Managing *Aceria malherbae* gall mites for control of field bindweed

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Managing *Aceria malherbae* gall mites for control of field bindweed

L.M. Lauriault, D.C. Thompson, J.B. Pierce, G.J. Michels, and W.V. Hamilton[1]

Introduction

Field bindweed (Convolvulus arvensis L.) originated in the Mediterranean area and the Middle East but is now found in temperate areas throughout the world. It was introduced into North America in the early 1700s and is now considered one of the worst weeds on the continent (Boldt and Sobhian, 1993). Field bindweed is a persistent competitor, robbing nutrients and moisture from desirable crops and producing long viny stems that clog harvesting equipment (Boldt and Sobhian, 1993). This species produces seed that can survive in the soil for 30 years or longer (Boldt and Sobhian, 1993; Rosenthal, 1983). Field bindweed also develops an extensive root system, reaching depths of 20 to 30 feet (Boldt and Sobhian, 1993), with lateral roots and rhizomes that help it spread and make it difficult to control chemically or mechanically (Rosenthal, 1983; Boldt and Sobhian, 1993). Mechanical removal or grazing by sheep is temporarily effective, but field bindweed plants recover quickly (Boldt and Sobhian, 1993) because they store carbohydrates in their root systems that can be used for recovery and regrowth (Boydston and Williams, 2004).

During the 1970s researchers went to southern Europe to collect possible agents for biological control. Of 155 organisms found, 10 appeared to have value. The most promising of these for low humidity areas like the semiarid U.S. Southwest is the bindweed gall mite, Aceria malherbae Nuzzaci (Acari: Eriophyidae) (Rosenthal, 1983). The USDA Animal and Plant Health and Inspection Service (APHIS) determined through quarantine and testing that the mite can survive only on field bindweed and hollyhock bindweed (C. althaeoides). Therefore, it was released in 1989 and is now well established at Bushland, Texas (Boldt and Sobhian, 1993; Michels et al., 1998). Since 2000, the mite has been successfully established in several areas throughout New Mexico (Lauriault et al., 2002). Once established, mite populations are persistent. But, as with many types of biological control that perform best in unmanaged land or perennial cropping systems (Boydston and Williams, 2004), the mite is generally slow to spread on its own. Although infestations of unknown origin are widespread, it is unlikely that the mite spreads readily by wind or running water because the plant protects it from such external forces. Additionally, the mite can crawl only about a foot (G.J. Michels, personal communication). So human intervention is necessary to spread the mite throughout large areas of bindweed and to infest new areas.

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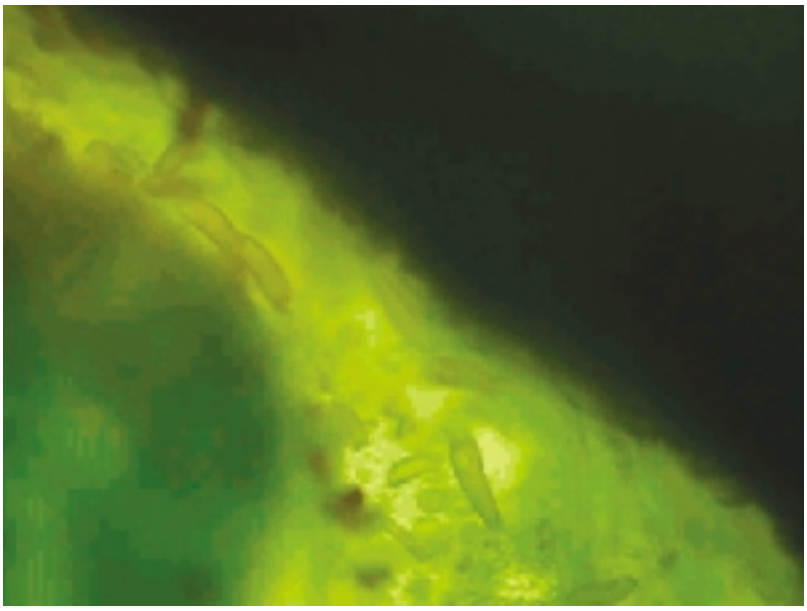

Figure 1. *Aceria malherbae* gall mites in the mid-vein of a field bindweed leaf (400x magnification).

ABOUT THE BINDWEED GALL MITE

Description. Adult bindweed gall mites (Fig. 1) are microscopic (about 0.007 of an inch long), having a yellow-white wormlike, segmented body with two pairs of legs at the front (Boldt and Sobhian, 1993). They can be seen with 40x magnification. Nymphs look like adults, and eggs are round and translucent (Rees et al., 1996). Multiple generations with two nymph stages are produced each year (Rees et al., 1996).

Life cycle. The mite's life cycle is synchronized to the seasonal growth of field bindweed. When bindweed is actively growing, all growth stages of the mite can be found on leaves, especially along the mid-vein. Mites are easier to find in spring, early summer, and fall than in mid- to late summer. Lower mite populations in mid- to late summer might be related to bindweed drought stress.

During winter or other dormant periods, the mite migrates to bindweed's root system, where it overwinters as adults or nymphs (Rees et al., 1996) and feeds on buds just below the soil surface. These buds are precursors to the next growth of stems or lateral roots. The mite emerges with or shortly after dormancy is broken and growth is initiated by the bindweed (Rosenthal, 1983).

Symptoms. Mite feeding can inhibit leaf formation, stem elongation, and flowering by the field bindweed. Infested leaves fold, curl, and fuse along the mid-vein where mites feed (Boldt and Sobhian, 1993). Figure 2 shows classic damage by mite feeding on unstressed field bindweed. Affected leaves thicken and develop a rough surface, having a yellowish to golden brown grainy or mealy appearance. Stem buds that have been damaged will not elongate but will form a mass of galled leaves that act as a nutrient sink (Fig. 3). If infestations are great enough, transfer of carbohydrates to the root system and formation of flower buds can be inhibited (Rosenthal, 1983). Root buds that have been fed on during dormant periods either do not grow at all or produce severely stunted roots or stems (Fig. 4).

CURRENT RECOMMENDATIONS FOR USING THE BINDWEED GALL MITE TO CONTROL FIELD BINDWEED

Getting started. Establishing a convenient source of mites (an insectary) for distribution to other areas is the first step in controlling field bindweed with bindweed gall mites. The best times to establish nurseries or to spread mites from a insectary to another area are spring and fall, when bindweed is actively growing. The insectary site should be a convenient size (20 to 50 feet in diameter) in an easily accessible location. While mites have been observed to establish more easily on white-flowered field bindweed, they can also colonize purple-flowered biotypes (G.J. Michels, personal communication).

Getting infested stems. Stems from infested bindweed plants can be collected

Figure 2. Classic damage by *Aceria malherbae* gall mites to field bindweed when unmanaged. Note the folding of the leaves (a) and the curving of the mid-vein (b).

using a lawnmower with a bagger attachment or by hand. If collecting by hand, select plants with longer stems (>6 inches) because this will make infesting new sites easier. If the material will not be used immediately, it should be placed in a paper or plastic bag and kept cool. Don't seal the bag because the mites could die from lack of oxygen or increased heat or humidity inside the bag.

Keep mite-infested bindweed in a cooler with ice or icepacks until you are ready to distribute it. Insulate the mites from the ice with a layer or two of newspaper. Generally, as long as mite-infested bindweed is kept fresh (moist) and cool, mites can survive 2 to 3 days; although some have survived for up to three months in chopped bindweed refrigerated in a paper bag (G.J. Michels, personal communication). It is best to take the mites straight from the insectary to the infestation area.

Establishing an insectary (or spreading the mites to larger areas). To release the mites, separate infested stems into pieces longer than about six inches. Begin at the center of the area infesting healthy stems from several plants by twisting them together around a single piece of infested stem.

Figure 3. Stages of damage to field bindweed caused by *Aceria malherbae* gall mites. All stems show some level of damage. Longer stems (a) are outgrowing the effects of the mite. Moderately damaged plants (b) have heavily distorted stems near the center, but stems at the perimeter outgrow mite feeding. Severe damage (c) is indicated by a mass of gnarled leaves, in this case only about an inch in diameter. This is a nutrient sink that limits transport of carbohydrates.

Continue this procedure at regular intervals while walking in a spiral outward from the center of the bindweed patch as well as around the perimeter (Fig. 5). If chopped bindweed is used, simply scatter the material over the area. When infested material dries, the mites crawl onto living stems and establish colonies in about 10 days.

After mites are released into a new area, wait two weeks then rotary mow the area. Mowing in a circular pattern from the outside in and discharging the mowed material toward the outside the first time might help spread the mites. Repeat mowing every two weeks, changing the mowing pattern each time. Clippings should be redistributed over the entire area. Grazing also is very effective for spreading mites throughout pastures, although the mechanisms are not well understood.

This procedure should establish a healthy insectary ready to use the following fall or spring. While mowing every two weeks aids in the distribution of the mites, under certain conditions it can reduce stem production by field bindweed. The resulting stems will be much shorter and harder to harvest for establishing another insectary or spreading mites to new areas. Once uniformly infested, the insectary should be managed less intensively to maintain mite populations and to provide sufficient material to transfer the mites. Over time, the original insectary might become too thin or inconvenient to harvest stems or plant parts, and another one might need to be established.

Spreading the mites to larger areas. The same methods can be used to transfer mites to other small areas as were used to establish the insectary. However, it may be more difficult to distribute them by hand and get them to spread rapidly in larger areas, because the release sites will be farther apart. Harvesting stems with a mower or flail chopper and spreading them from a truck bed or with a manure spreader might work well. Another suggestion is to swath, bale green and immediately spread with a hydroseeder or some other blower with a chopper attachment. Spread the infested

Figure 4. The effect of moderate damage by *Aceria malherbae* gall mites to the root system of field bindweed. The plant on the right (uninfested) has a strong lateral root approximately an inch below the soil surface. The plant on the left (moderately damaged) has no such lateral root. Often, when uninfested plants are pulled, the stems snap at or just above the soil surface. When damaged plants are pulled, the root will snap at approximately an inch below the surface.

material before it begins to heat. Also, be careful when spreading chopped bindweed that you spread it only on existing areas of bindweed to prevent establishing new areas of uninfested plants.

MANAGING BINDWEED GALL MITE-INFESTED FIELD BINDWEED

The effectiveness of field bindweed control with the bindweed gall mite is dependent on the property manager's commitment more than any other factor. Some control can be achieved with minimal management, but this is necessary for any control. Growth of unmanaged mite-infested field bindweed will be reduced, but seed production and competition with desirable crops, including turf, will not be eliminated. To eventually remove field bindweed, a long-term intensive management plan should be developed using several techniques.

Enhancing the effect of the mite in controlling field bindweed. Stresses from other sources are effective in enhancing control. In early spring, field bindweed

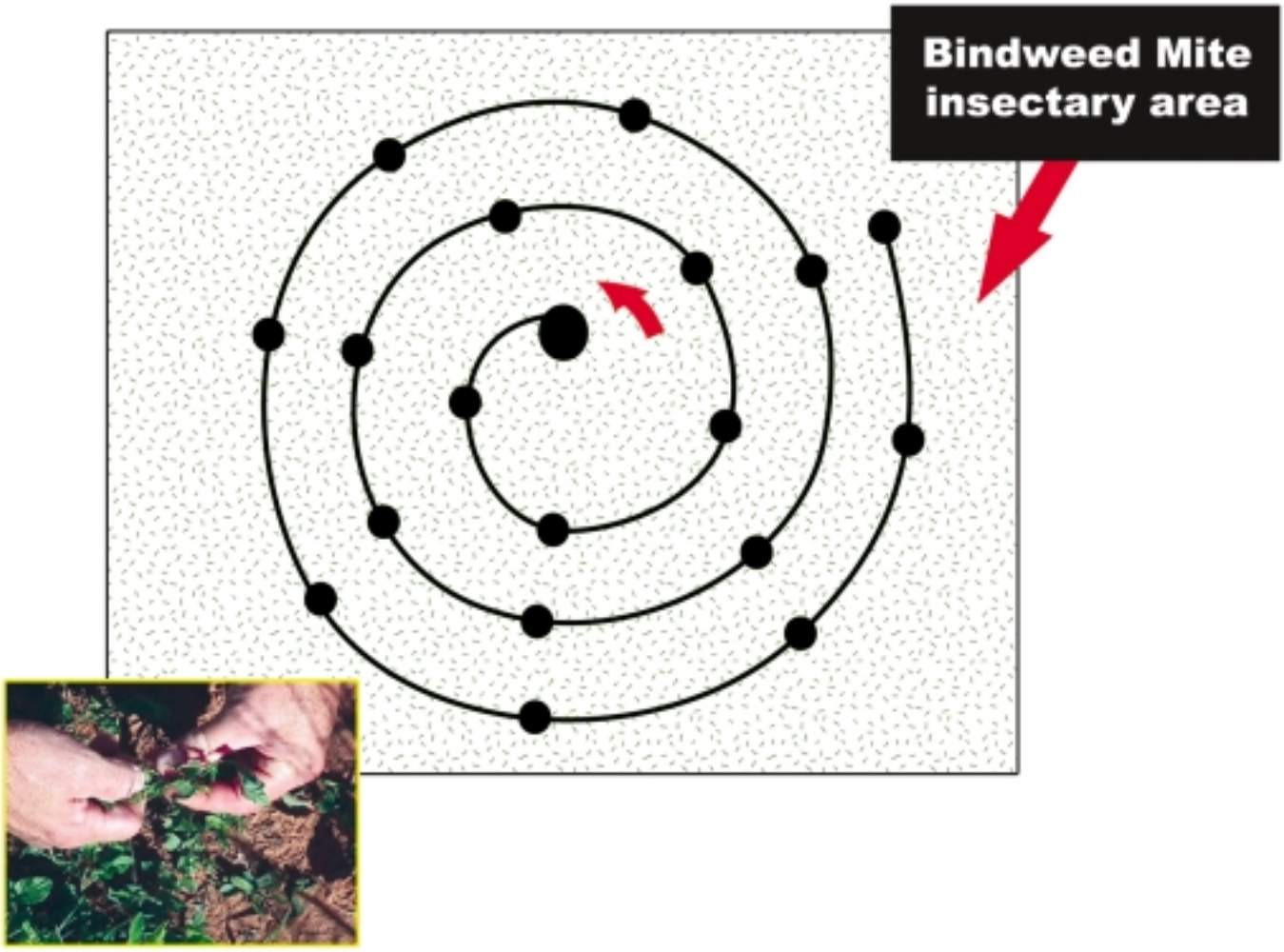

Figure 5. Distribution pattern and stem twisting technique for releasing *Aceria malherbae* gall mites into field bindweed.

appears to outgrow the effects of the mite. Stems seem longer, and leaves are not as damaged. Frequent defoliation (approximately every two weeks) will remove many of the leaves, spreading mites to other plants and encouraging them to concentrate on remaining leaves. For forages harvested as hay (annual or perennial), it is hoped that mites at the bottom of the swath will move onto uninfested plants. As with mowing, the swathing pattern should be changed each harvest if possible to help the mites spread. Grazing also is very effective for defoliation in pastures, although care should be taken if bindweed is flowering or has produced fruit, to avoid spreading seeds to other pastures the animals will be grazing.

Mite feeding on the roots in winter weakens the plant and reduces competition in the spring. During the summer, when bindweed dies back due to drought and heat, mites likely concentrate on the remaining green leaf area, then migrate back to the root system. In the laboratory, sublethal applications of 2, 4-DB and glyphosate used in combination with mites reduced bindweed stem and root growth more than mites or either herbicide alone (Boydston and Williams, 2004). Live mites were present on the bindweed three weeks after the

herbicide applications (Boydston and Williams, 2004). Burning down topgrowth with herbicides might simulate dormant season effects, when bindweed would normally be actively growing and replenishing root carbohydrate reserves for regrowth. After such 'dormant' periods, regrowth consumes much of the carbohydrates stored in the root system, further weakening the plant. The combination of the herbicide, mite infestation, and frequent defoliation weakens perennial plants and can prevent new plants from developing a strong root system.

At New Mexico State University's Agricultural Science Center at Tucumcari, mite damage was observed on regrowth of field bindweed that had been treated with 0.5 lb A.I./A dimethylamine salt of 2,4-D and 0.25 lb A.I./A triclopyr in a mixture; 1.4 lb A.I./A dimethylamine salt of 2,4-D and 0.25 lb A.I./A dimethylene salt of dicamba in a mixture; 10 gal/A of 2.5% glyphosate; and 0.25 lb A.I./A paraquat dichloride, all of which burned down the field bindweed topgrowth. Be sure that all herbicides are used only according to their labels.

Annual grain cropping systems. The greatest concern about using the bindweed gall mite in annual cropping systems is tillage. Mites do survive and reestablish colonies after tillage, though populations might be reduced. These populations can be managed to aggressively spread and control the bindweed in ways similar to those previously described. However, this might be difficult in an intensive row-cropping system because it might interfere with the crop's life cycle or decrease production.

Establish the mites in annual crops after the crop and bindweed have emerged. Allow the bindweed to grow with the crop. When harvesting, use a stalk shredder to chop the bindweed and spread infested stems throughout the field. Again, as with mowing, the combining pattern should be changed each time if possible to help the mites spread.

During fallow, use mowing or grazing to spread the mite and defoliate the bindweed in combination with labeled herbicides to induce plant 'dormancy'. Before plowing fields with established mite populations, use a burndown herbicide. Wait 14 days after the bindweed is 'dormant' to allow the mites to migrate to the root system and colonize there before beginning tillage. When the soil is worked, the mites should move with the below-ground plant part they have colonized and any plant that results should be infested.

CONCLUSION

Field bindweed is a perennial weed that develops and spreads by a massive root system as well as by seed. Even with effective control measures, bindweed will be a problem as long as seed remains viable in the soil (30 years or longer). High seed and root production make chemical control extremely difficult, but a program that combines the bindweed gall mite with management practices that stress bindweed can reduce growth and reproduction of bindweed, greatly reducing its competition with desirable plants.

Should you decide to give the mites a try there is a survey at the end of this publication we would like for you to complete to help us learn more about the adaptation of the mite and the successes (or lack thereof) users experience. You can fill in the form in the publication and mail it to:

Wendy Hamilton
Office of Program Development and Accountability, MSC 3AE
P.O. Box 30003
Las Cruces, New Mexico 88003-8003

There also is an online version of the survey (http://cahe.nmsu.edu/aes/tucumcari).

Please read over the form in this publication and fill in dates and other information as those occur. Then send the form or fill in the online version six months AFTER you release the mites. Thank you.

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Bindweed Gall Mite Use Survey

Website: http://tucumcarisc.nmsu.edu

Please complete this survey six months after applying bindweed gall mites. Your responses will help New Mexico State University researchers more rapidly understand the best management practices necessary to eradicate bindweed and provide YOU with clear/cost effective management instructions. Thank you.

1. When you complete this survey, you are providing valuable information for researchers working on bindweed eradication. Because additional observation information may be needed from you, please provide the contact information below.

   Name: _____

   Company: _____

   Address 1: _____

   Address 2: _____

   City/Town: _____

   State: _____

   Zip: _____

   Phone: _____

   Email Address: _____

2. Please identify below, the location where you received your gall mites.

3. Please indicate as closely as you can, the date you picked up your bindweed gall mites.

4. Did you receive training on mite usage?

   ___ Yes ___ No

5. How did you transport your mites?

6. AFTER seeing the effects of gall mites at the insectary, AFTER reading NMSU Circular, “Managing Gall Mites for Control of Field Bindweed”, and BEFORE releasing your mites, did you notice any signs of gall mite infestation in your patch?

___ Yes ___ No If ‘yes’, go to Question 7. If ‘no’, go to Question 10.

7. If you answered ‘yes’ to Question 6, how UNIFORM were the signs of mite infestation?

____ Across the entire field

____ In different parts of the field

____ In one part of the field

8. How HEAVY was the damage in that patch?

___ Severe

___ Moderate

___ Light

9. How had you managed that patch in the past? Please list any pesticide products used and/or frequency of mowing or grazing.

___ Mowing (please describe) _____

___ Grazing (please describe) _____

___ Spraying (please describe) _____

___ Other (please describe) _____

10. When you released your gall mites, did you:

___ Release your mites into the field you originally planned to release them in?

___ Release your mites into a different field because you found your first field already infested with gall mites?

___ Other, please explain. _____

_____

_____

11. How soon after obtaining your gall mites did you release them?

___ Same Day

___ Next Day

___ Third Day

___ Other, please specify. _____

_____

_____

12. How did you release your mites?

___ Opened the ice chest and let them fly out.

___ Walked around the field and scooped them out.

___ Poured them out in the middle of the field.

___ Other, please specify. _____

_____

_____

13. After six months, do you feel you have a uniform establishment of mites?

___ Yes ___ No ___ Not Sure If 'yes', go to Question 15. If 'no', go to Question 15. If 'not sure', go to Question 14

14. If you answered 'not sure' in Question 13, would you like a New Mexico State University Specialist to visit your site? (Please request this ONLY if you are really 'not sure')

___ Yes ___ No

15. Have you done anything to enhance the effect(s) of the gall mites?

___ Yes ___ No If 'yes', please explain. _____

_____

_____

16. As a result of your experiences with the gall mites, do you plan to use mites as an eradication method for bindweed in other areas?

___ Yes ___ No If 'yes', please explain. _____

_____

_____

17. Would you recommend the use of mites to eradicate bindweed to others?

___ Yes ___ No If 'no', please comment. _____

_____

_____

18. Is there anything else you want to tell NMSU Specialists about your mite application efforts?

___ Yes ___ No If 'yes', please comment. _____

_____

_____

19. After completion of this survey, would you like to continue to participate in this study?

___ Yes ___ No

After completing this survey please mail it to:
Dr. Wendy V. Hamilton
Program Development and Accountability
New Mexico State University
MSC 3AE
P.O. Box 30003
Las Cruces, NM 88003-8003
E-mail: whamilto@nmsu.edu

To find more resources for your home, family or business, visit the College of Agriculture and Home Economics on the World Wide Web at www.cahe.nmsu.edu.

September 2004 **Las Cruces, NM**
Electronic Distribution January 2004 5C