Effects of Seeding Rate and Row Spacing on Dry Bean Production

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Yields of both determinate and indeterminate dry edible beans increased as rows were more closely spaced. Seeding rate within the limits tested had little effect on yield. There was no significant interaction between row spacing and seeding rate.

Introduction

The row spacing chosen by a farmer for cultivated crops often is determined by past experience, machinery available, and other row crops produced on the farm. In North Dakota dry edible beans are grown in rows spaced from 24 to 38 inches apart with 30 inch row spacing the most common.

The concept of closely spaced rows to increase yield of dry edible beans is now new. Several sources (3, 4, 5) report variable and inconsistent yield response to closely spaced rows. Information on seeding rate or plant density per acre also is reported (1, 3, 4, 5). Research indicates that responses due to increased seeding rate or plant population are variable. Generally seed yield is not affected significantly by plant density unless populations are so high that interplant competition affects plant development or so low that plants cannot compensate by increased pod number and seed size. Environment will influence both plant compensation and yield of variable populations and row spacing.

The bush (determinate) and vining (indeterminate) plant types may respond differently to variable plant population or row spacing in different environments. The indeterminate or bush plant type will complete its vegetative growth and then flower and produce seed, while the indeterminate or vining type will produce stem and leaf tissue alternately or at the same time as when flowering and seed set occur. A typical dry bean field under present recommended production practices in North Dakota would have plant populations of 90,000 and 70,000 plants per acre for the bush and vining plant type, respectively (2).

The objective of this study was to determine the response of bush and vining plants to variable row spacings and plant populations under dryland and irrigated conditions in North Dakota.

Procedure

Two cultivars of dry edible beans, 'Seafarer' navy bean with a bush or determinate plant growth, and 'UI 114' a pinto bean with an indeterminate or vining plant type, were evaluated in separate experiments for seed yield in variable row spacing and plant populations at several North Dakota locations from 1976 through 1978. The trial was conducted at Oakes and Fargo in 1976; and Oakes, Fargo, and Carrington (dryland and irrigated) in 1977 and 1978. All trials at Oakes were irrigated while all trials at Fargo from 1976-1978 were on dryland. The irrigated trials at Carrington in 1977 were destroyed by hail and the 'Seafarer' plots at Fargo in 1978 drowned out.

The trial consisted of a split plot design with row spacing the main plots and plant population the subplots. Plants per 10 foot row at each row spacing and plant population for both plant types are given in Table 1. Plots were planted approximately the third week of May all years of the study. The beans were planted in rows spaced 10, 20, 30, and 40 inches apart. All plots were oversown and then thinned to the desired population after seedling

Table 1. Plants per 10 foot row of determinate 'Seafarer' navy and indeterminate 'UI 114' pinto dry edible beans at four row spacings and four plant populations.

'Seafarer' bush or determinate type

	Plants/acre x 1000			
	60	90	120	150
Row spacing (in.)	Plants/10 foot of row			
10	11	17	22	28
20	23	35	46	58
30	35	52	70	87
40	45	67	90	112

'UI 114' vining or indeterminate type

	Plants/acre x 1000			
	40	70	100	130
Row spacing (in.)	Plants/10 foot of row)			
10	8	13	19	25
20	15	27	38	50
30	23	40	57	74
40	31	54	76	99

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emergence. Plant populations of 60,000, 90,000, 120,000, and 150,000 plants per acre were established for the bush type and 40,000, 70,000, 100,000, and 130,000 plants per acre for the vining type. The highest population for each of the two plant types was evaluated only in 1977 and 1978. Weeds not controlled with the use of Treflan (trifluralin) at ¾ pound/acre preplant incorporated were removed by hoeing. Seed was harvested at physiological maturity.

Results

Dry bean seed yields from the different row spacings averaged over all plant populations at the various locations under irrigated and dryland conditions are reported in Tables 2 and 3. Yields were lower on dryland than with irrigation. Seed yields of both plant types were equal to or were significantly increased with grown in 10 inch rows as compared to 30 or 40 inch rows at all locations in the years tested. General response of the bush and vining plant types to row width was similar.

Seed yields from the various plant populations averaged over all row spacings under irrigation and dryland are shown in Tables 4 and 5. No positive yield response as compared to the check of 70,000 plants/acre was evident in the vining type with the exception of 1976 and 1977 at Fargo (Table 4). The vining plant type, because of its indeterminate growth characteristics, appears to compensate to variable plant populations better than does the bush (determinate) type (Table 5). A significant yield response with increased plant populations as compared to the check of 90,000 plants/acre was evident only at Fargo and Oakes in 1977 in the bush type.

Alterations in plant morphology and other agronomic characteristics were observed at the different plant populations. As plant populations decreased, stem diameter of both plant types increased. A slight amount of lodging was ovserved in 'Seafarer' sown at 10 inch row spacing and 60,000 plants/acre with irrigation at Oakes. No differences in time to first flower or maturity as a response to either row spacing or plant populations were observed in either bean type at any location in any year.

At Oakes with irrigation full canopy cover, or the time when the soil between the rows is completely shaded, occurred approximately 3 to 4 days earlier in the 10 inch spaced rows than in 30 inch spaced rows. Soil between rows spaced 40 inches apart was never completely covered by canopy. Similar trends were observed under dryland although the level of canopy cover was influenced more by growing conditions of a particular season. Soil cover by the bush type was much less than by the vining type and was frequently incomplete.

Discussion

The data indicate that potential bean yields may be increased if grown in closely spaced rows. However, weed control may be a problem with narrow spaced rows in both the bush and vining plant type. Available preplant, preemergence, and postemergence weed control chemical treatments may not provide complete weed control. Further, narrow spaced rows cannot be cultivated to control weeds with the ease of more conventional spaced rows. The problem may be nullified to a certain extent, since dry beans grown in narrow spaced rows, especially at higher populations, tend to shade and crowd out most of the later

Table 2. Pounds of bean seed per acre averaged over four plant populations of 'UI 114' pinto beans (indeterminate plant type) grown under irrigation and dryland at four row spacings at several North Dakota locations from 1976 to 1978.

	Irrigated					
	Oakes			Carrington	4 station	Percent of 30 in.
Row spacing (in.)	1976	1977	1978	1978	year avg.	rows
10	4455	4070	4485	3941	4238	124
20	3179	3788	3728	4011	3677	108
30	3151	3734	3367	3421	3418	100
40	2784	3584	3613	3712	3423	100
LSD (5%)	1040	NS	760	502		

	Dryland						
	Fargo			Carrington		5 station	Percent of 30 in.
Row spacing (in.)	1976	1977	1978	1977	1978	year avg.	rows
10	551	2600	2511	2276	818	1752	122
20	492	2072	2503	1841	660	1514	106
30	602	2153	2145	1629	627	1431	100
40	610	1864	2092	1441	726	1347	94
LSD (5%)	NS	479	NS	407	NS		

Table 5. Pounds of bean seed per acre averaged over four plant populations of 'Seafarer' navy beans (determinate plant type) grown at four plant populations under irrigations and dryland at several North Dakota locations from 1976 to 1978.

	Irrigated					
	Oakes			Carrington		Percent of 90,000
Plants/ac. x 1000	1976	1977	1978	1978	Average	plants/ac.
60	2164	2465	3356	2900	2722	102
90	2094	2380	2985	3196	2664	100
120	2142	2668	3386	3062	2815	106
150	--	2668	3224	3311	3068 1/	108 2/
LSD(5%)	NS	210	NS	NS		

	Dryland					
	Fargo		Carrington			Percent of 90,000
Plants/ac. x 1000	1976	1977	1977	1978	Average	plants/ac.
60	709	1876	1348	651	1146	94
90	604	2112	1438	709	1216	100
120	739	2269	1478	608	1274	105
150	--	2294	1567	638	1500 1/	106 2/
LSD (5%)	NS	159	NS	NS		

1/ Average of years that this population was evaluated.

2/ Calculated as a percent of 90,000 plants/acre in comparable years.

developing weed seedlings. Future development of broad spectrum postemergence herbicides would solve many of the potential weed problems of bean production in narrow spaced rows. However, these herbicides are not yet available. An alternative to complete narrowly spaced rows would be the combination of 10-inch and 30-inch spaced rows arranged in a pattern to allow tractor movement through the fields for cultivation.

Harvest operations may need to be changed with more narrow row production of beans. Some producers now straight combine bush type beans if the crop matures evenly and weeds are not a problem. The vining type could possibly be straight combined if the right type of header could be developed and the foliage were dry. Unfortunately the vining type, because of its growth habit, usually is not dry until after a hard frost. Uneven ripening is the reason vining dry beans are undercut in present production practices. Present equipment could possibly be altered to harvest narrow spaced rows. Other solutions to this problem may be (a) the label clearance of a chemical for desiccation and/or (b) the growing of more determinate cultivars. Anticipated yield response to narrow row spacing of a more determinate pinto might be similar to that obtained with a determinate navy such as 'Seafarer.' None of the now available determinate pinto cultivars performs well in North Dakota.

Dry bean production in the narrower spaced rows possibly could alter the spread of white mold or Sclerotinia (*Sclerotinia sclerotiorum*) in areas where the disease is already present. Under very favorable growing conditions and high plant populations, increased and more rapid canopy development will result in more moisture and higher humidity at the base of the plant which could enhance the development of white mold. Narrow row spacing at populations equal to current recommendations offset these conditions to a certain extent by the increase in interplant spacing in the row (Table 1). No white mold or increased incidence of any other dry bean diseases were observed in these trials during the period studied due to the practices and seeding rates evaluated.

Conclusions

Narrow row spacing in both determinate (bush) and indeterminate (vining) bean types has the potential to significantly increase yield but (a) adequate post-emergence weed control and (b) improved dry-down and harvesting methods need to be developed.

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Continued on Page 21

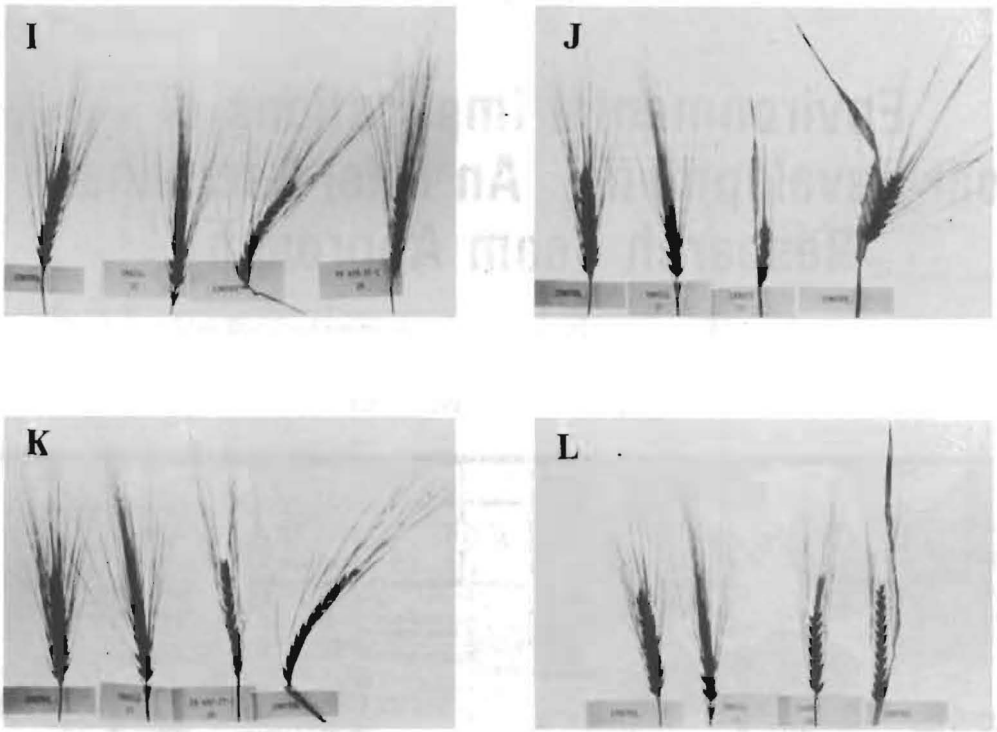

Fig. 3-I through L. Comparison of head types and seed set of lines and varieties inoculated as seedlings with yellow dwarf virus with their respective controls.

CONCLUSIONS

Lines of barley highly tolerant to the barley yellow dwarf virus have been obtained from crosses of cultivated barley with wild species of *Hordeum* and *Elymus*. These lines will be useful in the development of new commercial yellow dwarf tolerant barley varieties.

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