EFFICACY AND YIELD IMPACTS OF REGISTERED AND EXPERIMENTAL ACARICIDES IN CALIFORNIA COTTON

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Abstract

Selected registered and experimental acaricides were compared in terms of efficacy on spider mites, *Tetranychus* spp. and capacity to protect cotton yield from losses from spider mites in studies conducted from 1995 to 2000. Zephyr continues to provide excellent spider mite control in California cotton; however, in many cases the residual control does not appear to be as long as it was in the mid-1990's. Resistance to Kelthane and Comite is present in the SJV, but appears to be manageable allowing these products to have a fit in cotton production. Savey fills an important niche as a resistance management tool. Experimental products, including Acramite and the V-1283 compound, look promising and will provide additional management tools. Given the propensity of spider mites to develop resistance to pesticides, multiple tools are needed to enhance long-term management.

Introduction

Spider mites are key arthropod pests, accounting for estimated losses as high as 4% (not counting the cost of control), in San Joaquin Valley cotton fields. Spider mites cause damage by feeding on the cotton leaf surface, thereby reducing photosynthetic activity of the plant and yield. There are three species of spider mites in cotton; strawberry spider mite (*Tetranychus turkestani*), two-spotted spider mite (*T. urticae*), and pacific spider mite (*T. pacificus*). In most years, strawberry mite is more likely to cause defoliation and is the first to appear. The other two species gradually build in numbers as the season progresses. Strawberry mites prefer field crops, pacific mites prefer trees and vines, and two-spotted spider mites have no preference. Therefore, the species present in a cotton field is influenced by the neighboring crops.

A binomial sampling plan is used for spider mites which involves inspecting leaves for the presence of immature and adult spider mites (Wilson et al. 1983). The treatment threshold is 30% of the 5th main stem node leaves infested with mites which is an adaptation of the spider mite - cotton response research of Wilson et al. (1991). In general, spider mites are an early to mid-season pest. Spider mite populations begin in cotton because overwintering adult mites emerge from the soil or move through the air into a field from neighboring crops or weeds. These populations usually develop gradually with ample time for growers to monitor and make decisions. In fields with low natural enemy populations, the spider mite population can increase more quickly. Late season problems are often associated with the use of disruptive, broad spectrum insecticides, which release spider mites from their natural enemies, thus allowing damaging populations to build up. Spider mite problems can also be due to heavy infestations blowing in from neighboring crops such as corn, alfalfa, sugarbeets, or beans that are drying out.

Currently registered selective miticides include sulfur, Kelthane®, Comite®, Zephyr®, and Ovasyn®. The efficacy of these products was reported in 1995 (Wynholds and Godfrey 1995). The broad spectrum systemic insecticides Temik® and Thimet® can also effectively control mites. In recent years, Savey® has been available under a Section 18 registration as another tool to detour the development of resistance. In laboratory bioassays conducted during the 1980s to the present, strawberry mite has never been shown to be resistant to any of the currently registered miticides. Laboratory bioassays have demonstrated that Kelthane and/or Comite resistance has been detected in 25% of two-spotted spider mite and 40% of pacific mite populations (Grafton-Cardwell et al. 1987a, b). While Kelthane and Comite resistances can be a problem in the San Joaquin Valley, these resistances are not dominant in inheritance and so with sufficient mixing of susceptible and resistant spider mites resistance frequently declines during field seasons. Careful rotation of miticides will help keep resistance frequencies low, as well introducing new products for use in cotton.

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Methods

The efficacy of registered and experimental acaricides was evaluated from 1995-2000. Data from 1996, 1998, and 2000 will be highlighted herein but studies conducted during the other years were equally useful. Materials were applied as the spider mite population reached the economic threshold (30% infested leaves). This corresponded to 19 June, 1996, 13 July 1998, and July 6, 2000. Studies in 1996, 1998, and 2000 were conducted at the UC West Side Research and Extension Center near Five Points, CA in Fresno County in irrigated acala cotton cv. 'Maxxa'. The plot size utilized was generally 6 rows by 90' with 4 replicates. Treatments were applied with a tractor powered CO_2 propelled sprayer at 15-25 GPA and three to five nozzles per row, depending on year. Mite populations were sampled by collecting a 20 leaf sample of the 5th main stem node leaf from terminal per plot. Samples were taken to the laboratory and mites were recovered with a leaf washing technique (a modification of Leigh et al. [1984]) and specimens were counted with aid of a microscope. Samples were taken pretreatment and weekly after treatment for 5 to 7 weeks, depending on the year. Populations of natural enemies and key cotton insect pests, i.e., cotton aphids were evaluated in some studies. The effects of the treatments on harvest parameters were quantified by harvesting 2 rows of each plot in October with JD9910 picker. Cotton was ginned for turnout in 1998 and 2000; a 34% turnout assumed in 1996.

Results

Treatments that were consistent across years, i.e., registered standards, and key experimental materials are compared. Rates and products are presented in Table 1.

1996

Spider mite populations were present in this field from the time of seedling emergence; percentage infested plants ranged from 5-10%. On about 10 June, the population started to quickly build and treatments were made on 19 June with ~50% mite infested plants. This percentage was slightly higher than desired, although the number of motile mites per leaf was still fairly low. For the species breakdown, two spotted spider mites were most common, although a substantial number of strawberry mites were present throughout this test.

The Savey treatment performed moderately and appeared to hold the population growth down for 28 days (Fig. 1). The Savey + Kelthane treatment provided some of the best control in this test with good mite control for 28+ days. Similar results were seen with Savey + Zephyr. Alert provided good spider mite control albeit for a maximum of 21 DAT. The Kelthane alone treatment worked well, especially when considering the treatments went on somewhat later then Kelthane is typically used. Zephyr provided spider mite control for 28 DAT. Spider mite control with Comite was moderate. Populations held for ~28 DAT, but were not really reduced substantially. Ovasyn consistently reduced the mite population from 7 to 35 DAT and overall performed acceptable. Finally, Capture provided good, short-term spider mite control.

Seed cotton yield was significantly influenced by the miticide treatments (Fig. 2). The Zephyr, Kelthane, Savey+Zephyr, and Savey+Kelthane plots yielded the highest with an average of 1033 lbs. lint/A. This yield was respectable considering that lygus bugs and other cotton insect pests were left uncontrolled. The untreated averaged only 308 lbs. lint/A. The yields from the other treatments were between these extremes and generally in close agreement with the mite density data.

1998

The mite population in this test was nearly 100% two-spotted spider mites. During May and most of June, there was a low level of spider mites in the plot. On the day of treatment, populations had built to ~25% infested leaves and ~4 mites per leaf.

At 7 DAT, numerically the Kelthane treated plots had the lowest number of mites and reduced the population ~90% (Fig. 3). In the untreated plots, the population increased ~3-fold during the 1-week period after treatment. Conversely, the population declined in the Kelthane, Zephyr, and Savey+Kelthane treatments; in all other treatments the population increased over this period but not as much as in the untreated, i.e., some control was provided by all treatments except Ovasyn and Alert. At 14 DAT, the Capture treatment statistically increased the number of mites. Numerically, populations were lower in the Kelthane, Zephyr, Savey+Zephyr, and Savey+Kelthane treatments. The S-1283 compound provided good mite control. At 21 DAT, excellent control efficacy continued with Kelthane, Kelthane+Zephyr, and Savey+Kelthane. Zephyr provided only moderate control. These same treatments gave the best control at 28 DAT.

Cotton yields were low in this test (Fig. 4). The highest yield was 823 lbs. lint/A. Numerically, the Savey+Zephyr treatment yielded the most, but the Zephyr alone, S-1283, and Savey+Kelthane treatments also yielded well. The untreated yielded less than 400 lbs. lint/A.

2000

Spider mite populations averaged 3.4 per leaf on the day of application. At 7 DAT, mite populations in the untreated had continued to increase and averaged 15.1 mites per leaf. This trend continued to an average of 42.0 mites per leaf at 14 DAT. Mite populations at 21 DAT were starting to decline with the untreated averaging only 33.3 mites per leaf. Populations continued to crash at 28+ DAT, making the results difficult to interpret.

At 7 DAT, all treatments except Ovasyn and Comite, significantly reduced the spider mite levels (Fig. 5). Numerically, the Savey+Kelthane treatment provided superior control. Zephyr provided the best mite control (numerically) at 14 DAT. Savey+Zephyr, Savey+Kelthane, and Acramite all provided 80% or more mite control. All treatments tested reduced the population by at least 50%. Zephyr, V1283, and Acramite gave numerically the best control at 21 DAT; the Savey alone and combination treatments were also quite effective.

Cotton yields were significantly effected by the spider mite infestation (Fig. 6). Lint yield was lowest in the untreated at 1030 lbs. lint/A; numerically, the Savey+Zephyr treatment produced the most lint yield (an increase of ~300 lbs./A over the untreated) and statistically the Zephyr, Savey, Savey+Zephyr, Savey+Kelthane, Acramite, and V1283 treatments outyielded the untreated.

Summary

The registered acaricides generally provided good to excellent spider mite control in replicated field studies from 1995 to 2000. Pesticide resistance (although not quantified), less than optimal application timing, and environmental conditions may have influenced the activity of some products during some years. An application of an acaricide prevented a 73% cotton lint yield loss (~800 lbs./A) from the spider mite infestation in 1996. Yield losses were less severe during the other years with ~300 lbs/A lint loss in 2000 from spider mites.

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Table 1. Treatments and rates evaluated in spider mite management studies in 1996, 1998, and 2000.

Products (Rate/A) Tested - 1996	Products (Rate/A) Tested - 1998	Products (Rate/A) Tested - 2000
Kelthane MF- 1 qt.	Kelthane MF - 1.5 qt.	Kelthane MF - 1.5 qt.
Zephyr 0.15EC- 8 oz.	Zephyr 0.15EC- 12 oz.	Zephyr 0.15EC - 12 oz.
Comite 6.55E - 1.5 pt.	Comite 6.55E- 1.5 pt.	Comite 6.55E - 2 pt.
Ovasyn 1.5E - 2 qt.	Ovasyn 1.5E - 2 qt.	Ovasyn 1.5E - 2 qt.
Capture 2E - 6.4 oz.	Capture 2E - 6.4 oz.	Capture 2E - 6.4 oz.
Savey 50W - 4 oz.	Savey 50W - 4 oz.	Savey 50W - 4 oz.
Savey + Kelthane - 2 oz. + 1 qt.	Savey + Kelthane - 2 oz. + 1 qt.	Savey + Kelthane - 2 oz. + 1 qt.
Savey+Zephyr - 2 oz. + 4 oz.	Savey + Zephyr - 2 oz. + 4 oz.	Savey + Zephyr - 2 oz. + 4 oz.
Alert 2SC - 6.4 oz.	Alert 2SC - 9.6 oz.	Acramite 4L - 1.5 pts.
	S-1283 3FL - 1.9 oz.	V-1283 72WDG - 1.4 oz.

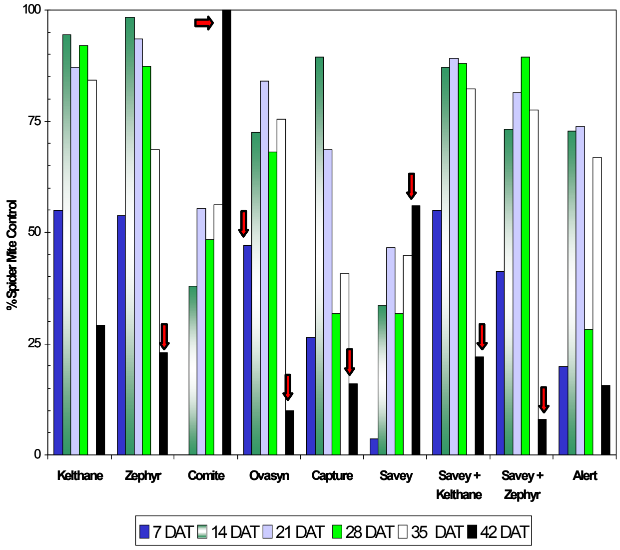

Figure 1. Influence of registered and experimental acaricidal products on spider mite populations (% control) in 1996. Arrows indicate a flaring, i.e., increase in mite numbers over the untreated. The height of the bar indicates the extent of the flaring on the indicated treatment/DAT combination.

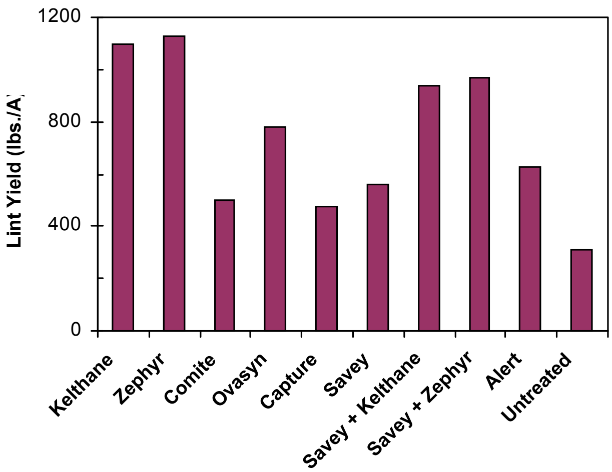

Figure 2. Influence of acaricide treatments on cotton lint yield, 1996.

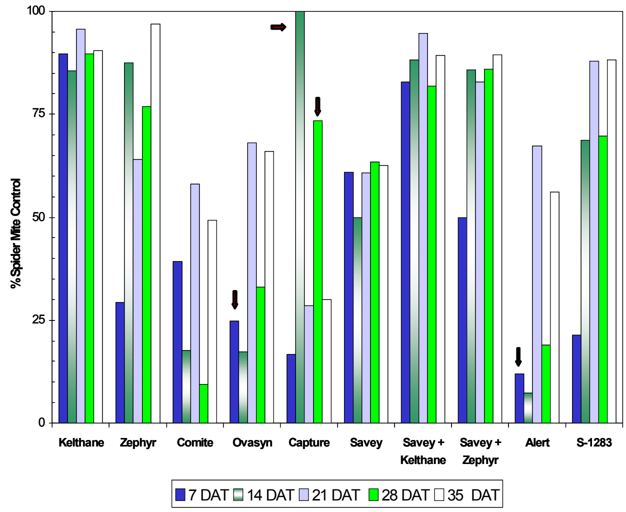

Figure 3. Influence of registered and experimental acaricidal products on spider mite populations (% control) in 1998. Arrows indicate a flaring, i.e., increase in mite numbers over the untreated. The height of the bar indicates the extent of the flaring on the indicated treatment/DAT combination.

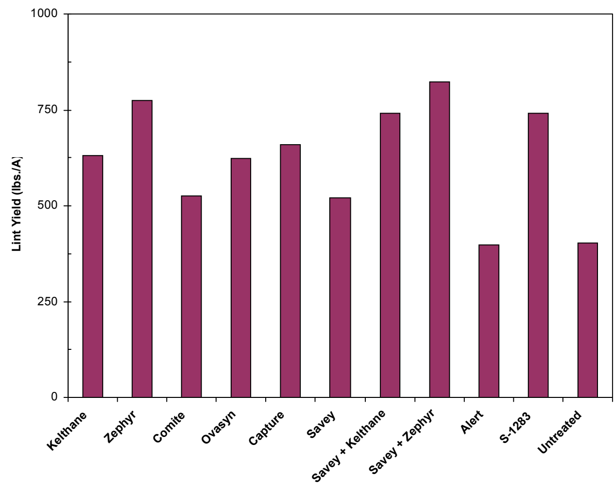

Figure 4. Influence of acaricide treatments on cotton lint yield, 1998.

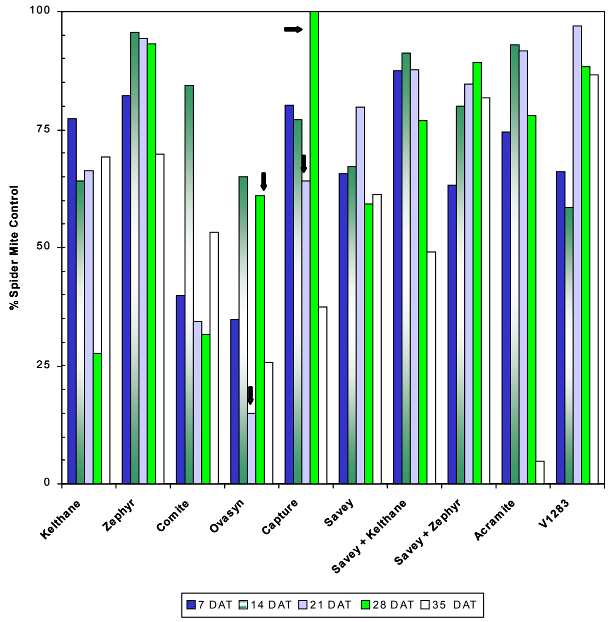

Figure 5. Influence of registered and experimental acaricidal products on spider mite populations (% control) in 2000. Arrows indicate a flaring, i.e., increase in mite numbers over the untreated. The height of the bar indicates the extent of the flaring on the indicated treatment/DAT combination.

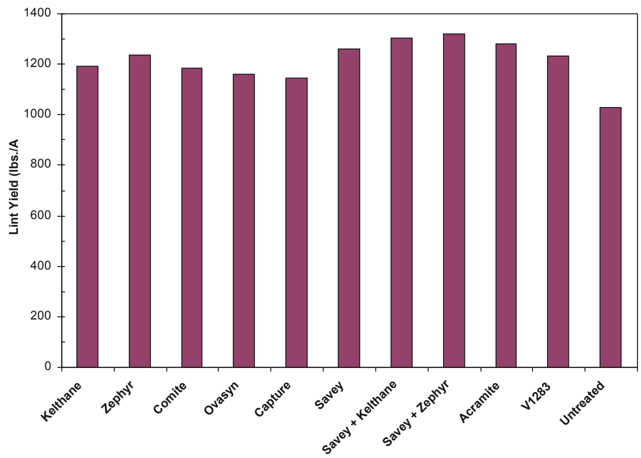

Figure 6. Influence of acaricide treatments on cotton lint yield, 2000.