Managing the Mint Bud Mite on Peppermint in the Midwest

The mint bud mite, Tarsonemus sp., is a highly destructive pest of Midwestern peppermint. Mint bud mite infestations are typically associated with older stands of peppermint and can result in dramatic reductions in the yield of essential oils. Symptoms, which first appear in mid season, consist of shortened terminal internodes, curling of new leaves and a twisting or puckering of apical buds. This collection of symptoms is commonly referred to as "squirrelly mint". However, symptoms are not always readily apparent and mint that looks healthy and productive can have reduced oil yields of 60-80%. Spearmint is less severely damaged but older stands can also sustain high mint bud mite populations and exhibit oil loss.

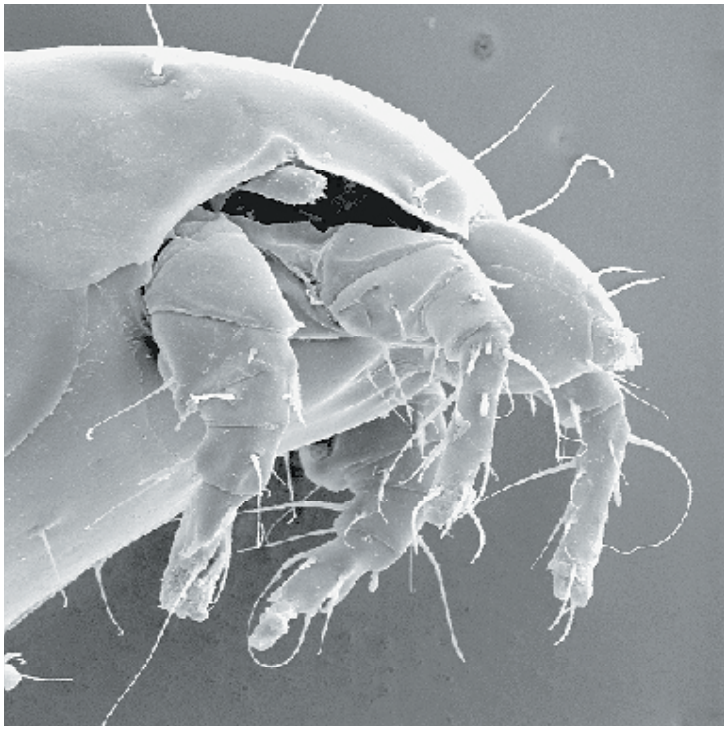
Over the past ten years researchers at the Universities of Purdue and Wisconsin have attempted to determine effective management techniques for the control of the mint bud mite. This guide attempts to summarize those research efforts; providing growers with a background in mint bud mite biology as well as offering advice on proper scouting and treatment options. The contents of this publication are aimed primarily at peppermint production but also apply to spearmint except where mentioned directly.

History of the Mint Bud Mite

To understand the history of the mint bud mite it is important to begin with the phenomenon known as squirrelly mint. Squirrelly mint is a disorder found primarily in mature peppermint fields and, when severe, results in stunted plant growth and dramatic reductions in yield. While oral histories suggest that squirrelly mint has been a problem throughout the Midwest since the early 1900's, until recently researchers were uncertain of its cause.

A potential explanation was first articulated in 1995 when Dr. Ralph Green, emeritus professor at Purdue University, discovered an unknown species of mite present in the buds of severely squirrelly peppermint. Research efforts the following year established this new species of mite (now known as the mint bud mite) as the cause of squirrelly mint.

Researchers at the University of Purdue recognized the mint bud mite as a member of the mite family Tarsonemidae. Tarsonemid (tar-son-nem-id) mites feed on a wide variety of crop plants and have long been known to inject toxins during feeding. While the exact mechanism of damage is not well understood it is thought that these toxins are responsible for the deformities and yield loss characteristic of squirrelly mint.



Description of the Mint Bud Mite

The bud mite undergoes four distinct life stages during development; egg, larva, pupa and adult.

Eggs

Eggs are clear to milky-white in color, oblong in shape and relatively large, about 75% the size of the adult female. Because of their large size, eggs are sometimes confused with immature mites but can be distinguished by the smooth appearance of the outer shell and absence of legs. Mites remain in the egg stage for about half of their development time, and transition from clear to milky-white as the larva completes development.

Larvae

Six legged larvae are the mobile stage of the immature mite. The larval phase is the shortest lived of the developmental life stages, often lasting only 24 hours under favorable conditions. While some feeding takes place during this time, it is suspected that the larval stage serves primarily to relocate the mite to a suitable site for pupation.

Pupa

The pupal phase is the resting stage of the immature bud mite during which transformation to the adult occurs. Pupae closely resemble larvae but are immobile and are found in

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leaf depressions either as individuals or in tightly packed groups as bud mite densities increase.

Adult mites

Eight legged adult mites are clear to light yellow in color, gradually darkening to an amber-yellow as the mites age. Males, which are approximately 75% the size of the female, can be easily distinguished by the triangular shape of their bodies as well as the semi-erect position of their rear legs which are used to carry both adult and pupal females during the mating process. Females are larger and more rounded than males and are the most visible during scouting.

Life History

The mint bud mite overwinters underground on mint stolons or on plowed down mint debris in the adult female stage. Adult female mites emerge from the soil in early to mid May (depending on spring temperatures) and begin depositing eggs in terminal buds soon after emergence. Cool temperatures early in the season typically slow development and rapid population increases are not seen until late May or early June. However, the bud mite is extremely responsive to changes in temperature, so a warm spring may result in an earlier and more rapid build-up of mites. During periods of moderate to warm temperatures, 70oF to 85oF, mites can complete a generation is as little as a week, laying an average of one egg per day (Table 1). Field studies have indicated that under optimum conditions the number of bud mites can double in under a week.

Table 1. Mint Bud Mite developmental times and average number of eggs laid per day at varying temperatures

Mean Temperature ^{o}F	Days Needed for Development (egg-adult)	Average number of eggs per female per day
55	No Development	0.01
60	30	0.1
65	13	0.6
70	9	1.0
75	8	1.1
80	7	1.2
85	7	1.2
90	No Development	0.2

Mite populations typically peak from early to mid July (Fig. 1). As the buds begin to bloom mite populations decrease in the terminal bud as new flowers provide poor habitat for the mites. However flower bloom can also force mites into side buds resulting in additional damage.

[FIGURE 1.]

While the majority of mites are eliminated during harvest, post-harvest mite populations can build up after the stubble begins to sprout new buds (Fig.1). This post-harvest build-up contributes to the overwintering generation, and thus next years spring emergence.

Mites overwinter as adult females in plowed-under mint buds as well as on the rootstock itself. It is possible that the mites may also overwinter in soil surrounding the rootstock, however to date no mites have been recovered from soil samples taken from infested fields.

Distribution In Wisconsin

Surveys conducted in 2001 indicated that 80% of Wisconsin peppermint fields surveyed were infested with bud mites, with approximately 50% of the infested fields with moderate to severe levels of infestation. Previous studies had suggested that only peppermint on muck soil suffered from damaging bud mite densities. However, the 2001 study demonstrated that both peppermint and spearmint, on both muck and mineral soils, were susceptible to bud mite damage. However, damage in spearmint is less frequent with only 17% of the spearmint surveyed showing severe to moderate infestations. Since 2001, many severely infested peppermint fields have been removed from production and although the bud mite is still widely distributed in the state, populations are generally lower.

Impacts and Symptoms of Mint Bud Mite Infestation

Bud mite feeding within the terminal buds damages young leaves and can dramatically reduce oil accumulation. While the exact mechanism is not yet understood, mites closely related to the mint bud mite often inject toxins during feeding which can disrupt normal leaf functioning. Oil glands that are normally green and productive in healthy peppermint turn an amber or brown color and appear to “dry up” during bud mite infestations. Preliminary studies have indicated that moderate to severe bud mite infestations can reduce oil yields as much as 50-80%.

Symptoms of severe bud mite infestations include a twisting or puckering of the mint bud, curling of leaf edges and a shorting of the internodes. However, only heavy infestations of bud mites (25+ mites/ bud) produce obvious damage and yield reductions can often occur without any notable symptoms. Once symptoms become apparent, mite populations are extremely difficult to control with currently available miticides and early detection of mite infestation levels through careful scouting is an essential component of management.

Scouting

Scouting should begin during early to mid May, however warm temperatures may result in an early build up of mites and spring temperatures should be taken into consideration when determining when to begin scouting. Samples should ideally be taken at 7 to 10 day intervals after crop emergence but if frequent scouting is not possible, sampling efforts should be focused in late May, as spray applications are often needed by early June. Post treatment scouting may also be necessary as many growers report that harvesting before the mites rebound to damaging levels has been effective in reducing yield loss. Damaging mite densities are most common in fields that are three or more years old (Fig 2.), and scouting should be focused on older fields. However if rootstock from infested fields is used to establish new plantings, mite densities can build up to damaging levels as early as the first year of production.

How to Scout

Fields should be walked in a "W" or "Z" pattern and terminal (uppermost) buds collected at appropriate intervals to achieve a uniform sampling of the field. Approximately 15 buds should be collected in small fields (less than 10 acres), 25 buds for medium size fields (10-30 acres) and 30-35 buds from large fields (30+ acres). Fields larger than 50 acres may need to be subdivided into smaller units for sampling purposes.

Bud mites are often found in "hot spots" in the field. If scouting reveals a limited number of dense infestation patches, then early spot treatments with miticides may be effective in controlling populations for that year. However, hotspots typically expand to more widespread infestation the following year or later in the same season and whole field treatments are usually required when a field has been infested for two or more years.

Once sample buds have been collected, the use of a hand lens (12x - 20x magnification) or microscope is needed to determine infestation levels. Terminal buds should be peeled back to reveal the base of the innermost leaves where mites typically feed (Photo 6). Adult mites are amber in color and are relatively fast moving. Immature mites (larvae and pupae) are clear to white in color. Larvae are slow moving, while pupa are immobile and can be found tucked into leave depressions. When determining treatment thresholds count both adults and immatures collectively, but do not include the number of eggs.

Treatment Thresholds

Treatment should occur when mite densities reach an average of 1-3 mites per bud when determined by hand-lens counts, or 3-10 mites per bud when using more efficient microscope counts. Hand lens counts detect only about a quarter of the mites detected in microscope counts, but both thresholds are equally effective for treatment purposes. Counts should be made under bright light or in direct sunlight.

Treatment thresholds for both hand lens counts and microscope counts have been developed as guide lines for when a miticide treatment is needed (Table 2). These thresholds have been developed for peppermint and while specific thresholds for spearmint have not been determined, they would most likely be considerably higher than densities listed here.

Table 2. Treatment thresholds for mint bud mite infestations based on both microscope and hand lens counts in peppermint

Average number of mites per bud when using 16x hand lens	Average number of mites per bud using microscopic dissection	Potential Damage	Treatment Recommendation
<1	0-4	Low	Do not treat
1-3	5-10	Moderate	Treat, and consider removing field from production after harvest
3-5	11-25	Heavy	Treat, and remove field from production after harvest
>5	>25	Severe	Treat, and remove field from production after harvest

Timing Miticide Applications

Scouting thresholds serve as indicators of treatment needs. When populations exceed thresholds, miticides should be applied immediately prior to the rapid population increase that typically occurs in late May to early June (Figure 1). Treatments applied too early loose effectiveness and do not prevent late season increase, while treatments applied after the rapid increase is underway only offer temporarily suppressive effects. Studies have shown that effectively timed sprays can double oil yields as compared to poorly timed applications.

Control Options

Chemical controls

Comite®/Omite®.

Currently propargite under the brand names Comite®/Omite® is the only registered compound for the control of the mint bud mite in Wisconsin. Comite® is a moderately effective miticide when applied in accordance with established treatment thresholds. However, late season applications of Comite® serve only to temporarily suppress bud mite infestations and in some studies late season applications have been unable to reduce mite densities at all. The other key consideration when applying Comite® is the need for high spray volumes (GPA) and

thorough spray coverage. Studies have shown that increasing the gallons of water per acre from 30 GPA to 60 GPA can double the efficacy of Comite®. It is highly recommended that 50-60 gallons of water per acre be used when applying Comite®. For best control apply 2.5 to 3.0 pints of Comite® per acre (2.05-2.46 lbs ai/ A) in two applications, 7-10 days apart. Applications of Comite® under 2 pints per acre are not recommended.

Kelthane®

Kelthane MF® (dicofol) is a highly effective miticide used on mint in Indiana and Michigan. However, Kelthane® contains trace amounts of DDT and as a result cannot be used in Wisconsin. Control of the mint bud mite can be achieved by one application of Kelthane® at 2.5 pints per acre (1.25 lbs ai/A) followed by one application of 2-3 pints of Comite® 10 to 20 days later.

Cultural Controls

Rotation

While research regarding rotation as a means to control the mint bud mite is limited, observational data strongly suggests that bud mite infestations occur considerably less often in first and second year mint (Fig. 2). Frequent rotation, using uninfested rootstock dug from first year fields, greatly reduces the need to spray for bud mites during the first three years of production. If a field does need to be treated then it is recommended that the field be removed from mint production at the end of the season and rotated into other crops for two to three years before reintroducing mint.

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