An Evaluation of Insecticide Seed Treatments Against Thrips in Southern Australia

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ABSTRACT

Thrips (Thrips tabaci and Frankliniella schultzei) are common seedling pests of Australian cotton crops. They are controlled using insecticide seed treatments, soil applied insecticide granules or foliar insecticides. To assess the relative value of these control options, their efficacy was assessed in the field. The yield response of cotton was also assessed to indicate the effect of thrips damage on yield. Cotton protected with thiodicarb, imidacloprid, or a combination of thiodicarb and fipronil, applied as seed treatments was compared with that protected by in-furrow applied aldicarb granules and with untreated seed. Replicated experiments were carried out on commercial cotton farms at 14 sites throughout Australia over 2 seasons. Experiments were unsprayed through the early season, when thrips were present, but after that, insect pests were managed according to best commercial practice. Varieties expressing the Cry 1A(c) protein were used to minimize potential confounding effects due to damage by Helicoverpa spp. Aldicarb provided the best control of thrips, followed by imidacloprid, fipronil and thiodicarb. Yield increases were recorded at only 4 of the 13 sites harvested. The magnitude of the yield increase from thrip control appeared to be related to the seasonal abundance of thrips, the growing conditions and treatment efficacy.

Introduction

Thrips are regarded as key early season pests of cotton in Australia (Wilson and Bauer, 1993), though their true pest status has been questioned (Sadras and Wilson, 1998). Thrips cause damage to cotton during the four to eight week period from emergence until the plants have about eight true leaves, after which they are no longer regarded as damaging. Feeding damage by thrips causes distorted growth of leaves, leading to reduced leaf area, and severe infestations may kill the growing terminal, known as ‘tipping out’, causing a delay in plant development as a new terminal is produced. Heavy damage can result in excessive tipping out throughout a cotton field, resulting in delayed maturity and/or yield loss (Sadras and Wilson, 1998). Thrips may also feed on young cotton buds (squares) causing them to shed, although this is not common. Despite this array of symptoms, the pest status of thrips in cotton remains controversial. Some authors have reported that thrips cause significant effects on cotton yield or maturity while others reported that thrip damage was mainly cosmetic, with little effect on the economic value of the crop (Hawkins et al., 1966; Rummel et al., 1988; Terry, 1992).

Seed treatments have been used as a convenient method of protecting seedling cotton plants against thrips in Australia for the last 20 years. Thiodicarb (Semevin®) is currently the standard seed treatment used and is applied to over 50% of the cotton seed used for planting in Australia. During the last 5 years, however, there has been a substantial increase in the use of granular insecticides such as aldicarb (Temik®) and phorate (Thimet®). These compounds are applied with the seed at planting and are taken up systemically by the seedling. Additionally, a new seed treatment, imidacloprid (Gaucho®) became commercially available in Australia for the first time in 1997 and a combination seed treatment, thiodicarb plus fipronil (Semevin Super®), is being developed to provide control of both thrips and wireworm and may have replaced Semevin in 1999. The aim of this study, therefore, was firstly, to compare the range of seed treatments against one of the granular insecticides (aldicarb) in terms of efficacy against thrips and secondly, to evaluate the yield responses of cotton to protection from thrips.

Methods

A total of fourteen large-scale trials were established on commercial farms in southern Queensland and northern NSW in 1996 and 1997. In each experiment a randomized block design was used with four replications. Plots sizes ranged from 8 m x 400 m to 12 m x 1000 m, depending on the planting equipment used and the field length.

The experimental plots were not sprayed with insecticides during the first 6 weeks after emergence to allow natural thrip infestations to develop, especially in the untreated plots. Transgenic cotton varieties (Ingard®) containing the Cry 1A(c) gene were used at each location to reduce the potential confounding effect of damage by Helicoverpa spp during the
un sprayed period. The varieties used were Sica
da and Exp94 4, both normal leaf varieties and Siokra V-1
which was okra leaf.

In experiments in 1996 there were four treatments;
three seed treatments and aldicarb. In experiments in
1997 there were five treatments; an untreated control,
three seed treatments and aldicarb. The seed treatments
were applied using a large cement mixer to agitate the
seed while the required rate of insecticide was added
to ensure consistent and even coverage. A polymer
called Peridium® was applied to all seed, as was a
standard fungicide mix containing Apron® and
Quintazine®. Thiodicarb was applied at a rate of 450
g ai / 100 kg of seed, imidacloprid at 525 g ai / 100 kg
of seed and the mixture of thiodicarb plus fipronil at
250 and 50 g ai / 100 kg of seed respectively. Aldicarb
was applied in the furrow with the seed at planting,
using the growers’ equipment, calibrated to apply
aldicarb at the rate of 450 g ai / ha. The seed was
planted using the farmer’s equipment at rates ranging
from 12-16 kg/ha. At most sites, the cotton seed was
planted into dry soil or irrigated to ensure
germination but some sites, the seed was planted into
moist soil or received rain after planting.

Insect and plant assessments began within a week of
emergence and continued for 4 weeks on a weekly
basis. The abundance of thrips was assessed by
collecting 10 to 20 cotton seedlings from each plot into
large glass jars containing 100% methanol, to kill and
preserve the thrips. Thrips were washed from the
plants and counted using a microscope at a later date.
Counts of thrips were separated into nymphs and
adults. Damage to cotton plants, caused by thrips, was
assessed each week after emergence. Damage was
rated visually using a 1 to 5 scoring system where 5 =
no damage and 1 = severe damage. Plant density was
assessed in 5 m of row in each plot in each experiment
and assessments were completed 2-3 weeks after
emergence.

Yield was assessed by picking the cotton from the
central four or eight rows of each plot using a
commercial mechanical cotton picker and weighing
the picker on a set of portable picker scales. A sample
of the seed cotton was taken from the cotton picked
from each plot to determine gin turnout and fiber
quality.

Analysis

Data from all sites for each year were combined and
analyzed using analysis of variance to test for
treatment differences. Fisher’s protected least
significant difference was used to separate treatment
means. Thrip counts were transformed (In + 1) before
analysis.

Results

Experiments in 1996

Aldicarb provided the highest level of control of both
adult and nymph thrips, compared with all other
treatments in both years (Figures 1 and 2). Damage
levels were worst on the thiodicarb and thiodicarb plus
fipronil seed treatments, significantly less on the
imidacloprid seed treatments and least on the aldicarb
treatments, mirroring the thrip levels (Figure 3). In
1996, significant differences in lint yield were found
between treatments at three of the seven sites (Table
1). Overall, when all 1996 sites were analyzed
together, yield was slightly but significantly higher in
the aldicarb treatment than in other treatments except
imidopropil (Figure 4).

Experiments in 1997

Aldicarb provided the best control of thrips, both
adults and nymphs, compared with other insecticides
and the untreated control (Figures 5 and 6). Imidacloprid provided significantly better control of
thrips nymphs than thiodicarb but was similar to
thiodicarb plus fipronil (Figure 5). Thiodicarb alone
was not significantly different from the untreated
control. All seed treatments provided significant
control of adult thrips (Figure 6). Damage levels were
significantly lower in all insecticide treatments than
the untreated control. Thiodicarb and thiodicarb plus
fipronil had slightly but significantly less damage than
the untreated control, imidacloprid less again and
aldicarb the least (Figure 6). In 1997, significant
differences in lint yield were recorded between
treatments at one of the six sites harvested. When all
sites were analyzed together, there were no significant
differences in yield between treatments.

Discussion

At all trial sites, aldicarb gave the best control of thrips,
both nymphs and adults. Aldicarb kept nymph numbers at very low levels for up to 40 days after
planting, reducing breeding of thrips. In contrast, the
seed treatments did not control thrips as well as
aldicarb and control was for a relatively short period.
Imidacloprid was the most efficacious seed treatment.
These trends occurred over 2 years but some individual
sites diverged from the trends.

Observations of plant damage generally correlated
positively with nymph numbers. The aldicarb treated
cotton showed very little sucking pest damage and
appeared to be more vigorous than the other
treatments, though the plants in the imidacloprid plots
were almost as vigorous as those in the aldicarb
treatment. The thiodicarb and thiodicarb plus fipronil
seed treatments provided a marginal reduction in
damage levels compared with the untreated control.

Overall analysis showed significant differences in
yield between treatments only in 1996, when aldicarb
treated cotton yielded significantly more than the other
treatments. Three of the seven individual sites had
significant yield differences between treatments in
1996, while in 1997, only one of the six sites picked
had a difference in yield between treatments. Where significant differences occurred, the aldicarb plots produced the highest yield. The 1996 season was relatively cool while 1997 had ideal conditions after planting. The results suggest that cotton seedlings can tolerate quite high levels of thrip, provided seasonal conditions encourage rapid plant growth. These results confirm those of Sadras and Wilson (1998), who found that although thrips could cause significant reduction in leaf area and in the dry weight of cotton seedling, the plants were able to recover from all but the most severe damage with negligible loss of yield.

Conclusion

Aldicarb controlled thrips nymphs and adults for up to 4 weeks after emergence and produced virtually unblemished plants. imidacloprid was the most efficacious seed treatment while thiodicarb and thiodicarb plus fipronil gave only slight control; both in terms of thrips abundance and preventing damage. No consistent yield responses were recorded between treatments, confirming that cotton plants can often compensate for the thrip damage.

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References


| Table 1. Mean lint yield (kg / ha) for each treatment at each location in 1996. |
|------------------|--------|--------|--------|--------|
| Site             | Aldicarb | Imidacloprid | Thiodicarb | Thiodicarb + Fipronil |
| Warren           | 2152a    | 2081a     | 1932b       | 2026b       |
| Breeza           | 1519a    | 1479a     | 1290b       | 1334b       |
| Wee Waa          | 1913a    | 1902a     | 1963a       | 1862a       |
| Moree            | 2433a    | 2327a     | 2478a       | 2383a       |
| Goondiwindi      | 2080a    | 2020b     | 1962b       | 1990b       |
| Bongeen          | 2035a    | 2052a     | 1918a       | 1974a       |
| MacAlister       | 1721a    | 1710a     | 1682a       | 1665a       |

At each location means with different letters are significantly different at p = 0.05 using ANOVA, LSD.

| Table 2. Mean lint yield (kg / ha) for each treatment at each location in 1997. |
|------------------|--------|--------|--------|--------|
| Site             | Aldicarb | Imidacloprid | Thiodicarb | Thiodicarb + Fipronil |
| Warren           | 2097a    | 1990b    | 1946b     | 2063a     | 1962b     |
| Wee Waa          | 1946a    | 2040a    | 1939a     | 1937a     | 1921a     |
| Moree            | 2034a    | 1975a    | 1947a     | 1964a     | 1923a     |
| Goondiwindi      | 2129a    | 2199a    | 2216a     | 2142a     | 2212a     |
| Bongeen          | 2253a    | 2161a    | 2313a     | 2300a     | 2273a     |
| MacAlister       | 1655a    | 1678a    | N/A       | 1689a     | 1659a     |

At each location means with different letters are significantly different at p = 0.05 using ANOVA, LSD.
Figure 1. Cumulative abundance of thrips nymphs on cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.) or thiodicarb (Thio.) across 7 experiments in 1996.

Figure 2. Cumulative abundance of thrips adults on cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.) or thiodicarb (Thio.) across 7 experiments in 1996.

Figure 3. Cumulative thrips damage rating for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.) or thiodicarb (Thio.) across 7 experiments in 1996.

Figure 4. Mean lint yield for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.) or thiodicarb (Thio.) across 7 experiments in 1996.

Figure 5. Cumulative abundance of thrips nymphs for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.), thiodicarb (Thio.) or untreated (UTC) across 7 experiments in 1997.

Figure 6. Cumulative abundance of thrips adults for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.), thiodicarb (Thio.) or untreated (UTC) across 7 experiments in 1997.
Figure 7. Cumulative thrips damage rating for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.), thiodicarb (Thio.) or untreated (UTC) across 7 experiments in 1997.

Figure 8. Mean lint yield for cotton treated with imidacloprid (Imid.), aldicarb (Ald.), thiodicarb plus fipronil (Thio.+Fip.), thiodicarb (Thio.) or untreated (UTC) across 7 experiments in 1997.

Values are means ± SE. Treatments with different letters are significantly different at p = 0.05 using ANOVA, LSD.