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Moving Beyond Methyl Bromide With Biofungicides

Richard Jones

Previously published online in <u>Growing Produce</u> February 2016



These strawberries were planted in November and are shown here in mid-December. The bed on the right had Actinovate applied to the transplants at planting followed by another application a few weeks later. The bed on the left did not have this treatment – the difference in plant size was statistically significant. Photo courtesy of Mark Bolda

There's nothing currently available to growers that provides the same all-around preplant fumigation results methyl bromide did, and perhaps there never will be. But that doesn't mean there aren't effective programs you can implement in your crops, and biofungicides are an interesting new tool in that mix, says Mark Bolda, Farm Advisor in Strawberries and Caneberries with University of California Cooperative Extension.

"Biological fungicides have been part of the picture for some time, but not that many have

been tested in university trials. And certainly not in strawberries," he says. "As we transition from methyl bromide, we cannot be leaving any stone unturned. We have to look at everything."

PrePlant Fumigation Programs

The loss of methyl bromide left growers looking for alternatives to battle tough soil diseases like Verticillium, Macrophomina, and Fusarium. But Bolda says those diseases aren't really the target of his research with biofungicdes. His goal in trialing the technology is not to completely eliminate soil pathogens, but to keep them in check enough to help the plants perform better. "I'm working on plant performance. I am not necessarily focused on these materials as being toxic to fungi — but they do seem to be enhancing plant performance to some extent."

At this point, research has been combining alternative chemical fumigants with other materials, including biofungicides. In the 2013 production season, Bolda tested 14 different biofungicide materials in a series of strawberry trials. He saw clear plant response with a few of the products, including *Bacillus amyloliquefaciens* (Double Nickle, Certis), *Trichoderma virens* (SoilGard, Certis), Bacillus subtilis (Serenade, Bayer), and *Streptomyces lydicus* (Actinovate, Monsanto).

He followed that up in 2014 by testing this smaller list of products in soil that had been treated with anaerobic soil disinfestation, which is flooding with the addition of a carbon source. In 2015, Bolda narrowed testing down to one product which had shown the best results in his '14 trials, an application of *Streptomyces lydicus* (Actinovate), following an application of a chemical fumigant called allyl isothiocyanate (Dominus, Isagro USA).

"We saw good results. It did help us close the gap between what we would achieve with Dominus alone and what we normally see with methyl bromide," Bolda says.

Improve Plant Performance

As an illustration, he says to look at the crop yield you would have expected using methyl bromide.

"With something like Dominus in trials, I was looking at an 80% yield in comparison to what we may have gotten using methyl bromide. As a grower I'm looking to do whatever I can do to close that 20% gap in plant performance better fertility practices, or managing the plant a little bit better at planting. I can also use some of these biological fungicides which may give me between a 5% and 10% boost in yield. That's what I'm looking for," he says.

What growers need to start doing, Bolda says, is ask, "How do I close the gap between what I used to get with methyl bromide and where I am now?"

"If you use these things to try and prevent fungal infection of the plant, that's not the way I would be thinking. I think that's a mistake. If you have a material you can put on the plant and continue to put through the drip tape once a month, and it's going to give you a 5% or 10% gain in plant performance, that's good."

The cost for real gains is a reasonable investment, Bolda says.

"Adding some of these biofungicides is not that expensive. In our trial, an application is about \$20 an acre. You do that once or twice a month. With something like strawberries which is a very high-value crop per acre, it's really affordable and if it gets you that 5% or 10% increase in yield, the gain is significant."

Bolda's work with strawberries is continuing. He also has a trial in blackberries this year and expects to see similar results. The key, Bolda emphasizes, is that growers not expect too much. There's simply not a single solution to replacing what methyl bromide did. But that may not be a bad thing.

"When you use these fumigation alternatives, you're leave behind a different soil ecology than you did fumigating with methyl bromide. Biological fungicides are, by and large, fungi and/or bacteria. I'm using living organisms. It may perform better in a soil that's been treated with an alternative than it would in a soil that's been treated with methyl bromide," Bolda says. "Biofungicides are additive in a strong program of plant culture."

\$130 Million In Funds For Fruit And Vegetable Education And Research

Christina Herrick

Previously published online in <u>Growing Produce</u> May 2016

USDA recently announced that \$130 million in funding is available for research, education, and Extension projects to support sustainable, productive, and economically viable plant and animal production systems, including certified organic production. This funding is available through the Agriculture and Food Research Initiative (AFRI) Foundational Program, authorized by the 2014 Farm Bill and administered by USDA's National Institute of Food and Agriculture (NIFA).

"Investing in agricultural research ensures that our farmers and ranchers have innovative, safe, and sustainable management practices to meet the food needs of the rising world population," Tom Vilsack, USDA secretary, says. "In addition, studies have shown that every dollar invested in agricultural research now returns more than \$20 to our economy."

AFRI is the nation's premier competitive, peerreviewed grants program for fundamental and applied agricultural sciences. In the seven years since AFRI was established in 2008, the program has led to true innovations and groundbreaking discoveries in agriculture to combat childhood obesity, improve and sustain rural economic growth, address water availability issues, increase food production, find new sources of energy, mitigate the impacts of climate variability, and enhance resiliency of our food systems, and ensure food safety.

This round of funding is offered through the <u>AFRI Foundational Program</u>, which funds projects that continue building a foundation of knowledge in fundamental and applied food and agricultural sciences. The Foundational Program addresses six priority areas of the 2014 Farm Bill, with various amounts of funding allocated to each priority area. Funding for 2016 is allocated as follows:

- Plant health and production and plant products, \$33 million;
- Animal health and production and animal products, \$31 million
- Food safety, nutrition and health, \$19 million;
- Bioenergy, natural resources, and environment, \$14 million;
- Agriculture systems and technology, \$11 million;
- Agriculture economics and rural communities, \$17 million.

This request for application (RFA) also includes research topics proposed to be funded equally by eligible national and state commodity boards and NIFA, as authorized by the 2014 Farm Bill. <u>Commodity board</u> priority topics include those proposed for the plant breeding for agricultural production program area, improving the food safety program area, as well as \$3 million for the Critical Agriculture Research and Extension (CARE) program area.

Also, \$2 million in funding is available for the Exploratory Research Program (ERP) to address critical and emerging issues. NIFA is offering the Educational Literacy Initiative through the AFRI program to support education, training and workforce development through the pre- and postdoctoral fellowships program, research and Extension experiences program for undergraduate students, and professional development for secondary school teachers and educational professionals.

Finally, the AFRI Foundational program is piloting a "Distributed Peer Review" process, a modified peer-review approach intended to improve peer review efficiencies for three select program area priorities while maintaining the quality and integrity of the review process. Additional information on the distributed peer review process is available on the <u>NIFA website</u>.

Application submission deadlines vary by program. To view the RFA, visit the NIFA website.

Science funded by AFRI is vital to meeting food, fiber, and fuel demands as the world's population is projected to exceed nine billion by 2050 and natural resources are stressed under a changing climate. In addition, AFRI programs help develop new technologies and a workforce that will advance our nutritional security, our energy self-sufficiency, and the health of Americans. <u>The President's 2017 budget</u> <u>request</u> proposed to fully fund AFRI for \$700 million; this amount is the full funding level authorized by Congress when it established AFRI in the 2008 Farm Bill.

Survey: Beekeepers Lost 44% Of Bees Last Year

Christina Herrick

Previously published online in <u>Growing Produce</u> May 2016

Beekeepers across the U.S. lost <u>44% of their</u> <u>honeybee colonies</u> during the year spanning April 2015 to April 2016, according to the latest preliminary results of an annual nationwide survey. Rates of both winter loss and summer loss — and total annual losses — worsened compared with last year. This marks the second consecutive survey year that summer loss rates rivaled winter loss rates.

The survey, which asks both commercial and small-scale beekeepers to track the health and survival rates of their honeybee colonies, is conducted each year by the <u>Bee Informed</u> <u>Partnership</u> in collaboration with the Apiary Inspectors of America, with funding from USDA. Survey results for this year and all previous years are <u>publicly available</u> on the Bee Informed website.

"We're now in the second year of high rates of summer loss, which is cause for serious concern," said <u>Dennis vanEngelsdorp</u>, an Assistant Professor of <u>Entomology</u> at the University of Maryland and Project Director for the Bee Informed Partnership. "Some winter losses are normal and expected. But the fact beekeepers are losing bees in the summer, when bees should be at their healthiest, is quite alarming."

Beekeepers who responded to the survey lost a total of 44.1% of their colonies over the course of the year. This marks an increase of 3.5% more than the previous study year (2014-2015), when loss rates were found to be 40.6 %. Winter loss rates increased from 22.3% in the previous

winter to 28.1% this past winter, while summer loss rates increased from 25.3% to 28.1%.

New Herbicide For Tomatoes, Strawberries

Rosemary Gordon

Previously published online in <u>Growing Produce</u> April 2016

Tomato and strawberry growers now have a new herbicide to add to their arsenal. From Helm Agro US, Inc., Helm Sulfentrazone 4F has received federal Section 3 registration. Classified as a Group 14 herbicide, the product is registered for control of more than 100 broadleaf, grass, and sedge species. In addition to tomatoes and strawberries, the list of crops includes soybeans, sunflowers, and tobacco. "In addition to its broad-spectrum activity, Sulfentrazone 4F offers growers many important benefits," noted Jan Stechmann, President of Helm Agro US. "It's highly effective against ALS (acetolactate synthase)-resistant weeds, such as kochia and Russian thistle, plus it can be applied pre-plant or pre-emergence in any tillage system. Furthermore, Helm Sulfentrazone 4F gives growers the flexibility to apply it by ground, air, or through sprinkler irrigation systems." The herbicide contains four pounds of sulfentrazone per gallon of product and comes packaged in 2-by-2.5-gallon cases, with 36 cases per pallet.

Use Common Sense Growing Berries That Are Food-Safe

Charlie O'Dell

Previously published online in <u>Growing Produce</u> March 2016



Berry growers must be watchful to maintain excellent sanitation in and around their berry fields, parking areas, and all facilities associated with their berry enterprises. Federal and state regulations in the interest of public health and safety are more numerous than in the

Charlie O'Dell

past and are updated from time to time. It seems a good idea, or may be required in some states, to post our complying best management practices prominently and work to adhere to all such regulations that pertain to our berry enterprises.

While we growers may feel that food safety is not our favorite berry growing topic, none of us wants to be responsible for a foodborne illness from pathogen-contaminated berries. This is by no means a comprehensive and complete review of all we may need to do, but I want to list some of the common-sense actions needed to help ensure our berries are wholesome, safe, and pathogen-free:

- During the ripening and harvest season, use drip irrigation instead of sprinkler irrigation that throws water from ponds or streams onto developing and ripening berries. However, during bloom and early fruit development, sprinkler irrigation is necessary for frost protection in many areas.
- 2. Most berry crops are hand-harvested except for blueberries that are machine-

harvested by larger growers. Blueberries are tough skinned and firm enough to be tank-water washed, then air-dried, then belt-moved on packing lines, inspected, and graded as they move toward automatic filling of clamshell containers. Soft fruit berry crops include strawberries, blackberries, and most raspberries that are hand-harvested. Clean, dry berries are gently field-picked and placed in their clean, new final retail containers. Pickers' hands must be clean. Portable in-field toilet and hand washing stations are needed to maintain clean picking hands. Sanitation must be practiced and monitored carefully at all times.

- 3. Larger growers, those who pack and ship soft-type berries, must invest in forced-air cooling to be used immediately after harvest to rapidly remove field heat. All berry handlers need to have clean hands, washed after each break. A good idea: Each worker also should have access to hand sanitizing dispensers near their berry handling work stations.
- 4. Pick-your-own growers too, need neat and clean check-in/check-out stations. plus clean, well-kept public toilet facilities that contain hand-washing soap and water dispensers in working order, cleaned daily, and kept in good repair. Clean, new containers only should be offered for sale to customers. (They can recycle them by bringing them for re-use after they wash them at home). It is always a good idea to keep hand sanitizing dispensers handy at your check-in station and invite folks to wash their hands before picking their berries. It is always good to show your concern for their health. You do this by reassuring them you use no pesticides on ripe berries and that they in turn should not pick berries that contain bird droppings, or pick up berries from the ground,

possibly contaminated by fungi or other unwelcome microbes.

- 5. Pick-your-own customers should be forewarned that dogs or other pets are not allowed. Ask them to please not bring them nor leave them in their vehicles. This seems harsh to the public, but is necessary to help ensure food safety. Whatever form of social media you use to announce your berry season opening and update news, all forms of customer-communication must stress this fact. Also, post signs in your entranceway and in the parking fields that read: "No Pets Allowed."
- 6. Finally, we want our customers who will be consuming berries from our farm to know it is always a good idea to wash their berries under running tap water before eating them. We make every effort to produce pathogen-free berries and use only new, clean containers for harvesting them, but it is good to remind them to wash fruit before eating it. Many, perhaps most, pick-your-own berry customers freeze much of their berries for use yearround. Freeze only dry berries, then wash them after thawing from the freezer, so that berries do not adhere to each other in the freezer bag. Berries washed and placed into a freezer bag while wet become a frozen lump. Your customer might wish to remove just a cup of berries from the freezer bag each morning, possible only with dry berries. They will appreciate your advice about this while they are at the check-out stand.

Breeding For The Ideal Fresh Blueberry

Jessica L. Gilbert

Previously published online in <u>Growing Produce</u> March 2016



Almost everybody favors sweet blueberries, but poor texture was the most mentioned downer, according to a University of Florida study.

Breeding blueberries is not easy. Breeders often work closely with growers and are aware of their changing needs. But consumer satisfaction with the end product is influencing new directions in research and development of horticultural crops, encouraging breeder focus on traits such as improved flavor.

With lengthy breeding cycles — up to 20 years from lab to the produce department, though we hope to cut that time considerably — it is critical to test the psychological perceptions that potentially influence consumer blueberry purchases before devoting resources and time to traits that might not have limited effect on marketability. Additionally, this information would be important for development of marketing, advertising, and packaging messages directed toward consumers.

However, consumer desires can be difficult to nail down. Multiple attributes influence a

consumer purchase decision (think color, size, and perceived flavor) but the consumer might not necessarily be rational or consciously aware of the reasoning for this decision. Furthermore, cognitive bias may be introduced by and outright asking the consumer to identify their desires. To avoid this, in two recent online studies we conducted, the consumer was presented with sets of three to four individual descriptive phrases or elements at a time, assaying the impact of a total of 36 specific blueberry sensory and psychological traits. In this manner, we were able to identify the individual traits that most impacted the likelihood of fruit purchases. First, and this was perhaps most predictable, sweet and intense blueberry flavor resulted in the most positive purchase interest. Of those surveyed, 61% were most interested in the aspects of blueberry flavor. The two attributes that scored highest in consumer favorability were the flavor elements, with comments such as "so sweet - no sugar added" and "bold and intense blueberry flavor."

In contrast, five quality traits most detrimental to purchase weren't from poor berry taste, but firmness and texture categories such as seediness or mealiness. Negative comments on texture included "mealy, pasty, and dry," "lots of seeds, a bit of grit," "tough chewy skin," "mushy, melts in your mouth," and "meaty, not juicy."

If that wasn't complicated enough for blueberry breeders, the second most favorable attribute was not, as might be expected, great firmness and texture. The second largest segment of respondents (39%) was most influenced by the perceived health benefits commonly associated with blueberry fruit consumption.

Besides taste and texture, three elements from three separate categories stood out as being among the top five highest attributes desired by consumers. These were represented by such sample responses as: "full of juice," "full of antioxidants," and "berries are dark blue throughout."

Historically, many traits have been selected for blueberry breeding programs with growers in mind, rather than consumers. This has led to a focus on traits such as yield, disease resistance, and climatic adaptation, as the grower is the "customer" for new blueberry varieties. However, we believe fruit quality traits of interest to the consumer are what will continue to fuel production and profitability.

In recent surveys, only 48% of U.S. consumers had bought blueberries in the past 12 months compared with 88% of consumers who had bought the highest selling fruit, bananas. Of the 48% of U.S. consumers who purchased blueberries in the past year, 15% of these consumers were reportedly regular buyers of blueberries, according to Dave Brazelton of Fall Creek Nursery in Oregon.

Converting occasional blueberry purchasers into frequent purchasers would be the quickest way to increase market share. To provide the level of product satisfaction that will result in repeat purchases, it is critical to assess the expectations of blueberry consumers. Likewise, encouraging blueberry purchases by consumers who have not enjoyed fresh blueberries will be important to increase market penetration. This study suggests breeders and growers should devote resources toward selecting for improved blueberry flavor, and marketing strategies to sell blueberry cultivars of superior flavor may be appropriate to meet consumer desires.

More Apps Help Growers Identify Insects And Diseases

Christina Herrick

Previously published online in <u>Growing Produce</u> May 2016



The MyIPM series of apps are available for Android and IOS devices. (Photo Credit: Scott Miller / Clemson University)

Following the <u>release of MyIPM</u>, Clemson University has expanded its smartphone app series with more crops covered.

With <u>two new MyIPM apps</u>, growers now have information on dozens of insects and diseases that attack peaches, blueberries, and strawberries (**MyIPM-SED**) as well as apples, pears, cherries, cranberries, and blueberries (**MyIPM-NED**). A third app (**MyIPM-SEP**) features advanced blueberry pest-control solutions and soon will feature the same for strawberries and peaches.

The three MyIPM apps are available at the <u>Apple Store</u> and <u>Google Play</u>. The NED version covers fruit crops preferentially grown in the Northeastern U.S., the SED and SEP versions cover crops preferentially grown in the Southern U.S.

The apps include tips on identifying and managing crop-threatening diseases with instructions for growers to manage disease resistance and submit pathogen samples for resistance profiling.

Initially tailored for peach and strawberry growers in the Southeast, the MyIPM smartphone app series created by Clemson Plant Pathologists Guido Schnabel and Mengjun Hu with Clemson Computer Scientists Greg Edison and Roy Pargas has been expanded through a collaboration with researchers from Cornell University, the University of Massachusetts, Penn State University, North Carolina State University, and the University of Georgia.

"With the app, growers can reference highresolution images to help diagnose disease or identify pests," Schnabel said. "Audio files with university scientists outline treatment and prevention options. Interactive tables outline effective chemical or organic control options, with research-based efficacy and toxicity profiles on dozens of commercial products. Information on the causal organisms, disease cycles, symptoms, biology, and pesticide-resistance management are also covered."

"It is important that the app is available free to all growers, so they have access to this information regardless of the resources they may have to invest in new technology," Schnabel said.

The MyIPM app is the only app of its kind, said University of Georgia Pathologist Phil Brannen, who collaborated with Schnabel on the project. "Some of things we produce, which are really good resources, are more designed for the web and viewing on a computer screen. With this app and the photos and the identification tools that we have, it's a readily available resource they can pull out of their pocket if they're in the field," Brannen said. "If they do identify a disease or an organism causing a disease, they'll have treatment options at their fingertips immediately." Erika Saalau Rojas, an Extension Plant Pathologist at the University of Massachusetts Cranberry Station, said a mobile-diagnostic tool for growers had not been available in her state before MyIPM.

"What's amazing about this app is that it's very user-friendly," she said. "Having the ability to view high-resolution pictures and being able to tell symptoms and signs, really streamlines the process of diagnostics."

The MyIPM series is maintained at the Southern IPM Center, University of Georgia in Tifton, GA, and the back-end database allows regional experts to update information at any time, making the apps easy to keep up to date with the newest information as science evolves.

Summer 2016 Caneberry Chores

This list was developed by Dr. Gina Fernandez, Small Fruit Specialist at NC State University. Chores and timing may be somewhat different in your area or for your cropping system.

Plant growth and development

- Fruit development for floricanes fruiting types
- Rapid primocane growth
- Flower bud development for primocane fruiting types later in summer
- Floricanes senesce

Pruning and trellising

Floricane-fruiting raspberries:

- May need to adjust primocane numbers if canes are too thick (i.e. remove less vigorous primocanes at their base)
- Train primocanes to the trellis
- Pinch black raspberry primocanes at 2 to 3 ft. to promote lateral growth

Primocane-fruiting raspberries:

• Train primocanes within a trellis to hold canes erect

Erect floricane -fruiting blackberries

- Tip the new primocanes when they are about 6" to 12" below the top wire of the trellis to encourage lateral branching
- Continue tipping at monthly intervals to maintain desired branching and height of canopy (laterals should reach top wire)
- Prune out spent floricanes after they have produced fruit, do not thin out primocanes until mid-to late winter
- Train primocanes to trellis to minimize interference with harvest. Shift trellises or V trellises make this relatively easy

Trailing floricane-fruiting blackberries

- Train new primocanes to middle of trellis, on the ground in a weed-free area, or temporarily to trellis outside of fruiting area (depends on trellis type)
- Cut back side shoots to 18" (after dormancy in cold climates)
- Remove spent floricanes after harvest

Primocane-fruiting blackberries

• Tip canes twice, soft tip once when they reach 1.5 ft and then soft tip the laterals at 1.5 ft.

Weed management

- Mow along side of row to maintain the width of the bed to 3 to 4 ft.
- Weed growth can be very vigorous at the same time as the crop peaks.
- Weed control is best done earlier in the season before harvest commences.
- Mow middles regularly to allow pickers to move through rows easily.

Insect and disease scouting

- Scout and treat for these pests: Insects
 - Spotted winged drosophila

- Raspberry crown and cane borers (canes girdled and wilt)
- Psyllid
- Two-spotted spider mite
- June beetle
- Japanese beetles
- Stink bugs
- Fire ants

Diseases

- Botrytis
- Rusts
- Orange felt (orange cane blotch) (blackberry)
- Sooty blotch (blackberry)
- Orange rust
- Powdery mildew
- Double blossom (blackberry)
- Cane blight (blackberry)
- Powdery mildew

Water management

- Raspberry and blackberry plants need about 1-2 inches of water/week; this amount is especially critical during harvest.
- Give plants a deep irrigation after harvest.

Nutrient management

- Take leaf samples after harvest and send to a clinic for nutrient analysis
- Blackberry growers typically use drip irrigation through the spring and early summer to supply about 50 lb/N acre. Growers should ease off N during harvest, but give plants additional nitrogen (about 10-30 lbs/acre) after harvest. Amounts needed will vary with plant health, crop load and soil conditions. Check with your local Extension agent for recommendations.

Harvest and marketing

• The busiest time of the year for a blackberry or raspberry grower is the harvest season. Each plant needs to be harvested every 2-3 days. For larger plantings, that means fruit is picked from some part of the field every day of the week.

- Pick blackberries when shiny black for shipping. Those that are dull black are fully ripe and suitable for PYO only.
- Pick directly into clamshells with absorbent pads, or for PYO use clean cardboard flats, take-home baskets, or sanitized re-usable containers.
- Keep harvested fruit in shade and move into coolers as soon as possible to lengthen the shelf life of the fruit.
- Use forced-air precoolers for best removal of field heat.
- Store at 32 to 34°F and 95% relative humidity.
- Freeze excess fruit for jam, juice, or wine.
- Keep good records of what cultivars are picked, what fields are picked and when they are picked. Good record keeping will help you predict harvest potential in the future.
- Keep your customers informed with social media.

Small Fruit News Volume 16, No.3

July 2016

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Published is four times a year. Small Fruit News is available on the Southern Region Small Fruit Consortium (SRSFC) web site www.smallfruits.org.

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