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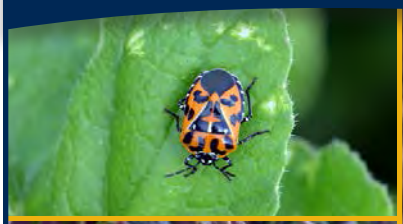

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Genetically engineered crops – are they safe?

As mentioned in the previous issue of *IPM Chronicle*, major row crops, such as corn, soybeans and cotton, are genetically engineered to tolerate pests, such as weeds and insects. These crops are able to tolerate herbicides but will kill weeds and/or are able to kill insects upon feeding on crop parts. Undoubtedly, these modern technologies are essential to keep up with the increasing demand for food and fiber; however, the safety of GE foods to human health, the environment and socio-economic implications are vital for their long-term adoption.

A consumer is often bombarded with mixed messages regarding the safety of GE foods. Claims and viewpoints related to the positive and negative effects vary widely. The National Academy of Sciences appointed a committee to perform a rigorous and scientific review of available information to address food safety, along with its environmental and socio-economic aspects. Visit *https://nas-sites.org/ge-crops/* to view the 584-page report of their findings, which was released during the summer of 2016.

Figure 1. A pigweed (Amaranthus palmeri) prevalent in genetically engineered cropping systems that has evolved resistance to the commonly used herbicide glyphosate. (Photo credit: R. Chandran)

Findings

The committee felt comfortable expressing that GE crops posed no adverse effects on human health directly, based on reasonable evidence generated by a large number of animal feeding studies. Livestock health was also not affected by consumption of GE crops. Based on examination of epidemiological data related to the incidence of cancers and other human health problems, they found no substantial evidence indicating that foods derived from GE crops were less safe than that from non-GE crops.

Although the impact of GE crops related to environmental aspects is more complicated, the committee was not able to pinpoint any adverse effect to the widespread use of such crops. The plant biodiversity in fields where GE crops were grown was not lower than those where non-GE crops were raised. In fact, there was evidence of higher levels of insect biodiversity on farms where *Bt* crops were planted compared to those treated with synthetic insecticides.

The socio-economic effects of GE crops have been positive overall, based on the findings of this committee. In general, farmers benefitted from the availability of GE crops; however, small farmers faced certain challenges.

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Plum curculio: a troublesome pest of tree fruits

The plum curculio, *Conotrachelus nenuphar* (Herbst), is an important early-season pest of tree fruits. They can cause considerable damage to apple, pear, apricot, peach, plum, nectarine, cherry and other fruits.

Description

Plum curculio adults are a type of weevil (or snout beetle), approximately 6 millimeters (¼ inch) in length with a mottled combination of brown, black and gray colors over the body. They have four small humps on their wing covers (elytra) and a characteristic curved snout (Figure 2).

The adults overwinter in ground debris within woodlands or along field edges and begin moving into tree fruit plantings in the spring to feed on buds, flowers and newly formed fruit. Egg-laying begins as soon as fruit set occurs and can continue for about four to six weeks.

Symptoms

Surface feeding and egg-laying by weevils can scar or deform fruit

Figure 2. Adult plum curculio and feeding damage on plum. (Source: E. Levine, The Ohio State University, Bugwood.org)

Figure 3. Plum curculio egg-laying damage on cherry fruits. (Source: P.J. Chapman, New York State Agricultural Experiment Station, Bugwood.org)

by harvest. The crescent-shaped scars cut into the fruit surface from egg-laying are a characteristic sign of plum curculio damage (Figure 3 and Figure 4). In apple, plum curculio larvae are unable to complete development within growing fruit because of the pressure exerted by the hard, expanding tissue. However, feeding by larvae can cause fruit to drop prematurely from trees and it is within these apples that they are able to complete development.

Larvae will generally spend two to three weeks feeding within fruit before exiting to pupate in the soil. The next generation adults emerge in late summer and also feed on fruit, but they generally do not reproduce until the following spring.

Control

There are few effective non-chemical methods for controlling plum curculio in tree fruits. However, home orchardists can help reduce future populations by promptly picking up and destroying any fallen fruit from the ground (particularly from May through June).

Adult populations can be suppressed in the spring with well-timed applications of effective insecticides immediately after petal fall. Insecticides labeled for use against plum curculio and available for homeowners include carbaryl (Sevin), malathion and kaolin clay (Surround). Care should be taken when using carbaryl and malathion, because these products can be highly toxic to pollinators and beneficial insect predators, and may promote outbreaks of secondary pests (e.g., mites). In addition, care should be taken when using carbaryl in apples, because it can act as a fruit thinner when applied within two to three weeks after bloom. For organic growers, kaolin clay is a particle film that when applied to fruit and foliage helps discourage feeding and egg-laying.

Figure 4. Plum curculio egg-laying damage on apple fruit. (Source: New York State Agricultural Experiment Station, Cornell University, Bugwood.org)

Discouraging herbicide-resistant weeds

There has been exponential increases in the number of weeds resistant to various herbicides commonly used to manage them, especially in field crops in the last 25 years. To better understand herbicide resistance and to minimize its development, we should examine the processes that govern it.

Figure 5. Horseweed (Conyza canadensis) resistant to glyphosate in a field with herbicide-tolerant soybeans. (Photo credit: R. Chandran)

Herbicides may be classified into various families or groups based on the growth process affected by the herbicide, referred to as mode of action. Slight differences in the genetic makeup of a very small fraction of the population of a particular weed species, referred to as a biotype, may allow them to tolerate a particular herbicide group.

So, when herbicides belonging to the same group are used in a given area over lengthy periods, populations of such weeds build up through selection pressure. The particular species is then referred to as an herbicide-resistant weed. The primary cause of herbicide resistance is the repeated use of the same herbicide, or herbicides, with the same mode of action.

Life cycle

The life cycle of the weeds play an important role in the development of resistance.

Annual weeds with shorter life cycles develop resistance faster. Perennial weeds take longer time to develop resistance. More and more instances of weed biotypes are reported as evolving resistance to glyphosate. Common weeds, such as horseweed (Figure 5) or marestail *(Conyza canadensis)*, waterhemp *(Amaranthus rudis)*, palmer amaranth *(Amaranthus palmeri)*, common ragweed *(Ambrosia artemisiifolia)*, giant ragweed *(Ambrosia trifida)* and johnsongrass *(Sorghum halepense)*, have been reported as resistant to glyphosate in the United States.

Implication for growers in West Virginia

Necessary adjustments in the herbicide program should be made to account for resistance as one of the factors in the weed management decision-making process.

It is likely that isolated, insignificant populations of glyphosate-resistant biotypes are present in parts of the state where Roundup Ready®-based weed control programs were adopted early on. If glyphosate was the primary herbicide used in the past five years, growers should switch to herbicides with different modes of action.

Rotation to crops that facilitate the use of herbicides with different modes of action is also recommended.

Glyphosate is too valuable of a weed management tool to lose, and sound judgment when choosing an appropriate herbicide program becomes critical.

An integrated pest management method that employs cultural, mechanical and chemical control methods will help delay, or avoid, the buildup of herbicide-resistant weeds. Whenever feasible, mechanical or other non-chemical methods should be implemented.

For a given crop, consider rotating different families of herbicides, tank-mixing herbicides that have different modes of action, and occasionally using different nonselective herbicides to control all weeds.

Do not apply herbicide above or below the recommended rates. Monitor and report unaffected weeds following an herbicide application, and discuss potential resistance management herbicide programs with your WVU Extension Service county agent.

Landscape spring cleanup

Sunny days, warm temperatures and spring rains are waking up the landscapes. Trees and shrubs are pushing out new leaves and flowers embracing the new season. Just like plants, people are eager to get out and spend time in their landscapes and gardens.

The best thing to do at this point is to clean up. Grassy areas would greatly benefit from vigorous raking that would stimulate and invigorate grass growth. Spreading some fertilizer will account for early luscious grass growth. The other focus of our attention should be on ornamentals, which may require some pruning.

Why prune?

Nicely trimmed shrubs and trees not only look better, but they are healthier, too. Start by removing all dead, diseased and damaged shoots and limbs. Next, remove all the limbs that are crossing and rubbing, serving as a source of injury that will result in increased disease and insect injury potential.

Pruning hydrangeas

In order to improve the vigor of your hydrangea, remove some of the oldest shoots. The best blooms tend to be on the younger two-to five-year-old shoots. The shoot-removing cuts should be made at the soil line.

Figure 6. A well-pruned 'Apache' blackberry bed. (Photo credit: M. Danilovich)

It is important to know what species of hydrangea you have, since this will influence your pruning decisions. The old-fashioned, smooth hydrangea can be cut all the way down to the ground, since they produce flowers on the current season's growth. On the other hand, the hard-stem, woody hydrangea that produces flowers on last year's shoots will require more selective pruning. The weak, thin shoots should be removed leaving a few strong shoots.

The shrub should not be crowded with a thick shoot growth but rather airy with some space between shoots for better air movement. Good airflow through the shrub and/or canopy is a key to faster drying conditions and reduced potential for fungal disease development.

Pruning brambles

Brambles are great plants to have; however, they can be very invasive if not tamed by pruning. If not kept within the allotted space, they will take over the yard.

For florocane-bearers, or brambles that produce fruit on last year's growth, first cut off all brown, dead-looking shoots that produced fruit last year. Cut them all the way down to the ground. Next, remove all diseased and weak shoots leaving no more than five of the healthiest and strongest shoots for the upcoming season.

Primocane-bearers, which produce the fruit on the current season's growth, can be cut down to the ground leaving a few nice and strong shoots from the previous year to produce earlier (summer) harvest. The fruit produced on the primocanes will ensure a second (fall) harvest.

Genetically engineered crops *– continued from page 1 –*

Despite modest yield gains, there are damaging levels in the buildup of resistance among various pests. For instance, in West Virginia there are weeds, such as Palmer amaranth *(Amaranthus palmeri)* and giant ragweed *(Ambrosia trifida)*, that have evolved resistant to the herbicide glyphosate in parts of the state were herbicide-resistant crops have been grown for several years (Figure 1). Also, certain corn rootworms *(Diabrotica spp.)* have developed resistance to proteins produced by *Bt* corn intended to kill such insect pests in other parts of the country.

It appears that this technology has become a mainstay in modern agricultural systems. Public acceptance of this technology may depend upon rigorous testing of the safety related to this technology, and a sound scientific understanding of its intended and unintended consequences, and any potential hazards.

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An ounce of prevention is worth . . .

You have heard the old adage that "an ounce of prevention is worth a pound of cure" and in high tunnel production that is sound advice. Pest management inside a high tunnel is particularly difficult, because there are few chemicals registered for use on crops grown in them. Also, the structure is vented to the outside, which allows the possible influx of pests on a regularly basis.

Weeds are a constant problem inside and outside of growing structures. Weeds compete with your crop for light, nutrients and water. They also increase the possibilities of insect and disease problems by harboring these pests in or around your tunnel. Finally, they can reduce air circulation within structures when they are vented.

Prior to construction

Perennial weeds are best managed prior to construction of your high tunnel. If possible, you should avoid placing your tunnel on a site with a high population of noxious perennial weeds. Consider using a systemic herbicide a year or two prior to installing the high tunnel to kill the vegetative propagules of such weeds.

An alternative strategy would be the repeated removal of top growth to deplete the stored sugars for regrowth thereby killing them. Tillage may sometimes aggravate the problem by chopping up the underground parts and spreading them, unless they are removed carefully. Crop rotations and cover/smother crops are additional strategies to consider, prior to installation, especially to manage annual or biennial weeds.

Figure 7. Weeds are a constant problem inside and outside of growing structures, because they compete with your crop for light, nutrients and water. (Photo credit: B.E. Liedl)

After construction

Once the tunnel is up, your options for control are limited. Cultivation or hand weeding can manage weeds within rows. Plastic or organic mulches are often used to suppress weeds within rows and along the edges of the tunnel. If you use an organic mulch be sure to use something that does not contain seeds; otherwise, you will create a new weed problem to fix. Consider using a landscape fabric where rows or edges need to be kept covered in the long term.

A vegetation-free strip should be maintained around the outside of your high tunnel. This will reduce the chance of weed seeds entering your production area and reduce sources for diseases and insects. Removing or mowing the vegetation are both good options, as well as applying a mulch such as landscape fabric, around the house to suppress any weeds.

Finally, if you do use herbicides on your farm, be careful to not allow drift to enter your high tunnel. Many herbicides can easily disperse and spray drift can damage your plants. If herbicides are being used elsewhere on your farm, it is best to close your vents to limit the potential of drift on your plants and/or be sure to be downwind of your high tunnel before applying a spray.

The best advice to preventing weed problems is to reduce them before erecting your high tunnel. Then, continue to keep any new weeds at bay to reduce this pest in your high tunnel production.

Genetically engineered crops *– continued from page 4 –*

The methods by which GE crops will be developed in the future are expected to be less aggressive compared to how they were developed in the past. With a better understanding of the underlying principles, scientists are now able to edit genes within closely related species to generate desirable traits as opposed to introducing them from unrelated species. The next issue of the *IPM Chronicle* will examine some of these newer techniques.

Coyotes more common in West Virginia

Historically found in the Great Plains or prairies of the mid-western United States, the eastern coyote *(Canis latrans)* is becoming more and more common across West Virginia. Over the past 100 years, the coyote has expanded its range across the United States and most of North America.

Background

Records for the coyote in the mid-Atlantic states date back only 50 years, with the first record of a coyote in West Virginia appearing in the 1970s. This remarkably rapid expansion has been due in part to the near extinction of larger predators, such as the mountain lion and timber wolf, and also to the population growth of white-tailed deer. Humans have also aided in the coyotes' expansion by moving and releasing coyotes for sport hunting. Coyotes are very adaptable in what they eat and where they live; therefore, they have been able to easily expand into forested, agricultural, suburban and urban environments.

The coyote is a habitat generalist and omnivore, eating a variety of food items, such as small rodents, rabbits, insects, plant material, fruits, berries and carrion. Coyotes will feed on white-tailed deer and livestock.

While the coyote is a predator and predation is an important component of a healthy ecosystem, conflicts arise when coyotes feed on livestock, such as sheep, goats and cattle.

Management

Since coyotes have thrived among West Virginia wildlife, livestock producers must maintain coyote management practices throughout the year. Much of the coyote's livestock depredation occurs from late spring through September when coyotes are raising pups.

Figure 8. Records for the coyote in the mid-Atlantic states date back only 50 years. (Photo credit: https://www.flickr.com/photos/drphotomoto/10669948324)

By changing the season of lambing or calving, many producers have been able to reduce loss to coyotes. Changing the location of lambing or calving by bringing animals out of remote pastures and into barns or paddocks may also be effective. Lights above corrals or pens have also been used to reduce loss.

Coyotes can cross through, over or under conventional livestock fencing. Constructing electric fences or modifying existing fencing with charged wires will exclude coyotes from pastures or barn lots. Producers may also consider livestock guard animals to repel coyotes. It may also help to implement a lethal control program to reduce livestock loss.

West Virginia has an annual regulated trapping season where coyotes can be harvested, along with a continuous open hunting season on coyotes. Coyotes can even be hunted at night with artificial light or night vision technology during certain times of year. Check the current West Virginia Division of Natural Resources Hunting and Trapping Regulations for up-to-date information.

Since no single method is effective in every situation, successful coyote management must involve an integrated approach that includes a variety of methods combining good husbandry practices with effective management techniques. U.S. Department of Agriculture's Animal and Plant Health Inspection Service leads the livestock protection program in West Virginia and can provide technical or operational assistance to landowners.

For more information regarding coyotes, please contact WVU Extension Specialist Sheldon Owen (304-293-2990 or *sheldon.owen@mail.wvu.edu*) or USDA/APHIS Wildlife Services (1-866-4USDAWS or 304-363-1785).

New tomato variety released possessing multiple disease resistance

Late blight resistant West Virginia '63 tomato is a favorite to organic and small growers in West Virginia. However, its susceptibility to Septoria leaf spot concerns growers.

Cornell University released a F_1 hybrid, Iron Lady, with resistance to Septoria leaf spot and late blight partly obtained from the WV '63. We crossed the WV '63 with the Iron Lady and selected field-grown plants resistant to Septoria leaf spot. We tested for this tolerance by inoculating six-week old, nutrient-stressed plants in the greenhouse. The WV '63 plants were killed; whereas, the hybrid selections survived.

Figure 8. Newly released tomato variety. (Photo credit: MM Rahman)

Progenies from these plants were then grown in field plots under naturally occurring disease pressure and selected for genetic homogeneity. Two selected lines had greener foliage at the end of the season. These two selections, tentatively named WV '17A and '17B, will be released in honor of the 150th anniversary of WVU Davis College of Agriculture, Natural Resources and Design.

Both selections carry single-gene and multiple-gene resistance to late blight and the dominant Ve-gene and I-gene for Verticillium and Fusarium wilt resistance. The vine type of both is indeterminate, and the fruit carried the uniform ripening gene and high color. Fruit set is higher in the WV '17A and is more firm than that of WV '63. Fruit of WV '17B is similar to a beefsteak type and is sweeter with significantly higher brix content compared with the WV '63.

During the 2016 WVU Organic Farm Field Day, we conducted a taste test where 90 percent preferred the WV '17B over the WV '63. More than 300 seed packets containing each of the two lines and WV '63 were distributed. We're asking growers to provide feedback on the total yield, disease resistance against late blight and Septoria leaf spot, as well as taste and fruit firmness. Data will be utilized to select one of these two lines to release as named tomato variety.

Although we expect these new lines will tolerate Septoria leaf spot better than the WV '63, growers are advised to take precautions that are normally followed for managing the disease. Some common cultural adjustments that can prevent, or reduce, Septoria leaf spot severity include rotating the growing area with non-solanaceous crops, using certified seeds, removing infected plant debris, removing lower leaves, using mulch, using drip irrigation and adopting methods such as wide spacing or row orientation for air movement and sunlight penetration.

Growers may also use bio-rational products, such as fixed copper (Kocide, Champ, Copper sulfate etc.), Regalia, Serenade or Actinovate, if rainy and cloudy weather persists for a long time. Considering the tolerance these lines possess, growers may not need any harsh chemicals for control.

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