Management of Spider Mites Infesting Pre-tassel Corn for Prevention of Economic Damage

A Report to the Texas Corn Producers Board

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Summary

A study was initiated in 2010 to determine how effective pre-tassel miticide applications are at preventing economic damage from spider mites. Understanding factors that contribute to mite development and survival during early vegetative growth will give producers a better knowledge of how to manage mite infestations so that the management options available are the most economical and best for preventing significant yield losses from spider mites. Field trials were conducted on two producer fields and at the Texas AgriLife Research station at Halfway to understand how effective early miticide applications to pre-tassel corn can be, and to assess the need for making these early applications. A trial near Dimmit, TX on 1.5 foot tall corn showed that mites migrating from adjacent natural grass fields were naturally controlled by predation from heavy migration of western flower thrips. The effectiveness of spraying miticides was overshadowed by this natural predation. A trial near Tam Anne, TX on 4 foot tall corn indicated miticide applications provide good control of mites (> 86%) which may have prevented damaging levels of spider mites after tassel. Unfortunately, a hail storm severely damaged the corn and prevented further evaluations. The trials at Halfway never developed spider mites throughout the entire season. This was probably due to heavy rains during June and July. Taken together, these trials show the unpredictability of early season pre-tassel spider mites to develop into damaging infestations, and they reinforce the need for scouting instead of making automatic application of miticides to pre-tassel fields. This one year study is only the beginning to understanding when producers and consultants can justify making decisions to spray. Continuation of this project will increase data information from different field situations that will improve our ability to know if and when pre-tassel miticide applications should be made to prevent damaging mite infestations.

Introduction

Spider mites infesting corn are responsible for significant economic losses for Texas producers from lost yield and excessive costs to control mite infestations. Mites will infest, on average, 50% of the corn acreage on the Texas High Plains yearly and cause 20% or more yield loss. The costs associated with making an application and purchasing chemicals can be as high as $25 per acre per application. None of the transgenic corn hybrids being marketed for control of caterpillar pests or corn rootworm have any effect on spider mites. Mite infestations are most damaging after corn has tasseled and during the grain filling growth stages. There are three currently registered miticides that spider mites have not developed resistance to, but optimum spray coverage is required for them to be effective. Since spray coverage is key to effective control, producers and crop consultants have adopted the practice of spraying these products when corn is in the early to mid vegetative growth stages. Although this has become a common practice, producers and their consultants do not know exactly 1) when an application is justified or how long the chemical will be effective, 2) what impact natural predators and environmental conditions have on mite control or on the need to spray, 3) which vegetative stage and what mite infestation level justifies a chemical application and 4) which product would be most effective and economical under different mite infestation circumstances. Understanding the impact of these factors on mite management will allow control strategies to be identified so miticide applications can be used more effectively and economically. This information will reduce wasteful applications and improve the efficacy of the miticides when applications are needed. A study was initiated in 2010 to address these questions so producers will have a better knowledge of how to manage mite infestations and so that the management options available are the most economical and best for preventing significant yield losses from spider mites.

Objective:

1. Evaluate miticide applications at vegetative growth states V3-V5 (up to 2 ft tall) and V6-v8 (approximately 4 ft tall) for prevention of damaging infestations.
2. Evaluate the efficacy of Comite, Oberon, and Onager when applied at the designated growth stages for economical season long damage protection.
3. Determine the impact natural predators and environmental conditions have on pre-tassel mite infestations related to early season miticide applications.

Methods & Materials

We initially established 6 trials on producer’s fields and on fields at the Texas AgriLife Research Stations at Halfway and at Etter. At both the Halfway and Etter stations there were two fields, one for the early V3-V5 (1 to 2 ft tall corn) application study and one for the V6-V8 (3 to 4 ft tall corn) application study. A study for the early V3-V5 (1 to 2 ft tall corn) application was on a producer’s field approximately 3 miles southeast of Dimmit, TX, off of Hwy 194. Another study for the V6 –V8 (3 to ft tall corn) application was on a producer’s field approximately 3 mile west and 3 miles north of Tam Anne, TX. Even though the two fields at Etter were hand infested with spider mites in June, plots were severely damaged by 4 hail storms during June and July and could not be utilized to collect data.

Each of the other test fields were designed the same way. Plots were arranged in a randomized block design with 4 replications. All trials had the same treatments (Comite II @ 3.38 pt/acre, Oberon 4SC @ 6 fl. oz./acre, Onager 1EC @ 12 fl. oz./acre, and an untreated check). Each Oberon and Onager treatment was mixed with a 1% v/v crop oil concentrate. The following provides the experimental procedures (application dates, mite sampling, etc.) for each of the trials. Data for all tests were statistically analyzed using analysis of variance.

AgriLife Research Station – Halfway

Corn was transgenic, planted on 40 inch rows, center pivot irrigated (drag hoses) to just a slight water stress. Record rainfall in early July eliminated water stress for approximately the first two weeks of the month. Plots were 4 rows wide by 35 feet long. Miticide applications (23 June) were made with a CO_2 backpack sprayer with four hollow cone nozzles delivering a total of 17.07 GPA. Corn averaged 4.5 feet in height. Four consecutive rows were treated and data were taken from the center two rows.

On each sampling date two leaves were pulled from each of three plants chosen at random from those near the center of each plot. Leaves were labeled, bundled and taken to the edge of the field for mite counting. An OptiVisor was used to provide magnification. All mites and beneficial arthropods were counted and recorded. Leaves in position 2 and 4 were pulled on 7 DAT. At 14 DAT, leaves from position 3 and 4 were collected, and at 21 DAT leaves from position 4 and 5 were chosen. Pollen shed occurred at 14 DAT. Data were collected at 7 (30 June), 14 (7 July), and 21 days (14 July) after application. A survey of plots on 28 days application revealed the presence of neozygites fungi and very significant mite mortality due to predation. Data collection at 28 days would not have been meaningful and hence was halted.

Dimmit Trial

A transgenic corn hybrid was planted on 30 inch rows and center pivot irrigated (LEPA). Plots were 6 rows wide by 50 feet long. Miticide applications (3 June) were made with a CO_2 backpack sprayer with five XR8002VS flat fan nozzles on 20 inch centers that was calibrated to deliver a total of 14.5 GPA. Corn averaged 1.5 feet in height. The four center rows were treated and mite data were taken from the 1st and 4th treated rows per plot.

On each sampling date two leaves were pulled from each of five plants chosen at random from plants within 30 feet center of each plot. Leaves were labeled, bundled and taken to the edge of the field for mite counting. An OptiVisor was used to provide magnification. All mites and beneficial arthropods were counted and recorded. Leaves in position 2 and 4 (leaf 1 was the lowest leaf with at least 1/3 green leaf area) were pulled on the day treatments were made (before treatment) and on all post treatment sample dates. Pollen shed occurred at 35 DAT. Data were collected before treatment (3 June) and at 7 (10 June), 14 (17 June), 28 (1 July), 42 (15 July), 56 (29 July), and 68 days (10 August) after application (DAT). At the 68 DAT sample corn was in the dent growth stage where mite feeding does not cause further yield losses. Therefore, no further mite samples were collected.

Harvest samples were collect 14 September by hand from one 17.4 ft linear section per plot. Ears were shelled with a small plot sheller and processed (weights, moisture content, bu weight) to determine yield.

Tam Anne Trial

A transgenic corn hybrid was planted on 38 inch rows and center pivot irrigated (LEPA). Plots were 6 rows wide by 50 feet long. Miticide applications (24 June) were made with a CO_2 backpack sprayer with 4 XR8002VS flat fan nozzles on 19 inch centers that was calibrated to deliver a total of 15.5 GPA. Corn averaged 4 feet in height. All six rows were treated and mite data were taken from the 2nd and 5th treated rows per plot.

On each sampling date two leaves were pulled from each of five plants chosen at random from plants within 30 feet center of each plot. Leaves were labeled, bundled and taken to the edge of the field for mite counting. An OptiVisor was used to provide magnification. All mites and beneficial arthropods were counted and recorded. Leaves in position 2 and 4 (leaf 1 was the lowest leaf with at least 1/3 green leaf area) were pulled on the day treatments were made (before treatment) and on all post treatment sample dates. Pollen shed occurred at 14 DAT. Data were collected before treatment (24 June) and at 7 (1 July), and 14 days (8 July) after application (DAT). The field was severely damage by hail after the 14 DAT sample and before the scheduled 28 DAT sample. Data collection would not have been meaningful and was discontinued.

Results & Discussion

Spider mite infestations are an extremely difficult problem for producers in the Texas High Plains because the miticide products that are toxic to mites are less effective when sprayed to tasseled corn, which is when mite infestations cause the worst damage and greatest yield loss. The primary reason for poor control on tassel stage corn is related to less than optimum spray coverage. Therefore, applications are often applied before tassel in an attempt to improve spray coverage and miticide efficacy and as a preventative treatment. Unfortunately, the effectiveness and benefits from making these early season applications are really unknown because there are many factors (climate, natural enemies, etc.) that can prevent mite infestations from ever reaching an economically damaging level. This project was initiated in 2010 to learn more about the dynamics of early season spider mite infestations and mite control efforts. The studies for this project were designed to learn how effective early season miticide applications are for season long mite management. This involves understanding what impact climatic conditions and natural predators have on early season spider mite populations and efficacy and residual control of miticide products. To understand these interactions all of the studies this year were conducted under natural field conditions.

The trial near Dimmitt, TX was conducted to represent when miticides are automatically applied when producers spray Roundup herbicide for early weed control. The justification is that the application will control mites migrating from adjacent wheat fields and natural grass areas. The data showed mites moving into the corn field and starting to establish in the test plots on 3 June (Pre-treatment) (Figure 1, Table 1). But, mite populations were quickly removed in all plots by migration of western flower thrips (Figure 2 – 7 DAT, Table 2). All of the miticide applications may have been killing mites, but the impact of western flower thrips predation overshadowed the miticides' ability to provide season long control. Mite densities were reduced to such low levels by 14 DAT that for 68 DAT mites never developed to economically damaging infestations. This is also evident by yields and bushel weights being similar across all treatments (Table 3). The trial shows the importance of predator populations and the need for scouting early infestations instead of making automatic applications. Under these circumstances the costs of purchasing miticides and spraying could have been saved.

The trial near Tam Anne, TX was conducted to represent applications to corn at later vegetative growth stages (V6 –V8). Spider mites were present, but populations were relatively low (< 13 per 2 leaves) when miticides were applied on 24 June (Figure 3, Table 4). Predator numbers were also low and had very little impact on the spider mite populations (Figure 4, Table 5). All three miticide treatments provided good initial reductions of mite densities (> 86% control) (Figure 4, Table 4). The untimely damage by the hail storm prevented us from being able to assess the effectiveness of these sprays to protect corn during the tassel stage growth stages. This is because at 14 DAT the corn plants were in the silk growth stage which is when mite populations begin to increase rapidly. And, there were fields in the surrounding area that missed the hail and had to be sprayed for damaging mite infestations after corn had tasselled.

The two fields at the Texas AgriLife Research station at Halfway, TX had extremely low levels of spider mites throughout the entire season. The field designated for applications at 1-2 ft tall corn never developed any spider mites. A few mites could be found occasionally on plants in the other trial when plants reached 4.5 feet in height. Even though mite populations were low, the field was treated on 23 June to determine if mite populations would develop later after tassel and if, so, would the miticides keep populations below damaging infestations. For 7 DAT and 14 DAT no spider mites were found in any test plots and by 21 DAT spider mites were only found in the untreated check plots (but at very low numbers). A survey of plots on 28 days application revealed the presence of neozygites fungus and very significant mite mortality due to predation. Data collection at 28 days would not have been meaningful and hence was halted. The low density of spider mites in this field and the other field at Halfway was probably due to heavy rains throughout June.

These trials demonstrate the unpredictability of spider mite infestations and the need for scouting before making decisions to spray pre-tassel corn. This one year study is only the beginning to understanding when producers and consultants can justify making decisions to spray. Continuation of this project will increase data information from different field situations that will improve our ability to know if and when pre-tassel miticide applications can be made to prevent damaging mite infestations.

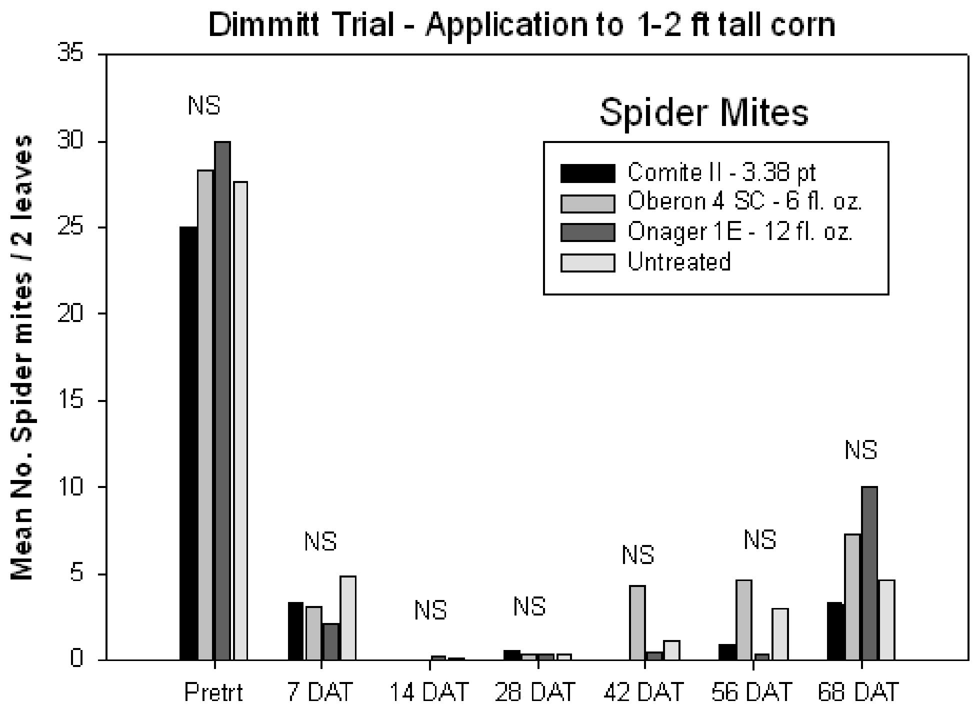

Figure 1. Spider mite densities before treatment and to 68 days after application (DAT). Dimmitt Trial. NS indicates no significant differences among treatments at each of the sample dates.

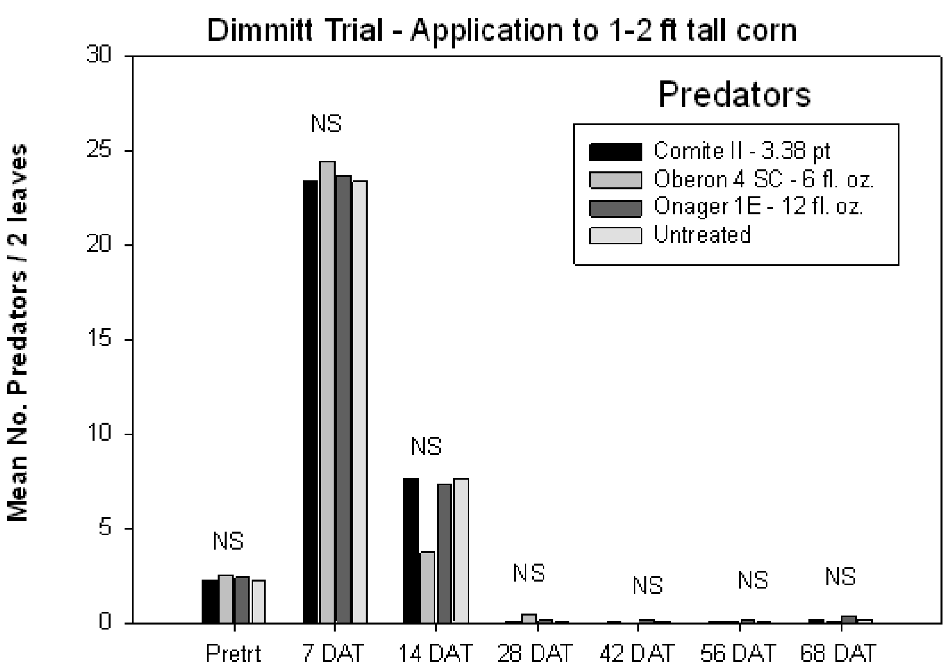

Figure 2. Predator densities before treatment and to 68 days after application (DAT). Dimmitt Trial. NS indicates no significant differences among treatments at each of the sample dates.

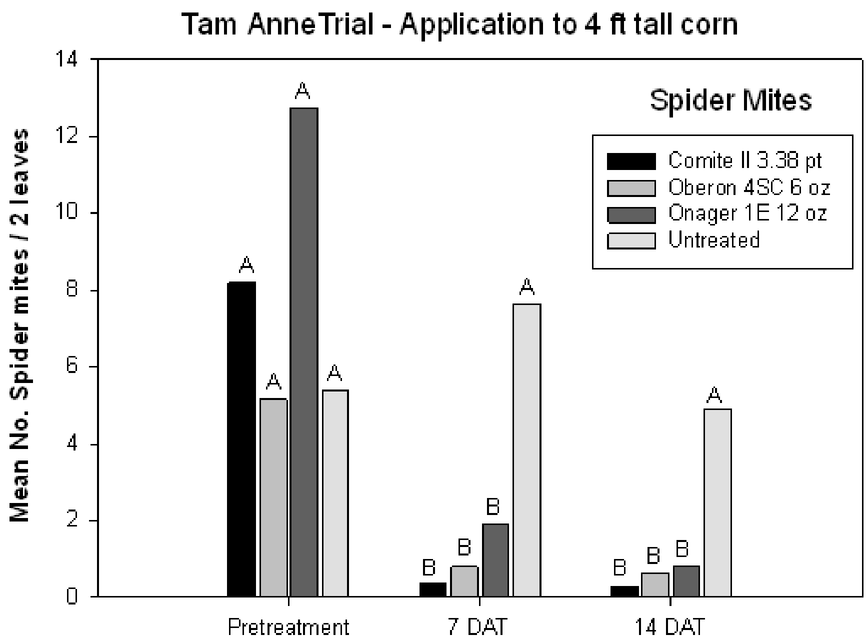

Figure 3. Spider mite densities before treatment and at 7 and 14 days after application (DAT). Tam Anne Trial. Means for treatments having the same letter within a sample date are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

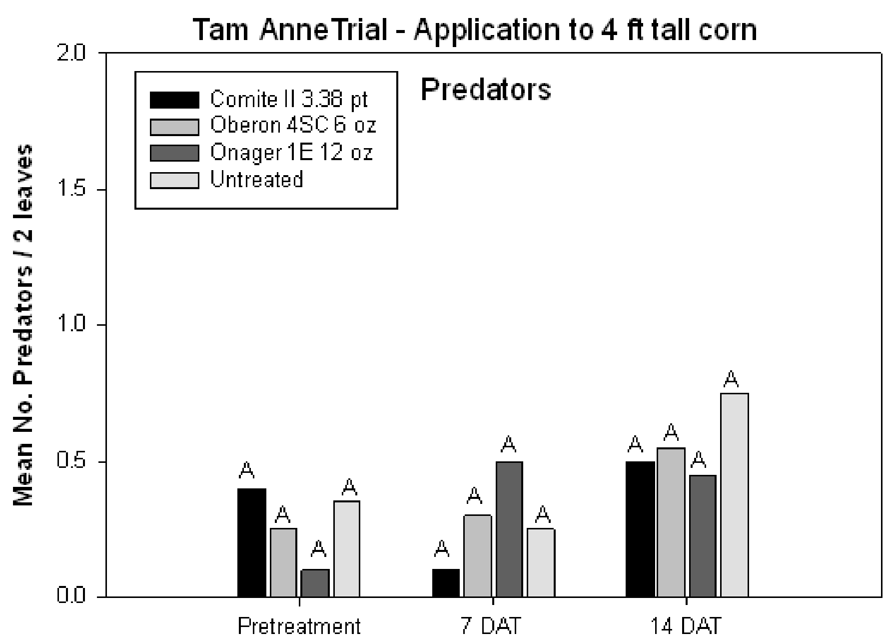

Figure 4. Predator densities before treatment and at 7 and 14 days after treatment (DAT). Tam Anne Trial. Means for treatments having the same letter within a sample date are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009)

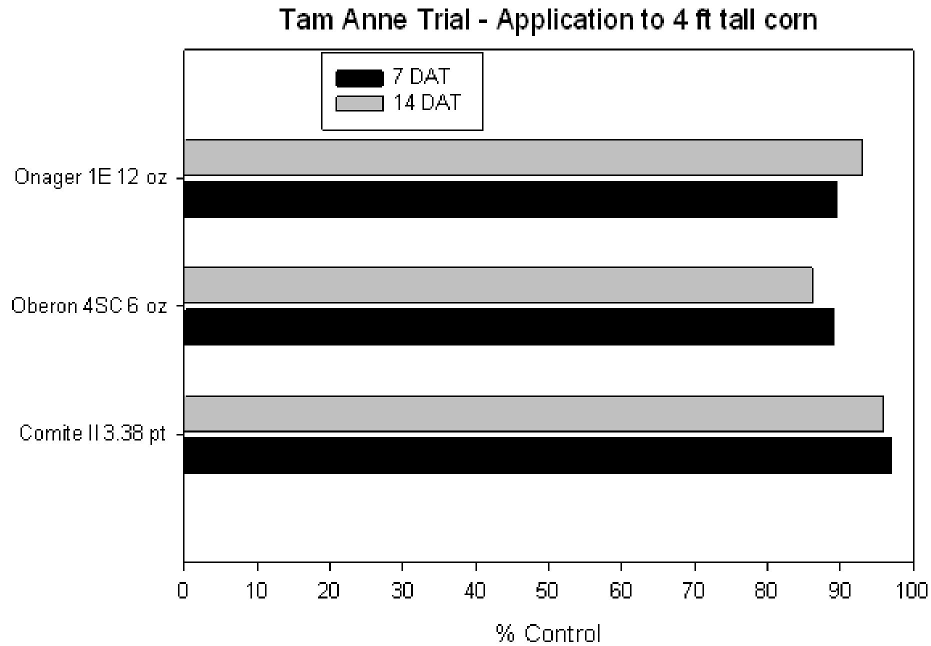

Figure 5. Percent control for miticides at 7 and 14 days after treatment. Tam Anne Trial.

Table 1. Mean number of spider mites at sample dates before treatment (Pretrt) and to 68 days after application (DAT). Miticides were applied 3 June when corn was 1 to 2 feet tall. Dimmitt Trial.

		Mean No.Mites / 2 leaves [a]						
Treatment	Rate / ac	Pretrt	7 DAT	14 DAT	28 DAT	42 DAT	56 DAT	68 DAT
Comite II	3.38 pt	25.0 a	3.4 a	0.0 a	0.6 a	0.0 a	1.0 a	3.3 a
Oberon 4 SC	6 fl oz	28.4 a	3.1 a	0.1 a	0.4 a	4.4 a	4.7 a	7.3 a
Onager 1E	12 flo z	30.0 a	2.1 a	0.2 a	0.4 a	0.5 a	0.3 a	10.1 a
Check		27.6 a	4.9 a	0.2 a	0.3 a	1.1 a	3.0 a	4.7 a

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

Table 2. Mean number of predators at sample dates before treatment (Pretrt) and to 68 days after application (DAT). Miticides were applied 3 June when corn was 1 to 2 feet tall. Dimmitt Trial.

		Mean No. Predators / 2 leaves [a]						
Treatment	Rate / ac	Pretrt	7 DAT	14 DAT	28 DAT	42 DAT	56 DAT	68 DAT
Comite II	3.38 pt	3.9 a	24.4 a	5.9 a	0.1 a	0.9 a	0.2 a	0.2 a
Oberon 4 SC	6 fl oz	2.6 a	24.5 a	3.8 a	0.5 a	0.0 a	0.1 a	0.1 a
Onager 1E	12 fl oz	2.4 a	23.7 a	7.4 a	0.2 a	0.2 a	0.2 a	0.4 a
Check		2.3 a	23.4 a	7.7 a	0.1 a	0.1 a	0.1 a	0.2 a

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

Table 3. Mean number of plant, bushel weight, and yield. Miticides were applied 3 June when corn was 1 to 2 feet tall. Dimmitt Trial.

Treatment	Rate / ac	No.Plants[a]	Avg Bu wt[a]	Yield Bu/ac[a]
Comite II	3.38 pt	24.5 a	60.3 a	246.5 a
Oberon 4 SC	6 fl oz	25.0 a	60.3 a	256.7 a
Onager 1E	12 fl oz	24.5 a	60.2 a	259.7 a
Check		24.0 a	60.4 a	249.8 a

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

Table 4. Mean number of spider mites (SM) per 2 leaves before treatment (Pretrt) and at 7 and 14 days after application (DAT) and percent control (%Control). Tam Anne Trial[a].

			7 DAT		14 DAT	
Treatment	Rate / ac	Pretrt[b]	SM[b]	% Control	SM[b]	% Control
Comite II	3.38 pt	8.2 a	0.35 b	97.0	0.3 b	96.0
Oberon	6 fl oz	5.15 a	0.8 b	89.0	0.65 b	86.1
Onager	12 fl oz	12.75 a	1.9 b	89.5	0.8 b	93.1
Untreated Check		5.4 a	7.65 a		4.9 a	

[a] Miticide applications were made 24 June when corn was 4 feet tall.
[b] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

Table 5. Mean number of predators per 2 leaves before treatment (Pretrt) and at 7 and 14 days after treatment. Tam Anne Trial[a].

Treatment	Rate / ac	Pretrt[b]	7 DAT[b]	14 DAT[b]
Comite II	3.38 pt	0.4 a	0.1 a	0.5 a
Oberon	6 fl oz	0.25 a	0.3 a	0.55 a
Onager	12 fl oz	0.1 a	0.5 a	0.45 a
Untreated Check		0.35 a	0.25 a	0.75 a

[a] Miticide applications were made 24 June when corn was 4 feet tall.
[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

Table 6. Mean number of spider mites per 2 leavers at 7, 14, and 21 days after treatment. Halfway Trial[a]

Treatment	Rate / ac	7 DAT[b]	14 DAT[b]	21 DAT[b]
Comite II	3.38 pt	0 a	0 a	0 a
Oberon	6 fl oz	0 a	0 a	0 a
Onager	12 fl oz	0 a	0 a	0 a
Untreated Check		0 a	0.04 a	1.9 a

[a] Miticide applications were made 23 June when corn was 4.5 feet tall.
[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).

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