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Developing a decision threshold for potato leafhopper, Empoasca fabae, control in dry beans.
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Introduction

The potato leafhopper is a serious pest of dry beans in Ontario. Not only does it reduce the photosynthetic capability of the plant as a result of direct feeding and hopper burn, it is suspected as a vector of several foliar diseases such as common bacterial blight and bean common mosaic virus.

The recommendations for control in Ontario are not well defined (Anon. 1989) There is no published decision threshold for leafhoppers in dry beans. The threshold used in the U.S. midwest is nominal, and depends on sweep net sampling. Sweep net sampling in dry beans poses a risk of spreading bacterial disease in and amongst fields.

Growers are uncertain about the need for and timing of insecticide sprays for controlling leafhoppers. There is also political pressure to reduce the pesticide load in the environment. Thus there is a need for improving control recommendations for leafhoppers in dry beans. In Michigan, growers band dimethoate over the row, treating on the plant and not the row middles. This results in a reduction in the pesticide load on the field.

The objectives of this study were two-fold. First we hoped to develop a decision threshold for potato leafhoppers based on the stage of crop development using nymphs as the target and leaflets as the sample unit. Second, we wanted to evaluate the merits of timed sprays while banding the spray rather than using a broadcast application.

Methods

Caging studies. In 1988 and 1989, micro-plots consisted of hoop cages with dimensions of 0.9 X 0.6 X 0.9 m (L X W X H), made of LUMITE[R] 52X52 mesh placed on white bean rows which were spaced at 0.6 m apart. Microplots were thinned to a plant stand of 12 plants per cage. Cages were placed on the plots shortly after emergence and remained until maturity. The experiment was a 2 X 5 factorial arranged in a randomized complete block design with four replicates. Main effects were stage of crop growth (fourth trifoliate and bloom), and level of infestation (0, 0.5, 1, 2 and 4 nymphs per trifoliate).
Non-caged and sprayed checks were included for comparison of cage effects. Leaflets of white beans carrying leafhopper nymphs were collected from nearby dry bean fields and transferred immediately to the desired cage. Sufficient leaflets were collected and introduced to arrive at the desired number of nymphs per cage. In 1989, four cages were added to check survival of nymphs one week after infestation. Two nymphs were introduced per trifoliate in these cages and the microplots were destructively sampled one week later. In 1988, solar-shielded thermistors were added to one cage to compare the crop canopy temperature in and outside the cage.

Field plots. In 1988 plots were established in a commercial adzuki bean field. Plots were 4 rows (0.6 m row spacing) and 6 m long. The trial was arranged in a randomized complete block design with 3 replicates. Treatments include banded sprays with dimethoate timed to first cultivation (4th trifoliate), or second cultivation (bloom) or both. Dimethoate was applied at 0.48 kg ai/ha and the band was adjusted to cover only the foliage. The rate was adjusted to the area actually treated. Plots were evaluated by sampling 20 leaflets (5 per row) at random per plot and deriving a count of nymphs per trifoliate. In 1989, the design was similar, however there were 4 replicates, 6 row plots and white beans were planted. Yield was taken in both years.

Results and Discussion

Plants grown in cages were etiolated. Yields in the cages were approximately 45 to 70 percent (1988 and 1989, respectively) of those outside the cages. There was no significant difference in degree-day accumulation in the cage canopy compared to the canopy outside the cage. Thus, the yield

loss due to the cage effect was probably a result of decreased light intensity and/or quality.

In 1988, we experienced a severe drought. Leafhopper populations introduced to cages at both crop stages thrived until maturity. There was a good correlation between nymph density at introduction and yield loss. Under these conditions yield loss was significant (0.6 T/ha or 38%) after an introduction of 1 nymph/trifoliate at the fourth trifoliate stage and 2 at the bloom stage.

In 1989, recovery of living leafhoppers one week after introduction was 35 and 30 percent of the nymphs introduced at the fourth trifoliate and bloom stages, respectively. The reduction in numbers could be a result of mortality, escape when sampling, and inefficient searching when sampling. In 1989, after cool moist weather in early August, the population crashed. There was a significant yield loss only at 4 nymphs per trifoliate at the bloom stage.

In 1988, there was no early influx of leafhoppers from the south. Populations only started to build on the adzuki beans in mid July. Since a decision threshold of 1 nymph per trifoliate was not reached in the early vegetative stage, there was no yield advantage in applying dimethoate this early in the season. A single application of dimethoate at bloom resulted in a 1 T/ha (66%) yield increase.

In 1989, there was an early influx of leafhoppers from the south. The decision threshold was reached at the fourth trifoliate stage and there was a significant yield advantage (0.1 T/ha, 12 %) in a single application of dimethoate. A second application did not show any yield advantage over a single application. This was largely due to unfavorable environmental conditions for leafhoppers in early August.

Timed applications, resulted in yield increases which more than paid for the application costs. Excellent control of leafhoppers was achieved by banding the dimethoate over the row.

Using sample data from prespray counts in the dimethoate spray trials in 1989, an optimum sample size was calculated. Four samples of 5 leaflets yielded a mean of 11.6 nymphs per sample with a variance of 12.6. This followed approximately a poison distribution. Given a precision of 10% of the mean and 90 % confidence level, the optimum sample size should be 5 samples of 5 leaflets per sample. This does not pose a formidable increase in sampling effort.

These results are encouraging. Using nymphs as the sample target appears to be a viable alternative to sweep net sampling. The sample size required is manageable. Decision thresholds of 1 and 2 nymphs per trifoliate at 4th trifoliate and bloom stages, respectively, appear to be close estimates. Further refinement and validation of the decision thresholds are required. Expected weather should be incorporated into future thresholds.