REDEFINING THE AGRONOMY OF FABABEAN FOR IRRIGATED PRODUCTION IN SOUTH-CENTRAL SASKATCHEWAN

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ABSTRACT

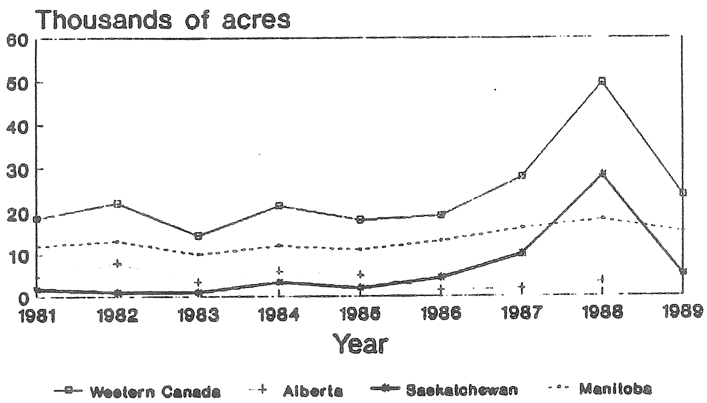
Two years of research on irrigated fababean production are completed. Evaluation of seeding dates on a field scale showed that early seeding increases yield and seed size. Research of seeding rates for two varieties at 20, 30 and 40 plants per square meter in 20, 40 and 60 cm row spacing combinations showed that yield was not significantly different among these treatments. These results have implications for recommending irrigation specific production guidelines for fababean production.

INTRODUCTION

Fababean acres in Western Canada have stabilized at an annual production of about 25,000 acres (Figure 1). A production peak occurred in 1988 when Saskatchewan production increased dramatically in response to protein feed export opportunities in Europe (Saskatchewan Agriculture and Food, 1989).

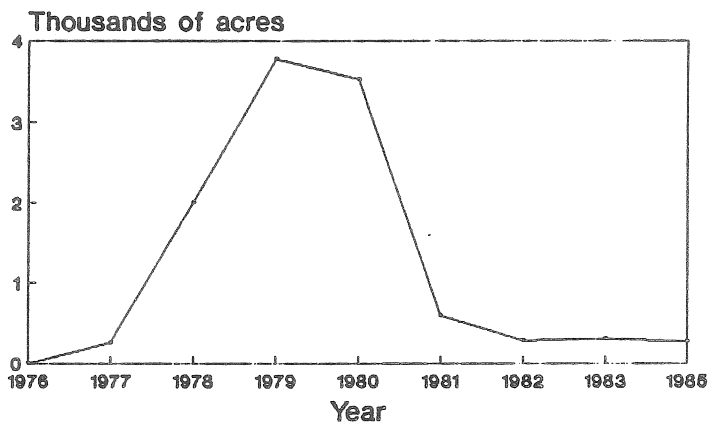
Irrigation farmers in south-central Saskatchewan are in a favourable position to fill the fababean market niche because the crop responds well to irrigation (Krogman et al, 1980). Irrigated production should allow growers to achieve consistent high yield of good quality fababean and thereby command a premium price. However, there is currently negligible irrigated fababean production, even though there was definite interest in the crop in the South Saskatchewan River Irrigation District No. 1 in the late 1970's and early 1980's (Figure 2). Growers state that low prices, high input costs, inconsistent yields or combinations of these factors discouraged production. Figure 3 shows that historical fababean prices compared favourably to pea and hard red spring wheat from 1984 to 1988. In 1988, a small research and demonstration program was initiated at SIDC with the objective of identifying possible reasons for inconsistent yield in irrigated fababean production. Virtually all previous fababean research in Western Canada was conducted under dryland conditions. In addition to ongoing variety evaluation, specific experiments were conducted to determine the effect of seeding date, row spacing, seeding rate and potassium fertilizer addition on the yield of irrigated fababean.

Figure 1. Fababean production in Western Canada, 1981-1989



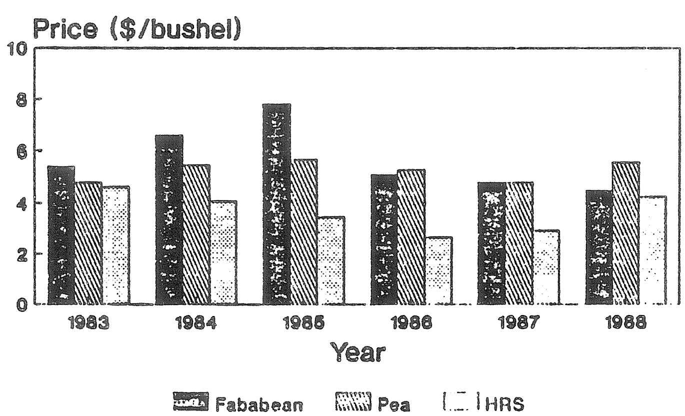
Source: 1989 Specialty Crop Report, SAF

Figure 2. Fababean production in SSRID #1 from 1976-1985



Source: Sask Water Corporation, 1987

Figure 3. Historical prices of fababean, pea and HRS wheat, 1984-1989



Source: 1989 Specialty Crop Report, SAF

MATERIALS AND METHODS

General

All experiments were conducted under centre pivot irrigation systems at the Saskatchewan Irrigation Development Centre in Outlook on Bradwell sandy loam soil. All seeds were inoculated with a commercial *Rhizobium* strain specific for fababean. All plots were swathed at the black pod stage, then harvested with either a Wintersteiger Elite or Massey small plot combine. Seed was air-dried, cleaned and weighed after harvest. All data were analysed using a SAS Version 6 microcomputer program (SAS Institute Inc., North Carolina).

Variety evaluations

In addition to the Fababean Cooperative Yield Trials, a Determinate Fababean Cultivar Test was conducted in both 1988 and 1989. This test included lines carrying the "ti" gene which causes the growth habit to be determinate in contrast to the indeterminate growth habit of currently registered Western Canadian fababean cultivars. Plot sizes were 1.2 m X 3.7 m in 1988 and 2.4 m X 3.7 m in 1989. Four randomized complete blocks were established. In 1988, three indeterminate check cultivars were included ('Herz Freya', 'Erfordia' and 'Outlook'). These were compared to three determinate cultivars 'Tigo', 'Ticol' and 'Tinova'. In 1989, a fourth determinate was added ('Tina') while Herz Freya was replaced by 'Aladin' and 'Encore' as indeterminate checks. An analysis of variance was performed, including a contract comparison between the two growth habit types.

Seeding rate/row spacing experiments

Treatments in this experiment were all combinations of two cultivars (Aladin and Outlook), 3 row spacings (40 cm and 60 cm) and 3 intended seeding rates (20, 30 and 40 seeds/m^2). Six randomized complete blocks were established. In 1988, plots were 2.4 X 3.7 m of which the centre 1.2 m (2, 4 or 6 rows for 60 cm, 40 cm and 20 cm row spacings, respectively) was harvested. In 1989, plots were 4.8 m X 6.1 m of which the middle 3, 5 or 7 rows were harvested for 60 cm, 40 cm and 20 cm row spacings, respectively.

Seeding date studies

An experiment with six replications of three cultivars sown at three seeding dates was established in 1988. The dates were April 29, May 11 and May 19. The cultivars were Outlook, Aladin and Herz Freya. Plot size was 1.2 X 3.7 m. The entire plot was harvested. In both 1988 and 1989, field scale irrigated fababean demonstrations evaluating seeding dates were established. Three replications of three dates were established in both years. A

14-ha field was divided into 9 strips. Three were seeded on each date. Dates were April 20, May 2 and May 14 in 1988 and April 21, May 2 and May 28 in 1989. Yield was estimated by combining swaths 4.6 m wide X 152 m long from each seeding date strip.

Soil fertility investigation

In both 1988 and 1989, potassium response experiments were established. Treatments were a control, and rates of 50, 100 and 200 kg/ha K_2O using both chloride and sulfate forms. Four randomized complete blocks were used. Plot size was 4.8 m X 9.2 m of which the middle 2.4 m X 9.2 m were swathed and combined.

RESULTS AND DISCUSSION

Variety evaluation

Results were too variable in 1988 (CV = 21.3%) to observe significant differences in yield between the two groups of cultivars (Table 1). As a group, indeterminate cultivars showed a mean yield advantage of 15%. In 1989, indeterminate cultivars had a significant yield advantage (37%) over determinate types (CV = 17.5%). Determinate cultivars are reputed to show yield advantages in Europe. Under irrigated conditions in Saskatchewan, indeterminate cultivars appear to be higher yielding. The indeterminate growth habit may be more suited to the variable, short-season continental climate of south-central Saskatchewan.

Seeding rate/row spacing study

In 1989, approximately 30% of the plots were not included in the analysis because equipment problems at seeding creating gaps in the plots. However, there were at least three replications per treatment and yields were analyzed using a least squares general linear model.

Aladin significantly outyielded Outlook in both years. In both 1988 and 1989, there were no significant differences in yield for either seeding rate or row spacing treatments (Tables 2 and 3). This was confirmed in demonstration plots at SIDC in 1989 in which irrigated fababean yields were not significantly different in 40 cm rows compared to 20 cm rows (Irvine, 1990).

These results suggest that under irrigated conditions, the optimum economic seeding rate for fababean may be less than the 38-46 plants/m^2 reported earlier for dryland production in Western Canada (Graf and Rowland, 1987; Seitzer and Evans, 1973; Kondra, Z.P., 1975). Seeding rates of 34 plants/m^2 or possibly lower were considered economically optimum in a Manitoba study (McVetty et al., 1986). This study supports that finding.

Table 1. Growth habit and yield of cultivars included in the determinate fababean evaluation at Outlook in 1988-1989.

Year	Cultivar	Growth habit	Yield (kg/ha)
1988	Outlook	indeterminate	3131
	Herz Freya	indeterminate	3015
	Erfordia	indeterminate	2905
	Group mean		3017
	Tigo	indeterminate	3046
	Ticol	indeterminate	2754
	Tinova	indeterminate	2094
	Group mean		2631
1989	Outlook	indeterminate	4460
	Aladin	indeterminate	4425
	Encore	indeterminate	4383
	Enfordia	indeterminate	4577
	Group mean		4461*
	Tigo	indeterminate	3512
	Ticol	indeterminate	2578
	Tinova	indeterminate	3400
	Tina	indeterminate	3503
	Group mean		3248

*Significant at P < 0.05 level.

Table 2. Effect of seeding rate on yield of two fababean cultivars under irrigation at Outlook, Saskatchewan, 1988-89.

Year	Cultivar	Seeding rate (seeds/m^2)			
		20	30	40	Mean
		------------kg/ha------------			
1988	Aladin	4419	4628	4393	4480
CV = 16%	Outlook	4216	4051	4435	4226
	Mean	4318	4340	4413	
1989	Aladin	4077	4481	4454	4337
CV = 14%	Outlook	3810	4079	3941	3943
	Mean	3943	4279	4197	

Table 3. Effect of row spacing on yield of two fababean cultivars under irrigation at Outlook, Saskatchewan, 1988-89.

Year	Cultivar	Row spacing (cm)			
		20	40	60	Mean
1988	Aladin	4474	4570	4397	4480
CV = 16%	Outlook	4107	4442	4116	4226
	Mean	4301	4506	4257	
1989	Aladin	4240	4455	4317	4337
CV = 14%	Outlook	3922	4109	3798	3943
	Mean	4081	4282	4058	
Mean	Aladin	4357	4512	4337	4408
	Outlook	4014	4275	3957	4082
	Mean	4191	4394	4107	

Most fababean production guidelines in Western Canada recommend narrow row spacing. Results of this experiment suggest that, under irrigated conditions, widening the rows to 40 or even 60 cm may have no effect on yield. There may be additional benefits to wide row cultivation. Fababean plants may remain shorter, reducing the bulk of swaths, thereby reducing drying time and minimizing the risk of field quality losses. Band spraying of herbicides and inter-row cultivation may reduce herbicide costs. Wide row spacing may allow fababean to be used as a companion crop for seedling alfalfa. The more open canopy of wide row spacing may also reduce foliar development of chocolate spot (*Botrytis cinerea f. sp. fabae*). This research requires validation on a field scale.

Seeding date

The results of the 1988 experiment showed a significant yield increase with early seeding (Table 4). Dates of seeding were confounded with field location, but these results agree with previous research showing substantial yield benefits for early seeding (Rowland, 1978; McVetty et al., 1986). On-farm demonstration results from both 1988 and 1989 had the same result (Table 5). In both years, the late seeded treatment had significantly reduced seed size. The earliest seeded treatments were consistently higher yielding than both later dates, and were significantly higher yielding than the late seeded date in both years.

There is no risk to early seeding of fababean. In 1989, there was frost below the seeding zone on April 21. Potential advantages of early seeding include higher yield, earlier harvest (reduced risk for quality loss), reduced plant height, and increased seed weight. A better quality crop is more easily marketed at a higher price. Irrigation usually delays maturity of any crop relative to dryland production in Saskatchewan. Therefore, early seeding is virtually an absolute requirement for achieving consistent high yield potential for irrigated fababean.

Soil fertility investigations

A consistent but non-significant response to potassium application was observed in 1988 (Table 6). On average, plots treated with added potassium yielded about 8% more than the control. In 1989, there was less than 1% difference between the mean of all potassium treatments and the control. More research is needed to document the frequency with which a potassium response can be expected for high-yielding fababean crops on fields with low to moderately low levels of potassium based on soil tests.

Table 4. Effect of seeding date on yield of three fababean cultivars at Outlook, Saskatchewan, 1988.

Cultivar	April 29	May 11	May 19	Mean
	---------------kg/ha---------------			
Outlook	5916	3781	3761	4486
Aladin	6320	3305	2783	4136
Herz Freya	5462	3316	3219	3999
Mean	5899	3467	3254	
CV%	19	19	23	
Pooled S.E.				514

Table 5. Effect of seeding date on yield, seed size and height to the first podded node for Outlook fababean grown under irrigation at Birsay, Saskatchewan, 1988-89.

Year		Seeding date	Yield	Seed weight	Height to podded node	Plant height
			(kg/ha)	(mg)	(cm)	(cm)
1988	(1)	April 20	3638	411	27	89
	(2)	May 2	3517	368	30	105
	(3)	May 14	3302	321*	39	115
CV = 8%						
		Mean	3486	367		
1989	(1)	April 21	4195	376	35	152
	(2)	May 2	4162	362	43	156
	(3)	May 28	2438*	330*	50	152
CV = 7%						
		Mean	3598	356		

*Significant at P<0.05 level.

Table 6. Effect of potassium fertilizer application on yield of Outlook fababean under irrigation, at Outlook, Saskatchewan, 1988-89.

Potassium source	Rate of K_2O applied	Yield		
		1988	1989	Mean
		------------kg/ha-----------		
Control	0	4651	4461	4556
KCl	50	5400	4588	4994
KCl	100	5007	4248	4627
KCl	200	5247	4588	4917
K_2SO_4	50	5086	4461	4773
K_2SO_4	100	5099	4461	4780
K_2SO_4	200	4953	4461	4707
		5079	4467	
CV(%)		8	11	
LSD		NS	NS	

CONCLUSIONS

Results from these studies show that under irrigated conditions in south-central Saskatchewan:

1. Current recommended fababean cultivars with indeterminate growth habit are higher yielding than new determinate cultivars of European origin.

2. Seeding as early as possible in spring (mid-April) is necessary to reach consistent high yield potential for irrigated fababean in south-central Saskatchewan.

3. Seeding rates for irrigation may be reduced to 75% of currently recommended rates without substantial risk of yield loss. This requires field scale confirmation.

4. Widening row spacing to 40-60 cm from 20 cm does not reduce irrigated fababean yield. There may be additional agronomic benefits associated with this agronomic practice. These results require field scale verification.

5. Responses to potassium fertilizer addition may be possible in irrigated fababean crops. More soil fertility investigation is required to enable cost/benefit analysis and positive response frequencies to be determined.

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