varieties; DATE=planting dates; ROW=row spacings; SEED=planting rates; and MGMT=special foliar inputs.

[2]PM=physiological maturity.

[3]DAP=days after planting.

Soybean intensive management trial under irrigation.