TEXAS MASTER GARDENER
TEXAS A&M AGRILIFE EXTENSION
Bastrop County

What's Growing On?

BASTROP COUNTY MASTER GARDENER ASSOCIATION

January 2025

Cabbage Looper

By Wizzie Brown

Cabbage loopers are caterpillars that can be found on multiple crops such as tomatoes, squash, pumpkin, melons, cucumbers, greens, beans, peas, celery, cabbage, lettuce, broccoli, and cauliflower. They tend to have sporadic populations, with heavy infestations one year and light the next.

Loopers have a complete life cycle with four life stages: egg, larva, pupa, adult. Eggs are dome shaped and laid singly or in small clusters on both tops and bottoms of foliage. Eggs are yellow to green in color. Larvae change colors as they get older, beginning a whitish color with hairs and turning greenish with a white stripe down the side of the body and losing hairs as they age. Larvae have three pairs of true legs. These are on the thorax which is directly behind the head- and three pairs of prolegs, which are also known as “false legs”. Prolegs are fleshy protuberances on the abdomen that help the loopers to walk and cause their “inching” movement where they scrunch up the body and then stretch it out to move forward. Mature larvae can reach lengths of 1.25-1.5 inches. Pupae are white, thin and on the underside of foliage or in debris in the soil. Pupal cases are around 0.75 inches, look like a silken mat, and start off green but turn brown. Adults have a wingspan of 1.25 inches and mottled brown and gray in color. The center of the front wing has a light dot and U-shape. Adults are typically active at night.

Damage is caused by the larvae feeding on foliage with their chewing mouthparts. Smaller larval stages feed on the underside of leaves and tend to feed more on tender parts of the plant while larger stages chew large holes in leaves and can bore into heads of cabbage. When looking for cabbage loopers, you may not see the caterpillars, but may instead find their frass which look like small brown pellets.

Management strategies could include row cover before plants are infested, egg removal, insecticidal soap on smaller stages, Bacillus thuringiensis

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variety kurstaki, Spinosad, or neem/ azadirachtin. As with any IPM program, try to conserve beneficials by using pesticides as a last resort.

For more information or help with identification, contact Wizzie Brown, Texas A&M AgriLife Extension Service Program Specialist at ebrown@ag.tamu.edu.

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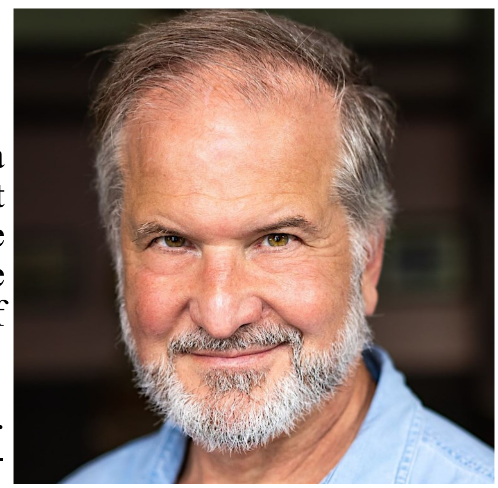
Texas A&M AgriLife Extension

President's Column

By Chris Toth



Dear Bastrop Master Gardeners:

Happy New Year!

It is my privilege to serve as BCMGA president for 2025. I am in a great position because of all the hard work and dedication of last year's president, Terri Pierce, and all my other predecessors on the Executive Committee. We are in a very sound financial state and are brimming with great projects and committed volunteers because of the efforts of those that came before me.

You should all take great pride in being a Bastrop Master Gardener. What we do matters. We make our home county a better place by educating our fellow citizens about sound ecological practices and contributing to wonderful projects that both educate and bring beauty to our county. We help others to appreciate nature's bounty and work in concert with our natural surroundings. That's a great mission!

I am very excited about the enthusiasm you all show in fulfilling this mission. I am particularly excited about the Master Gardener intern class that just graduated. Their eagerness, passion and commit-

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New Website Features

Check out our website, which features project slideshows, a new photo gallery section, and an events calendar to check out upcoming activities. Find news articles and our newsletters. Thanks to Dave Posh for keeping the info timely for us https://txmg.org/bastropcounty/

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ment bode well for our organization's future.

Keep working hard on those volunteer hours. There are numerous opportunities with our chapter to satisfy yearly requirements. We are also working on additional ways to satisfy requirements no matter your weekly schedule. Stay tuned. Also, you may already know that Texas A&M AgriLife has raised the yearly continuing educational requirements from 6 to 10 hours. We will work to provide more educational opportunities to assist you in meeting the higher number of hours.

In addition to taking advantage of our current projects, I encourage all of you to foster your creative and innovative instincts in thinking of new and additional ways we can satisfy our mission. Great ideas are encouraged and appreciated!

I look forward to working with all of you this year.

Chris Toth

Balancing Mycorrhizae and Phosphorus Means Less Fertilizer, Healthier Plants

By Howard Nemerov

[Note: This is the first in a series of articles discussing the interplay between beneficial soil fungi and nutrients, helping you become a better gardener.]

In Nature, too much of a good thing can be harmful. It's cheap and easy to promote the growth of a group of beneficial fungi called mycorrhizae. To optimize the mutualistic relationship between mycorrhizae and nearly everything growing in your garden, get your soil tested regularly. You can save money on fertilizer and encourage Nature to enhance nutrient absorption.

Nearly all garden plants benefit from mycorrhizae

Mycorrhizae are fungi that generally act as symbionts with plant roots, where both organisms benefit from "close and prolonged interaction."[1] Mycorrhizae attach to plant roots and extend out into the soil farther than root systems normally go, creating an enhanced "virtual root system" providing water and nutrients plants normally couldn't access (left). In exchange, plants provide mycorrhizae with carbon (food). It's a mutually beneficial relationship, each providing nutrients that the other couldn't get on its own.

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Volunteering

Master Gardeners volunteer in the community to teach others about horticulture. We follow the research-based recommendations of Texas A&M AgriLife Extension. Members who complete 50 hours of volunteer service in the year after training earn the designation "Texas Master Gardener." We use our title only when engaged in Texas A&M AgriLife Extension activities.

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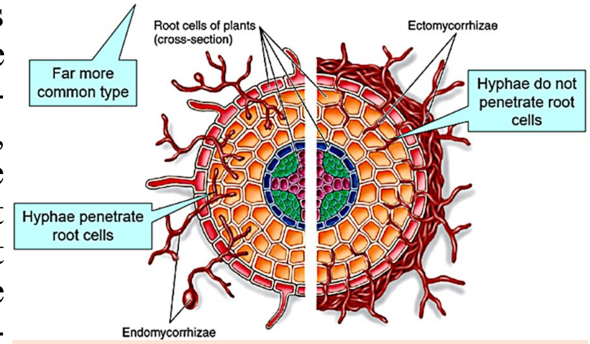

Courtesy of PlantScience4U

For landscape and vegetable plants, there are two main groups of mycorrhizae: **endo**mycorrhizae and **ecto**mycorrhizae (right). **Endo**mycorrhizae—also known as arbuscular mycorrhizae (AM)—usually partner with vegetable crops, annuals, and perennials. All mycorrhizae produce hyphae, threadlike growths making up mycelium that function similarly to plant roots. With endomycorrhizae, these hyphae grow inside plant roots, whereas **ecto**mycorrhizal hyphae grow outside the root."[2] Generally, woody perennials like trees and shrubs partner with **ecto**mycorrhiza. There are exceptions, and some plants like brassicas (e.g. cabbage, kale, cauliflower, mustard greens) don't partner with mycorrhiza at all. Downloading a mycorrhizal reference chart, listing plants by family and genus, helps you buy appropriate products.[3]

During photosynthesis, plants produce sugars (carbon) in their leaves and send it down into their roots for fungi to access as food. Researchers published in the journal *Biothech* noted certain benefits and aspects of mycorrhizae:

- Endomycorrhizae are found in "80% of vascular plant roots.
- Mycorrhizae increase root surface area, allowing plants to uptake water and nutrients more efficiently from a large soil volume.
- Fungicides or herbicides don't seem to affect the mycorrhizal growth.
- Mycorrhizae increase the supply of essential nutrients to their associated plant.
- Mycorrhizae improve phosphorus uptake in plants.
- Mycorrhizae enhance uptake of zinc, copper, nitrogen and iron.

They concluded: "It is widely accepted that there are higher growth rates in plants inoculated with mycorrhizae than in control plants because of the increase in photosynthetic activities."[4]

Growers usually use some sort of potting mix to produce plants for sale. Since these planting mixes vary in ingredients, it can be useful to add mycorrhizae to the mix before planting, a process called ***inoculation***. Even though I use pre-inoculated mixes, I amend with a dry powder containing mycorrhizae spores in a neutral matrix, often clay particles.[5] Mixing this in before planting disperses spores throughout a container, to activate upon contact with living roots as happens naturally.

More soil nutrients, less mycorrhizae

The rest of this article focuses on one peer-reviewed publication because there's so much relevant research explaining how nutrient levels, plants, and mycorrhizae interact. Researchers published in *Plos One* agreed that mycorrhizae alleviate nitrogen and phosphorus deficiencies in soil by creating a large "virtual" root system:

> *The fungal mycelium emanating from the root system reaches far beyond the rhizosphere [plant's root system] and therefore can acquire nutrients from soil volumes to which roots have no access.*[6]

They also found that plants growing in high-nutrient soil have less mycorrhizae.

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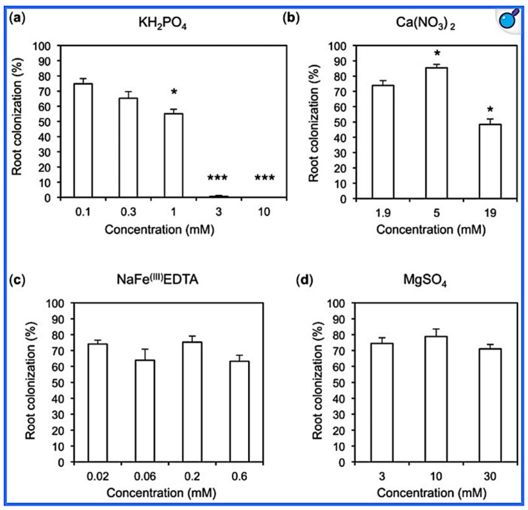
> *[T]he suppression of AM by high P_i levels can be regarded as an energy-saving negative feedback mechanism under conditions under which the plant is optimally supplied with nutrients without the fungal symbiont.*

[Note: P_i is "inorganic oxidized form phosphate," a mineral salt fertilizer commonly used in agriculture and lawncare.]

In plain English, this means plants don't need mycorrhizae when soil contains lots of inorganic phosphorus, as if plants tell mycorrhiza: "I don't need your help gathering phosphorus, so I'm not sharing my nutrients with you."



Researchers also reported that high nitrogen levels reduce mycorrhizal growth, though not as much as phosphorus:

> *Apart from P_i (Figure 1a), the only nutrient salt that significantly affected AM development was $Ca(NO_3)_2$ [calcium nitrate] which caused a modest reduction of colonization.*

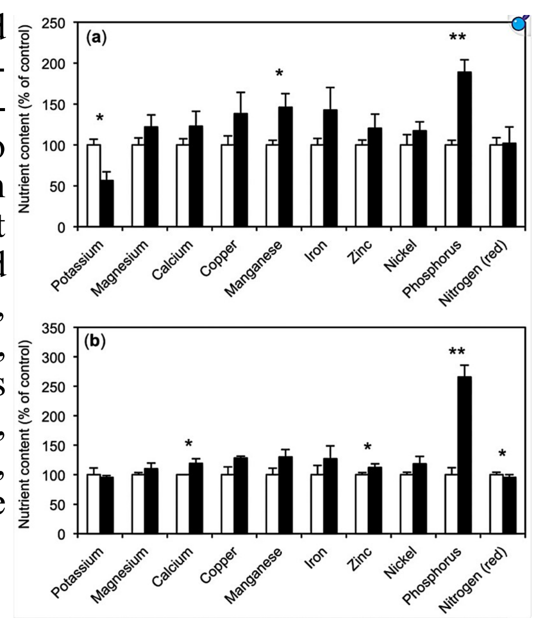
They also found that higher levels of other necessary micronutrients like iron and magnesium didn't have the repressive effect on mycorrhizal growth that nitrogen and phosphorus did (graphs on left).

Conversely, they also found that "the starvation for some macronutrient(s)" stimulates plants to help grow more mycorrhiza, so much so that it "counteracts the inhibitory effect of high Pi."

Do mycorrhizal plants uptake *more* nutrients?

The next question researchers explored was: Do plants inoculated with mycorrhizae have *relatively more* nutrients in their leaves than uninoculated plants? This is a different criterion than whether or not these plants have *enough* nutrients, which we'll discuss later.

Researchers grew petunias in "70% sand with 30% unfertilized soil" under various test conditions and then analyzed nutrient levels in their leaves. Graph (a) compares plants given a "basic nutrient solution" with the white bars showing uninoculated plants (no mycorrhizae) and black bars representing plants inoculated with mycorrhizae. Graph (b) shows petunias given plain water without additional nutrients: white bars again represent non-inoculated plants. Consider these graphs as if researchers were saying, "Control plant leaves (white bars) had *this* much of each nutrient, and we're calling that 100%." Then they say, "The leaves of plants given mycorrhizae had *that* much of each nutrient." In most cases, mycorrhizal plant leaves had up to 50% higher nutrient levels, compared to non-mycorrhizal plants, showing how mycorrhizae produce higher nutrient assimilation.



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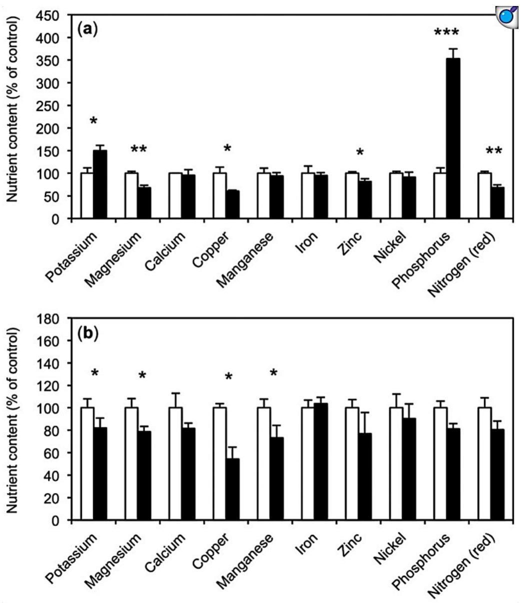
It's interesting to note that mycorrhizae reduced relative potassium levels in fertilized plants (a), but had less impact in unfertilized plants (b). Phosphorus levels were over twice higher in unfertilized plants, indicating mycorrhizae's ability to extract phosphorus from soil that may be nutrient-deficient. Mycorrhizae slightly reduced nitrogen uptake, while all other nutrient levels were higher in inoculated plants and potassium levels were higher than they were in fertilized plants though slightly lower overall. The no-fertilizer test (b) shows how mycorrhizae enhance nutrient uptake in unfertilized soil. The authors concluded: "mycorrhizal plants profited from a qualitative improvement in mineral nutrition."



Next, researchers fertilized a set of petunias *only* with monopotassium phosphate (left). White bars represent plants given water alone; black bars are plants given monopotassium phosphate. Graph (a) represents plants not inoculated with mycorrhizae. When given only monopotassium phosphate, plants had higher phosphorus and potassium levels (both included in the amendment) but other nutrients were lower.

In graph (b), black bars represent plants inoculated with mycorrhizae; white bars represent uninoculated plants. Again, researchers fed plants monopotassium phosphate. Inoculated plant nutrient levels were lower except for iron. Authors found "levels of several nutrients were further reduced in these mycorrhizal plants relative to the respective non-mycorrhizal controls treated with only Pi."

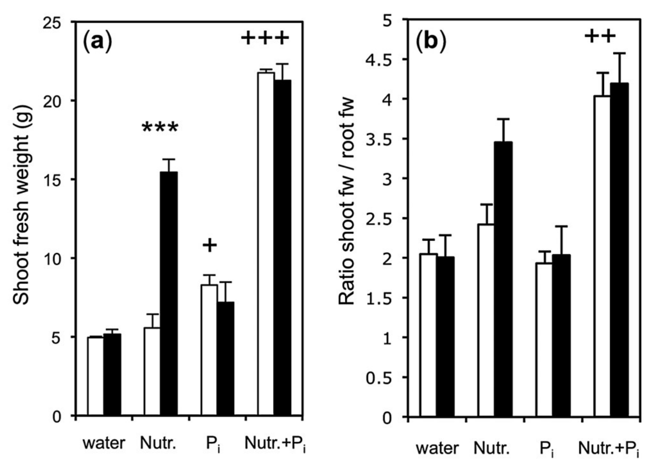
They concluded that mycorrhizae were an overall nutrient loss under high-P conditions:

> *This indicates that the AM fungus did not provide a nutritional benefit, but rather acted like a parasite by consuming carbohydrates, and at the same time holding back mineral nutrients.*

Researchers concluded that only fertilized plants "were well supplied with nutrients" compared to unfertilized plants. This is because the graphs above only show relative nutrient levels in leaves, not if that level is enough for healthy growth. Remember that the graphs above only show that plants inoculated with mycorrhizae had *more* nutrients in their leaves than those given no nutrients. They ran the following test to determine which plants had *enough.*

In the graphs on the right, white bars represent uninoculated plants and black bars are mycorrhizal plants. They analyzed shoot weights (a) and shoot-to-root ratio (b). Plants were grown under four conditions:

1. Water only ("water").
2. Nutrient solution ("Nutr.").
3. High-phosphorus solution ("P_i").
4. Nutrient solution plus high-phosphorus solution ("Nutr.+P_i").



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To understand shoot-to-root ratio (S/R), authors said a 3.5–4 ratio "indicates that plants are well supplied with mineral nutrients, whereas a ratio around 2 indicates that plants are starved and allocate relatively large amounts of resources to the root system to compensate nutritional deficits." In other words, larger tops compared to their root system is a sign of healthy growth, up to a certain point.

When given water, mycorrhizal plants had slightly larger shoots and slightly lower shoot-to-root ratio, though all plants were undernourished. Plants given nutrient solution that were also inoculated with mycorrhizae had larger shoots and a healthy ratio of shoots to roots. Plants given phosphorus solution had smaller shoots and the S/R indicated these plants were also undernourished. Plants given both nutrient and phosphorus solution again showed that higher phosphorus reduced overall shoot weight, though still the largest of any sample. These plants were also the best-nourished, with mycorrhizal plants even more so.

Researchers concluded inoculated plants were the healthiest when provided with fertilizer solution with or without additional phosphorus:

> *Shoot growth was significantly induced by AM in fertilized plants, and by high Pi in combination with nutrient solution, indicating that these plants experienced favorable nutrient supply… Similarly, the strong growth effect of mycorrhizal plants with nutrient solution…translated into a pronounced increase of S/R ratio.*

Overall, researchers found that when given a balanced nutrient solution: "mycorrhizal plants contained approximately 6-fold the amount of Pi compared to fertilized plants without AM, and approximately 4- fold the amount of the other nutrients."

Caveats

Researchers performed these tests on Petunias; other species may respond differently but the key message remains: inoculate with mycorrhizae and provide enough nutrients.

Central Texas soils tend to be naturally high in phosphorus, so it's vital to test your soil first.[7] Adding fertilizers with phosphorus to high-P soils will inhibit mycorrhizal development, resulting in poor growth, wasted resources, and increased pollution from fertilizer runoff.[8]

Conclusion

This research underscores the importance of balancing mycorrhizae and nutrient availability. It also shows the importance of regular soil testing to monitor nutrient levels, so you can apply the right nutrients when needed.

Endnotes

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[4] Huey CJ, Gopinath SCB *et al*. "Mycorrhiza: a natural resource assists plant growth under varied soil conditions." *3 Biotech*. 2020 May;10(5):204. Accessed November 22, 2024. https://pmc.ncbi.nlm.nih.gov/articles/PMC7165205/

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[6] Nouri, Eva et al. "Phosphorus and Nitrogen Regulate Arbuscular Mycorrhizal Symbiosis in *Petunia hybrida.*" *Plos One*, April 29, 2015. Accessed January 8, 2024. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3946601/
[7] "The Real Dirt on Austin Area Soils." Texas A&M AgriLife Extension. Accessed January 14, 2025. https://travis-tx.tamu.edu/about-2/horticulture/soils-and-composting-for-austin/the-real-dirt-on-austin-area-soils/
[8] Nemerov, Howard. "The Benefits of Soil Testing." *What's Growing On?* pages 3–6. https://txmg.org/bastropcounty/files/2021/12/12-Dec.pdf

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Native Plants Hardier Than Introduced

Text and Photos by Howard Nemerov

I revised this bed last fall, planting mostly natives with one non-native groundcover (*Sphagneticola trilobata* or Creeping Oxeye). I took these photos after the night of January 11–12, when it reached 28.2°. The natives were green the next day and the non-native froze. On either end is *Conoclinium dissectum* (Gregg's Mistflower). In the middle is *Pavonia lasiopetala* (Rock Rose).

Sphagneticola trilobata: https://tinyurl.com/dw2uvab9

Conoclinium dissectum: https://tinyurl.com/3eat5j3y

[Note that Gregg's Mistflower has been reclassified from *Conoclinium greggii* to *C. dissectum.*]

Pavonia lasiopetala: https://tinyurl.com/3e3hww78