STEWARD™ RAINFASTNESS AND RESIDUAL CONTROL ON COTTON

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Abstract

Experiments were conducted in 1998 & 1999 using artificial rainfall from overhead irrigation comparing Steward™ (Indoxacarb), with and without surfactants, to two cotton insecticide standards (i.e. Karate™ or Karate-Z™ & Tracer™). The test in 1998 was designed to look at the effect of the amount of rainfall on this new compound and the two insecticide standards. Two different levels of rainfall were used in this test (i.e. 0.5 in. & 2.0 in.). The test conducted in 1999 looked at the effect of drying time after insecticide application on rainfastness of Steward™ and the standards. Three different drying times were used for this experiment (i.e. < 1.0 hr., 2.0 hrs. & 24 hrs.).

These two experiments suggest that Steward™ does as well or better than the current cotton insecticide standards in terms of residual and rainfastness. In 1998 there was no significant difference in Indoxacarb activity loss between the three rain treatments (i.e. no rain, 0.5, or 2.0 inches of rainfall). In 1999 there was no significant difference in activity loss of Steward™ when allowed to dry 2 hrs. vs. 24 hrs. before rainfall was applied. However, a drying time of less than 1 hour was detrimental to all 3 insecticides tested. Certain surfactants may provide additional rainfastness for Indoxacarb particularly at its recommended lower use rates for cotton.
Analytical analysis of Indoxacarb found on cotton leaves in 1999 correlated reasonably well with biological mortality data. Thus, as is expected, the more active ingredient on the leaf the higher the mortality. A multi-variant model for Indoxacarb deposition based on the analytical data showed that rate, use of adjuvants, and plant part sampled (i.e. leaf vs. square) all had a significant effect on residual deposit of Steward™ on leaves.

Introduction

Rainfastness and residual are important concerns for cotton growers and their consultants when choosing a pesticide for insect control. Often growers would like to know- how much material is lost after rainfall; or how long the material needs to dry before it is "rainfast"? These concerns are often paramount with new materials with which the grower has little experience. Indoxacarb is the active ingredient of Steward™ a new cotton insecticide from DuPont that should be commercially available in the US by 2000 or 2001. The purpose of these experiments were to investigate rainfastness of Indoxacarb compared to several current cotton insecticide standards. The standards chosen for these tests were the synthetic pyrethroid Karate™ (Zeneca Ag) and the new spinosyn compound Tracer™ (Dow Ag). We also investigated the effect of surfactants on rainfastness and residual of Indoxacarb. All surfactants were used at their recommended label rates for cotton.
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Methods

Two experiments were conducted in 1998 and 1999. In both experiments artificial rainfall was applied using a Renke™ overhead irrigation system and cotton leaves collected at various times after the rain event to be bioassayed in the lab for percent mortality on 3-day-old *Heliothis virescens*. In 1999 squares were also collected and compared to leaves for rainfastness and residual. In addition, samples were taken in 1998 and 1999 for analytical analysis. Indoxacarb was extracted from these samples to quantify active ingredient remaining on leaf after rainfall. All analytical data was expressed in μg. a.i./cm^2 of cotton leaf or square.

1998 Methods

In 1998 a 45 treatment test was conducted. The treatments consisted of: 12 Indoxacarb treatments, 2 chemical standards (i.e. Karate™ & Tracer™), and 1 untreated check all applied under 3 different rain events (i.e. no rain, 0.5 in. and 2.0 in of rain). The Indoxacarb treatments consisted of: 6 treatments with Steward™ at 2 rates (i.e. 0.065 & 0.11 lbs. a.i./ ac) with and without the addition of 2 surfactants (i.e. Soydex™ & Kinetic™) and 6 treatments with Avaunt™ using the same rates and surfactants as for Steward™. Karate™ and Tracer™ were applied at .028 and .067 lbs. a.i./ ac., respectively. All treatments were allowed to dry for two hours and then pseudo-replicated by rain event 3 times. Cotton leaves were sampled 3 times from each replicate (i.e. immediately after the rain had dried, and 3 days and 7 days post-application) and tested on lab reared *Heliothis virescens.* Leaves were placed in 16 cell HIS trays and one 3 day old *H. virescens* was placed in each cell. Mortality was assessed at 120 hr. A total of 48 insects were tested per treatment. Mortality data was analyzed using analysis of variance (ANOVA) and means compared using Fisher's Least Significant Difference (SAS institute). In addition, analytical samples were removed from each Indoxacarb treatment immediately after the rain had dried. Ten one in. leaf punches were removed from 10 leaves and analyzed for presence of Indoxacarb using a triple quad Hewlett Packard LCMS.

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1999 Methods

In 1999 a 66 treatment test was conducted. The treatments consisted of 8 Indoxacarb treatments, 2 chemical standards (i.e. Karate-Z™ & Tracer™), and 1 untreated check all applied under 2 different rain events (i.e. no rain & 1.0 in) with 3 different drying times (i.e. <1.0 hr, 2 hr. & 24 hr.).

There were 8 Indoxacarb treatments in this test including: Steward™ at 2 rates (i.e. 0.065 & 0.11 lbs. a.i./ ac) with and without the addition of 3 surfactants (i.e. Induce™ DyneAmic™ & Kinetic™). In addition, there were 2 treatments with Tracer™ (i.e. .067 lbs. a.i./ac with and without DyneAmic™) and one treatment with Karate-Z™ at .028 lbs. a.i./ac. All treatments were pseudo-replicated by rain event 3 times. Cotton leaves were sampled 4 times from each replicate (i.e. immediately after the rain had dried by drying time treatment [<1, 2 or 24 hr.], and 2, 5, and 7 days post-application). Cotton squares were sampled 3 times during the test - immediately after the rain had dried by treatment [<1, 2 or 24 hr.], and 2 and 5 days after the insecticide applications. Mortality data for leaves and squares were determined as described in 1998 methods. Analytical samples were removed from each Indoxacarb treatment immediately after the rain had dried except the <1.0 hr. drying time treatment. Ten leaf punches were removed from 10 leaves per treatment or 10 squares were analyzed per treatment as described in the 1998 methods above.

Results

1998 Results

Data from the 1998 test showed that there was no significant loss of activity with Indoxacarb between any of the three rain events for the data collected the first day of application (Figure 1). However, both standard insecticides (i.e. Karate™ and Tracer™) lost significant activity compared to the no rain samples (Figure 1) from the first sample date. In both the 0.5 in and 2.0 in rain events Steward™ was significantly more active than Karate™ which preformed significantly better than Tracer™ (Figure 1). The addition of Kinetic™ improved rainfastness of Indoxacarb at the low use rate (i.e. 0.65 lbs. a.i./ac) compared to the same treatment without surfactant on the first sample date. There were no other differences due to surfactants throughout the remainder of the test.

1999 Results

In the 1999 test on rainfastness there were no significant differences between treatments for a 24 hr vs. 2 hr. drying time on leaves or squares for all sample dates. For the day one sample there was no significant activity loss with Steward™ or Karate-Z™ between no rain and a 2 hr. drying time. There was significant activity loss for Tracer™ between no rain and a 2.0 hr. drying time. However, there were significant differences for all three of the insecticides tested between no rain and a < 1.0 hr. drying time (Figure 2). In addition, there was significant activity loss for Steward™ and Tracer™ between a 2 hr and <1.0 hr. drying time. Only Karate-Z™ showed no significant activity loss between a 2.0 hr. and a <1.0 hr. drying time for the day 1 sample (Figure 2). Figure 3 represents a mean average for the rest of the leaf sample dates (i.e. average of the 2, 5, & 7 day readings). The results are similar to Figure 2 but the overall mortality ratings are lower, probably due to dilution from plant growth and other sources of residue loss (Figure 3). The data for cotton squares was similar to the data for leaves but again the overall mortality was lower possibly due to the reduced initial deposits on squares vs. leaves. This hypothesis is supported by the analytical data for Indoxacarb. Figures on square mortality will not be published in this paper but are available from the authors on request. There were no significant differences between Steward™ plus surfactants with rain and no rain. However, at the high rate of Steward™ (i.e. 0.11 lbs. a.i./ ac) in the treatments with 2 hr. drying time and 1.0 inch of rain Steward™ + Induce™ and Steward™ + DyneAmic™ gave significantly better control than Steward™ alone or Steward™ + Kinetic™.

1999 Analytical Data

The analytical results from 1998 and 1999 were similar and only the 1999 data will be discussed here. A regression of the Indoxacarb analytical data (i.e. active ingredient found on the leaf or square) against mortality on leaves or squares gave a reasonable fit with an R^2= 0.60 for both regressions. In addition, a multi-variant model used to analyze this data set found that rate, use of an adjuvant, and plant part tested all were highly significant in explaining the sources of variance associated with leaf and square residual of Indoxacarb. Other key sources of variation can be explained by the interactions of rate with the use ofsurfactants, rate with the presence (or lack thereof) of rainfall, and presence of rainfall and plant part tested. Drying time was not significant, however, only 2 hr and 24 hr data was taken which was not significantly different based on the biological mortality data.

Discussion and Summary

These two experiments suggest that Steward™ does as well or better than the current cotton insecticide standards in terms of residual and rainfastness. In 1998 there was no significant difference in Indoxacarb activity loss between the three rain treatments (i.e. no rain, 0.5, or 2.0 inches of rainfall). In 1999 there was no significant difference in activity loss of Steward™ when allowed to dry 2 hrs. vs. 24 hrs. before rainfall was applied. However, a drying time of less than 1 hour was detrimental to all 3 insecticides over the duration of the 1999 test. Certain surfactants may provide additional rainfastness for Indoxacarb particularly at its recommended lower use rates for cotton. Analytical analysis of Indoxacarb found on cotton leaves in 1999 correlated reasonably well

with biological mortality data. Thus, as is expected, the more active ingredient on the leaf the higher the mortality. A multi-variant model for Indoxacarb deposition based on the analytical data showed that rate, use of adjuvants, and plant part sampled (i.e. leaf vs. square) all had a significant effect on residual deposit of Steward™ on leaves.

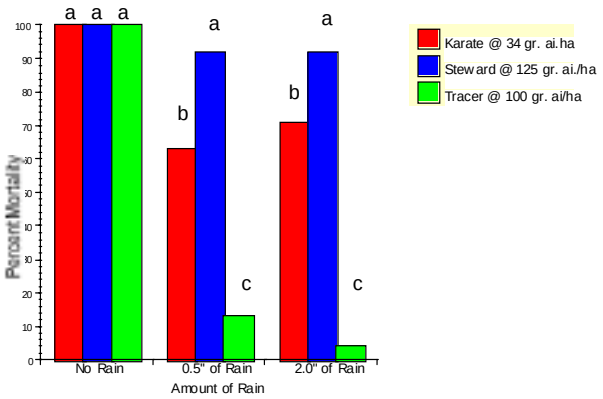

Figure1. Mean mortality of *Heliothis virescens* fed leaves from cotton plants which had been sprayed with three different insecticides and exposed to no rain or two different amounts of artificial rainfall. Data taken immediately after rain had dried. Columns with the same letter are not significantly different based on ANOVA and Fisher's LSD.

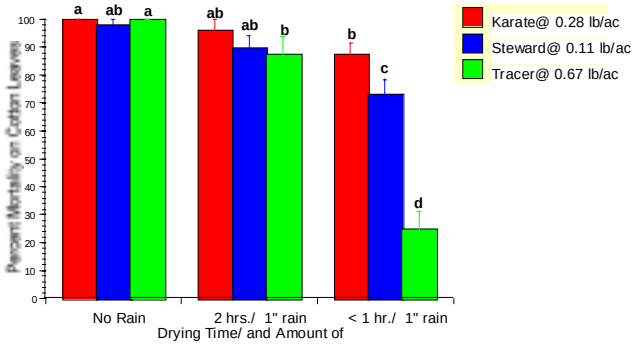

Figure 2. Mean mortality of *Heliothis virescens* fed leaves from cotton plants which had been sprayed with three different insecticides and exposed to no rain or two different drying times. Data taken immediately after rain had dried. Columns with the same letter are not significantly different based on ANOVA and Fisher's LSD. Error bars are standard error of the mean.

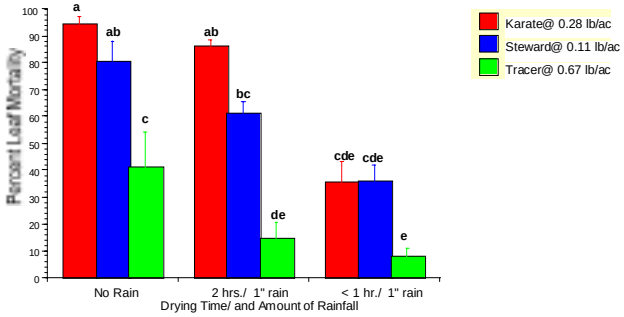

Figure 3. Mean mortality of *Heliothis virescens* fed leaves from cotton plants which had been sprayed with three different insecticides and exposed to no rain or two different drying times. Data represents mean mortality of the 2, 5, and 7 day readings. Columns with the same letter are not significantly different based on ANOVA and Fisher's LSD. . Error bars are standard error of the mean.