The Effect of Seeding Date, Seeding Rate, and Applied Nitrogen on the Yield of Canaryseed

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By

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EXECUTIVE SUMMARY

Between 1992 and 1997, the acres of canaryseed in Saskatchewan have fluctuated between 233,000 and 580,000 acres and the farm gate sales have fluctuated between $18 and $88 million . At present, the major areas of production in Saskatchewan are the Regina plains, Kindersley-Elrose and Melfort. In a survey of canaryseed growers on the Regina plains the biggest problem was the year to year variability in seed yield. The cause of this fluctuation in yield is not known, but suggestions include seeding rate, seeding date, nitrogen rate, potassium, sulfur, aphids, a fungus called leaf mottle, and lack of moisture during grain filling. To determine the cause of this fluctuation in yield and to optimize the agronomics of canaryseed production research examining the effect of planting date, seeding rate and nitrogen rate at three locations, Melfort, Indian Head and Stewart Valley (north of Swift Current) was started in 1999. In 2000, with additional funding from the Potash and Phosphate Institute of Canada, and Agriculture and Agri-Food Canada work was started on potassium and sulfur.

The yield of canaryseed did not readily respond to changes in seeding or nitrogen rates. Slight increases in yield occurred at Melfort and Weyburn in 1999 and 2000 as the seeding rate was increased and a slight decrease occurred at Indian Head in 2001. The other seven times this experiment was conducted, seeding rate had no effect on yield. Canaryseed yield responded to the addition of nitrogen fertilizer by increasing at 5 of the 12 site years and decreasing at 2 of the 12 site years over the three years.

The response of canaryseed to potassium chloride (KCl or potash) has been mixed. Yield increased when KCl was applied at 5 out of 11 site years. At Indian Head in 2001, the addition of KCl increased seed yield while the addition of K_2SO_4 did not increase yield. This may be an indication that the chloride has a larger effect on yield than potassium. Further study is required to increase our under standing of the effects of potassium and chloride on canaryseed yields. Sulfur had no consistent effect on canaryseed yield.

Seeding date and Septoria leaf mottle had a large effect on canaryseed yield. Over the 13 site years the highest yield was obtained on the first seeding date at 6 site years, the second seeding date at 3 site years. Seeding date had no effect on yield at 3 site years. Controlling Septoria leaf mottle with Tilt did provided a yield response 4 out of 8 site years. The four sites where a response did not occur had low levels of infection.

In conclusion, seeding rate, nitrogen rate, and sulfur did not have a large effect on yield variability in canaryseed. Seeding date, potassium chloride, and Septoria leaf mottle do have an affect on the yield variability experienced by canaryseed growers.

TECHNICAL REPORT

INTRODUCTION

Between 1992 and 1997, the acres of canaryseed in Saskatchewan have fluctuated between 233,000 and 580,000 acres and the farm gate sales have fluctuated between $18 and $88 million . At present, the major areas of production in Saskatchewan are the Regina plains, Kindersley-Elrose and Melfort. In a survey of canaryseed growers on the Regina plains the biggest problem was the year to year variability in seed yield. The cause of this fluctuation in yield is not known, but suggestions include seeding rate, seeding date, nitrogen rate, sulfur, aphids, a fungus called leaf mottle, and lack of moisture during grain filling. To determine the cause of this fluctuation in yield and to optimize the agronomics of canaryseed production, research examining the effect of seeding date, seeding rate, nitrogen rate and Septoria leaf mottle was initiated at two locations, in 1998, Indian Head and Weyburn. With additional funding from Saskatchewan Agriculture and Food's Agricultural Development Fund, research was expanded to four locations in 1999, Indian Head, Weyburn, Melfort and Stewart Valley (north of Swift Current). In 2000, additional funding was obtained from the Potash and Phosphate Institute of Canada, and Agriculture and Agri-Food Canada to further investigate the effect of potassium and sulfur. This is a joint project between the Indian Head Agricultural Research Foundation and Agriculture Agri-Food Canada.

The overall objective of this study was to develop management strategies which optimize economic returns to canaryseed producers. The specific objectives of this study were:

1. To determine the effect of the rate of nitrogen fertilizer on the yield of canaryseed
2. To study the impact of date of seeding on the yield of canaryseed
3. To determine the effect of seeding rate on the yield of canaryseed
4. To determine the effect of controlling Septoria leaf mottle on the yield of canaryseed
5. To determine the effect of potassium and sulphur on the yield of canaryseed

RESULTS AND DISCUSSION

Two problems occurred during the 1999 season. At Melfort, hail damaged the plots in early August reducing yield and the reliability of the data obtained. At Weyburn, bird damage and drought at the end of the season reduced yields. In 2000, the Septoria leaf Mottle experiments were lost at Indian Head due to flooding and excessive wild oat pressure at Weyburn. In 2001, we experienced a very dry year with low yields. The dry conditions were exasperated by an inordinate amount of wind in May at several locations.

The yield of canaryseed did not readily respond to a change in the seeding rate. Slight increases in yield occurred at Melfort and Weyburn in 1999 (Figure 1) and 2000 (Figure 2) as the seeding rate was increased and a slight decrease occurred at Indian Head in 2001 (Figure 2). The other seven times this experiment was conducted, seeding rate had no effect on yield. These plots were all relatively weed free. It appears that varying the seeding rate will not greatly improve the yield stability of canaryseed, since the variation in yield between the sites was much larger than the response to increasing the seeding rate. There is likely some benefits to be obtained with higher seeding rates under weedy conditions. At the present time the data suggests that a seeding rate of 30 lbs an acre is appropriate.

Canaryseed yield responded to the addition of nitrogen fertilizer by increasing at 5 of the 12 site years and decreasing at 2 of the 12 site years over the three years (Figures 3 and 4). (A site year is defined as the test being carried out at one location in one year. Indian Head in 1998 would be considered one site year.) At Stewart Valley, the canaryseed yield responded to higher nitrogen rates in 1999 and 2000 but not in 2001. In 1999 at Indian Head, there was a statistically significant response, however, the response does not appear to be biologically significant or relevant to farmers growing canaryseed. At Indian Head and Weyburn, yield increased in 2000 and decreased in 2001. Although statistically significant the increases and decreases were very small. Varying the amount of applied nitrogen does not help us much in understanding the yield variability in canaryseed.

The effect of potassium chloride (KCl) and sulphur on canaryseed yields were mixed. In 2000, yield increased as KCl (potassium chloride) was increased at two locations, on a sandy loam south of Indian Head and Stewart Valley, while at Saskatoon the 13 lbs/acre rate lowered yield and the 27 lbs/acre rate increased yield (Figure 5). Weyburn followed the trend observed at Saskatoon when sulphur wasn't added but KCl had no effect when sulphur was added. At Melfort, yield did not respond to KCl . The addition of sulfur decreased yield at Indian Head and increased yield at Stewart Valley.

In 2001 there was a significant response to KCl at Indian Head, Stewart Valley and Saskatoon. The largest response occurred at Indian Head followed by Stewart Valley. The response at Saskatoon was very small. At Indian Head an extra treatment K_2SO_4 was added to the experiment. Unlike KCl, the K_2SO_4 did not increase yield. This may indicate that the Cl component of the KCl
is increasing the yield of canaryseed in some situations. The addition of sulfur had no effect on yield at any location in 2001 (data not shown). The residual levels of potassium and sulphur for each site at the beginning of the growing season are in Table 3. Further investigation into the effects of potassium and chloride on canaryseed are required.

Delayed seeding of canaryseed had a large effect on yield (Figures 6 and 7). Over the 13 site years, the highest yield was obtained on the first seeding date at 6 site years, the second seeding date at 3 site years. Seeding date had no effect on yield at 3 site years. At Indian Head in 2001, yield increased as seeding was delayed until early June. Soil conditions were getting dryer as seeding was delayed, however, the early June seeding date was not as exposed to the numerous windy days that placed a large amount of stress on the canaryseed. A fall seeded treatment with coated seed was added to the seeding date test at Indian Head for 2000 and 2001. Unfortunately spring emergence was low in both years. The data suggests that a mid April to early May seeding date is appropriate for the south west portion of Saskatchewan and a early to mid May seeding date is appropriate for the rest of Saskatchewan. From my own personal observations I would not recommend seeding canaryseed in to a cold wet soil. I recommend waiting until good seed bed conditions can be achieved to ensure adequate seed to soil contact.

Septoria leaf mottle had a large effect on yield. Controlling Septoria leaf mottle with Tilt reduced the severity of the septoria at all three sites in 1999 (Figure 8). Seed yield increased at 4 out of 8 site years (Figure 9) . At Indian Head in 1998, controlling the heavy infestation of Septoria leaf mottle with Tilt resulted in a 29% increase and controlling a moderate infestation at Indian Head in 1999 resulted in a 22% increase in yield. Even at Melfort in 1999 where yields

were reduced by hail the application of Tilt resulted in a yield increase and in 2000 the yield increase was 40%. When the infestation of Septoria was light; Stewart Valley in 1999, 2000 and 2001; and Indian Head in 2001; there was no response to the application of Tilt. I believe that Septoria leaf mottle may be a part of the answer to the yield variability experienced by farmers growing canaryseed.

Only the yield data was presented in this report. The rest of the collected data is available on request.

ACKNOWLEDGEMENTS

I would like to thank Saskatchewan Agriculture and Food, the Potash and Phosphate Institute of Canada, and Agriculture and Agri-Food Canada for their financial support. The collaborators on this project are Guy Lafond, Yantai Gan, Pierre Hucl, and Adrian Johnston. Technical support was provided by Roger Geremia, Orla Willoughby, Chris Holzapfel, Glen Davidson, and Bob Linnell.

Table 1. Potassium and Sulphur levels at the test sites

	Indian Head Sandy Loam	Weyburn	Stewart Valley	Saskatoon	Melfort	Scott
	lbs/acre					
	2000					
Potassium (0-6")	310	540	601	528	507	
Sulphur (0-6")	31	25	15	59	53	
	2001					
Potassium (0-6")	660	510	483		540	502
Sulphur (0-6")	53	36	83		38	20

Table 2. The effect of potassium and sulfur on canaryseed at Indian Head(sandy loam soil) in 2001

	Yield		Plant Density[Z]	Head Density		Seed Density		Seed weight	Test Weight	Height
Kg ha^{-1}	Kg ha^{-1}	lb ac^{-1}	plants m^{-2}	heads m^{-2}	heads $plant^{-1}$	seeds $head^{-1}$	seeds m^{-2}	g 1000 $seeds^{-1}$	g $L^{-0.5}$	cm
Sulfur										
0	917*a*	817	219*a*	594*a*	2.9*a*	20.9*a*	11625*a*	7.9*a*	356*a*	86*a*
20	891*a*	794	211*a*	599*a*	2.9*a*	20.2*a*	11395*a*	7.8*a*	354*a*	86*a*
Potassium										
0	791*a*	704	203*a*	588*a*	3.0*a*	18.6*a*	10208*b*	7.7*b*	350*b*	87*a*
15	899*a*	801	211*a*	609*a*	3.1*a*	20.0*a*	11474*ab*	7.8*ab*	356*a*	86*a*
30	1023*a*	911	231*a*	593*a*	2.6*a*	23.1*a*	12847*a*	8.0*a*	360*a*	85*a*
Contrasts										
Linear	*		NS	NS	NS	NS	*	**	**	NS
Quadratic	NS		NS	NS	NS	NS	NS	NS	NS	NS
K_2SO_4	621	553	199	589	3.2	14.1	8015	7.8	349	88.9
Contrasts										
K_2SO_4 vs 0 P+20 S	NS		NS	NS	NS	NS	NS	NS	NS	NS
K_2SO_4 vs 30 P+20 S	**		NS	NS	NS	0.06	0	NS	**	NS
CV	21		15	20	30	33	21	1.7	1.6	5.2

[Z] The fertilizer was side banded 1" to the side and 2" below the seed. A Conserva Pak seeder was used.

Table 3. Residual N at the test sites in 1998, 1999 and 2000

		Depth	Nitrogen
Year	Location	inches	lbs/acre
1998	Indian Head	0-24	24
	Weyburn	0-6	14
1999	Indian Head	0-24	31
	Weyburn	0-6	27
	Swift Current	0-24	24
	Melfort	0-24	56
2000	Indian Head	0-24	30
	Weyburn	0-6	23
	Swift Current	0-24	28
2001	Indian Head	0-24	40
	Weyburn	0-12	48
	Swift Current	0-24	23

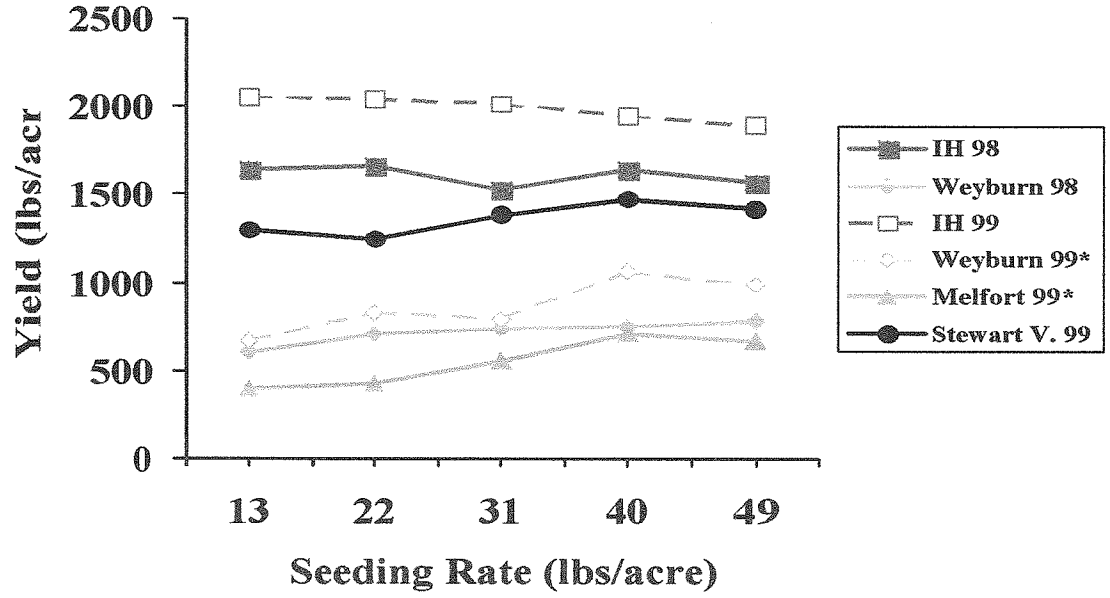

Figure 1. Seeding rate and canaryseed yield in 1998 and 1999

*there was a statistically significant difference at that site y ear

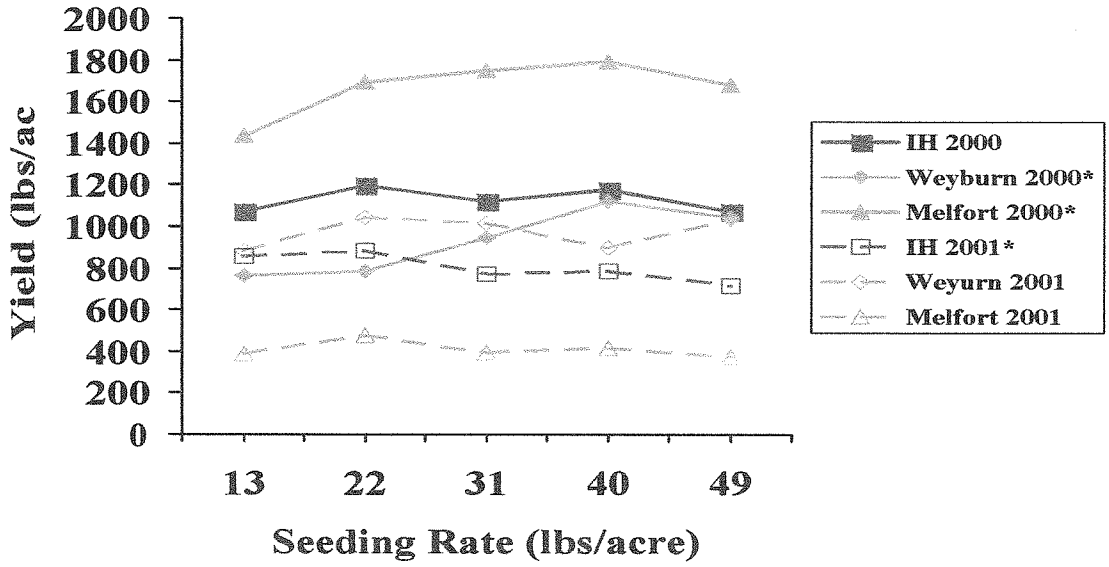

Figure 2. Seeding rate and canaryseed yield in 2000 and 2001

*there was a statistically significant difference at that site y ear

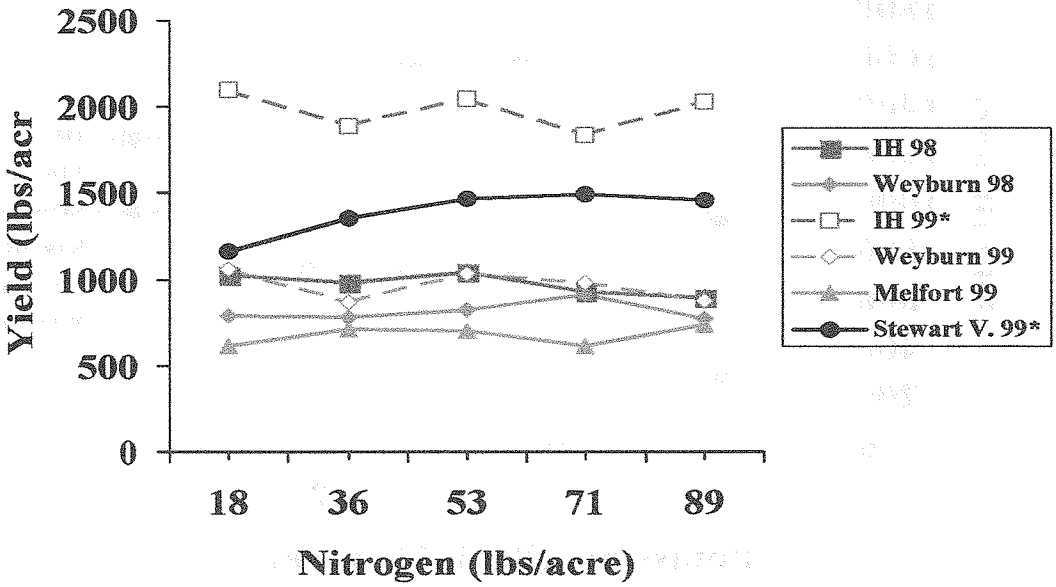

Figure 3. Nitrogen rate and canaryseed yield in 1998 and 1999
*there was a statistically significant difference at that site year

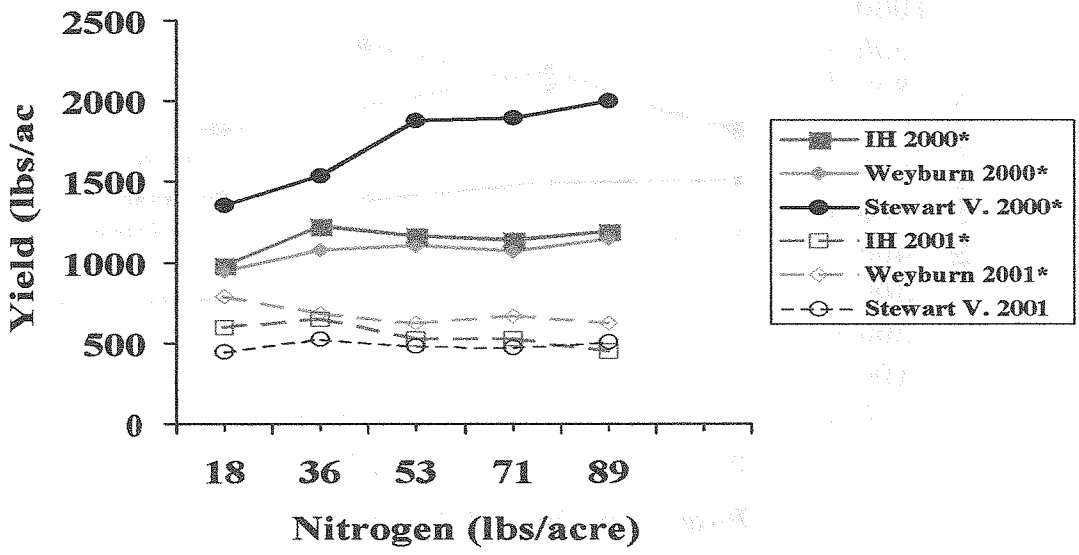

Figure 4. Nitrogen rate and canaryseed yield in 2000 and 2001
*there was a statistically significant difference at that site y ear

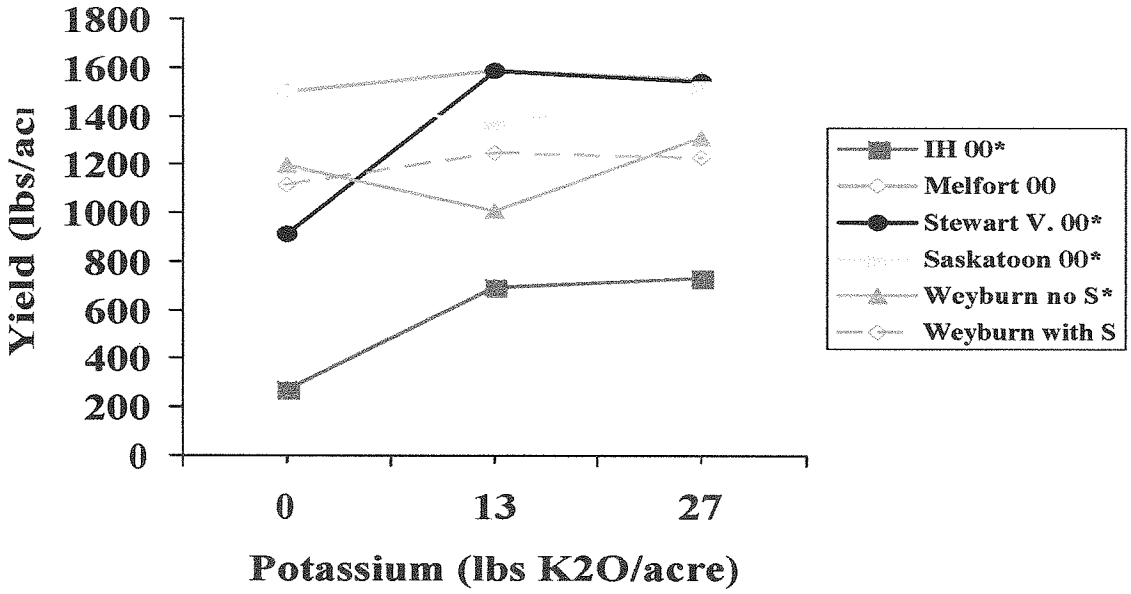

Figure 5. Potassium, sulphur andcanaryseed yield in 2000

*there was a statistically significant difference at that site y ear

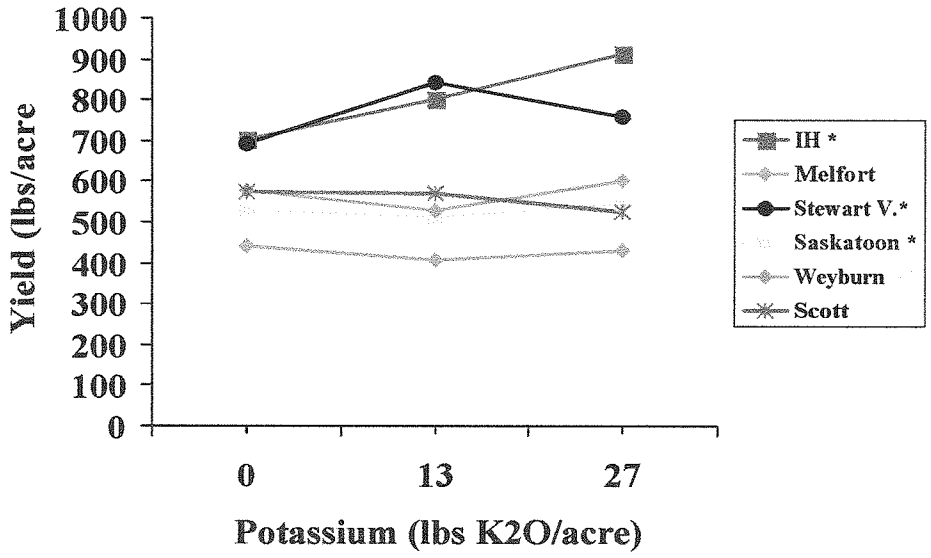

Figure 6. Potassium, sulphur andcanaryseed yield in 2001

*there was a statistically significant difference at that site year

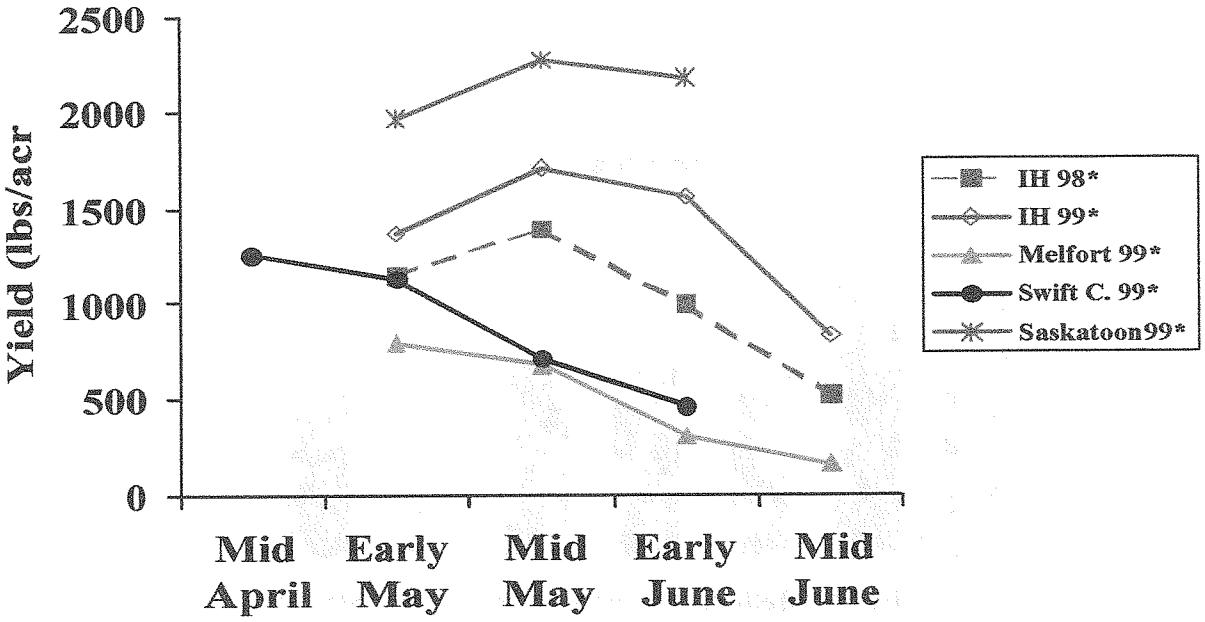

Figure 7. Seeding date andcanaryseed yield in 1998 and 1999

*there was a statistically significant difference at that site year

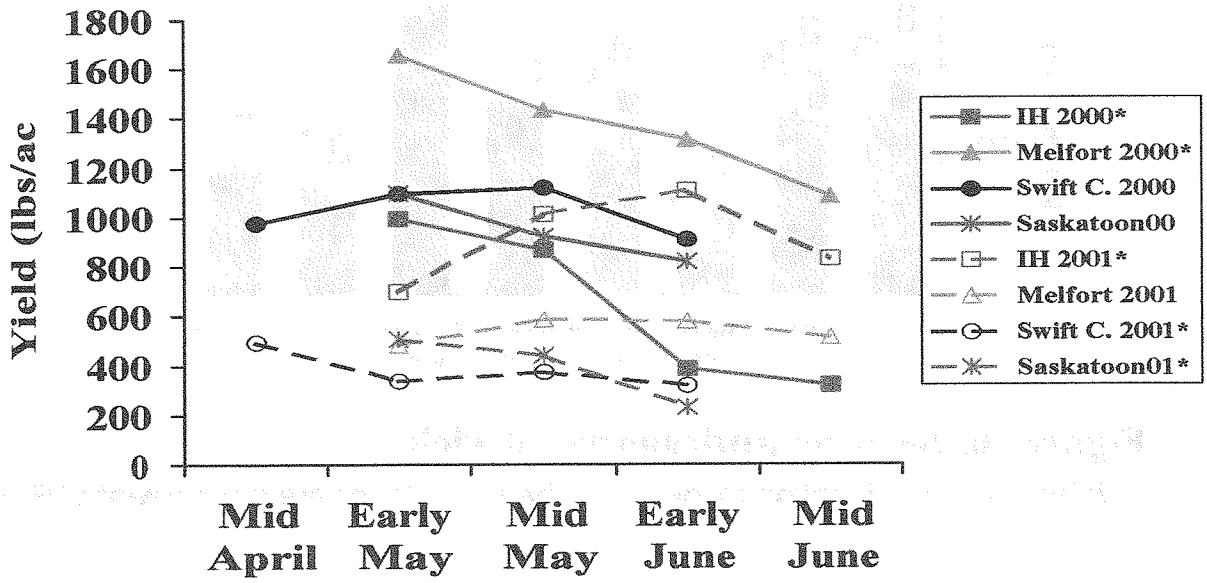

Figure 8. Seeding date and canaryseed yield in 2000 and 2001

*there was a statistically significant difference at that site y ear

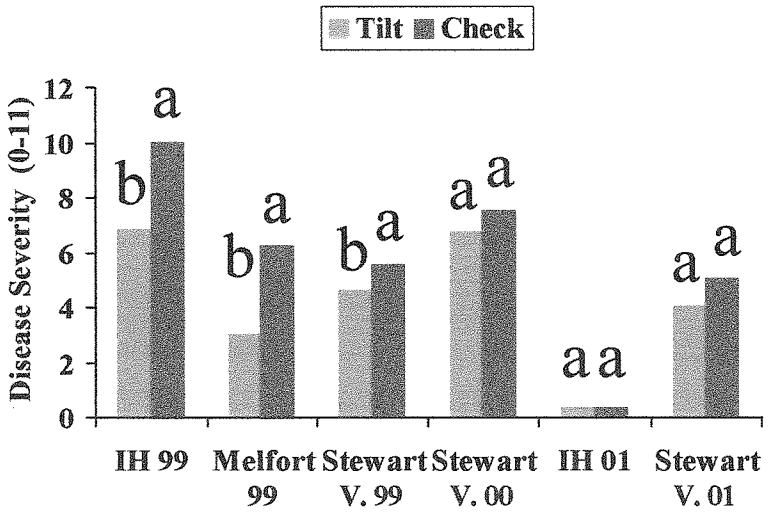

Figure 9. Severity ofSeptoria.
a-b Bars within a location followed by the same letter are not different at *P* = 0.05

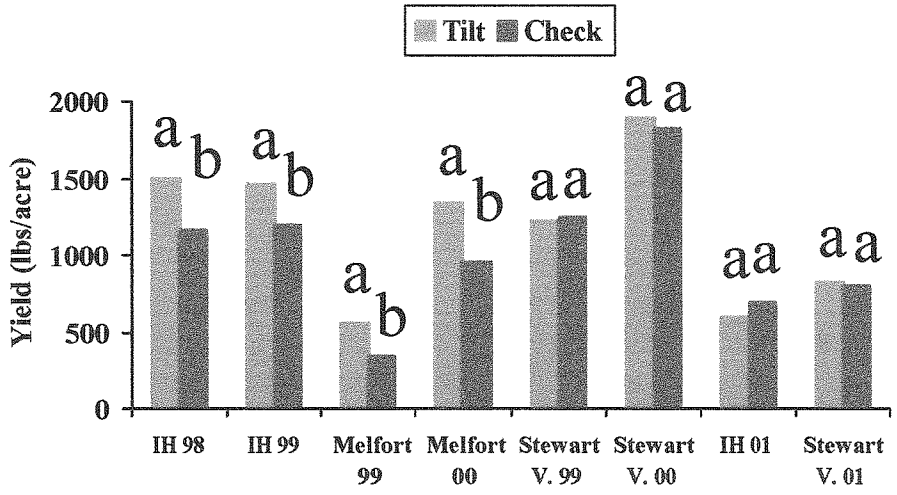

Figure 10. Septoria andcanaryseed yield.
a-b Bars within a location followed by the same letter are not different at *P* = 0.05