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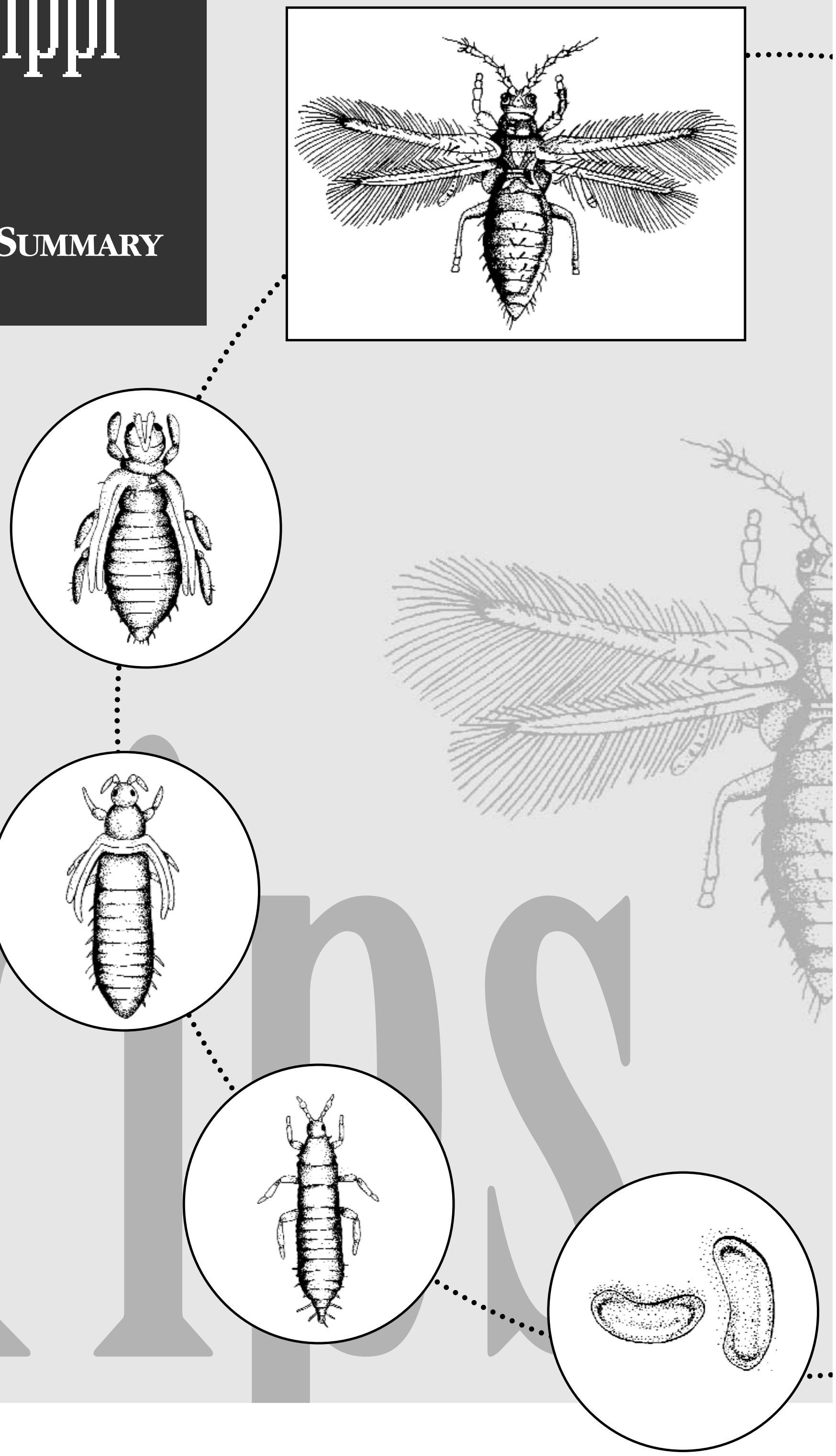

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Classification and Identification

Thrips are in the order Thysanoptera (Thysano meaning fringe, ptera meaning wings), a name referring to the delicate fringe of hairs on the wings of most species. Although there are two suborders of thrips, only the suborder Terebrantia will be discussed because all the primary cotton pest species are assigned to that suborder. The terebrantians insert their eggs into leaf tissue, where they are hidden from view and predation.

There are somewhere between 4,000 (Arnett 2000) and 8,000 (Lewis 1997) described species of thrips, but of those, only three are primary pests of cotton in Mississippi. These are all in the genus *Frankliniella* and are as follows: *F. occidentalis* (Pergande) (western flower thrips), *F. tritici* (Fitch) (flower thrips), and *F. fusca* (Hinds), (tobacco thrips). *Neohydatothrips variabilis* (Beach), the soybean thrips, is also often found in cotton along with a few other species that may occur in very low numbers. Identification of these species is not difficult under adequate magnification, but field identification can be difficult. Field identification of dark-colored thrips on seedling cotton as tobacco thrips would be correct most of the time. However, the western flower thrips may range from a light amber color to a dark brown, and some tobacco thrips are very light colored, particularly the males. The soybean thrips has banded wings and is relatively easy to separate from most other species on seedling cotton. Flower thrips (sometimes called eastern flower thrips) and western flower thrips are nearly identical and can be positively identified only with the aid of high magnification. In addition to the primary thrips species, several additional species have been collected from cotton in Mississippi (Table 1), although two of these species were collected only from cotton grown in greenhouse studies.

In Mississippi, usually more than 90% of the adult thrips found on seedling cotton have been tobacco thrips. During the years 1997-1999, the dominant species of thrips were distributed according to Figure 1. This distribution is based on whole plant samples and a washing technique modified from that of Burris et al. (1989) to dislodge thrips. There appears to have been a slight increase of thrips other than tobacco thrips in the last 2 years. 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 has been 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 [Karboutli 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 last 2 years of drought or other factors is yet to be determined.

Table 1. Species of thrips collected from seedling cotton in Mississippi ranked in accordance to relative abundance.[1]

Ranking	Species
1	*Frankliniella fusca* (Hinds)
2	*Frankliniella occidentalis* (Pergande)
3	*Frankliniella tritici* (Fitch)
4	*Neohydatothrips variabilis* (Beach)
5	*Thrips tabacci* Lindeman
Incidental	*Microcephalothrips abdominalis* D. L. Crawford
Incidental	*Aelothrips bicolor* Hinds
Incidental	*Anophothrips obscurus* Muller
Incidental	*Caliothrips fasciapennis* (Hinds)
Incidental	*Chirothrips texanus* Andre
Incidental	*Sericothrips cingulatus* Hinds
Incidental	*Thrips nigripilosus* Uzell
Greenhouse	*Echinothrips subflavus* Hood
Greenhouse	*Scolothrips pallidus* (Beach)

[1]Rankings: 1 = most abundant; 5 = less abundant. Greenhouse-collected cotton grown in a greenhouse.

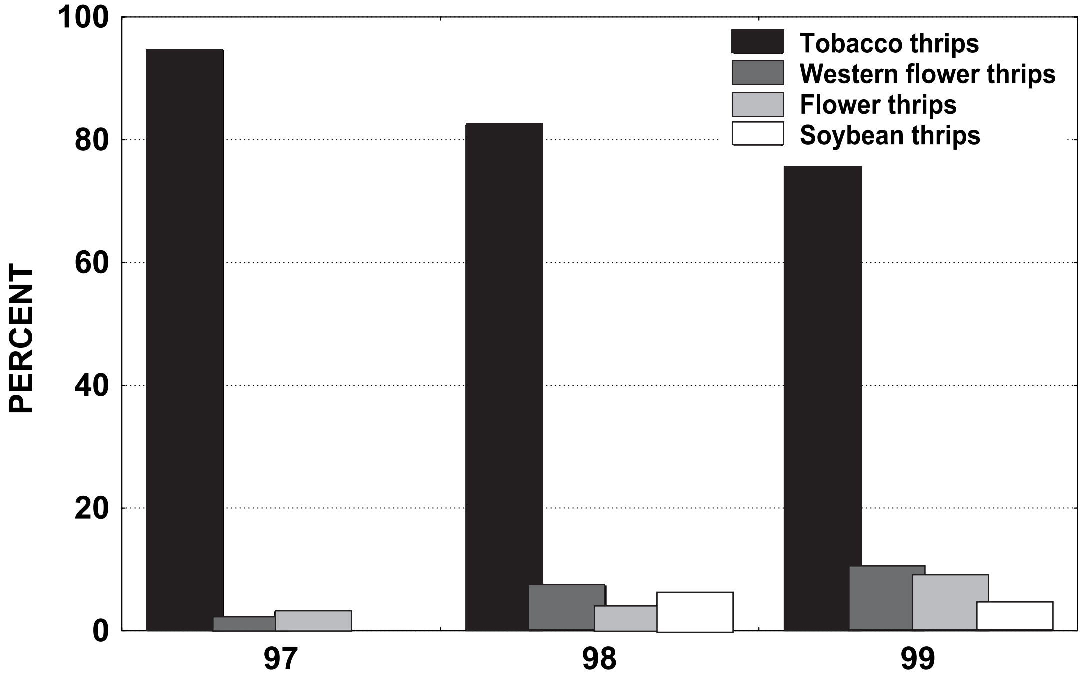

Figure 1. Relative abundance of species of thrips collected from seedling cotton in Mississippi from 1997 to 1999.

Feeding and Crop Damage

Thrips are unique within the insect world because of the asymmetrical structure of the head and mouthparts. It may be said that thrips smile out of one side of their face (Figure 2), a fact resulting from the loss of one mandible somewhere down the evolutionary trail that added a rather skewed appearance to the thrips head. Mouthparts include the left mandible and two maxillary stylets, which fit together along their length to form a sucking tube. The mandible and maxillary stylets are normally enclosed by the oral cone (Figure 3), which is apparently depressed when the thrips presses it against the leaf surface, allowing the mandible (Figure 4) or stylets (Figure 5) to protrude. Thrips feed by driving the mandible through the surface of a leaf, inserting the maxillary stylets in the hole made by the mandible, and sucking up the contents of damaged cells. The length of the stylets differs widely among species, indicating that some may have the ability to feed much deeper in the leaf tissue than others. However, the stylets in all three *Frankliniella* species infesting cotton appear to be about the same length.

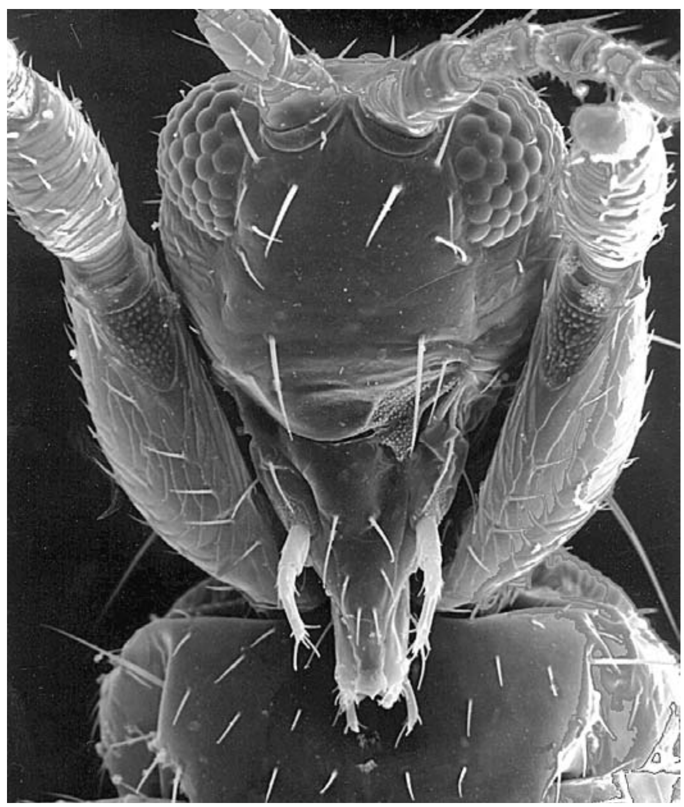

Figure 2. Scanning electron micrograph of the head of a western flower thrips.

Wardle and Simpson (1927) reported that the epidermal cells may be largely undisturbed by feeding

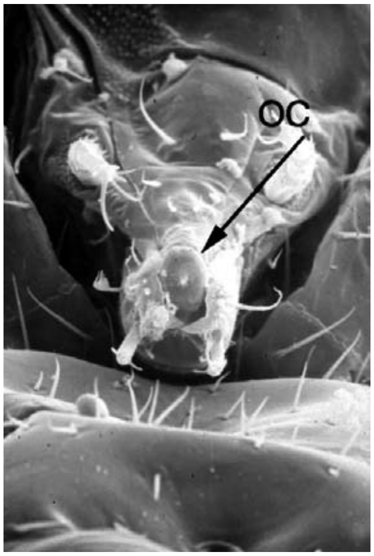

Figure 3. Scanning electron micrograph showing the tip of the oral cone (OC) of a western flower thrips.

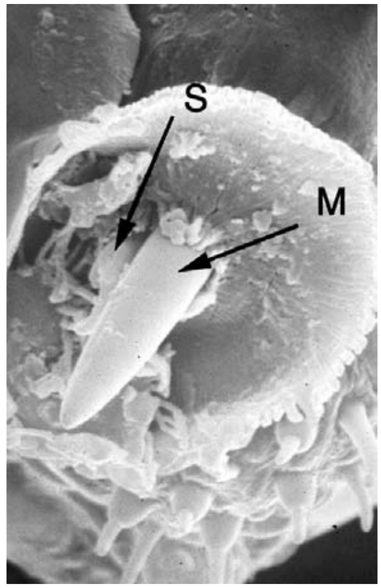

Figure 4. Scanning electron micrograph of the mandible (M) protruding from the oral cone of a western flower thrips. The tips of the maxillary stylets (S) are visible next to the mandible.

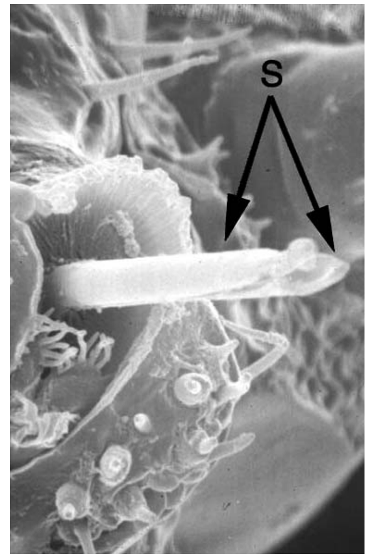

Figure 5. Scanning electron micrograph of the maxillary stylets (S) protruding from the oral cone of a western flower thrips.

thrips, and that the silvery appearance of feeding sites results from damage to the mesophyl layer of cells. They described the results of feeding to produce first a silvery appearance and then as necrosis occurs within the leaf, a brown spot. Undamaged leaf tissue appears as in Figure 6a. Areas of thrips (western and eastern flower thrips) feeding during the silvery to early necrotic or brown stage are shown in Figure 6b. Note areas near the leaf surface with incomplete cell walls. Figure 6c depicts the late necrotic (brown) stage and shows nearly total disintegration of cell walls and lack of cellular contents. Actual penetration scars on the cotton leaf surface left by the thrips are minute because the mandible is only a few microns wide. Even under scanning electron microscopy, the scars are difficult to find. There is a bobbing motion of the thrips' head as it searches for or punctures acceptable cells in a leaf, and it is probable that this motion encouraged early entomologists to term the feeding behavior as rasping-sucking. It is now generally accepted that thrips are piercing-sucking insects, or sometimes they are referred to as punching-sucking insects.

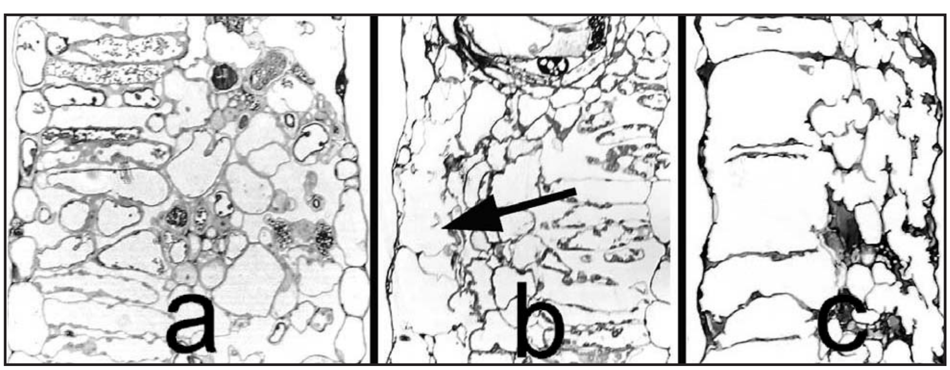

Figure 6. Cell damage resulting from thrips feeding: a = undamaged leaf; b = silvery stage (arrow indicates damaged cells); and c = necrotic or brown stage.

Biology

Figure 7. Adult female and larval thrips on cotton leaf.

There are six stages in the life cycle of thrips: egg, two larval instars, propupa, pupa, and adult. Larvae and adult thrips are depicted in Figure 7. The term “larva” is commonly applied to immature thrips by thysanopterists, but they may also be called nymphs. The propupa and pupa are more or less quiescent, nonfeeding stages that normally are found in the soil but may occasionally be found on foliage. As indicated by the quiescent stages of thrips, the metamorphosis of the order is neither holometabolous nor hemimetabolous, but lies somewhere between the two (Bryan and Smith 1936) because they have some of the characteristics of both. The life cycle of western flower thrips may take as little as 15 days from egg to adult at 30°C (86°F) or much longer at lower temperatures [44 days at 15°C (59°F)] (Lublinkhof and Foster 1977). Developmental time for tobacco thrips is approximately the same (Eddy and Livingstone 1931). Many thrips species have the capacity for parthenogenetic reproduction, the development of unfertilized eggs. In the case of *Frankliniella* species on cotton in the Midsouth, this apparently takes the form of arrhenotokous parthenogenesis producing only male offspring in tobacco thrips (Eddy and Livingstone 1931) and flower thrips (Watts 1936). According to Watts (1936), a ratio of up to 100% females to males has been observed in offspring of individual females in natural populations of flower thrips on seedling cotton. The thrips from the genus *Frankliniella* that infest cotton also have the ability to produce offspring that have reduced wings (brachypterous condition) or lack wings altogether (apterous condition) (Figure 8). This may help insure reproduction on good-quality food sources because the wingless thrips are unable to fly to other sources.

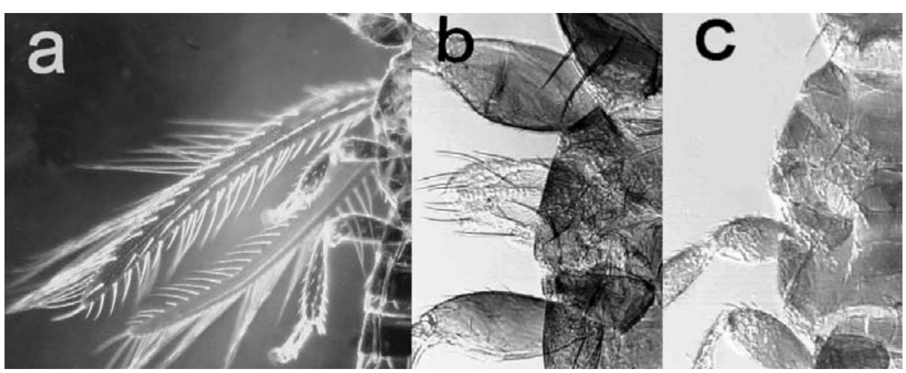

Figure 8. Different wing configurations of tobacco thrips adults: a = normal; b = brachypterous condition with reduced wings; and c = apterous condition with no wings.

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 several problems: 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 7 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 before 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 (Figure 9), as does the average number of applications of foliar insecticides and the thrips-caused yield loss (Figure 10). Based on data presented in the proceedings of the 2000 Beltwide Cotton Conferences (National Cotton Council 2000), 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) (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).

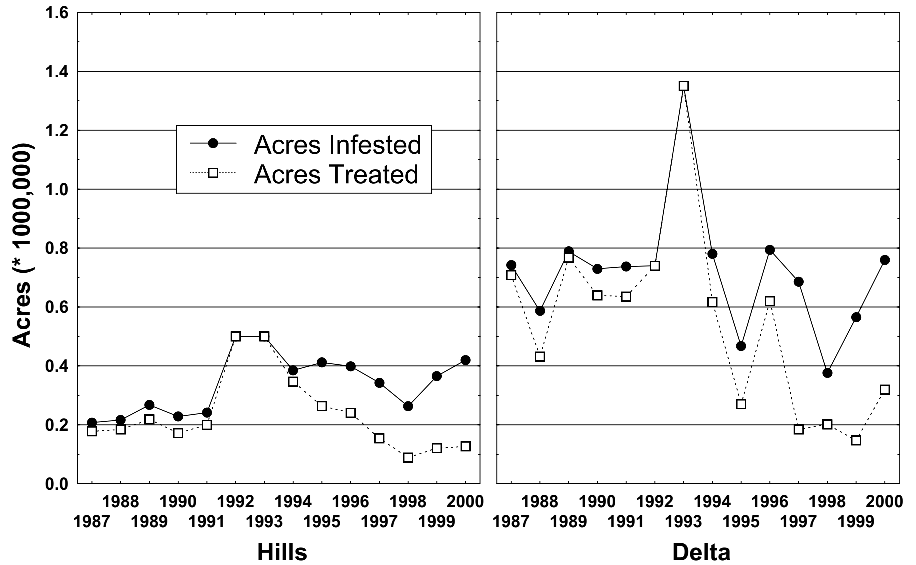

Figure 9. Acres of cotton infested with thrips and receiving foliar insecticide applications for thrips management from 1989 to 2000 in the Hills and Delta regions of Mississippi.

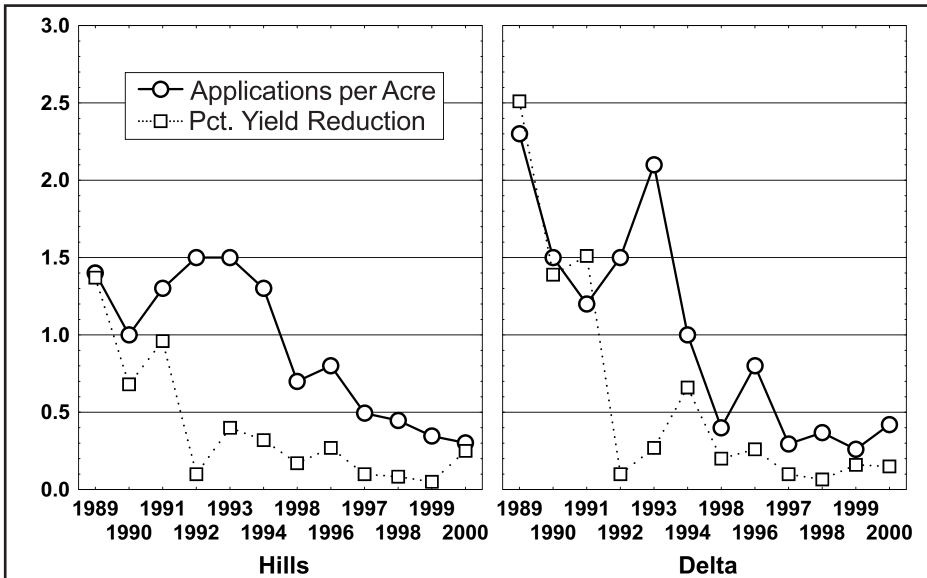

Figure 10. The number of foliar insecticide applications per acre for thrips management and the estimated percent yield reduction caused by thrips in the Hills and Delta regions of Mississippi.

Review of Pesticide Evaluations

Materials and Methods

Most of the tests summarized in this paper were small-plot (50 feet long, four 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 Research Center 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 after 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 five 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 1986-1989, 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 for verification of identifications.

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 1 and multiplying by 100, the efficacy ratio was converted to percent control values. Yield data were normalized in like manner, but the mean yield (pounds of 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.

Common and trade names of compounds evaluated in the trials and the insecticide classification of each compound are included in Appendix A. Appendix B contains tables summarizing each trial included in the analyses presented in this paper. Three trials from 1999 and 2000 are included in the tables that are not included in the database and except where noted, are not included in summary information presented herein.

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 10 years (Figure 11). 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 pound of active ingredient per acre (lb ai/A) (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 2-6, respectively. Aldicarb increased in control of larval thrips as rate was increased up to 1 lb ai/A. The low label rate of Temik is 0.5 lb ai/A, and 0.75 lb ai/A is the high label rate. As seen in Table 2, 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 some 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 1.1 lb ai/A (Table 3). Rates above that amount did not improve efficacy, and rates below that amount were noticeably less efficacious in control of larval thrips. Imidacloprid (Table 4) 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/A or more. Terbufos (Counter) (Table 5) provided 70% or less control at rates up to 2 lb ai/A, and phorate (Thimet) (Table 6) appears for some reason to be more efficacious at 0.5 lb ai/A than at 0.75 lb ai/A. The high standard deviation of the data for the 12 tests at 0.75 lb ai/A 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 with in-furrow treatments

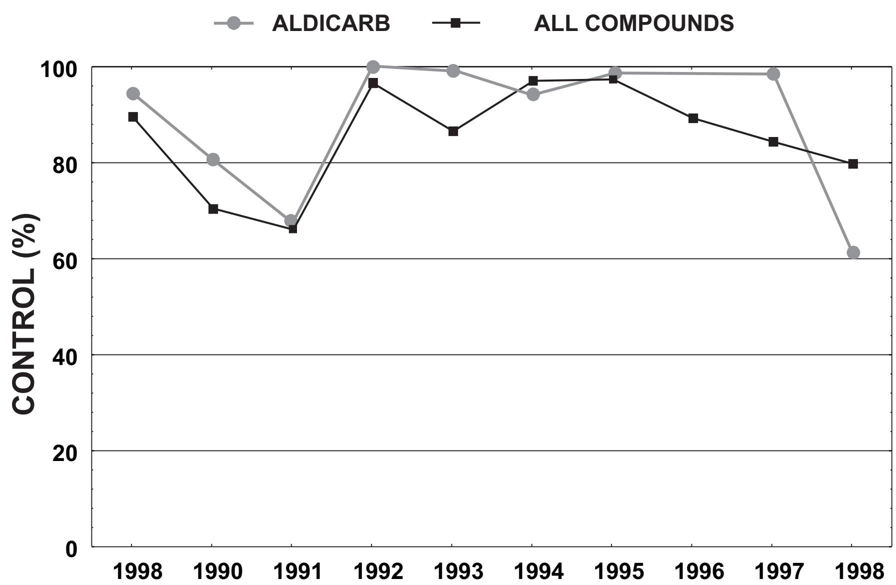

Figure 11. Efficacy of aldicarb insecticide compared with the average of all other insecticides over the years of these trials. All rates are included, but the vast majority of Temik rates are 0.5 lb ai/A, which was included in most trials as a standard. Other rates are typically those expected to provide good control.

Table 2. Efficacy of aldicarb (Temik 15G) applied in-furrow for control of larval thrips on seedling cotton for the first 3 weeks after 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 3. Efficacy of acephate (Orthene) applied in-furrow for control of larval thrips on seedling cotton for the first 3 weeks after 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

when only adult thrips are considered (Figure 12), and not at all when only larval thrips are considered (Figure 13). A comparison of seed and in-furrow treatments over time as summarized from all trials for different insecticide classes is depicted in Figure 14. In general, seed treatments demonstrate reduced efficacy for control of larval thrips about 4 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 (4 weeks or more). Such reduction in efficacy probably has little if any effect on yield because 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 7. Thiamethoxam has not been adequately tested in these trials, but available data indicate that it will be very effective as both a seed treatment and an in-furrow treatment. Thiamethoxam was tested in-furrow at two rates, 0.02 and 0.05 lb ai/A in 1998. Thrips numbers were very high that year, averaging nearly 20 thrips per plant during the first 3 weeks after planting. Yield increase for thiamethoxam compared with the untreated check was more than 40% in that trial.

Seed treatments currently available on cotton in Mississippi are acephate (Orthene), imidacloprid (Gaucho), and thiamethoxam (Cruiser). In 37 test entries, imidacloprid seed treatment controlled 91% (Std. Dev. = 13%) of the larval thrips during the first 3 weeks after planting, compared with 63% in 14 acephate entries (Std. Dev. = 38%). Thus, the neonicitinoid, imidacloprid,

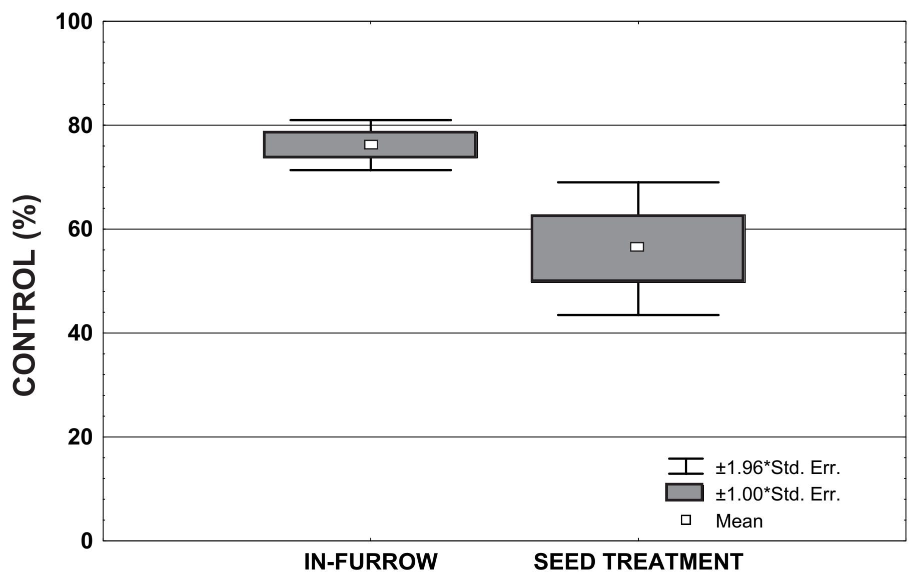

Figure 12. Comparison of efficacy of insecticides applied as in-furrow treatments and seed treatments for control of adult thrips (mostly tobacco thrips). Data cross all studies and rates and all insecticides used but are restricted to the second, third, and fourth weeks following planting.

Table 4. Efficacy of imidacloprid (Admire) applied in-furrow for control of larval thrips on seedling cotton for the first 3 weeks after 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 5. Efficacy of terbufos (Counter 15G) applied in-furrow for control of larval thrips on seedling cotton for the first 3 weeks after 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

appears to be a somewhat more consistent performer than acephate. Thiamethoxam is marketed as a seed treatment under the name of Adage, and it is also a neonicitinoid. Its performance appears to be very much like that of Gaucho.

Table 8 summarizes the efficacy of different insecticide classes for larval thrips control during the first 3 weeks after planting when used as foliar, in-furrow or seed treatments on seedling cotton. Based on the standard deviation (except for classes with only one entry), fipronil and the neonicotinoids were the most consistent performers of the insecticide classes. Mixtures for in-furrow and seed treatments were also consistent in larval thrips control across trials. The only seed treatment mixture was that of acephate plus imidacloprid. Both seed treatments and in-furrow-applied materials provided approximately 80% control of larval thrips during the first 21 days after planting. Foliar applications in these trials were applied on cotton that was planted without in-furrow insecticide or seed treatment. These were evaluated 3-5 days after application and typically showed a relatively short residual. Multiple foliar applications of insecticides are necessary to provide good control of thrips, and the first application should be applied at the cotyledon stage.

Table 9 summarizes the results of the different compounds and rates used in the foliar application trials.

Table 6. Efficacy of phorate (Thimet 20G) applied in-furrow for control of larval thrips on seedling cotton for the first 3 weeks after planting.

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

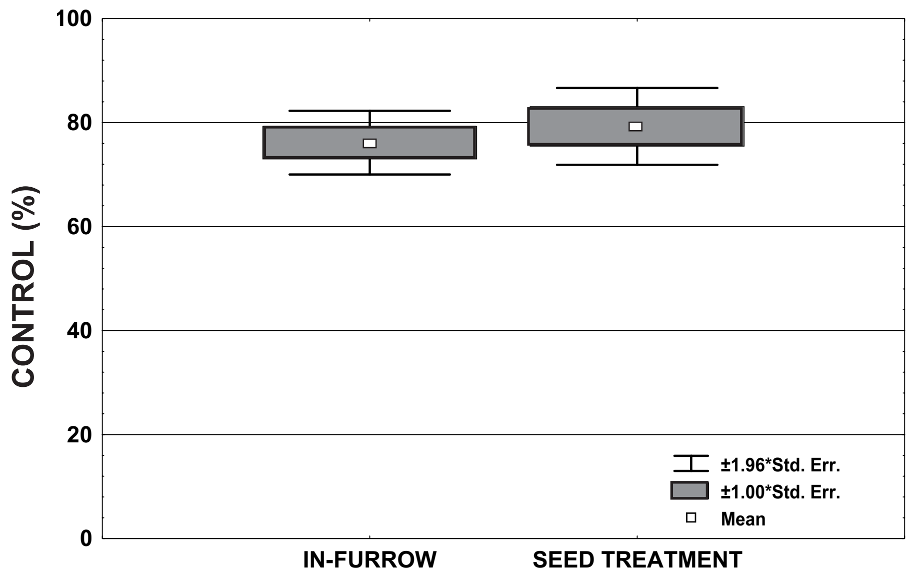

Figure 13. Comparison of efficacy of insecticides applied as in-furrow treatments and seed treatments for control of larval thrips (mostly tobacco thrips). Data cross all studies and rates and all insecticides used but are restricted to the second, third, and fourth weeks following planting.

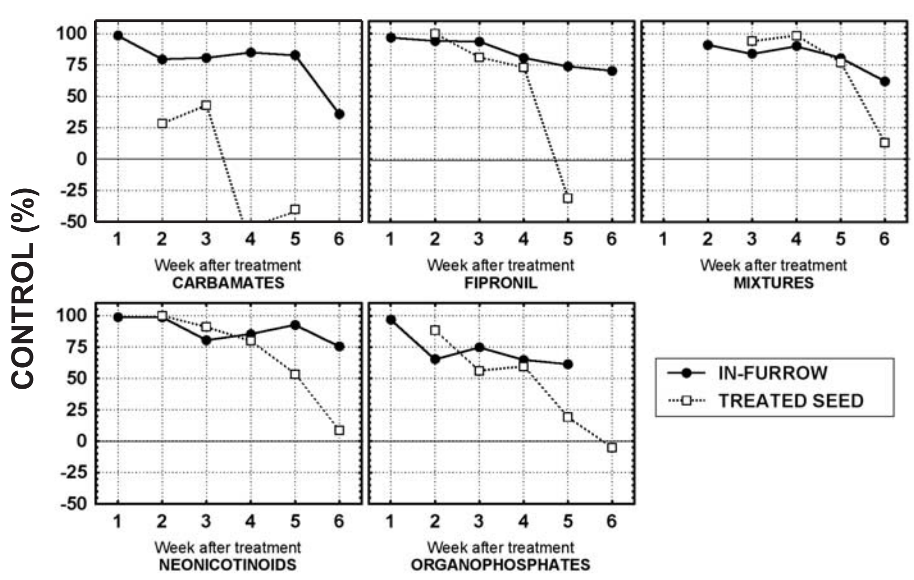

Figure 14. Residual activity of insecticides applied as in-furrow and seed treatments summarized by class over all trials, compounds, and rates.

Table 7. Percent yield (pounds of seed cotton) increase or decrease compared with the untreated check.[1]			
Compound	**% Difference from check**	**Number of entries**	**Standard deviation**
Seed treatment			
Acephate	8.2	9	0.17
Imidacloprid	15.0	15	0.09
Thiomethoxam	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
Thiomethoxam	43.0	2	0.234

[1]Data include results of trials for 1986 to 2000.

Table 8. Mean percent control and standard deviation of larval thrips resulting from foliar, in-furrow, and seed-applied insecticides summarized over the years 1986 to 1998.[1]			
Insecticide class	**Mean percent control**	**Number of entries**	**Standard deviation**
Foliar applications			
Carbamates	13	1	0
Formamadine	-27	1	0
Fipronil	68	25	46
Mixtures	80	3	35
Neonicotinoids	57	9	52
Organophosphates	62	41	42
Pyrethroids	53	17	43
	Mean = 61	**Total = 104**	**Mean = 44**
In-furrow			
Adjuvants	47	5	28
Biologicals	-4	2	49
Carbamates	81	60	48
Fipronil	94	17	5
Mixtures	83	9	20
Neonicotinoids	90	16	23
Organophosphates	72	125	55
	Mean = 76	**Total = 238**	**Mean = 49**
Seed treatment			
Carbamates	36	4	25
Fipronil	87	3	11
Mixtures	96	7	5
Neonicotinoids	91	39	13
Organophosphates	63	14	38
	Mean = 80	**Total = 69**	**Mean = 31**

[1]Period of assessment is restricted to sample dates within 21 days after treatment.

Table 9. Efficacy of foliarly applied compounds for control of larval thrips on seedling cotton for the first 3 weeks after planting for the years 1986-1998.					
Insecticide class	**Compound**	**Lb ai/acre**	**Number of entries**	**Percent control**	**Standard deviation**
Carbamates	Oxamyl	0.1	2	13	—
	Methomyl	0.1	3	-5	98
		0.2	2	60	—
		0.4	2	65	10
		0.75	1	73	—
Formamidine	Chlordimeform	0.125	1	-27	—
Fipronil	Fipronil	0.02	1	88	—
		0.025	12	66	45
		0.038	11	66	52
		0.1	1	100	—
Mixtures	Acephate + Imidacloprid	0.038 + 0.5	1	100	—
	Sulprofos + Chlorpyrifos	0.33 + 0.33	1	100	—
	Chlorpyrifos + Profenofos	0.25 + 0.125	2	40	—
	Disulfoton + Imidacloprid	0.038 + 0.5	1	100	—
	Endosulfan + Methyl Parathion	0.5 + 0.75	2	-1	50
Neonicotinoid	Imidacloprid	0.038	1	85	—
		0.05	1	96	—
	Imidacloprid + Polyaspartate	0.038 + 1pt	1	100	—
Organophosphate	Acephate	0.2	13	85	12
	Amitraz	0.2	1	13	—
	Dicrotophos	0.2	7	59	29
	Chlorpyrifos	0.5	3	17	47
	Dimethoate	0.2	9	84	13
	Disulfoton	0.8	1	96	—
	Methamidophos	0.2	2	7	—
		1.0	1	60	—
	Phosphamidon	0.15	2	40	—
		0.4	1	-83	—
		1.5	8	-5	55
Pyrethroid	Cyfluthrin	0.012	2	-10	30
		0.015	3	8	59
	Cypermethrin	0.02	3	76	3
		0.06	1	26	—
	Lambda cyhalothrin	0.005	3	83	6
		0.01	3	74	12
	Tralomethrin	0.05	3	67	13

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Appendix A

Pesticide classes, common names, and trade names of compounds evaluated in small-plot cotton thrips control trials from 1987 to 1998.		
Insecticide Class	**Compound**	**Trade Names or Experimental Number**
Adjuvants	Crop Oil Concentrate	Agridex
	Non Ionic Surfactant	SM 9
	Polyaspartate-L	Experimental
Carbamates	Aldicarb	Temik
	Oxamyl	Vydate
Fiproles	Fipronil	Fipronil, Regent
Formamidines	Chlordimeform	Fundal, Galecron
Neonicotinoids	Thiamethoxam	Adage, Centric, Cruiser
	Imidacloprid	Admire, Gaucho, Provado, NTN 33893
Organochlorines	Endosulfan	Thiodan, Phaser
Organophosphates	Acephate	Orthene, Payload
	Azinphosmethyl	Guthion
	Chlorpyrifos	Lorsban, XRM-4656
	Dicrotophos	Bidrin
	Dimecron	Dimecron
	Dimethoate	Cygon, Dimethoate
	Disulfoton	Di-Syston, Disyston
	Fenamiphos	Nemacur
	Methamidophos	Monitor
	Methyl Parathion	Cythion
	Monocrotophos	Azodrin
	Oxydimeton methyl	Metasystox R
	Phorate	Thimet
	Phosphamidon	Swat
	Profenofos	Curacron, CGA 15324
	Sulprofos	Bolstar, Bay NTN 9306
	Terbufos	Counter
Others	CMC	Carboxilated Methyl Cellulose
	Garlic Extracts	Garlic Barrior
Pyrethroids	Bifenthren	Capture
	Cyfluthrin	Baythroid, BAY FCR 1272
	Cypermethrin	Ammo, Cymbush, FMC 45806
	Fenpropathrin	Danitol
	Lambda-cyhalothrin	Karate
	Tralomethrin	Scout
	Zeta-cypermethrin	Fury
Synergists	Piperonyl Butoxide	Buticide

Appendix B

Efficacy summaries of individual small-plot pesticide evaluations for thrips management on cotton

Table 1. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment							
			-1	2	3	7	15	18	23	27
Foliar	Chlorpyrifos	0.05	0.60	-38.50	76.00	40.50	—	—	—	—
	Cypermethrin	0.02	1.23	74.50	—	68.50	—	—	—	—
	Cyhalothrin	0.005	0.78	77.00	—	73.00	—	—	—	—
		0.01	1.90	87.50	—	60.50	—	—	—	—
	Tralomethrin	0.05	1.28	51.00	—	60.50	—	—	—	—
In-furrow	Aldicarb	0.4	—	—	—	—	-17.00	29.00	69.00	61.00
	Terbufos	0.5	—	—	—	—	9.50	28.00	53.50	19.00
		1	—	—	—	—	69.00	18.00	59.00	49.50
		2	—	—	—	—	47.50	87.50	74.50	74.50
	Phorate	0.75	—	—	—	—	26.00	53.00	73.00	61.00
Seed	Acephate	0.19	—	—	—	—	16.00	46.50	48.00	26.50
	Tefluthrin	11.8 fl oz/cwt	—	—	—	—	7.50	-58.50	40.00	8.50
Thrips per sample unit, untreated check			9.55	30.00	18.65	19.80	9.55	30.00	19.80	19.30

[1]Date of planting — 6 May 1986; Location — Stoneville, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 2. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Trial average
Foliar	Acephate	0.25	53.00
	Acephate + Buticide	0.25+0.25	11.00
	Sulprofos	0.5	47.00
	Sulprofos + Chlorpyrifos	0.25+0.25	20.00
	Bifenthrin	0.06	17.00
	Bifenthrin + Endosulfan	0.04+0.33	28.00
	Cypermethrin	0.06	26.00
	Fenpropathrin	0.1	-5.00
	Endosulfan	1.5	2.00
	Endosulfan + Methyl Parathion	0.5+0.75	32.00
	Methamidophos	0.4	72.00
	Monocrotophos	0.4	19.00
	Dimecron	0.15	24.00
Thrips per sample unit, untreated check			4.40

[1]Date of planting — 17 May 1988; Location — Stoneville, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 3. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			-1	5	20	28
Foliar	Acephate	0.2	1.17	87.00	—	—
	Azinphos methyl	0.2	1.25	13.00	—	—
	Dicrotophos	0.2	1.08	53.00	—	—
	Chlordimeform	0.125	1.08	-27.00	—	—
	Chlordimeform + Profenofos	0.25+0.125	1.75	40.00	—	—
	Methamidophos	0.2	1.25	60.00	—	—
	Monocrotophos	0.2	1.17	7.00	—	—
	Oxamyl	0.1	1.75	13.00	—	—
	Dimecron	1.5	1.92	40.00	—	—
In-furrow	Terbufos	5.2 oz/1000 ft	—	—	42.00	53.00
	Aldicarb	0.39	—	—	17.00	80.00
	Terbufos	1	—	—	67.00	60.00
		2	—	—	58.00	60.00
	Phorate	4.5 oz/1000 ft	—	—	25.00	60.00
Seed	Acephate	0.5 lb/100 lb	—	—	—	—
		8 oz/cwt	—	—	33.00	-33.00
Thrips per sample unit, untreated check			1.20	1.50	1.20	1.50

[1]Date of planting — 5 May 1987; Location — Stoneville, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 4. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	5 Days after treatment
Foliar	Acephate	0.25	44.00
	Dicrotophos	0.2	67.00
	Sulprofos + Chlorpyrifos	0.33+0.33	100.00
	Dimethoate	0.2	56.00
	Cyhalothrin	0.025	56.00
	Monocrotophos	0.3	11.00
		0.5	33.00
	Oxydimiton-methyl	0.25	56.00
	Tralomethrin	0.025	33.00
Thrips per sample unit, untreated check			2.25

[1]Date of planting — 14 June 1988; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 5. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	6 Days after treatment
Foliar	Dicrotophos	0.2	-81.00
	Bifenthrin + Endosulfan	0.02+0.33	-149.00
	Chlorpyrifos	1	-117.00
	Profenofos	0.5	40.00
		1	-40.00
	Fenpropathrin	0.1	0.00
	Dimethoate	0.2	60.00
		0.25	60.00
		0.4	0.00
	Oxydimiton-methyl	1.25	-105.00
	Monocrotophos	0.5	60.00
		1	60.00
In-furrow	Agridex + Fenpropathrin	0.1	-40.00
Thrips per sample unit, untreated check			0.63

[1]Date of planting — 5 May 1988; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 6. Mean control (percent) of thrips on seedling cotton.[1]			
Application	**Compound**	**Rate/acre[2]**	**Trial average**
In-furrow	Acephate	0.5	41.75
		0.75	20.50
		1	37.00
		2	78.00
	Aldicarb	0.75	52.75
	Disulfoton	0.75	55.00
		1	68.50
	Phorate	0.75	52.00
Thrips per sample unit, untreated check			1.05

[1]Date of planting — 12 May 1989; Location — Holly Springs, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 7. Mean control (percent) of thrips on seedling cotton.[1]					
Application	**Compound**	**Rate/acre[2]**	**Days after treatment**		
			6	**15**	**19**
Foliar	Acephate	0.2	99.00	54.20	38.40
	Azinphos methyl	0.2	63.00	57.20	69.20
	Dicrotophos	0.2	92.40	65.80	92.40
	Dimethoate	0.2	89.80	40.00	53.80
	Methamidophos	0.2	95.80	8.60	97.00
Thrips per sample unit, untreated check			0.40	0.08	0.14

[1]Date of planting — 23 May 1991; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 8. Mean control (percent) of thrips on seedling cotton.[1]			
Application	**Compound**	**Rate/acre[2]**	**Trial average**
In-furrow	Acephate	0.5	60.33
		0.75	73.33
		1	74.00
		2	77.00
	Aldicarb	0.75	92.33
	Disulfoton	0.5	70.33
		0.75	75.33
		1	76.33
	Disulfoton + Fenamiphos	0.5+0.5	78.00
	Fenamiphos	1	69.67
	Phorate	0.75	64.33
Thrips per sample unit, untreated check			6.23

[1]Date of planting — 12 May 1989; Location — Holly Springs, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 9. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			12	18	27	33
In-furrow	Acephate	1	59.00	56.00	2.00	22.50
		1.8	97.00	81.50	51.00	45.00
	Aldicarb	0.5	98.50	96.00	82.00	91.50
	Disulfoton	0.5	82.50	40.00	56.50	54.00
	Disulfoton + Fenamiphos	0.5+0.5	87.00	48.50	73.50	88.50
	Fenamiphos	1	84.00	83.50	79.50	66.50
	Phorate	0.75	54.50	79.00	86.50	72.00
Thrips per sample unit, untreated check			1.01	6.41	9.90	17.20

[1]Date of planting — 25 May 1990; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 10. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment				
			13	20	26	33	40
In-furrow	Acephate	0.45	74.33	64.17	52.67	68.00	-216.00
		0.95	84.33	78.17	67.00	73.67	-119.00
		1.8	92.00	74.17	-35.33	68.33	-22.33
	Aldicarb	0.5	75.33	86.50	83.33	81.00	-78.67
		0.75	97.67	93.33	85.50	89.67	-107.33
	Disulfoton	0.5	81.17	83.00	82.00	76.50	-6.00
		0.75	87.33	77.33	76.83	74.50	28.67
		1	80.17	81.50	73.50	70.50	2.33
	Phorate	0.75	91.33	75.67	83.83	69.00	-15.67
Thrips per sample unit, untreated check			0.50	0.83	2.53	2.03	0.55

[1]Date of planting — 10 May 1990; Location — Holly Springs, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 11. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment				
			7	15	21	26	33
In-furrow	Acephate	0.45	100.00	100.00	75.00	19.00	4.00
		0.9	100.00	100.00	90.00	53.00	32.00
		1.8	100.00	100.00	95.00	71.00	45.00
	Aldicarb	0.5	100.00	100.00	99.00	98.00	81.00
		0.5/2.0	100.00	100.00	—	98.00	89.00
		0.0/2.0	100.00	0.00	-2.00	3.00	29.00
		1	100.00	100.00	100.00	98.00	98.00
Thrips per sample unit, untreated check			2.60	0.50	23.00	33.20	19.90

[1]Date of planting — 17 May 1990; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 12. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			11	15	21	30
In-furrow	Acephate	0.9	81.86	94.00	92.57	67.14
	Aldicarb	0.05	97.71	95.00	88.57	70.57
	Disulfoton	0.75	98.43	96.86	92.57	83.86
	Disulfoton + Fenamiphos	0.5+0.5	96.57	67.71	84.00	81.71
	Disulfoton + Terrachlor	1.5	85.43	75.29	89.86	85.29
	Fipronil	0.05	94.43	78.67	77.29	49.57
		0.1	97.00	75.57	92.71	70.00
		0.15	97.00	96.71	86.71	62.00
		0.5	—	100.00	—	—
	SM9	1 qt	76.14	36.00	71.71	69.86
	Terrachlor	1.5	49.71	41.43	68.86	46.43
Thrips per sample unit, untreated check			7.07	8.25	14.07	1.00

[1]Date of planting — 10 June 1991; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 13. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			15	22	27	32
In-furrow	Acephate	1.5	66.00	24.29	22.43	35.43
	Aldicarb	0.5	61.86	34.00	32.86	16.71
	Phorate	0.75	75.57	49.00	22.43	44.43
Thrips per sample unit, untreated check			7.99	9.99	16.03	15.44

[1]Date of planting — 1991; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 14. Mean control (percent) of thrips on seedling cotton.[1]							
Application	Compound	Rate/acre[2]	Days after treatment				
			6	14	20	25	29
In-furrow	Acephate	1.5	95.57	40.14	36.86	38.29	36.57
	Aldicarb	0.5	92.86	75.71	35.57	26.14	-42.00
	Phorate	0.75	91.29	44.57	70.00	25.71	-5.14
Thrips per sample unit, untreated check			3.89	17.23	18.66	3.96	7.13

[1]Date of planting — 1991; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 15. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			21	27	34	41
In-furrow	Acephate	1.5	68.83	32.50	23.83	-45.67
	Aldicarb	0.5	91.17	76.50	86.67	-37.50
	Phorate	0.75	94.83	76.50	75.50	31.33
Thrips per sample unit, untreated check			0.37	1.06	1.36	0.75

[1]Date of planting — 18 May 1990; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 16. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			21	27	34	41
In-furrow	Acephate	1.5	79.00	40.00	38.17	53.83
	Aldicarb	0.5	89.33	44.17	79.50	47.50
	Phorate	0.75	96.67	55.33	69.83	60.83
Thrips per sample unit, untreated check			0.65	0.79	1.50	1.36

[1]Date of planting — 18 May 1990; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 17. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			11	18	22	26
In-furrow	Acephate	0.5	72.20	40.20	-10.80	14.80
		0.75	49.60	29.60	-17.60	26.20
		1	69.60	35.00	-13.00	25.00
		2	88.00	72.40	44.00	21.80
	Aldicarb	0.75	85.60	51.40	16.20	50.00
	Disulfoton	0.75	80.20	30.80	32.80	46.20
		1	83.80	76.20	20.40	52.40
	Phorate	0.75	82.20	51.40	-16.20	19.60
Seed	Acephate	Seed	59.20	30.80	-6.40	19.40
Thrips per sample unit, untreated check			0.47	0.87	0.36	1.07

[1]Date of planting — 12 May 1989; Location — Holly Springs, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 18. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment		
			10	14	19
In-furrow	Acephate	0.5	68.75	93.00	-21.64
		0.68	71.36	92.00	-30.91
		0.9	32.09	95.36	16.10
		1	75.07	95.47	15.88
	Aldicarb	0.5	61.91	90.18	39.08
Thrips per sample unit, untreated check			1.55	4.80	15.48

[1]Date of planting — 17 May 1990; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 19. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 16	23	29	32
In-furrow	Acephate	0.181	70.00	14.00	0.00	-5.00
		1	74.00	38.00	80.00	2.00
	Aldicarb	0.56	93.00	79.00	37.00	85.00
	Disulfoton	1.12	81.00	87.50	43.50	93.50
	Imidacloprid	0.161	79.00	95.00	80.00	72.00
		0.202	100.00	100.00	92.00	97.00
		0.233	94.00	100.00	92.00	80.00
		0.291	100.00	98.00	100.00	100.00
Seed	Imidacloprid	0.015 kg/cwt	95.00	50.00	-43.00	60.00
		0.113 kg/cwt	100.00	93.00	55.00	75.00
Thrips per sample unit, untreated check			1.45	2.05	0.40	1.00

[1]Date of planting — 1 June 1992; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 20. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 11	16	23	29	31
In-furrow	Aldicarb	0.5	57.80	100.00	95.67	99.00	61.50
	Fipronil	0.1	54.20	92.00	74.50	91.00	44.00
	Fipronil	0.1	100.00	98.00	75.17	95.17	62.67
Thrips per sample unit, untreated check			0.10	7.53	0.82	0.12	0.43

[1]Date of planting — Not Recorded; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 21. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 17	24	28	35	40
Seed	Imidacloprid	1.5	60.50	7.50	-21.50	-24.50	11.50
		1 oz/cwt	29.00	-4.00	-74.00	-9.50	7.50
		2 oz/cwt	57.50	19.00	2.00	3.00	11.50
		5.3	88.00	67.50	45.50	29.00	15.00
		6	80.00	46.50	23.50	25.50	32.50
		8	75.50	49.00	42.50	16.50	7.50
Thrips per sample unit, untreated check			19.90	75.20	117.20	104.00	89.10

[1]Date of planting — 7 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 22. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 17	24	28	35	40
In-furrow	Acephate	8	71.00	23.50	-8.50	-48.00	2.50
	Aldicarb	0.45	96.50	78.50	99.00	69.00	54.50
Seed	Imidacloprid	8	67.00	24.50	14.50	-60.50	-7.50
Thrips per sample unit, untreated check			15.80	64.90	75.00	66.70	79.10

[1]Date of planting — 7 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 23. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment				
			17	24	28	35	40
Seed	Imidacloprid	1.5 oz/cwt	60.50	7.50	-21.50	-24.50	11.50
		1 oz/cwt	29.00	-4.00	-74.00	-9.50	7.50
		2 oz/cwt	57.50	19.00	2.00	3.00	11.50
		5.3 oz/cwt	88.00	67.50	45.50	29.00	15.00
		6 oz/cwt	80.00	46.50	23.50	25.50	32.50
		8 oz/cwt	75.50	49.00	42.50	16.50	7.50
Thrips per sample unit, untreated check			19.90	75.20	117.20	104.00	89.10

[1]Date of planting — 7 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 24. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment				
			17	24	28	35	40
In-furrow	Aldicarb	0.45	96.50	78.50	99.00	69.00	54.50
Seed	Acephate	8 oz/cwt	71.00	23.50	-8.50	-48.00	2.50
	Imidacloprid	8 oz/cwt	67.00	24.50	14.50	-60.50	-7.50
Thrips per sample unit, untreated check			15.80	64.90	75.00	66.70	79.10

[1]Date of planting — 7 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 25. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Day before treatment	Trial average
Foliar	Acephate	0.2	0.65	70.50
	Acephate + Carboxilated Methyl Cellulose	0.1+1000 ppm	0.94	80.00
		0.1+500 ppm	1.20	71.00
	Azinphos Methyl	0.2	0.70	60.50
	Dicrotophos	0.2	0.68	75.50
	Carboxilated Methyl Cellulose	500 ppm	1.05	7.50
	Pyrrole + Crop Oil Concentrate	0.15+0.25%	0.77	45.50
	Methamidophos	0.2	0.64	67.50
	Pyrrole	0.05	0.87	42.00
		0.1	1.10	64.50
		0.15	1.36	58.00
Thrips per sample unit, untreated check			21.25	153.63

[1]Date of planting — 21 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 26. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			8	13	19	23
In-furrow	Acephate	0.5	88.50	68.50	69.00	18.00
		0.75	93.50	81.00	79.00	39.50
		0.9	88.50	84.00	75.50	26.50
		1	92.50	90.50	83.50	31.50
	Acephate + SM9	0.45+1 qt	88.00	75.50	61.50	28.50
	Aldicarb	0.5	99.00	95.50	91.00	72.50
	Disulfoton	0.75	92.50	84.00	87.00	44.50
	Fipronil	0.038	92.00	87.00	72.50	7.50
	Imidacloprid	0.09	96.50	83.00	65.00	-10.50
		0.18	94.50	92.50	83.00	52.50
	Phorate	0.5	94.00	95.50	87.50	59.50
	SM9	1 qt	21.00	32.00	30.00	-24.00
Thrips per sample unit, untreated check			38.25	214.50	145.13	18.88

[1]Date of planting — 26 May 1993; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 27. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			17	21	27	33
In-furrow	Aldicarb	0.525	100.00	98.00	89.00	86.00
Seed	Imidacloprid	3 oz/cwt	100.00	89.00	62.00	36.00
		4 oz/cwt	98.50	95.25	60.00	54.00
Thrips per sample unit, untreated check			5.40	36.00	39.90	46.00

[1]Date of planting — 13 May 1994; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 28. Mean control (percent) of thrips on seedling cotton.[1]							
Application	Compound	Rate/acre[2]	Days after treatment				
			14	19	21	25	35
Foliar	Acephate	0.2	-79.00	62.00	79.50	46.50	59.50
	Dicrotophos	0.2	-9.00	13.50	89.50	43.00	44.00
	Dimethoate	0.2	0.00	52.00	84.50	47.00	86.00
	Fipronil	0.025	-65.00	15.00	88.00	50.00	77.50
		0.038	24.00	48.50	82.00	50.00	89.50
	Water	0	22.50	56.50	34.50	40.00	27.00
In-furrow	Aldicarb	0.5	79.50	88.50	85.50	53.00	83.00
Thrips per sample unit, untreated check			6.15	16.25	12.05	20.05	14.90

[1]Date of planting — 12 May 1994; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 29. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment -1	5	12	19	26	33	40	Average
Foliar	Acephate	0.2	0.72	100.00	93.33	—	—	—	—	44.00
	Dimethoate	0.2	1.12	99.00	88.67	—	—	—	—	38.00
	Fipronil	0.025	1.15	64.33	95.67	—	—	—	—	27.50
	Fipronil	0.025	0.60	83.00	85.60	—	—	—	36.00	63.00
		0.038	1.32	66.00	82.00	—	—	—	—	18.50
In-furrow	Acephate	1.1	—	—	—	—	108.50	83.00	100.00	99.00
	Aldicarb	0.5	—	—	—	—	73.50	99.33	94.83	86.50
	Fipronil	0.1	—	—	—	—	98.67	81.67	95.67	94.50
		0.15	—	—	—	—	93.17	99.67	95.67	94.00
	Imidacloprid	0.14	—	—	—	—	85.00	50.00	77.50	91.50
		0.28	—	—	—	—	94.00	99.33	95.67	91.00
Thrips per sample unit, untreated check			19.50	68.50	6.18	22.83	1.93	68.50	8.50	21.88

[1]Date of planting — 10 May 1995; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 30. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 16	21	28	38
In-furrow	Aldicarb	3.5	99.33	85.83	97.17	19.40
Seed	Imidacloprid	8 oz/cwt	69.83	89.83	49.17	-2.80
Thrips per sample unit, untreated check			8.00	18.23	8.10	4.80

[1]Date of planting — 15 May 1995; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 31. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment 17	21	27	33
In-furrow	Aldicarb	0.525	55.60	80.80	95.29	93.00
	Imidacloprid	3 oz	77.40	26.40	-128.29	37.00
		4 oz	82.80	11.80	-119.71	71.00
Seed	Imidacloprid	4 oz/cwt	39.20	-2.80	-39.57	55.50

[1]Date of planting — 13 May 1994; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 32. Mean control (percent) of thrips on seedling cotton.[1]											
Application	Compound	Rate/acre[2]	Days after treatment								
			-1	2	6	14	16	19	21	25	35
Foliar	Acephate	0.2	1.09	79.50	-46.33	—	48.60	—	—	—	—
	Dicrotophos	0.2	0.98	89.50	62.00	—	50.20	—	—	—	—
	Dimethoate	0.2	0.74	84.50	65.00	—	82.00	—	—	—	—
	Fipronil	0.025	1.25	88.00	-77.67	—	56.00	—	—	—	—
		0.038	0.64	82.00	-77.33	—	75.80	—	—	—	—
	Water	0	0.60	35.00	4.67	—	12.60	—	—	—	—
In-furrow	Aldicarb	0.5	—	—	—	79.50	—	88.50	86.00	69.00	80.80
Thrips per sample unit, untreated check			12.60	12.05	13.47	6.15	6.42	16.25	24.10	40.40	32.10

[1]Date of planting — 12 May 1994; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 33. Mean control (percent) of thrips on seedling cotton.[1]							
Application	Compound	Rate/acre[2]	Days after treatment				
			17	21	24	31	38
In-furrow	Acephate + Imidacloprid	0.05+0.5	43.00	89.50	89.50	92.00	60.00
	Aldicarb	0.5	95.50	90.00	86.50	97.50	73.50
	Disulfoton + Imidcloprid	0.025+0.5	58.50	82.50	65.50	45.00	57.50
		0.05+0.5	82.00	75.00	71.50	60.00	70.00
	Imidacloprid	0.025	54.50	18.00	43.50	36.00	32.50
		0.05	44.50	41.50	78.00	71.00	77.50
		0.2	86.50	66.00	77.50	99.00	92.50
Thrips per sample unit, untreated check			1.91	18.52	44.63	15.81	5.52

[1]Date of planting — 12 May 1997; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 34. Mean control (percent) of thrips on seedling cotton.[1]								
Application	Compound	Rate/acre[2]	Days after treatment					
			17	21	24	28	32	39
In-furrow	Aldicarb	0.33	95.50	99.50	90.00	91.00	99.50	92.50
		0.525	93.00	91.00	58.00	99.50	99.50	78.50
	Phorate	0.5	88.00	94.50	50.50	55.50	22.50	64.00
	Thiamethoxam	3.2 oz/cwt FB 0.02 lb (ai)	100.00	82.00	1.00	73.50	0.00	—
Seed	Imidacloprid	8 oz/cwt	95.50	81.00	-58.00	23.00	20.00	61.50
	Thiamethoxam	3.2 oz/cwt	97.50	83.50	89.50	65.00	73.00	64.00
		3.2 oz/cwt FB 0.02 lb (ai)	—	—	—	—	—	36.00
Thrips per sample unit, untreated check			6.65	48.10	57.67	22.72	23.80	9.70

[1]Date of planting — 12 May 1997; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise. FB = followed by foliar application after emergence

Table 35. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment				
			-1	2	5	9	12
Foliar	Acephate	0.2	1.32	—	100.00	—	89.00
	Dimethoate	0.2	2.33	—	98.50	—	81.00
	Fipronil	0.025	1.26	—	65.00	85.00	78.67
		0.038	2.15	—	49.00	—	96.50
In-furrow	Acephate	1.1	0.00	79.50	—	100.00	—
	Aldicarb	0.5	0.23	99.00	—	94.00	—
	Fipronil	0.1	0.02	77.50	—	83.00	100.00
		0.15	0.14	99.50	—	96.50	—
	Imidacloprid	0.14	0.08	80.00	—	91.50	—
		0.28	0.09	99.00	—	96.50	—
Thrips per sample unit, untreated check			9.75	68.50	34.25	8.50	4.25

[1]Date of planting — 10 May 1995; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 36. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Trial average
In-furrow	Acephate	1	76.50
	Acephate + Disulfoton	0.25+1	84.50
		0.33+1	88.00
		0.5+1	84.50
	Aldicarb	0.5	92.50
	Aldicarb + Disulfoton	0.25+0.5	93.50
		0.5+0.5	89.50
	Disulfoton	0.25	78.50
		0.33	79.50
		0.5	82.00
		0.75	83.00
	Disulfoton + Flucythrinate	0.25+1	88.50
		0.33+1	87.50
		0.5+1	92.50
Thrips per sample unit, untreated check		23.70	

[1]Date of planting — 17 May 1995; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 37. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment					
			17	22	25	29	33	40
In-furrow	Aldicarb	0.33	95.50	100.00	90.00	91.50	99.50	92.50
		0.525	93.00	91.00	58.50	99.50	99.50	78.50
	Phorate	0.5	88.00	94.50	50.50	55.50	22.50	64.00
Seed	Imidacloprid	8 oz/cwt	95.50	81.00	-58.00	23.00	20.00	61.50
	Thiamethoxam	3.2 oz/cwt	77.50	84.00	89.50	65.00	73.00	64.00
Thrips per sample unit, untreated check			6.65	48.10	57.67	22.72	23.80	9.70

[1]Date of planting — 12 May 1997; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 38. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			17	21	28	38
In-furrow	Aldicarb	3.5	100.00	76.50	99.00	82.00
Seed	Acephate	8 oz/cwt	94.50	65.50	71.00	14.50
	Imidacloprid	8 oz/cwt	80.00	85.50	66.00	12.50
Thrips per sample unit, untreated check			16.80	50.30	21.40	7.10

[1]Date of planting — 15 May 1995; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 39. Mean control (percent) of thrips on seedling cotton.[1]							
Application	Compound	Rate/acre[2]	Days after treatment				
			16	20	23	31	38
In-furrow	Acephate	0.9	57.00	98.00	40.00	68.00	57.50
	Aldicarb	0.5	91.00	99.00	85.00	84.00	88.50
	Fipronil	0.1	59.00	99.00	41.00	65.50	55.50
	Garlic Barrier	1	11.50	30.50	-13.00	57.00	9.00
	Imidacloprid	0.2	88.00	100.00	35.50	95.00	97.00
Seed	Acephate + Imidacloprid	4 oz + 6.4 oz/cwt	82.00	99.50	-50.50	34.00	43.00
	Imidacloprid + Dynacoat	8 oz/cwt + 2.5 oz/cwt	98.00	97.00	6.50	79.00	70.00
	Imidacloprid	8 oz/cwt	89.00	94.00	21.50	78.00	70.00
Thrips per sample unit, untreated check			3.83	16.65	46.80	15.36	4.40

[1]Date of planting — 13 May 1997; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 40. Mean control (percent) of thrips on seedling cotton.[1]								
Application	Compound	Rate/acre[2]	Days after treatment					
			16	20	23	27	31	38
Foliar	Cyfluthrin	0.012	-4.50	30.50	7.00	52.00	8.50	-5.50
		0.015	-9.50	29.00	28.50	18.00	42.50	-12.00
	EXP61096	0.05	21.50	26.00	39.50	20.50	10.50	-37.50
		0.1	29.00	-14.50	24.50	37.00	-24.00	-63.50
	Fipronil	0.025	-8.00	19.00	-16.00	3.50	-8.00	-20.00
		0.038	-30.50	57.50	49.50	4.00	-37.00	-9.50
	Methamidophos	0.1	-27.50	15.00	14.50	37.00	39.00	1.50
In-furrow	Aldicarb	0.5	93.50	94.00	97.00	84.50	90.50	84.50
Thrips per sample unit, untreated check			5.13	25.26	79.07	18.65	13.67	3.19

[1]Date of planting — 13 May 1997; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 41. Mean control (percent) of thrips on seedling cotton.[1]					
Application	Compound	Rate/acre[2]	Days after treatment		
			16	21	31
Seed	Acephate	8 oz/cwt	87.00	39.50	8.50
	Fipronil	12 oz/cwt	68.50	32.50	-14.50
	Imidacloprid	12 oz/cwt	61.00	7.50	14.50
		8 oz/cwt	80.50	26.50	15.00
Thrips per sample unit, untreated check			22.30	17.90	126.90

[1]Date of planting — 7 May 1996; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 42. Mean control (percent) of thrips on seedling cotton.[1]						
Application	Compound	Rate/acre[2]	Days after treatment			
			10	16	21	31
Seed	Acephate	8 oz/cwt	96.50	87.00	39.50	8.50
	Fipronil	12 oz/cwt	94.50	68.50	32.50	-14.50
	Imidacloprid	12 oz/cwt	94.50	61.00	7.50	14.50
		8 oz/cwt	96.50	80.50	26.50	15.00
Thrips per sample unit, untreated check			2.80	22.30	17.90	126.90

[1]Date of planting — Not Recorded; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 43. Mean control (percent) of thrips on seedling cotton.[1]							
Application	Compound	Rate/acre[2]	Days after treatment				
			-1	2	21	27	29
Foliar	Acephate	0.2	0.85	61.00	—	—	—
	Cyfluthrin	0.015	0.97	50.50	—	—	—
	Fipronil	0.02	0.81	88.00	—	—	—
		0.025	0.67	63.00	—	—	—
	Methamidophos	0.1	0.98	79.00	—	—	—
In-furrow	Aldicarb	0.5	—	—	68.50	85.00	23.00
	Thiamethoxam	0.02	—	—	93.50	78.00	43.00
		0.05	—	—	95.50	92.00	80.50
Thrips per sample unit, untreated check			70.07	96.49	50.82	89.32	96.49

[1]Date of planting — 12 May 1998; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 44. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			13	21	27	29
Foliar	Acephate	0.8	57.50	9.50	8.00	52.00
	Acephate + Imidacloprid	0.038+0.5	87.50	80.50	76.00	38.50
	Disulfoton	0.8	82.50	76.50	86.00	89.50
	Disulfoton + Imidacloprid	0.038+0.5	87.50	89.00	77.00	59.00
	Imidacloprid	0.038	33.00	72.00	39.50	29.00
		0.05	91.50	92.00	78.00	55.50
	Imidacloprid + Polyspartate	0.038+1 pt	75.00	69.00	69.50	23.00
In-furrow	Acephate	0.8	0.00	-21.00	-16.00	37.00
	Acephate + Imidacloprid	0.038+0.5	77.00	71.00	59.00	32.00
	Aldicarb	0.5	100.00	63.67	85.67	88.00
	Disulfoton	0.8	57.00	88.00	86.00	87.00
	Disulfoton + Imidacloprid	0.038+0.5	67.00	91.00	66.00	62.00
	Imidacloprid	0.038	-17.00	68.00	4.00	-20.00
		0.5	90.00	89.00	62.00	55.00
	Imidacloprid + Polyaspartate	0.038+1 pt	40.00	64.00	48.00	5.00
Thrips per sample unit, untreated check			5.17	35.17	27.52	48.08

[1]Date of planting — 12 May 1998; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 45. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment	
			15	24
Foliar	Acephate	0.9	10.75	21.25
Thrips per sample unit, untreated check			5.28	23.78

[1]Date of planting — 18 May 1998; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 46. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment			
			14	22	28	31
In-furrow	Aldicarb	3.51	5.00	72.50	12.50	25.50
Seed	Acephate + Imidacloprid	3 oz+4.8 oz/cwt	71.00	77.00	16.50	41.50
	Imidacloprid	3 oz/cwt	72.00	76.00	33.50	-84.50
		8 fl oz/cwt	75.50	63.00	2.00	55.00
Thrips per sample unit, untreated check			11.90	58.90	54.03	46.35

[1]Date of planting — 11 May 1998; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 47. Mean control (percent) of thrips on seedling cotton.[1]					
Application	Compound	Rate/acre[2]	Days after treatment		
			14	22	31
In-furrow	Aldicarb	0.525	95.33	79.67	80.33
Seed	Thiamethoxam	3.2 fl oz/cwt	93.33	65.67	39.67
		4.82 fl oz/cwt	74.67	63.00	27.00
	Imidacloprid	4 fl oz/cwt	60.67	71.33	-23.33
Thrips per sample unit, untreated check			17.28	49.35	65.01

[1]Date of planting — 11 May 1998; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 48. Mean control (percent) of thrips on seedling cotton.[1]				
Application	Compound	Rate/acre[2]	Days after treatment	
			3	10
Foliar	Acephate	0.2	69.7	81.0
	Spinosad	0.01	-7.6	-36.2
	Spinosad	0.02	15.2	19.0
	Spinosad	0.03	39.4	9.5
	Spinosad + Acephate	0.01 + 0.1	83.3	44.8
	Spinosad + Acephate	0.01 + 0.05	71.2	68.6
	Imidacloprid	0.02	75.8	38.1
	Dicrotophos	0.2	75.8	52.4
	Dimethoate	0.2	75.8	76.2
	Zeta-cypermethrin	0.015	54.5	47.6
Thrips per sample unit, untreated check			66.0	10.5

[1]Date of planting — 17 July 1999; Location — Mississippi State, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 49. Mean control (percent) of thrips on seedling cotton.[1]					
Application	Compound	Rate/acre[2]	Days after treatment		
			13	20	26
Seed	Thiamethoxam	300 g/cwt	92.0	81.4	76.5
	Imidacloprid	250 g/cwt	100.0	81.4	96.9
	Acephate	8 oz/cwt	95.0	76.7	76.5
In-furrow	Aldicarb	0.51	100.0	88.4	96.9
	Aldicarb	0.74	92.0	88.4	94.9
Thrips per sample unit, untreated check			10.0	4.3	9.8

[1]Date of planting — 30 May 2000; Location — Verona, Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

Table 50. Mean control (percent) of thrips on seedling cotton.[1]

Application	Compound	Rate/acre[2]	Days after treatment		
			13	22	30
Seed	Thiamethoxam	300 g/cwt	96.0	81.3	76.5
	Imidacloprid	250 g/cwt	76.0	81.4	96.9
	Acephate	8 oz/cwt	100.0	76.7	76.5
In-furrow	Aldicarb	0.51	96.0	88.4	96.9
	Aldicarb	0.74	100.0	88.4	94.9
Thrips per sample unit, untreated check..			7.5	5.8	7.0

[1]Date of planting — 30 May 2000; Location: — Mississippi State Mississippi.
[2]Rate per acre is lb ai, unless specified otherwise.

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