Flax Response to Nitrogen and Seeding Rates

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INTRODUCTION

Current North Dakota State University nitrogen (N) recommendations for flax production are three lb/acre for each bushel/acre of yield goal (2). Seeding rate recommendations range from 20 to 45 lb/acre, depending on yield potential (1). A stand of 70 plants/ft^2 may optimize yield potential. Recently, growers in east-central North Dakota have commented that the use of recommended N rates for high yield has resulted in lodged stands and reduced seed yield.

The objectives of this trial were:

1. Determine flax response to N levels and seeding rates (lb/acre and pure live seed/acre).
2. Determine the influence of N level on oil yield, alpha linolenic acid concentration, and flavor.

MATERIALS AND METHODS

The field trial was conducted at the NDSU Research Extension Centers in Carrington in 2000-01, and in Langdon and Minot in 2001. The experimental design was a randomized complete block with a split-plot arrangement and four replications. Main plots were the N treatments and sub-plots were the seeding rates. Soil N levels included an untreated check (soil N < 60 lb/acre sampled at 0- to 2-ft depth), and 60, 90, or 120 lb/acre (seed yield goal of <20, 20, 30, and 40 bu/acre, respectively). Fertilizer N was preplant applied to reach the selected N levels. 'Cathay' flax was seeded in May at 20, 32, and 44 lb/acre.

RESULTS AND DISCUSSION

N response:

Plant lodging (0 at Carrington and 1 at Langdon = no plants lodged and 9 = all plants lodged) did not differ among N rates (Table 1). Lodging occurred at Langdon due to heavy rain in late July and subsequent disease (pasmo and sclerotinia). Flax seed yield did not increase with N greater than 60 lb/acre at Carrington in 2000, and yield did not differ among N rates at Carrington and Langdon in 2001. Soil N levels at the 2- to 4-ft depth at Carrington in 2000 and 2001, and Langdon in 2001 were 64, 34, and 32 lb/acre, respectively. According to NDSU recommendations, a N credit of 27 lb/acre was available at Carrington in 2000. This may explain the lack of flax yield response to N rates above 60 lb/acre. However, in 2001, minimal deep-soil N credits (2 to 3 lb/acre) were available at Carrington and Langdon. Factors other than N levels (e.g. lodging, less than optimum soil moisture, or high-temperature stress) apparently limited yield. Agronomic data from Minot are not discussed due to variable plant stands caused by dry soil conditions after planting.

Seed oil content and alpha linolenic acid content of seed oil generally decreased with increasing N rates (Tables 2 and 3). Seed samples bulked by N rates had oil flavor ratings (data not shown) ranging from 1.0 to 6.5 (1 to 10 scale with 10 most desirable).

NDSU Carrington[1], Langdon[2], and North Central[3] Research Extension Centers

The samples from all N levels generally were not suitable for edible oil. Thus, this limited database indicates that other factors may be influencing oil flavor.

Table 1. Flax response to N (across seeding rates), Carrington, 2000-01 and Langdon, 2001.

	Carrington, 2000		Carrington, 2001		Langdon, 2001	
N	Lodging	Seed yield	Lodging	Seed yield	Lodging	Seed yield
(lb/acre)	(1-9)	(bu/acre)	(1-9)	(bu/acre)	(0-9)	(bu/acre)
check	-	-	0	23.7	7.4	12.6
60	0.8	36.3	0	25.8	7.3	13.3
90	0.9	36.6	0.1	25.5	7.8	10.5
120	2.1	33.3	0.6	30.8	7.8	13.3
LSD 0.05	NS	2.0	NS	NS	NS	NS

Table 2. Influence of N on seed oil content (across seeding rates).

N	Seed oil (%)				
(lb/acre)	Carr '00	Carr '01	Langdon '01	Minot '01	mean
check	-	41.1	39.7	-	-
60	47.1	41.6	41.1	42.1	43.0
90	46.4	40.3	38.0	41.3	41.5
120	45.5	40.4	40.8	41.6	42.1
LSD 0.05	0.7	NS	0.7	0.4	-

Table 3. Influence of N on alpha linolenic acid content of seed oil (across seeding rates), 2001.

N	Alpha linolenic acid (%)			
(lb/acre)	Carrington	Langdon	Minot	mean
check	51.9	47.3	-	-
60	51.5	47.1	48.3	49.0
90	50.6	47.0	47.3	48.3
120	50.1	47.1	47.8	48.3
LSD 0.05	NS	NS	0.6	-

Seeding rate response:

Flax plant density, recorded at physiological maturity, was highest at the 44 lb/acre seeding rate at Carrington and Langdon (Tables 4 and 5). Plant stands at Carrington in 2000 and at Langdon were near optimum densities, based on current NDSU recommendations. A lower plant density occurred at Carrington in 2001 due to deeper seeding depth (about 1.25 inches) and crusted soil surface during shoot emergence. Plant lodging and seed yield did not differ among seeding rates. Low to average yield at the locations did not allow seeding rates based on lb/acre or pure live seed/acre (data not shown) to influence yield.

Table 4. Flax response to seeding rates (across N rates), Carrington, 2000-01.

Seeding rate	Carrington, 2000			Carrington, 2001		
	Stand	Lodging	Seed yield	Stand	Lodging	Seed yield
(lb/acre)	(stems/ft^2)	(1-9)	(bu/acre)	(stems/ft^2)	(1-9)	(bu/acre)
20	38	1.2	24.4	27	0.1	26.3
32	55	1.5	26.3	36	0.2	27.1
44	64	1.1	25.7	41	0.2	25.7
LSD 0.05	4	NS	NS	3	NS	NS

Table 5. Flax response to seeding rates (across N rates), Langdon, 2001.

Seeding rate	Stand	Lodging	Seed yield
(lb/acre)	(stems/ft^2)	(0-9)	(bu/acre)
20	38	7.4	14.2
32	53	7.7	12.6
44	75	7.7	10.5
LSD 0.05	5	NS	1.2

SUMMARY

N rates did not impact plant lodging and generally did not impact seed yield. Seed oil content and alpha linolenic acid concentration tended to decrease with increasing N rates. Also, N did not affect oil flavor in limited testing. Seeding rates based on lb/acre or PLS/acre did not impact plant lodging or seed yield.

The data generated from this trial identifies flax response trends. However, the limited response is in contrast to testimony from experienced flax growers. Further research is planned in 2002 to collect additional data and improve our knowledge of flax response to N and seeding rates.

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