Use of direct silk treatments with corn oil and Bacillus thuhngiensis for control of Lepidopteran pests of sweet corn

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Abstract

Field studies in 2000 and 2001 evaluated the efficacy of an alternative strategy for control of corn earwomn, Helicoverpa zea (Boddie), a key Lepitopteran pest of sweet corn in Massachusetts. Corn oil and Bacillus thuringiensis subsp. kurstaki were applied, alone or in combination, directly into the silk channel of the ear at a rate of 0.5ml/ear. All treatments were applied on day 5 after silk initiation. Two first-instar corn earworm larvae were placed in the silk channel on silk days 3, 6. 9, 12, 15 or 18, and ears were evaluated 4 days after placement for feeding damage to kernels and larval mortality. Bt, oil, and Bt plus oil all increased com earworm mortality and reduced kernel damage compared to untreated ears, but the combination of Bt and oil gave the best and most consistent protection which lasted for 13 days following treatment.

Introduction

Corn earworm (CEW7 is a serious pest of sweet com throughout the northeastern U.S., causing up to 100% infestation of ears in late-season corn. Female moths lay eggs singly on the silk, and newly hatched larvae move down the silk and into the ears to feed on the tip of the ear. Vegetable oil that is applied directly to the tip of each ear coats the silks down inside the silk channel and kills larvae as they enter. This technique was widely used by sweet corn growers in the 1940's, before the development of synthetic insecticides. Since 1992, University of Massachusetts researchers have been exploring how to make this method economical and effective, using vegetable oils and Bt. Typically a single application is made to silks on day 5 after silk initiation. In field situations, H. zea larvae may enter ears either before or after oil is applied. The objective of this experiment was to determine the efficacy of a silk treatment with corn oil and Bt, alone and in combination, against larvae entering prior to or after treatment, throughout the period of ear development.

Methods

Sweet corn was planted on 20 April 2000 ('Temptation') and 1 May 2001 ('Peto6803'). Silk day 0 was designated as the day that a minimum of 50% of the primary ears had approximately 2.5 cm of silk protruding from the ear. Every three days thereafter (days 3, 6, 9,12,15, and 18), two first-instar corn earworm larvae were placed on the silks of six randomly chosen ears in each plot.

Treatments were applied on silk day 5. To prepare the oil and Bt mixture, 900 mL of food grade corn oil with emulsifier (10% by volume Atlox.Uniqema, New Castle, Del.) were combined with 28.57 g of Bacillus thuringiensis subspecies kurstaki (Dipel DF, Valent Agricultural Products, Richardson, Texas) that had been previously mixed with 100 mL of distilled water. The Zea-later® oil applicator (Johnny's Select Seed, Albion, Maine) was used to deliver 0.5 mL of suspension directly into the silk channel of each com ear. Four treatments were used in a factorial design:

1) untreated

3) Bt alone (in water)

4) oil + Bt.

Ears were harvested 4 days after each larval placement (silk days 7,10,13,16,19, and 22) and evaluated for the number of live, dead, or missing larvae and the level of damage to each ear or silk. The sweet corn was mature on Day 22.

Damage was assessed on a scale from 0 to 5: 0=no damage; 1=damage to silk only; 2=damage on ear from tip to 2.5 cm; 3=damage to ear from 2.5 to 5 cm below the tip; 4=damage to ear from 5 to 7.5 cm below the tip; and 5=damage to ear 7.5 cm or more below the tip.

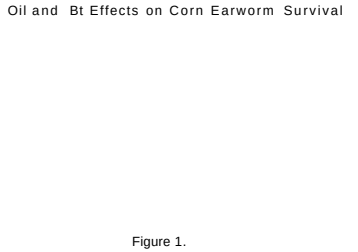


Figure 1.

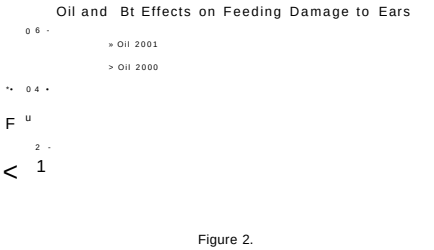


Figure 2.

Results Bt alone and oil alone showed significantly greater corn earworm mortality than no treatment. The highest level of mortality was achieved when oil and Bt were used in combination. (Figure 1). Similarly, oil and Bt together significantly lowered the amount of feeding damage when compared to no treatment and oil or Bt used alone (Figure 2).

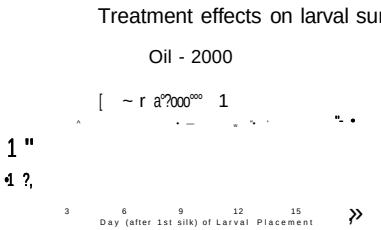


Figure 3.

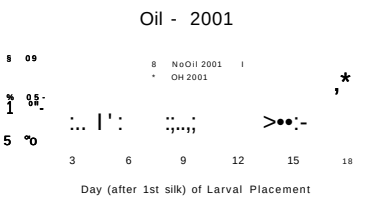
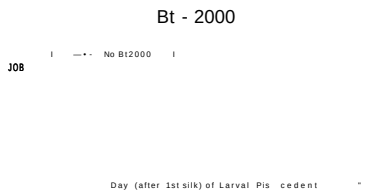


Figure 4,



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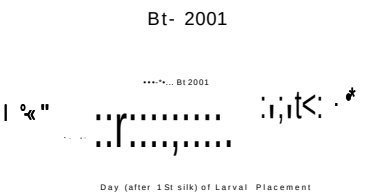

Figure 6.

Results. In 2000 and 2001, the use of oil increased larval mortality (Figures 3 and 4). This effect was consistent for nearly all larval placement dates and lasted for 13 days, from treatment through final placement. Bt as a treatment also increased larval mortality in both years (Figures 5 and 6), but showed less efficacy against larvae that entered the ear prior to the treatment date (Day 3).

PO

First instarfrom laboratory being placed in silk channel using a brush.

Zea-later being used to apply treatment directly into the silk channel on silk day 5.

3 9 10 11 12 13 1-4 15 16 IV 18 19 20 21

CD Days from Silk Initiation

Mature corn earworm larvae feeding inside of ear.

Typical silk development on silk day 1, when at least 2.5 cm protrudes from the silk channel.

Silk channel and ear development on silk day 5. At this stage, pollination of the silk is nearly complete. Oil and Bt penetrate the long silk channel above the ear.

Silk development when sweet corn is mature.