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BENEFITS OF TEMIK IN COTTON: A HISTORICAL REVIEW

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Abstract

The active ingredient of Temik pesticide, 2-methyl-2-(methylthio) propionaldehyde 0-(methylcarbamoyl) oxime, was discovered by Union Carbide in 1962. The molecule designated as UC-21149, showed outstanding systemic activity against insects and mites and excellent nematicidial properties. In 1967, the name "Temik[R]" was registered as a trademark for all granular formulations of UC-21149; aldicarb was accepted as the common chemical name for the active ingredient in 1968.

Scientific evaluation and commercial experience indicate that Temik has a minimal impact on beneficial predators and parasitoids. By conserving the existing natural enemy complex in cotton, Temik can be a valuable component of integrated pest management. In 2004, producers planted a high percentage of their acreage to transgenic cotton but still rely on chemical pesticides to control early season pests to produce a profitable crop. There are alternatives to Temik such as: (1) seed treatments, (2) other soil applied granular systemic insecticide, (3) soil applied sprays and (4) foliar sprays.

Introduction

The first crop registration of Temik brand aldicarb pesticide was granted in 1970 for use in cotton. Today Temik is registered in the U.S. for use on up to 13 crops that include four major crops – citrus, cotton, peanuts and potatoes. Worldwide, Temik is used to control pests and increase productivity of agricultural crops in more than 32 countries. In cotton, Temik is usually applied at planting in-furrow or after plant emergence as a side-dress application. In cotton, early season pests can reduce quality and delay crop maturity. In 2001, cotton producers across the cotton belt lost over 324,000 bales of cotton to thrips and Lygus alone. Increases in yield from controlling early insects with Temik and other chemistries relative to an untreated check has been documented in every cotton producing state in the U.S. At planting, application of Temik at the proper rate is effective in reducing parasitic nematodes. In addition to promoting higher yields, Temik in many instances enhances crop maturity.

Prior to 1980 the major causes of early square loss were attributed to physiological or environmental stresses. Since that time Dr. J.R. Mauney, Plant Physiologist at the ARS Western Cotton Research Lab in Phoenix, AZ, has shown that 80 to 90% of early square loss is from insects, primarily thrips and plant bugs. In this study, it was determined that early boll load induces "a growth habit that leads to much easier management throughout the season.

Review of Literature

Prior to registration on cotton several researchers reported increases in bollworm and tobacco budworm populations after application of Temik, more so when it was side-dressed in dosages varying from 1 to 4 lbs (AI)/acre (Cowan et al. 1966, Cowan and Davis 1967, Ridgeway et al. 1967, Hopkins and Taft 1965, Coppedge et al. 1969 and Bariola et al. 1971). However some researchers reported difficulty in relating the increase in Heliothis in cotton entirely to reductions in beneficial arthropods (Rummel and Reeves 1971, Kinzer et al. 1977). The effects of Temik on beneficial arthropods varies depending on the arthropod populations and species, dosage, method and time of application. Ridgeway et al. (1967) found that Temik was detrimental to hemipterous predators, but had little effect on total number of hymenopterous insects.

During 1974 and 1975, a major problem developed in much of the cotton in the Mississippi Delta (Hanny et al. 1977). Plants had aborted terminals, swollen nodes, excessive branching of the main stem and delayed fruiting. In the study it was determined that the tarnished plant bug, Lygus lineolaris caused 98% of the damage. Rummel and Quisenberry (1979) evaluated five cotton genotypes over a two year period to determine effects of thrips injury on leaf development and yield under two different control methods and in untreated plots. Genotypes with pubescent leaves exhibited a high degree of resistance to thrips injury as measured by leaf area development, and yields were not significantly different regardless of treatment. Untreated glabrous types showed a significant reduction in leaf area development. However, when treated with a systemic insecticide (Temik) at planting, glabrous types exhibited increased leaf area and greater yields. Foliar insecticide treatments made after thrips injury resulted in some improvement in leaf area development but did not result in increased yields in the glabrous genotypes.

Scott et al. (1985) reported that the use of Temik did not result in increased damage from the bollworm and tobacco budworm. In these studies from 1981-83 all Temik treatments suppressed tarnished plant bug, although the high rate (1 lb [AI]/acre) gave the most consistent control for a 7-8 week period after planting. Control of mainly the tarnished plant bug resulted in a higher squaring rate and increase in the number of bolls in the insecticide treatments. Yields of seed cotton were significantly higher in plots with insecticide (dimethoate and high and medium (0.5 lb[AI]/acre) rates of Temik when compared to the untreated check for 2 years of study. Ratchford and Burris (1985) reported that when early season insects and percent yield increase were considered that Temik and Temik + TSX were two of the better treatments. Parrot et al. (1985) reported on results of a 3-year study to evaluate the effects of Temik on early season populations of the tarnished plant bug. Results of the study showed that Temik used at 2 lb[AI]/acre reduced tarnished plant bugs and increased yield, and Temik occasionally increased yield through some unknown mechanism that could not be explained by reduced numbers of tarnished plant bugs. Scott et al. (1986) reported that Temik in-furrow (0.5 lb [AI]/acre) used in combination with foliar insecticides increased total yield in 4 of 5 treatments. Burris et al. (1987) reported on the results obtained from twelve in-furrow systemic insecticides – nematicicides for early season insect control. The only treatment that produced comparable yields to Temik was Counter. Treacy et al. (1985) evaluated Temik for control of early season pests of cotton. All three at-planting, Temik treatments had significantly fewer fleahoppers than the untreated on 19 June, however when Temik was applied at 0.75 lb [AI]/acre the treatment tended to have fewer fleahoppers for the entire season. The higher yields were in treatments with Temik at the 0.75 [AI]/acre rates. Luttrell et al. (1986) compared the control of early season pests of cotton with insecticides applied as seed treatments, granular, and foliar sprays. Temik treatments in general had the highest yield of fourteen treatments.

Scott et al. (1987) studied the benefits of controlling early season insects (thrips and plant bugs) with pyrethroids, carbamates, organophosphates and formidine insecticides with and without at-planting Temik. In the study the treatments with Temik had higher mean yields in most cases than the same treatments without Temik. Langston and Shuster (1989) evaluated various insecticide treatments applied in-furrow for thrips control and determined the effects on plant height and earliness. Yields from the 0.75lb [AI]/acre Temik treatment was significantly higher than all treatments except Thimet.

Ratchford et al. (1989) conducted a study that included in-furrow sprays, and granular applications with fungicides, insecticides and starter fertilizers. Various treatments that included Temik were the highest yielding. Burris et al. (1989) did a comparative analysis of a plant washing for monitoring early season pests of cotton. In this study, the insecticide (Orthene and Temik) treated plots had fewer pest than the control. The Temik treated plots had significantly lower total pests than Orthene plots. Carter et al. (1989) evaluated various thrips control strategies and their effect on crop growth, yield and maturity. It was found that heavy thrips pressure delayed maturity about 2 weeks. Also, fiber properties were greater in the undamaged plots (Temik in-furrow). Dye uptake studies showed that fibers in the thrips damaged plots never reached maturity resulting in lower micronaire. Cochran et al. (1989) conducted an economic analysis of yield and fiber properties on cotton damaged by thrips. Johnson et al. (1989) reported that when thrips were controlled by Di-Syston and Temik yields were increased 21% over the control. Trammell et al. (1989) compared liquid in-furrow sprays of Orthene with Temik at-planting for early season insect control. This study showed that Orthene at 0.5, 0.75, and 1.0 lb [AI]/acre was compared to Temik at same rates and that yield was comparable. Lesser (1986) reported that thrips control was controversial in the Texas High Plains. In a thrips management study, heavy thrips pressure resulted in a significant reduction of true leaf surface area, delay in square initiation, reduction in number of early fruit set and reduction in final yield. Preventative treatments that included Temik provided the maximum benefits. Parker and Huffman (1986) evaluated seed and at-planting in-furrow insecticides on cotton growth in the Coastal Bend of Texas. All treatments had higher yields than the untreated control. Durant (1988) evaluated yield responses in cotton from early season foliar treatments of chlordimeform and Temik banded over the row at planting for two years. Findings were that heavy thrips pressure significantly reduced yields and earliness in no-Temik plots for some cultivars in 1985. In 1986, Temik significantly increased second harvest yields in some cultivars. Burris et al. (1989) studied thrips populations on seedlings cotton and related problems on control. In this study seed, soil and foliar treatments were evaluated. The results were that Temik was the most consistent material among those evaluated as in-furrow sprays or granules. Seed treatments normally provided control for 2-3 weeks while in-furrow sprays or granules provided 4-6 weeks control. The investigations showed that yields were often higher in treatments that received in-furrow applications of Temik. Scott (1990) conducted a three year study evaluating the use of Temik applied at planting (0.50 lb[AI]/acre) and dimethoate applied after plant emergence for early season insect control. At 60% open bolls plots received a foliar application of either ethephon (Prep) or tribuphos (Folex) as a harvest aid. During all 3 years, the trend was for the Temik treated cotton to have slightly higher boll counts than cotton treated with foliar dimethoate. All years (1987-1989), cotton treated with Temik had significantly higher yields at first harvest. Earliness was enhanced by the use of ethephon.

Reed et al. (1991) evaluated twelve in-furrow and/or side-dress treatments for thrips and aphid control. Thrips control was excellent with all in-furrow combinations, but those with Temik were effective longer than the Orthene treatment. Parker and Huffman (1991) conducted tests over a seven year period to evaluate soil applied systemic insecticide performance on dry land cotton in the Texas Coastal Bend. Temik (0.50 lb[AI]/acre) provided the most favorable economic return and in 22 comparisons lint yield increases averaged 58 lbs/acre. Lint yield from foliar Orthene, and granular carbofuran treated plots was numerically lower but not significantly different from that of Temik.

Cooke et al. (1992) did a survey to determine the impact of Temik on yields and returns to cotton in the mid-south. The five year study from 1985 through 1989 shown in research plots that used Temik 0.50 lb[AI]/acre resulted in yield increases each year compared to plots treated 3-4 times with dimethoate. The value of increased yield ranged from $48.37 to $140.93 per acre. When the cost of 0.5 lb[AI]/acre of Temik was subtracted an average value for the five years was $74.90 per acre. Burris et al. (1992) studied the influence of starter fertilizer on cotton seedlings growth and its compatibility with selected in-furrow insecticide treatments. Yields were significantly increased by the Temik + starter fertilizer treatment and by comparison there was no significant differences among other treatments. Christian (1992) studied the effectiveness of Temik in side-dress treatments in controlling aphids in the Texas High Plains. In the trial, all Temik treatments significantly controlled cotton aphids. Detailed plant mapping indicated that Temik at 1.0 lb[AI]/acre significantly increased the number of first position bolls from nodes 5-10. This same treatment also significantly increased lint and seed weights. Scott and Adams (1992) studied the effects of various in-furrow insecticide treatments in yield in 30 inch and 40 inch row spacings of cotton. Cotton in both row widths were treated with Temik and Orthene at planting and/or foliar treatments of dimethoate after plant emergence. Yield was higher in both in-furrow treatments than in foliar treatment. The Temik treatment averaged fewer plant bugs, more bolls and highest yield per acre in both row spacings in comparison to the Orthene and dimethoate treatments. Cathey et al. (1992) reported the effect of Temik and Prep on boll development and fiber properties of cotton treated with Temik and foliar sprays. Large plots were defoliated with Folex and five days later one-half of each plot was sprayed with Prep. Eighteen feet of row was harvested at seven day intervals for yield determination and percent earliness. Total lint yield was greater each year in the Temik treated plots than in the no-Temik (foliar) treatment (3 year average increased 12.5%). The ethephon treatments also resulted in total yield increases in both the Temik and foliar treatment (8.7% vs. 4.2%). The difference in ethephon effect was attributed to an increase in boll development in the Temik treated plots. The bolls were larger and the boll opening rate was increased by Temik. In addition, the Temik + ethephon plots were ready for machine harvest 6 to 8 days earlier than the foliar treatment with no ethephon. Fiber length, length uniformity, micronaire and color (white) of bolls gathered prior to the ethephon application were in favor of Temik treated plots.

Cooke et al. (1994) did an economic analysis of a large number of field trials that were conducted in eight states from 1985-1989 of Temik and alternative early season insect control. In this study, Temik provided meaningful yield and income increases when compared to other insecticide materials, both in-furrow and foliar applied. One treatment in one of eight states of an alternative material provided a higher return. However, when averaged on a state or regional basis, an excellent return to the use of Temik was indicated. Those returns ranged from a low of $16.73 per acre to a high of $56.59 per acre. Tugwell and Teague (1996) evaluated foliar applications of fipronil and side-dress application of Temik on mortality of the tarnished plant bug in cage studies. In this study, there was no significant difference in mortality of fipronil applied at 0.038 and 0.050 lb [AI]/acre and Orthene at 0.50 lb [AI]/acre. Mortality in above treatments were 93.3, 100.0 and 91.3 percent respectively. Mortality due to Temik that had to be knifed in 7 days earlier was 39.3 %. Some control from Temik was still evident at 21 days after side-dressing. Reed and Jackson (1995) evaluated the effects of Gaucho treated seed and Temik in-furrow at planting for thrips control. Results across all sampling dates showed that the seed treatments provided significant control of adult thrips compared to the untreated check, but lacked the level of control afforded by Temik. Yields of check plots and Gaucho (4oz/cwt) treated plots were significantly lower than that of Temik. Burris et al. (1994) evaluated several comprehensive pest management programs for 3 years to determine the effects of pest management control strategies on populations of beneficial and pest insects. Information was collected on damage to plants, effect on stand, plant height, leaf area, maturity and yield. Treatments were: main plot one (M1) was double treated seed (Captan + Vitavax) plus granular Terraclor Super-X, main plot two (M2) same as M1 + Orthene (8oz/cwt) seed treatment, main plot three (M3) same as M1 + Temik in-furrow (0.50 lb [AI]/acre) and main plot four (M4) untreated control with double treated seed. Yield results: Seed cotton varied from year to year and the rankings of the average yield of the main plot treatment were consistent. The M3 strategy, Alicarb + TSX in-furrow had the highest yield all three years. The M2 strategy, Orthene seed treatment + TSX in-furrow always had the second highest yields. Almand (1995) determined that Gaucho seed treatment provided excellent protection against thrips damage, thus allowing uninhibited early growth. Plant size and early square set were favorably influenced in the better performing treatments, Gaucho and Temik. These two treatments yielded considerably more lint than Orthene seed treatment or the untreated. Studbaker et al. (1995) studied the response of thrips injury to various cotton varieties for four years. Data collected at different locations indicated that DPL 5415 and LA 887 had the greatest response for Temik. Some varieties appeared to be tolerant to certain levels of thrips injury.

Burris et al. (1996) evaluated Temik with selected fungicides for Pythium alone and in combination with Temik for early season pest and disease control. In the study, all treatments with Temik + TSX2E or Terraclor 2E + Ridomil had significantly higher yields than the Temik/Pythium inoculum. Burris et al. (1999) studied the efficacy of Temik side-dress treatments on the tarnished plant bug under moderate insect pressure. Check plots 50 ft from the field border had significantly higher numbers of TPB compared with the treatments. There were significantly lower numbers of TPB in the Temik treated side-dress plots than the check. Cook et al. (1999) evaluated thrips densities in at-planting seed and soil treatments with three different soil environments. When yield was considered there were no significant differences at either environment between treatment and check. Herbert (1998) evaluated select in-furrow applied insecitiicdes/nematicides with and without additional foliar insecticides for control of thrips. Temik and granular Orthene treatments had significantly less thrip injury than Thimet on 2 June. All treatments resulted in significantly higher yields than the untreated check yields and in most instances were increased with the foliar sprays of Orthene. Herbert (1998) again evaluated selected in-furrow and foliar insecticides for control of thrips in cotton. On the date of the highest injury Temik showed significantly less injury than other treatments. All treatments resulted in significantly higher yields compared to the untreated check. Temik at 1.0 lb [AI]/acre resulted in the highest yield. Faircloth et al. (1999) studied the impact of thrips on cotton productivity. In test 1, Temik and Orthene showed better thrips control than Gaucho. Temik treatments showed the better "earliness profile." In test 2, there were no differences. Yields in test 1 were statistically greater than the untreated control. Reed and Jackson (1999) evaluated two rates of imidacloprid compared to Temik for thrips control in cotton. The end result was that at 15 DAT, there was no significant differences between treatments and untreated. At 24 DAT, there was a difference indicating that the order of efficacy was Temik 0.5 lb[AI]/acre ---- Admire at 0.1lb[AI]/acre ---- Admire at 0.05 lb[AI]/acre, respectively. Yields were not different significantly between insecticide treatments, but there was a yield increase between 300 and 500 lbs seed cotton with Admire and Temik, respectively.

Smith et al. (1998) investigated the impacts of current at-planting systems have in the growth and development of cotton. The results from a West TN location showed that the Temik treatment provided less thrips injury, fewer plants with aborted terminals, greater initial plant height and first position boll retention, improved earliness and increased yield over comparative treatments. Box mapping showed that the Temik treatment increased pounds of lint cotton/acre from nodes 4-8 and 9-14 and overall yield. In a separate test Turnage et al. (1998) reported that Temik treatment across 15 cotton varieties showed less thrips injury, improved plant stands, first position boll retention, improved earliness, and yield over the Orthene treatment. Furr et al. (1998) evaluated different treatments for thrips control for five years. During this time numerous insecticide treatments and classes were evaluated. Overall, Temik applied at 0.50 to 0.75 lb[AI]/acre was the most consistent product tested based on thrips reduction and yield. Gaucho seed treatments were comparable to other in-furrow granules and in-furrow sprays in most cases for thrips control and yield. Thrip management was studied by Van Duyn et al. (1998) with Gaucho and/or Temik in North Carolina. In comparison, Gaucho showed short term thrips control and favorable performance against cotton aphids. Temik showed a better earliness profile. In four tests, yields were statistically superior compared to the untreated check for Gaucho and Temik. However, Temik always was the highest yielding treatment and averaged 89 pounds/acre more lint over all the studies. Cook et al. (1998) conducted field trials that evaluated the efficacy of selected at-planting insecticides across three soil environments. Across soil environments, Temik (0.50 lb [AI]/acre) provided significantly greater control of adult thrips compared to other treatments, except for Orthene (0.90 lb[AI]/acre). However, all treatments (Temik, Orthene, Admire and Gaucho) did not improve yield significantly compared to the untreated check. Herbert (1998) conducted an evaluation of thrips damage on maturity and yield of Virginia cotton. In the in-furrow with/without an additional foliar treatment test, there were few significant differences in yield among treatments. However, Temik and Payload applied in-furrow with an additional foliar insecticide, yielded significantly more than the Gaucho seed treatment alone. The additional foliar treatment resulted in a numerical yield increase in four of five in-furrow treatments. Goddard and Lesser (1997) reported their findings from tests conducted for 1994-1996 on the effects of soil systemic insecticides and cotton seed vigor on cotton stands and yields. During this time, treatments with Temik and Thimet significantly increased lint yield an average of 91 pounds/acre over the untreated check. Yields during this time were numerically greater with Temik.

Capps et al. (2000) reported the results of insecticide treatments on thrips control and damage. Four tests were conducted over the two year period 1998-1999 that identified the treatments that control thrips and lowered damage. Most treated plots did not show a significant difference in yield, but numerical trends consistently favored Temik, Admire, and Gaucho. Also, fewer significant differences in thrips counts were noted by trends favoring Temik. Roberts and Bader (2000) studied various early season thrips management programs in ultra-narrow row vs. normal row plantings of cotton. In these studies Temik treatments and Orthene seed treatments supplemented with additional foliar sprays significantly reduced thrips populations. In cotton planted 1 May, Temik treatments yielded over 100 lbs more lint than Orthene treated seed plus two foliar treatments.

Lohmeyer et al. (1999) evaluated six rates of Temik that were precision placed in comparison with five rates applied in-furrow for thrip control in cotton. On 24 May all treatments were significantly different compared to untreated check with respect to total thrips. In-furrow applied Temik at .5 lb [AI]/acre showed the most significant reduction. All treatments were significantly different than the check on 3 June. On 14 June, all treatments were again significantly lower than check with precision placed Temik 0.768 lb[AI]/acre and 0.38 lb[AI]/acre showing the most reduction. There were no significant differences in yield found among treatments compared to untreated check, although the Temik in-furrow 0.50 lb [AI]/acre yielded 691 lbs seed cotton more than the next closest treatment.

Faircloth et al. (2002) studied the effects of insecticide treatments and environmental factors on thrips population, plant growth and yield of cotton. In this study, Temik and Orthene provided better thrips control than did imidacloprid in all three years (1997-1999). In 1997, the Temik treatment resulted in "earliness" while in 1998 and 1999 there were few differences in these parameters. In 1997, all insecticide treatments resulted in statistically higher yields than the untreated check. Van Duyn et al. (2002) conducted tests to determine the relative effectiveness of hill-drop application of Temik as compared to the normal drill application. Hill-drop application of Temik to hill-drop cotton seed was shown to be equal or better than drill applied Temik at greatly reduced rates/acre. The test did not include an untreated control, data from an adjacent test UTC was used for comparison purposes. Thrips populations were very high at 25 days after planting and peaked at 32 days after planting. The drill applied Temik in 12" hill-drop seed plots had significantly lower numbers of thrips at 25 days over the normal drill applied/drilled seeded treatment. However this did not persist to 32 days. Compared to the outside untreated check, yield increases due to Temik ranged from 626 to 1024 lbs seed cotton per acre. Hopkins et al. (2002) carried out an experiment on thrips management in Arkansas cotton. At the Mississippi County location Adage 5FS, Gaucho 480FS, Gaucho 480FS + Orthene and Temik at four rates. The data suggested that Adage and Gaucho seed treatments offer a level of thrips protection equal to Temik under light to moderate pressure. There were no statistical differences between treatments and untreated control yields. Reed et al. (2002) reported on a 15 year summary of pesticide evaluations on thrips on seedling cotton in Mississippi. Most of the cotton acreage in Mississippi is affected by thrips. Based on data from 2000 Beltwide Cotton Conference, 38% of the 1999 cotton crop was treated with foliar insecticide. In 2000 91% of Delta cotton and 82% of hill cotton received either a seed treatment or an in-furrow treatment at planting. When the control obtained with Temik was compared with the average of all other insecticide over all years (1989-1998), cotton treated with Temik in-furrow averaged less thrips in most years.

Lohmeyer et al. (2002) carried out a study addressing reduced planting time with Temik use in cotton that utilized precision placement. Findings were that the precision placement of Temik at various rates significantly reduced thrips infestation in comparison with the untreated check, and were as effective as the standard in-furrow rate. Results also indicated that precision placement could result in reduced amounts of insecticide needed for thrips management. Dobbs et al. (2003) studied the effects of soil insecticides and seed treatments during 2000 & 2001 on early season insect control in ultra narrow row cotton. Thrips populations were high in 2000 and there were no differences in populations among treatments. In 2001, thrips populations were lower than the check for all Temik treatments. Gaucho without Temik showed no differences in populations compared to the check of Temik applied at 0.53 lb [AI]/acre. Both years, Temik at 0.53 lb [AI]/acre produced yield equal to or greater than other treatments. No yield increase was obtained from the Gaucho/Temik combinations. Scott and Snodgrass (2001) reported on the efficacy of Temik applied as a side-dress application at two rates on mortality of caged nymphs and adults of the tarnished plant bug. At 48 and 72 hr, one caged plant with adults and one with nymphs were removed from each replication in the field to determine mortality. Mortality in check cages did not exceed 17% for adults or nymphs. Mortality for adults with Temik applied at 1.0 and 1.5 lb [AI]/acre at 48 and 72 hrs was 62 and 50%, respectively. Nymph mortality exposed to the same rates for the same period of time was 63 and 57%, respectively. Burris et al. (2002) evaluated selected seed treatments and in-furrow Temik for early season pest control. Adage or Gaucho seed treatments and Temik at 0.975 lb[AI]/acre resulted in increase seed cotton yield compared to untreated control. Burris et al. (2002) evaluated Temik in-furrow and as side-dress for early season pest and nematode control. No differences occurred among treatments for thrips, aphids, and tarnished plant bugs. Treatments significantly increased yield of seed cotton compared to the untreated. Hopkins et al. (2002) evaluated in-furrow insecticide applications and seed treatment for thrips control in cotton. All treatments significantly reduced thrips below that of the untreated check at 15 and 21 days after treatment. The Adage seed treatment, Nemacur, Temik (0.75 lb[AI]/acre) had the lowest population 15 DAT. Residual activity with Temik at 21 DAT increased as rate increased. Burris et al. (2001) studied various in-furrow insecticides for early season thrips control. All insecticide treatments reduced the number of adults and larvae compared to untreated check. Gaucho seed treatment plus Temik side-dress, Orthene, Di-Syston, Temik (0.75 lb[AI]/acre), and Temik (0.75 lb[AI]/acre) + Temik side-dress (0.75 lb[AI]/acre) treatments reduced the number of aphids below the untreated plots. There were no differences among treatments for seed cotton yield. Kharboutli and Allen (2001) ran studies to determine the efficacy of selected insecticides against thrips and the influence of thrips species on thrips control in cotton. All treatments have acceptable levels of thrip control on sampling dates of 2, 7 and 15 June. Adage ST was the most effective treatment on 2 June, while Orthene 90SP and Centric were the least effective. Thrips counts on 2 June tended to be greater in plots that were foliar treated than those treated with in-furrow (Temik) or seed treatments. Lint yields were statistically similar among all treatments. Western flower thrips and tobacco thrips were the two major species found on cotton early in the 2000 growing season.

Costello et al. (2002) evaluated various selected insecticides for thrips control. All treatments reduced thrips larvae in comparison to untreated. Treatment of Orthene, Temik, Adage, and Gaucho significantly increased seed cotton yield compared to untreated. No significant differences among insecticide treatment were noted for insect control or yield. Costello et al. (2002) evaluated Gaucho, Orthene, Adage seed treatments in comparison with Temik in-furrow. All treatments resulted in higher yields of seed cotton than the untreated check. Herbert and Malone (2002) evaluated selected in-furrow and seed applied insecticides, with and without a foliar band or broadcast application for thrips control on cotton. Treatments were Gaucho alone as seed treatment, Gaucho seed treatment plus Orthene foliar, Gaucho seed treatment + Orthene broadcast Temik alone and with other broadcast. All treatments resulted in significantly higher lint yields compared to untreated check. Yield increases ranged from 303 to 519 lb lint/acre. Numerically the highest yields were with Temik plus foliar and Gaucho plus foliar. Bachelor and Mott (2003) evaluated at-planting and foliar insecticides for thrips control in North Carolina. Treatments in the study were Orthene foliar treated twice, Adage seed treatment plus Orthene foliar, Adage plus Temik treatment plus Temik, Gaucho and Cruiser seed treatments. In each case, except for the Adage plus Temik treatment, when a foliar treatment was made to the Gaucho or Temik plots a significant positive yield response was observed. Fromme and Bachelor (2002) conducted a study utilizing Cruiser, Gaucho and Orthene seed treatments with Temik and Thimet applied in-furrow for thrips and aphid control on cotton. No differences were found in number of thrips at the 2-3 true leaf stage cotton 19 DAP. A significant reduction of total thrips was noted at the 4-5 true leaf stage 30 DAP in all insecticide treatments. Number of aphids were not significant at 19 and 30 DAP. The impact of strip till on thrips levels in cotton (Bachelor and Mott 2002) was studied utilizing Temik treatments. Immature and total thrips levels in the strip till plots were approximately one-half those found in conventional plots in the Temik and no-Temik plots at two sampling dates. Johnson et al. (2003) screened various insecticides for thrips control in Arkansas. Tobacco thrips were the predominant species infesting cotton. When rated at 15, 22, 29 and 36 DAP, the treatments did not differ significantly than the untreated check. Temik applied at 0.5, 0.75, and 0.75 lb[AI]/acre had numerically higher thrips than the untreated check. Numerically the highest yielding treatments in the trial were Adage, Gaucho, and Gaucho + Orthene. Yield in all Temik treatments was less than the untreated.

Thrips control with in-furrow insecticides and seed treatments were evaluated for thrips suppression in Arkansas (Studebaker et al. 2003). Thrips populations were quite high in the test during the first two sampling dates at two locations. Treatments consisted of Temik in-furrow at 0.50, 0.60, and 0.75 lb [AI]/acre, Gaucho, Cruiser, L0263 seed treatments and Orthene foliar. At the Kiser location, Temik (0.75 lb[AI]/acre) and Cruiser seed treatments had the highest yields but did not differ significantly form Temik at lower rates and the Gaucho treatments. Foliar treatment of Orthene and the untreated yielded significantly less than all treatments. At Marianna, even though thrips pressure was about the same, the treatments and untreated check did not differ significantly in yield. Experiments were conducted in Georgia that reduced Temik requirements for thrips management in cotton (Lohmeyer et al. 2003). Temik was precision placed at rates of 0.1, 0.2, 0.4, 0.9 and in-furrow at 0.2, 0.5, 0.9 lb[AI]/acre, respectively. Yields of cotton among treatments did not differ significantly than the untreated. Burris et al. (2003) evaluated various seed treatments and Temik in-furrow for early season pest control. Seed treatments were Cruiser and Gaucho and Temik in-furrow at 0.5, 0.6 and 0.75 lb [AI]/acre. All treatments reduced thrips larvae compared to untreated check. Cruiser actually resulted in fewer thrips than Temik applied at 0.5 lb [AI]/acre. There were no significant differences in yield among treatments and treatments had significantly higher yields than the untreated. Seed treatments, in-furrow and side-dress applications were evaluated for early season pest control in Louisiana (Burris et al. 2003). Seed treatments were Gaucho and Cruiser, in-furrow was Temik at 0.5, 0.6, 0.75 and 0.9 lb[AI]/acre, Temik in-furrow at 0.75 lb[AI]/acre and 1.0 lb[AI]/acre, respectively. All insecticide treatments except Temik in-furrow reduced populations significantly below that of the untreated check. Seed cotton yield did not differ among most treatments, although Temik at 0.9 lb [AI]/acre and Gaucho seed treatments (8oz/cwt) had significantly higher yields than the untreated. Cook et al. 2003 studied the residual toxicity of seed treatments and soil applied insecticides on the tarnished plant bug. It was found that acephate and imidacloprid provide little control of the tarnished plant bug. Temik and thiamethoxam provided significant levels of mortality (76% vs. 57% respectively) for approximately seven days after seedling emergence. Mortality with Temik declined to approximately 30 % at 26 days.

In 1990, Reddy et al. studied the influence of Temik on growth, development, and photosynthesis of cotton grown in sunlight temperature controlled growth chambers (SPAR). Cotton plants were grown from seed planted in sterilized clay loam soil. Temik at the rates equivalent at 0.11 lb[AI]/acre at planting followed by 0.3 lb[AI]/acre at initial squaring that was incorporated into soil at 0.3cm in depth. The day/night temperature cycles in the growth chambers were maintained at 20/12, 25/17, 30/22, 35/37 and 40/32°C. During the season, measurements of plant height, number of nodes, and biomass accumulation in different plant parts were recorded. Temik treated plants were more vigorous and accumulated higher biomass earlier in the vegetative period when compared to untreated plants at all temperatures. Temik increased gross photosynthesis (Pg) and respiration. Temik promoted earliness, and increased the number and weight of bolls and squares at all temperatures. Reddy et al. (1997) studied growth responses of cotton to Temik and temperature. In the study Temik increased early season vegetative growth of cotton plants grown at day/night temperatures of 25/17, 30/22 and 35/27°C but not for plants at 20/12 and 40/32°C. Temik treated plants had more growing roots and greater root length. The results showed that Temik promoted cotton earliness by enhancing growth rates and promoting roots to grow deeper into soil.

Throughout the literature search the results of many tests recognized earliness associated with the use of Temik in-furrow or as a side-dress application in cotton production. Maximum control of early season pests with other treatments could result in earliness. In recent years, no management technique has shown a greater potential to increase profits for cotton farmers than the production of a crop with a timely harvest. Earlier harvest results in higher yields, better lint quality, improved harvesting efficiency, less risk of damage of lint and seed from weather and a greater overall economic return. Parvin et al. (1985) reported on the "Economics of Cotton Harvesting in the Mid-South." In this study, it was reported that a one-week delay in crop maturity extends the time required to complete harvest 34 days, reduces recoverable yield by 8% and reduces revenue 9%. A two week delay extends the required harvest period by 60 days and reduces harvested yields by 23% and revenue by 25%. In 1985, Parvin and Smith documented a loss in lint weight of 0.5 of 1% a day with no rain. Tugwell (1986) reported a smaller, yet significant loss in potential yield of open cotton in Arkansas of 1% per week. Williford et al. (1995) reported of the effect of harvest timing on cotton yield and quality from 1991-1993. Cotton was harvested at approximately one week intervals to determine the influence of delay harvest on cotton yield and quality. In the study, harvest date significantly influenced yield and quality. Yield increased for about 30 days after defoliation and then decreased with a major yield loss being associated with rainfall. Lint grade was highly influenced by rainfall. The study indicates a harvest window of about 30 days after defoliation is available before significant yield and/or grade is lost. These findings on harvesting cotton in a timely manner is still applicable in cotton production today.

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