



WEEKLY CROP UPDATE

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Vegetable Crops

Vegetable Crop Insect Scouting - David Owens, Extension Entomologist, owensd@udel.edu

Asparagus

Asparagus is emerging from the soil and air temperatures have been favorable for insect activity. Be on the lookout for asparagus beetle. If 5-10% of spears are infested with adults, or 2% of spears with eggs, treatment may be advised. Please refer to the Mid-Atlantic Vegetable Production Recommendations for treatment options if necessary, which can be found here: <http://extension.udel.edu/ag/vegetable-fruit-resources/commercial-vegetable-production-recommendations/>.

Brassicas

Imported Cabbageworm adults are active (see the Guess the Pest answer in this edition from last week's challenge). Begin scouting for worm activity.

Overhead Irrigation of Vegetable Crops - Irrigate to Insure Even Emergence, Understanding Water Use - Gordon Johnson, Extension Vegetable & Fruit Specialist, gcjohn@udel.edu

Irrigation is a critical management tool for producing high yielding and high-quality vegetable crops. Direct seeded vegetables such

as peas, lima beans, sweet corn, spinach, cucumbers, and snap beans require adequate soil moisture and certain soil temperature optimums to germinate and emerge. If soils are dry at planting, irrigation will be required to assure rapid and even emergence. This is particularly critical for processing vegetables where delays in emergence can cause lengthened times to maturity, affecting harvest timing. Irregular emergence in dry soils can also lead to difficulties in processing crop harvest scheduling due to variable maturities in the field.

Sandy loam soils need about a half inch of irrigation to wet the soil down to 6 inches to insure germination until the next rain. Heavier loam soils may need 0.7 inches to 0.9 inches of water to wet the top 6 inches of soil.

In extremely dry soils, such as planting no-till into a burn-down rye cover crop, irrigation water should be applied prior to planting to improve planter performance and seed germination. Fields with heavy cover crop also may require irrigation prior to burndown and planting

Having the irrigation system ready to run when you plant can make the difference between a good stand with maximum yield potential or having a poor or variable stand with lower yield potential.

Scheduling irrigation for different vegetables grown under center pivot, travelling gun, or solid set overhead systems involves knowledge of the soil water holding capacity, the effective rooting depth of the crop (how deep water can

be drawn by the crop), how efficiently water is being delivered (water losses to evaporation before it reaches the crop and how much water is lost to runoff), how much water is being used by the crop (transpiration) and how much water is being lost from the soil and wetted surfaces directly (evaporation). The combination of transpiration and evaporation losses is termed evapotranspiration.

To schedule irrigation, the goal is to replace water lost through evapotranspiration without excessive runoff or excessive loss through percolation out of the root zone. Another factor to consider is the permissible water depletion; how much will you allow the soil to dry down between irrigations. For most crops we set this at 50% of the water holding capacity of the soil. However, for some shallow rooted crops you may want to keep that value lower (only allow for 30% depletion between irrigations). By knowing how much water is being lost and how much is left in the soil, you can determine when to irrigate and how much to irrigate.

Pollenizer Systems and Spacing for Seedless Watermelon Revisited -Gordon Johnson, *Extension Vegetable & Fruit Specialist*; gcjohn@udel.edu

There are four pollinizer systems that have been successful for seedless watermelons. The original research with seedless production showed that for standard size seedless watermelons a 1:3 ratio of pollenizers to seedless maximized yields and field space. A 1:2 ratio did not increase yield. A 1:4 ratio gave similar results often to a 1:3 ratio. However, if there were any pollinizer losses, the reduction in pollen production had a much greater yield effect. For example, a 20% pollinizer loss in a 1:3 ratio results in a final ratio of about 1:3.8; in contrast, a 20% pollinizer loss in a 1:4 ratio results in a final ratio of 1:5 which can be pollen limiting.

Pollenizers can be planted in several configurations:

1. Pollenizers are planted in separate rows between seedless rows

2. Pollenizers are planted every fourth plant in the seedless row at even spacings
3. Evenly spaced seedless plants with the pollinizer placed between every third and fourth seedless plant in-row
4. Every third plant is co-planted with seedless and pollenizer in the tray and then planted in-row

Research has shown that the in-row pollinizer planting method (3) and the co-planted pollenizer method (4) have the highest yield potential per area planted.

One issue with in-row pollenizer planting is the need to have a separate pollinizer planting operation at the same time the seedless is being planted. This has led to problems with mixing up pollenizers and seedless plants by planting crews. One way that this can be avoided is by spraying a white particle film clay product on the pollenizers to "color code" them so that crews can tell them apart from the seedless. Research at UD has shown that this coating has no effect on pollinizer performance as new leaves that are produced are normal green in color.

Another way that this issue has been addressed is to switch to co-planted pollenizers. In this program, every third plant double planted with a seedless and a pollinizer plant. The planting crew then pulls plants in order from the tray and the correct ratio (1:3) of pollinizer to seedless is planted without needing a separate planting operation. This eliminates the need for separate planting trays of pollenizers to keep track of and reduces by $\frac{1}{4}$ the number of trays to be carried in the field.

With seedless spacing, research has shown that with standard seedless types (36-60 count seedless), a 3-foot spacing between plants give the best yield and economy (plants used). Closer spacing had the potential for higher yield but did not justify the higher plant cost while wider spacing (4 ft. between plants or greater) sometimes reduced yield or increased hollow heart.

In mini-watermelons (under 8 lbs), the standard recommendation has been to plant at a 2 ft spacing between plants. However, other

research has shown that yield and size grades were optimized at a 1 ft in-row spacing.

Research on pollenizers for seedless watermelon production in several production regions including Delmarva, Georgia, and Indiana have shown some interesting results. The bottom line is that pollenizer selection can be as important for overall yield, fruit quality, and early crown set as the triploid seedless variety selected.

Research at the University of Delaware and the University of Georgia showed that early flowering differed with pollenizers and seedless varieties and that some combinations were better matched than others.

An interesting point to consider is that currently, no one pollenizer is perfect for achieving high early sets, high later sets, reduced hollow heart, and total over all yields. In addition, some standard seeded and special pollenizers are better suited for in-row use than others.

The following are some points on how to get achieve the best results for seedless watermelon production with pollenizer choice:

- For in-row and co-planted systems, choose only those pollenizers that provide good male flower production but that are not overly competitive. Most special pollenizers work well, but fewer standard seeded types are adapted to these uses (Stargazer, MickyLee, hybrid icebox types). In contrast, the more vigorous seeded types are well suited for separate bed systems (such as Sangria, Estrella).
- Advances have been made with special pollenizer breeding and newer generation pollenizers have better disease packages and more extended flowering. If one pollenizer is being used, consider these new varieties (SP-7 from Syngenta or Wild Card Plus from Sakata as examples).
- Consider using two pollenizers in a field. Choose a good early flowering type for effective early yield and long flowering type for sustained yield. Field surveys have shown good results where this type of combination has been used.
- In fields where diseases are a concern such as second year fields, or those that have had shorter rotations, use only pollenizers with good

disease resistance packages. For example, research in Indiana has shown that some pollenizers are much more susceptible to anthracnose and Fusarium wilt than others.

Sanitation is Important in Transplant Production Houses - Jerry Brust, IPM Vegetable Specialist, University of Maryland; jbrust@umd.edu

By now almost all growers have started transplant production or have hired someone else to grow their transplants. With all of the important things that go into transplant production one of the sanitation factors that is somewhat neglected is weed control. Figure 1 shows the outside edge of a high tunnel production house in February. The grower was getting ready to drop seed in just a few days after they cleaned up the house from the fall growing season. This particular grower had been having intermittent problems with thrips (and consequently tomato spotted wilt virus) and two spotted spider mites in their production house. The chickweed you see on the outside and more on the inside at the base of the high tunnel was harboring a few thrips and a few mites. All the thrips and mite holdovers from the fall were female and would be ready to feed and lay eggs in the next week. The grower was cleaning up the weeds and debris from last fall five days before they were to start their seedling trays. This is not enough time to eliminate the pest problems that were on the overwintering weeds. Three and probably four weeks would have been much better to greatly reduce the mite and thrips populations. Not only can chickweed harbor these two major insect and mite pests, but the weed also can act as a host for tomato spotted wilt virus along with other weeds such as Canada thistle, ragweed, redroot pigweed, nightshade, chicory, yellow sweet and white clovers, phlox and many others. This makes it imperative that growers control their weeds weeks, if not months, before they drop seed for their vegetable or flower transplants. This includes controlling the weeds throughout the production period. Often times growers become very busy this time of season and neglect managing new weed problems as they arise (Fig.

2). I know we are always asking you to control your weeds in your vegetable fields, which is a difficult thing to do, but it is much more manageable to control weeds in a high tunnel or greenhouse over a period of a few months.



Figure 1. Chickweed present inside and outside a high tunnel being prepared for transplant production



Figure 2. Weeds growing alongside transplants

Besides insects and viruses weeds also can harbor fungal and bacterial diseases. One of the worst diseases and one that is becoming much more of a consistent problem in our tomato fields is bacterial spot caused by four species of *Xanthomonas* (Fig. 3). I think part of the reason bacterial spot has become such a problem is that it establishes itself in the field early in the season. This may be due to several factors such as weeds in the field harboring bacterial spot

disease, *Xanthomonas* strains with copper resistance and by transplants being infected. Transplants can become non symptomatic carriers of bacterial spot. Studies have found that a tray with one seedling that is infected can result in several plants in that tray and surrounding trays having *Xanthomonas* spp. bacteria on them but with no infection. It would be impossible to know which plants were carriers and which were not. Bacterial spot is so prolific a disease that one infected seed in 10,000 can start an epidemic in the field. To help reduce any chance of bacterial spot in your transplants, good sanitation practices need to be used in the production area and seeds should be hot-water treated, which will eliminate the bacteria from the surface of the seed and more importantly from within the seed.



Figure 3. Bacterial spot on a tomato leaf

Agronomic Crops

Agronomic Crop Insect Scouting - David Owens, Extension Entomologist;
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For the next 7 weeks, we will be maintaining true armyworm and black cutworm pheromone-baited universal moth bucket traps. Trapping data does not necessarily imply that a field is going to receive a damaging population of either pest. What traps can provide is a general indication of moth activity and, in the case of black cutworm, a good biofix for degree day calculations (see last week's article on degree days here:

<http://extension.udel.edu/weeklycropupdate/?p=12842>). BCW trap catches of about 2 moths per night trigger a degree day biofix, with a target of 300 DD, base 50 for larval scouting. Having

said that, in several locations we have already exceeded this, so it is not possible to determine if our first significant BCW flight occurred this past week or a week earlier.

Complicating pheromone trap interpretation is the trap design itself. Some states use the wire cone traps you may see when we are surveying corn earworm (trapping for CEW will begin at the end of April). Kentucky has been trapping for TAW and BCW using cone traps for many years. In 2008, their traps peaked at 600 and 1700 TAW moths per week and wheat experienced worm outbreaks. Unfortunately, there is no clear pattern or correlation between the cone and bucket traps. That's where your input is helpful, especially if you are growing organic or untraited corn that does not have as much worm protection. If you observe worm activity from either species, let us know. It is also important to keep in mind that both moths go to other grasses, not just small grains and corn and so may not necessarily be present in fields. It will help us learn more about these traps and what they mean.

Trap Location	True Armyworm per night	Black Cutworm per night
Willards, MD	1.1	2.6
Salisbury, MD	0.1	0.3
Laurel, DE	2	3.1
Seaford, DE	1.1	5.3
Bridgeville, DE	1.8	0.4
Harrington, DE	0.3	0
Pearson's Corner, DE	0	0
Kenton, DE	2	0.1
Smyrna, DE	7.1	0.1

Wheat

Cereal leaf beetles are out there, somewhere. We found a single egg at the end of last week, and adult feeding scars in a couple of fields, but as of right now, this one appears to be a non-issue.

The previous week's unusually warm weather has resulted in a large increase in aphid numbers. Bird cherry oat aphids have become abundant in several fields, whereas last week there were none. This aphid overwinters on wild

cherry and migrates to small grain. Thresholds for small grains are about 150 per row foot and parasitoid/predator activity less than 1-2 per 100. Right now, predator activity seems to be delayed, but with the warm weather today, followed by somewhat cooler weather next week we may see predators and parasitoids catch up. If you hit threshold, what does that mean? It means that a spray may pay for itself. Will it pay more than that? With current prices, it might not. Predators and parasitoids might come in and control aphids. And with all the other field preparation and the planting season here, do you have the time?

Alfalfa

Scout your alfalfa now! First and second instars have been observed feeding in fields near Laurel. Count the number of larvae per stem from at least 30 stems in the field. Larvae can be dislodged by beating stems in a white bucket, or looking at stems through a magnifying lens. Thresholds depend on price of hay, number of weevils, height of alfalfa, and application cost. There is a good dynamic threshold for alfalfa weevil that can be found here:

<https://ento.psu.edu/extension/factsheets/alfalfa-weevil>. Insecticide recommendations can be found here: <https://cdn.extension.udel.edu/wp-content/uploads/2012/05/25073121/Insect-Control-in-Alfalfa-2018.pdf>.

Managing Fusarium Head Blight - Alyssa Koehler, Extension Field Crops Pathologist; akoehler@udel.edu

When it comes to controlling Fusarium Head Blight (FHB) and keeping deoxynivalenol (DON) levels low, it is important to have an integrated approach. When thinking about the disease cycle of FHB (Figure 1), the FHB pathogen (*Fusarium graminearum* and other *Fusarium sp.*) is able to grow on crop residues from corn and small grains. In your field rotation plan, try to avoid planting wheat or barley into corn residue; this will help to reduce the amount of initial inoculum in your field. As the pathogen grows on debris, it eventually releases spores that can be rain dispersed or moved through air currents. As the grain is flowering, spores land on the head or

anthers, colonize these tissues, and move into the grain head. Once inside the grain, water and nutrient movement is disrupted which results in the bleached florets we associate with FHB (Figure 2). Shriveled and wilted “tombstone” kernels can reduce yield and result in grain contaminated with mycotoxins. DON, also referred to as vomitoxin, is a health hazard to humans and animals. Wheat heads colonized later in development may not show dramatic symptoms but can have elevated DON.

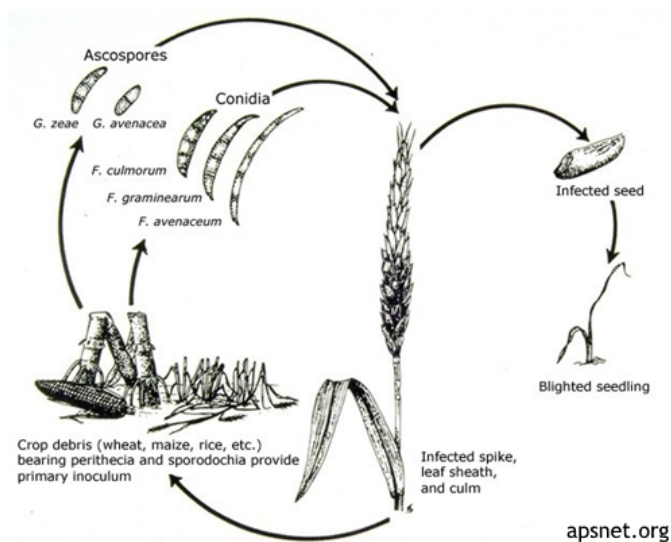


Figure 1. Fusarium Head Blight Disease Cycle. For more information on the FHB disease cycle visit <https://www.apsnet.org/edcenter/disandpath/fungalasco/pdlessons/Pages/Fusarium.aspx>



Figure 2. Wheat head showing bleached florets from Fusarium Head Blight.

In addition to rotation considerations, seed selection is another important piece of FHB management in wheat. There is no complete host resistance against FHB, but you can select wheat varieties with partial resistance. The University of Maryland sets up a misted nursery to compare FHB index and DON levels across local wheat varieties to aid in variety selection decisions https://scabusa.org/pdfs/UMD-UDE_Misted-Nursery_Factsheet-2018.pdf. Unfortunately, barley does not have any resistance to FHB. At this point in the season, rotation order and variety are established, but you can consider these factors as you plan for next season.

As we think about 2019 in-season disease management strategies, a well-timed fungicide

application can help to reduce disease severity and DON levels. It is important to remember that fungicides can help to reduce disease levels and DON (traditionally around 50% reduction on a susceptible variety) but they do not eliminate FHB or DON. To maximize the efficacy of fungicides, it is important to apply at the correct timing. Fungicides for FHB are most effective when applied during flowering in wheat and at head emergence in barley. As wheat approaches heading, the Fusarium Risk Assessment Tool (www.wheatcab.psu.edu) is a forecasting model that uses current and predicted weather forecasts to predict FHB risk. Historically about 70% accurate, this tool can help you assess your risk for developing FHB as your wheat approaches flowering. The pathogen that causes FHB infects through the flower and rainfall 7 to 10 days prior to flower can allow for spore production and increased risk of infection. Optimal wheat fungicide application is at early flowering (10.5.1) to about 5 days after. When wheat heads begin to flower, look for yellow anthers in the middle of the wheat head. When at least 50% of main stems are flowering, you will want to initiate fungicide applications. As the flowering period continues, anthers will emerge from the top and then the bottom of the wheat heads (Figure 3). Anthers can stay attached after flowering but usually become a pale white. Triazole (FRAC group 3) fungicides that are effective on FHB include Caramba (metconazole), Proline (prothioconazole), and Prosaro (prothioconazole + tebuconazole). This year there is also a new mixed mode of action product on the market, Miravis Ace. This product contains propiconazole (DMI, FRAC 3) and pydiflumetofen (SDHI, Group 7). On this label, application can begin at Feekes 10.3 through 10.5.2. Although this product can be applied at the earlier timing, preliminary data has shown that optimal FHB control and lower DON levels are achieved at the 10.5.1 timing or a few days beyond this timing. If you spray too early, heads that have not emerged will not be protected by the fungicide application. Rainfall during flowering can increase levels of FHB and delay the ability to get into fields to apply fungicides.

The expanded application window of Miravis Ace may offer options if periods of extended rainfall are in the forecast, but 10.5.1. to about 5 days after should still be the target if the weather allows. As a reminder, fungicides containing strobilurins (Qol's, FRAC 11) should not be used past heading because these fungicides can result in elevated levels of DON.



Figure 3. From left to right Feekes 10.5, Feekes 10.5.1 (beginning flowering), Feekes 10.5.2 (flowering growth stage), Feekes 10.5.3 (full flower). Image from https://mccracken.ca.uky.edu/files/identifying_wheat_growth_stages_agr224.pdf

Soil Temperature for Corn Planting - Jarrod O. Miller, Extension Agronomist, jarrod@udel.edu

The preferred soil temperature for corn germination is 50°F, which allows the seed to begin root and shoot growth. When soils fall below this temperature, germination may be limited and seeds may rot in the ground. This past week has seen increased air temperatures across Delaware, but soils take longer to warm up.

In the past few days, we have started to see consistent temperatures for corn planting. Since April 1, average daily soil temperatures ranged from 45-58°F in Newark, 46-60°F in Dover, and 48-63°F in Georgetown. This has mostly been a linear increase in temperature, with soil temperatures consistently above 50°F the last few days. Temperatures over the next week have highs in the 70s, with a few nights in the

lower 50s, so our soil temperatures may hold for corn planting.

If you are interested in daily soil temperatures in your area, check the Delaware Environmental Observing System (DEOS) website:

http://www.deos.udel.edu/data/agirrigation_retrieval.php.

Treating Soybeans with New Herbicide

Traits - Mark VanGessel, *Extension Weed Specialist*; mjv@udel.edu

A recent article in an ag newsletter raised the question of what herbicide brands can be sprayed on the new herbicide traits. The article asked about use of glyphosate on soybean varieties that are “glyphosate-resistant” but the soybeans are not designated as “Roundup Ready”. Many brands of glyphosate are labeled specifically for “Roundup Ready” crops. So with the help of industry contacts and Delaware Department of Agriculture we have sorted out the issues. It is important that crops are treated only with the registered herbicide brands, so it may require re-reading labels to be sure they can be applied to new varieties.

Liberty Link crops are stated on the label of most brands of glufosinate, the active ingredient in Liberty.

Roundup Ready crops are stated on most brands of glyphosate.

Roundup Ready 2 Xtend soybeans can be treated with most glyphosate brands because of the “Roundup Ready” designation. But these can only be treated with dicamba formulations approved for “Xtend”-branded crops (Engenia, Fexapan, or Xtend).

Enlist E3 soybeans are resistant to glyphosate, glufosinate, and 2,4-D choline. Enlist One (2,4-D choline alone) and Enlist Duo (2,4-D choline plus glyphosate) can be applied to these soybeans. But Enlist soybeans do not carry the brand name of “Roundup Ready” or “Liberty Link”. If the glyphosate brand says only use on “Roundup Ready” crops then it cannot be applied to Enlist soybeans. These soybeans can only be treated with glyphosate brands that allow application to

“glyphosate-resistant” or “glyphosate-tolerant” crops. Likewise, if the label specifies use on “Liberty-Link” soybeans then it cannot be used. Only glufosinate brands that say they can be applied to “glufosinate-resistant” or “glufosinate-tolerant” crops are allowed.

Enlist corn is resistant to 2,4-D choline, glyphosate and registered postemergence grass herbicides. Currently, Assure II (quizalofop) has a special label for use with Enlist corn.

LLGT27 Soybeans are resistant to glyphosate, glufosinate, and an HPPD herbicide. These soybeans are branded as “Liberty Link” and can be treated with most glufosinate brands. While these soybeans are resistant to glyphosate they are not “Roundup Ready” and must be treated only with glyphosate brands labeled for “glyphosate-resistant” or “glyphosate-tolerant” soybeans. The HPPD herbicide product currently is not approved by the EPA.

Many herbicide companies are changing their labels to allow application to these new soybeans, so more brand options will soon be available. But be sure to read the label of the brand you intend to use to be sure it is labeled for use.

If using crops with herbicide-tolerance traits be sure you keep detailed records of which fields are planted with which traits. Likewise, when switching varieties, you may need to clean out your planter to avoid mixing traits.

Beyond Herbicide Site of Action:
Considering “Effective” Sites of Action - Mark VanGessel, *Extension Weed Specialist*; mjv@udel.edu, Claudio Rubione, *University of Delaware*; and Michael Flessner, *Virginia Tech*

Herbicides and Site of Action

Weeds are the major pest that farmers need to control on an annual basis. Weeds reduce yields through plant competition for light, moisture, and nutrients; they interfere with harvest; their seeds can contaminate grain; and they can harbor other pests.

Many growers have relied on herbicides for controlling weeds, but some biotypes have

evolved resistance to herbicides. Often, when resistance develops to a herbicide, other herbicides with the same group number are also no longer effective. Therefore, resistance limits the options available for control.

Reducing the risk of developing herbicide resistant biotypes requires an integrated approach to weed control. Integrating prevention, mechanical, cultural, and biological as well as chemical control is critical to forestall herbicide resistance. When it comes to herbicides, farmers are hearing about rotating and using multiple herbicide groups.

Understanding the concept of herbicide site of action is key to effectively managing herbicide resistance. Herbicide containers and labels now display a herbicide group number that identifies the site of action. The site of action is the specific biochemical site where the herbicide interferes with plant growth. This is different than herbicide mode of action, which describes how the plant responds (or dies) when treated with a herbicide.

While the message has been to use herbicides with different group numbers, it is important to emphasize that the different herbicide groups must also be effective for the weeds of concern. Using two herbicides with different sites of action, where only one of those herbicides is effective at controlling the weed of concern, is not an effective resistance strategy. Using at least two effective sites of action for weeds greatly reduces the risk of herbicide resistance development. Effective sites of action can and should be diversified through tank mixtures or using premix products. Research has demonstrated two or more effective sites of action is a better herbicide-resistance strategy than using effective sites of action in sequence with one another. Rotating crops can help increase herbicide diversity by increasing herbicide options.

It is important to know which weed species are resistant to which herbicides in your area. This allows an effective management plan to be developed. If resistant biotypes are present, these herbicides are no longer effective and other herbicides are needed for control. Local extension educators are the best source of

information for local herbicide-resistance issues.

It is not practical or economical to use a multiple effective sites of action approach for all species, but this approach needs to be implemented for species in your region with resistance or species prone to developing resistance.

What is an Effective Site of Action?

A herbicide is considered effective when it results in 80% control or better

Example 1. Introduction to Effective Site of Action.

Herbicide	Weed Species		
	Fall panicum	Common ragweed	Palmer amaranth
	----- % Control -----		
Product A (group 15)	90	60	85
Product B (group 5)	60	85	90
Number of effective sites of action	1	1	2

In this example, Product A is a group 15 herbicide and Product B is group 5, two different herbicide sites of action. Fall panicum is controlled by Product A, but not by Product B. On the other hand, common ragweed is not controlled by Product A, but is controlled with Product B. Palmer amaranth is controlled by both Product A and Product B. Based on this herbicide program only Palmer amaranth is being treated with two effective sites of action.

Palmer amaranth is a weed species that is prone to developing resistance and has become one of the most troublesome species in much of the US. A large reason for the difficulty in controlling this species is the loss of effective herbicide options due to resistance. So, it is very important that this weed is treated with at least two effective sites of action, as in this example. Taking it one step further, applying Product A and Product B together in tank mixture is a more effective herbicide-resistance strategy than applying these herbicides at two different times.

Common ragweed is only controlled with Product B (group 5). Common ragweed biotypes resistant to glyphosate (group 9), PPO-inhibiting herbicides (group 14), and ALS-inhibiting herbicides (group 2) have been reported recently and are spreading. So in this situation it is best to treat with an additional effective site of action. Additionally, fields need to be scouted regularly to identify common ragweed biotypes that escape control and could form the basis for a herbicide-resistant population.

Fall panicum is a species that to date has not developed resistant biotypes in the US. The fact that only a group 15 herbicide is used for control is not of great concern at this time.

Example 2. Evaluating Effective Sites of Action for Control of Glyphosate-Resistant Common Ragweed.

Application timing	Herbicide	SOA number	Total SOA	Effective SOA
PRE	Bicep	5 + 15	2	1
POST	atrazine + glyphosate	5 + 9	2	1
Season totals			3	1

In Example 2, glyphosate-resistant common ragweed control is a concern. The field is treated with Bicep (a combination of atrazine (group 5) plus S-metolachlor (group 15)) at planting and treated postemergence with a tank mixture of atrazine (group 5) and glyphosate (group 9). Bicep contains two different herbicide sites of action, but only atrazine controls common ragweed. So there is only one effective site of action used at planting. Likewise, with the postemergence application, only atrazine is providing effective control since common ragweed is resistant to glyphosate. Atrazine is the only herbicide providing effective control with both the at-planting and postemergence applications. Over the course of the season, glyphosate-resistant common ragweed is treated with only one effective herbicide, atrazine.

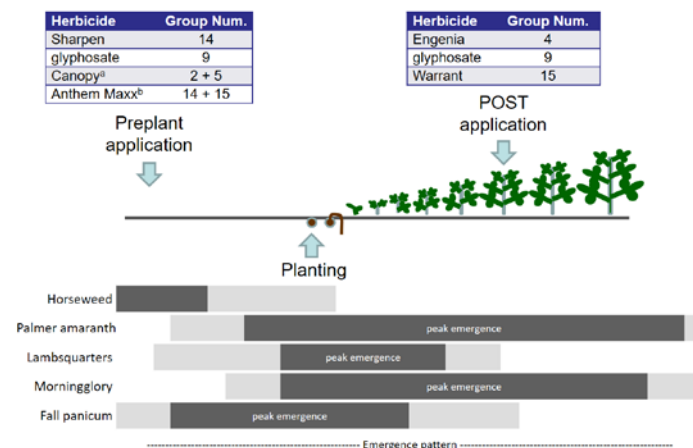
This situation puts a lot of selection pressure from atrazine on the common ragweed population, increasing the risk of biotypes resistant to atrazine surviving and producing seeds. Including dicamba (group 4) in the postemergence application is one option to

reduce selection pressure on this population, since it is an effective site of action. Another option, although less effective, is to rotate to an alternative herbicide with an effective site of action the next season.

Example 3. Example of Implementing Effective Sites of Action for the Entire Season: Considering Multiple Weed Species.

In Example 3, no-till soybeans are planted in a field with a history of glyphosate- and ALS-resistant horseweed, glyphosate- and ALS-resistant Palmer amaranth, common lambsquarters, annual morningglory species, and fall panicum. A total of six different herbicide groups will be applied preplant and during the growing season. Each herbicide is included for at least one of these weeds.

In this example the field is treated with a herbicide application three weeks before planting to control winter annual weeds (including horseweed) and a postemergence herbicide. In order to reduce the number of applications, residual herbicides are included in the preplant application. In order to better manage resistance, application timing needs to be considered in relation to the weed emergence period.



^aCanopy is a prepackaged mixture of metribuzin (group 5) and chlorimuron (group 2).

^bAnthem Maxx is a prepackaged mixture of pyroxasulfone plus fluthiacet. Pyroxasulfone (group 15) provides residual control of susceptible species but provides no postemergence control; fluthiacet (group 14)

provides postemergence control of a few species, but provides no residual control.

Number of effective sites of action (and group number)		
Weeds	Preplant application	Postemergence application
emerged horseweed plants	1 (group 14)	1 (group 4)
emerged Palmer amaranth plants	2 (groups 5, 14)	1 (group 4)
residual control of Palmer amaranth	2 (groups 5, 15)	1 (group 15)

Comments for each species:

Horseweed emerges in the fall and throughout the spring until early-summer; some fields experience populations that emerge after soybean planting. This field has horseweed biotypes resistant to glyphosate (group 9) and ALS-inhibiting herbicides (group 2). Anthem Maxx and metribuzin do not provide control of emerged horseweed plants. Control of emerged weeds with the preplant application is only from Sharpen (group 14). Sharpen and metribuzin (group 5) will control seedlings that germinate in the spring, but seedlings emerging 3-4 weeks after the preplant application probably would not be controlled due to herbicide degradation. Engenia (group 4) in the postemergence application will control these late-emerging plants.

For season-long resistance management of horseweed, this example is fair to good. The herbicide program has two effective sites of action for control of emerged horseweed plants, but they are applied in sequence rather than as a tank mixture. Residual control is provided by two effective sites of action.

Palmer amaranth begins emerging in the spring and continues throughout the summer. The preplant application of Sharpen (group 14), fluthiacet (group 14) (portion of Anthem Maxx), and metribuzin (group 5) will control Palmer

amaranth seedlings that have emerged at time of application. Metribuzin (group 5) and pyroxasulfone (group 15 portion of Anthem Maxx) provide control of seedlings germinating up to 4 weeks after application, but after that Palmer amaranth seedlings would begin to emerge. Engenia (group 4) controls Palmer amaranth plants that had emerged at time of postemergence application, but does not provide adequate residual control. Warrant (group 15) provides residual control but will not control emerged plants.

For season-long resistance management of Palmer amaranth, this example is poor to fair. The preplant application is applied when only a small percentage of the Palmer amaranth seedlings have emerged and will have limited utility as part of a season-long approach. The residual herbicides have two effective sites of action, but since application is made so early, the benefits of the two effective sites of action are minimized. This program would be much stronger if the residual herbicides were applied at planting rather than three weeks prior. The postemergence herbicide relies on only one effective site of action which increases the selection pressure for dicamba resistance.

Common lambsquarters begin to emerge in the early spring and continues to early summer. Sharpen (group 14), glyphosate (group 9), and fluthiacet (group 14 portion of Anthem Maxx) provide control of lambsquarters seedlings that have emerged by the time of preplant application, and Anthem Maxx (pyroxasulfone portion only (group 15)) provides residual control. Postemergence application of Engenia (group 4) and glyphosate (group 9) also provide common lambsquarters control.

For season-long resistance management of common lambsquarters, this example is good. Three effective sites of action are used in the preplant application, an effective residual herbicide is used, and then two effective sites of action are used postemergence. Common lambsquarters is treated twice with glyphosate but both times it is used in combination with another effective herbicide group.

Annual morningglory emerges from spring to mid-summer. Annual morningglory have not

begun to emerge prior to the preplant application and so chlorimuron (group 2 portion of Canopy) would provide an effective level of residual control. Effective control from postemergence application is provided by glyphosate (group 9) and Engenia (group 4), but Warrant does not provide residual morningglory control.

For season-long resistance management of annual morningglory, this example is good. Only one effective site of action is used with the preplant application (chlorimuron), but the postemergence application includes two effective sites of action. The effective sites of action are different for both applications and applying the residual herbicide closer to planting would improve the resistance management of this program.

Fall panicum emerges in the spring and early summer so glyphosate (group 9) portion of the preplant application has some effect. Pyroxasulfone (group 15 portion of Anthem Maxx) is the only effective herbicide applied prior to planting. Effective control from postemergence application is provided only by glyphosate (group 9).

For season-long resistance management of fall panicum, this example is poor. Glyphosate used in the preplant application will control emerged seedlings and the residual herbicide will provide control over most of the peak emergence period. Glyphosate is the only herbicide to control emerged fall panicum plants in the postemergence application. While Warrant (group 15) does provide residual control of fall panicum, it is not applied until after the fall panicum emergence period. Thus there is only one effective site of action used at either application timing. However, there have been no reports of herbicide resistance in fall panicum so incorporating additional sites of action may not be justified at this time.

Summary

These examples were developed to demonstrate considerations when evaluating effective sites of action. Herbicide resistance is less likely to develop when multiple effective sites of action are applied as a tank mixture, at the appropriate time, and at full rates. Understanding weed

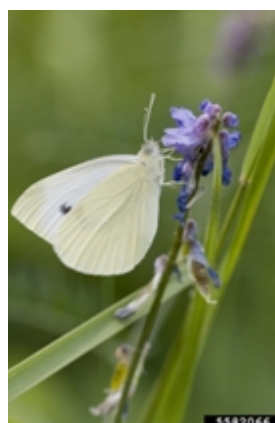
emergence timing and the likelihood of the species to develop resistance can help to refine the herbicide program and ensure herbicide programs are targeting resistant biotypes and species with a tendency to develop resistance.

Herbicide management is only one component of a successful integrated weed management program. Visit <http://integratedweedmanagement.org/> for more information.

General

Guess the Pest! Week 1 Answer: Cabbage White - David Owens, *Extension Entomologist*, owensd@udel.edu

Congratulations to Joe Streett for correctly identifying last week's Guess the Pest challenge as cabbage white, also known as the imported cabbageworm. Joe won a heavy duty sweep net for catching the butterflies and will be entered for the end of season raffle along with all others who submitted correct answers. This is one of the early harbingers of spring. I saw my first April 1 and it is now the most common butterfly out. It is a Brassica specialist. Females lay eggs on wild mustard, brassica cover crops like turnip or radish, and cultivated brassicas such as broccoli and cabbage which are being transplanted now. Larvae are green, about an inch long, and fuzzy. They are easiest to find when 'hiding' on the leaf's upper midrib. Pre heading, brassicas can tolerate a good deal of defoliation (30% infested plants), but once heading initiates, thresholds for this and other defoliating worms drop to 5%.



Guess the Pest! Week 2 - David Owens,
Extension Entomologist, owensd@udel.edu

Test your pest management knowledge by clicking on the GUESS THE PEST logo and submitting your best guess. For the 2019 season, we will have an "end of season" raffle for a \$100.00 gift card. Each week, one lucky winner will also be selected for a prize and have their name entered not once but five times into the end of season raffle. A lucky winner will also receive a heavy duty sweep net.

[Why are we concerned when we see these?](#)



To submit your guess, click the Guess the Pest logo or go to:
https://docs.google.com/forms/d/e/1FAIpQLSfU-PYLZnTRsol46hXmqgj8fvt5f8-JI0eEUHb3QJaNDLG_4kg/viewform?c=0&w=1



New Mandatory Paraquat Training
(Provided by EPA Office of Pesticide Programs) - Mark VanGessel, Extension Weed Specialist; mjv@udel.edu

A new certified applicator training module for paraquat (also known as Gramoxone) is now available. The training was developed by paraquat manufacturers as part of EPA's 2016

risk mitigation requirements and approved by EPA.

Paraquat is one of the most widely used herbicides in the U.S. for weed control in many agricultural and non-agricultural settings and is also used as a harvest aid. Paraquat is a restricted use pesticide for use only by a certified applicator. The restriction applies to mixing, loading, and applying paraquat, as well as other pesticide handling activities.

Since 2000, 17 deaths have been caused by accidental ingestion of paraquat. Many of these deaths were as a result of people illegally transferring the pesticide to beverage containers, and the victim later mistaking it for a drink. A single sip can be fatal. In addition to the deaths by accidental ingestion, three more deaths and many severe injuries have been caused by the pesticide getting onto the skin or into the eyes of those working with it.

To help prevent these tragedies, **certified applicators must now take paraquat-specific training before use.** The training emphasizes that the chemical must not be transferred to or stored in improper containers. The training also covers paraquat toxicity, new label requirements and restrictions, consequences of misuse, and other important information.

The requirement for training is only one of several actions EPA has taken to prevent poisonings, including making label changes, restricting the use of all paraquat products to certified applicators only, and requiring closed-system packaging for all non-bulk (less than 120 gallon) end use product containers of paraquat.

Training module can be found at:
<https://campus.extension.org/course/view.php?id=1660>

List of FAQs at EPA website:
<https://www.epa.gov/pesticide-worker-safety/paraquat-dichloride-training-certified-applicators>

Mitigation decision and other supporting documents at www.regulations.gov under docket # EPA-HQ-OPP-2011-0855.

Assistance Available to Delaware Farmers through the Updated Conservation Stewardship Program

Sign up deadline of May 10, 2019

Delaware farmers are encouraged to sign up by May 10 for financial and technical assistance to take their voluntary conservation activities to a higher level. Assistance is now available through the updated Conservation Stewardship Program (CSP) administered by the USDA Natural Resources Conservation Service (NRCS).

Through CSP, agricultural producers and forest landowners earn payments for actively managing, maintaining, and expanding conservation activities like cover crops, ecologically-based pest management, buffer strips, and pollinator and beneficial insect habitat – all while maintaining active agriculture production on their land.

Through the adoption of cutting-edge technologies and new management techniques, Delaware farmers will address the state's priority resource concerns. These include soil quality degradation, water quality degradation, insufficient water, degraded plant condition and air quality impacts. On-farm benefits include increased crop yields, decreased inputs, wildlife population improvements; and better resilience to weather variables.

Delaware has 78 active CSP contracts on 67,000 acres of private lands. "CSP continues to be a valuable tool in helping our farmers implement a higher level of conservation activity to achieve their management goals," said Kasey L. Taylor, Delaware State Conservationist.

The 2018 Farm Bill made several changes to this critical conservation program that will benefit Delaware farmers. Highlights include:

- Enrollment of eligible, high ranking applications based on dollars (not acres) to cover part of the cost for implementing new conservation activities and maintaining current practices.

- Higher payment rates for certain conservation measures, including cover crops and resource conserving crop rotations.
- Specific support for organic operations and those transitioning to organic production.

Producers interested in CSP should contact their [local USDA service center](#). In Delaware's Sussex County, call 302-856-3990, ext. 3; in Kent County, call 302-741-2600, ext. 3; and in New Castle County, call 302-832-3100, ext. 3. Or visit the [Conservation Stewardship Program](#) webpage for more information.

U.S. Census of Agriculture Data to Assist Decision Making - *Stacey Hofmann, Chief of Community Relations, Delaware Department of Agriculture; Stacey.Hofmann@delaware.gov*

On April 11 the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Delaware office announced the results of the 2017 Census of Agriculture with new information about 2,302 Delaware farms and ranches and those who operate them, including first-time data about on-farm decision making, at the state and county level.

"Agriculture continues to play an important role in Delaware's economy. I want to thank all of our family farmers who took the time to participate in the 2017 U.S. Census of Agriculture," said Delaware Secretary of Agriculture Michael T. Scuse. "The information our farmers provided in the Census will help local and federal legislators, businesses, and others make informed decisions, especially on federal programs, that will directly impact our farms."

Census data provide valuable insights into demographics, economics, land and activities on U.S. farms and ranches. Some key state highlights include:

- The average age of all producers (a person involved in making decisions for the farm operation) was 57.4 years of age.
- The number of female producers increased by nearly 12 percent from 2012.

- The per farm average net income increased from \$130,842 in 2012 to \$277,316 in 2017.

The new Census data also shows that agriculture remains Delaware's largest single land use, with 42 percent of Delaware's land (or 525,324 acres) in farms, up from 508,652 acres in 2012. Poultry production ranked first in the state for market value of agricultural products sold with more than \$1.1 billion, with grains, oilseeds, dry beans, and dry peas; vegetables, melons, potatoes, and sweet potatoes; nursery, greenhouse, floriculture, and sod; and milk from cows rounding out the top five commodity areas.

"The Census shows new data that can be compared to previous censuses for insights into agricultural trends and changes down to the county level," said NASS Administrator Hubert Hamer. "We are pleased to share first-time data on topics such as military status and on-farm decision making. To make it easier to delve into the data, we are pleased to make the results available in many online formats including a new data query interface, as well as traditional data tables."

For the 2017 Census of Agriculture, NASS changed the demographic questions to better represent the roles of all persons involved in on-farm decision making. As a result, in 2017 the number of all producers in Delaware was 3,907 up from 3,789 producers in 2012.

Other demographic highlights include:

- New and beginning producers with 10 years or less of farming comprised of 851 producers.
- Published for the first time, producers with military service encompassed 390 producers.

The Census tells the story of American agriculture and is an important part of our history. First conducted in 1840 in conjunction with the decennial Census, the Census of Agriculture accounts for all U.S. farms and ranches and the people who operate them. After 1920, the Ag Census happened every four to five years. By 1982, it was regularly conducted once every five years. Today, NASS sends questionnaires to nearly 3 million potential U.S. farms and ranches. Nearly 25 percent of those who responded did so online. Conducted since 1997 by USDA NASS - the federal statistical

agency responsible for producing official data about U.S. agriculture - it remains the only source of comprehensive agricultural data for every state and county in the nation and is invaluable for planning the future.

Results are available in many online formats including video presentations, a new data query interface, maps, and traditional data tables. All Census of Agriculture information is available at www.nass.usda.gov/AgCensus.

Announcements

Farming Assistant Position with the Delaware Food Bank

Part Time Farming Assistant

The Food Bank of Delaware is looking to fill the position of Part Time Farming Assistant in our Newark Facility. The Farming Assistant will work with the Farm Manager in all steps of crop production at the Food Bank of Delaware's Newark Farm including maintaining outdoors vegetable gardens, indoors high tower gardens, farm plot. In addition the Farming Assistant will also assist the Farm Manager with all components of the agricultural workforce development activities of Delaware Food Works; this includes but is not limited to recruitment of students, classroom and field instruction, internships and field trips.

Additional details about the position and application information are available online at:

<https://www.fbd.org/job-opportunities/>

Rotem Controller Workshop

Thursday, April 18, 2019 10:00 a.m.-4:00 p.m.

The Frankford Fire Company Hall
7 Main Street, Frankford, DE 19945

Rotem's Controllers set new standards in the poultry industry. These controllers enable poultry farmers to raise their flocks under the best conditions possible while reducing operating expenses and increasing efficiency. This Workshop will provide information to help you decide to use, whether you are a new grower or an existing grower. Put on by the University of Maryland Extension, along with the University of Delaware Cooperative Extension and Delmarva Poultry Industry, Inc., this Workshop will cover both standard and precision mode controllers.

This is a **free** workshop. Lunch will be provided.

To register go to Eventbrite (Free):

<https://www.eventbrite.com/e/rotem-controller-workshop-additional-location-added-tickets-58647031851>. Any questions, please contact **Jenny**

Rhodes, jrhodes@umd.edu, (410) 310-0103, **Jon**

Moyle jmoyle@umd.edu, (410) 742-1178, or **Georgie**

Cartanza, cartanza@udel.edu, (302) 632-3173

Sponsored by: Rotem, University of Delaware Cooperative Extension, Delmarva Poultry Industry, Inc., University of Maryland Extension

Weather Summary	
Carvel Research and Education Center Georgetown, DE	
Week of April 4 to April 10, 2019	
Readings Taken from Midnight to Midnight	
Rainfall:	
0.05 inch: April 5	
0.34 inch: April 8	
Air Temperature:	
Highs ranged from 81°F on April 8 to 52°F on April 5.	
Lows ranged from 61°F on April 9 to 37°F on April 4	
Soil Temperature:	
57.3°F average	
Additional Delaware weather data is available at http://www.deos.udel.edu/monthly_retrieval.html and http://www.rec.udel.edu/TopLevel/Weather.htm	

Weekly Crop Update is compiled and edited by Emmalea Ernest, Associate Scientist - Vegetable Crops

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