Canola Council of Canada Report
May 17, 2007

Research Objectives

The objective of this research is to investigate the responses of major insect pests of canola to the two bacterial strains, *Pseudomonas chlororaphis* (PA23) and *Bacillus amyloliquifaciens* (BS6). These bacterial species have been shown to control the fungal pathogen *Sclerotinia sclerotiorum* in canola and are currently being investigated for their potential to control the Blackleg pathogen. These bacterial strains are able to control fungal pathogens through the production of bacterial metabolites, such as antibiotic and volatile compounds, as well as through induced systemic resistance. This is a form of plant-mediated resistance in which the plants natural defences are activated and enhanced. In addition to the two bacterial strains, jasmonic acid was also added as a treatment, because it is a signalling molecule required for induced systemic resistance, and its application has been shown to induce defencive compounds in canola. Jasmonic acid has also shown potential for use in the control of insect pests on other crops.

Laboratory Research

Diamondback moth experiments

Over the past year laboratory experiments have been carried out on the diamondback moth (*Plutella xylostella*). The diamondback moth experiments were designed to look at the effects of the treatments on the feeding and growth rate of the larvae. Canola plants were given one of the four treatments (PA23, BS6, jasmonic acid, untreated control) to look at the effects on larval feeding and growth rate. Photos of the leaves were used to calculate the amount of leaf area consumed, and relative growth rate was calculated for each of the larvae using an average initial weight.

Results

From the analysis of leaf area consumed, we found that there were significant treatment effects, with significantly lower area consumed by larvae on the jasmonic acid treated plants (figure 1). From the analysis of relative growth rate, we found that there were also significant treatment effects, with larval weights significantly lower for those larvae feeding on jasmonic acid treated plants (figure 2).

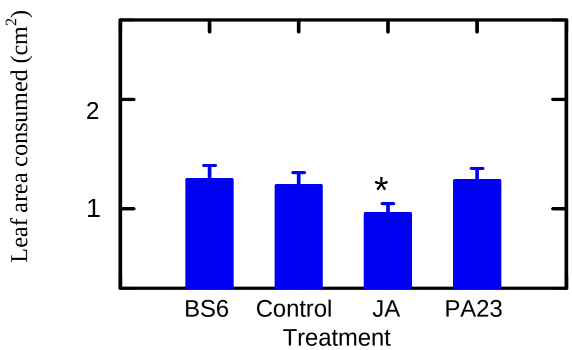

Fig. 1. Average leaf area consumed for each treatment

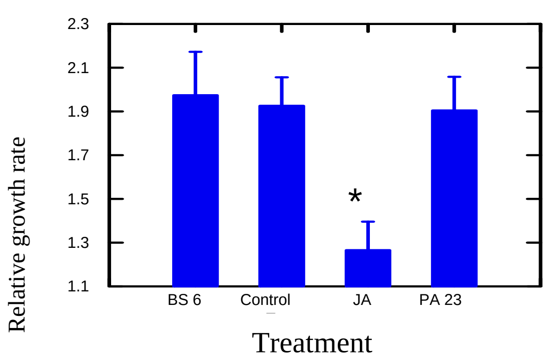

Fig. 2. Relative growth rate for each treatment

In addition to these results, we also found that there was a trend that was not quite significant for the jasmonic acid treated plants to have a greater number of feeding initiation sites. Prior to this larval experiment, we looked at the effects of the treatments on diamondback moth oviposition preference. From this experiment we found that there were also significant treatment effects, with jasmonic acid treated plants received significantly more eggs than the control.

These results indicate that the jasmonic acid could be affecting the plant chemistry leading to greater oviposition attraction and greater feeding deterrence. It is also possible that the insects are responding to chemical residues on the plants. We have also seen that there were no bacterial effects seen in these experiments. It is possible that there changes occurring in the plants but they are not affecting the insects, or that the bacteria are not induces chemical changes in the plants. In order to more fully understand the results we will be analyzing the leaf tissue for certain defensive compounds.

Turnip Aphid Experiment

Experiments are currently being carried out using the turnip aphid, *Lipaphis erysimi*. Canola plants were treated with four treatments, control, jasmonic acid, PA23, or PA23 + blackleg pathogen. This blackleg treatment was added to investigate the interaction between the biocontrol bacteria and pathogens. This experiment will examine the effects on aphid development time and reproductive output. No results are available at this time.

Field Work

In 2006, fieldwork was conducted at the University of Manitoba's research station in Carmen. The first application of treatments was to be sprayed on the cotelydons prior to flea beetle emergence to see if there was an effect of treatment on the level of flea beetle damage. 10 cotyledon and first true leaf whole plant samples were taken prior to spraying and 1 week after spraying to compare the level of damage between the treatments. No significant treatment effects were found for any of these samples.

The emergence in this field was very uneven, and many plots did not appear to have sufficient numbers of plants to accommodate sampling later in the season, so it was decided that a second field should be planted. This field had significantly better emergence, and was used for the second treatment application and subsequent sampling. This second field was sampled at 1 and 3 weeks following the application of treatments by sweep net and beat cloth. The insects were brought back to the lab and frozen until they could be identified to family, genus or species. Although there were a large number of insects sampled, there were no significant effects on any of the insects sampled by sweep net and there were no significant treatment effects for virtually all the species sampled by beat tray, with the exception of the 26 July sample of flea beetles, *Phylotreta cruciferae* and *P. striolata*. Figure 3 shows the mean numbers of flea beetles for each of the treatments on each of the sampling dates, with the 26 July sample in red and the 9 August sample in blue. However, further analysis did not reveal any of the treatments to be significantly different than the controls and this significance did not persist in the second sampling date, so it was probably just a random effect.

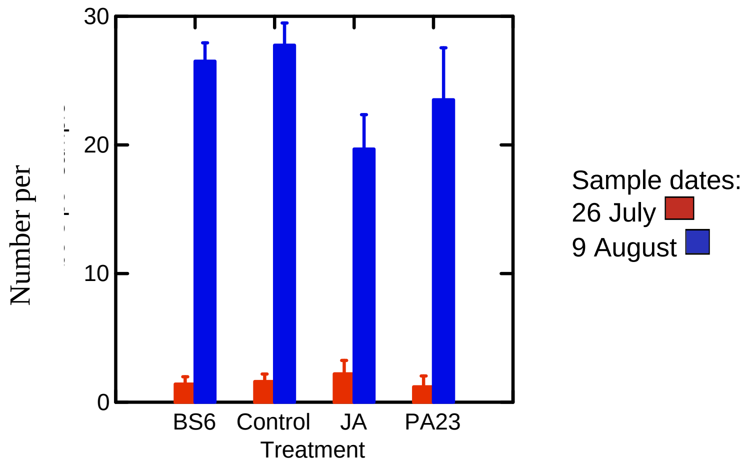

Fig. 3. Mean number of flea beetles per plot

In addition to sweep net and beat tray sampling, root samples were taken to investigate the effects of the treatments on *Delia radicum*, the cabbage root maggot. Root samples were taken on 3 sampling dates, 1 and 3 weeks following treatment, when the beat tray and sweep net samples were taken and again one week after harvesting the canola. Roots were rated on a scale of 0-4, with 0 for no damage, 1 for 1-25% damage, 2 for 25-50% damage, etc.

Figure 4 shows the average damage rating for each treatments for each of the sampling dates, shown in red, blue and yellow. No significant treatment effects were found for any of the sampling dates and there were no significant treatment effects on pattern of change over time.

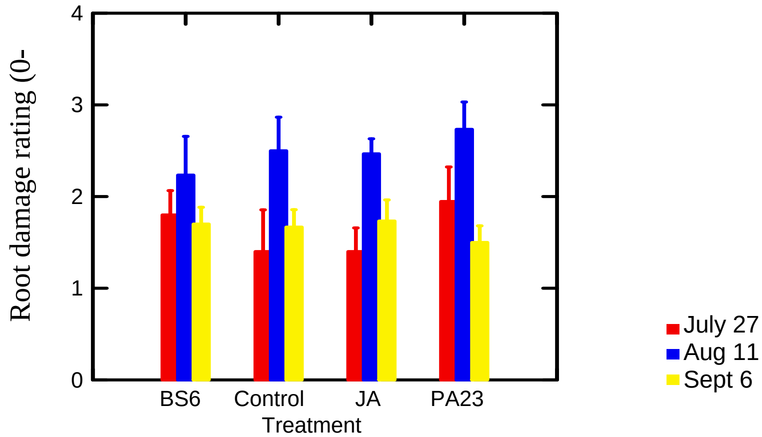

Fig. 4. Average root damage rating for each treatment

In addition to looking at canola root damage, pupae were collected from the field following harvest to look at levels of parasitism. Pupae were collected from each plot and were brought back to the lab and reared in vials over the fall and winter. Preliminary results indicate that there were no significant effects for any of the treatments.

Future Work

Although another field season will not be completed, because of the problems with applying treatments last season, this research will be continuing for the next few months. Dr. Neil Holliday has received funding from ARDI to continue this project. With this additional funding the laboratory studies outlined below will be completed.

Further Laboratory Experiments

In addition to the earlier experiments, preliminary wind tunnel experiments have been carried out with diamondback moth using jasmonic acid and control plants to determine whether the increased attraction is due to the induction by JA, or if it is due to residues on the plants. In the preliminary trials there were difficulties getting the moths to fly upwind, but if time allows, these experiments will be attempted again with more trials and variations on the methodology.

Experiments are also going to be carried out to investigate the effects of the treatments on treated and untreated portions of the plant. Using a similar design as used in the adult and larval diamondback moth experiments, these experiments will look at spatial separation of the treatments and the insects to examine the systemic response in the plant. If half the leaves of the canola plants are treated and we see similar effects to those seen in earlier experiments but for insects on untreated leaves, this will indicate that the treatments have induced a systemic response in the plant.

Leaf tissue analysis

Leaf tissue will be analyzed for various defensive compounds associated with induced resistance, including polyphenol oxidase, peroxidase and phenolics. Some of this analysis was done previously, but the parts of the procedure were done incorrectly. The larval experiment will be done again with a larger number of samples. Samples for each of the compounds analyzed will come from this pooled sample of 4 plants to be considered one replicate.