Dry Bean Response to Nitrogen Fertilizer

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Field trials were conducted at the North Dakota State University Carrington and North Central (Minot) Research Extension Centers to evaluate nitrogen (N) management of dry bean. Seven levels of N were evaluated without inoculation with *Rhizobium*, as well as a comparison with and without inoculation at the lower N levels and an evaluation of the response to split applications of N (pre-plant and side-dressed prior to flowering). Soil test data (0-24") indicated 15 lbs. NO_3^--N in Carrington and 51 lbs. in Minot. Urea (Carrington) or ammonium nitrate (Minot) was broadcast to the desired levels of total N and incorporated in the 10' x 22-25' plots prior to planting on 14 June in Carrington and 28 May in Minot. Plots consisted of four 30" rows and were arranged in a randomized complete block design with four replicates. Cultivar 'Maverick' (pinto) was evaluated at both sites. At Carrington, cultivar 'Vista' (navy) was also included and a split-plot arrangement was used with cultivar as the main plot factor and N treatment as the subplot factor. Weeds were controlled with herbicide, cultivation, and hand rouging. Significant insect and disease pressure was not observed at either site. Slight hail damage occurred on 6 June and 25 August in Minot and a light frost on 20 August at both sites.

The 2004 growing season was exceptionally cool. Maverick reached physiological maturity at both sites, while Vista was killed by frost before achieving maximum yield. However, no significant cultivar x N treatment interactions were observed in Carrington and the navy bean data is included as recorded.

In Carrington, the yield of Maverick was superior to that of Vista (Table 1). The failure of Vista to reach physiological maturity before frost was undoubtedly a key factor in this difference. Across cultivars, yield peaked at 100 lbs. total N / acre and all treatments with less than 75 lbs. total N / acre yielded significantly less than the 100-lb. treatment. Across cultivars and inoculation treatments, incremental yield increases were observed as total N increased from 15 to 50 to 75 lbs. / acre (Table 2). Inoculation resulted in slight yield decreases at all three N levels tested. Side-dressing N treatments showed no advantage over applying 100 lbs. pre-plant.

Table 1. Dry bean response to soil nitrogen level, NDSU Carrington, 2004.			
		Test	Seed
Treatment	Yield	Weight	Weight
	(lb/acre)	(lb/bu)	(g/250)
Variety			
Maverick	1851	59.4	75.7
Vista	1458	60.9	37.1
P-value	0.0571	0.0013	<0.0001
N Treatment (lbs. total N / acre)			
N15	1480	60.4	56.1
N50	1642	60.2	55.7
N75	1736	60.2	55.7
N100	1839	60.1	56.5
N125	1703	60.1	55.8
N150	1743	60.0	56.3
N200	1663	60.3	58.3
N15-In	1455	60.3	55.5
N50-In	1546	60.1	55.8
N75-In	1610	60.1	58.1
N50-In+50	1618	60.0	56.2
N100-In+50	1815	60.0	56.6
P-value	0.0007	0.3811	0.4577
LSD (0.05)	184	NS	NS
LSD (0.01)	245	NS	NS
Mean	1654	60.1	56.4
C.V. (%)	11.1	0.6	4.6

Table 2. Main effects of the lowest 3 N rates with and without inoculation, NSDU Carrington, 2004.			
		Test	Seed
Treatment	Yield	Weight	Weight
	(lb/ac)	(lb/bu)	(g/250)
N Level (lbs. total N/acre)			
15	1468	60.3	55.8
50	1594	60.2	55.7
75	1673	60.2	56.9
P-value	0.0036	0.2993	0.3059
LSD (0.05)	115	NS	NS
LSD (0.01)	155	NS	NS
Inoculation			
- Inoculant	1619	60.3	55.8
+ Inoculant	1537	60.2	56.5
P-value	0.0838	0.3141	0.3103

In Minot, no statistically significant ($P < 0.05$) yield differences were observed (Table 3). However, 75 lbs. total N / acre or higher tended to increase yield over the lowest N treatments. Yield was numerically highest with

200 lbs. PPI and the split application. Inoculation resulted in a slight yield increase at each N level tested.

Table 3. Dry bean response to N treatments, NDSU Minot, 2004.

Treatment (lbs. total N / acre)	Days to Flower	Height	Vigor	Plant Stand	Vine Length	Pods	Seed Damage	Plant Weight	Seed Weight	Test Weight	Yield 2004
	DAP[1]	inches	0-9[2]	PFR[3]	cm	#	%	grams	g/1000	lb/bu	lb/A
Control (no fert, no inoc.)	52	15	7.3	7.6	39	151	1.3	297.3	356.7	60.4	1803
50 lbs N (soil test+fert) /a	53	14	7.8	8.0	34	150	1.5	283.2	379.4	60.8	1810
75 lb N/a	52	16	8.8	7.4	40	136	1.3	259.5	366.9	60.2	1987
100 lb N/a	52	15	9.0	9.4	38	151	1.8	288.0	365.0	59.9	1914
125 lb N/a	53	17	9.0	8.0	43	130	1.8	229.2	364.4	60.3	1948
150 lb N/a	53	16	9.0	9.1	40	163	2.0	304.5	369.4	60.2	1976
200 lb N/a	53	16	9.0	7.3	41	159	1.8	310.2	363.7	60.5	2022
Inoculant (No Fert)	52	16	7.5	7.5	40	143	1.5	253.8	375.1	60.4	1969
50 lb N/a + Inoculant	52	18	7.8	9.3	45	158	1.8	286.5	370.7	60.7	1891
100 lb N/a + Inoculant	52	15	8.8	8.8	39	147	1.3	262.0	356.1	59.9	1960
50 lb N PPI + 50 lb Post	52	16	8.8	8.3	40	138	1.5	260.3	355.9	60.0	2053
Mean	52	16	8.4	8.3	40	148	1.6	275.8	365.74	60.3	1939
C.V.%	1.4	9.4	5.6	15.7	9.4	13.7	36.1	15.2	1.9	0.7	8.3
LSD 5%	NS	NS	0.7	NS	NS	NS	NS	NS	NS	NS	NS

[1]Days after planting
[2]0 = very low vigor, 9 = very high vigor
[3]Plants / linear foot of row

Summary. The 2004 results of this trial are inconclusive. The current recommendation of 100 lbs. total N / acre for a 2000-lb. yield goal seems appropriate. However, yields at both sites may have been reduced by environmental stresses (cool weather, frost, hail), which may have prevented better expression of treatments. The consistent slight response to inoculation at Minot is interesting, since this field did not have a previous history of dry bean production, whereas the Carrington site did. The lack of cultivar x N treatment interaction at Carrington is encouraging, in that it suggests that the results of this research may apply to a broader range of cultivars and market classes.

Dry bean response to nitrogen treatments, Minot, ND.