THRIPS ON SEEDLING COTTON IN MISSISSIPPI WITH A 15-YEAR SUMMARY OF PESTICIDE EVALUATION

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Abstract

Historically, more than 90% of the adult thrips found on seedling cotton in Mississippi have been tobacco thrips. Seedling cotton may be infested by thrips immigrating from early spring host plants as soon as the cotton plants emerge. Thirty eight percent of the 1999 Mississippi cotton crop was treated with foliar insecticide for early season thrips management (30% in the hills, 42% in the delta region) (Williams, 2000). During the 2000 season, 91% of delta cotton and 82% of hill cotton received either a seed treatment or an in-furrow insecticide at planting (Williams 2001). In-furrow, prophylactic treatments have longer residual activity then seed treatments and demonstrate better efficacy against adult thrips than do seed treatments. In general seed treatments lose efficacy for control of larval thrips beyond three weeks after planting, with efficacy after that time below that of compounds applied in-furrow. Both seed treatments and materials applied in-furrow provided approximately 80% control of larval thrips during the first 21 days after planting. Rate-related efficacy of several insecticides applied in-furrow is reviewed. A 2001 trial incorporating foliar application of several compounds is discussed.

Introduction

Of the 4000 (Arnett, 2000) to 8,000 (Lewis, 1997) species of thrips, three of the genus *Frankliniella* make up the bulk of pest numbers on seedling cotton in Mississippi. Usually more than 90% of the adult thrips found on seedling cotton in the state have been tobacco thrips, *Frankliniella fusca* (Hinds). There appears to have been a slight increase in numbers of western flower thrips (*F. occidentalis* (Pergande)) and flower thrips (*F. tritici* (Fitch)) in the last 2 years (Fig. 1). The possible cause for the slight shift in species composition is the drought condition during the spring of 1998 and 1999 and a lack of blooming wild host plants. There was an abundance of western flower thrips in seedling cotton in the Mississippi River Delta during the year 2000, with this species approaching 100% of the thrips population in some areas (Kharboutli, 2001; Burris (personal communication)). Whether this is the forerunner of a permanent shift in species associated with cotton or whether it is associated with the two years of drought or other factors is yet to be determined.

Seedling cotton may be infested by thrips immigrating from early spring host plants as soon as the cotton plants emerge. Unlike the infestation of cotton fields with aphids that start with spotty, localized infestations, thrips appear to infest an entire field fairly uniformly. This infestation, coupled with generally cool weather and slow growing plants early in the spring, can lead to stunting, delayed fruiting, loss of apical dominance resulting in 'crazy cotton', and possible loss of stand. Immature thrips are collected regularly from cotton in the cotyledon stage and within seven days after planting. This indicates that thrips have oviposited on cotton plants just as the plant cracks the soil and begins to emerge. It is possible that the thrips that lay eggs at this early stage of crop development are present on the soil at the time of planting, having been deposited by the wind over time prior to or shortly after planting.

A summary of the annual cotton insect damage reports published in the proceedings of the Beltwide Cotton Conferences, indicates that thrips are an annual pest throughout Mississippi. The number of acres infested with thrips and the number of acres treated with a foliar application of insecticide fluctuates considerably from year to year (Fig. 2). Based on data presented in the proceedings of the 2000 Beltwide Cotton Conferences, 38% of the 1999 Mississippi cotton crop was treated with foliar insecticide for early season thrips management (30% in the hills, 42% in the delta region) (Williams, 2000). During the 2000 season, 91% of delta cotton and 82% of hill cotton received either a seed treatment or an in-furrow insecticide at planting (Williams 2001). It is obvious that thrips are a serious pest of cotton in Mississippi. Research concerning thrips management, particularly pesticide efficacy trials, has been performed for many years. A summary of some of this research from 1989 to the present is presented here to help clarify factors relating to management of thrips in seedling cotton with insecticides.

Materials and Methods

Most of the tests summarized in this paper were small plot (50 ft x 4 rows wide) insecticide evaluations. Generally the tests were planted mid-May. Locations included the North Mississippi Branch Experiment Station at Holly Springs, the North Mississippi Research and Extension Center at Verona, the Delta Branch Experiment Station at Stoneville, the Plant Science North Farm at Mississippi State University, the Black Belt Branch Experiment Station at Brooksville and occasional farm sites where foliar applications were made. Foliar applications were applied with a high-clearance small plot spray tractor equipped with a compressed air spray system with nozzles at 19 inch centers for broadcast applications and 38 inch centers for banded applications. Initial post-spray samples were normally made 2 to 3 days following treatment. A John Deere 7100 planter equipped with Almaco seed and granule dispensers (Almaco Co., 99 M. Ave., Box 296, Nevada, IA 50201) was used for planting tests incorporating insecticides applied in-furrow. A CO_2 powered liquid application system utilizing a flat fan nozzle turned to direct the entire spray pattern into the furrow was used for in-furrow liquid applications. Liquids were applied with water as carrier and at rates between 5 and 10 gallons per acre.

Sampling was accomplished by collecting 5 plants from the center two rows of each plot by gently cutting them immediately above ground level and quickly placing them in a self-sealing plastic bag. During the years 1986 to 1989, 10 plants were collected per plot. The bags were then brought to the laboratory where the thrips were washed onto filter paper using a technique modified from that of Burris (Burris et al. 1989), and the thrips were counted under magnification. Adults were usually identified to species by use of a dissection microscope. Some specimens from the samples were mounted on microscope slides to verify identification.

For the purposes of summarization, data from each of the tests were normalized by dividing the mean number of thrips from a treated entry by the mean number obtained from the untreated check plots, forming an efficacy ratio. This number approached 1.0 when there was no mortality in the insecticide-treated plots, or 0.0 if there was 100% mortality. By subtracting the efficacy ratio from one and multiplying by 100, the efficacy ratio was converted to percent control values. Yield data were also normalized in like manner, however the mean yield (lb seed cotton) from treated plots was divided by the mean yield from the untreated or water treated check plots. Subtracting 1 from the yield ratio and multiplying by 100 provided a percent change in yield in treated plots from that of the untreated check. These data were then entered into a comprehensive computer database from which the summaries were prepared for this paper.

Results and Discussion

The broad use of insecticides for control of thrips on seedling cotton would suggest the possibility of rapid selection for insecticide resistance in the common species. However, because only one or two generations of thrips develop on the crop during and immediately following the critical seedling stage of growth, there is ample opportunity for thrips to return to wild hosts to mate with wild populations and thereby greatly reduce the probability of selection for insecticide resistance. Control of larval thrips on seedling cotton by aldicarb and other compounds has been relatively consistent over the last ten years (Fig. 3). Fluctuations in efficacy may have been caused by weather, soil conditions, species present or other factors. Although western flower thrips has been reported to be resistant to insecticides in several areas, that species has generally not been present in sufficient numbers to greatly influence results of these trials. Western flower thrips on seedling cotton in Georgia remain susceptible to acephate applied at a rate of 0.2 lb ai/acre (G. Herzog, personal communication), yet areas of the Mississippi River Delta in Mississippi, Arkansas and Louisiana have had populations that were difficult to manage on seedling cotton.

Efficacy of different rates of aldicarb, acephate, imidacloprid, terbufos and phorate are summarized in tables 1-5, respectively. Aldicarb increased in control of larval thrips as rate was increased up to one pound of active ingredient per acre. The low label rate of Temik is 0.5 lb ai/acre and 0.75 lb ai/acre is the high labeled rate. As seen in Table 1, these rates do not produce 100% control of larval thrips. Research at the North Mississippi Research and Extension Center during 1998 and 1999 has indicated that yield may be reduced under certain conditions with aldicarb and some other insecticides applied in-furrow when cotton is planted under conditions that are optimum for plant growth. This appears to occur more often in very late plantings and suggests a phytotoxicity that may be masked under conditions with cooler growing conditions and noticeable thrips damage.

Acephate applied in-furrow either as a liquid spray or granules appears to be optimum at a rate of 1.1lb ai/acre (Table 2). Rates above that did not improve efficacy and rates below that were noticeably less efficacious in control of larval thrips. Imidacloprid (Table 3) has a very flat response curve relative to rate, and although the compound is not typically recommended for in-furrow application, it is very effective at rates of 0.09 lb ai/acre or above. Terbufos (Counter) (Table 4) provided 70% or less control at rates up to 2.0 lb ai/acre, and phorate (Thimet) (Table 5) appears for some reason to be more efficacious at 0.5 lb ai/acre than at 0.75 lb. The high standard deviation of the data for the 12 tests at 0.75 lb ai/acre for phorate indicates that there was a great deal of variation in the data. Thus a few tests with very high numbers of thrips may have drastically influenced these summary data.

There is a considerable reduction in efficacy of seed treatments compared to in-furrow treatments (2-4 weeks after planting) when only adult thrips are considered 56.2 (SE=6.50) and (76.2% (SE=2.50), respectively). Control by in-furrow and seed treatments did not differ when only larval thrips were considered. A comparison of seed and in-furrow treatments over time as summarized from all trials for different insecticide classes is depicted in Fig. 4. In general seed treatments demonstrate reduced efficacy for control of larval thrips about four weeks after planting, with efficacy after that time below that of compounds applied in-furrow at planting. Efficacy often becomes negative in seed-treatment plots indicating that there are more thrips on the treated plots than on the untreated plots. This may occur when untreated check plots become heavily thrips-damaged and become unattractive to thrips, particularly near the end of the efficacy period for a compound (four weeks or more). Such reduction in efficacy may have little if any effect on yield since by that time the plants are rapidly growing and less susceptible to thrips damage.

Yield increases associated with seed and in-furrow treatments of the commonly used compounds, as well as an unlabeled compound, are summarized in Table 6. Thiamethoxam has been not been widely tested in these trials, however available data indicate that it will be very effective as both a seed treatment and an in-furrow treatment. Thiamethoxam, tested in-furrow at two rates, 0.02 and 0.05 lb ai/acre in 1998, increased yield over 40%. Thrips numbers were very high that year, averaging nearly 20 thrips per plant during the first 3 weeks following planting.

Seed treatments currently available on cotton in Mississippi are acephate (Orthene), imidacloprid (Gaucho), and thiamethoxam (Adage/Cruiser). In 37 test entries, imidacloprid seed treatment controlled 91% (Std. Dev. = 13%) of the larval thrips during the first three weeks after planting, compared to 63% in 14 acephate entries (Std. Dev. = 38%). Thus the neonicitinoid, imidacloprid, appears to be a somewhat more consistent performer than acephate. Thiamethoxam is marketed as a seed treatment under the name of Cruiser, and is also a neonicitinoid. Its performance appears to be very much like that of Gaucho.

Foliar applications of insecticide are less effective and have reduced residual compared to seed treatments or in-furrow applications. Results of a 2001 trial are represented in Fig. 5 and presents efficacy results of many compounds against a population of tobacco thrips. Only the combination of a pyrethroid and a neonicotinoid (Karate Z + Centric) reduced the population below the currently accepted threshold of one thrips per plant. Typically one can expect to make more than a single application of insecticides to control thrips on seedling cotton if foliar application is the only management procedure.

Summary

The primary thrips pest on seedling cotton in Mississippi is the tobacco thrips. Seedling cotton may be infested by thrips immigrating from early spring host plants as soon as the cotton plants emerge. Most of the acreage planted in cotton in Mississippi is affected by thrips. Thirty eight percent of the 1999 Mississippi cotton crop was treated with foliar insecticide for early season thrips management (30% in the hills, 42% in the delta region). During the 2000 season, 91% of delta cotton and 82% of hill cotton received either a seed treatment or an in-furrow insecticide at planting. In-furrow, prophylactic treatments have longer residual activity then seed treatments and demonstrate better efficacy against adult thrips than do seed treatments. In general seed treatments lose efficacy for control of larval thrips beyond three weeks after planting with efficacy after that time below that of compounds applied in-furrow. Both seed treatments and materials applied in-furrow provided approximately 80% control of larval thrips during the first 21 days after planting.

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Table 1. Efficacy of aldicarb (Temik 15G) applied in-furrow for control of larval thrips on seedling cotton for the first three weeks following planting.

Lb ai/acre	Percent control	Number of entries	Standard deviation
0.33-0.4	43	5	54
0.50-0.525	87	39	48
0.75	90	4	14
1.000	100	2	0

Table 2. Efficacy of acephate (Orthene) applied in-furrow for control of larval thrips on seedling cotton for the first three weeks following planting.

Lb ai/acre	Percent control	Number of entries	Standard deviation
0.45-0.5	65	15	53
0.65-0.75	64	11	57
0.9-1.0	67	31	91
1.1-1.5	91	6	13
1.8-2.0	91	8	22

Table 3. Efficacy of imidacloprid (Admire) applied in-furrow for control of larval thrips on seedling cotton for the first three weeks following planting.

Lb ai/acre	Percent control	Number of entries	Standard deviation
0.09	96	3	3.6
0.14	100	2	0.0
0.18	96	3	3.5
0.2	91	3	9.0
0.28	99	2	1.4

Table 4. Efficacy of terbufos (Counter 15G) applied in-furrow for control of larval thrips on seedling cotton for the first three weeks following planting.

Lb ai/acre	Percent control	Number of entries	Standard deviation
0.5	22	2	11
1.0	61	4	29
2.0	70	4	23

Table 5. Efficacy of phorate (Thimet 20G) applied in-furrow for control of larval thrips on seedling cotton for the first three weeks following planting.

Lb ai/acre	Percent control	Number of entries	Standard deviation
0.5	95	5	4.2
0.75	72	12	32

Table 6. Percent yield (lb seed cotton) increase or decrease compared to the untreated check. Data include results of trials for 1986 to 2000.

Compound	% Difference from check	Number of Entries	Standard deviation
Seed Treatment			
Acephate	8.2	9	0.17
Imidacloprid	15.0	15	0.09
Thiamethoxam	20.8	2	0.22
In-Furrow			
Aldicarb	23.4	26	0.25
Terbufos	0.0	7	0.11
Phorate	2.2	6	0.29
Acephate	13.4	17	0.28
Imidacloprid	5.7	6	0.15
Thiamethoxam	43.0	2	0.234

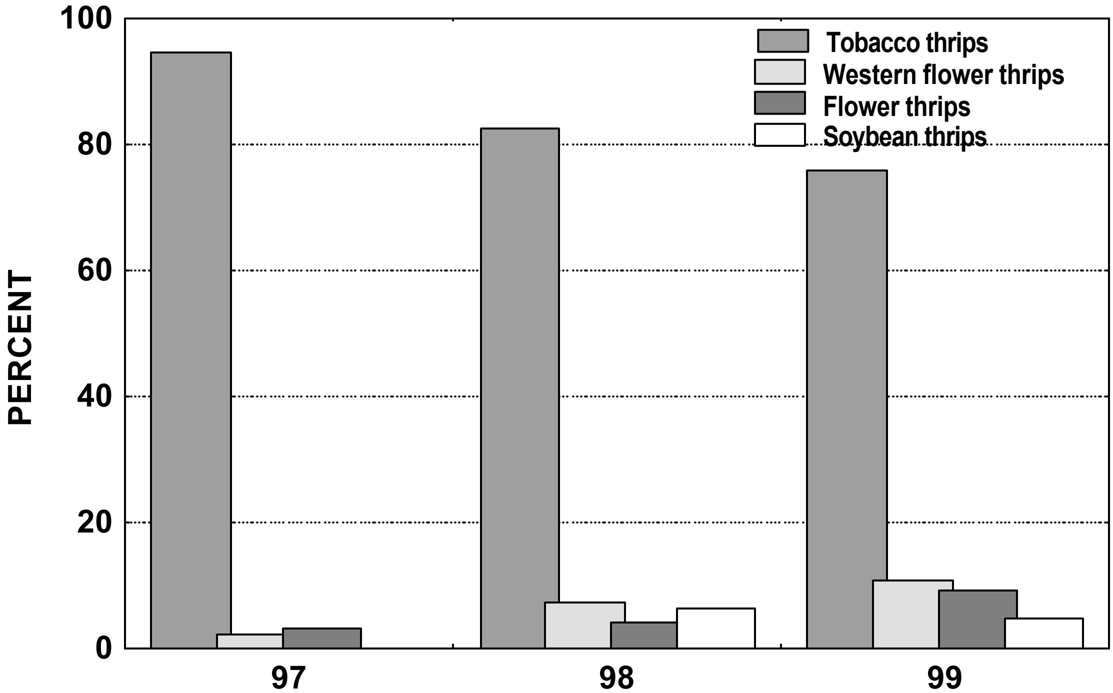

Figure 1. Relative abundance of species of thrips collected from seedling cotton in Mississippi from 1997 to 1999.

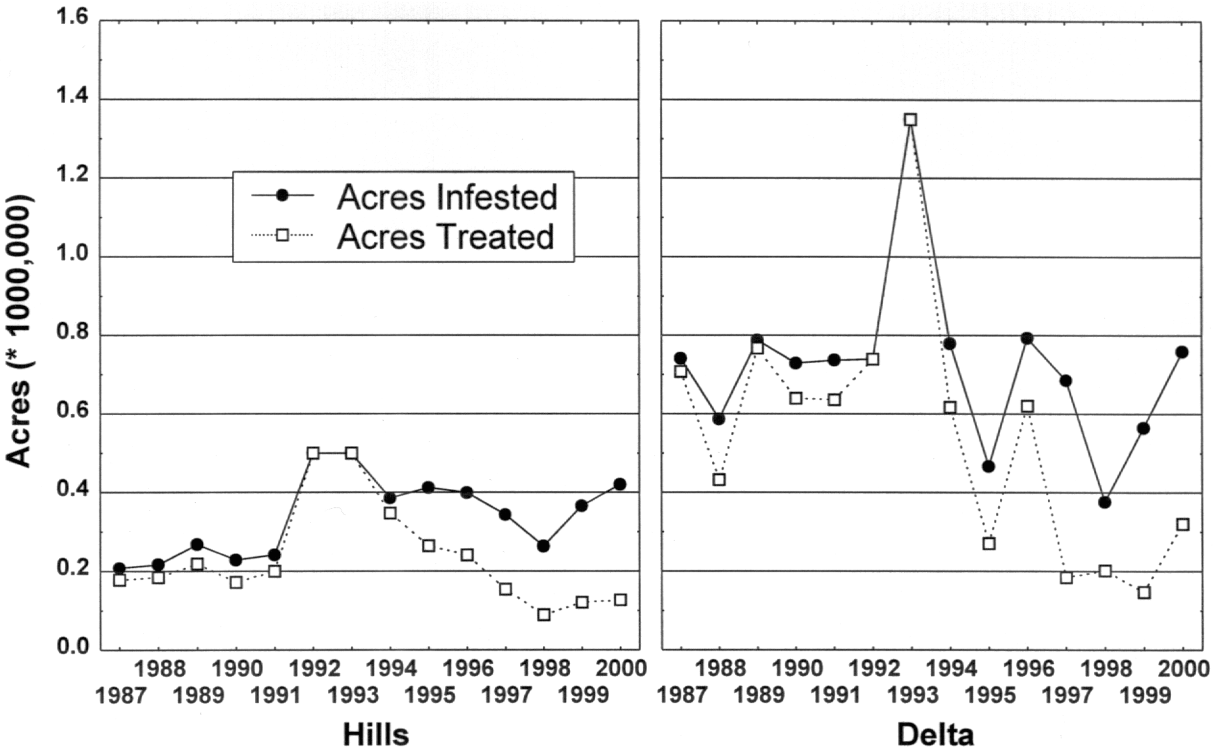

Figure 2. Acres of cotton infested with thrips and receiving foliar insecticide applications for thrips management from 1987 to 2000 in the hills and delta regions of Mississippi.

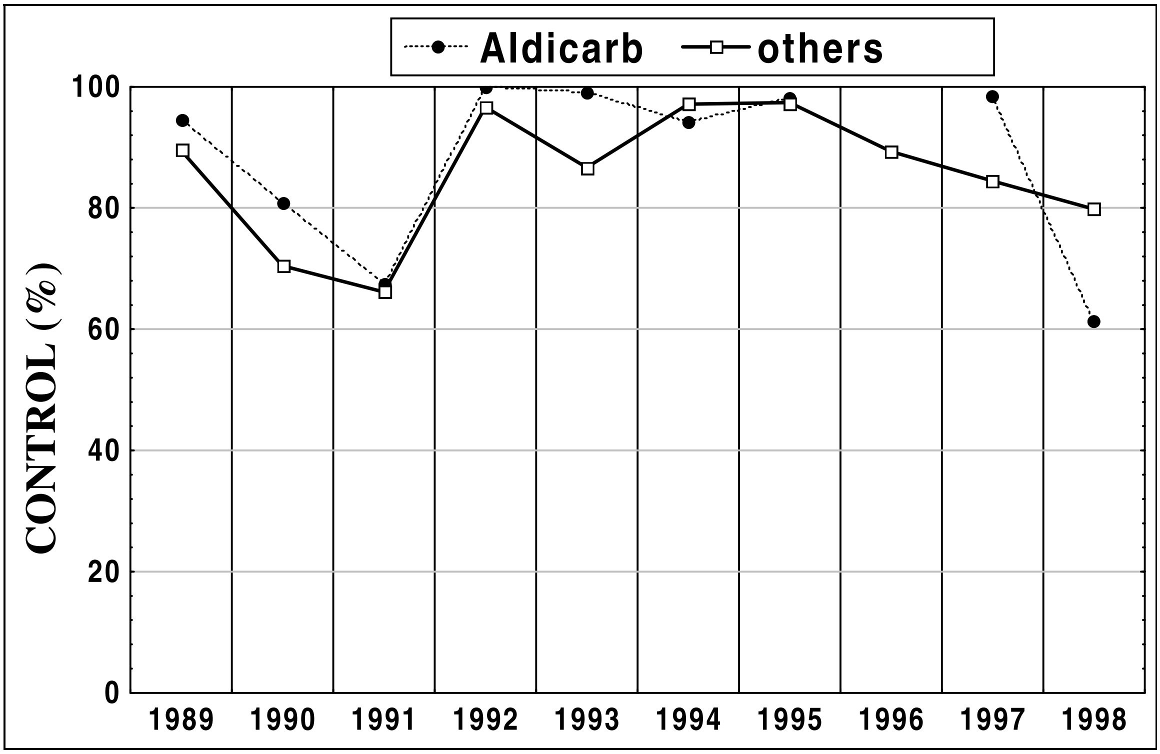

Figure 3. Efficacy of aldicarb insecticide compared with the average of all other insecticides over the years of these trials. All rates are included, but the vast majority of Temik rates is 0.5 lb ai/acre and was included in most trials as a standard. Other rates are typically those expected to provide good control.

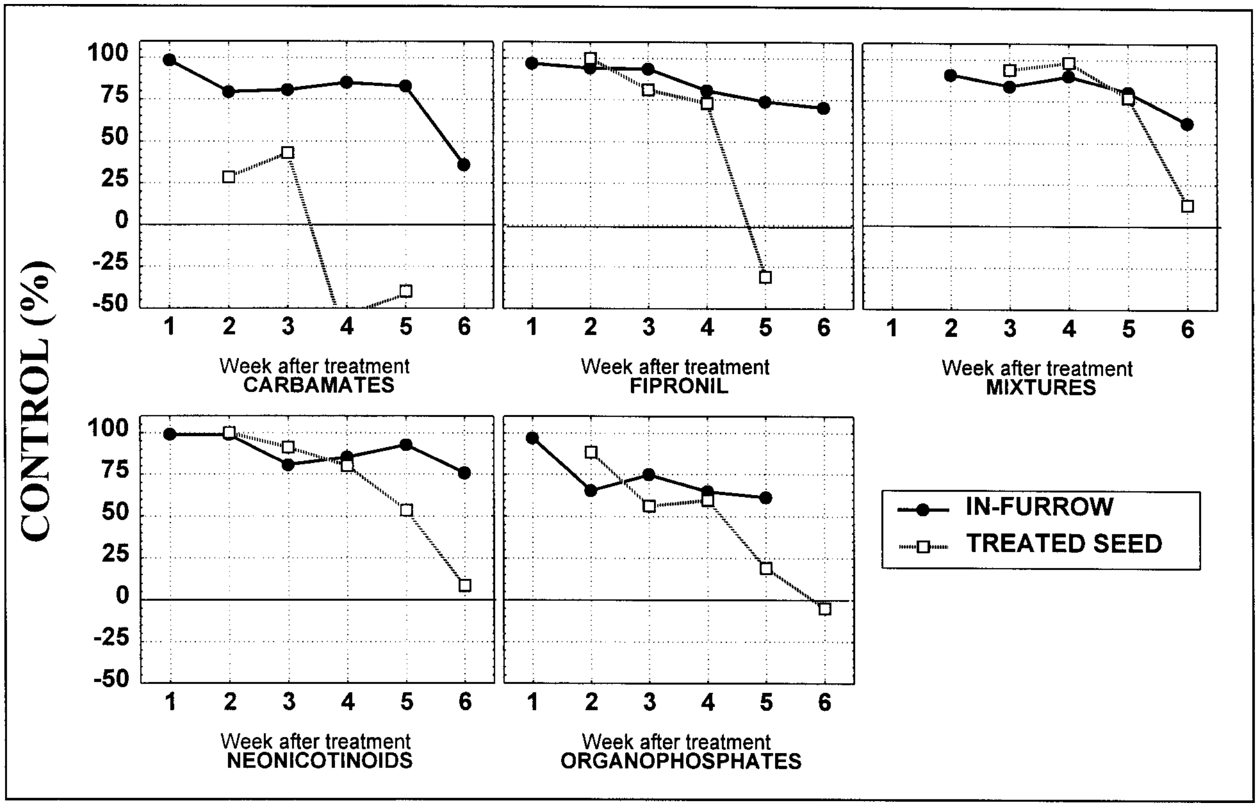

Figure 4. Residual activity of insecticides applied as in-furrow and seed treatments summarized by class over all trials, compounds and rates.

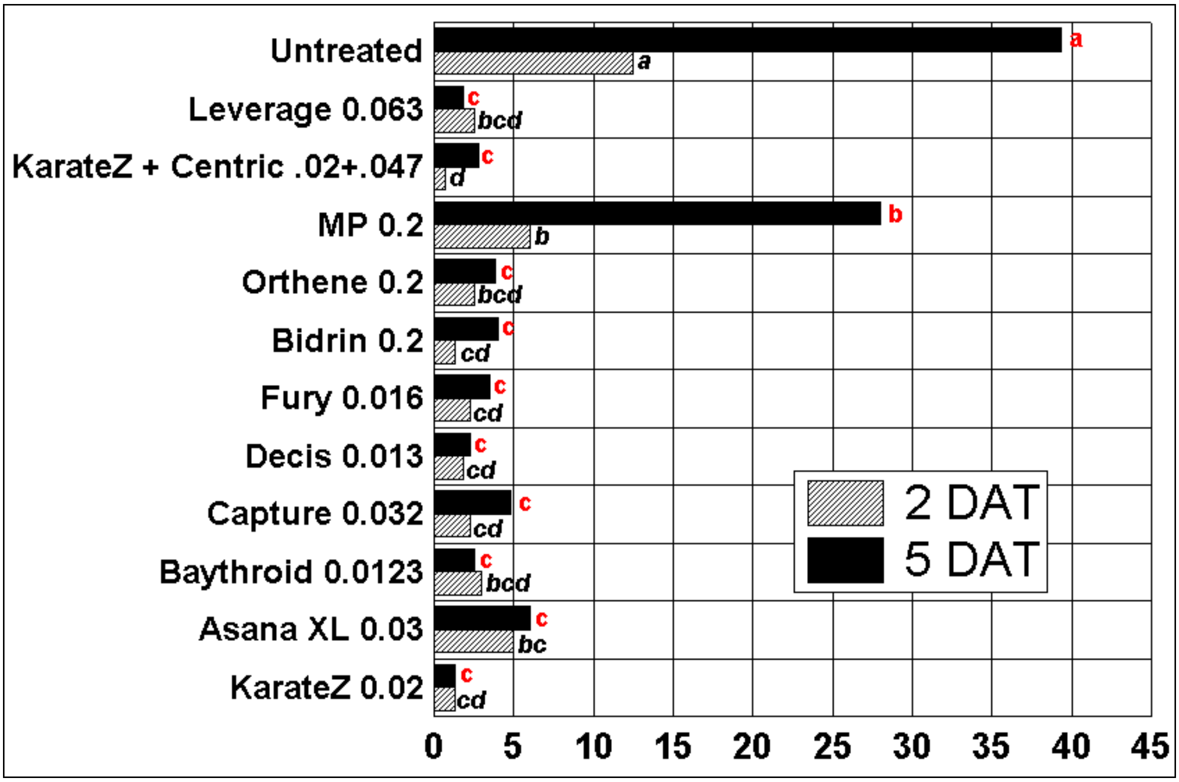

Figure 5. Number of thrips per 5 plants. Results of a single foliar application on immature thrips on seedling cotton. Test completed at Verona, MS., with spray application on June 13, 2001. Means within the same date not sharing a common letter differ significantly (LSD; p=0.05).