Proposal Category: Research

Title: Determining the Impact of Early and Late Summer Broad Mite Infestations and Evaluating New Products for Potential Registration.

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Abstract

Late-summer broad mite infestations are becoming commonplace in blackberry across the Southeast. It is not currently understood how damage to first-year canes could affect floricane production in the following year. Additionally, miticides that control broad mite have a preharvest interval (PHI) of 7 days, meaning that control of infestations is often complicated. This study aims to better understand damage by both early and late-summer infestations of broad mites by comparing damaged and undamaged plots, and to generate data on miticides with low preharvest intervals that can manage broad mite. A yield impact trial was initiated in 2021 and was assessed through 2022, while two miticide alternative trials were initiated in 2022. Four replications of the following treatments were established on 5 plant plots for the yield impact trial: treated plots with one well-timed miticide application when damage symptomology was first observed, and untreated plots where no broad mite control was utilized. Damaging levels of broad mite were observed for 2 months in 2021, which was confirmed with observations of cane damage, but no impact on yield was observed in 2022. This trial will be replicated in 2022-2023. Two miticide trials were established: trial 1 assessed 5 miticides compared to an untreated check. Trial 2 compared Portal with two known standards, Magister and Agri-Mek, as well as the UTC. Results from both trials indicate that Portal is an excellent miticide to utilize during blackberry harvest, and both Agri-Mek and Magister offer excellent control and residual activity.

Introduction

Broad mite, *Polyphagotarsonemus latus* (Banks), was first reported as a pest of blackberry in the United States in 2007 and was further realized as a serious threat to commercial blackberry production in 2014 (Vincent et al. 2010; Johnson and Garcia 2015). In 2019, serious late-summer broad mite infestations

were observed in Arkansas and other states across the Southeast (NC, SC, and VA). Many of these infestations were far more serious than previously observed across much of Arkansas. Some plants exhibited heightened forms of the typical broad mite symptomology; extreme leaf distortion and curling, stacking of nodes on all canes of a plant, and even tip die-back (growth at cane tips becomes necrotic). Infestations of broad mite were not yet observed this late in the season, and the overall population dynamics and effect on crop are still not well understood.

Currently Agri-Mek (abamectin) and Magister (Fenazaquin) are the only registered and effective products for use in Southeast commercial blackberries for broad mite (Lefors and Johnson 2017). The combination of these products allows three total applications across a growing season with all applications warranting a 7-day pre harvest interval (PHI). Considering the potential for both early and late season infestations, and that infestations were observed in 2019, 2020, and 2021 during primocane fruit harvest, an increased variety of control options with lower PHI's is needed.

We proposed to assess the impact of yield by both early and late-summer broad mite infestations in AR and NC, and screen additional unregistered miticides in AR and NC to support expanded labels in Southeastern commercial blackberry production.

Objectives

1. To determine the impact on yield of both early-summer and late-summer broad mite (*Polyphagotarsonemus latus*) infestations in AR and NC.

2. To generate data on currently unregistered pesticides against broad mites to support expanded labels in the Southeastern US.

Materials and Methods

Yield Impact Trial

A field trial was initially established at the University of Arkansas Fruit Research Station in Clarksville, Arkansas in 2020. This trial was abandoned going in 2021 due to a lack of damage observed in untreated plots after initial miticide applications. A new blackberry planting was established for 2021 that was isolated from other blackberry research trials and potential drift. A yield impact trial was established across two rows of first year "Ouachita" blackberries that consisted of 5 plant plots with 5 ft. bare ground buffers between each plot. Treatments were replicated four times and consisted of the following two treatments: **treated** plots with one well-timed miticide application when damage symptomology was first observed, and **untreated** plots where no broad mite control was utilized. Plots consisted of 5 plants and a buffer of 5ft between each plot (Figure 1). The trial was organized as a randomized complete block design with 2 blocks being present on each of two rows of blackberries. Within each block 4 untreated and 2 treated plots were established (16 untreated and 8 treated plots total). A large number of plots were left untreated to minimize the impact of the miticide treatment on the total present population and to maximize the potential damage to untreated plots.

Broad mite density was monitored at least weekly by pulling 5 leaflets per plot and quantifying the number of adult mites. These leaflets were pulled from leaves near the ends of canes, where broad mites are known to feed. Plots were monitored before treatments were initiated until adults were no longer observed in the Fall. Additionally, the amount of broad mite damage was also observed by calculating a broad mite damage rating (BMR) number which quantified the average number of canes exhibiting broad mite damage symptomology in new growth. Ten canes were observed in each plot and the BMR was

determined as the number of canes exhibiting “fresh” broad mite damage in the newest growth, with a potential score of 0-10.

This trial was initiated once broad mite populations were observed to be established at damaging levels across the station on August 16, 2021. Agri-Mek at 3.5 fl oz/acre + 1% non-ionic surfactant was applied at an output of 40 GPA using a single nozzle hand boom after initial leaf count observations on 8/16/2021. It is important to note that all surrounding blackberry plantings at the Clarksville Fruit Station were sprayed with the same rate of Agri-Mek on 8/30/2021 to suppress infestations present in breeding and production trials.Yield was assessed for each plot in 2022 by measuring marketable weight, cull weight, total yield, percent cull, and average berry weight over the course of 6 harvest dates. These yield metrics were converted to yield per plant where appropriate and were analyzed using proc GLIMMIX in SAS v 9.4, and a Tukey’s HSD post hoc analysis was used to separate means at α=0.05.

Miticide Alternative Trial

The efficacy of multiple miticides were assessed with two separate spray trials compared to known standards in commercial blackberries in Arkansas. These trials were performed in a grower field where broad mite injury was easy to find and preliminary sampling indicated broad mite numbers to be well above threshold (1-5 per leaf). Trials utilized a randomized complete block design with 4 replications of each treatment in 5 plant plots with 3 plant buffers between each plot. Cane damage ratings were taken at each sampling date, with 10 random canes within the 5-plant plot examined and rated from 1-5 as shown in figure 2. Leaf samples consisted of 10 leaflets, from 10 unique leaves, pulled from the first node with fully unfurled leaves (generally the 3rd node from the terminal) and were taken back to the lab where the number of adults, immatures, and eggs were counted per leaf. Trial 1 assessed 5 miticides compared to an untreated check (UTC), and a second application was made 21 days after the first (21 DAA) (Table 1). Trial 2 compared Portal with two known standards, Magister and Agri-Mek, as well as the UTC. Trials were assessed 0, 3, 5, 7, 10, 14, and 21 days after application where possible. Treatments containing Portal and Agri-Mek in Trial 1 were resprayed after 21 days due to plots breaking control, and those plots were reassessed for 14 days after the second application (DA2A). Trial 1 and 2 were accidentally over sprayed by the producer on 14 DA2A in trial 1 and 14 DAA for trial 2. Trials were terminated after the overspray, as samples from the following week were devoid of broad mite. Average adult+immature broad mites per leaf and damage ratings were analyzed using proc GLIMMIX in SAS v 9.4, and a Tukey’s HSD post hoc analysis was used to separate means at α=0.05.

Table 1. Miticides used in two different miticide efficacy trials where all products were compared to an untreated check (UTC) at a grower field in Arkansas.

	Trial 1		
Active Ingredient	**Product**	**Rate**	**PHI**
Acetamiprid	Assail 70WP	2.3 oz/acre	1
Hexythiazox	Savey	25.4 fl oz/acre	1
Fenpyroximate	Portal	32 fl oz/acre	1
GS-omega/kappa-Hxtx-Hv1a	Spear Lep	32 fl oz/acre	1
abamectin	Agri-Mek	3.5 fl oz/acre	7
	Trial 2		
Active Ingredient	**Product**	**Rate**	**PHI**
Fenpyroximate	Portal	32 fl oz/acre	1
Fenazaquin	Magister	36 fl oz/acre	7
abamectin	Agri-Mek	3.5 fl oz/acre	7

Current Results and Future Plans

Yield Impact Trial

Treatments were initiated once broad mites were found across the Clarksville Fruit Station and damage began to appear. Leaf samples from directly before the miticide application indicated that plots were averaging over threshold (1-5 adults per leaflet) at the time of the first application on 8/16/2021, which is a typical situation for most growers (Figure 3). Directly after the miticide application, treated plots dropped below threshold levels within 7 days. Treated plots continued to stay around 1 broad mite adult per leaf except for a 2-week period where numbers spiked to upper threshold levels, and then quickly collapsed again. Untreated plots remained above threshold limits throughout the entire sampling period until populations collapsed at the end of October. This collapse was associated with the first true cold temperatures (<40°F) observed on the station.

Broad mite damage ratings (BMR) closely followed a similar trend to the number of broad mite adults observed (Figure 4). Untreated plots consistently exhibited more damage than treated plots and damage began to increase as broad mite numbers increased. Although broad mites were at damaging levels throughout the trial, this damage was initially hard to find due to the intense amount of growth exhibited in the heat of late summer. Plants grew out of the initial damage that was observed in mid-August, but plots that were untreated exhibited a much larger increase in damage than treated plots. Treated plots never averaged above 20% cane damage (BMR=2) whereas untreated plots stayed above this level throughout most of the trial and reached 50% cane damage (BMR=5) by the end of the fall when plants began to slowdown in growth.

Yield from each plot was assessed and no significant differences were observed between sprayed and unsprayed plots (Table 2). Marketable weight, cull weight, total yield, percent cull, and average berry weight were not found to be different in sprayed and unsprayed plots. It's likely that broad mite damage occurred on these plants too late to effect portions of cane that were not pruned, and the average damage observed was not serious enough to impact the entire plant. This trial has been repeated in 2022, and yield and broad mite density data will be reported in the 2023 report. Additionally, we changed our damage rating metrics to what we used in the miticide alternative trial, and we plan to specifically look at impact on damaged portions of canes in addition to whole plant yield. We also plant to prune some canes and not others to assess whether portions of canes that were damaged due yield less fruit.

Miticide Alternative Trial

Results from Trial 1 indicated that Portal was able to suppress broad mite populations as good as Agri-Mek over a 7-day period compared to the UTC (Figure 5). Broad mite populations rebounded much more quickly in plots containing Portal around 10 days after the first application and were well above threshold 14 DAA (Days after application) (Figure 5). Acetamiprid, Hexythiazox, and Spear-Lep did not offer acceptable suppression and were not found to be significantly lower than the UTC on most sampling dates. When considering damage ratings, Portal and Agri-Mek were similar 14 DAA, but at 21 DAA excessive damage was observed in Portal (Figure 6). After the second application (sprayed on 21 DAA), broad mite numbers and damage ratings in Portal plots crashed once again, but did not look as good as Agri-Mek. This likely indicates that Portal could be a short-term solution for broad mite and potentially should be sprayed on tighter intervals if issues persist and if allowed by the label (14-day restriction).

Results from Trial 2 indicated that all 3 miticides (Portal, Magister, and Agri-Mek) were able to knock back excessive broad mite populations (Figure 7). Magister and Portal exhibited less residual control compared to Agri-Mek, with populations bouncing back to 3-4x threshold by 13 DAA. Samples could not

be assessed for 21 DAA as this trial was accidentally over-sprayed by the grower. Damage ratings in this trial indicated an excessive 3.5 rating at 0 DAA when initial applications were made, and all three miticides were able to reduce ratings under 3 by only 7 DAA (Figure8). These results indicate that Agri-Mek was most effective with the best residual control, and both Portal and Magister would likely warrant a second application within 14 DAA if broad mite persisted.

Our results indicate that Portal is an excellent option to utilize during harvest. Agri-Mek continues to provide excellent control with great residual, but a 7-day preharvest interval hampers its usefulness. Portal is a good option for growers that are either looking to finish out floricane harvest or need to protect developing fruit while harvesting primocane fruiting varieties. Results from both trials indicate that Portal will knock back damaging broad mite populations and limit the amount of plant injury that is observed, while offering a 1-day preharvest interval. We would likely expect higher efficacy in real-world applications, as less reservoirs for reinfestation would exist compared to our small plot trials. However, any grower that uses Portal should continue to scout for damage and mites. A second portal application of Portal should only be considered 14 days (label restriction) after the first if harvest is ongoing, and either Agri-Mek or Magister should be prioritized for a second application to help reduce the likelihood of resistance.

Table 2. Yield results for sprayed and unsprayed plots reported in pounds per plant from blackberry plots in Clarksville, AR.

Treatment	Marketable Weight (lbs)	Cull Weight (lbs)	Total Yield (lbs)	Percent Cull	Average Berry Weight (g)
Unsprayed	4.28	2.335386	6.61	35.4	5.77
Sprayed	3.92	2.40	6.32	38.7	8.82

* No significant difference was observed in Sprayed and Unsprayed plots for any metric above according to a t-test at α=0.05.

Figure 1. Ouachita blackberries where the yield impact trial was established. This picture shows the plot layout of 5 plants per plot with a 5 ft buffer between plants.

Figure 2. 1-5 Rating scale for broad mite damage. A rating of 1 has no shortened internodes or leaf cupping. A 2 rating indicates leaf bronzing, reduced internode length and the beginning of leaf cupping or upturned leaves. A rating of "3" exhibits excessive leaf cupping and a rating of 4 indicates that leaves are beginning to become necrotic. A rating of 5 indicates tip-dieback and excessive necrosis of new leaves. Photos by Ryan Keiffer and Aaron Cato.

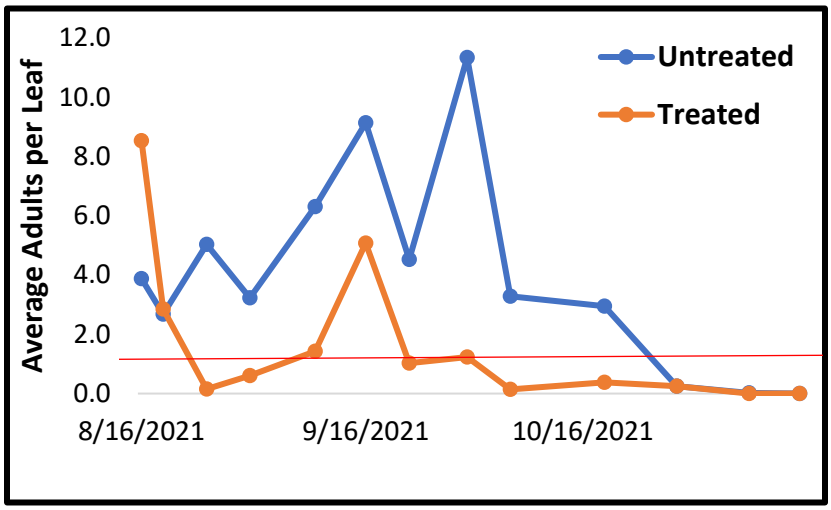

Figure 3. Average number of adult broad mites observed per leaf in treated and untreated blackberry plots in Clarksville, AR in 2021.

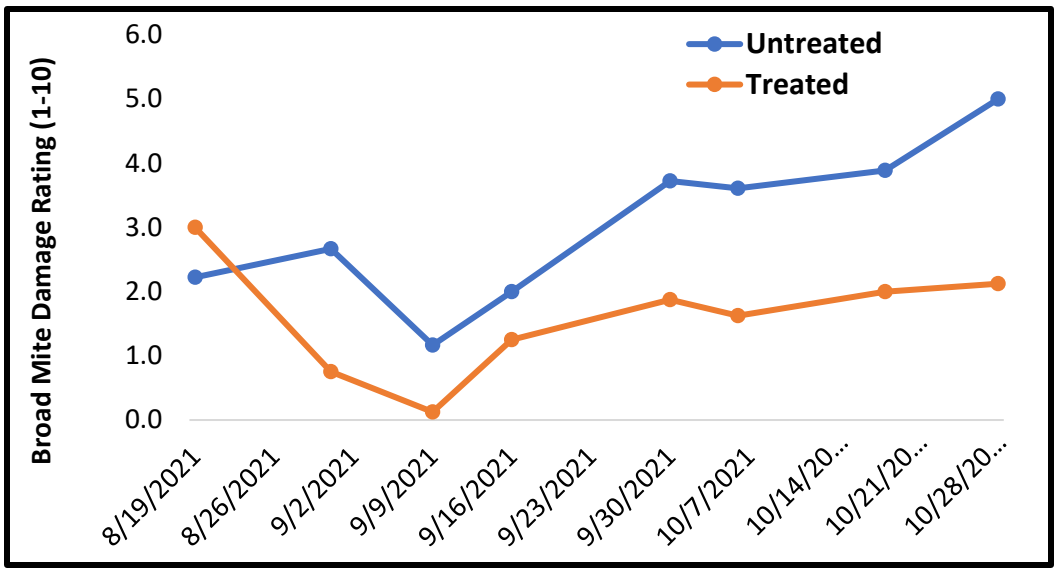

Figure 4. Average broad mite damage rating (BMR) of treated and untreated blackberry plots following a single application of a miticide to treated plots in Clarksville, AR on 8/16/2021.

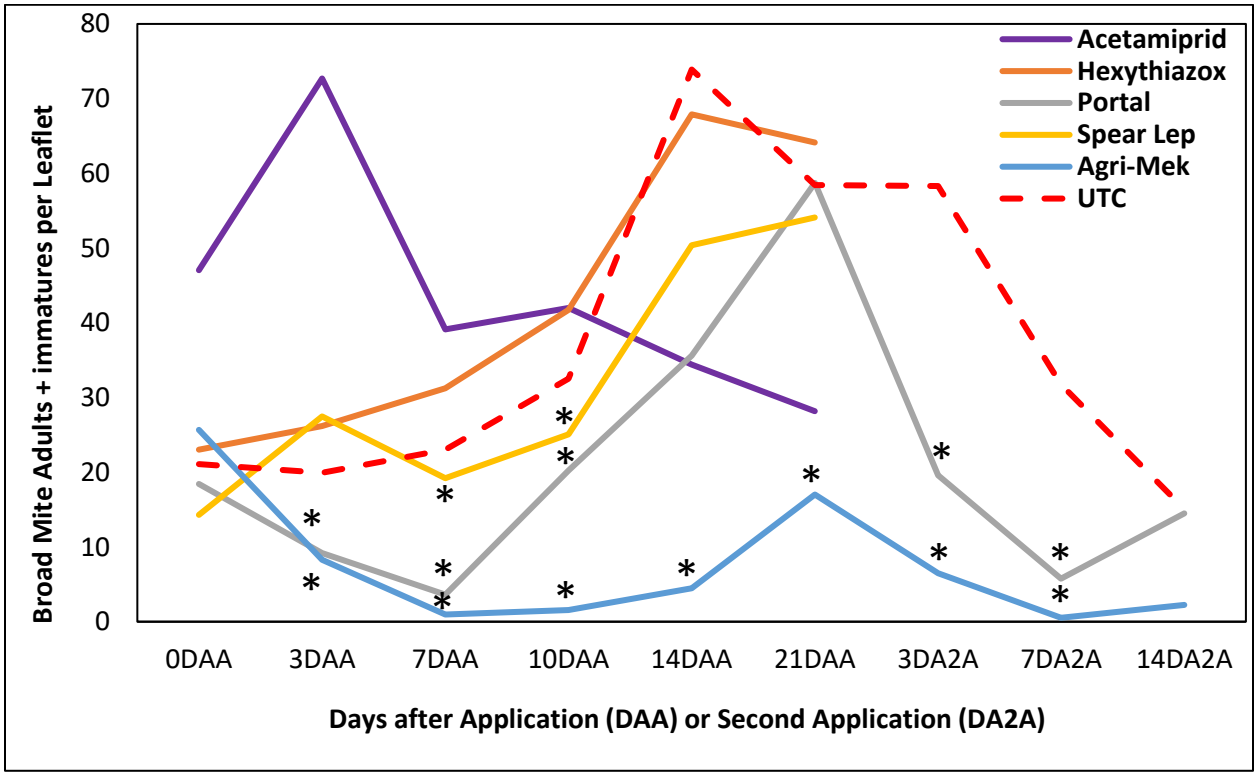

Figure 5. Broad mite adults and immatures observed per leaflet in Trial 1 across 5 miticide treatments in blackberry compared to an untreated check (UTC) observed 0-21 days after the first miticide application (DAA) and 3-7 days after the second miticide application (DA2A) on a grower field in White County, AR. *indicates significant difference from Untreated Check.

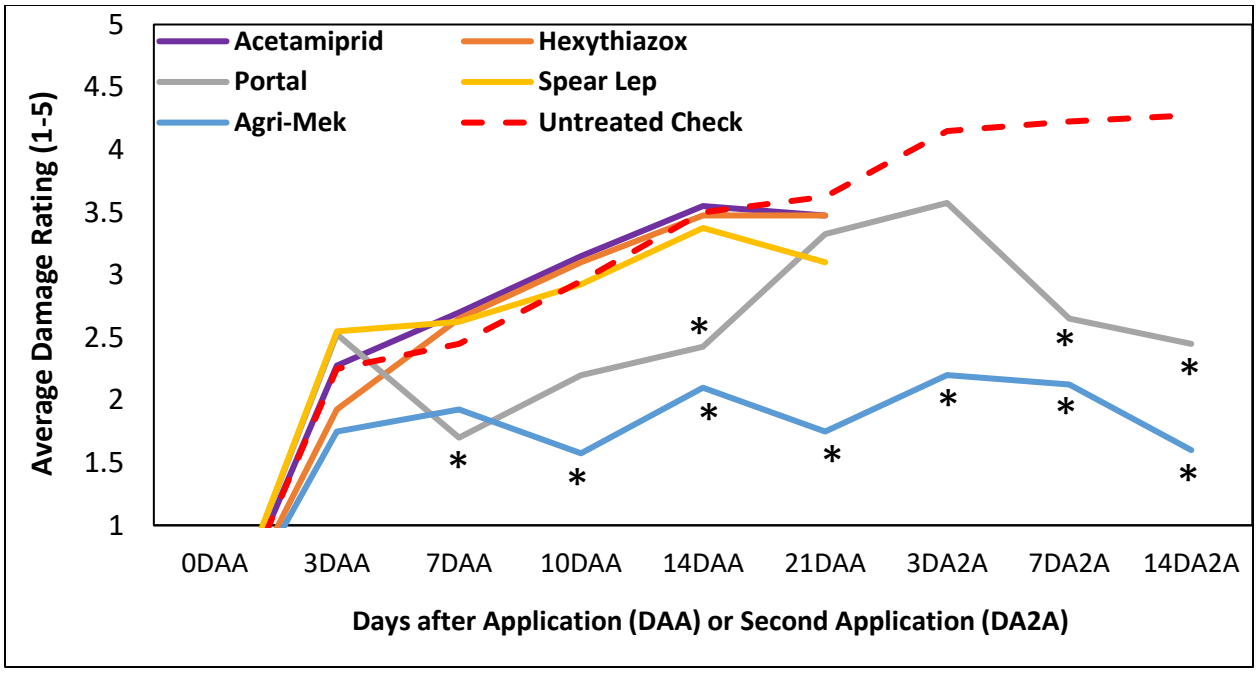

Figure 6. Broad mite damage ratings (1-5) in Trial 1 across 5 miticide treatments compared to an untreated check observed 0-21 days after the first miticide application (DAA) and 3-7 days after the second miticide application (DA2A) on a grower field in White County, AR.. *indicates significant difference from Untreated Check.

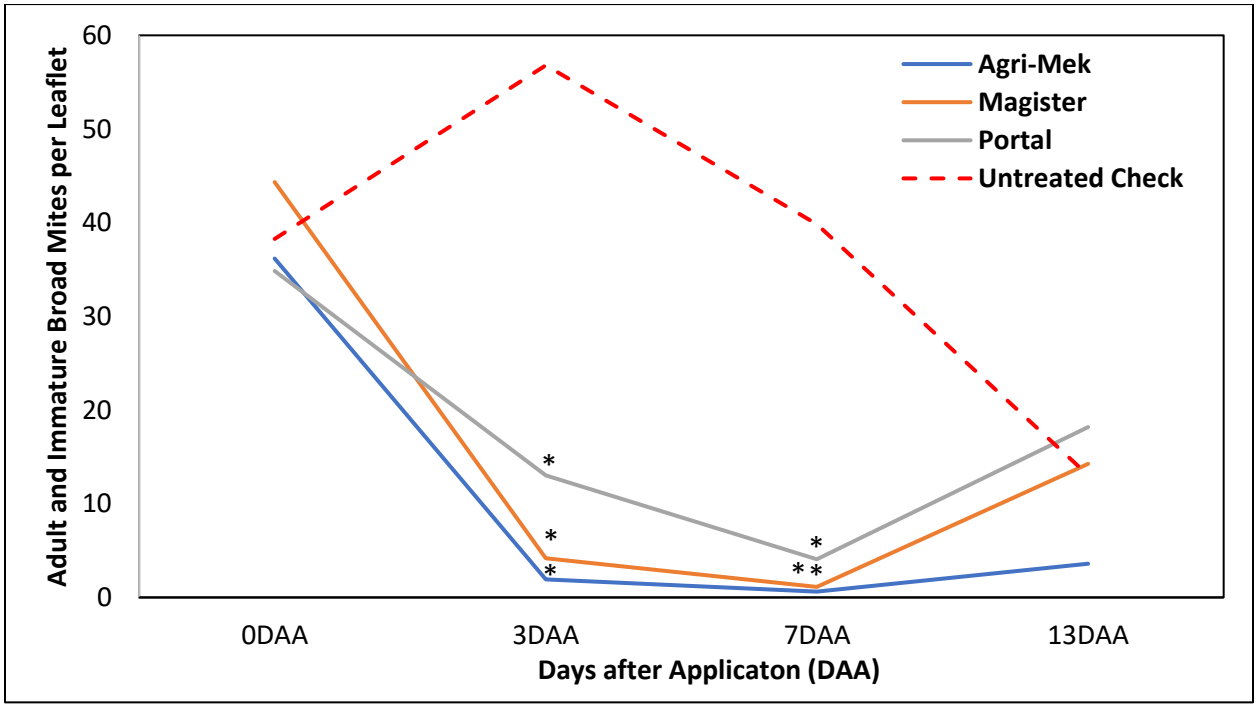

Figure 7. Broad mite adult and immatures observed per leaflet in Trial 2 across 3 miticide treatments in Blackberry compared to an untreated check observed 0-13 days after application (DAA) on a grower field in White County. *indicates significant difference from Untreated Check.

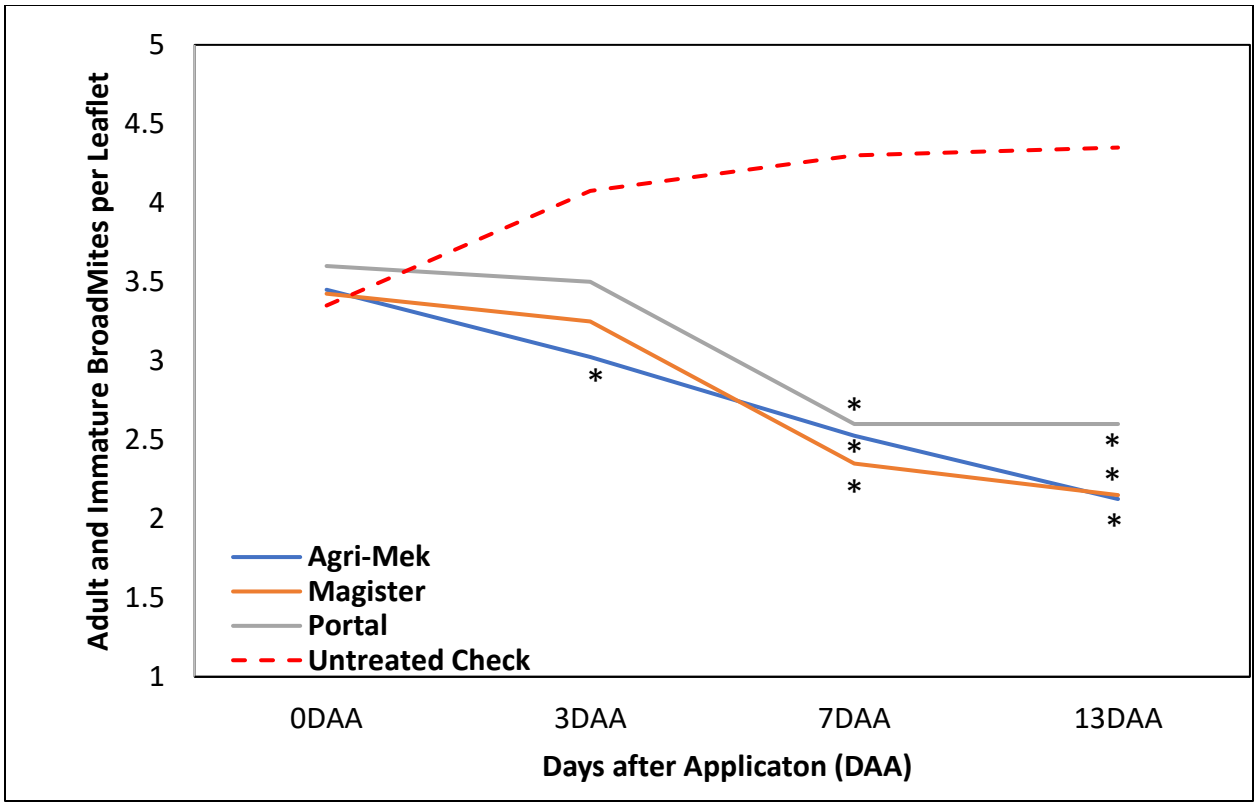

Figure 8. Broad mite damage ratings (1-5) in blackberry across 3 miticide treatments compared to an untreated check observed 0-13 days after application (DAA). *indicates significant difference from Untreated Check.

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