Efficacy of *Penicillium bilaiae* on Fall Seeded Canola

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Introduction

Phosphorus (P) is vital to plant growth and thus is important to agriculture on the Canadian prairies. Although P is not as abundant as N and K in temperate soils it is just as important to plant nutrition. Prairie soils are often high in total P, but relatively low in plant available P (Tisdale et al., 1993). Cool temperatures slow the release of P from soil organic matter, lower absorption and translocation rates in plants, and reduce nutrient movement by diffusion in soils (Lanyon and Griffith, 1988). Both soil temperature and soil moisture are at their lowest during the first critical 4-6 weeks after seeding when P requirements are at their highest (Doyle and Cowell, 1993). Thus, an increase in P during the cool early spring should increase plant growth.

Due to inadequate levels of available P for plant growth, P is usually added as fertilizer. Recently, microbial inoculants have been used to increase the amount of P found in the soil solution, thereby increasing the amount of P available for uptake by the plant.

Studies conducted in southern Alberta by Kucey (1983) concluded that *P. bilaiae* was the superior soil fungal organism in its ability to solubilize P. Gleddie (1992) reported *P. bilaiae* maintained its ability to solubilize P at temperatures as low as 4 ºC. Furthermore *P. bilaiae* has shown to grow and survive under field conditions, has the ability to survive the winter, and does not move below 10 cm in the soil (Keyes, 1990). These characteristics suggest that *P. bilaiae* might be an effective inoculant on fall-seeded crops.

Seeding canola in the fall enables producers to take advantage of early spring moisture. The avoidance of flowering in hot, dry July conditions is necessary for canola production in the Dark Brown and Brown Soil Zones (Grow Tec Inc., 1999). Late fall-seeding advances the maturity of canola so that it can be harvested 25 days earlier than mid-May seeded canola (Kirkland and Johnson, 1999). Additional advantages of fall seeding canola include increased crop yields, larger seeds produced and higher oil content (Kirkland and Johnson, 1999). Practical advantages to the producer include reducing the work load at traditional, busy seeding and harvest times. It is necessary that the canola be seeded as close to freeze-up as possible to avoid early germination.

Materials and Methods

Site selection was based on the following criteria: (1) the land was out of canola production for the last three years before soil sampling occurred; (2) past management of the site included low fertilizer and no chemical applications that would hinder canola growth; (3) stubble fields; (4) total soil P levels were below 40 lb/ac; (5) the soil was relatively uniform and nonsaline. Three sites meeting the criteria included North Battleford, Stewart Valley and Aberdeen.

Variety LG3235 was obtained from Monsanto Inc. (Saskatoon, SK) and treated with Vitavax RS®, excluding the brightener. *Penicillium bilaiae* viability increases substantially when the brightener is eliminated from the polymer that is added to the Vitavax RS® treatment (Sherrilyn Phelps, Philom Bios Inc., personal communication). Some fall treatments included an Extender® polymer coating that was preapplied by Grow Tec Inc.. *Penicillium bilaiae* was applied as the Philom Bios Inc. product, Jumpstart®. The recommended rate of water was added to the Jumpstart® and applied as slurry onto the seed coat immediately before seeding.

Treatments included a control, *P. bilaiae* treatment and a P treatment of an additional 10 lb/ac of 12-51-0 placed with the seed, and was equivalent to the soil test recommendation. Nitrogen and Sulfur were applied to all of the plots at the recommended rate given by soil tests from Enviro-Test Laboratories. Phosphorus was side banded at 10 lb/ac less than the recommended rate to all plots.

Some of the fall seeded treatments included a polymer coating, Extender® that is used to prevent the seed from germinating in the fall. These treatments were not looked at separately for this study and were averaged into the data.

The fall seeded canola at North Battleford was seeded on October 24, 2000 and the comparative spring seeded canola on April 30, 2001. Aberdeen fall seeded canola was seeded on October 25, 2000 and the spring seeded canola on April 27, 2001. Stewart Valley seeding dates were October 26, 2000 and April 28, 2001.

Samples were harvested at four and six weeks after emergence by removing all of the aboveground biomass in a square meter of each plot. Samples were dried at 42°C and weighed. Gleddie et al. (1993) reported a low response of canola to *P. bilaiae* after the eight week stage thus reducing the need for more additional samples to be taken.

The samples collected were ground and used for analysis for P uptake. The samples were digested using sulphuric acid following the procedure of Thomas et al. (1967). Phosphorus uptake was determined colorimetrically. Only the Aberdeen and North Battleford sites were analyzed for P uptake.

When greater than 50% of the plants were ready for harvest the entire site was combined. The seeds were dried and weighed.

Results and Discussion

Both the *P. bilaiae* and P fertilizer treatments yielded higher than the control at the four week growth stage (Figure 1). The beneficial effects in terms of growth of each treatment was not consistent between the sites, the largest increase in growth varied between *P. bilaiae* and P fertilizer treatments.

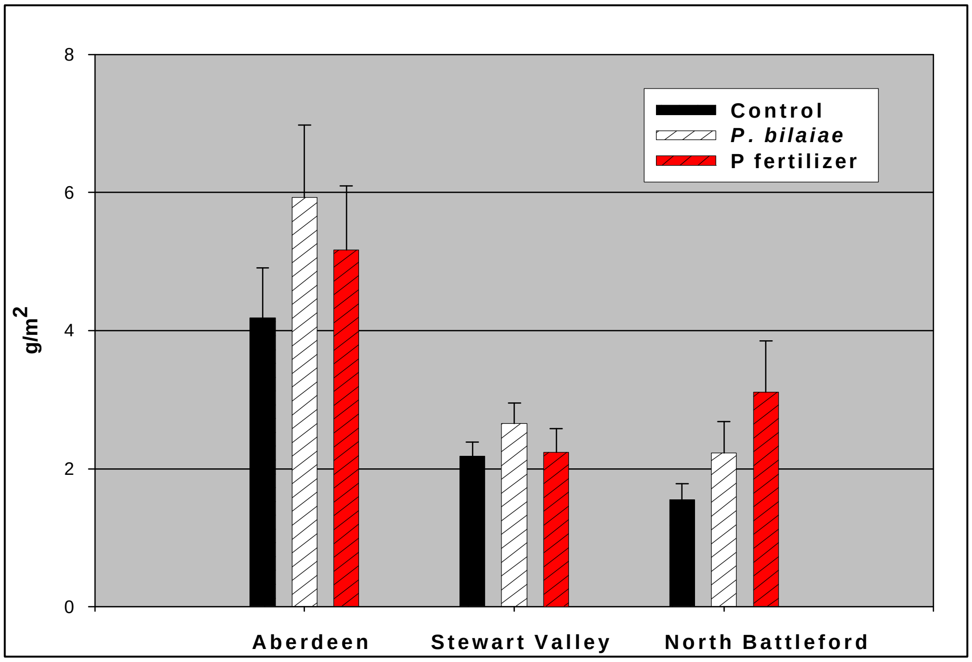

Figure 1: Dry matter yield at 4 weeks after emergence.

Phosphorus uptake (Figure 2) showed the same trend as dry matter yields. This indicates that P uptake was greatly influenced by plant growth. Phosphorus uptake independent of growth would mean that more P was available for the plants to take up resulting in an increase in P uptake.

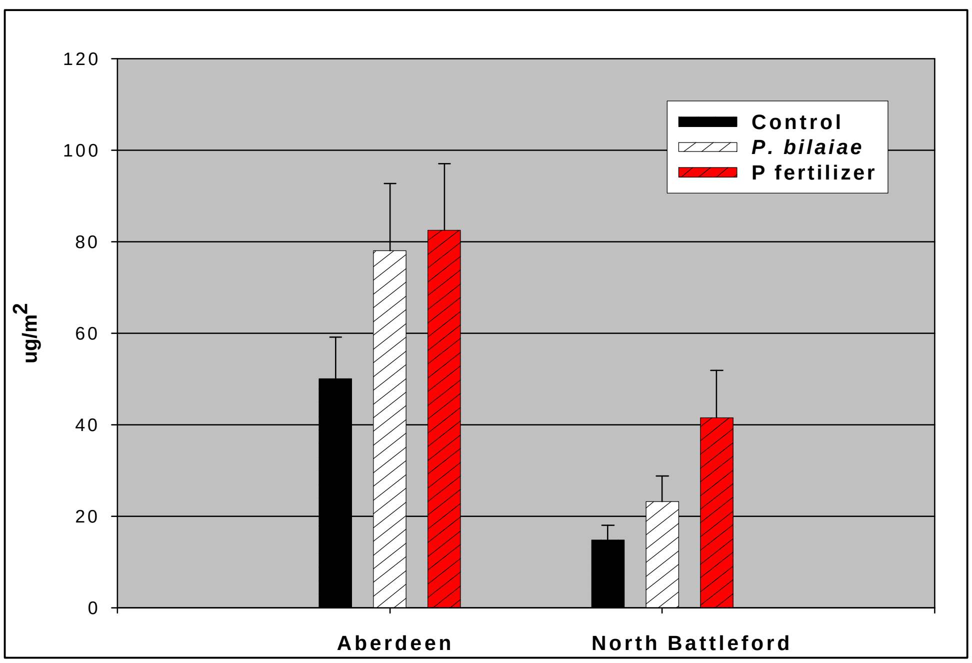

Figure 2: Phosphorus uptake at 4 weeks after emergence.

Results for six week dry matter sample and the six week P uptake data showed the same response across treatments (data not shown). Gleddie et al. (1993) reported a low response of canola to *P. bilaiae* after the eight week stage. The low response at the earlier six week stage may be a result of the poor moisture conditions further limiting treatment differences.

The combining of all of the sites showed that the *P. bilaiae* and P fertilizer treatments yielded higher when spring seeded than when the treatments were fall seeded (Figure 3). There was a difference in yield between the two seeding dates for only the P fertilizer treatment. The fall seeded treatments showed no difference with the additional P fertilizer compared to the controls. However, the plots receiving the *P. bilaiae* treatment showed an increase in dry matter at the fall seeding dates compared to the control.

Some of the differences in fall seeded and spring seeded treatments can be attributed to weather restrictions. The North Battleford site received a heavy snowfall in late April, which left a surface crust that inhibited fall seeded canola emergence.

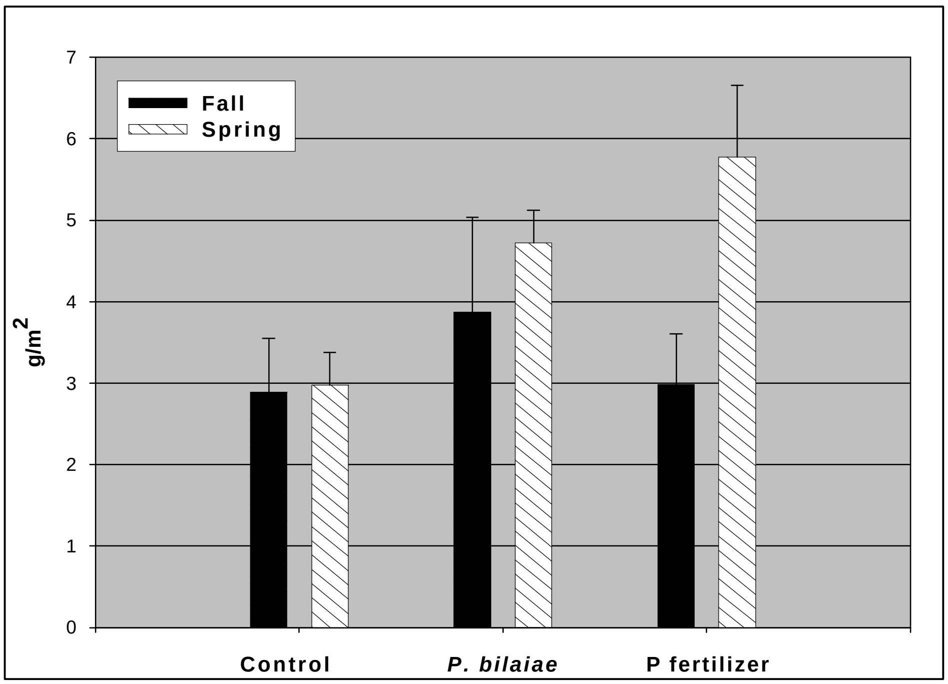

Figure 3: Fall seeded canola compared to spring seeded canola at 4 weeks after emergence. All of the sites were averaged together and grouped according to treatment.

Treatment differences at harvest were not as evident as they were at the four week growth stage (Figure 4). Moisture limitations decreased treatment differences at all of the sites resulting in fairly even harvest yields within each site. Stewart Valley received only 35 mm of rainfall during the growing season, which resulted in poor yields.

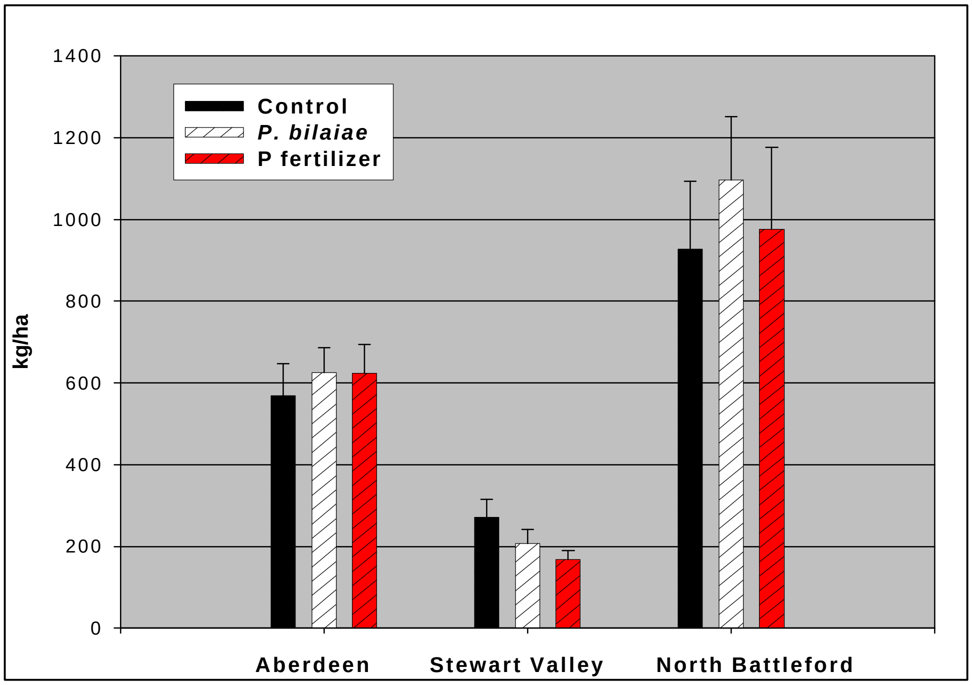

Figure 4: Comparison of treatments using seed yield at all three sites.

Conclusion

Treatment differences in terms of plant growth, P uptake and seed yield were inconsistent throughout the experiment due to the limiting factor being moisture not P. Moisture may also have been responsible for the higher yields found in the spring seeded canola over the fall seeded canola. *Penicillium bilaiae* and P treatments improved plant growth and P uptake at the four week growth stage however, plant growth controlled P uptake.

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