

Status of Broad Mites on Blackberries
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Distribution and Hosts: Broad mites are a pest worldwide in tropical and subtropical regions. In temperate and subtropical areas, the broad mite has been a pest in greenhouses. Broad mite feeding injects a toxic saliva into young, expanding leaf and fruit tissue that causing leaf curling or fruit scarring of a diversity of crops including: apple, avocado, blackberry, beans, cantaloupe, citrus, coffee, cotton, cucumber, eggplant, grapes, guava, lemon, mango, papaya, pear, potato, strawberry, tea, tomato, and watermelon. In 1890, broad mites were first described damaging tea in Sri Lanka. By 1904, broad mites entered the United States in Washington D.C. on figs and mango plants. In 1979, the more humid coastal lemon groves in California had broad mites feeding on expanding lemon leaves and young lemons causing leaf curling and fruit surface scarring (Faber 2013). In 2006, broad mites were first reported in Arkansas damaging terminals of primocane-fruiting blackberries in plantings grown in a field and high tunnel (Vincent et al. 2010). In 2014, broad mites caused damage in a commercial primocane-fruiting blackberry planting. It also damages strawberry in Florida (Renkema et al. 2017).

Spread in United States: Broad mites are a new pest of primocane-fruiting blackberries produced in plantings outdoors and in high tunnels in the warmer southern United States. Broad mites feed on and damage expanding terminals and laterals and greatly reduce fruit yield. Since 2014, we have had additional reports of broad mites causing significant damage to primocane-fruiting blackberries across the USA. In Pennsylvania, we first found broad mites on blackberries in 2013. In 2015, we found that broad mites can contribute to a nearly total crop loss on primocane-fruiting blackberries (Demchak and Johnson 2017). By 2017, broad mites were also detected on blackberries in California, Illinois, Indiana, Maryland, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia (Johnson 2017 personal communication) and in Oklahoma (Rebek 2017). China, South Africa and Mexico have also reported the presence of this pest on blackberries (Seagraves 2017 personal communication from Driscoll's). The reason for the sudden prevalence of broad mites on blackberries is not known, but recent mild winters may be contributing factors (Rebek 2017). Jones and Brown (1983) reported that broad mites survive and reproduce at temperatures between 53.6°F to 95°F and population increase was greatest at 68°F and 90% RH. Temperatures above 86°F coupled with low humidity were lethal to the egg and nymphal stages.

Biology: In 2017, minimum daily temperatures increased above 53.6°F (12°C) from late-March in Hope, AR (Fig. 1). By 11 May, adult female broad mites first appeared on terminal leaves. By 30 May numbers exceeded the proposed damage threshold of 5 broad mites per leaflet: first appearance of damaged expanding terminal leaves (field hot spots) with broad mite spotted eggs and adult males.

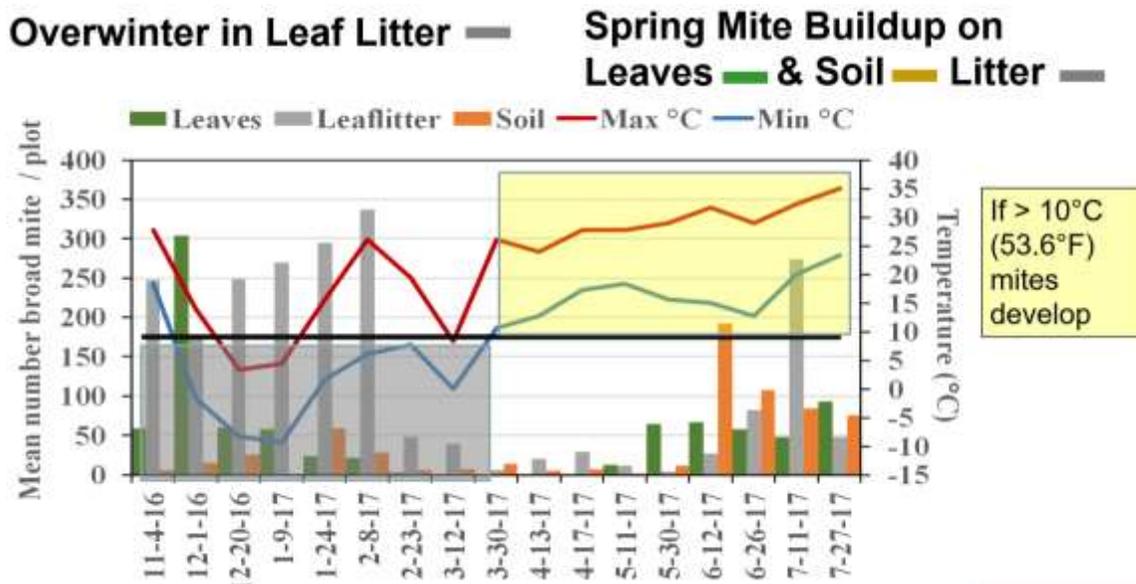


Figure 1. Overwinter (gray box) and spring buildup (yellow box) of broad mites in a primocane-fruited blackberry planting in Hope, AR (2016-2017).

By 12 June, we saw that numbers of broad mites increased in samples of soil and leaf litter under blackberry plants indicating dispersal was occurring. By 26 June broad mites dispersed and were causing terminal damage in plants across the field in Judsonia, AR (Fig. 2).

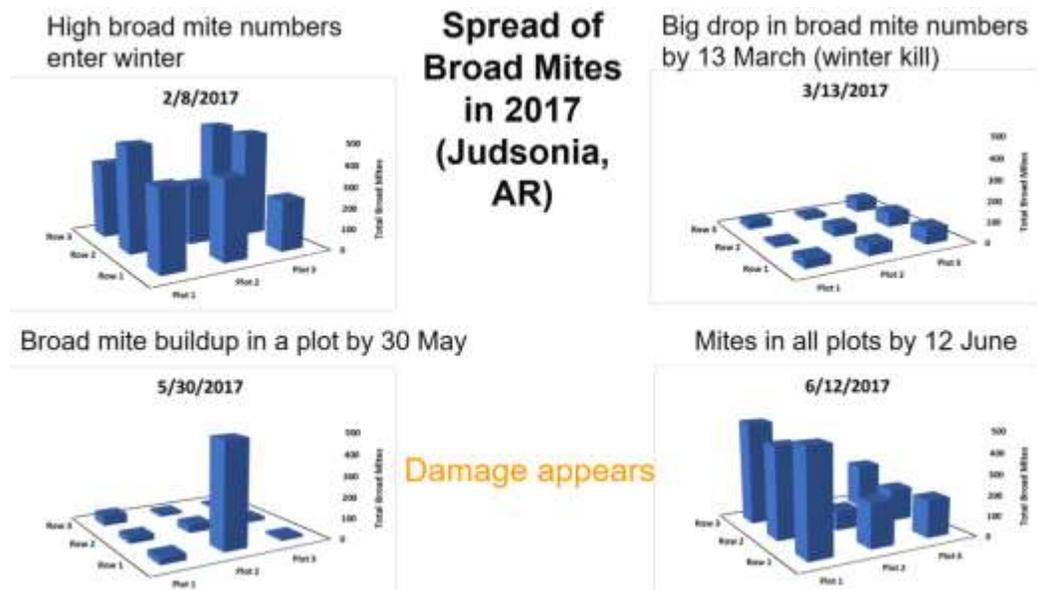


Figure 2. Seasonal changes in numbers of broad mite per plot across primocane-fruited blackberry field with nine, 10 plant plots in Judsonia, AR (2017).

From 1 December to 30 March, average daily temperatures dropped below 68°F (20°C). This caused broad mite counts per leaf to drop from high on 1 December to zero by 23 February. From 4 November to 8 February, broad mites appeared to move from blackberry leaves and occur mostly in leaf litter samples. From 23 February to 11 May, broad mite numbers were reduced to very low numbers per leaf litter sample but by 11 May moved to terminal primocane

blackberry leaves. Thus, we expect that broad mites may survive winter and damage blackberries in other southern States with mild winter temperatures like that in Arkansas.

Goal: To develop a broad mite pest management system for blackberry.

Blackberry Damage: Broad mites feed on and inject saliva with toxin into expanding leaves and flower bud/fruit tissue on terminals and laterals of primocanes. This causes leaves to become less shiny than light green healthy leaves, to curl downward or upward, become rigid, bronze and eventually die (Fig. 3). This damage results in reduced and even no yield of primocanes in field and high tunnel plantings.

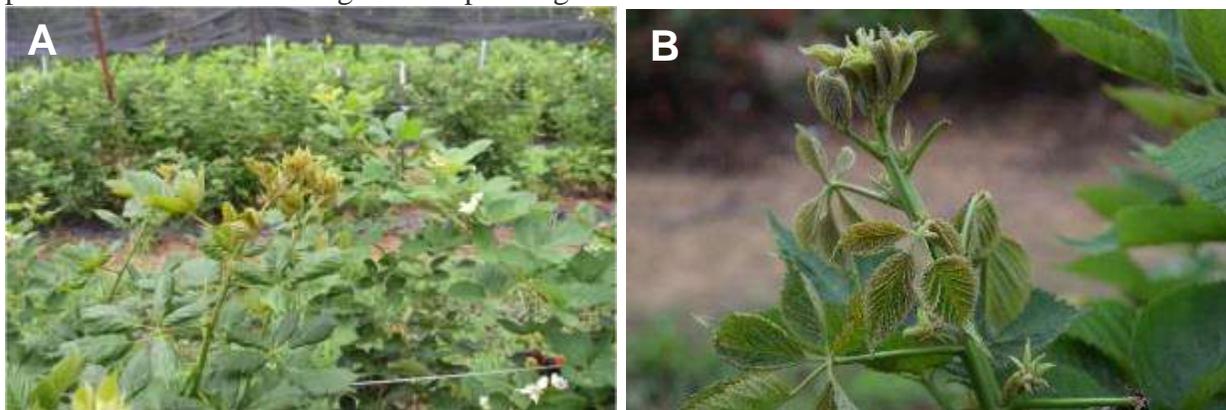


Figure 3. A) Bronzing and cupping of terminal leaves and B) leaf death on primocane blackberries in Arkansas.

Monitoring: Weekly from mid-May to October, growers should inspect primocanes in each blackberry planting for the first sign of broad mite damage of terminal leaves. If you see damage, collect 10 leaflets from that cane and adjacent primocanes by picking an expanding leaflet (open) from the second leaf down from that terminal tip (10 leaflet sample) (Fig. 4). Look on underside of these leaflets for presence of amber colored adult broad mites using a 30x-60x jewelers LED hand lens or a stereomicroscope (usually available at your Extension office). We average the number of broad mites per leaflet from these ten leaf counts. The damage threshold appears to be above 5 broad mites per leaflet which is when we see the first leaflet curling and bronzing and eggs and adult males.



Figure 4. Collect leaflet from A) second leaf (arrow) below terminal, collect a sample of 10 leaflets and C) count broad mites on underside each leaflet and average the count per leaflet.

Management: Apply a miticide when you see the first damaged terminals and mites exceed 5 mites per leaflet (damage threshold). Current recommended effective miticides against broad mites that caused > 85% mite mortality include:

- If daily temperature exceeds 90°F, apply either:

- ✓ Agri-Mek SC + non-ionic surfactant (NIS)
(EPA label – page 15: http://www.syngenta-us.com/current-label/agri_mek_sc)
- ✓ Magister® SC miticide – recently labeled against broad mites on canberries in Arkansas, Florida, Georgia, Illinois, Maryland, North Carolina, Pennsylvania, South Carolina, and Virginia (label: <https://www.gowanco.com/products/magister-sc>)
- If daily temperature less than 90°F apply one of these miticide that are also approved for organic production by the Organic Materials Review Institute (OMRI):
 - ✓ MPede 2% or Microthiol Disperss 15 lbs/acre or JMS Stylet Oil 2% or Trilogy 1%
(these miticides could cause phytotoxicity if applied at > 90°F)

In 2016, four treatments were applied to ten plant plots each randomly distributed within six rows (blocks) in a field of primocane-fruited blackberry in Judsonia, AR. Microthiol Disperss (sulfur) was applied on 5 and 20 May whereas one of two predatory mite species, *Neoseiulus swirskii* or *N. cucumeris*, were released 20 May and 7 July with six untreated control plots (Fig. 5). Treatments of sulfur sprays and releases of two predatory mite kept broad mite numbers at lower levels than in untreated control (above 5 mites per leaflet) from 9 through 24 June. By 7 July, it appears that broad mites dispersed from untreated plots to adjacent treated plots so all plot had above 40 broad mites per leaflet and exhibited terminal damage. The experiment ended and grower applied Agri-Mek SC + NIS to all plots which reduced broad mite numbers to near zero by 21 July.

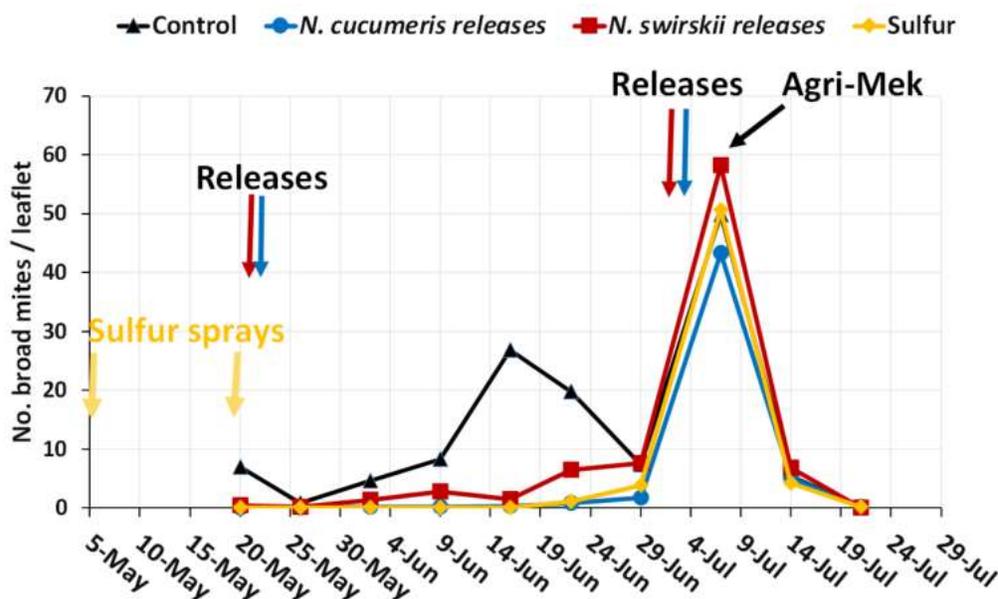


Figure 5. Effects of two applications of Microthiol Disperss (sulfur) on 7 and 20 May and releases of two predatory mites on 20 May and 7 July on broad mite numbers per leaflet in ten plant plots of primocane-fruited blackberry. On 7 July, Agri-Mek SC + NIS was applied to all plots to prevent further damage throughout planting (Judsonia, AR 2016).

Biological control: There is potential for biological control of broad mites by releasing predatory mites. In Arkansas, broad mite numbers on primocane-fruited blackberries were suppressed for a several weeks by a May release of predatory mites (Fig. 5) of one of several

predatory mites: *Neoseiulus andersoni*, *Neoseiulus swirskii*, *Neoseiulus cucumeris* or *Neoseiulus californicus*.

Summary:

- Developed sampling methods for terminal blackberry leaves, leaf litter and soil
- Most broad mites die during winter, but a few survive in leaf litter
- In May, broad mites infest and damage a few plants, but by mid-June spread and cause terminal and lateral damage throughout planting
- Proposed treatment damage threshold is 5 broad mites per leaflet or when you detect the 1st terminal damaged plant in field
- Spring foliar sulfur sprays or a release of predatory mites (*Neoseiulus swirskii*, *N. cucumeris* or *N. californicus*) delayed buildup of broad mites
- A foliar spray of Agri-Mek SC + NIS on 7 July reduced broad mite numbers from peak of 40 mites per leaflet to near zero by 21 July

Research Needs:

- ✓ To determine if winter removal of understory leaf litter will greatly minimize broad mite numbers and delay spring and summer buildup of broad mites.
- ✓ To determine how much of this mite dispersal is by: male mites carrying immature females to adjacent plants; wind; and/or human activities like tip pruning of primocanes, harvesting fruit from floricanes or even air blast spray applications for spotted wing drosophila during June harvest of floricanes.
- ✓ To determine what proportion of broad mites disperse across a blackberry planting by males walking to adjacent plants, wind, or human activity (tip pruning, fruit harvest, spraying, etc.).
- ✓ To continue to evaluate efficacy of miticides with other modes of action against broad mites on blackberries.
- ✓ To determine the best time to apply each effective miticide against broad mites and how to determine if it needs to be re-applied.
- ✓ To identify the most effective predatory mite species for biological control of broad mites on blackberry in several climates, the number of predatory mites to release, timing of each release relative to broad mite numbers per leaflet (best to release before damage threshold), and number of repeated releases in field or high tunnels.
- ✓ To determine if there are effective strains of fungi (like Bt) that control broad mites.

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