



The Berry Basket

Newsletter for Missouri Small Fruit and Vegetable Growers

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Reviewing the Basics

by *Ben Fuqua*

New and potential growers of highbush blueberries in Missouri need to become acquainted with the "Basics" of blueberry culture *before* starting a planting. Blueberries are unique plants that require rather specific soil conditions for best growth and production. Being aware of these requirements and making appropriate adjustments prior to setting plants in the ground can often save time, money, and many headaches.

1. Marketing Strategies: A marketing plan should be the first step for anyone considering a commercial blueberry planting. A sound, well-planned marketing scheme is often the difference between success and failure of a blueberry operation. Nothing is more frustrating than seeing blueberry bushes loaded with ripe, high quality berries and having no buyers. A good marketing plan incorporates several factors, including: the number of potential customers within a 25-30 mile radius of your planting, the number and acreage of other blueberry growers in the same general area, the type of market preferred (i.e. U-Pick, on-farm markets, farmer's markets), the availability of labor (especially during harvest), facilities (cold storage, weighing and selling areas, parking), advertising outlets, and the location of the market in relation to the consumer. Adding "value-added" goods expands the marketing plan by offering processed blueberry products throughout the year.

2. Site/soil selection: Selecting a good site for blueberry plants is one of the most important decisions a grower has to make. The large capital investment at the time of establishment and the fact

From the Editors

by *Marilyn Odneal*

I hope you are all enjoying this wonderful fall weather with its colorful show. It has been beautiful around Mountain Grove although Gaylord insists it's prettier in Springfield.

The **2002 Missouri Small Fruit Conference** is scheduled for **February 18 - 20** at the Clarion Inn in Springfield. A vegetable session has been added to the conference and the bramble session has been combined with Table Grapes and Minor Crops to make room for it. Please mark your calendars. We hope to see you there!

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that blueberry plants produce fruit for many years makes site selection and site preparation crucial decisions.

An “ideal” site for highbush blueberries will have a well-drained, low pH soil that has a high organic matter content. The site should be exposed to full sunlight, have good air circulation, and have access to water for irrigation. The planting site should also be conveniently located in respect to other buildings or facilities of the blueberry operation.

3. Site preparation: Site preparation should start one to two years before planting, as most sites require some slight modification(s) to prepare the soil for growing blueberries. Perennial weeds, such as Johnsongrass and Bermuda grass should be completely eradicated from the site by chemical and/or mechanical means. Soil samples should be taken to determine the soil pH and other nutrient levels. Soil organic matter content can be increased by incorporating residues from cover crops, such as sudan, millet, rye, or wheat into the proposed plant rows. Forming berms or raised beds for the plant rows will improve drainage around the plants. Sulfur, fertilizers, and other amendments needed to correct pH or nutrient deficiencies in the soil should be done at least 6 months prior to plant establishment.

4. Variety/plant selection: Growers should select blueberry varieties that are adapted to Missouri climates and meet the objectives of their marketing plan. Most growers in Missouri prefer early-season and mid-season varieties that ripen from early June to mid-July. Growers wanting to extend the blueberry season can add a late-maturing variety that produces ripe fruit from mid-July to mid-August.

All plants should be purchased from reputable, certified nurseries. Two-year old potted or bare rooted plants normally have an extensive enough root system to survive being transplanted directly to the field. Buying older, larger plants cannot generally be justified because of the higher costs for plants, transportation, and planting.

One-year rooted cuttings cost less than the older plants, but should not be planted directly in the field. Rooted cuttings need to be grown in pots for an additional year to develop a larger root system

before being planted.

5. Planting: Transplanting the blueberry plants to the field can be done in either fall or spring. The planting hole (or trench) should be large enough to hold approximately one gallon of wet peat moss in addition to the mass of plant roots. Soil around individual plants should be compacted slightly to insure good root to soil contact and eliminate air pockets. Blueberry plants need to be mulched with sawdust or similar materials as soon as possible after planting. An irrigation system must also be installed at or shortly after planting to provide supplemental water as needed.

6. Requirements after establishment: Several other operational procedures must be done each year to maintain healthy, highly productive blueberry plants. Mulches must be replenished every one to two years in order to maintain a 4- to 6-inch depth of mulch around the plants. Irrigation pumps, filters, and lines require regular maintenance and repair in order to supply supplemental water to plants during the growing season. Weed control is a year-round challenge. While mulches help reduce weed problems, chemical and/or mechanical control methods are needed almost every year. Annual pruning of blueberry bushes during late winter/early spring is necessary to sustain healthy, vigorous plants capable of producing high yields of large-sized berries. Blueberry plants will also need fertilizing, via organic or chemical fertilizers, periodically throughout the growing season.

Summary: Highbush blueberry plants have proven to be a profitable and fun crop for Missouri growers. Growers have done an excellent job of producing high yields of quality berries. Growers have also done an outstanding job of selling “Missouri-grown blueberries” to the public as evidenced by the high demand for fresh and processed blueberries. The basic information on growing blueberries in Missouri has evolved over the 25 years of blueberry production within the state. Both Missouri blueberry growers and researchers have contributed to developing these guidelines. Thus, all growers, even the experienced ones, should occasionally review the “basics” for growing blueberries in Missouri.

(A more detailed description of these requirements can be found in *Growing Blueberries in Missouri*, Bulletin #42, available from the SMSU Departments of Agriculture or Fruit Science)

Blues News

by Jay Chism

Change is in the air. The days are getting shorter and fall color is showing on our 16-year-old blueberry patch. And yes, the crabgrass along the edge of my mulch will soon be killed by frost. Yea!!

As blueberry growers, you know about change. Our farms are always changing . . . sometimes larger, sometimes smaller, but always changing. We are constantly learning about new ways to grow our crops and new ways to market our products. We are always changing.

Mindy and I will be changing things in our life as well. We have decided to sell our farm and our interior plant rental business. I have decided to further my education and will be attending the University of Missouri in January of 2002 to pursue my Masters of Science in Horticulture.

My time as Blueberry Council President is rapidly drawing to a close. I have enjoyed getting a chance to talk and share thoughts and ideas with many of you. There are some things, however, I want to bring up before my time runs out.

I want to see you, as growers, lobby your state representative for more funding for blueberry research. I believe that funds should be provided for blueberries from the wine tax that exists now. Research monies should not always go to the same commodity groups without any thought or evaluation. I agree that the grape industry is a viable option for farmers in Missouri, and I think that research that is funded through the wine tax is worthwhile. But growers, like you, who are frontrunners in the industry, should also have the benefit of additional research dollars. We have learned from growers in Northwest Arkansas what high quality wines can be made from blueberries. If research is done on blueberries for wine

production, other valuable information will be obtained for growers who sell fresh market berries. Who knows what information will be obtained for growers who sell fresh market berries. Who knows what benefits could be discovered if more research was done on the blueberry plant as a wine crop. Blueberries may be an option for some growers whose soils may not be suited to grow grapes for wine production. I think any funding for research on blueberries would have a positive effect on our organization and our industry.

Another point I want to mention is the organization of our commodity group. We, as an organization, need to meet together more than one time a year. Someone once said "If you always do things the way you have always done them, then you will always get what you have always gotten." I think it is time for our organization to do more. If we truly want to take advantage of our position of being first in a new industry, we must continue to build the industry. I know what you're thinking . . . we barely are able to get our group together one time a year. I know that the Blueberry Council in the past has tried to get the officers together at different times of the year and has had only limited success. In today's world of e-mail and faxes I think that we should be able to communicate with each other even if we are separated in the far corners of the state. To be something more, we have to meet more often, discuss, dream, plan, set goals, and CHANGE.

With communication in mind, I am asking for volunteers to make blueberry sauce for the Governor's Conference on Agriculture on December 16th. I think we may need as much as 5 gallons of blueberry sauce. Please let me know as soon as possible if you can help. You can reach me at 417-673-3734 or email me at mchism@juno.com. Hopefully by the time you are reading this article I already have all the volunteers I will need to attend this conference, but if I have not contacted you and you would like to join us, please let me know.

Hope to hear from you soon!

Winter Mulch for Strawberries

by *Patrick Byers*

Fall is here, and an important fall job in a strawberry planting is mulching. While commercial strawberry production extends into colder climates, such as the northern US and Canada, the strawberry plant is actually vulnerable to cold injury at relatively warm temperatures. The key to consistent production in cold climates, such as Missouri, is mulching. Research in Ohio and elsewhere has shown that the crowns of non-mulched strawberry plants can suffer damage after winter temperatures below 12°F. Unprotected strawberry plants are also vulnerable to desiccation damage from drying winter winds. The disease black root rot is more severe in nonmulched plantings.

Winter mulch offers several benefits for a strawberry planting. The mulch protects plants from severe cold. Desiccation is a problem, especially after winter temperature fluctuations, and mulch will protect plants from drying out. Mulches will also protect plants from injury caused by soil heaving, which results from freezing/thawing cycles during the winter.

When should the strawberry grower plan to apply mulch? Research from Illinois suggests that a good guide is to apply mulch after three consecutive days with a soil temperature of 40°F. This soil temperature usually occurs after several frosts, and the plants have slowed growth in response to cooler temperatures. Apply mulches before the soil freezes. In Missouri, mulches are usually applied in late November.

Production systems for strawberries in Missouri are undergoing changes that affect mulching. Plants on raised beds, for example, are more vulnerable to cold injury than plants in level plantings. Annual production systems, such as fall planted plasticulture, may utilize less hardy or disease susceptible cultivars. As we will see, mulching practices must adapt to these new systems.

The traditional mulching material for strawberries in Missouri is straw. Straws from wheat, rice, oats,

or Sudan grass work well. Straws coarser than Sudan grass are not recommended. A good straw source will deliver straw that is clean, free from weed seed, and contains a minimum of grain seed. Strawberry growers can produce their own mulch, often cutting the straw before the grain seed is viable. Store straw for mulching in a dry area. Occasionally grain seedlings can become a weed problem the following spring; an application of sethoxydim will give good control.

A traditional level matted row planting will require 2.5-3 tons of straw per acre for a 2-3 inch deep mulch. This equates to about 300 small bales of average weight. Raised bed plantings may require twice this amount for adequate coverage. Smaller plantings may be mulched by hand. Larger plantings often use bale choppers to break up the straw bales and distribute the straw over the bed. Choppers are available for both small bales and large round bales. Plasticulture plantings of cultivars such as Chandler are usually not mulched with straw.

A recent development of great interest to strawberry producers concerns floating row covers. These covers are composed of a plastic such as polypropylene, spun bonded into a fabric that is permeable to light, air, and water. Research and growers' experience demonstrate that these covers are useful for winter protection of strawberry plantings. While floating rowcovers are available in several weights, only the heavier weights are recommended for winter protection. At present a widely available weight recommended for winter strawberry protection is 1.25 oz/yd² (42 g/m²). A variety of fabric widths are available, with common widths ranging from 15 feet to 60 feet. At present this material costs about 4 cents per square foot. With proper care, this heavier fabric should last 3-4 seasons. Floating row covers are widely used to protect annual plasticulture plantings.

Row covers are best applied on still days. Be sure to line up sufficient labor to place the row cover. If possible, use wider widths for more efficient application. The row cover edges must be anchored, as must areas where two covers overlap. A variety of methods are used to anchor the edges. Edges may be anchored with posts, rocks, or tube

sand. The edges may also be covered with soil.

Once the mulch is in place, the job is not done for the winter. Monitor the planting frequently. If straw has blown off areas, replace at once. Watch the edges of row covers, and adjust anchors if needed. Repair any rips or holes as soon as possible.

Cover Crops

by *John Avery*

Now is the time of year to start planning and preparing sites for a new fruit crop planting. Growers often expand into former pastureland and may leave the pasture cover for the row middles. This can be a mistake! Most pastures have Kentucky 31 tall fescue as the primary grass in the mix. Tall fescue is a hardy grass that will stand up to heavy traffic but it is extremely competitive. If your plants do poorly in this situation, the problem is probably competition from tall fescue. I recommend that a new site for a fruit crop be plowed and cover cropped for at least one year to kill out the fescue and other weeds which may be present in pastures. If a new site has been in woods then cover cropping for a year or two will give time for old tree roots to die and start to decay.

There are several reasons for plowing and cover cropping a site before putting in the new fruit crop. The first is to kill the existing vegetation on the site. When planting into mature grasses and particularly tall fescue, new plants can be subject to stresses from the grasses, which will result in slow growth or high mortality losses among the young plants. It is generally better to kill the existing ground cover and reseed between rows after the new plants are in and growing. Even if the intent is to have tall fescue as the between row ground cover it is better to start over with a new seeding. This will give the new fruit plants a good start with a year free from competition.

The second is to reduce weed seeds by encouraging germination when the soil is tilled. By turning and disking the soil a couple of times a year to incorporate the cover crop the weed seed are exposed to conditions which encourage germination. Be careful not to let weeds develop and produce a new seed crop though. This is more

of a problem with summer cover crops than with winter cover crops. Be sure to mow and/or disk in the cover crop with the weeds before their new seed crop matures.

The third reason to plow and cover crop is to incorporate biomass from the cover crop and weeds to increase the organic matter in the soil. Organic matter will increase the nutrient holding ability of the soil as well as its water holding capacity. The tilth of the soil is also increased making it easier to work. The cover crop pulls nutrients from deep in the soil and leaves them in the top layer of soil with the organic matter thus making them available to the new fruit crop.

So, what are some of the crops to consider when developing a plan for cover cropping a new planting site? There are two broad categories of crops to select from, the grasses and the broadleaves. The grasses would include the cereal grains; rye, wheat, oats, etc; and the sorghums and their hybrids. The broadleaf crops would include the clovers, buckwheat, and other crops such as sunflower.

What are the considerations in a choice of a cover crop? You want something that will produce a high biomass, something that is fast growing, and is an annual or biennial, or if perennial will not become a weed itself in your fruit planting. Stay away from plants like white clover or perennial grass because they can become a weed if they are in the row with the fruit plant.

Another thing to consider is that there are two seasons in which to consider cover crops, the fall planting season and the spring season. In the next few paragraphs I will discuss various cover crops to use and their benefits and drawbacks.

Winter cover crops: The cereal grains are a good choice for cover cropping a new site. They have a relatively long window in which they can be planted and are easy to find. In southwest Missouri rye is one of the easiest crops to find because of its use as forage for livestock. But wheat and oats are equally abundant. They are relatively inexpensive unless you go with some of the forage rye cultivars. If you have trouble finding seed of wheat or rye, you can use un-milled feed oats but be warned some of these are spring oats and will winter kill. Spring oats, however, will grow late into the winter

and only severe cold will kill it. The cereal grains should be allowed to grow until early spring and then should be mowed and disked into the soil at the early tiller stage (when the seed heads first appear) of growth. If allowed to mature the seed will germinate during the summer and can be a problem when the fruit crop is planted after the cover crop.

The cereal grains can be planted from September to the end of October and in some years can be planted as late as the middle of November. The main requirement is adequate soil moisture at or close to planting. If soil moisture is lacking due to drought, wait until the fall rains start before planting, the seed loses viability rather quickly once planted and the fall flocks of birds love the grain.

The clovers are also a good selection for a winter cover crop. Most of the clovers are perennial, and thus can be a problem in the new fruit crop if allowed to establish. The clovers are a good cover crop of choice because they fix their own nitrogen in addition to producing a high biomass. One of the best of the clovers for nitrogen fixation is crimson clover. In addition it is one of the few annual clovers, although it will reseed itself if allowed to mature. The one drawback to crimson clover is the northern border for growing it runs through the Ozarks. In a severe winter it will winter kill, but it survived -4 degrees F a few years ago at Mountain Grove. Crimson clover is hard to find at most common farm outlets but they should be able to order a bag or two if wanted.

Red clover is a biennial clover, which is readily available locally. It is a good nitrogen fixer and biomass producer. It generally will not put up seed heads until late spring or early summer of its first year. Although I would recommend a fall planting it can be planted in the spring as a summer cover crop also. But be sure it is disked in before it matures its seed crop.

The sweetclovers are biennial in nature and can be used as a fall or spring cover crop. Our soils are generally too acid for them but where lime has been incorporated for the new crop they will produce good growth and biomass. The seed can be hard to find locally and must be ordered. The clovers in general produce hard seed along with soft seed.

Hard seed can remain in the soil for years before germinating. Thus, do not let the clovers produce a seed crop before disk them into the soil or they can become a weed that will emerge in the fruit crop row for years to come.

Summer cover crops: These should be planted in May after the danger of frost is past. Good forage sorghums or their hybrids are an excellent choice for a cover crop. They can be cut two to four times during the summer and will re-grow from basal buds. This allows for the mowing down of any weeds that have emerged with the cover crop. Do not disk or turn the field until late summer or fall when the last growth is mown down. These forage grasses are relatively inexpensive, have a fast growth rate and will germinate with lower soil moisture than other alternatives. They will pull nutrients from deep in the soil but will give best growth with a nitrogen fertilizer although if planted after a crop of clover none will be needed.

Another good selection is the annual crop, buckwheat. Buckwheat is fast growing and matures seed rapidly. Buckwheat will mature in 40 days from sowing under normal conditions. After the crop is mown down the seed and plant matter should be disk into the soil. A new crop of buckwheat will then germinate and grow. Two or three crops of buckwheat can be grown through the summer. The chief advantage of buckwheat is its' rapid growth. Any weeds that emerge will be mown down and killed before it can produce a seed crop. With the disking of the ground a new set of weeds will emerge and the cycle starts again, thus reducing the number of weeds seeds without allowing production of a new crop of weed seed. For best production of buckwheat, fertilizer should be incorporated with the first sowing but there is no need to fertilize later. Again, if the buckwheat is following a clover crop there is no need to fertilize.

There are several other crops, which can be used as a cover crop for new fruit planting sites. In the legume family there is soybeans, vetch, and subterranean clover. In the grasses there is ryegrass, barley, several different millets, and sudangrass. The characteristics to look for in a cover crop are the production of high biomass and an annual (one-year) or biennial life (two-year)

cycle. Remember that you can plant different crops together such as a legume with a grass. The purpose of cover cropping a new fruit crop site is to kill the present ground cover, to reduce the number of weed seeds, and to increase the organic matter in the soil, which will increase the nutrient and water holding capacity of the soil.

Pesticide Labels Online - Some Second Thoughts

by Paul Andre

In the last issue (Summer 2001) of *The Berry Basket*, Suzi Teghtmeyer did an excellent job of discussing pesticide labels and using the Internet or World Wide Web as a resource for obtaining further information about pesticides and their use. She pointed out one of the more serious issues that pesticide users face – an unreadable label. On the surface it appears that the Internet provides a timely solution for this issue. This may not be so.

The label, the information printed on or attached to the pesticide container, must be reviewed by EPA to ensure it meets label requirements. If approved, it serves several purposes. To the manufacturer, it is a license to sell the product. Pesticide regulators view the label as a way to control the distribution, storage, sale, use, and disposal of the product and container. To the buyer or user, the label is the main source of information on how to use the product correctly, legally, and safely.

As pesticide regulators, we often repeat our mantra, “The label is the law.” This concept is rather simple. You must follow the label. If the crop or site is not on the label, you can’t use it. If it’s on the label, you must use it only as directed. If you don’t follow the label, you can be in violation of both state and federal law.

Having drawn that rather firm line in the sand, the question that may arise is, “Which label?” Even before the Internet explosion, there were potentially several labels available. Product labels change regularly so there may be several versions in the

market place. There may be sample labels created for education or advertising purposes. There may even be similar labels from other manufacturers. So, which label?

The only label by which a pesticide can be legally used is the label that is attached to or comes with the product from the manufacturer. If you use any other label, whether on another container, from your dealer, from the Internet, or from any other source, and it’s different from the original manufacturer’s label, you may be in violation of state and federal pesticide laws. Labels change frequently. The subtlety of these changes can increase the potential for misusing a pesticide.

Some may ask, “How will pesticide regulators know?” There is a Murphy’s Law of pesticide use. It is surprising how many times we do find out about pesticide misuse and illegal pesticide residues. There is also the potential for human injury and environmental damage.

Where does this leave a user with an unreadable label? A product with an unreadable label is considered unusable and must be properly disposed of. This can be very expensive.

The most important solution to this situation is prevention. There are several things that growers and other pesticide users can do to prevent problems with unreadable labels.

- ✓ Buy only the amount of the product you need for the current season or use. The low per unit cost of buying large quantities may seem like a good deal. However, if you factor in the potential costs for spills, disposal, and unused or wasted product, the deal isn’t so good.
- ✓ Keep your storage area neat and organized. This helps prevent containers getting “lost” on the shelf where there is a greater potential to lose or damage labels.
- ✓ Use older products first. This lessens the chance that labels will be damaged.

- ✓ Use care when pouring the chemical and clean the outside of the container. The pesticide product may cause the label to deteriorate more quickly.

There are a large number of web sites that can provide good information about pesticides. Be sure that you understand the source of the information before relying on it. Some sites that might be of interest are:

- ✓ Missouri Department of Agriculture – <http://www.mda.state.mo.us>
- ✓ U.S. EPA – <http://www.epa.gov> or <http://www.epa.gov/pesticides>
- ✓ MU Pesticide Applicator Training – <http://ipm.missouri.edu/pat>

You may also contact the **Missouri Department of Agriculture, Pesticide Program** at 573.751.5504 for further information.

I want to thank Paul for clarifying the regulations concerning pesticide labels. Whereas the pesticide labels online are a good start for research, they can't replace the original label on the container.

—Suzi Tegtmeyer

Blueberries: Nature's Healthy Blue Treat

by Suzi Tegtmeyer

Over the last few years people have awoken to the healthy aspects of blueberries. As a pleasant consequence there are a number of informative websites out there addressing the positive qualities of blueberries and their culture.

Michigan State University Extension - Blueberries

<http://www.msue.msu.edu/msue/iac/agnic/blueberry.html>

This is the Agriculture Network Information Center's go-to website for blueberry information. Under the category "Subject Area" are the subjects Home Gardening, Commercial Production, Plant Pests & Diseases, Publications & Resources, and Food & Nutrition. Clicking on a subject leads to extensive compilations of subject-based extension publications from many states. In addition, under "Miscellaneous" is the Citation Library, a bibliography of blueberry literature. Citations can be search by keyword or selecting the leading letter of subjects and authors. Please note that MSU doesn't supply the articles, but you can try your local library.

Fun Fruit Facts - Blueberries

<http://www.barc.usda.gov/psi/fl/fun-bb.html>

This site is from the USDA Fruit Laboratory in Beltsville, Maryland. Some of the facts included about blueberries:

- are related to azaleas, camelias, heathers, and rhododendrons?
- won't ripen once they are picked!
- 1/2 cup of blueberries has only 42 calories
- have more antioxidants than most other fruits and vegetables.

The site also offers growing tips, recipes and other informative links.

Crop Profiles: Blueberries

<http://pestdata.ncsu.edu/cropprofiles/cplist.cfm?org=crop>

Cultivation practices, pest and disease management, and statistical information are provided about blueberries (in addition to other fruits grown in the United States). Profiles are listed by state under each crop, crops in this case being Blueberries [General], Blueberries (Highbush), and Blueberries (Wild).

Insect Pollination Of Cultivated Crop Plants - Chapter 7: Small Fruits and Brambles - Blueberry

<http://gears.tucson.ars.ag.gov/book/chap7/blue.html>

This detailed treatise describes the botanical structure of *Vaccinium spp.* (family Ericaceae), and the resulting pollinators, pollination needs, and pollination recommendations and practices.

U.S. Standards for Grades of Blueberries - Fresh Market

[Effective March 20, 1995; Reprinted January 1997]

<http://www.ams.usda.gov/standards/frutmrkt.htm> and

U.S. Standards for Grades of Blueberries for Processing

[Effective March 5, 1950; Reprinted - January 1997]

<http://www.ams.usda.gov/standards/frutpro.htm>

The two sites above come from the Agricultural Marketing Service of the USDA. Each describe the standards and qualifications of produce necessary for marketing. These are the standards by which commercial producers and sellers must follow.

North American Blueberry Council

<http://www.blueberry.org/>

This organization consists of members of the highbush blueberry industry in the USA and Canada along with other associated industry members. The website addresses highbush blueberry production through the categories: The Blueberry, Consumers, Tech Zone, Healthy Blueberries, and Blueberry Industry.

U.S.A. Cultivated Blueberry Council

<http://www.blueberry.org/usabc.html>

Recently established, this Council was formed after the North American Blueberry Council submitted a proposal to Agricultural Marketing Service for a national research and promotion program covering domestic and imported cultivated blueberries. The Council's members, mission, and achievements to-date are described on this site and through its links.

Researchers Create Perfume Lure for Female Codling Moth

(This article is reprinted from the *Fruit Growers News*, October, 2001, pp. 35-36.)

Agricultural Research Service (ARS) scientists have discovered that a chemical in pears provides just the right perfume to attract female codling moths to traps. The breakthrough could advance IPM in apple, pear, and walnut orchards worldwide – and will help growers continue providing safe food, according to USDA's ARS.

Codling moths are the most severe and widely distributed pest of apples, pears, and walnuts in the world. The moths, accidentally introduced into the United States from Europe in the 1700's, through their larvae, can destroy up to 95% of an apple crop and 60% of a pear crop.

"Sex attractants called pheromones have been the main tool available to growers for monitoring codling moths in orchards," says ARS entomologist Douglas Light.

Pheromones, which are chemicals given off by female moths to attract males for mating, have allowed scientists and growers to trap and monitor male moths in orchards.

A synthetic version of the codling moth pheromone has been available for 30 years and provides the basis for mating-disruption programs. Growers can disrupt the ability of males to find a mate by flooding the orchard canopy with pheromone. Or they can time insecticide sprays according to the number of moths found in traps baited with pheromone.

Now Light has found a new, potentially more useful tool.

"We've found a natural chemical in a fruit that is as effective as pheromones in attracting moths. But more importantly, this compound not only attracts males, it lures females," Light says. He works in the USDA-ARS Plant Protection Research Unit at the Western Regional Research Center in Albany, Calif.

While pheromone-based programs target male moths, the real goal has always been to reduce the

female's ability to reproduce. Females can lay 50 to 100 eggs, and two or three generations can hatch each growing season. Attracting females directly would allow growers to eliminate the females and their unlaidd eggs and to monitor mating cycles more precisely.

"IPM programs are based on the relationship between the time when male moths appear in pheromone traps and the time eggs begin to hatch," says ARS entomologist Alan Knight. To predict insect development, scientists use a measurement tool called a degree-day model. For codling moths, eggs are believed to hatch after the accumulation of 250 degree days – which ranges from 15 to 30 calendar days – after the males emerge and are detected in sex-pheromone-baited traps.

"There's a lot of potential error in estimating egg hatch based on the number of males trapped," says Knight. "We think that being able to monitor females should be a lot more accurate."

In field tests, Knight verified that the pear derived attractant is more effective than pheromones in monitoring – and potentially predicting – mating and egg laying.

"In the past, growers would use long-lasting insecticides that would cover the range of possible days when moths could lay eggs and larvae could hatch," Knight says. "But as environmental regulations require use of less toxic and shorter-lived pesticides, it becomes important to know exactly when the females mate and begin their egg laying."

Once the larvae hatch, there is only a short time before they crawl to and bore into the developing fruit, where they are safe from external controls.

Although apples and pears generally suffer more from codling moth attacks, Light was looking for a way to protect walnut orchards. He wondered if using one of their preferred foods – pears – would lure the insects away from walnuts.

Light worked with a team of ARS chemists at the Albany laboratory to obtain 37 combinations of the chemicals that make up pear odors and flavors. Improvements in chemical detection methods over the last two decades allowed the scientist to isolate and identify the many components that make up a

wide range of fruit and nut odors and flavors.

One of the mixtures showed extraordinary promise as a codling moth attractant. They discovered that the key attractant was a chemical known as the pear ester, or ethyl (2E, 4Z)-2,4-decadienoate.

To pursue the commercial potential of his discovery, Light established a cooperative research and development agreement with Trécé, Inc., of Salinas, Calif. Clive Hendrick, vice president of research and development at Trécé, used synthetic chemistry techniques to confirm that one key chemical in pears attracted the moths.

Pear ester, they found, acts as a kairomone. Unlike a pheromone, which involves only one species, kairomones are chemicals emitted by one species – in this case, pears – that attract and benefit another, such as codling moths. The moths have apparently evolved to detect this odor and use it to locate a preferred food.

ARS and Trécé have applied for a patent on use of the pear ester for codling moth monitoring and control. Trécé also plans to include the attractant in a lure containing insecticides. This attracticide will kill moths that contact it. "This approach will use less than 10% of the amount of insecticide that would normally be used," Hendrick says.

Researchers estimate that 90 – 95% of male codling moths in an orchard must be trapped or prevented from finding a mate to reduce the number of fertile eggs laid to an economically manageable level.

"Right now, there is no effective and economical way to determine how many females are in an orchard," says Light. "Female lures may help growers reduce pesticide use either by disrupting mating or by helping growers time their pesticide use more precisely." For information contact Douglas Light (510) 559-5831 or Alan Knight (509) 454-6566.

Fertilization, Liming and Soil Sampling for Vegetable Crops

by *Gaylord Moore*

Fall vegetable harvest is over and it's time to put away equipment and tools for the winter rest. Most growers welcome the break from the grind of a long growing season, but may be missing one important step to production for next year. How long has it been since you soil tested production fields? Have you been haphazardly fertilizing or liming crops by the guess method? I was amazed several years ago when polling a group of farmers at a commercial vegetable growers meeting by asking how many had tested their soil during the past five years. Less than 5% indicated they had tested for pH and nutrient levels. I would not have been so surprised with a group of home gardeners, but with commercial growers who depend upon production and quality for a living, I guess I was a little surprised.

Inadvertently applying lime and fertilizer can have negative effects on crop production and the pocketbook. Less than ample nutrient levels available for the crop will mean reduced production and quality whereas over fertilization can become quite costly. Supplying the crops nutrient needs based upon soil test recommendations is highly encouraged.

Maintaining mineral soil at a pH 6.0 to 6.8 is recommended for most vegetable crops. Improper pH levels may affect the availability of some nutrients to specific crops. For instance, vegetables grown under acid soil conditions lack vigor and yield poorly. Under severe conditions, visible injury on the foliage can occur as a result of magnesium deficiency and/or manganese toxicity. Soil pH should be adjusted only on the basis of a soil test. If limestone is needed, adjustments in pH may take up to six months after application and incorporation. If pH levels are too high you may need to make changes in the type of fertilizer composition that you are using. For example, ammonium sulfate may be a method to lower pH while supplying needed nitrogen.

Needed soil fertility levels may vary depending

upon the crop you are producing. The value of a soil test will give present nutrient levels plus future fertilizer suggestions based directly on the crop being produced. Be sure to request your soil samples are submitted on commercial soil test forms. Help in interpretation of test results may be available through your Horticulture or Agronomy Specialist. Several soil testing services may be available. University of Missouri Extension provides this service at a reasonable charge and there will be an office near you.

Soil test accuracy is only as good as the sampling procedures. Be sure you get representative samples from fields to be tested. Planting fields or areas that have received different treatments over the past years or large areas where specific crops have been grown may need to be tested separately. Samples may be gathered by a soil auger, soil tube or shovel. Numerous subsamples should be collected from the test area. A uniform subsample from top to bottom up to a depth of 6 or 7 inches should be collected. Place all subsamples in a clean container and mix thoroughly. Remove a pint of soil from the mixed samples for testing. Guide **G9110 "How to Get a Good Soil Sample"** is available through University Extension Centers or on the University of Missouri website <http://outreach.missouri.edu> XPLOR Guide Sheets online.

Now is the time to soil test. Don't put the shovel up yet! You may have a few more holes to dig. If corrective treatments are necessary, especially lime, late fall may be the best time to apply and incorporate.

Anytime I can assist you with soil fertility recommendations, please give me a call or contact me by email at mooreg@missouri.edu.

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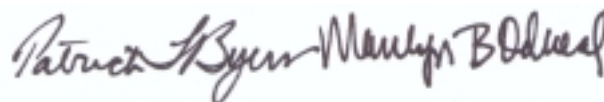
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