SCLEROTINIA CONTROL IN IRRIGATED DRY BEAN

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ABSTRACT

White mold, caused by *Sclerotinia sclerotiorum*, can devastate an irrigated dry bean (*Phaseolus vulgaris* L.) crop. The fungal infection begins on the petals when the weather is cool and damp and the microclimate within the crop canopy remains humid. *Sclerotinia* infection can be reduced by an application of fungicide on the bean petals before the infection begins. Because leaves shield the flowers on dry bean plants, conventional field sprayers may not be the most effective method of applying fungicide. A three year project involving a network of cooperating farmers was conducted to compare the skid-boom and airblast sprayers to conventional sprayers for effectiveness of fungicide application. Effectiveness was measured by the number of *Sclerotinia* infected plants and yield of irrigated dry bean. Differences in yield and infection incidence among sprayer types were not significant. Yield and infection incidence differences among years were significant. The decision to apply fungicide for *Sclerotinia* control in irrigated dry bean in south-central Saskatchewan depends on the probability of cool, moist weather occurring during the flowering period.

INTRODUCTION

Irrigated dry bean production in Saskatchewan is in its infancy. One of the major constraints to irrigated production of dry bean is the fungal disease *Sclerotinia* (white mold). *Sclerotinia* is the most serious disease of irrigated dry bean in Alberta[1] and threatens dry bean production in North Dakota[2]. Dry bean growers in Saskatchewan must consider options for disease control.

Hard bodied sclerotia in the soil are the inoculum source for *Sclerotinia* (white mold). When environmental conditions are favourable (cool and moist), the sclerotia germinate as funnel-shaped apothecia which release spores. If this happens within the canopy when dry bean plants are flowering, the spores land on the flowers. Infected blossoms may lodge in the petiole axils. Successful infection leads to mycelial growth in stems, petioles and pods and leads to development of new sclerotia. Infected plants or portions of plants wilt prematurely, reducing yield. Yield is further reduced by pod infection which results in seed abortion and reduction in seed size.

Sclerotinia (white mold) has the potential to completely devastate a crop of irrigated edible dry bean. There are four agronomic practices that may reduce the risk of *Sclerotinia* infection in irrigated dry bean crops: 1) selecting fields with low inoculum levels, 2) delaying canopy closure by seeding in rows 50 - 60 cm apart, 3) seeding rows in the direction of the prevailing winds, 4) planting cultivars that avoid infection, and 5) applying a fungicide at early bloom.
With good management under irrigation, dry bean plants grow and branch profusely. Canopy closure occurs at the same time as flowering, maximum daily water use, peak irrigation water application and maximum susceptibility to *Sclerotinia* infection. Fungicide application is costly.

For optimum fungicidal control of *Sclerotinia* the flowers, lower branches, and stems, must receive a thorough coverage of fungicide3. Dry bean flowers are partially protected by leaves. Therefore, applying fungicide with a conventional field sprayer may not be the most effective method.

Airblast sprayers and skid-boom sprayers are possibly more effective for fungicide application in dry bean crops for irrigated dry bean crops. The airblast sprayer has a large fan that blows air through a manifold, down the booms, and out a grommet with an air foil. The fungicide is metered into the air stream and blasted into the crop canopy as very small droplets. The skid-boom sprayer has skid plates that slide on the ground between rows. Two nozzles are mounted at upward-facing angles on each plate, directing the spray at the blossoms, lower branches, and stem of the dry bean plants. The boom and skid plates are mounted on the front of the tractor while the tank (3-point hitch mounted) and pump are at the rear.

A demonstration project was conducted from 1989 to 1991 with a network of cooperating irrigation farmers. This project had three objectives: 1) to determine what level of yield loss is attributable to *Sclerotinia* (white mold) for irrigated dry bean production in Saskatchewan; 2) to evaluate the effectiveness of fungicidal control of *Sclerotinia* by comparing airblast, conventional, and skid-boom spraying; and 3) to demonstrate production of a new irrigated specialty crop.

MATERIALS AND METHODS

Most of the on farm demonstration sites were northeast of Outlook, Saskatchewan. One site was located at Dunblane, Saskatchewan. Each year, three sites were chosen for the airblast sprayer vs. conventional sprayer comparison and three sites were used to compare the skid-boom sprayer to the conventional sprayer. The locations and co-operators varied from year to year.

The fields used for the projects ranged in size from four to 14 hectares (10 to 35 acres). Each field was subdivided into six strips. Two strips for each of the three treatments. Treatments were: 1) airblast or skid-boom sprayer, 2) conventional sprayer, and 3) a control strip.

Rows were spaced 53 to 61 cm (21 to 24 in.) apart. Most sites were seeded in the east-west direction, to take advantage of the prevailing winds.

Benlate (benomyl) was applied at each site at 2.2 kg/ha (2.0 lb/ac). Conventional sprayers used 45 to 90 litre/ha (10 to 20 gal/ac) of water with flat fan nozzles. The airblast sprayer applied Benlate with a water volume of 20 litres/ha (4.5 gal./acre). Wide angle full cone nozzles were used on the skid-boom. These nozzles applied Benlate with 228 litres/ha (50 gal/ac) of water.
Just prior to harvesting, each strip was surveyed to determine the incidence of *Sclerotinia* infection. Samples of 100 plants were randomly selected at five locations within each strip. Each plant was observed for signs of *Sclerotinia* infection.

Commercial combines equipped with a floating cutter bar (flex header) and an air-reel were used to harvest the dry bean crops. A five hundred foot sample, the width of the combine header, was harvested from the centre of each treatment strip. A weigh wagon was used to determine the yield. Harvest losses were determined by counting the number of bean seeds on the ground in a 1/4 m^2 quadrat, at several random locations within each field.

Saskatchewan producers of irrigated dry bean use flex headers and air reels to direct harvest the crop. This method is being adapted from lentil production and requires some modifications to reduce harvest losses. Harvest losses ranged from 10 to 50 percent. To avoid influencing yield results from interaction with harvest loss factors, the yield is reported as potential yield. Potential yield is the net yield plus harvest losses.

RESULTS AND DISCUSSION

Yield and *Sclerotinia* infection data from all demonstration sites over three years were combined and analyzed to detect any differences among years. Results are shown in Figure 1. In 1990 the number of *Sclerotinia* infected plants was significantly greater than in 1989 or 1991. The *Sclerotinia* infection incidence was 20% in 1990 and yield in 1990 was significantly greater than in 1991. These results indicate that *Sclerotinia* infections and yield are highly dependant on the weather patterns and agronomic management within a given year. Mean maximum temperatures for July 15 - 31 in 1989, 1990, and 1991 were 30 oC, 24 oC, and 26 oC respectively. Late July of 1990 was cool and had ideal environmental conditions for *Sclerotinia* infection.

At sites where the skid-boom sprayer was tested, yield was significantly higher in 1991 than 1990 (Figure 2). The incidence of *Sclerotinia* did not differ between 1990 and 1991 (Figure 3). This indicates that factors other than *Sclerotinia* infection, were responsible for yield differences.

At the skid-boom sites Benlate application reduced *Sclerotinia* infection incidence compared to the controls for both sprayer types in all three years. No significant difference in *Sclerotinia* incidence or yields was evident between conventional or airblast spraying of fungicide (Figure 4).

The variability of yield among years is shown in Figure 4. At the airblast sites, yield was significantly lower in 1991 compared to 1989 and 1990. Incidence of *Sclerotinia* in 1991 was virtually nil in these fields (Figure 5). No *Sclerotinia* infection and low yield potential indicate a shortage of irrigation. Without an adequate supply of water, dry bean plants do not grow enough to close the canopy to create an environment favourable for Sclerotina infection.

Benlate application using the airblast sprayer had the lowest incidence of *Sclerotinia* and the highest yield compared to the conventional sprayer treatment (Figures 4 , 5). The differences were not significantly different.

SUMMARY AND CONCLUSION

Sites where the skid-boom sprayer was demonstrated, had a consistently higher incidence of *Sclerotinia* than fields where the airblast sprayer was demonstrated. Benlate application caused the greatest reduction in *Sclerotinia* infection at the skid-boom sites.

Sclerotinia infection incidence and yield were significantly different among years. The highest yield was achieved in 1990 when the *Sclerotinia* infection incidence was the greatest. Benlate application and airblast spraying did not result in yield increases or changes in the incidence of *Sclerotinia* infection compared to conventional spraying or control strips. Irrigation management was a significant factor in these comparisons.

Irrigated pinto bean growers in south-central Saskatchewan may not need to apply Benlate if the following criteria are met: 1) beans are seeded into fields with low levels of *Sclerotinia* inoculum, 2) rows are spaced 53 to 61 cm (21 to 24 in.) apart, 3) rows are open toward the prevailing winds, and 4) cool moist weather does not occur during the flowering period.

Achieving high yield potential however, requires that adequate irrigation be maintained during late July and early August if necessary. If cool moist weather patterns are prevalent in late July a Benlate application may be economically justifiable if the field has a high level of *Sclerotinia* inoculum.

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Airblast sprayer: Agriculture Canada Research Station -- Regina

Skid-boom sprayer:
Designers: John Konst and Harry Ostevik
Manufacturer: Harry O's Welding

Co-operators:
Bruce Davison
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Jerry Eliason
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Rainbow Farms (John Konst)

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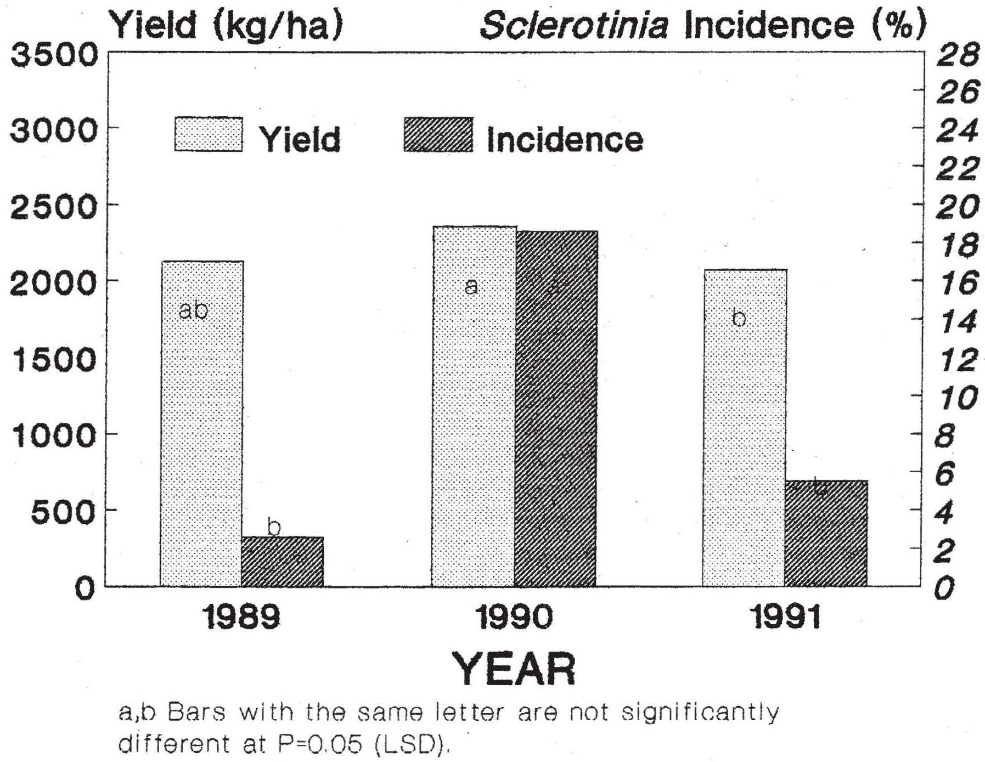


Fig. 1. Average Yield and *Sclerotinia* Incidence of Irrigated Dry Bean 1989-1991.

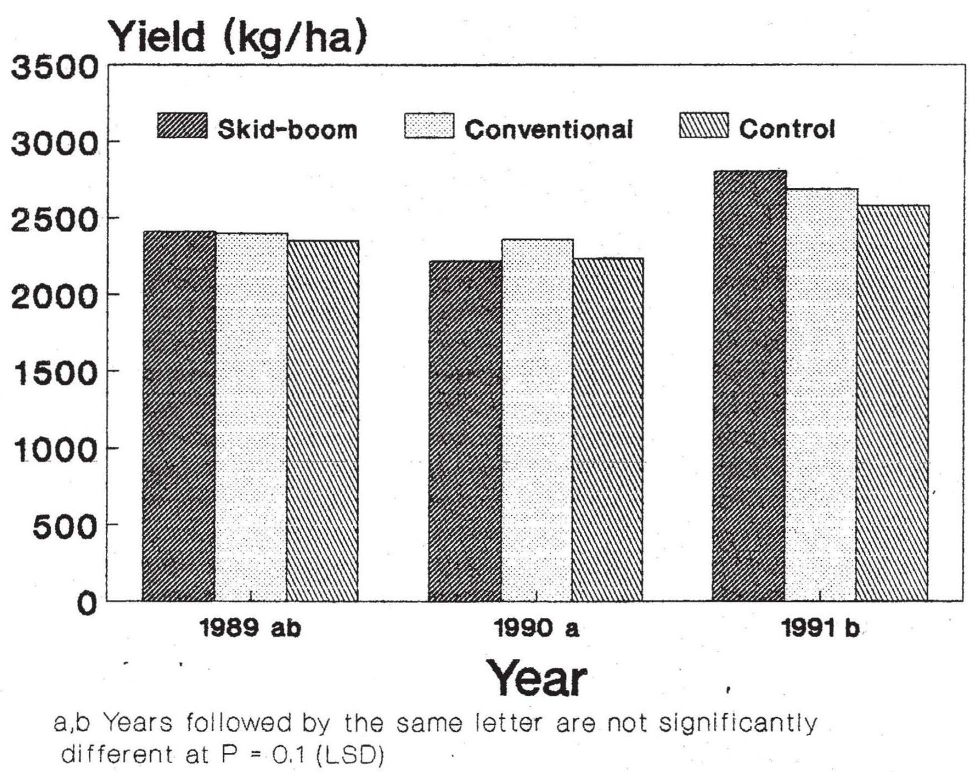
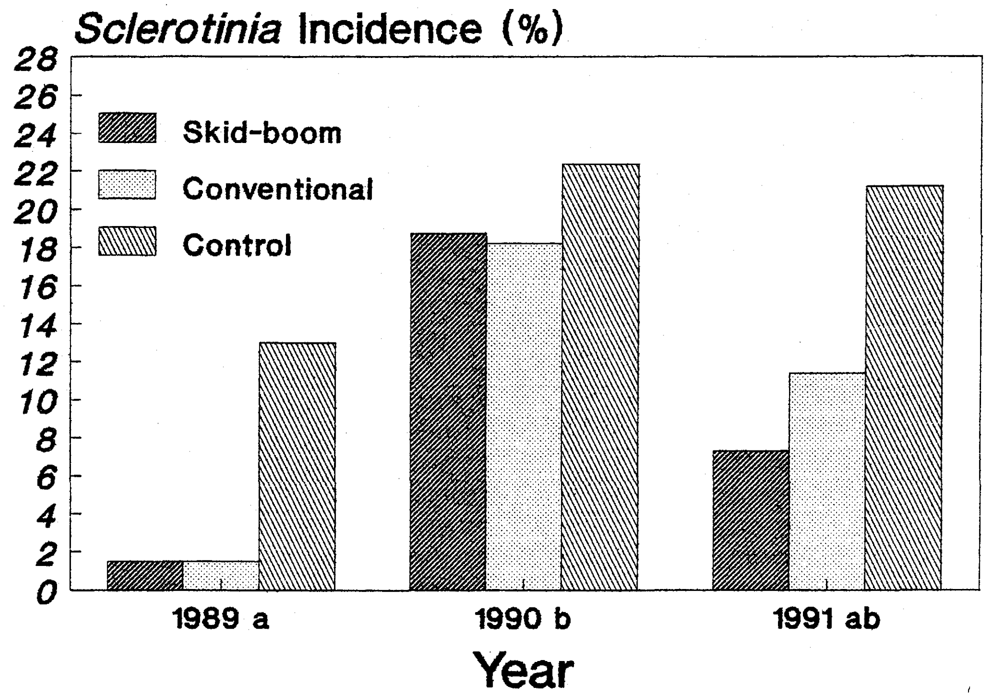
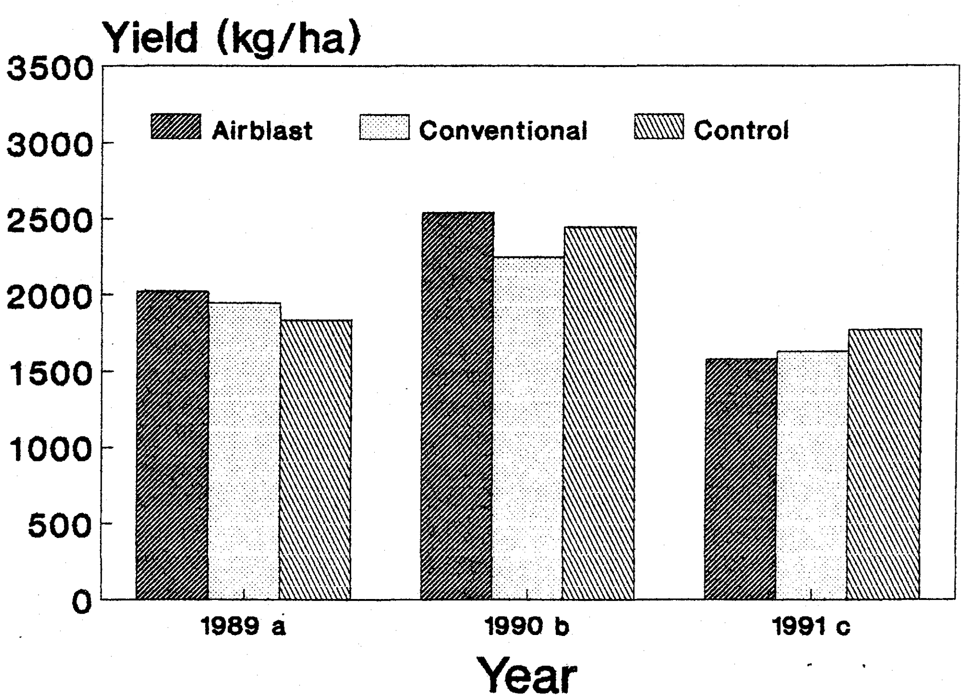


Fig. 2. Average Potential Yield of Irrigated Dry Bean at Skid-boom Sites 1989-1991.



a,b Years followed by the same letter are not significantly different at P = 0.05 (LSD)

Fig. 3. Average *Sclerotinia* Incidence in Irrigated Dry Beans at Skid-boom Sites.



a,b Years followed by the same letter are not significantly different at P = 0.05 (LSD)

Fig. 4. Average Potential Yield of Irrigated Dry Bean at Airblast Sites 1989-1991.

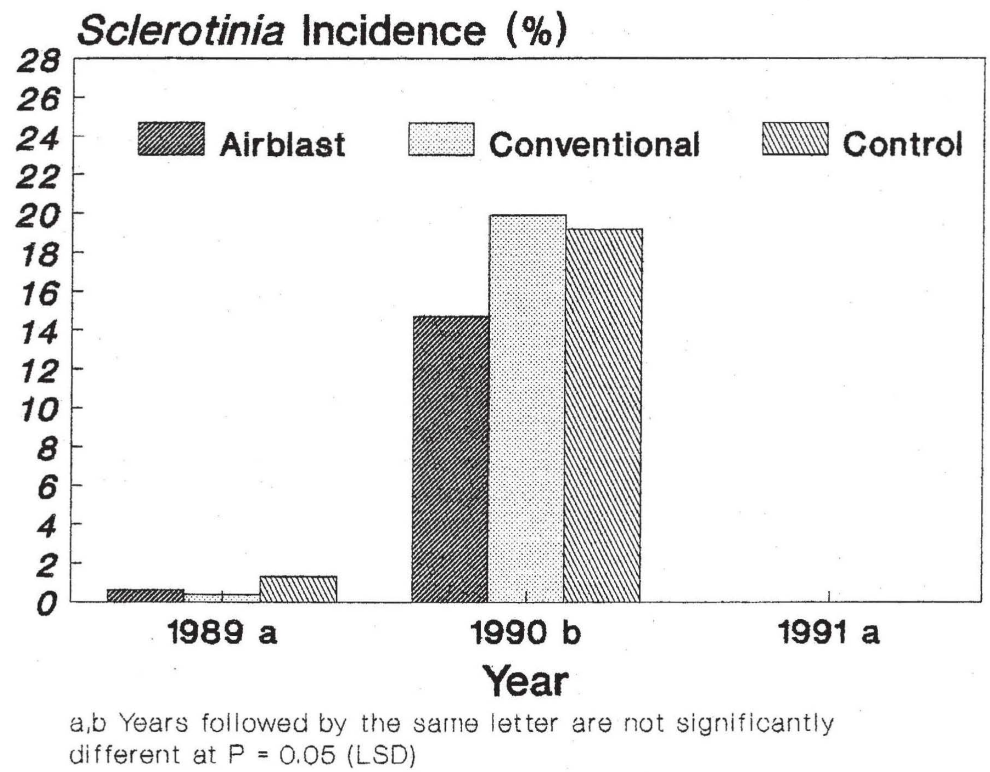


Fig. 5. Average *Sclerotinia* Incidence in Irrigated Dry Bean at Airblast Sites 1989-1991.