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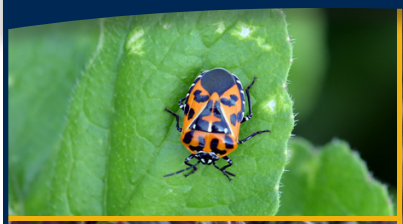

In This Issue:

Transgenic crops – Large scale field experimentation?

The past five issues of the *IPM Chronicle* featured developments related to the deployment of genetically modified organisms to manage pests in agriculture and landscapes. The goal of this series was to bring the readers up to speed on this rapidly evolving branch of science, which was first published by WVU Extension Service in the early 2000s and in a similar series in *West Virginia Farm Bureau News*.

The current series discusses the evolution of food production and generational changes related to food consumption, derived from crops that were bred conventionally or through transgenic technology [Vol. 5(1)]. The subsequent issue [Vol. 5(2)] examined the safety of foods derived from GMOs, concluding that while they do not pose any known health hazards, public acceptance of this technology would depend on continued testing and a sound understanding of the consequences and any potential hazards. The subsequent issues, [Vol. 5(3/4)], performed an objective analysis of old and current techniques used to enhance crops while focusing on newer and less invasive procedures, followed by a discussion of silencing genes and the use of RNAi technology to manage pests [Vol. 6(1)]. The final issue, [Vol. 6(2)], highlighted genetically modified mosquitoes as a tool for combating certain life-threatening vector-borne viral diseases.

One of the major changes is the proportion of our population engaged in bringing food to the table.

To sum up, we have come a long way from the time humans domesticated plants and animals to modern farming systems. One of the major changes over the millennia is perhaps the proportion of our population engaged in bringing food to the table. Prior to the Neolithic revolution, close to 100 percent of humans were engaged in procuring food. Today, a much smaller fraction of the population is engaged in food production, especially in developed countries. For instance, less than one percent of the population in the United States is engaged in agriculture compared to 60 to 70 percent during the Lincoln-era.

Such changes could entail certain long-term effects to our environment that are complex and not easily comprehensible. While GMO-based foods are proven to be safe, the processes involved in their production could very well offset certain fine balances in the ecosystem. For example, raising monocultures of crops

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Pruning and removal of cankers or affected dead twigs for disease management

A sustainable plant disease management strategy includes methods to reduce the initial plant disease inoculum (part of a pathogen that starts disease), reduce the infection rate and reduce the length of the disease. Among those, other methods such as reduction of initial inoculum by destroying or inactivating the sources through sanitation, removal of reservoirs of inoculum and removal of alternate hosts can not only reduce disease severity, but also provide the most economically feasible means of plant disease management in perennial plants, such as tree fruits, landscape trees, brambles and other berries. For efficient disease management, it is recommended to remove the inoculum reservoir by pruning cankered (Fig. 1) or blighted areas or areas with black knots (Fig. 2), followed by application of an effective bactericide/fungicide.

Cankers

Cankers are localized dead areas of bark and underlying wood on tree twigs, branches and trunks that can be caused by biotic (e.g., fungi, bacteria) or abiotic factors (e.g., hail, high wind, temperature extremes, injury from lawn mower, weed trimmer, etc.). Abiotic injuries resulting in cankers can be invaded by disease causing organisms that can overwinter there from one growing season to another. These cankers serve as the overwintering source for fungal spores of apple bitter rot *(Colletotrichum sp.)*, stone fruit brown rot *(Monilinia fructicola)* and pome fruit fire blight *(Erwinia amylovora)* during the season, as well as create a conducive environment for other fungi, such as fungi causing white *(Botryosphaeria dothidea)* and black *(Botryosphaeria obtusa)* rot on apple.

Figure 1. Fire blight canker on an apple tree limb that is a known source of bacteria for new infection of blossoms. (Photo credit: MM Rahman)

Figure 2. Black knot on a tree twig. (Photo credit: Mirjana Bulatovic-Danilovich)

Cankered wood can be identified as:

- Localized roughened or cracked bark, especially around wounds, branch stubs and old pruning cuts. Incomplete removal of cankered areas can create more harm than good. For example, fire blight canker needs to be removed 12 to 18 inches below the symptomatic area, because infection can extend farther without producing any visible symptom on the outer surface of the bark.
- Infected bark is normally darker than the surrounding healthy bark tissue.
- Roughened/darkened areas may become wrinkled or sunken over time.
- Small pimple-like fungal spore forming structures known as pycnidia (may be red, dark brown or black, depending on the fungus) are visible on cankered areas.

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- Wood-decay fungi that attack dead wood often appear as white protrusions growing out of the bark.
- Nectria twig blight or Nectria canker will often take advantage of cankers, producing bright orange spores.
- In stone fruit trees, gummosis is often associated with cankered wood, which produces an amber-colored gum.

Black knot on stone fruits

Black knot fungus *(Apiosporina morbosa)* can infect all stone fruit, although it primarily affects plum, cherry, apricot and peach trees and occasionally, the ornamental *Prunus* species. Infection disrupts normal twig development, and a knot is subsequently formed as the fungus causes the plant to produce tumor-like growths through hormonal imbalance. Over time, the knots may grow and girdle the whole twig creating a darker appearance and brittle texture.

Figure 3. Juniper twig showing telial horn stage of cedar apple rust disease. (Photo credit: Missouri Botanical Garden)

The first step in treatment is to cut away branches and stems that have knots. Black knot fungus may extend further inside the tissue than the visible width of the gall, so make the cuts 2 to 4 inches below the gall to be sure you are cutting back to disease-free wood. Application of fungicides, such as Topsin-M or Indar, in the early spring can offer significant protection, but are unlikely to be effective if pruning and sanitation are ignored.

Pruning and disposal

The best time for pruning is after all the leaves have fallen in the winter. Dormant pruning is recommended, because it prevents the spread of organisms and new infections; however, it can be done any time of the year if appropriate precautions are taken to minimize the spread of pathogen by sterilizing pruners with 10 percent bleach or 70 percent ethanol. Dispose of cankered wood by burning all tissue to destroy any overwintering bacteria or fungi.

Reduction of the infection source can be effective in many other host pathogen combinations. For example, anthracnose is a common disease on flowering dogwood caused by the fungal pathogen *Discula destructiva*. This organism often overwinters in the stem canker. Removal of these cankers are essential for controlling the disease. The same principle can also be extended to season crop plants where a diseased plant or plant parts can be removed before secondary spread of organisms take place. However, it is very difficult to remove all infected tissues because symptoms may not be visible until a certain point. Thus, application of a recommended fungicide immediately after pruning provides additional protection by suppressing the early stage of infection or spore production.

There are many fungal diseases of plants, especially rusts, that need multiple hosts to complete their life cycle and cause disease. For example, cedar apple rust caused by *Gymnosporangium juniperi-virginianeae* needs both apple and cedar trees to complete its life cycle. If juniper trees showing galls or telial horns (Fig. 3) can be removed from the periphery of an orchard or apple trees and treated with fungicide, disease severity will be low. However, like many other diseases mentioned above, fungicide application alone will not provide satisfactory disease control.

Sleep tight. Don't let the bed bugs bite!

Bed bugs have plagued humans for centuries. Historical records show that this pest has been linked with humans for more than 3,000 years. Bed bugs are known as ectoparasites, a group of insects that live outside on the bodies of warm-blooded animals. During the day, they hide in cracks and crevices of bed frames and headboards, behind wallpaper and woodwork, inside mattresses and box springs, and even inside electronics. At night, they come out to feed, gorging themselves on blood.

Description

There are many species of bed bugs. The common bed bug, *Cimex lectularius*, and the bat bug, *C. adjunctus*, are frequently found in homes throughout the United States. The common bed bug is not native to North America. They arrived with the first colonists who crossed the Atlantic Ocean from Europe. Until the 1940s, they thrived in the United States as a result of improved living conditions and an increase in woodwork in homes. Following a change in style to less ornate homes and furnishings, increased use of electric vacuum cleaners and washing machines, and the application of DDT, bed bug populations plummeted over the years. However, a resurgence of bed bugs has occurred in the past 20 years due to increased travel from countries having high bed bug populations. Bed bugs are easily transported by people from one place to another on clothing, used furniture and through apartment building and hotel walls.

Adult bed bugs are light tan to reddish brown in color with oval-shaped,wingless bodies (Fig. 4). Prior to feeding, they are ¼ to ⅜ inch long (about the size of a pencil eraser) and almost as flat as a piece of paper. After feeding on blood, they become bloated and dark red to black in color.

Figure 4. Adult bed bugs are light tan to reddish brown in color with oval-shaped, wingless bodies. (Photo credit: Daniel Frank)

Life cycle

Young bed bugs look like smaller adults. The young (nymphs) go through five stages of development before they become adults. Each time they progress to another stage, they must shed their exoskeleton (molt), requiring them to feed on blood. Bed bugs take about 21 days to mature from egg to adult, and can live for 6 to 12 months.

In most cases, bed bugs have been in a living space for a while before they are noticed. Because they can live for about six months without food, they may even be present in abandoned buildings or vacant apartments and homes. In the early stages of infestation, adults and nymphs may be seen on the seams and tufts of mattresses. As the population grows, they move to cracks and crevices in headboards and bed frames, behind wallpaper and woodwork, in drapes and among cushions. Bed bugs may also leave behind drops of blood-colored excrement on mattresses, pillows and sheets.

Health concerns

Bites from bed bugs are more of an irritation than a threat to human health. Bed bugs feed at night for about 5 to 10 minutes while people sleep and then retreat to their hiding places. Most people don't notice anything until they wake up the next morning with red, itchy spots on their face, neck, arms and hands. These spots can develop into welts that can persist for several days. Since

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bed bugs also inject their saliva into the bite, some people can have more severe reactions, resulting in painful, swollen areas. The nighttime feedings may also cause stress and sleeplessness. Fortunately, bed bugs do not spread disease; however, they may cause a mild skin infection from scratching the bites.

Control

The best treatment for bed bugs is prevention. When traveling always inspect the room that you will be staying in. The inspection should focus around the bed. Start with the headboard and move to the sheets and pillows checking for bed bugs or blood spots. Next, pull back the sheets and check the seams of the mattress and box spring. If possible, do not unpack clothing into drawers and keep luggage closed on a luggage rack pulled away from the wall. When coming back home, launder clothing as soon as possible. Suitcases, backpacks and other items should be carefully inspected before putting them away.

Controlling bed bugs is extremely difficult and people are encouraged to seek professional services for control. A pest management professional can save you time and money in the long run. When controlling bed bugs it is important to follow a multistep approach that includes thorough cleaning, application of appropriate pesticides and preventing re-infestation.

Cultural and mechanical control

- Bedbugs like to hide in various nooks and crannies (e.g., folds and seams of mattresses, under carpet, around the baseboard of beds, under box springs and bed frames), so it is important that infested rooms are thoroughly vacuumed and vacuumed often. Immediately empty vacuum contents in a sealable bag and dispose outside the home.
- Regularly wash bedding materials and clothes with hot water and dry on high heat.
- Use mattress and box spring encasements to discourage bed bugs where people sleep.
- Avoid bringing used furniture (especially beds) into the home.
- Choose light-colored bedding to make it easier to see bed bugs and blood spots.
- Do not store things under beds, and keep bedding and dust ruffles from touching the floor.
- Use bed bug interceptor traps (e.g., Climbup) to monitor bed bug populations and effectiveness of controls.

Chemical control

- Insecticides that are most effective for control of bed bugs are used by licensed pest management professionals and may require specialized application equipment.

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Transgenic crops – Large scale field experimentation?

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in vast expanses could potentially affect the diversity of flora and fauna, hence affecting the food chain and the ecological services provided by various organisms. Managing vegetation in extensive tracts of land could ultimately result in less functional ecosystems and habitat destruction. In our attempt to efficiently protect crops from pests, we may be at a juncture where certain adjustments are warranted. We may be on our way in carrying out large scale field experimentation at unprecedented levels. Transdisciplinary research is needed to understand the complicated interactions surrounding modern agricultural production systems.

The use of transgenic technology is undoubtedly vital to support the growing demand for food; however, our biggest challenge would be to use it judiciously without wasting shared resources. By itself, the durability of this technology is only finite without proper long-term approaches in place to mitigate resistance development by pests.

Bulbous buttercup

We can all remember picking those tiny, yellow flowers and holding them under our friends' chins to see if they "like butter." Spotting buttercups in your lawns and pastures is sure to bring back childhood memories, but for some, the sight of it might not be as joyous.

Identification

Bulbous buttercup *(Ranunculus bulbosus)* is a perennial weed prevalent in pastures, hayfields and occasionally, in lawns and gardens (Fig. 5). It produces bright yellow flowers with cup-shaped petals glistened by a shiny upper surface when held against sunlight causing a reflection.

Two closely related species are creeping buttercup *(Ranunculus repens)* and tall buttercup *(Ranunculus acris)*. Bulbous buttercups, however, have a characteristic bulb-shaped base, referred to as 'corm,' just beneath the soil surface and curved sepals that are pointed towards the stem (Fig. 6).

Life cycle

Seeds of bulbous buttercup germinate during fall months forming rosettes that can remain dormant in the fields during winter months. Shoots from the corm emerge as the soil starts to warm up during early spring. It comes to bloom from mid-April to May and are considered to be toxic to animals, especially horses, by virtue of a toxic glycoside called ranunculin. They tend to grow in nutrient-deficient soils and can be managed culturally by improving the growing conditions.

Figure 5. Bulbous buttercup (Ranunculus bulbosus) flowers characterized by shiny bright yellow flowers. (Photo credit: R. Chandran)

Figure 6. Bulbous buttercup (Ranunculus bulbosus) root system characterized by a corm (bulb) capable of vegetative reproduction. (Photo credit: R. Chandran)

Control

Mechanical removal of the entire root system is effective for small populations. In a lawn or pasture, application of a herbicide would be more cost-effective and/or less time consuming.

Tank mixtures containing both 2,4-D and dicamba (several formulations) along with a surfactant provide good control when applied in early spring while the rosettes are actively growing and getting ready to bloom.

If bulbous buttercup appears to be a persistent problem, a soil test followed by any remediation methods are recommended to improve soil condition. Please contact your WVU Extension Service agent for information related to proper safe use of pesticides and collecting soil samples for analysis.

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- Common household products and bug bombs are generally not effective, and they can even cause bed bugs to spread into other areas of the home.
- Insecticides used alone will not eliminate bed bugs.

Why is my broccoli headless?

A common question this season has been "Why is my broccoli headless?"

There are several reasons why broccoli will not form heads. This issue can be related to insects, diseases or nutritional imbalance, particularly if there is too much nitrogen; however, most often, it is temperature related, or more specifically, timing of seeding and/or transplanting.

Broccoli is a cool-season plant that grows best when the temperature is between 65 F and 75 F. If planted too late, high soil temperature may cause the plant to flower (bolt) before it sets heads (Fig. 7 and Fig. 8). Keep the soil temperature below 75 F to avoid early bolting. Frequent watering and a thick layer of mulch will also keep the soil cool.

On the other hand, if broccoli is planted very early and goes through a cold spell without any cover protection, it might not form heads at all or it might form button-like heads that will fall off. If the heads do stay, they often do not develop into nice, usable heads. Row covers provide protection from the hot, direct sun light exposure and prevent overheating, which results in delayed bolting. According to WVU Extension Commercial Horticulture Specialist Lewis Jett, the best heat-tolerant broccoli cultivars are 'Lieutenant,' 'Green Magic' and 'Emerald Crown.'

The other abiotic factors might be that the transplants were too old at planting or planted too close together causing overcrowding and bounding of the roots.

Figure 7. (Photo credit: https://roundrockgarden.files.wordpress.com/2010/03/broccoli1.jpg)

Figure 8. (Photo credit: https://www.salisburypost.com/wp-content/uploads/2016/04/0429-HG-loosebroccoli.jpg)

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