INTEGRATION OF TRAP CROPPING AND REDUCED AREA INSECTICIDE TREATMENT TO MANAGE SUGARBEET ROOT MAGGOT

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ABSTRACT

An experiment was conducted during the 2001 season to evaluate the effectiveness of combining trap cropping with reduced area (perimeter treatment) insecticide treatment as an integrated program for managing populations of the sugarbeet root maggot, *Tetanops myopaeformis* (Röder). The experiment involved establishing strips of sugarbeet along the outside perimeter of previous-year sugarbeet fields (spring wheat in current year) to arrest newly emerged adults from dispersing to mate or search for oviposition sites in current-year beet fields.

Data from 2001 indicate that the trap crop reduced female movement into current-year beets during two weeks of high fly activity that included the peak oviposition period. Similar trends were observed with males, although significance was restricted to the third week of high fly activity. A slight trend toward lower feeding injury in current-year sugarbeets adjacent to the trap crop was observed, but the difference was not significant. Further study will be necessary to adequately determine the pest management potential of this integrated approach for protecting sugarbeet fields from *T. myopaeformis* injury.

INTRODUCTION

The sugarbeet root maggot, *Tetanops myopaeformis* (Röder), is a major economic pest of sugarbeet production the Red River Valley growing area of North Dakota and Minnesota, USA. The insect is univoltine in most sugarbeet production areas, and overwinters in the soil as a mature third-instar larva. The larva of *T. myopaeformis* is its only damaging stage. All three larval instars cause injury to the plant by rasping the surface of the developing sugarbeet root with an oral hook. Larvae cause injury to the plant by scraping the root surface with oral hooks. Heavy larval feeding pressure can predispose the plant to severe yield losses and can result in plant mortality if feeding causes the taproot to become severed. The available literature suggests that this insect is capable of causing yield losses ranging from 40 to 100% in the absence of control measures (Blickenstaff *et al.*, 1981; Campbell *et al.*, 1998).

Control of *T. myopaeformis* is typically achieved via planting-time soil insecticide applications (Yun and Sullivan, 1980; Bergen, 1984). Also, supplemental postemergence applications are occasionally needed in years when severe population levels develop. Well over 90% of all products applied used for protection of Red River Valley sugarbeets from *T. myopaeformis* are organophosphate insecticides. Thus, populations in areas that typically receive more than one application of an organophosphate per year are under a substantial amount of selection pressure for the development of resistance to this valuable insecticide class. This is a grave concern among area pest managers, and it is exacerbated by the fact that few efficacious chemical alternatives exist. The overall goal of this investigation was to assess the viability of integrating trap cropping with reduced area insecticide applications as a management option for this important pest. The primary objective in meeting this goal was to determine if strips of sugarbeet seedlings ("trap beets") along the edge of *T. myopaeformis* source (previous-year sugarbeet) fields would arrest females from dispersing to mate or search for oviposition sites in current-year beet fields. A secondary objective was to measure the management potential of concentrating emerged *T. myopaeformis* adults in the trap beet zone and treating the area with a foliar insecticide, thus, leading toward reducing the overall insecticide load necessary to protect localized fields.

MATERIALS & METHODS

Our experiment was carried out during the 2001 growing season near St. Thomas in northeastern North Dakota, USA. Experimental design was a randomized complete block with three field sites in each year that served as replicates. Each site consisted of a previous-year ("source") sugarbeet field (i. e., root maggot overwintering site) that was immediately adjacent to a current-year beet field. The previous-year field was planted to spring wheat during the study year for all replicates. The trap crop was established by planting a strip of sugarbeet (26.8 m wide x 805 m long) into the newly planted spring wheat along ½ of the length of the edge of each source field. The remaining length (805 m) was planted only to spring wheat without trap beets, and served as a non-trap control.

The first portion of our experiment involved monitoring of adult *T. myopaeformis* activity using the "sticky stake" trapping technique described by Blickenstaff and Peckenpaugh, (1976). Activity was monitored throughout the fly activity cycle in trap and non-trap zones in source fields as well as in the adjacently current-year sugarbeet fields. Fly counts in the following treatments were compared: 1) the source (previous-year) field in the trap beet zone; 2) source field zone without trap crop; 3) current-year beets adjacent to trap zone; and 4) current-year beets not adjacent to the trap crop. Adult *T. myopaeformis* fly activity was monitored throughout the growing season with counts being recorded by sex. All trapping data were converted into six one-week time intervals.

The second portion of the experiment involved root injury ratings and soil sampling to determine levels of larval survival and assess the overall success of our program in preventing *T. myopaeformis* feeding injury in the current-year sugarbeet field. Therefore, the treatments in this portion of the experiment were: 1) untreated sugarbeets adjacent to a trap crop; 2) untreated sugarbeets without an adjacent trap crop; 3) insecticide-treated sugarbeets adjacent to a trap crop; and 4) insecticide-treated sugarbeets without an adjacent trap crop.

Larval feeding injury to sugarbeet roots was assessed on four ten-root samples per plot, and damage was quantified according to the numerical 0 to 9 rating scale of Campbell *et al.*, (2000). In this scale, a zero indicates no observable feeding scars and a score of nine indicates that more than 75% of the root surface is blackened with *T. myopaeformis* feeding scars. Typically, injury is not economically significant until it averages over a six on this scale; however, environmental conditions throughout the growing season can alter the impacts of feeding injury on actual yields.

Larval densities assessed by collecting ten soil core samples (5 cm diameter x 10 cm depth) from four locations within each treatment plot. Soil samples were processed in the laboratory by sieving them for the presence of live larvae. All data were subjected to analysis of variance using the general linear models procedure (SAS Institute, 1999), and all treatment comparisons were carried out using contrasts (Steele and Torrie, 1980) at a 0.05 alpha level for detection of significance.

RESULTS & DISCUSSION

Our report on adult fly activity is restricted to data for female *T. myopaeformis* (Fig. 1) because they are more important in relation to colonization of current-year sugarbeet fields. Female activity in current-year sugarbeets was significantly lower during weeks two (P = 0.0043) and three (P = 0.0012) in zones where a sugarbeet trap crop was established in the adjacent previous-year sugarbeet (source) field. This is very important biologically because weeks two and three coincided with seasonal peak fly activity and, correspondingly, high levels of mating and oviposition.

The data in Figure 2 represent numbers of *T. myopaeformis* larvae recovered in soil samples from untreated and insecticide-treated plots that were either adjacent to the trap beet zone or without an adjacent trap crop, as well as an overall contrast for the impact of the trap crop, irrespective of treatment. Our analysis indicated that significantly (P = 0.0239) fewer larvae were recovered in untreated control plots that were adjacent to the trap crop zone as compared to untreated beets that were not next to a trap crop. Also, in contrasting larval densities according to the main trap crop effect overall (irrespective of whether soil insecticide was used), statistically fewer (P = 0.0239) larvae were present in soil collected from zones adjacent to the trap crop sugarbeets. Although numerically fewer larvae were also recovered in soil insecticide-treated plots that were adjacent to the trap crop zone when compared with insecticide plots that were not protected by the trap beets, the difference was not significant (P > 0.05). This finding could have resulted from the soil insecticide killing larvae in soil of both trap and non-trap zones and, thus, moderating the true impact of the trap crop on protecting the adjacent sugarbeet field.

Figure 3 represents the impacts of the trap crop on *T. myopaeformis* root feeding injury in the neighboring sugarbeet field. No significant differences (P > 0.05) were detected in our contrasts of the trap crop versus no adjacent trap beets, regardless of whether a soil insecticide was used; however, it is interesting to note that numerically lower root injury ratings were consistently observed in both untreated and insecticide-treated plots that were located adjacently to the trap crop strip.

CONCLUSIONS

In summary, we observed that the sugarbeet trap crop, when established along the perimeter of a previous-year sugarbeet field, reduced movement of female *T. myopaeformis* in to adjacent current-year beet fields during two weeks of high adult activity. Those trapping periods also coincided with typically the highest mating and egg-laying activity in the insect's life cycle. In addition, lower numbers of larvae were recovered in soil samples collected from untreated plots, and a similar finding resulted from contrasting the trap crop versus no cover crop overall. Although root rating data showed trends toward lower injury in plots adjacent to the trap crop, no statistical differences in those contrasts were obtained. Therefore, additional research is warranted to improve the efficacy of this integrated experimental approach to manage *T. myopaeformis* before North American sugarbeet producers can safely adopt it.

ACKNOWLEDGEMENT

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Fig. 1. Weekly capture of adult female T. myopaeformis in sugarbeet trap crop and non-trap crop zones in previous-year (source) and current-year sugarbeet, St. Thomas, ND, USA, 2001. Pairs of means within a contrast (Steele and Torrie 1980) are not significantly different when probability (P) exceeds 0.05.

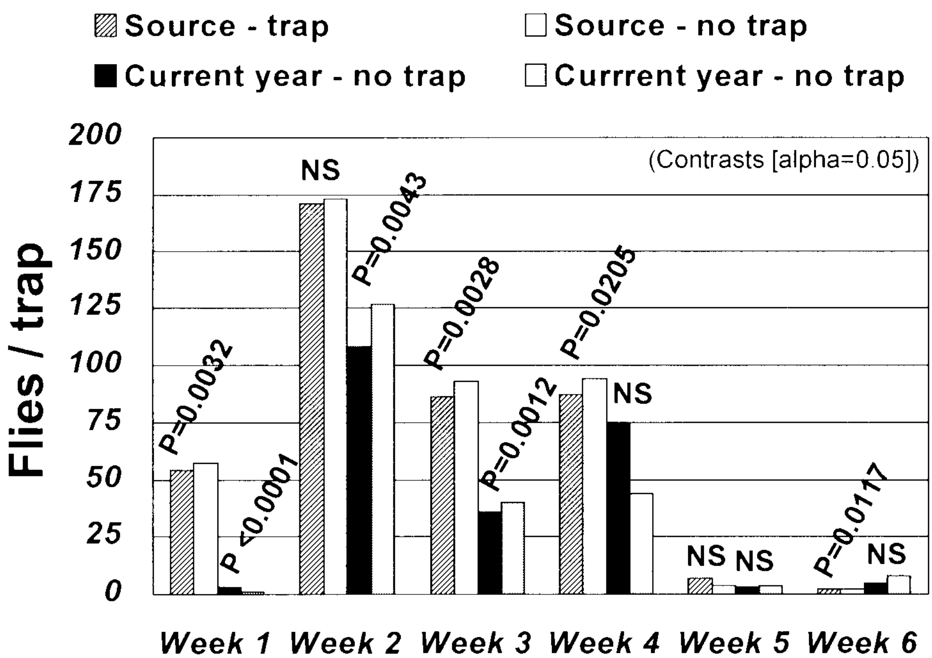

Fig. 2. Numbers of T. myopaeformis larvae recovered in a current-year sugarbeet field from soil core samples collected in insecticide-treated and untreated plots either with or without a trap crop in adjacent previous-year (source) field, St. Thomas, ND, USA, 2001. Pairs of means within a contrast (Steele and Torrie 1980) are not significantly different when probability (P) exceeds 0.05.

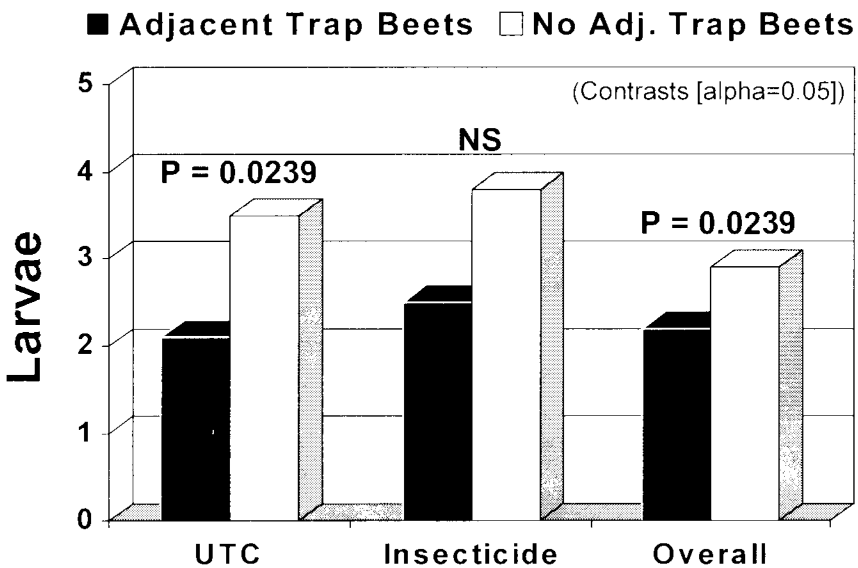

Fig. 3. Mean T. myopaeformis feeding injury ratings (0 to 9 scale of Campbell et al. 2000) in insecticide-treated and untreated plots either with or without a trap crop in adjacent previous-year (source) field, St. Thomas, ND, 2001, St. Thomas, ND, USA, 2001. Pairs of means within a contrast (Steele and Torrie 1980) are not significantly different when probability (P) exceeds 0.05.