Ohio Private Pesticide Applicator
2023 Recertification Proceedings
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OSU Extension Resources

Agricultural Teams and Resources

Agricultural Health and Safety Program: agsafety.osu.edu/

- Safe Tactics for Ag Today (STAT) Newsletter: agsafety.osu.edu/newsletter/ag-safety-stat

Agronomic Crops Network: agcrops.osu.edu/

- CORN Newsletter: agcrops.osu.edu/newsletter/corn-newsletter
- Field Crop Diseases: u.osu.edu/osufieldcropdisease/
- Agronomic Crop Insects: aginsects.osu.edu/home
- Agronomy and Farm Management Podcast: go.osu.edu/iTunesAFM or go.osu.edu/StitcherAFM

Soybean & Small Grain Agronomy: stepupsoy.osu.edu

Beef Team: u.osu.edu/beefteam/

- Ohio Beef Cattle Letter: u.osu.edu/beef/

Dairy Team: dairy.osu.edu/

- Dairy Issue Briefs: dairy.osu.edu/dibs

Farm Office: farmoffice.osu.edu/

- Ag Law Blog: farmoffice.osu.edu/blog

Forages: forages.osu.edu/home

Livestock Handling Safety: agsafety.osu.edu/programs/cfaes-osha/livestock-handling-safety

Meat Goat Team: ohioline.osu.edu/factsheet/14

New and Small Farm Team: agnr.osu.edu/programming/new-small-farms

Ohio Ag Manager Team: u.osu.edu/ohioagmanager/

Ohio Farm Business Analysis and Benchmarking Program: u.osu.edu/farmprofitability/ Ohio

Women in Agriculture: u.osu.edu/ohwomeninag/

OSU Farm Management: aede.osu.edu/research/osu-farm-management

Weed Management: u.osu.edu/osuweeds

- YouTube: youtube.com/user/osuweeds

Poultry Team: u.osu.edu/poultry/

Precision agriculture: digitalag.osu.edu

Sheep Team: u.osu.edu/sheep/

- Program Coordinator: Brady Campbell, Campbell.1279@osu.edu, 740-434-3252
- Sheep Team Blog: http://u.osu.edu/sheep/

Soil Fertility: soilfertility.osu.edu/

Sustainable Streams and Watershed Stewardship: fabe.osu.edu/node/532

Swine Team: porkinfo.osu.edu/who-we-are/swine-team

Horticultural Teams and Resources

Aquaculture Team: southcenters.osu.edu/aquaculture

- Program Coordinator: Jordan Maxwell, Maxwell.411@osu.edu, 740-289-2071
- Aquaculture Extension Specialist: Matthew Smith

Buckeye Turf: buckeyeturf.osu.edu/

Buckeye Yard and Garden Online: bygl.osu.edu/

Extension Nursery Landscape and Turf Team: bygl.osu.edu/team

- Amy Stone, stone.91@osu.edu, 419-578-6783

Floriculture Extension Team: hcs.osu.edu/extensionoutreach/floriculture

Fruit and Vegetable Safety Team: producesafety.osu.edu/

Fruit Pathology Lab: u.osu.edu/fruitpathology/

- Ohio Fruit News: u.osu.edu/fruitpathology/fruit-news-2/

Fruits: southcenters.osu.edu/horticulture/fruits

- Gary Gao: gao.2@osu.edu, 740-289-2071 Ext. 123

Grape Wine Team: ohiograpeweb.cfaes.ohio-state.edu/

Integrated Pest Management: ipm.osu.edu/

Maple Syrup Program: agnr.osu.edu/specialty-crop-business/maple-syrup

Ohio Woodland Stewards Team: woodlandstewards.osu.edu/

Organic Food and Farming Education and Research Program: offer.osu.edu

Vegetable and Fruit Insect Pest Management: u.osu.edu/pestmanagement/

- Vegnet Newsletter: u.osu.edu/vegnetnews/

Vegetable Disease Facts: u.osu.edu/vegetablediseasefacts/

Miscellaneous Resources

Biting Insect Team Education: u.osu.edu/bite

C. Wayne Ellett Plant and Pest Diagnostic Clinic: ppdc.osu.edu/

Master Gardeners: mastergardener.osu.edu/

- Program Director: Pam Bennett, bennett.27@osu.edu, 937-521-3860

Pollinators: cfaes.osu.edu/impacts/pollinators

OSU Extension Publications: extensionpubs.osu.edu/

Online Pesticide Recordkeeping: pested.osu.edu/onlinerecords

Apps

- Bed Bug Field Guide: Available for free for IOS or on Google Play for Android devices

Agencies

- Ohio Department of Agriculture: agri.ohio.gov, 614-728-6987
- Ohio EPA: https://www.epa.state.oh.us/, 614-644-3020
- Environmental Protection Agency: www.epa.gov/

Weather

- State Climate Office: climate.osu.edu/
- FARM (Field Application Resource Monitor): farm.bpcrc.osu.edu/
- ODA Applicator Forecast: agri.ohio.gov/wps/portal/gov/oda/divisions/plant-health/resources/ohio-applicator-forecast

Departments:

- Entomology: entomology.osu.edu/home, 614-292-8209
- Plant Pathology: plantpath.osu.edu/, 614-292-1375
- Horticulture and Crop Sciences: hcs.osu.edu/, 614-292-2001
- Animal Sciences: ansci.osu.edu/, 614-292-6401
- Food, Agriculture and Biological Engineering, fabe.osu.edu, 614-292-6131
- Pesticide Safety Education Program: pested.osu.edu, 614-292-4070
- School of Environment and Natural Resources: https://senr.osu.edu/, 614-292-2265

Spotlight on Key Extension Resources

Pesticide Safety Education Program: The Pesticide Safety Education Program helps private and commercial pesticide applicators apply pesticides safely and legally in Ohio. Applicators and trained servicepeople can review the requirements for licensing and locate new applicator training and recertification meetings throughout Ohio on the program website. Dicamba-specific training sessions will be listed for 2020 as they become available. Information on Worker Protection Standards, Pesticide Safety, Storage, and Disposal, and free online self-study modules for the pesticide core exam are also available. For resources, see: pested.osu.edu or call 614 292-4070 to talk to PSEP staff.

Nutrient Education & Management: This web resource helps farmers and commercial agricultural applicators apply fertilizers legally in Ohio. Applicators can review the requirements for fertilizer certification and locate fertilizer recertification meetings throughout Ohio on the program website. This site is also managed by the Pesticide Safety Education Program. For resources, see: nutrienteducation.osu.edu or call 614 292-4070 to talk to PSEP staff.

Online Pesticide Recordkeeping: This website is available free of charge for private, commercial and fertilizer applicators in Ohio to assist in compliance with Ohio Pesticide and Fertilizer recordkeeping requirements. Keep records on any electronic device where Wi-Fi is available. Data is user name and password protected for security, allowing for multiple users for each account. Easily export, copy or delete files according to your needs. pested.osu.edu/onlinerecords

FARM: The Field Application Resource Monitor uses advanced weather forecasting to advise farmers when to apply fertilizers and pesticides to keep them on the field and out of Ohio waters. This app is easily accessible by most computers and electronic devices, providing highly specific forecasts for areas as small as 1.5 miles wide. FARM provides guidance on the best time to apply fertilizer and manure based on precipitation forecast, saving farmers time and money. For details, go to: farm.bpcrc.osu.edu/

Resources up to date as of 10/12/2022

Farm Stress Handouts

Developed by Sarah Noggle, Extension Educator, Extension, Paulding County, The Ohio State University.

Thanks for checking out the farm stress resources. This list includes websites, articles, and handouts from across the US. If you have additional questions or want to reach out for help.

Bridget Britton MSW, LSW

Chat with our OSU Extension, Behavior Health Field Specialist,
Bridget Britton, britton.191@osu.edu or call 330-365-8160

Ohio resources and handouts

- Ohio State Extension Rural and Farm Stress Website and Blog http://u.osu.edu/farmstress
- Ohio State Rural and Farm Stress Task Force https://extension.osu.edu/about/resources/extension-task-forces/rural-and-farm-stress
- Resources relating to Rural and Farm economics, Workforce Development, and Personal Stress Management
- OSU Extension/Center for Public Health Practice https://u.osu.edu/cphp/ohio-mental-health-resource-guides/
- Based on resources in every county
- Knowledge Exchange – Ohio State https://kx.osu.edu/
- Ohio Department of Agriculture Farm Stress www.gotyourbackohio.org
- Options for males, females, and youth
- #GotYourBack Ohio

Potential Training

- *Mental Health First Aid Training* https://www.mentalhealthfirstaid.org/
- *Trauma-Informed Care* https://fcs.osu.edu/programs/healthy-relationships-0/trauma-informed-care-approach
- *Handle with Care* https://www.handlewithcareoh.org/

Other University Extension Resources

- North Central Farm and Ranch Stress Assistance Center https://farmstress.org/
- Michigan State University – Managing Farm Stress https://www.canr.msu.edu/managing_farm_stress/
- Farm Crisis Center https://farmcrisis.nfu.org/
- University of Minnesota *Coping with Farm Stress* https://extension.umn.edu/rural-stress
- North Dakota State University *Farm and Ranch Stress* https://www.ag.ndsu.edu/farmranchstress
- University of Illinois Extension https://web.extension.illinois.edu/agsafety/factsheets/copefm.cfm
- Upper Midwest Agricultural Safety and Health Center (UMASH) *Stress & Mental Health* http://umash.umn.edu/stress/
- Resilient Farms, Families, Businesses & Communities: Responding to Stress https://fyi.extension.wisc.edu/farmstress/
- University of Wisconsin Education Disaster Education Network http://www.uwyo.edu/uwe/programs/wyo-disaster/stress.html
- South Dakota State Extension https://extension.sdstate.edu/tags/farm-stress
- Purdue University Extension https://extension.purdue.edu/farmstress/coping-with-farm-stress/

THE OHIO STATE UNIVERSITY EXTENSION

Go.osu.edu/farmstress

Video Links

- *Stress and Our Bodies.*

https://ed.ted.com/lessons/how-stress-affects-your-body-sharon-horesh-bergquist

- *Facing Suicide*

https://www.youtube.com/watch?v=NwAKNIzwTu0

Other helpful places to go

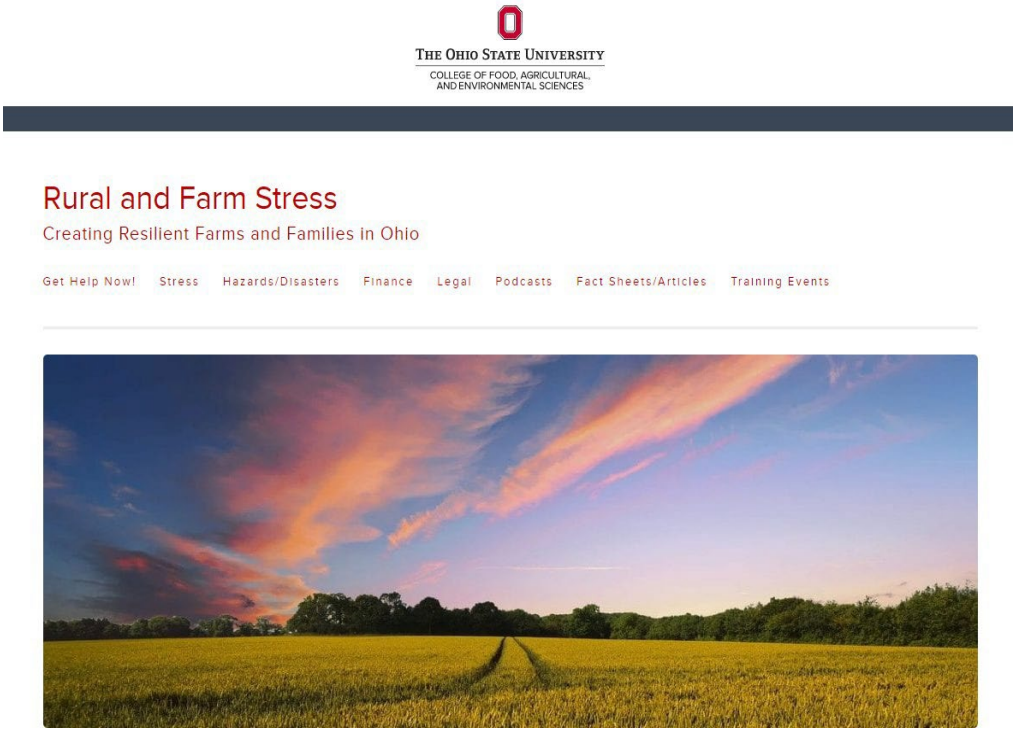
- Center for Rural Affairs: http://www.cfra.org/news/180130/10-helpful-resources-farmers
- Crisis Text Line: Text "CONNECT" to 741741: https://www.crisistextline.org/textline/
- Iowa State University. Iowa Concern 24-hour hotline: 1-800-447-1985
- National Suicide Prevention Lifeline: 1-800-273-TALK (8255)
- National Suicide Prevention Lifeline Crisis Chat: https://suicidepreventionlifeline.org/talk-to-someone-now/
- Veterans Crisis Line: 1-800-273-8255, Press 1 (website also has a chat option) https://www.veteranscrisisline.net/

Ohio and National Crisis Call and Textline

- Call or Text 988 to connect with a trained licensed professional counselor within five minutes.
- Free, confidential, anonymous, and secure 24/7.
- Features active rescue where trained counselors connect with emergency services to save texters from immediate self-harm.

Other Stress handouts related to farms

- My Coping Strategies Plan, Kansas State https://www.bookstore.ksre.ksu.edu/pubs/MF3418.pdf
- Responding to Distressed People, NDSU https://www.ag.ndsu.edu/publications/kids-family/responding-to-distressed-people/fs1805.pdf



Mental Health and Addiction Emergency or Crisis?

Mental Health and Addiction EMERGENCY

A mental health and/or addiction emergency is a life-threatening situation. An immediate response from law enforcement or medics is needed. A person may be actively trying to harm themselves or someone else. In other situations, a person may be out of touch with reality, be unable to function properly, or may be out of control.

Examples of mental health and addiction emergencies are:

- Active suicide threat.
- Threatening harm to self or others.
- Self-injury that needs medical attention.
- Severe intoxication.
- Inability to care for oneself.
- Apparent drug overdose.

If someone is having a mental health and/or addiction emergency,
CALL 911.

What to expect when you call 911:

- A dispatcher will answer your call and ask about your emergency.
- Local law enforcement or paramedics will be sent to your location.
- In some cases, a crisis intervention team will accompany law enforcement.
- You will get help dispatched immediately.
- You may be transferred to 988, if appropriate.

911

Mental Health and Addiction CRISIS

A mental health and/or addiction crisis is not a life-threatening situation. Intervention may be possible without an immediate response by law enforcement or medics. A person may be thinking about hurting themselves or someone else or may be extremely emotionally upset or distressed.

Examples of a mental health and addiction crises are:

- Talking about suicide or planning to harm oneself.
- Talking about harm to self or others.
- Self-injury that doesn't need immediate medical attention.
- Overuse of alcohol or other drugs.
- Extreme depression, anxiety, or other mental illness symptoms.

If someone is having a mental health and/or addiction crisis,
CALL 988.

What to expect when you call 988:

- A trained professional will answer your call.
- The professional will ask you to describe your crisis.
- In many cases, the professional will assist you over the phone and link you to additional care as necessary.
- In some cases, a mobile team will be sent to your location.
- If necessary, the person experiencing a crisis will be taken to a stabilization facility.
- You may be transferred to 911, if needed.

988

988 SUICIDE & CRISIS LIFELINE

mha.ohio.gov/988

MENTAL HEALTH & ADDICTION SERVICES Ohio

RECOVERY Ohio

Where to Send Plant Samples for Problem Diagnosis

Francesca Rotondo, Suranga Basnagala, Abby Welsh

Sample	Who/Where to Send it To	URL	Notes
All turfgrass disease/pest samples	Todd Hicks at the Ohio Turfgrass Research Center	https://turfdisease.osu.edu/sampling	Website has instructions on how to ship
Noncommercial Plants and Pests; Commercial Production Samples (vegetable, floriculture, ornamental, fruit, hops, and field crops); Commercial Landscaping Companies and Arborists	Dr. Francesca Rotondo at the OSU Plant and Pest Diagnostic Clinic (Wooster)	Both plant samples and photos are accepted. See website for details: https://ppdc.osu.edu/news/where-send-your-sample Shipping instructions: https://ohioline.osu.edu/factsheet/HYG-2121	The Reynoldsburg location is no longer accepting samples. Noncommercial samples will be accepted at the Wooster campus beginning in fall 2022.
NOTE: Cannabis samples of any kind cannot be accepted, due to federal restrictions			

NOTE: Insect samples must be from a structure (such as one's home) or from the outdoors, not from a person's body or animal's body

For more information, visit https://ppdc.osu.edu/news/where-send-your-sample

Where to Direct Diagnostic Questions

Topic	Who to Contact	Email Address	Notes
Commercial Greenhouse, High Tunnel, and Open Field Vegetable Disease Diagnostics	Sally Miller	miller.769@osu.edu	http://u.osu.edu/vegetablepathologylab/diagnostic-submission
Commercial Tree Fruit, Small Fruit, Nut and Hop Disease Diagnostics	Melanie Lewis Ivey	ivey.14@osu.edu	http://u.osu.edu/fruitpathology/diagnostics/
Cereal Disease Diagnostics	Pierce Paul	paul.661@osu.edu	
Soybean Disease Diagnostics	Anne Dorrance	dorrance.1@osu.edu pierzynski.4@osu.edu	
Commercial and Homeowner Turf and Problem Diagnostics	Todd Hicks	hicks.19@osu.edu	https://turfdisease.osu.edu/sampling
Reporting Endangered Species	Your Nearest Fish and Wildlife Service Office	ohio@fws.com (If you are emailing the information, please attach a photo of the species if you can)	Columbus FWS Address: 4625 Morse Road, Suite 104, Columbus, OH 43230. Columbus Columbus FWS Phone Number: 614-416-8993 This link includes all the endangered species in Ohio including arthropods, https://ohiodnr.gov/static/documents/wildlife/state-listed-species/Ohio's%20Listed%20Species%20pub356.pdf

Drones for Spraying Pesticides—Opportunities and Challenges

By
Erdal Ozkan
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The Ohio State University
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In some situations, aerial application of pesticides may be the only viable option to apply pesticides. Traditionally, aerial spraying of pesticides has been done using conventional fixed-wing aircraft or helicopters with pilot onboard. However, this is changing. Small, remotely piloted aircraft (a.k.a. “drones”) are being used to apply pesticides around the world, especially in Southeast Asia. For example, about 30% of all agricultural spraying in South Korea, and about 40 percent of Japan’s rice crop is sprayed with remotely piloted aircraft. In the U.S.A., for many reasons I will explain later, currently the drone spraying is in its infancy. However, interest in this technology from the pesticide applicators has been steadily increasing.

This publication highlights specifications of drone sprayers, why they may be the choice of aerial spraying, and the challenges that may slow down their acceptability by the pesticide applicators.

Drones have entered the agriculture scene initially for non-spraying applications. They are mainly for collecting data on a variety of crop and field conditions to increase profitability in crop production. Examples of drone use for data collection include soil characteristics (type, moisture content, nutrient content); location of drainage tiles; crop nutrient stress level; crop emergence or stand count; and weed species and infestation level. Drones has been successfully and effectively used for plant growth surveillance by collecting and delivering real-time data all the way from the time of plant emergence to harvest. With the help of fast and accurate GPS technology, a very high-resolution camera, and together with variable flying speeds and altitudes, drones can provide us a wealth of information for every half square inch of crop or soil conditions on the ground.

Using drones for spraying pesticides are attractive mainly for two reasons: 1) The topography or the conditions of the ground don’t allow using traditional ground sprayers, and 2) Drones significantly reduce the risk pesticide applicators, especially people using backpack sprayers, face with being contaminated by the pesticides.

Types of Drone Sprayers

Although they are small, drone sprayers have nearly all the components of a large ground sprayer, or a conventional aerial sprayer, such as: a tank, a pump, a pressure gauge, hoses, filters, nozzles and a flow meter for rate adjustments in real time. Most drone sprayers are also equipped with a GPS antenna. Each part plays a critical role in achieving maximum performance from the sprayer. Therefore, each component must be selected carefully and must successfully perform their tasks.

Spraying with a remotely piloted aircraft is not new. It was put in practice with the *Yamaha RMax* single rotor drone sprayer which looked like a small helicopter shown in the picture on the next page. This drone sprayer has been used in Japan since the early 1990s. It has been approved for use in California since 2015. One important distinct requirement of the manufacturer is that they only lease the aircraft and have their own trained team (usually 2 or 3 persons) operate it.


Yamaha RMax single-rotor drone sprayer *Photo: D.K.Giles*

Currently, we are seeing a rapid proliferation of other types of lighter weight and easy-to-operate drones for spraying pesticides. They are lightweight but are powerful enough to lift a 10-to-15-gallon tank. The majority of drones used for spraying today are the multi-rotor type as shown in the pictures below. The small propellers on the drones create turbulence in the canopy which significantly improves penetration of droplets in lower parts of the canopy compared to the traditional ground sprayers, except for air-assisted sprayers. Most multi-rotor drones look the same except for four details: Number of rotors, number of nozzles, configuration of the nozzles, and whether the drone has a GPS and can be pre-programmed with a flight plan. For example, some drones of this type have nozzles located at the end of hoses a few inches below the rotors (the picture on the left below), while some others have the nozzles on a boom as seen in the two pictures below on the right. The boom size and the configuration of the nozzles on the boom are different between those two drones. Having a larger number of nozzles on the boom, and the boom not extending too far outside the rotors produces much better penetration of spray droplets into the target plant canopy and a better coverage of the target surface with droplets.

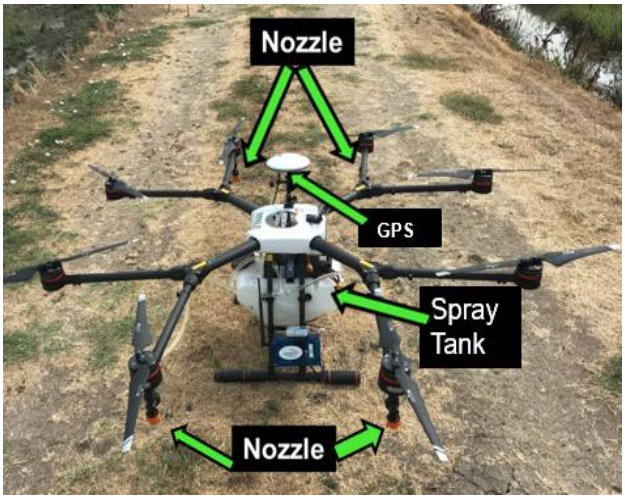

Photo: Dr. D.K. Giles


Photos: Dr. Xuan Li, FMC

Operating Characteristics of Drone sprayers

The application rate of drone sprayers is usually 1 to 2 gallons per acre. The rate depends on many factors, but mainly the flying speed, the number of nozzles on the boom, and the flow rate (volume sprayed per minute). So, a 5-gallon tank may take 10-15 minutes to empty. The maximum flying speed of multi-rotor drones varies between 15 to 20 miles per hour. Some drones can be programmed so that when the tank is empty, the drone flies to its home base to be refilled. Once replenished, it flies back to the same spot and continues spraying. Drone sprayers are usually flown 9 to 12 feet above the canopy manually. Some drones have an optional *Terrain Sensor* which is valuable to maintain the optimum flight height when spraying over uneven terrain. It

automatically navigates hills and slopes. The price of drone sprayers varies between 5,000 and 40,000 dollars depending on their size, spraying capacity, battery life and other features.

Success in pesticide application is heavily dependent on knowing and following best spraying practices. Unfortunately, not much operational information is available for drone sprayers. However, many of the general principles for operation of conventional large Ag Aircraft with pilot onboard also apply to drone sprayers. One of the crucial determinations in aerial spraying is knowing effective spray swath width so that you can adjust your next pass accordingly. Flight altitude affects both the swath width, and the quality of spray deposition into the canopy as well as pesticide coverage on the canopy. One way to increase deposition of product in the canopy is to minimize spray drift, the part of the spray that leaves the target area without depositing on the target. Wind velocity is usually the most critical factor affecting drift. The greater the wind speed, the farther a droplet will deposit off-target. My suggestion is, if you think it is too windy to spray, don't. Wait a while until the winds calm down. Even in light breezy wind conditions, leave a buffer zone between the area you are spraying and the field with sensitive crops downwind if the wind direction is towards the sensitive crops nearby. You can come back later and spray the untreated area when the wind direction is away from the sensitive crops nearby.

Flight altitude does not change the initial droplet size after it is released from the nozzle, but if the flight time of the droplet from the nozzle to the target gets longer because of the high altitude, the droplets will be subjected to the influence of the weather conditions such as wind, relative humidity, and temperature much longer time. This may increase drift potential of the droplets. Keep the flight height as close to the target as you can but it is still safe to fly the drone.

Major limitations of drone sprayers and obstacles for their adoption

Acceptance of drone sprayers has been slow for several reasons: 1) Not enough research data is available comparing their performance (mainly efficacy obtained and spray drift) to ground sprayers and conventional aircraft; 2) Fewer acres covered per hour of operation. The FAA requires that drones weigh less than 55 pounds unless an exemption has been granted by the FAA. This limits tank capacity to about 5 gallons, which leads to frequent refilling: 3) The battery powering the drone usually lasts just long enough to empty the spray tank. Having two battery packs means the battery can be replaced while refilling the spray tank. The spent battery can be recharged and ready for the next refilling; 4) The FAA imposes several operational restrictions on drones: the operator must maintain a visual line of sight with the drone or obtaining permission when flying in restricted air space; Drones can only be flown from 30 minutes before sunrise to 30 minutes after sunset. Perhaps the most severe restriction is that an operator can fly only one drone at a time. Fortunately, the FAA allows pilots to apply for waivers for several of these limitations such as night spraying and maintaining a line of sight; 5) Lack of clear information on chemical product labels related to drone spraying. Some labels don't allow aerial application of any form. Some labels allow "aerial application" of the product, but don't specify the type of aircraft that can be used. Currently, no pesticide label specifically says the product can be sprayed using a drone. Labels will eventually refer to some drone spraying. However, the EPA allows drone use for spraying pesticides if the pesticide is already labeled for conventional aircraft, and FAA rules for operating drones are followed.

Future of drone sprayers

Although drone spraying does not seem to be a viable option currently for broadcast spraying of large fields, this will likely change in the near future: 1) The FAA may ease the regulations and restrictions for use of drones, especially the restrictions on "swarming", in other words multiple drones being operated by one pilot or autonomously; 2) Continuation of work towards design and manufacturing of more efficient, longer lasting batteries; 3) Design of larger drones approved by the FAA which can have a much larger sprayer tank.

Even without these anticipated changes, spraying with the currently available drones may be the best option under following conditions: 1) Spot spraying. Treating some tall weeds that survived the previously applied herbicide may be critical to have a weed-free field the next year. This can be especially important to prevent weeds becoming resistant to specific herbicides. Spot spraying with a drone can be much more efficient than covering a whole field with typical ground equipment or aircraft; 2) Spraying portions of a field that cannot be reached by large, heavy ground sprayers because the soil is too wet. This happens frequently in some parts of Ohio; 3) Soil compaction concerns. Even after the wet ground dries enough to allow the large ground sprayer to get in the field, the sprayer is likely to cause a significant level of soil compaction resulting in reduced crop yield. Although it will take longer, drone spraying may be the best choice.

Summary and suggestions

Drone spraying is here. But is it a good option for everyone? My short answer to that question is: If you are well informed about this technology and aware of all the rules and regulations, then consider buying one. Otherwise, you should wait. Like other technologies in agriculture, developments and regulations can change rapidly. Keep up to date on research, pesticide product labels, FAA and EPA regulations, and new drone designs. The FAA website (https://www.faa.gov) will have current regulations governing use of drone sprayers.

To fly a drone, you must have an FAA "Part 107 Certificate" and a "Part 137 Certificate" or be under the direct supervision of a person who does hold this certificate. There are further restrictions on flying drones, including one that requires you to be at least 16 years old. To find out all the requirements to be a drone pilot and obtaining the pilot certificate required to fly a drone, you should visit the web site of FAA. (https://www.faa.gov/uas/commercial_operators). Another extremely informative and useful resource material I highly recommend is "FAA Remote Pilot Study Guide". Here is the link: https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf. An easy way to get to this site is a Google search: "FAA remote pilot study guide". Some of the topics discussed on this site include: airspace classification, operating requirements and flight restrictions, effects of weather on aircraft performance, emergency procedures, radio communication procedures, determining the performance of aircraft, physiological effects of drugs and alcohol on pilot performance, and registration and marking requirements

The web site prepared by Alan Leininger, Extension Educator at Henri County is an excellent source of practical information related to drone spraying, and all the FAA requirements to obtain appropriate certificates to fly a drone. (https://henry.osu.edu/program-areas/agriculture-and-natural-resources/precision-agriculture-technology).

There is a specific page on use of Drones for application of pesticides in Ohio Department of Agriculture (ODA) website. This website provides answers to many of the frequently asked questions such as: "what pesticide licenses are required by ODA to apply pesticides via a UAV (aerial drone)? The answer is: a certificate to fly drones does not mean you can spray pesticides. In Ohio, you must also complete Ohio Commercial Pesticide Category 1, which is called "the application of pesticides, except fumigants, by aircraft". Visit ODA's website to find answers to many of your questions, rules and regulations. (https://agri.ohio.gov/divisions/plant-health/pesticides/uas). Contact your OSU Extension Educator in your county and ODA for additional information on certification/licensing required to use drones to spray pesticides.

***Acknowledgement**: The author thanks Alan Leininger, OSU Extension Educator, Henri County, Ohio for reviewing this publication and providing useful comments.*

Ohio | Department of Agriculture

Division of Plant Health - Pesticide & Fertilizer Section
8995 East Main Street, Reynoldsburg, OH 43068
Phone: 614-728-6987 • Fax: 614-728-4235
www.agri.ohio.gov • pesticides@agri.ohio.gov

Ohio Requirements for Unmanned Aerial Vehicle (UAV) Pesticide Applications

Updated 09/13/2022

1. Are licenses or permits other than the pesticide licenses from ODA required?

The FAA requires that the UAV operator (person at the controls) hold a remote pilot certificate, obtained by passing the "Part 107" exam. The FAA also requires that the business hold a Part 137 Aircraft Operations Certificate.

2. What pesticide licenses are required by ODA to apply pesticides via a UAV (aerial drone)?

Any person applying any pesticide by aircraft (including UAVs) must have a *Commercial Pesticide Applicator License* with category C-1, "Aerial Application," on it. ***A copy of the FAA pilot license/certificate must be submitted to ODA as part of the aerial pest control licensure.***

If the application is being made to the property of another person for hire, a *Pesticide Business License* and *Certificate of Insurance* are also required.

3. At a UAV pesticide application site, who is required to have a pesticide applicator license?

Currently, the person operating the controls must be licensed as a pesticide applicator.

4. Do individuals assisting in the operation such as loaders, mixers etc., need to be trained if they are not making applications?

If the licensed applicator is conducting the application onsite, assisting employees do not need to be licensed currently. Employees assisting with mixing, loading, maintaining application equipment, or being a UAV spotter need to be trained as a Trained Serviceperson (TSP). TSP and supervision rules can be found here: https://agri.ohio.gov/divisions/plant-health/pesticides/trained-serviceperson.

5. Do private applicator's need a Commercial Applicator License to make an aerial UAV application?

Per Ohio Administrative Code Rule 901:5-11-2 (B)(14)(a), any person making an aerial pesticide application in Ohio is required to have a Commercial Applicator License with commercial category C-1 on their license.

5. Where can I find details on the FAA Part 107 and Part 137 requirements?

- **FAA - Certificated Remote Pilots including Commercial Operators**
  https://www.faa.gov/uas/commercial_operators

- **FAA - Dispensing Chemicals and Agricultural Products (Part 137) with UAS**
  https://www.faa.gov/uas/advanced_operations/dispensing_chemicals

Ohio | Department of Agriculture

Division of Plant Health - Pesticide & Fertilizer Section
8995 East Main Street, Reynoldsburg, OH 43068
Phone: 614-728-6987 • Fax: 614-728-4235
www.agri.ohio.gov • pesticides@agri.ohio.gov

Relevant Ohio Pesticide Rules and Regulations

Applicators

Ohio Administrative Code Rule 901:5-11-2 (B)(14)(a)
No person shall apply by aircraft any pesticide without having first obtained licensure for the aerial application pesticide-use category.

Trained Servicepersons

Ohio Revised Code Section 921.01 (XX) "Definitions"
Trained Serviceperson means an employee of a pesticide business, other business, agency of the United States government, state agency, or political subdivision who has been trained to apply pesticides while under the direct supervision of a commercial applicator.

Ohio Administrative Code Rule 901:5-11-02 (A)
(1) No employee shall act as a trained serviceperson unless, before the employee's first occupational exposure to pesticides, the employee has:

(a) Read the Ohio Department of Agriculture manual "Safety Training Guide for Trained Servicepersons," or
(b) Completed an employer sponsored training program which provides training equivalent to that provided in the manual.

(2) The employee and the immediate supervisor shall verify in writing that the employee has either read the manual or received equivalent training prior to the employee's first exposure to pesticides. The written verification shall be kept on file by the employer throughout the trained serviceperson's period of employment and for three years following termination of the trained serviceperson's employment. This written verification shall be made available to the director of agriculture for inspection.

(3) No trained serviceperson shall apply pesticides for their employer unless the trained serviceperson is directly supervised by a commercial applicator that is located within either twenty-five miles distance or two hours time to the work site during the trained serviceperson's pesticide application activities.

Ohio Administrative Code Rule 901:5-11-02 (D)
Pesticide applicators shall:

(1) Provide to trained servicepersons, immediate family members, and subordinate employees working under the pesticide applicator's direct supervision the necessary safety equipment as set forth on the pesticide label or as required by the pesticide being used.

(2) Acquaint trained servicepersons, immediate family members, and subordinate employees working under the pesticide applicator's direct supervision with any special hazards involved with those pesticides with which they might be in contact and instruct them in appropriate precautions to avoid those hazards.

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(3) Ensure that trained servicepersons, immediate family members, and subordinate employees working under the pesticide applicator's direct supervision do not apply pesticides in the absence of the supervising pesticide applicator unless the label of the pesticide they are applying is readily available to them at the worksite. The label of the pesticide shall be made available to the director for inspection during the application. Notwithstanding the foregoing, a pesticide applicator shall be present during application of a pesticide by their trained serviceperson, immediate family member or subordinate employee when the pesticide applicator's presence is required by the pesticide label.

(4) Report to the department of agriculture:

(a) By telephone within forty-eight hours after learning of any human illness requiring medical attention resulting from or allegedly resulting from a pesticide used by the pesticide applicator or a trained serviceperson, immediate family member, or subordinate employee working under the pesticide applicator's direct supervision. Such telephone notification shall be followed by a written report within seven calendar days.

(b) By written report within ten calendar days after learning of any property damage in excess of five hundred dollars resulting from or allegedly resulting from a pesticide used by the pesticide applicator or a trained serviceperson, immediate family member, or subordinate employee working under the pesticide applicator's direct supervision.

(5) Not apply a restricted use pesticide whose label requires that notice be given to occupants of nearby properties or that the area to be treated be posted with re-entry times unless those requirements have been met. This requirement is also applicable to all trained service persons, immediate family members, and subordinate employees working under the pesticide applicator's direct supervision.

(6) Provide to each customer and resident of the applied property if requested, or required by the pesticide label, a printed or legibly written statement of the pesticide applied, the amount applied, the date of application, and any other pertinent information as required by the pesticide label. This requirement is also applicable to all trained service persons, immediate family members, and subordinate employees working under the pesticide applicator's direct supervision.

Businesses

Ohio Revised Code Regulation 921.01 (LL) & (MM)
Pesticide business means a person who performs pesticide business activities, including the application of pesticides to the property of another for hire.

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Ohio Revised Code Regulation 921.09 (A)(1)
No person shall own or operate a pesticide business without obtaining a license from the director of agriculture. Licenses shall be issued for a period of time established by rule and shall be renewed in accordance with deadlines established by rule.

Ohio Revised Code Regulation 921.09 (B)(1)
Any person who owns or operates a pesticide business outside of this state, but engages in the business of applying pesticides to properties of another for hire in this state, shall obtain a license for the person's principal out-of-state location from the director. In addition, the person shall register each location that is owned by the person in this state and used for the purpose of engaging in the pesticide business.

Ohio Administrative Code Rule 901:5-11-07 (B)
Every pesticide business shall have in force a commercial general liability insurance policy and, either a separate professional liability insurance policy or an endorsement covering the properties under the care, custody, and control of the pesticide application business as it relates to the application of pesticides, including but not limited to the damage to the actual properties the pesticide business is treating or working on in each of the pesticide use categories in which the commercial applicators employed by the business are licensed. The policies and endorsements shall:

(1) Provide coverage for each registered location associated with the pesticide business;
(2) Provide coverage for bodily injury, property damage, products, and completed operations due to the application of pesticides at the location applied and for third party claims; and
(3) Contain the following minimum limits of insurance:
    (a) Three hundred thousand dollars policy general aggregate;
    (b) Three hundred thousand dollars per occurrence limit; and
    (c) Three hundred thousand dollars products and completed operations aggregate.

Ohio Administrative Code Rule 901:5-11-07 (D)
Every pesticide business that conducts aerial pest control applications shall have in force a comprehensive chemical liability insurance policy for the properties under the care, custody, and control of the pesticide application business as it relates to the application of pesticides from aircraft, including but not limited to the damage to the actual properties the pesticide business is treating or working on. The policy and endorsements shall:

(1) Provide coverage for bodily injury, property damage, products, and completed operations due to the application of pesticides at the location applied and for third party claims; and
(2) Contain the following minimum limits of insurance:
    (a) One hundred thousand dollars property damage coverage per occurrence; and
    (b) One hundred thousand dollars bodily injury (excluding passengers) coverage for each person; and
    (c) Three hundred thousand dollars bodily injury (excluding passengers) coverage per occurrence.

Climate Change Impacts & Adaptative Actions for Agriculture

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Department of Extension – CFAES, The Ohio State University
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Introduction

Weather affects many aspects of agriculture including planting and harvesting decisions, crop selection, fertilizer inputs, and pesticide applications. It is chaotic, rapidly evolves, and rarely is it just right throughout the entire growing season to make a perfect season. Farmers intuitively learn to adapt and change management decisions to get the most out of the conditions at hand. Over the longer-term, climate (which describes the long-term average weather conditions) was conducive to strong agricultural production in Ohio throughout much of the twentieth century, with warm humid summers and adequate rainfall.

However, evidence clearly demonstrates that our weather patterns, and therefore our climate, are changing rapidly. Globally, the last seven years (1880-present) are the seven warmest years on record during this period, with the top ten warmest all occurring since 2005. These changes are attributed to increases in greenhouse gases including carbon dioxide and methane, and through a positive feedback loop, warmer temperatures intensify evaporation rates leading to increases in atmospheric water vapor. This more energetic atmosphere leads to more extreme weather events, exemplified across the U.S. as heavy downpours, rapid oscillations between wet and dry conditions, expansive wildfires, and devastating hurricanes. Where one lives significantly dictates how one experiences these changes locally.

The following is a summary of 1) the changing climate of Ohio, 2) a selection of agricultural impacts in Ohio, and 3) resources available to help farmers and clientele begin adapting to and/or mitigating the worst of future outcomes.

Changing Climate of Ohio

Observed Climate

TEMPERATURE				PRECIPITATION			
RANK	YEAR	AVERAGE	DIFFERENCE	RANK	YEAR	TOTAL	DIFFERENCE
1	1998	54.1	2.4	1	2011	55.95	14.85
2	2012	54.0	2.4	2	1990	51.07	9.97
3	2016	53.6	1.9	3	2018	50.93	9.83
4	1921	53.5	1.8	4	1950	48.34	7.24
5	2017	53.2	1.6	5	2019	46.87	5.77
6	2021	53.2	1.5	6	1996	46.85	5.75
7	1991	53.1	1.5	7	2003	46.42	5.32
8	2020	53.0	1.4	8	1929	46.07	4.97
9	1931	52.9	1.3	9	2017	45.51	4.41
9	2006/1990	52.7	1.0	10	2004	45.45	4.35

Table 1: Top ten warmest and wettest years in Ohio's record (1895-present).

Table 1 shows that eight out of the top ten warmest and wettest years in Ohio (1895-present) have all occurred since 1990. This evidence shows that we are producing goods in a warmer and wetter world. However, the details of these changes matter including:

- Annual average temperatures over the recent period (1986-2016) have increased about 1.26°F across the Midwest, with a range of 0.5-1.5°F over Ohio, compared to 1900-1960.
- Winter and spring seasons are warming more rapidly than summer
- Nighttime temperatures in summer are warming much more rapidly than daytime highs
- Annual total precipitation has increased 5-15% over Ohio compared to the early 20th century
- Precipitation varies between 34 inches (northwest Ohio) to 44 inches (southern Ohio) with all locations experiencing about 2-4 inches more per year on average today (1991-2020) compared to the previous NWS operational period (1981-2010).
- Fall, winter, and spring have experienced the largest increases in precipitation
- The intensity of the precipitation has increased, with the percentage of events per year falling as 1 inch or greater increasing about 10% since 1948 (e.g., Fig. 1, Lima, Ohio).

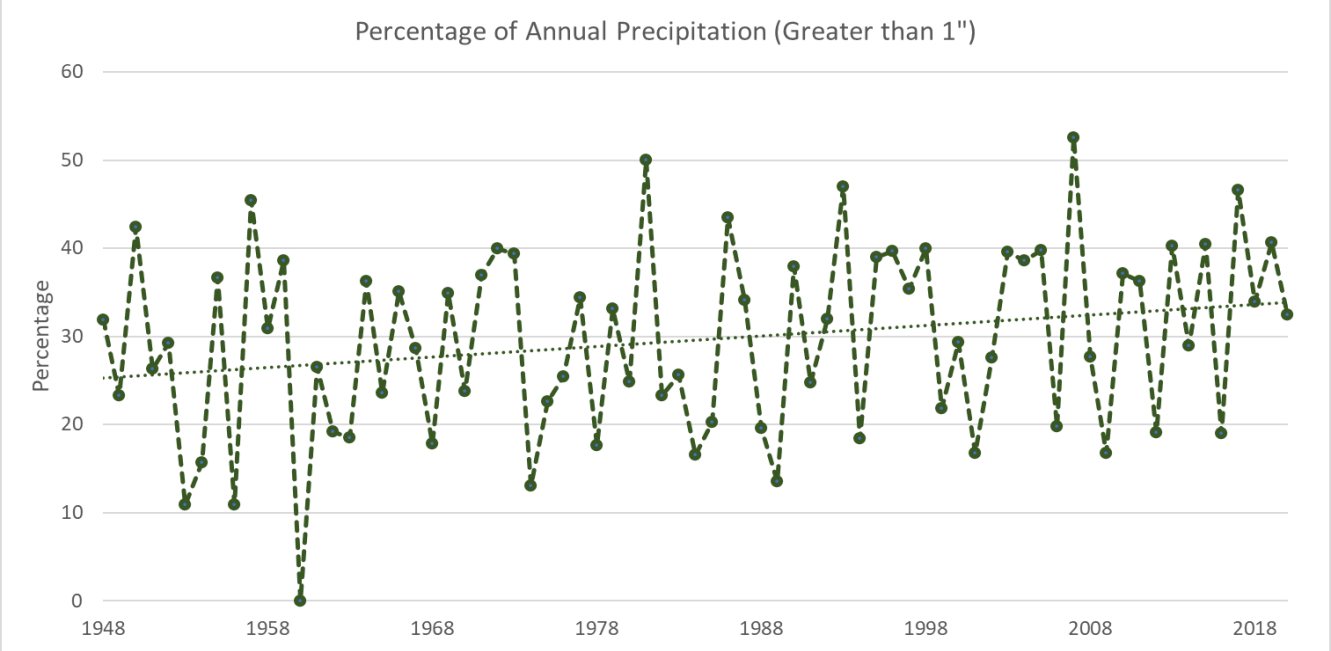

Figure 1: The number of daily precipitation events per year falling as 1 inch or greater amounts in Lima, Ohio, displayed as a percentage of the total number of daily precipitation events, over the period 1948-2020.

Future Climate

Atmospheric scientists use computer models of the atmosphere to run a series of scenarios based on assumed carbon emissions and socioeconomic factors to project future conditions. Figure 2 shows the projected change in temperature for the mid- and late-21st century based on a low (RCP4.5) and high RCP8.5 (emissions) scenarios. For mid-21st century, annual average temperatures are projected to be 3-5°F warmer than our contemporary climate, with end of century changes of 4-8°F warmer. These scenarios result in 20-40 more days with daytime temperatures in the summer and fall above 90°F and 20-30 fewer nights in the winter with temperatures below 32°F. Future precipitation patterns (not shown) show wetter winter and spring conditions with drier summers due to increased water vapor in the atmosphere and seasonal weather pattern changes associated with shifts in the jet stream.

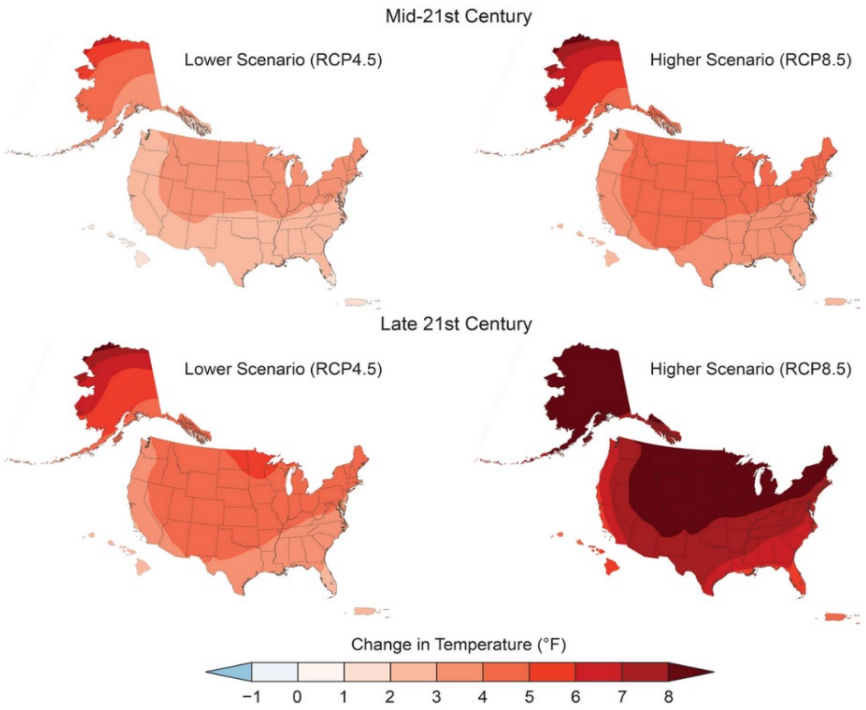

Figure 2: Projected differences in annual average temperature for mid-century (2036–2065, middle) and end-of-century (2070–2099, bottom) relative to the near-present (1986–2015).[1,2]

For more climate information, please visit the following resources:

- State Climate Office of Ohio – https://climate.osu.edu
- Fourth National Climate Assessment - https://nca2018.globalchange.gov/
- State Climate Summaries Ohio - https://statesummaries.ncics.org/chapter/oh/
- USDA Midwest Climate Hub - https://www.climatehubs.usda.gov/hubs/midwest
- Midwestern Regional Climate Center - https://mrcc.purdue.edu/

[1] Hayhoe, K., D.J. Wuebbles, D.R. Easterling, D.W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner, 2018: Our Changing Climate. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 72–144. doi: 10.7930/NCA4.2018.CH2

[2] Vose, R. S., D. R. Easterling, K. E. Kunkel, A. N. LeGrande, and M. F. Wehner, 2017: Temperature Changes in the United States. Climate Science Special Report: Fourth National Climate Assessment, Volume I. Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds., U.S. Global Change Research Program, Washington, DC, USA, 185–206. doi:10.7930/J0N29V45

Agricultural Impacts in Ohio
The changes in Ohio's climate detailed above have tangible impacts on agriculture in Ohio with opportunities but many challenges. These include:

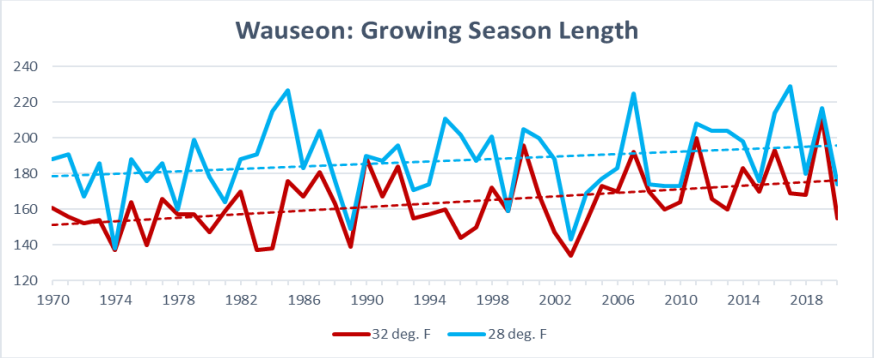

Figure 3: Number of days between last spring freeze and first fall freeze defined by 32°F (red) and 28°F (blue) thresholds for Wauseon, Ohio for the period 1970-2020. Dashed lines show linear trends.

Opportunities

- Warmer temperatures lead to longer growing seasons (Figure 3)
- New crops and potentially new markets
- Longer grazing periods for livestock
- Reduced maintenance costs

Challenges

- Additional (sustained) heat stress on livestock and farm labor
- Reduced food productivity and quality due to accelerated phenology
- Increasing weed, insect, and disease pressure
- Winter/spring wetness creating and disease and birthing issues in livestock
- Unpredictable growing seasons due to extreme variability
- Decreasing suitable fieldwork days for spring and fall activities (Figure 4)
- Invasive, non-native plants and animal ranges expanding
- Greater flood risk and frequency of flooding
- Reduced water quality from increasing runoff, soil losses, and nutrient losses
- Elevated health risks associated with flooding include mold and contaminants
- Future challenges to grain production (corn, soybean)

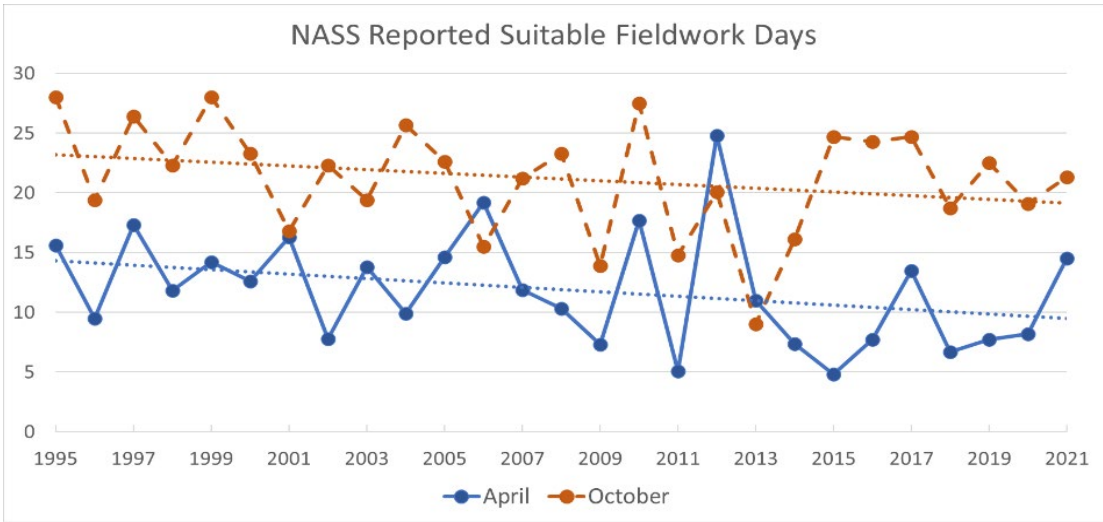

Figure 4. Time series showing the days suitable for fieldwork in Ohio, as reported by NASS, for April (blue) and October (orange) for the period 1995-2021. Dashed lines show linear trends.

For more on agricultural impacts, please visit the following resources:

- USDA Climate Indicators for Agriculture - https://www.usda.gov/sites/default/files/documents/climate_indicators_for_agriculture.pdf
- USDA Climate Change and Agriculture in the United States: Effects and Adaptation - https://www.usda.gov/sites/default/files/documents/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf
- Fourth National Climate Assessment - https://nca2018.globalchange.gov/
- USDA Midwest Climate Hub - https://www.climatehubs.usda.gov/hubs/midwest

Adaptation Resources

Knowing the potential impacts (exposure to changes in temperature, precipitation, or extreme weather) and adaptive capacity (how well can the system cope with these potential impacts) helps us define our vulnerability. When it comes to building adaptative capacity, we are trying to limit the vulnerability to our production system. Adaptation also means something different to each landowner because decisions are influenced by our values, culture, resources, site conditions, goals, equipment, procedures, and knowledge. There is no single answer to adaptation and landowners are encouraged to explore potential options that work for their operations. Suggestions include:

- Managing for higher temperatures in horticultural settings
    - Crop regulation and canopy management – using temperature data loggers to optimize temperatures and other greenhouse modifications
    - Using irrigation to ameliorate temperature extremes or sprinkler irrigation to reduce canopy temperatures
    - Developing vegetable and fruit hybrids with greater heat tolerances
- Adjusting to changes in seasonal precipitation cycles
    - Improving water harvesting and storage including:
        - Using dams and catchments to cope with projected rainfall and evaporation rates
        - Use in-row water harvesting for grapes and tree crops
        - Harvest water run-off from greenhouses
        - Increase investments in tanks and dam storages
    - Improving irrigation efficiency
        - Watering at night, using drip irrigation, or using subsurface drip irrigation to limit evaporation
        - Improve mulching with organic materials, consider plastic mulching
        - Reduce runoff with appropriate irrigation rates, contour sowing, minimum tillage
- Conservation practices to slow progress of water from fields to stream
    - Cover crops, no-till/minimum-till, and crop diversity/rotation to improve in field water storage capacity and increase organic matter in soil
    - Controlled drainage structures to improve runoff and mitigate damage potential from extreme rainfall events
    - Filter strips, grass waterways, riparian forest buffers and other conservation techniques that limit runoff into ditches and local streams

- Equipment decisions
    - Bigger equipment to deal with shorted planting seasons or smaller equipment to limit compaction in fields
    - Precision applications of fertilizer and other inputs to limit losses from extreme precipitation events

There are growing number of climate adaptation resources are available for agriculture and natural resource managers. For example:

- The Northern Institute of Applied Climate Sciences has created an adaptation workbook (https://adaptationworkbook.org) to help understand and respond to local threats through various curated lists of adaptation actions by topic and an online course designed to help practitioners create a custom adaptation plan.
- The USDA Adaptation Resources for Agriculture https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf helps producers consider short and long-term management actions around eight strategies:
    - Strategy 1: Sustain fundamental functions of soil and water.
    - Strategy 2: Reduce existing stressors of crops and livestock.
    - Strategy 3: Reduce risks from warmer and drier conditions.
    - Strategy 4: Reduce the risk and long-term impacts of extreme weather.
    - Strategy 5: Manage farms and fields as part of a larger landscape.
    - Strategy 6: Alter management to accommodate expected future conditions.
    - Strategy 7: Alter agricultural systems or lands to new climate conditions.
    - Strategy 8: Alter infrastructure to match new and expected conditions.

For more on adaptation, please visit the following resources:

- North Central Climate Collaborative - https://northcentralclimate.org/
- Climate Ready Farm Assessments - https://climateready.msu.edu/
- Soil Health Nexus - https://soilhealthnexus.org/

School of Environment and Natural Resources

Human – Wildlife Conflict Resources

Marne Titchenell, Extension Program Specialist - Wildlife, School of Environment and Natural Resources, The Ohio State University.

Wildlife Conflict Fact Sheets

OSU Extension Nuisance Wildlife Fact Sheets (woodlandstewards.osu.edu/publications/wildlife)

USDA Wildlife Damage Management Technical Series (go.osu.edu/usdawildlife)

Prevention and Control of Wildlife Damage: The Handbook (go.osu.edu/icwdm)

Wildlife Conflict Websites

ODNR, Division of Wildlife Nuisance Wildlife Information (go.osu.edu/dowconflictinfo) – *general prevention for variety of species*

MSU Extension Wildlife Management on the Farm (www.canr.msu.edu/ipm/wildlife-management/)

Wildlife Damage Management - National Cooperative Extension (wildlife-damage-management.extension.org/)

Internet Center for Wildlife Damage Management (icwdm.org/)

Ohio Community Wildlife Cooperative (u.osu.edu/ocwc) – *webinars from past conferences, upcoming conference date*

Other Wildlife Conflict Resources

List of Nuisance Wild Animals Control Operators

USDA, Animal Plant Health Inspection Service (APHIS) Wildlife Services (1-866-487-3297) – *vulture depredation permits, gas cartridges for groundhogs, coyote trapping and feral swine expertise*

ODNR, Division of Wildlife Orphaned and Injured Wildlife Information (go.osu.edu/injuredWL)
List of Wildlife Rehabilitators in Ohio

Ohio Bat Working Group (u.osu.edu/obwg) – *bats in buildings, injured bats, bat houses, bats and diseases, videos on Ohio bats*

Wildlife Damage Permit Information

Deer Damage Control Permit Information
Online permit application

Goose Damage Reporting Information
Online permit application

Ohio Landowner/Hunter Access Partnership Program

Site Visit for Evaluation of Forestry/Wildlife Resources

ODNR, Division of Forestry – Service Foresters
ODNR, Division of Wildlife – Private Lands Biologists
SWCD, Wildlife Specialists
Pheasants Forever Farm Bill Biologists

Want to learn more about wildlife?

The WildSide@OSU (u.osu.edu/wildside) – articles, webinars, links to resources on Ohio wildlife

The Ohio Woodland Stewards Program (woodlandstewards.osu.edu) – classes, workshops, webinars

Questions?

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THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

THE OHIO STATE UNIVERSITY EXTENSION

Bat Exclusion Guidelines for Ohio: go.osu.edu/batEX

- **14 or fewer bats may be removed at any time of year.**
  - Property owners OR licensed commercial nuisance wild animal control operator
- **Colonies of 15 or more bats may not be removed during the maternity season (May 16 - July 31) unless by written authorization by the Chief of the Division of Wildlife.**
  - Application for authorization is posted on DOW website (wildohio.gov)
- Exclusion is only legal means of removal.
- Must inspect structure to confirm bat maternity presence
  - During May 16-July 31: If no bats found, must perform at least 2 bat watches over a 7- day period prior to performing exclusion
    - Can be done by property owner or control operator

THE OHIO STATE UNIVERSITY EXTENSION

Ohio Bat Working Group

Communication and collaboration between bat-minded people.

Home | Annual Meeting | Bat Week | Coexisting with Bats | Educator Resources | Get Involved | Habitat Management | About

- Bat Exclusion
- Rabies Info
- Wildlife Rehabbers

OHIO BAT WORKING GROUP

- Bat Houses
- Forest Mgt

Follow us on Facebook at www.facebook.com/OhioBWG

BAT CONSERVATION INTERNATIONAL'S BAT HOUSE PROJECT

Bat Houses? Here's How!

Thank you for your interest in bat houses. Many people are discovering the benefits and wonder of bats by providing new homes for these fascinating mammals. We have learned much about the roosting needs and preferences of bats, and we share the latest information through BCI's website, free electronic newsletter, and *The Bat House Builder's Handbook*. Homeowners, farmers, organic gardeners, foresters and recreation managers around the world are installing bat houses for education and pest reduction. Please join us by providing an acceptable home for our beneficial bats and helping us improve the design, location and use of bat houses. Thanks again for your interest.

Answers to Frequently Asked Bat House Questions

Will attracting bats to bat houses in my yard increase the likelihood that they will move into my attic or wall spaces?
No. If bats liked your attic or wall spaces, they probably would already be living there.

How many bats can potentially occupy my bat house?
A single-chamber house can shelter 50 bats, while a larger multi-chamber design can attract colonies of 200 or more bats.

How can I determine the likelihood of attracting bats?
Throughout most of the United States and much of Canada there are occupied bat houses being used by one of North America's many crevice-dwelling bat species. Wherever bats live, they must find enough insects to eat, largely explaining their preference for roosting near aquatic habitats. The closer you live to cave or mine hibernating sites the better, and the existence of bat colonies in nearby buildings and bridges also increases your chances.

Why might bats not be attracted to my bat house?
The most frequent cause of failure is inappropriate exposure to solar heating. Alternatively, bats may not be able to live in your area due to heavy pesticide use, inadequate food supply or lack of available caves and mines within 50 to 100 miles (80 to 160 km). So far, we are unaware of large areas of North America (except for hot desert lowlands) that cannot attract bats.

If I have bats living in my attic, but would prefer that they occupy a bat house, what should I do?
Attics and other parts of buildings often provide ideal bat roosting sites. In most cases, bats will not voluntarily move from an attic. In such cases, alternative roosts ideally should be provided several months or one season before the desired move. The bats should be evicted from the attic at a time in the early spring or fall when flightless young are not present. Eviction is often easily accomplished. Watch to see where the bats emerge at dusk. Using 1/6" (4 mm) or smaller plastic mesh, bird netting or clear, heavy plastic, hang a large enough piece over the emergence point, extending a foot (30 cm) below and to each side of the exit. Secure the net in place so that it hangs free an inch (25 mm) or so away from the building. It will act as a one-way valve, permitting exit, but closing when bats land on it to return. For more information about bat eviction, please refer to the Bats in Buildings Project on BCI's website (*www.batcon.org*).

How effective are bats in controlling insects?
As primary predators of night-flying insects, bats play a key role in the balance of nature, consuming vast quantities of insects, many of which are costly agricultural and yard pests. Furthermore, many insects avoid areas where they hear bats.

Will having bat houses in my yard interfere with attracting birds?
No. They rarely compete for food or space.

Will bat droppings pose a threat to my family?
No more so than bird or cat droppings would. You should avoid inhalation of dust associated with animal feces of any kind.

What are the odds that a sick bat will endanger my family with rabies?
Only 14 people in more than 50 years have contracted rabies from North American bat species that commonly live in bat houses. Like all mammals, bats can contract rabies, though very few do (less than half of one percent). Unlike many other animals, even rabid bats rarely become aggressive. They quickly die from the disease, and outbreaks in their colonies are extremely rare. The odds of being harmed by a rabid bat are remote if you simply do not attempt to handle bats. *Any bat that can be easily caught should be assumed to be sick and left alone.* We do not recommend attracting bats to places where curious children are likely to attempt handling them. With or without bats in your yard, *the most important action you can take to protect your family from rabies is to vaccinate your family dogs and cats.*

Criteria For Successful Bat Houses

1. Design All bat houses should be at least 2 feet tall (61 cm), have chambers at least 14 inches (36 cm) wide, and have a landing area extending below the entrance at least 3 to 6 inches (8 to 15 cm) (some houses feature recessed partitions that offer landing space inside). Taller and wider houses are even better. Rocket boxes should be at least 3 feet (91 cm) tall and have at least 12 inches (30 cm) of linear roost space. Most bat houses have one to four roosting chambers—the more the better. Roost partitions should be carefully spaced 3/4 to 1 inch (19 to 25 mm) apart. All partitions and landing areas should be roughened. Wood surfaces can be scratched or grooved horizontally, at roughly 1/4- to 1/2-inch (6 to 13 mm) intervals, or covered with durable square, plastic mesh [1/8- or 1/4-inch (3 to 6 mm) mesh, available from companies such as Internet, Inc. at 1-800-328-8456]. Include vents approximately 6 inches (15 cm) from the bottom of all houses 24 to 32 inches (61 to 81 cm) tall where average July high temperatures are 85°F (30°C) or above. Front vents are as long as a house is wide; side vents 6 inches (15 cm) tall by 1/2 inch (13 mm) wide. Houses 36 inches (91 cm) or taller should have vents approximately 10 to 12 inches (25 to 30 cm) from the bottom.

2. Construction For wooden houses, a combination of exterior plywood (ACX, BCX or T1-11 grade) and cedar is best. Plywood for bat house exteriors should be 1/2-inch (13 mm) thick or greater and have at least four plies. Do not use pressure-treated wood. Any screws, hardware or staples used must be exterior grade (galvanized, coated, stainless etc.). To increase longevity, use screws rather than nails. Caulk all seams, especially around the roof. Alternative materials, such as plastic or fiber-cement board, may last longer and require less maintenance.

3. Wood Treatment For the exterior, apply three coats of exterior grade, water-based paint or stain. Available observations suggest that color should be black where average high temperatures in July are less than 85°F (30°C), dark colors (such as dark brown or dark gray) where they are 85° to 95°F (30° to 35°C), medium colors where they are 95° to 100°F (35° to 38°C) and white or light colors where they exceed 100°F (38°C). Much depends upon amount of sun exposure; adjust to darker colors for less sun. For the interior, use two coats dark, exterior grade, water-based stain. Apply stain after creating scratches or grooves, or prior to stapling plastic mesh. Paint fills grooves, making them unusable.

4. Sun Exposure Houses where high temperatures in July average 80°F (27°C) or less should receive at least 10 hours of sun; more is better. At least six hours of direct daily sun are recommended for all bat houses where daily high temperatures in July average less than 100°F (38°C). Full, all-day sun is often successful in all but the hottest climates. To create favorable conditions for maternity colonies in summer, internal bat house temperatures should stay between 80° and 100°F (27° and 38°C) as long as possible.

5. Habitat Most nursery colonies choose roosts within 1/4 mile (400 m) of water, preferably a river or lake. Greatest bat house success has been achieved in areas of diverse habitat, especially where there is a mixture of varied agricultural use and natural vegetation. Bat houses are most likely to succeed in regions where bats are already attempting to live in buildings.

6. Mounting Bat houses should be mounted on buildings or poles. Houses mounted on trees or metal siding are seldom used. Wooden, brick or stone buildings with proper solar exposure are excellent choices, and locations under the eaves often are successful. Single-chamber houses work best when mounted on buildings. Mounting two bat houses back to back on poles is ideal (face one house north, the other south). Place houses 3/4 inch (19 mm) apart and cover both with a galvanized metal roof to protect the center roosting space from rain. All bat houses should be mounted at least 12 feet (4 m) above ground; 15 to 20 feet (5 to 6 m) is better. Bat houses should not be lit by bright lights.

7. Protection from Predators Houses mounted on sides of buildings or on metal poles provide the best protection from predators. Metal predator guards may be helpful, especially on wooden poles. Bat houses may be found more quickly if located along forest or water edges where bats tend to fly; however, they should be placed at least 20 to 25 feet (6 to 8 m) from the nearest tree branches, wires or other potential perches for aerial predators.

8. Avoiding Uninvited Guests Wasps can be a problem before bats fully occupy a house. Use of 3/4-inch (19 mm) chambers reduces wasp problems. Wasp nests should be removed in late winter or early spring before either wasps or bats return. Open-bottom houses greatly reduce problems with birds, rodents or parasites, and guano does not build up inside.

9. Timing Bat houses can be installed at any time of the year, but are more likely to be used during their first summer if installed before the bats return in spring. When using bat houses in conjunction with excluding a colony from a building, install the bat houses at least two to six weeks before the actual eviction, if possible.

10. Importance of Local Experimentation It is best to test for local needs before putting up more than three to six houses, especially comparing those of different darkness and sun exposure.

To order *The Bat House Builder's Handbook*, *Building Homes for Bats* video or ready-made bat houses, call 1-800-538-BATS or visit Bat Conservation International's website at: *www.batcon.org*.

Core Information

INFORMATION

CFAES THE OHIO STATE UNIVERSITY EXTENSION

How to Safely Remove Disposable Gloves

1. 

Pinch outside of glove near wrist. *It is advisable to wash disposable gloves prior to removing remaining PPE.*

2. 

Peel glove downward away from wrist, turning glove inside out.

3. 

Pull glove away until it is completely removed, holding it in your gloved hand.

4. 

Carefully slip two fingers under the wrist of the remaining glove, only touching the inside of the contaminated glove.

5. 

Pull second glove downward over the first glove. *Dispose of gloves according to the pesticide label.*

6. 

Thoroughly wash hands after removing gloves.

The Ohio State University
College of Food, Agricultural, and Environmental Sciences

OSU Ag Safety and Health
agsafety.osu.edu
614-292-6008

The Pesticide Safety Education Program
pested.osu.edu
614-292-4070

Pesticide Update 2023

Mary Ann Rose
Pesticide Safety Education Program, Ohio State University Extension

Chlorpyrifos insecticide food uses revoked

Effective February 28, 2022, all crop tolerances for chlorpyrifos expired which effectively ended its use in crops. After tolerances were revoked, chlorpyrifos application would render any treated food adulterated and unable to be distributed in interstate commerce. Chlorpyrifos can still be legally used for non-crop uses, or if the agricultural commodity produced from a crop is not a food, for example, crops grown for seed and non-bearing fruit trees. There are many labeled pesticide alternatives to chlorpyrifos for managing pests and mites. See the Field Crops Insect Pest Management Guide for alternatives for common field crops of Ohio and Michigan: https://aginsects.osu.edu/sites/aginsects/files/imce/2021%20IPM%20Guide%20Online%20Version.pdf

Farmers who no longer have legal uses for chlorpyrifos stock may have opportunities for pesticide disposal through their local solid waste authority. In addition, Ohio Department of Agriculture provides several locations in July and August each year where growers may bring agricultural pesticides for disposal. Check pested@osu.edu in July for details.

Dicamba for Over-the-top Use in Dicamba-Tolerant Soybeans

In late 2020, new registrations or extensions were announced for the dicamba products designed for over-the-top use on dicamba-tolerant crops, i.e., Xtendimax, Engenia and Tavium. These pesticide labels will expire in December 2025. New restrictions were added to the labels, including a June 30 application cutoff date and increased buffer requirements. The addition of one or more tank additives is also required. Direct supervision is prohibited, so only the licensed applicator may purchase and apply these products. Applicators are required to take complete dicamba-specific training and keep the specific records in addition to those required by Ohio pesticide law. Dicamba-specific training opportunities for 2023 will be posted online at pested.osu.edu/privateapplicator as soon as they become available.

Enlist

The current Enlist label will expire in January 2029. New restrictions on the label include an earlier cutoff timing in soybeans (R1) and required runoff mitigation measures based on soil type. Application must take place no less than 48 hours before predicted rainfall (by National Weather Service or similar forecasting service).

Glyphosate Update

In 2022, the EPA's analysis of human health and ecological risks of glyphosate was challenged in court. As a result, EPA withdrew the Interim Glyphosate Registration Decision and will have to address the court's concerns in the next version. The US EPA still maintains that scientific findings indicate that there are no risks of concern to human health when glyphosate is used according to label, and considers the herbicide unlikely to cause cancer in humans.

Bayer intends to replace glyphosate in U.S. residential lawn and garden products with other pesticide active ingredients in 2023. Glyphosate will remain in professional and agricultural products.

Ohio Pesticide Law Reminders for Private Applicators

Mary Ann Rose

Pesticide Safety Education Program, Ohio State University Extension

Ohio Department of Agriculture

The Ohio Department of Agriculture has the authority to enforce Ohio and federal pesticide laws. ODA inspectors have the authority to investigate pesticide complaints and inspect pesticide records, pesticide storage, and application sites. ODA also registers all pesticides used in Ohio. Contact ODA at 614-728-6987.

Private Pesticide Applicator

Private pesticide applicators may apply restricted use pesticides in the production of agricultural commodities on property owned or rented by them or their employer. Licensed private applicators may supervise the use of restricted use pesticides by their employees or unlicensed family members; the license holder must provide the necessary safety equipment to the unlicensed applicator and instruct them in the appropriate precautions. If applying in the license holder's absence, the pesticide label must be available at the worksite to unlicensed applicators. No one under 18 years of age may handle, mix, or load a pesticide with a "Danger-Poison" signal word without on-site supervision by a licensed applicator.

Adverse Effects

Pesticide applications can potentially cause problems. These are sometimes due to illegal or faulty applications, but may occur even when proper precautions are taken.

Ohio Pesticide Law contains two regulations concerning problem reporting. Private and commercial applicators are required to report adverse effects to the Ohio Department of Agriculture (ODA):

By telephone, within 48 hours of his/her knowledge of any human illness requiring medical attention, resulting from, or allegedly resulting from a pesticide used by the applicator, followed by a written report within seven (7) days.

By written report within ten (10) days of his/her knowledge of any property damage, in excess of $500 resulting from or allegedly resulting from a pesticide used by the applicator.

Reporting the incident does not mean the applicator will be assumed guilty of wrongdoing. ODA will conduct an investigation into the incident. Records of the application and other evidence will be reviewed during the investigation.

Protecting Bees in Ohio

Applicators are required to read the label and follow directions to avoid harm to the environment, non-target organisms and endangered species. The label will indicate if the pesticide is toxic to non-target organisms such as fish, aquatic invertebrates, bees, or other organisms.

According to Ohio law, if a pesticide label indicates it is toxic to bees, it is the applicator's responsibility to contact any beekeepers with registered apiaries (beehives) within ½ mile of the area to be treated when the treatment area is more than ½ acre in size and the crop plant is in flower. Apiaries must be notified at least 24 hours before application. A complete list of registered apiaries is available through the ODA Apiary Section by contacting apiary@agri.ohio.gov or (614) 728-6373.

The law also states that pesticides with bee hazard statements on the label may not be applied at times when pollinating insects are actively foraging in the target area. Bees tend to be least active early in the morning or late in the evening.

Follow label precautions that relate to drift and be aware of the potential risk of drift to neighboring areas. Filter strips or other conservation areas that border fields may also have flowering plants and weeds with foraging bees that must be avoided.

Pesticide formulation has an impact on bee toxicity. Dusts and wettable powders are more toxic than emulsifiable concentrates. Ultra-low volume applications are generally more toxic than a high volume applications. Repellents are not effective in keeping bees away from treated areas.

Pesticide Storage Requirements

Storing pesticides correctly is important to prevent contaminating water and cross contamination with other stored items. Applicators need to be aware of Ohio regulations for storing pesticides and also follow any label instructions for storage. Applicators must not store pesticides in a manner that could contaminate animal feeds or fertilizers. It is advisable that pesticide storage areas not have a drain, or the drain should be plugged.

Use Inconsistent with the Label

Using a pesticide in a manner inconsistent with its labeling is illegal and considered a misuse. The label is the law. Examples of misuse may include:

Applying a pesticide to a site, crop, or for a use that is not listed on the label.

Applying a pesticide at a rate higher than the labeled rate or at more frequent intervals.

Handling a pesticide in a way that is against label instructions, such as:

• Not wearing appropriate personal protective equipment (PPE).

• Not observing well-setbacks.

• Not following preharvest- and restricted-entry intervals

Worker Protection Standard

Private applicators may be required to follow the guidelines for the Agricultural Worker Protection Standard (WPS). This regulation is issued by the Environmental Protection Agency (EPA) and enforced by the ODA.

The purpose of WPS is to reduce occupational pesticide-related illness. The regulations apply to growers who use pesticides for production of agricultural plants and employ workers or pesticide handlers who are exposed to such pesticides. You are required to follow the entire WPS if you employ anyone (even one employee) outside of immediate family who is working in areas that have had a pesticide application or a restricted entry interval (REI) in effect within the last 30 days. A limited number of WPS protections are also required for family members.

You must keep agricultural workers out of pesticide-treated areas during the restricted entry interval (REI) found on the pesticide label under "Agricultural Use Requirements." Alternatively, REIs may appear in the "Direction for Use" section under each crop. The Agricultural Use Requirements box cites the Worker Protection Standard, 40 CFR part 170. Most WPS requirements will not be on the label; you will need to consult the WPS compliance manual or the other resources found at **pesticideresources.org.**

In 2015, the Worker Protection Standard was substantially revised, including changes to safety training, decontamination sites, hazard communication, and entry restrictions. For more information, see the article on "The Worker Protection Standard" in this publication.

Drift is the Most Frequent Complaint to the Ohio Department of Agriculture

Historically, drift has been the most common pesticide-related complaint to ODA. The past year was no exception. There were 101 Agricultural drift complaints out of a total of 111 agricultural complaints in 2022. Nineteen of these complaints were related to dicamba use.

Ohio law states that you must not apply pesticides in a manner that adjacent crops, pasture land, water, or other areas will be damaged or contaminated. To help reduce pesticide drift on sensitive areas, ODA offers a free tool, the Ohio Sensitive Crop Registry. The FieldWatch component is for applicators to locate sensitive areas. Growers and beekeepers can securely share their locations with pesticide applicators using DriftWatch and BeeCheck (see the Ohio Sensitive Crop Registry article in this book).

Fertilizer Certification Requirements

Fertilizer applicators are also required to be certified if fertilizer is applied to more than 50 acres of agricultural production grown primarily for sale. Under this regulation, fertilizers are defined as materials that contain one or more recognized nutrients and have a guaranteed analysis; manure is not included.

Applicators can become certified by taking an exam offered by ODA, or by attending a 3-hour educational program offered by OSU extension. Every three years, one hour of recertification training, or passing the exam will be required to maintain certification. Pesticide applicators may obtain a fertilizer certificate at no additional cost, but those without a pesticide license must pay a $30 fee for the certificate.

Certified fertilizer applicators are required to keep records of all fertilizer applications.

For manure applications, no one may apply manure from a concentrated animal feeding facility (CAFF) unless: 1) the person is an Ohio Certified Livestock Manager (CLM) or 2) the person has been certified through the Fertilizer Applicator Certification (FACT) training.

In the Western Lake Erie Basin watershed, there are additional regulations that restrict manure, nitrogen and phosphorus fertilizer applications under certain weather and soil conditions. For more information about fertilizer certification/recertification, laws and record keeping, see **nutrienteducation.osu.edu.**

Ohio Private Applicator Pesticide Recordkeeping Requirements

Pesticide Safety Education Program

Ohio State University Extension

Private pesticide applicators are required to keep application records for all restricted use pesticides. Although there is no standard format required, Ohio pesticide application records need to follow these guidelines:

- **Who**
  - Record the responsible applicator's name and license number.

- **What**
  - Record the trade or brand name of the pesticide used.
  - List the EPA registration number which is the unique identifying number located on the front panel of the pesticide label. This will help indicate exactly what product was used.
  - Record the total amount applied.

- **Where**
  - Indicate location and/or field number of area treated. Farm map keys may be used.
  - Record the size of the area or acreage treated.
  - Remember to record spot treatments.
  - Specify the crop in the treated area.

- **When**
  - Record the month, date, and year of application.

- **Why**
  - Records are required by law for all restricted-use (RUP) applications, but are recommended for all pesticide applications.
  - Records must be:
    - Recorded on the day of application.
    - Kept for three years.
    - Provided to rental or lease landowners within 30 days of request.
    - Provided to the state pesticide regulatory agency (OH Dept. of Agric.) upon request.
  - Benefits of recordkeeping:
    - Easier handling of complaints and legal action.
    - Many lenders require pesticide records when property sells.
    - Keeping good records is a Best Management Practice.
    - Food processors may require history of fields for food security.
    - Evaluate Integrated Pest Management (IPM) effectiveness.

A sample excel file of the Private Applicator Restricted Use Pesticide Recordkeeping Form is available at **pested.osu.edu/PrivateApplicator/recordkeeping**

Your county extension office may have copies of the Ohio State University Extension, "Private Applicator Pesticide Records" books available for distribution.

ONLINE PESTICIDE RECORDKEEPING IS NOW AVAILABLE:
pested.osu.edu/onlinerecords

Private Applicator Restricted Use Pesticide Recordkeeping Form

Who: Name & License Number:

What			**Where**			**When**	Notes
Brand or Product Name	EPA Registration Number	Total Amount Applied	Size of Area Treated	Crop	Location	Application Date (mm/dd/yyyy)	

CASE #:

PESTICIDE COMPLAINTS

PESTICIDE REGULATION SECTION

The Ohio Department of Agriculture is responsible for regulating the sale, distribution, use and storage of pesticide products in Ohio. ODA also represents the U.S. Environmental Protection Agency (EPA) for inspection and investigation activities conducted under the federal pesticide law (FIFRA). The ODA pesticide section has 12 pesticide field inspectors covering 88 counties.

IMPORTANT CONTACTS

For medical emergencies, call 911

Poison Control Center
(800) 222-1222

Ohio Department of Agriculture
Pesticide Regulation Section
(614) 728-6987
(800) 282-1955
Email: pesticides@agri.ohio.gov
www.agri.ohio.gov

National Pesticide Information Center
(800) 858-7378
Npic.orst.edu

OSCR Ohio Sensitive Crop Registry
Brought to you by
FieldWatch
www.fieldwatch.com
FieldWatch is a secure web map showing locations in Ohio which are susceptible to damage by pesticide drift or off-target applications.

IF YOU BELIEVE YOUR PROPERTY HAS BEEN DAMAMGED OR CONTAMINATED BY A PESTICIDE APPLICATION, AND YOU WANT ODA TO INVESTIGATE AND ENFORCE THE OHIO PESTICIDE LAW:

1. Contact ODA immediately. A long time lapse will make it difficult for ODA to document violations for enforcement action.

2. You should record a detailed description of what you witnessed or what you believed happened. When you record details about the drift incident, be sure to include:
- The date, time, and location the alleged drift incident occurred.
- The name of the pesticide applicator.
- The wind speed (gusty, high, low) and wind direction (toward or away from your property).
- Take several photos and be sure the photos include a time and date stamp. It may take 7-10 days for herbicide symptoms to appear. You will not usually notice any plant damage or symptoms from insecticides and fungicides.
- Detailed notes of every conversation, phone call, and correspondence related to the incident.
- If you did not see the pesticide application, but noticed injury to plants, honeybees, fish, landscaping, etc., write down the date and details of when you first noticed the injury.

Ohio | Department of Agriculture

What to Expect After Filing a Pesticide Complaint

The Ohio Department of Agriculture (ODA) regulates the use and distribution of pesticides in Ohio. ODA also investigates consumer complaints when it appears that there are potential violations of Ohio Pesticide Law. The investigation of complaints is at no cost to the complainant.

Here's what will happen after you file a formal complaint with ODA:

1. ODA will immediately investigate cases that involve human health. Most other complaints can take up to 10 days or longer before action, depending on the inspector's case load.

2. An ODA inspector will make an appointment with you to see the location where the alleged violation occurred.

3. The inspector will examine and photograph the site and may take physical samples.

4. The inspector will contact the applicator to inquire about what pesticides were applied and other pertinent information.

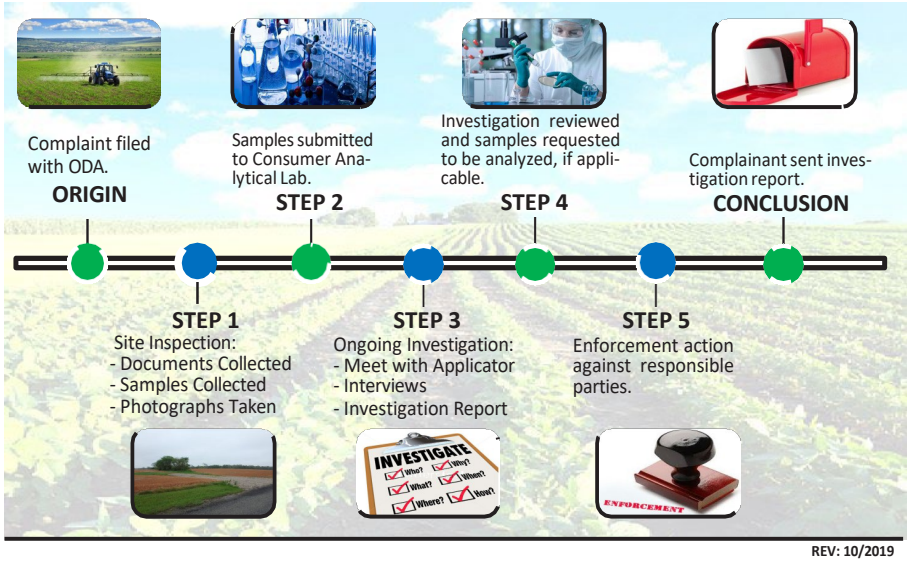
5. After the inspector has gathered all of the necessary information, ODA administrative and technical staff will review the case for possible violations of Ohio Pesticide Laws. This process can take a few months to a year.

6. If ODA concludes that there was a violation, ODA will address the violation with the applicator.

7. ODA will provide a case summary to the complainant at the conclusion of the investigation and enforcement action (if applicable). Completed ODA cases are considered public information and can be requested by anyone.

Remember: Ultimately, pesticide complaints are a civil matter between the parties involved. ODA's primary focus in any complaint investigation is to determine whether Ohio's pesticide laws have been violated. ODA is authorized to take enforcement action if a violation is found. However, ODA is not authorized to pursue damages or restitution on behalf of any individual or person whose property has been damaged due to a pesticide application. You may wish to contact an attorney to discuss any options that you may have to pursue restitution associated with any damaged property.

Complaint Timeline



REV: 10/2019

FREQUENTLY ASKED QUESTIONS

What is the role of the pesticide inspector?

After receiving a complaint, an inspector will contact pertinent individuals to conduct inspections and/or interviews. The investigator will document the incident through evidence collection that may include: maps, photographs, affidavits, pesticide label reviews, on-site assessments and sample collection. The inspector's observations will be compiled into a case report of the incident.

How soon after I make a complaint will an investigation be conducted?

An ODA inspector will generally make telephone contact with the complainant within 2-3 days of the initial complaint. This telephone contact will allow the inspector to schedule a site inspection at a mutually convenient time for the complainant and the inspector. The site visit will generally be conducted within 10 days of the initial complaint. Complainants are encouraged to complete a written statement prior to the inspectors arrival. Complainants should also collect and photocopy for the inspector all bills, invoices, contracts, correspondence or other documents that relate to the complaint.

What happens after the inspector's visit to my property?

After the site inspection, the inspector will meet the applicator to inquire about what pesticides were applied and obtain all other pertinent information. When the inspector has gathered all of the necessary information related to an investigation, a case report will be generated. Then the ODA staff will review the case for possible violations of Ohio Pesticide Law. If a violation has been detected, one of the following enforcement actions may be applied: Field Notice of Warning, Notice of Warning, Civil Penalty, License Action, or Criminal Prosecution.

How long does an investigation usually take from start to finish?

Although the goal of ODA is to complete every case as quickly as possible, many factors delay the conclusion of a case. (i.e. complicated laboratory analyses; lack of cooperation of applicator and complainant; the need to conduct follow-up investigations; and the need to respond to other complaint incidents). Because each case varies, it is impossible to provide an estimate on how long it may take to conclude a particular case. If you are interested in a status update of your case, you can contact ODA at (614) 728-6987 for an update.

Who has access to complaint investigation information and case summaries ?

A final written report will be provided to the complainant and anyone else who makes a public records request for it. Case files are public documents once the investigation has been concluded.

How will I be compensated for my pesticide damages?

The focus of ODA complaint investigations is to determine if pesticides were used according to label directions and applicable laws. Damage compensation is a civil matter between the parties that are involved in the complaint. ODA is not authorized to pursue damages or restitution on behalf of any individual or person whose property has been damaged due to a pesticide application. You may wish to contact an attorney to discuss any options that you may have to pursue restitution associated with any damaged property.

Who can I call if I have a question regarding a complaint?

Call ODA at 614-728-6987 Monday through Friday, 8:00am-5:00pm. Be sure to reference your case number.

Serving Farmers and Protecting Consumers Since 1846

Ohio Sensitive Crop Registry, Provided by FieldWatch, Inc.

Pesticide and Fertilizer Regulation Section

Ohio Department of Agriculture

The Ohio Sensitive Crop Registry (OSCR), which is now provided by FieldWatch, Inc., is a free and voluntary online tool for beekeepers and growers of both specialty and pesticide-intolerant row crops to securely share their locations with pesticide applicators. Applicators can search the map to see where these high-value, sensitive areas are that registered growers and beekeepers have mapped.

This registry displays the locations of registered apiaries, organic crops and pesticide-sensitive locations including but not limited to: fish farms, nurseries, orchards, greenhouses and high tunnels, vegetables and fruit such as brambles, grapes and tomatoes. Special varieties of row crops are also eligible to be registered, such as ACCase-inhibitor tolerant corn and HPPD-inhibitor tolerant soybeans.

OSCR is intended to be used by pesticide applicators and agricultural producers only. Both hobbyist and commercial honey bee hives are included, but only commercial specialty crop fields are mapped. Private gardens, yards, playgrounds, wildlife habitat and other sensitive areas are not included on the registry.

Benefits

Many pesticides now carry instructions concerning honey bees and susceptible crops; buffer zones and downwind restrictions are common when these sensitive areas are adjacent to the application area. Specialty crops are typically high-value (some may be 5-10 times more valuable than row crops) and sensitive to volatile pesticides like 2,4-D and dicamba. The registry provided by FieldWatch is a simple tool for growers of specialty crops to show applicators where these locations are, so label directions can be easily followed and risk of off-target damage minimized. It also allows beekeepers to inform applicators of their contact info and clearly identify their hive locations so that they may be contacted prior to spraying.

Since honey bees are sensitive to many pesticides, Ohio law has given them special protections. Pesticide applicators are required to contact beekeepers 24 hours before using a product that is labeled as being toxic to honey bees, if the crop to be treated is in bloom, greater than half an acre, and within a half-mile of a certified and identified apiary. This registry can help applicators easily locate these apiaries and find beekeeper contact information.

How it works

Users will need to create a free account with FieldWatch before searching or adding registered locations in Ohio. One of the benefits of the FieldWatch program is that users from one member state can view the sites in any other member state -without needing to create multiple accounts or use different registry programs.

1. Go to **fieldwatch.com**
   a. Applicators should click on "**FieldWatch for Applicators**" and create an account to search the maps.
   b. Beekeepers should click on "**BeeCheck for Beekeepers**" and create an account to add apiary locations to the registry.
   c. Specialty crop producers should click on "**DriftWatch for Specialty Producers**" and create an account to add commercial specialty crop locations to the registry.
   d. Row crop producers should click on "**CropCheck for Row Crop Producers**" and create an account to add commercial row crop locations to the registry.

People who register as Applicators will have access to search tools to view and print the location maps and access producer or beekeeper contact information. Applicators can also opt-in to receive automated emails that tell them when a commercial specialty crop field or apiary site has been newly approved.

Notifications can be set up based on the entire state, one or more counties, or a customized area.

Users who register as producers or apiarists will have access to tools allowing them to add, edit, or remove their locations from the map at any time during the year. There is no limit to the number or type of locations a user can add to the map.

Advanced Features

While using the FieldWatch registries are free, applicators and businesses who choose to become paid members will have access to some special features. Paid members will be able to download the registry data, or work with one of our Software Partners to view the sites directly from their navigation equipment. For more information about membership and these features, please contact FieldWatch, Inc. at 877-443-4353.

Requesting Bee Locations

As the locations in OSCR are voluntarily provided, it is not a complete listing of beehives in Ohio. Beekeepers in Ohio are required by law to register with the Department's Apiary Program (ORC 909); currently there are over 8,000 apiaries across the state. To find if there is a registered apiary in your spray area, you may request a copy of apiary locations by contacting the Apiary Program at apiary@agri.ohio.gov or 614-728-6373, specifying the county or counties you are interested in. Note that it may take several days to complete a records request.

Status

Ohio first started its honey bee and crop registry in the spring of 2014, and eventually grew to include over 17,000 registered acres. In the spring of 2018, Ohio joined the multi-state registry program provided by FieldWatch, Inc. At this time, 25 states are participating in the FieldWatch program, including Ohio, Michigan, and Indiana. Currently, Ohio has over 700 pesticide applicators & businesses using the system, and 1,800 crop producers and beekeepers.

Location Type	**Registered Count**
Apiaries	816
	Registered Acreage
Brambles/Berries	78
Corn	819
Fruit (Other)	180
Grapes	361
Greenhouse - High Tunnel	193
Hops	209
Non-specialty Certified Organic	8,894
Nursery Crops	110
Orchard	538
Other Specialty	1,343
Soybeans	1,374
Tomatoes	2,935
Vegetables (other)	6,721
Total Acres:	**23,755**

Contact Us

Questions about membership or for tech support, please contact FieldWatch, Inc:

Phone: 877-443-4353
Email: info@fieldwatch.com
Web: fieldwatch.com

General questions and concerns can be addressed to:

Phone: 614-728-6386
Fax: 614-466-9754
Email: SensitiveCropRegistry@agri.ohio.gov
Web: agri.ohio.gov/pesticides

The Worker Protection Standard

Mary Ann Rose

Pesticide Safety Education Program, Ohio State University Extension

What is the Worker Protection Standard (WPS)?

WPS is a federal regulation first established in 1992 to protect agricultural workers on farms, forests, nurseries and greenhouses from exposure to pesticides. These regulations provide protections to two types of employees: 1) workers involved in crop production who perform tasks such as weeding, watering, and harvesting; and 2) pesticide handlers who mix, load, and apply pesticides and those who assist them. For family operations, owners are exempt from providing some, but not all WPS protections to immediate family members who perform these kinds of tasks.

Who is responsible for WPS protections, and how do I know if they apply to my establishment?

If you grow an agricultural commodity (crops, not livestock) and employ workers or handlers as described above, you must provide WPS protections when using a pesticide with WPS labeling. Most pesticides used in crop production will carry the WPS reference; the WPS reference occurs in the "Agricultural Use Requirements" section of the pesticide label. Employers of commercial applicators who treat crops and agricultural labor contractors also must provide certain protections. In Ohio, the Ohio Department of Agriculture is responsible for enforcing WPS.

What kind of protections are required? - A brief review of the major components of WPS

Information & Training.

WPS requires annual pesticide safety training with specific content for workers and handlers, and a central display area that has pesticide application records, Safety Data Sheets, and the EPA-approved safety poster.

The Pesticide Educational Resources Collaborative (PERC) has developed free, EPA-approved materials that are available to download from the PERC website, pesticideresources.org. PowerPoint presentations and training videos for both workers and handlers are available in both English and Spanish versions, as well as handler training materials and a trainer reference manual. There are many other useful materials on the site including a "How to Comply" manual for employers. A new EPA-approved safety poster for use in the central display may be downloaded or copies may be ordered from PERC.

Protection.

WPS requires specific procedures for excluding workers from pesticide-treated areas. Workers must be notified, or in some cases, treatment areas must be posted to inform workers of pesticide applications on the premises so they may take all necessary precautions. Pesticide handlers must be provided with personal protective equipment (PPE) required by labels as well as other specific protections.

Exposure Reduction/Mitigation.

Decontamination supplies must be supplied to workers and handlers for both routine wash-up and emergency decontamination. Emergency transportation to a medical facility is required for an employee who becomes sick due to pesticide exposure.

WPS Revision

In 2015, a comprehensive overhaul was made of the existing WPS regulations. These changes were made to reduce pesticide exposure incidents. One key change was to require annual training for workers and handlers. Formerly there was a grace period for training new employees; this was eliminated, and workers now must receive training before they enter an area that was under a restricted entry interval within the past 30 days. Workers must be trained by either licensed pesticide applicators or someone who has taken an EPA-approved train-the-trainer course. Trainers must use EPA-approved training materials.

Pesticide handlers must be at least 18 years of age.

When pesticides requiring respirators are used, the applicator must have a medical evaluation, annual fit test and training in the care and use of the respirator.

The posting of signage during treatment and through the restricted entry period was previously required only in greenhouses; posting is now required in outdoor production if the pesticide has a restricted entry interval exceeding 48 hours. Depending on the type of application, application exclusion zones (AEZ) of up to 100 feet away from the application area may be required. Pesticide handlers must suspend application if anyone enters the AEZ during the application. Amounts of decontamination supplies for handlers and workers are also specified in the updated regulations.

In addition to posting pesticide application information at a central location, Growers must keep records of pesticide applications and relevant safety data sheets for two years. Workers, their designated representative, and medical personnel must have access to these records upon request. Records of training and respirator compliance also must be kept for two years.

When providing emergency assistance, the employer must provide to medical personnel specific information on the pesticide product, safety data sheet(s), as well as the circumstances of the application and exposure incident.

If I only employ family members on my farm, what parts of WPS apply to me?

Family are exempt from many of the WPS requirements, such as annual training. However, you must provide the following protections to family as well as yourself. You are required to supply personal protective equipment listed on the label, and to comply with restricted entry intervals and other restrictions during applications, including the application exclusion zone. When the label requires a respirator, the applicator must have a medical evaluation, fit test, and training prior to use.

The WPS family member definition has been expanded to include spouse, children, siblings, grandparents, grandchildren, aunts, uncles, nieces, nephews, first cousins, in-laws, foster or step-parent, child or sibling.

What is the respiratory protection requirement?

When the pesticide label requires a respirator, the user must have a medical evaluation, annual fit test, and training in the care and use of the respirator.

The purpose of the medical evaluation requirement is to prevent serious health complications that may be aggravated by wearing a respirator. The person who will use a respirator fills out a confidential medical questionnaire and submits it for evaluation by a professional. Respirator medical evaluations are available through online services, occupational safety clinics and physicians. If using an online service, be sure to choose one that is qualified to operate in your state. How someone responds to the medical questionnaire determines whether he is cleared for respirator use, requires further medical evaluation, or denied clearance. The medical evaluation is required only once unless someone develops new health issues or issues with wearing the respirator. Fees for medical evaluation through online services range from $20 to $50.

The fit test requirement ensures that a respirator forms a good seal, because without it, the respirator offers little protection. If the handler has facial hair between the sealing surface and the face, they cannot wear a tight-fitting respirator. Fit testing is required once a year, or whenever the respirator model is changed. You may purchase a test kit to do fit testing in-house, but for one or two fit tests per year it is probably easier and cheaper to go to an occupational safety clinic. Cost for fit testing ranges between $35 and $95. Some clinics offer package deals for both medical evaluation and fit test. The employer is responsible for costs associated with medical evaluation and fit testing.

WPS also requires keeping a record of compliance and training employees in the care and use of their respirators. In the absence of other indicators or manufacturer instructions, replace respirator cartridges after every 8 hours of cumulative use.

See pested.osu.edu/resources/wps/respiratorrequirements or call the Pesticide Safety Education Office at 614 292-4070 for more information about these requirements and for a list of fit testing and medical evaluations locations. Your local hospital also may have an occupational health clinic that provides the services. The Pesticide Safety Program also can help you with selecting an appropriate respirator for the pesticides you use.

How can I get more information on the new WPS rules?

The Pesticide Educational Resources Collaborative (PERC) (pesticideresources.org) has many resources for compliance and training. You also may contact the Ohio Pesticide Safety Education Program at 614-292-4070 or page pested.osu.edu/resources/wps for additional information.

Pesticide Calculation Challenge

Calculating Area, Rates and Tank fills Mary Ann Rose, Pesticide Safety Education Program

Helpful Conversions

- Dry weight measures: 16 oz = 1 lb
- Liquid volume measures: 1 gallon = 4 quarts = 8 pints = 128 fl. oz
- Area: 1 acre = 43,560 sq ft

Question 1: **How many acres are in a field that measures 385 feet long by 225 feet wide?**

a) Determine total number of square feet in field

b) Convert square feet to acres

Question 2: **How many gallons of herbicide product do you need to mix a full tank?**
Tank capacity = 1200 gallons
Spray volume = 15 GPA
Herbicide product rate = 1 pint per acre
Tractor speed = 14 MPH
Hint: there may be more information than you need.

a) Determine how many acres can you spray with a full tank

b) Next calculate how much product is needed in gallons

<u>Question 3</u>: You are using a postemergence herbicide and the label recommends adding a non-ionic surfactant at 0.25% v/v. How many gallons of surfactant do you need for 800 gallons of tank mix?

v/v is the volume concentration - it indicates the volume of the wetting agent per unit volume of the tank mix
Hint: 0.25% = .0025

Multiply the total volume of the tank mix by the wetting agent concentration

<u>Question 4:</u> How much water will you need to transport to the field to mix on-site and spray 225 acres if your sprayer is calibrated to apply 12 GPA?

Multiply the number of acres by the gallons per acre (GPA) to get the total volume of water you will need to transport to the field.

<u>Question 5</u>: You are spraying herbicide in 3' wide bands in rows that are 8' apart. If your entire field is 2 acres, how many acres are actually treated?

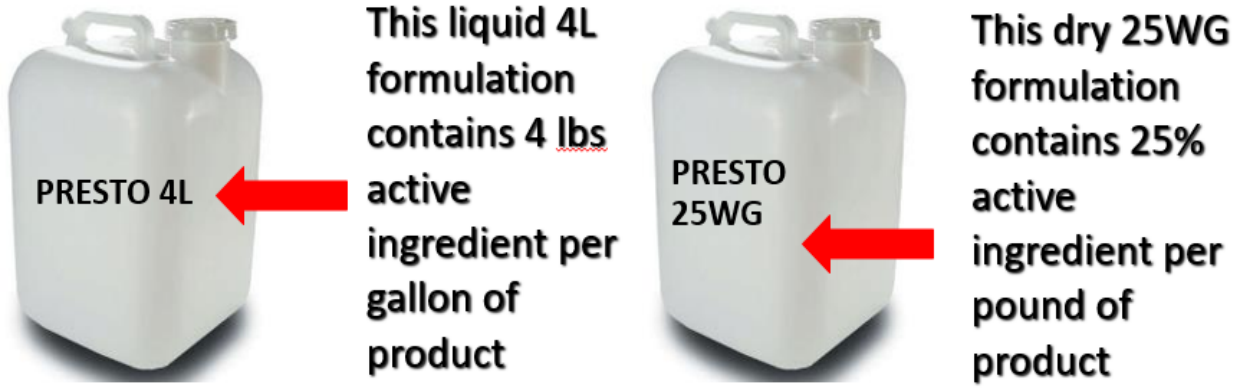
a) Divide the width of the band by the distance between the rows to get the percentage of treated area

b) Multiply the percentage of treated area by the total number of acres in the field.

Active Ingredient and Acid Equivalent Calculations

The active ingredient in a pesticide formulation is what packs the punch in terms of pest management. Pesticide products may be available in multiple concentrations of the same active ingredient, so application rates are sometimes expressed as amounts of active ingredient per acre (ai/a) instead of amount of product. You will have to convert ai/a to product per acre before doing your tank mix calculations. In dry products the concentration of active ingredient is

expressed as the percentage of dry weight and in liquid products as pounds active ingredient per gallon (some products may use metric units). Esters, amines, and other salt formulations may express the active ingredient in terms of the "parent acid" and rates may be expressed as acid equivalents per acre (ae/a). Calculating the amount of product needed from acid equivalents per acre is essentially the same as the calculation from active ingredient per acre.



Question 6. **How much Ambush 25W do you need to treat 15 acres if the rate is 1/8 lb. active ingredient per acre?**

a) Ambush is 25% active ingredient by weight. Convert the rate in pounds of active ingredient per acre to pounds of Ambush per acre. Hint: divide the amount you need in lbs ai/a) by the amount in product (for dry products, the percentage).

b) Multiply the rate in pounds per acre by the number of treated acres

Question 7: **Calculate how many gallons of Dicamba herbicide is needed for an 800-gallon tank fill. The rate is 0.5 lbs. dicamba acid per acre and the formulation is 4 lbs. ae/ gallon. You are calibrated to deliver 12.5 GPA.**

a) Determine how many acres can you spray with a full tank

b) Convert the rate in acid equivalents per acre to gallons of product per acre. (hint: divide amount needed (in lbs. ae/a) by amount in product (lbs. ae/gallon).

c) Multiply the acres treated by the rate in gallons of product per acre

Solutions to these problems are found at the back of this book

Grain and Cereal Crops

CATEGORY 1

Pesticide Safety Education Program, Ohio State University Extension

2022 Update on Field Crop Insects:
Asiatic Garden Beetle, Seedcorn Maggot, and Mealybugs

Kelley Tilmon
Andy Michel
Professors of Entomology
OARDC/OSUE
The Ohio State University

General update: In the field season of 2022 there was sporadic, typical pressure from common Ohio field crop pests including stink bugs, bean leaf beetle, slugs, and various caterpillars in soybean; cereal leaf beetle in wheat, some true armyworm, slug, Asiatic garden beetle, and corn earworm damage in corn; and leafhopper damage in alfalfa. Western bean cutworm trapping in the state, and damage in corn from caterpillar pests, was generally low this year. Information on Ohio's field crop insect pests is available at our Agronomic Crops Insects web site at https://aginsects.osu.edu The featured pests in this article are Asiatic garden beetle in corn, Seedcorn maggot in both corn and soybean, and mealybugs (an uncommon pest in soybean that appears at times).

Asiatic Garden Beetle (AGB)

In the past several years, corn growers in the Northwest part of OH have been dealing with a white grub called the Asiatic garden beetle. It causes the most problems in sandy soils. Its life cycle is similar to other annual white grubs such as Japanese beetle. Adults lay eggs in the soil in July and August. These eggs hatch into grubs which feed on plant roots for the rest of the summer but cause little damage to these relatively mature plants. In the fall the grubs dig deeper into the soil (as far as a foot down) to spend the winter. In April when the soil begins to warm, the grubs come back near the surface and feed on the roots of weeds and seedling corn until around the middle of May. This root feeding on young seedlings can cause the plant to wilt and often die, resulting in stunted plants or stand loss. In some fields up to 40% stand loss from AGB has been observed. Once damage occurs there is no rescue treatment. If there is sufficient time, growers may replant though indirect yield loss can occur from late planting. In mid-May or early June the grubs pupate -- enter a resting stage for the transformation to adult. In June and July adults emerge from the soil, mate, and lay eggs in the soil, completing the life cycle.

The most effective way to scout for AGB grubs is to dig the soil near the root zone of the plant and sift through the contents to look for grubs. AGB grubs are easy to distinguish from other white grub species from a bulbous structure near the mouthparts which give the appearance of "chubby cheeks." AGB grubs are also much more active than most other white grub species. They will wriggle and squirm in the hand and may even bite. There are no established thresholds for AGB – this is a current topic of research at Ohio State University. There are few effective management approaches. Tillage has only a modest effect at best. Most insecticidal seed treatments and in-furrow treatments are ineffective, even at high rates. We have also conducted some efficacy work on various lesser-used compounds. Liquid or granular products containing chlorethoxyfos (an organophosphate) are very effective but require a special closed delivery system products (liquid injection or closed handling box) for in-furrow use only. Preliminary research also suggests promise for products containing broflanilide, a meta-diamide (which is different than a diamide).

The main cultural control for AGB is late planting – as late as possible – to minimize the window of overlap between hungry grubs completing their development and young corn roots.

Seedcorn Maggot

These are tiny, wormlike larvae that will feed on both corn and soybean seed, causing poor emergence and skips in rows. The presence of seedcorn maggot is rare, but predictable. Normally, seedcorn maggots are only a problem in fields with heavy organic matter, for example tilling under a green cover crop or heavy manure applications. The highest risk comes when planting about 5-7 days later after heavy organic matter is present. Adult flies will be attracted to the decomposing organic matter and lay eggs. These eggs then hatch 5-7 days later (depending on temperature) and the larvae begin to feed on emerging seed. However precipitation patterns may

alter planting times which also changes risk to seedcorn maggot. Fortunately, seedcorn maggot can be easily controlled with clothianidin or thiomethoxam seed treatments (rows labeled 3 in the field photo show plants with insecticidal seed treatment). However, very early planting can diminish the effectiveness of these systemic products because they have a chance to wash off before the plant germinates and takes the product up into its system.

Once damage occurs there is no rescue treatment, and replanting is the only recourse if the damage is sufficient. Bear in mind that soybean in particular is very good at compensating for stand loss.

Mealybugs in Soybean

What the heck is a mealybug? Mealybugs are relatives of aphids and feed in the same way, by sucking on plant fluids with straw-like mouthparts. They can be found attached to different parts of the plant depending on species. In the summer of 2022 we visited a soybean field with an uncommon infestation of mealybugs on the roots. This does occur in Ohio but it is relatively rare. The symptoms in the plant are much like potassium deficiency with yellowing and poor stand; and in fact mealybugs may thrive in potassium-deficient environments. More research is needed to understand the relationship between mealybugs and potassium deficiency – how much is cause and how much is effect. If you have a soybean field with symptoms of potassium deficiency it's worthwhile to dig up some roots and look for grayish, waxy-looking insects attached to the roots which may at first glance look like nodules. Not much is known about management of this insect, but adjusting soil fertility and rotating away from legumes like alfalfa and soybean for a season may be helpful.

SOYBEAN DISEASES ACROSS OHIO SOYBEAN FIELDS IN 2022

Horacio Lopez-Nicora

Soybean diseases in Ohio in 2022 were less problematic than in previous years. The most common and widespread soybean diseases in Ohio in 2022 were white mold, sudden death syndrome, frogeye leaf spot, Phytophthora root and stem rot, bacterial blight, and the soybean cyst nematode. Commonly, infection and growth of these pathogens are favored by rain, moderate-to-warm temperatures (but cool night temperatures), high relative humidity, crop debris in soil, and use of susceptible varieties.

SUDDEN DEATH SYNDROME (SDS)

Several fields in Ohio were severely affected by sudden death syndrome (SDS) [Fig.1 and Fig. 2]. SDS is caused by the fungal pathogen *Fusarium virguliforme*. This species is the most prevalent in the region, however, other *Fusarium* species can cause SDS. SDS above-ground symptoms can be confused with those produced by a different fungus (*Cadophora gregata*) that causes brown stem rot (BSR). To distinguish SDS from BSR, symptomatic plants should be dug out and stem cut open longitudinally. SDS-infected plants have white, healthy-looking pith, while BSR-infected plants present brown discoloration of the pith. Moreover, fields with severe SDS symptoms can also have high levels of soybean cyst nematode (SCN).

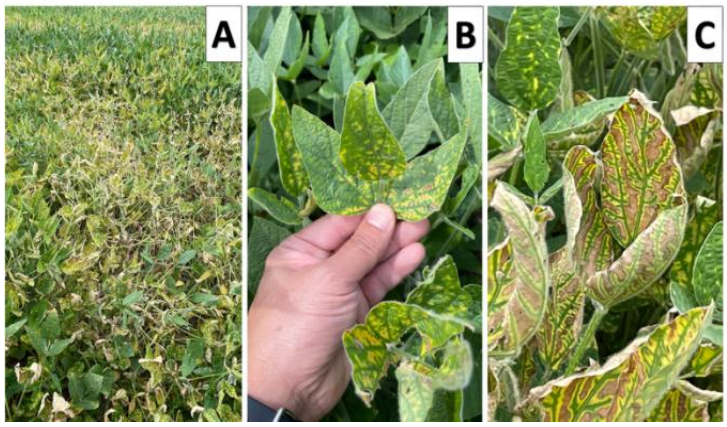


Figure 1. Soybean field in south Ohio severely affected by sudden death syndrome (SDS) with premature defoliation in the R5/R6 growth stage (A); symptoms begin with interveinal yellowing (chlorosis) of leaf (B); eventually leaf tissue dies and becomes brown but veins remain green (C). The fungus infects the root and produces toxins that are responsible for the above-ground symptoms.

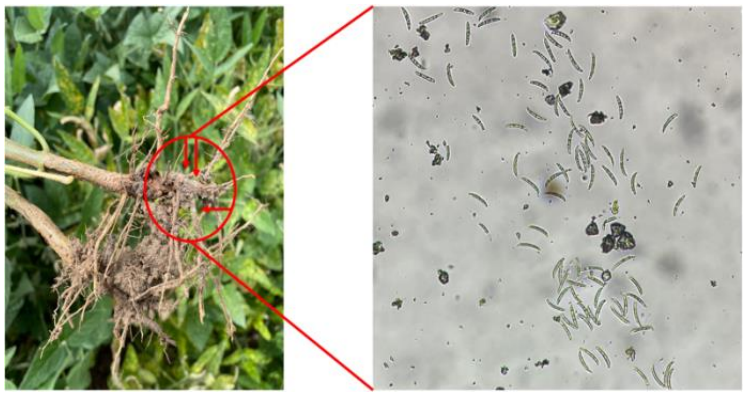


Figure 2. Soybean roots affected by the sudden death syndrome (SDS) fungus. Note the light blue mass (A) of fungal spores (B) on soybean roots with SDS.

We encourage submission of samples to the *Soybean Pathology and Nematology Laboratory* in the Department of Plant Pathology at The Ohio State University in Columbus (see address below). We can confirm if it is SDS or BSR; additionally, if it is SDS, we want to determine what *Fusarium* species is the causal agent. **To submit samples, dig out three to five symptomatic plants (including roots), placed them in a plastic bag, and submit them to our lab.**

BACTERIAL BLIGHT, WHITE MOLD, AND PHYTOPHTHORA ROOT & STEM ROT

Rainstorms with high winds and lower temperatures favored the development of bacterial blight (caused by *Pseudomonas savastanoi* pv. *glycinea*) in different parts of Ohio (Fig. 3). Angular brown lesions surrounded by chlorotic halo appear first in the upper canopy.

Figure 3. Upper to mid soybean canopy affected by bacterial blight in northcentral Ohio.

We observed fields in Ohio with white mold, a fungal disease caused by *Sclerotinia sclerotiorum*. To scout for this disease, we recommend walking soybean fields and looking in-between rows. A white fluffy mass of fungal mycelia will be observed in infected plants (Fig. 4). Black round sclerotia will be present amidst the white mycelia.

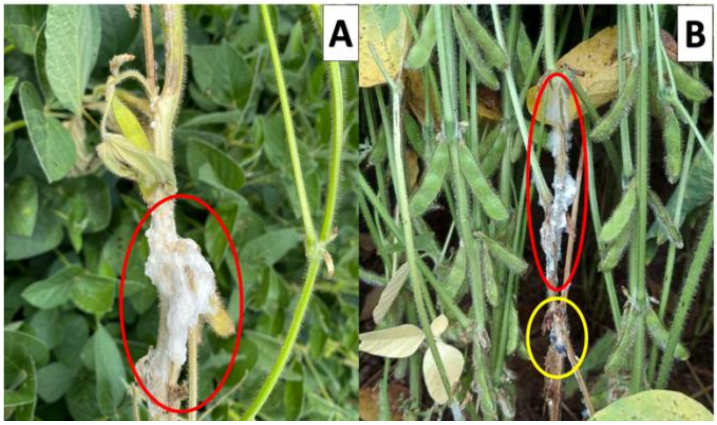


Figure 4. White mold of soybean in northeast (A, photo credit: Lee Beers) and south (B, photo credit: James Morris) Ohio. White, fluffy fungal mycelia (red circle) and sclerotia (yellow circle) on stem of infected soybean plants. Eventually, infected plants will wilt and die. Note how many soybean pods are lost when plants are affected by white mold compared to healthy plants (B).

We also received samples with plants affected by Phytophthora root and stem rot. Commonly, these samples come from fields with poor drainage. Phytophthora root and stem rot can sometimes be confused with stem canker and white mold. **Submit samples to the *Soybean Pathology and Nematology Lab* in the Department of Plant Pathology at The Ohio State University in Columbus for diagnosis.**

FROGEYE LEAF SPOT

We detected frogeye leaf spot in our fungicide trials in north and south Ohio (Fig. 5). Frogeye leaf spot is caused by a fungal pathogen (*Cercospora sojina*) which can reduce yield if plants are severely affected between R3 to R5 soybean growth stage. **We encourage growers to submit samples with frogeye leaf spot lesions to our lab. The fungus can develop resistance to fungicide, and we want to determine if these populations are present in Ohio.** Best way to submit frogeye leaf spot samples to our lab is by placing symptomatic leaves in a plastic Ziploc bag and mail it to our lab as soon as possible. Keep samples in cool conditions and avoid exposure to sunlight and heat.

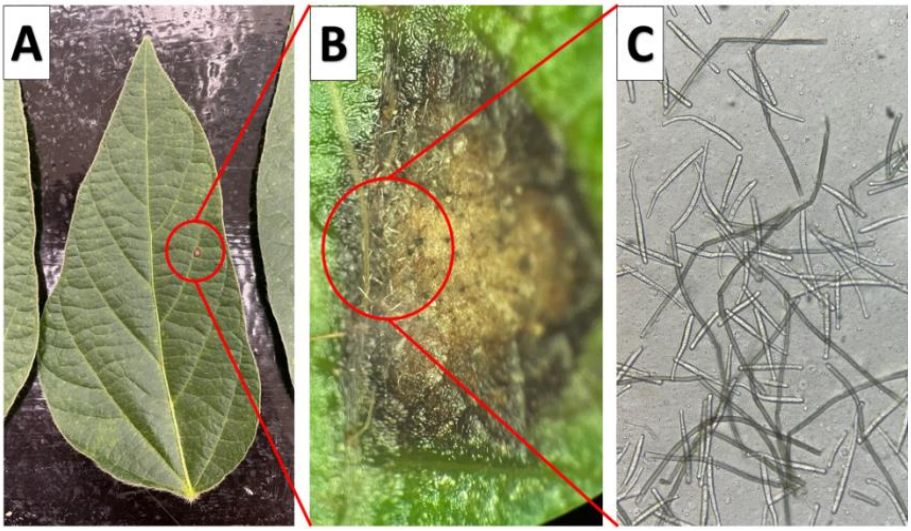


Figure 5. Frogeye leaf spot symptoms (A) in soybean plants at R3/R4 and R5 growth stage in north and south Ohio, respectively. Lesions (A) present conidiophores which produce conidia and look like whiskers (B). Spores (i.e., conidia) are club-shaped (C).

MANAGEMENT CONSIDERATIONS FOR OHIO

Whenever possible, selection of cultivars/varieties with resistance or moderate resistance to soybean pathogens will help mitigate yield reduction. Seed protectant and/or foliar fungicide application can also help prevent or reduce pathogen damage to soybean plants.

Foliar Fungicide and Fungicide Seed Treatments

The North Central Regional Committee on Soybean Diseases (NCERA-137) has developed the following information on foliar fungicide efficacy for control of major foliar soybean diseases and on fungicide seed treatments for control of seedling diseases of soybeans in the United States. Efficacy ratings for each fungicide listed in the table were determined by field-testing the materials over multiple years and locations by the members of the committee. Efficacy ratings are based upon level of disease control achieved by product and are not necessarily reflective of yield increases obtained from product application.

Fungicide Efficacy for Control of Soybean Foliar Diseases

[https://cropprotectionnetwork.s3.amazonaws.com/CPN1019_FungicideEfficacyControlSoybean_final2.pdf]

Fungicide Efficacy for Control of Soybean Seedling Diseases

[https://cropprotectionnetwork.s3.amazonaws.com/CPN1020_FungicideEfficacySoybeanSeedling_2022-1.pdf]

For foliar fungicide, timing of applications is critical. For white mold, the timing is when the first flowers have started to bloom in the field prior to cool, rain events. For the remainder of these foliar and pod diseases, timing in Ohio is between R3 and R5 growth stages. Later applications will not result in yield savings.

THE SOYBEAN CYST NEMATODE (SCN)

The soybean cyst nematode (SCN) is a major soybean pathogen that continues to spread throughout Ohio. Yield reduction commonly occurs with no visible above-ground symptoms. To know if this nematode is present in a field, soil samples must be properly collected. Active management of SCN begins by knowing if you have the problem. A composite soil sample will reveal the presence (or not) of SCN in your field, but most importantly, it will tell you the levels of SCN (Know your numbers!), which will help you select the best SCN management approach. You can collect soil sample for SCN test any time (i.e., in fall after harvest, spring before planting, or during the growing season).

The same composite sample collected for soil analysis can be divided into a subsample for SCN testing. Remember that nematodes are alive, and we want them alive until samples are processed. Therefore, samples must be protected from heat and direct exposure to sunlight until they are shipped to the lab. Find details about *how* to sample and *where* to send your SCN samples **here (https://www.thescncoalition.com/wp-content/uploads/2021/12/Scouting-and-Soil-Testing-for-SCN-Resource.pdf)**.

Furthermore, with funding from Ohio Soybean Council and The SCN Coalition, **growers may submit up to two soil samples to the *Soybean Pathology and Nematology Lab*, and we will test them for SCN *free of charge*.**

WE CAN HELP DIAGNOSE SOYBEAN DISEASES WITH YOU!

You are welcome to submit your samples to the address below. Contact us if you have any questions. Send your samples to:

Soybean Pathology and Nematology Lab
Attn: Horacio Lopez-Nicora, Ph.D.
110 Kottman Hall
2021 Coffey Rd.
Columbus, Ohio 43210
lopez-nicora.1@osu.edu

AGRICULTURE AND NATURAL RESOURCES FACT SHEET

ENT-39-14

Defoliators on Soybean

Ronald B. Hammond, Andy Michel, and James B. Eisley, Department of Entomology, The Ohio State University

Leaf feeding, or defoliation, is the most common type of insect injury that growers will often observe. Over the past 30–40 years, much research has been directed toward understanding the economic damage that will occur when soybeans are defoliated. Defoliation will usually be seen twice during the growing season; first during the early vegetative stages soon after plant emergence, and then during soybean reproductive stages in July and August.

Early planted soybeans, especially in the first fields to emerge in an area, may exhibit seedling injury due to feeding by overwintered adult bean leaf beetles, Mexican bean beetle populations, and slugs. Foliar injury from insects again becomes more common beginning at flowering stages in July and continuing through August and into early September. Defoliation during this time can be from either a single insect species acting alone, or more commonly, from a complex of insect pests all contributing to the overall level of leaf feeding.

Pest Species

Bean Leaf Beetle (BLB)

The BLB is a small beetle that varies in color from golden yellow to red, generally having six black spots on the wing covers, and always having a black triangle on the area centrally behind the thorax (fig. 1). The BLB overwinters in the adult stage, and resumes activity in the spring. It will be found feeding on soybean foliage soon after soybean emergence (fig. 2). The overwintered BLB adults feed on foliage and deposit their eggs in the soil. Unless beetle densities are abnormally high and feeding significant (> 40% leaf loss), this early season defoliation is usually not considered economic. If a soybean field is late planted relatively to other fields in the area, the first generation may not become established in the field and the probability of early season BLB damage is minimal. However, if planted late and missing the first generation, the likelihood of the field staying green in September enhances the chance of having a higher second BLB generation, and thus, more pod feeding.

Photo by R. Hammond

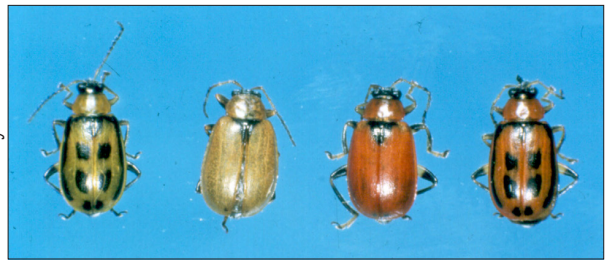


Figure 1. Bean leaf beetles.

Bean leaf beetle passes through two generations in Ohio with the true first generation of BLB beetles appearing in early summer when adult feeding resumes (fig. 3). The second and final generation appears around late August or early September when it is more of a pod feeder. The time of peak occurrence of BLB adults per generation may differ from field to field depending on the date of planting because the time of initial egg laying in a field depends on the time of initial emergence of the crop that attracts the overwintering beetles to the site. Growers should see the fact sheet **http://ohioline.osu.edu/ent-fact/pdf/0023.pdf** for more information on BLB.

Mexican Bean Beetle (MBB)

The MBB adult is a small, copper-colored beetle with numerous black spots, while the larva is yellow with black spines (fig. 4). The adult beetle resembles a lady bug or beetle because they are all members of

Photo by R. Hammond

Figure 2. Bean leaf beetle feeding damage on soybeans after emergence.

Photo by R. Hammond

Figure 3. Bean leaf beetle damage on soybeans in early summer.

Photo by R. Hammond

Figure 4. Mexican bean beetle adult (left) and larva (right).

Photo by R. Hammond

Figure 5. Gray garden slug.

Photo by R. Hammond

Figure 6. Gray garden slug defoliation of young soybean plants.

the same family of insects, Coccinellidae. MBB are one of the few members of this family that are plant pests.

The MBB also overwinters as adults in wooded areas near fields, entering soybean fields as they emerge from their overwintering sites. As with the BLB, earlier planted fields will tend to receive the majority of the overwintered adults. MBB also has two generations per year, but unlike BLB whose larvae occur in the soil feeding on roots, both the adult and larva will feed on soybean leaves. Thus, when scouting, growers need to be aware of both stages of this pest.

Gray Garden Slug (GGS)

The GGS (fig. 5) is often a problem in soybeans grown using conservation tillage practices, especially no-till. While able to cause significant stand reduction from feeding on germinating plants, GGS can also inflict significant defoliation to young soybean plants (fig. 6). Unlike the other pests discussed, foliar insecticides will have no impact on GGS or other slug species. Management comes from tilling the soil and the burial of crop residues, or the use of molluscicide baits. Growers should see the fact sheet **http://ohioline.osu.edu/ent-fact/pdf/0020.pdf** for more information on GGS.

Japanese Beetle (JB)

The JB adult (fig. 7) is a larger beetle that can cause significant defoliation to soybean. JB can feed on over 200 plant species, soybean being just one of them. Their larvae, or grubs, occur in the soil around grassy areas and can sometimes be a problem in field crops, although this is not common in Ohio. The behavior of the JB is unique in that it gives off various pheromones that attract other beetles. Thus, adult JBs are usually found in masses rather than as single individuals. Because of this aggregating behavior, they are not spread throughout the field like many insects, but usually occur in groups. When sampling for JB and their feeding, a grower must scout across the whole field to see how damaging the

Photo by R. Hammond

Figure 7. Japanese beetle adult.

Photo by R. Hammond

Figure 8. Japanese beetle feeding damage.

population is over the entire field. Also, JB are often more numerous along field edges, so it is important to move away from the edges of fields when scouting. JP feeding tends to skeletonize the leaves (fig. 8).

Green Cloverworm (GCW)

The GCW, a Noctuid moth species, is the only lepidopteran pest that is common and sometimes a concern on Ohio soybean. The damaging stage is a green-colored caterpillar with white longitudinal stripes along its body (fig. 9). It has three pairs of prolegs, which is an identifying characteristic. Also, when held in your hand, GCW larvae will often shake violently, which is a defensive mechanism against predators. The adult GCW migrates into Ohio each year from southern U.S. locations; there are two generations in Ohio. Seldom does the GCW occur in large densities by themselves to cause economic concern, although this occasionally does occur. When migrating populations are large, it is usually the first GCW generation in July during early soybean reproductive stages that can cause economic concern. When this does occur, the second generation will usually not occur in high numbers because a fungal pathogen, *Nomuraea rileyi*, will usually cause the population to crash. If the first generation is low, which is typical, the second generation will usually only add to the defoliation from other soybean defoliators.

Photo by M. Shepard

Figure 9. Green cloverworm caterpillar.

Grasshoppers

Numerous grasshopper species (fig. 10) will often be found in soybean, often at high numbers feeding on both leaves and pods. When sampling, growers will usually find that most of the grasshoppers occur on the field edges, having come in from grassy borders.

Photo by M. Kogan

Figure 10. Grasshoppers feed on soybean leaves and pods.

Other Defoliators

On rare occasions, soybean growers will find other defoliators in their fields. Although interesting, they usually are not found in densities that will cause concern, or add appreciably to the overall defoliation levels. A late spring insect is the painted lady, also known as the thistle caterpillar (fig. 11). This insect migrates from southern states each year. Larvae will usually be found inside leaves webbed together. Another insect is a very unique looking caterpillar known as the silver spotted skipper (fig. 12), another butterfly. Also, late in the season growers often find numerous yellow woollybear caterpillars (fig. 13). While these insects are often quite noticeable, they do little damage, and at most, only contribute to the overall defoliation.

Photo by R. Hammond

Figure 11. The painted lady, also known as the thistle caterpillar.

Photo by R. Hammond

Figure 12. The silver spotted skipper.


Photo by D. Keith

Figure 13. Yellow woollybear caterpillar.

Scouting

Early planted soybeans, relative to other fields in the area, may attract large numbers of overwintering BLB and MBB. Periodic inspection of early planted fields is advised, especially if the field in question is the first to emerge in an area. Although economic injury is relatively rare at this time of the season, severe leaf feeding can cause significant damage and should be stopped if defoliation goes over 40%, plants are being stunted, and beetles are still actively feeding.

In late June and July, when the first generation of BLB and MBB adults begin to appear, or the other insect pests make their presence known, field visits along with periodic sweep net sampling for determination of pest population abundance should be initiated plus periodic assessment made of defoliation injury. Sweep net sampling will provide a measure of pest abundance and facilitate an awareness of trends in insect activity. Sweep net sampling should be taken as sets of 10 sweeps at 3 to 5 locations in a field. For defoliation assessment, 20 random plants should be pulled from the soil and an estimation of the percent defoliation made. Defoliation is determined by comparing the actual defoliation to a chart of defoliation levels (see fig. 14). Care should be taken to estimate the percentage over the entire plant, not just the top third. Often, the level of defoliation is much higher on the top portions of the plant, with relatively little on the lower two-thirds.

Figure 14. Defoliation levels.

Treatment Decisions

During periods of insect activity in mid-summer, defoliation is usually a result of a complex of insects feeding rather than a single pest species. Decisions to apply an insecticide rescue treatment are based primarily on the observed defoliation caused by the total pest complex and continuing insect activity. Rescue treatment is justified when defoliation exceeds: 40% prior to bloom, 15% from bloom to pod-fill, and 25% after pod-fill to plant yellowing. Insects should still be present and active.

Management

When the decision to make a rescue treatment is made, there are numerous foliar insecticides to use. See Ohio State University Extension Bulletin 545, *Control of Insect Pests of Field Crops*, for those insecticides labeled on soybean, or for all insecticides labeled on soybean. The Agronomic Crops Insects web site (**http://entomology.osu.edu/ag/**) contains Bulletin 545 as well as fact sheets on many of these insect defoliators.

Additional information is available from your local Extension office or The Ohio State University Entomology Agronomic Crops Insects web site (**http://entomology.osu.edu/ag/**).

Keith L. Smith, Associate Vice President for Agricultural Administration; Associate Dean, College of Food, Agricultural, and Environmental Sciences; Director, Ohio State University Extension; and Gist Chair in Extension Education and Leadership.

Note: The soybean defoliation thresholds given on the previous page have been updated.

SOYBEAN DEFOLIATION

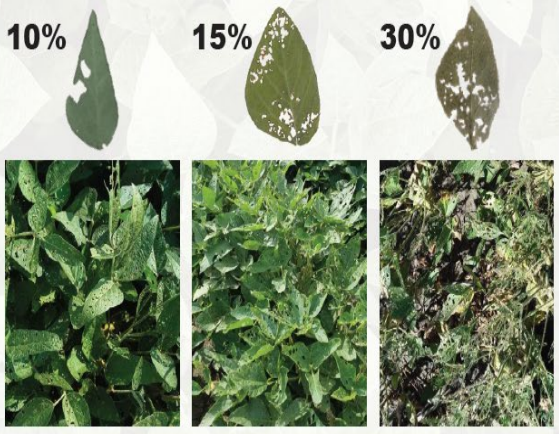
HOW TO SCOUT

- Look at several locations throughout the field, not just one area
- Estimate the overall level of insect defoliation at each location:
  - Consider the entire canopy, not just the uppermost leaves
  - Where you suspect economic injury, collect individual leaflets from the upper, middle and lower canopy and estimate defoliation of the leaflets
  - Identify responsible pests and confirm they are still present
- Consider an insecticide application if you reach threshold levels

THRESHOLDS

Growth stage	Description	Threshold
V1 - R2	vegetative - bloom	30 %
R3 - R5	pod development - fill	10 %
R6	full seed	15 %

Approximate defoliation levels:



OSU Weed Management Update

Alyssa Essman, Mark Loux, and Tony Dobbels

Where to find OSU weed management information

Information on weed and herbicide management can be found in numerous publications available at no charge on the OSU Weed Management website https://u.osu.edu/osuweeds/. The *Weed Control Guide for Ohio, Indiana, Illinois, and Missouri* can be purchased from OSU county extension offices, online at the OSU Extension eStore, or from the OSU publications office at 1-800-678-6114. Hard copies and the PDF can both be purchased online. The PDF is free with purchase of a hard copy. Timely weed management information is often available in the OSU C.O.R.N. newsletter. Subscribe to this newsletter service delivered weekly via email here. Our social media sites include twitter (@OhioStWeedSci), and contributions to the Agronomic Crops Team Facebook (@OhioStateAgronomy). Also be sure to check out the War Against Weeds podcast online or through preferred podcast providers.

Updates to the Weed Control Guide for Ohio, Indiana, Illinois, and Missouri – 2023

New herbicides added for the 2023 growing season – numbers in ( ) indicate site of action group:

Corn products

Maverick - premix of pyroxasulfone (15), mesotrione (27), and clopyralid (4) for control of grass and broadleaf weeds. Overall similar to Resicore XL, although the pyroxasulfone in Maverick is an overall more effective grass herbicide than the acetochlor in Resicore. The addition of atrazine will improve burndown activity and control of some broadleaf weeds. Can be applied preplant, preemergence, or postemergence on field and seed corn, and yellow popcorn.

Trivolt - premix of isoxaflutole (27), flufenacet (15), and thiencarbazone (2); controls grass and broadleaf weeds in field corn and seed corn. The addition of atrazine will improve control of large-seeded broadleaf weeds such as giant ragweed, morningglory, and cocklebur. Can be applied preplant, preemergence or early postemergence (spike to V2 corn).

Soybean products

Tendovo - premix of cloransulam-methyl (2), metribuzin (5), and S-metolachlor (15) that controls grass and broadleaf weeds. Can be applied preplant, preplant incorporated, or preemergence; has activity on small, emerged weeds in preplant burndown applications, but should usually be applied with burndown herbicides.

Small grains

Huskie FX – premix of fluroxypyr (4), bromoxynil (6), and pyrasulfotole (27); controls winter and summer annual broadleaf weeds in wheat, oats, and barley. Apply in fall or spring after the crop reaches the 1-leaf stage, and up to flag leaf emergence.

Osprey Xtra - mesosulfuron-methyl (2) and thiencarbazone-methyl (2); controls annual grass weeds and a few broadleaf weeds in winter wheat and triticale.

Status of waterhemp in Ohio

Waterhemp has become increasingly common and poses a serious threat to Ohio soybean production. The rate of increase of herbicide-resistant waterhemp populations in the state makes it a more immediate and widespread problem than Palmer amaranth. New infestations of waterhemp can occur via any of the same mechanisms described below for Palmer, but there is enough waterhemp in the state that it is likely to spread with floodwater, animals and birds, and

equipment. Waterhemp has many of the same characteristics that make Palmer amaranth so problematic. It also has the capacity to rapidly develop resistance to any new herbicide site of action used to control it. Waterhemp has the same potential as Palmer amaranth to increase herbicide costs and reduce net profit, and prevention of new infestations is well worth the effort, following the steps outlined below. Growers with established infestations need to be aware that the control strategies for this weed are substantially different than for marestail or giant ragweed. The Take Action fact sheet on waterhemp outlines these strategies.

Status of Palmer amaranth in Ohio

Palmer amaranth has been expanding its range throughout the Midwest over the past several years. It has been found in fields in over 28 counties, although many of these "finds" consisted of only a few plants and were promptly remediated. Fields where Palmer became a major infestation remain rare. There is no pattern to the infestations of Palmer in Ohio - it's all based on local introductions via several mechanisms. It's evident at this point that we have several primary mechanisms for the introduction of Palmer amaranth seed into an area: 1) the use of animal feed with cotton harvest byproducts as an ingredient, and the manure from these operations that is spread on crop fields (also have instances where the semi-trailers used to haul this feed are cleaned out in fields); 2) the import of infested hay from Kansas and other states where Palmer amaranth is endemic; 3) combines used in a field are infested with Palmer seed, either via purchase of equipment from another area of the country or custom harvesting; and 4) the contamination of seed originating from farther west and south that is used to establish CREP or wildlife areas. Control strategies are covered in the Take Action fact sheet on Palmer amaranth. ODA will screen any seed used for these purposes for the presence of Palmer amaranth seed. They have to come pick up the seed, contact them to get this done. Do not mail it or drop it off. Seed can also be screened for the presence of Palmer for a fee by the University of Illinois http://bulletin.ipm.illinois.edu/?p=3231.

Herbicide resistance in waterhemp and Palmer amaranth

Herbicide resistance, and especially multiple resistance, may be the most significant long-term issue for management of Palmer amaranth and waterhemp. Waterhemp populations across the Midwest have resistance to up to 7 herbicide sites of action. Resistance to multiple herbicide sites of action is already common in Ohio populations of Palmer amaranth and waterhemp, limiting the number of effective postemergence herbicide options. Resistance to glyphosate and group 2 herbicides (ALS) occurs in almost all populations. While not common, we have observed resistance to site 14 (PPO) in some Palmer amaranth populations. We estimate that at least 50% of waterhemp populations have some level of resistance to group 14, depending upon how frequently these herbicides were used for postemergence control. Producers of non-GMO soybeans should take steps in advance to determine whether waterhemp populations in all fields are resistant to group 14 herbicides, because these are the only postemergence options for waterhemp control in non-GMO soybeans. This information can be obtained by sending leaf samples to the University of Illinois for testing (bulletin.ipm.illinois.edu/?p=3619 - $50 per population).

Starting with 2019 populations, Ohio waterhemp populations were screened for resistance to foliar applications of groups 4 (2,4-D), 5 (atrazine), 14 (fomesafen), and 27 (mesotrione) herbicides. Soil-applied screens were also conducted for response to group 15 herbicides (s-metolachlor). The assumption at this point is that most waterhemp populations are glyphosate-resistant, so this treatment was removed from the screen. The response of populations collected in 2019, 2020, and 2021 were assessed, mostly from fields randomly encountered while conducting surveys of weed problems just prior to soybean harvest. Two herbicide rates were used for greenhouse characterization - a typical field use rate and four times this rate.

Observations on the results of these characterizations:
- Some populations were identified as “resistant” or “partially resistant” based on what percent of the plants survived. However, further characterization of suspect populations has not been conducted to be able to label them “resistant” based on standards generally accepted by weed scientists.
- Overall, the data show that Ohio waterhemp populations vary in their sensitivity to these herbicides. For all of the herbicides, at least some populations were resistant to the 1X rate and partially resistant to the 4X rate. It is assumed that this is an evolved lack of response that is developing over time in some fields in response to the use of these herbicides, and also movement of seed from field to field. This was expected, based on the history of resistance in areas west of Ohio with a longer history of waterhemp resistance problems.
- Herbicides do not necessarily work the same in the field versus the greenhouse, so results can vary between them for a given rate. It was evident that the 1X rate of the 2,4-D and S-metolachlor were probably not truly a use rate in the greenhouse. This doesn’t change the fact that there was variable response among populations.
- There could not really have been much selection by 2,4-D in these fields prior to 2019, based on the Enlist soybean adoption timeline. The lack of response of some populations to this herbicide may be due to a mechanism that confers resistance to multiple sites of action. A population from Illinois was identified several years ago where one mutation conferred resistance to atrazine, mesotrione and 2,4-D.
- Waterhemp populations from Ohio have been contributed to a regional project screening for resistance to dicamba and glufosinate. Resistance to these herbicides has not been observed in the populations provided. While 2,4-D and dicamba are both group 4 herbicides, resistance to one does not necessarily confer resistance to the other. Historically, there can be a loss of response to dicamba in some weed populations that are resistant to 2,4-D.
- Some populations were completely sensitive to all of these herbicides, and other populations had a reduced response to all. In one Darke County population, mortality from foliar applied herbicides did not exceed 60% at the 1X rate, and ranged from 77 to 96% at a 4X rate. Control from S-metolachlor did not exceed 60%. Darke County is one of the counties with the longest history of waterhemp issues, so selection for resistance has occurred for a while. But – another Darke County population was still sensitive to all herbicides.
- The populations tested are a composite sample from several plants at a field site. It is assumed that where some degree of resistance occurs, there are individual plants that may be mostly resistant and others that are still susceptible.

Overall, these results indicate that Ohio waterhemp populations will continue to develop resistance to additional sites of action used against them. We need to focus on herbicide and soybean trait management strategies to prevent multiple resistance, along with prevention of additional waterhemp seed. We assume that waterhemp and Palmer will develop resistance to any postemergence soybean herbicide after about three uses, even with a year of corn between soybean years. Research at universities with a longer history of waterhemp problems than OSU has shown the importance of two factors: 1) use of diverse herbicide programs, using combinations of at least two effective herbicide sites of action especially in foliar applications; and 2) management of herbicides alone will not prevent resistance unless growers also take steps to prevent any surviving plants from producing seed. Seed from these plants generally increases the seedbank and makes control more challenging in future years, and also likely carries herbicide resistance. Preventing seed keeps populations manageable and prolongs herbicide utility.

Managing Palmer amaranth and waterhemp

Additional information on Palmer amaranth and waterhemp can be found at the resources listed in this document. The most important advice for management of Palmer amaranth and waterhemp is: 1) do not let them become established in your fields if possible; and 2) even where an effective herbicide program is used, scout fields late-season and remove any escapes that might be herbicide-resistant. These plants can each produce up to one million seeds. Aside from being careful about the possible sources of infestation outlined above, essential steps include the following:

- If infestations occur near any of the fields that you farm, be aware of any movement and spread along roadsides;
- Use broad-spectrum residual herbicides in both corn and soybeans, which control the early-emerging Palmer amaranth and waterhemp plants and can reduce the chances of a disaster occurring within one growing season;
- If plants are evident before the field is treated with postemergence herbicides, modify the herbicides used in order to address glyphosate-resistance;
- Scout fields in late July/August for the presence of Palmer and waterhemp plants visible above the soybean canopy. Get help with identification if necessary and rogue out Palmer plants before they can produce seed.
- Be on the watch for Palmer amaranth and waterhemp while harvesting. Avoid harvesting through areas of plants with mature seed.
- Both weeds are on the Ohio Noxious Weed Law, which means that landowners/tenants, townships, and state agencies must control it and prevent additional seed.

Take Action/USB herbicide resistance information

There is a wealth of information on herbicide resistance and site of action at the Take Action website, along with recommendations for management of specific weeds that have developed resistance across the region (takeactiononweeds.com). The site contains online versions of the herbicide site of action chart that have been distributed around the state, along with other posters on identification of Palmer amaranth and fact sheets on control of marestail, giant ragweed, and other weeds. Full-sized copies of the chart and posters can be requested to be delivered via snail mail. At this site, you can take an online quiz to test knowledge about resistance, and use the online site of action lookup tool.

CFAES College *of* Food, Agricultural, *and* Environmental Sciences

ANR-102

The Parsley Family Identification Guide

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Alyssa Essman, Research Associate, Food, Agriculture, and Environmental Sciences, The Ohio State University.

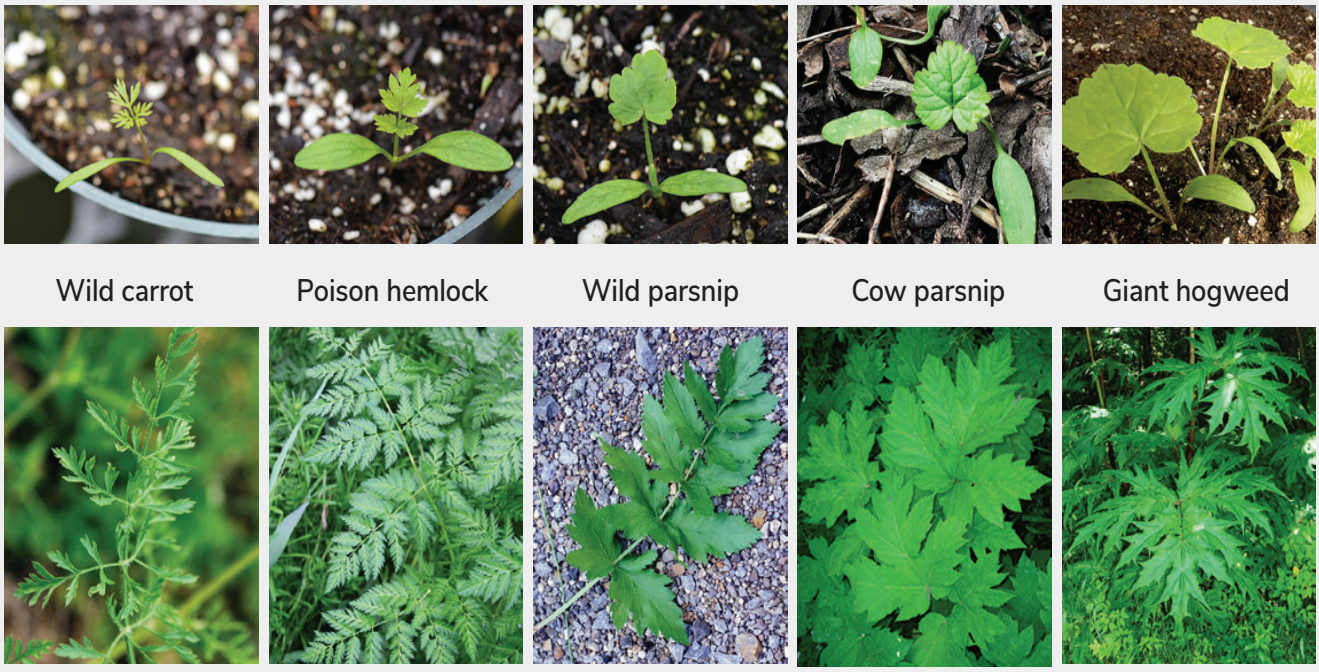
Several weed species in the *Apiaceae* or parsley family are commonly found in Ohio. These weeds can be similar in appearance and difficult to differentiate from one another. It is important to be able to distinguish among weed species in this family. They present a varying degree of concern economically, and some can be harmful to pets, livestock, and humans. Shown here are photos and key characteristics for five of the most common weeds: wild carrot (*Daucus carota*), poison hemlock (*Conium maculatum*), wild parsnip (*Pastinaca sativa*), cow parsnip (*Heracleum sphondylium*), and giant hogweed (*Heracleum mantegazzianum*). These weeds inhabit both disturbed and undisturbed sites such as forest edges, roadsides, ditches, wastelands, pastures, fence lines, landscapes, and no-till crop fields.

Seedlings

Plants in the parsley family can be distinguished from one another as seedlings if both the cotyledons and first true leaves are present. The cotyledons of wild carrot tend to be longer and slimmer than the cotyledons of poison hemlock, while cotyledons of wild parsnip, cow parsnip, and giant hogweed appear very similar. The first true leaves of wild carrot are more finely divided than those of poison hemlock. The first true leaves of giant hogweed tend to be larger and rounder than those of wild or cow parsnip.

Vegetative Stage

The leaves of wild carrot tend to be lacier and more finely divided than those of poison hemlock, for which it is often confused. Wild parsnip and cow parsnip both have large, deeply lobed leaves. Wild parsnip leaves consist of a main stem and up to fifteen toothed leaflets, while cow parsnip has three sets of deeply lobed leaflets. Giant hogweed is the largest of the parsley family species in this guide and has extremely large, deeply incised leaves. From a distance, many of these weeds are similar in appearance. An up-close inspection using several key identifiers, especially the stem of the plant, is often necessary to distinguish these look-alike species.



Figures 1–5 (top left to right): Seedlings of commonly confused parsley family weeds. Photo credits: Figures 1–3. Ohio State University Weed Science; 4. Skyline Gardens Alliance, skylinegardens.org; 5. Gerald A. Mulligan, Agriculture and Agri-Food Canada, weedscanada.ca.

Figures 6-10 (bottom left to right): Vegetation of commonly confused parsley family weeds. Photo credits: 6. Chris Evans, Illinois Wildlife Action Plan, Bugwood.org; 7. Robert Vidéki, Doronicum Kft., Bugwood.org; 8. OSU Weed Science; 9-10. Maine Department of Agriculture, Conservation, & Forestry, maine.gov.

THE OHIO STATE UNIVERSITY EXTENSION

ohioline.osu.edu/factsheet/anr-102

KEY IDENTIFIERS

Wild carrot
- Very finely divided leaves
- Solid, green stem
- Hair on leaves and stem
- Carrot odor

Poison hemlock
- Finely divided, fernlike leaves
- Hollow stem
- Purple spots on hairless stem
- Musty odor

Wild parsnip
- Deeply lobed leaves with up to 15 toothed leaflets
- Hairless leaves
- Hairless, grooved stem
- Yellow flowers

Cow parsnip
- Coarse hairy leaves
- Leaves with three, deeply lobed leaflets
- Grooved, hairy, green stem

Giant hogweed
- Deeply lobed leaves up to five-feet wide
- Hollow, rigid stem
- Purple blotches on hairy stem

Wild carrot | Poison hemlock | Wild parsnip | Cow parsnip | Giant hogweed

Figures 11–15 (top left to right): Stems of each of the described parsley family species. Photo credits: Figures 11–12. Ohio State University Weed Science; 13. NY Department of Environmental Conservation, dec.ny.gov; 14. Naja Kraus, NY Department of Transportation, dot.ny.gov; 15. Rob Routledge, Sault College, Bugwood.org.

Figures 16–20 (bottom left to right): Reproductive structures of the five parsley family weeds. Photo credits: 16, 18. Ohio State University Weed Science; 17. John Cardina, The Ohio State University, Bugwood.org; 19. Mary Ellen (Mel) Harte, Bugwood.org; 20. Terry English, USDA APHIS PPQ, Bugwood.org.

Reproductive Stage and Life Cycle

These species most often exist as biennials, meaning their life cycle takes place over two years. They emerge from seed the first year and develop into a rosette in a vegetative state, which overwinters. In the second year (the reproductive phase), plants bolt, then flower to produce a seed head, and finally finish their life cycle via seed production. Cow parsnip and giant hogweed can also be perennials, where they survive as a rosette for more than one year. All of these species die after flowering and reproduce exclusively by seed.

Potential Hazard

Several of these species can pose a serious threat to livestock and humans. Wild carrot is generally safe but can cause skin irritation on occasion. All parts of the poison hemlock plant are highly toxic, but only when ingested. Irritation of the skin and eyes is possible upon contact with this plant. Livestock tend to avoid eating poison hemlock due to its foul smell and unpalatable taste. Contact with the sap of wild parsnip can cause adverse skin reactions to sunlight, and lead to severe rashes and blisters. Cow parsnip sap can also make skin more sensitive to the sun following exposure and lead to severe sunburns. Giant hogweed sap is the most injurious of the parsley family species. Like wild and cow parsnip, giant hogweed is also phototoxic, causing adverse skin reactions following sun exposure. Injury caused by contact with giant hogweed sap and subsequent sun exposure can lead to severe burns, blisters, and permanent scarring. Contact with the eyes is potentially even more serious and can lead to permanent blindness.

Control

These species can be susceptible to chemical control by applications of glyphosate, triclopyr, and 2,4-D. Other options exist and may vary by species. Control with herbicides is always more effective when plants are in the rosette stage. Large plants and areas where seeds are regularly germinating in great numbers may require repeated herbicide applications. See the *Weed Control Guide for Ohio, Indiana, and Illinois* or contact local Ohio State University extension personnel for more control recommendations.

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O'Neill Jr., Charles R. 2009. "Giant Hogweed (*Heracleum mantegazzianum*) – Poisonous Invader of the Northeast. NYSG Invasive Species Factsheet Series: 07-1. New York Sea Grant SUNY College at Brockport. Published February 2007; revised August 2009. PDF. https://seagrant.sunysb.edu/ais/pdfs/GiantHogweedFactsheet.pdf.

NOV 2021

Pigweed Identification Guide

A number of pigweed species are found in Ohio. These species can become very problematic and reduce crop yields. Pigweed identification can be difficult, especially at the seedling stage of growth. This guide will help in making a correct identification based on typical pigweed characteristics.

Pigweed with hair on stems and leaves	Pigweed with no hair on stems and leaves		
Smooth/redroot pigweed	Waterhemp	Palmer amaranth	Spiny amaranth
			
Egg-shaped to round leaves	Long narrow leaves with short petioles	Petioles as long or longer than the leaf	¼ to ½ inch spines at leaf axils – very long and sharp

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u.osu.edu/osuweeds/
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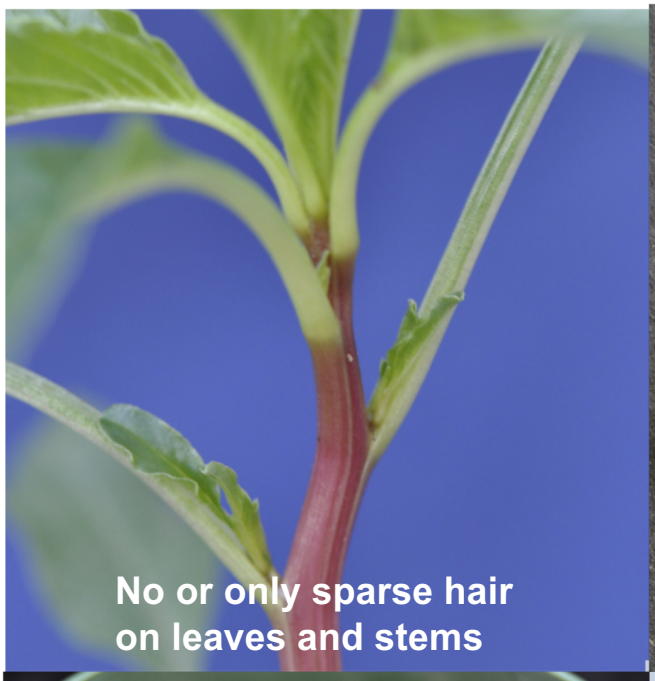
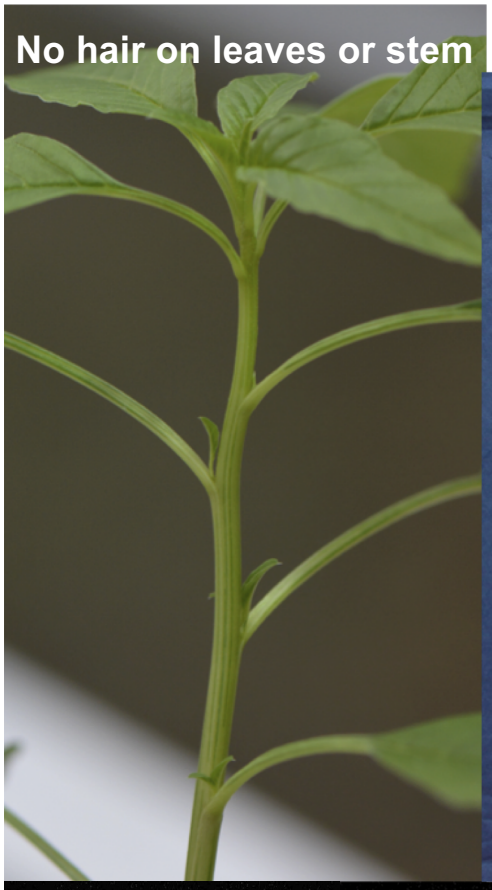
Palmer amaranth
Amaranthus palmeri



Waterhemp
Amaranthus rudis



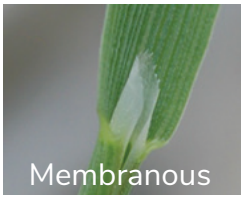
Smooth/redroot pigweed
Amaranthus hybridus/retroflexus

Authors: Bruce Ackley and Mark Loux, Horticulture and Crop Science, The Ohio State University. Revised 11/17

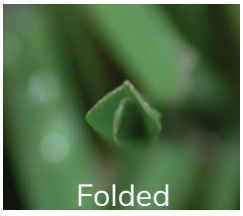
Weedy Grass Identification

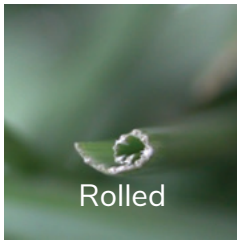
Dave Gardner, Dept. of Horticulture and Crop Science, The Ohio State University

Ligule

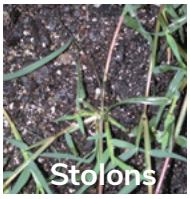


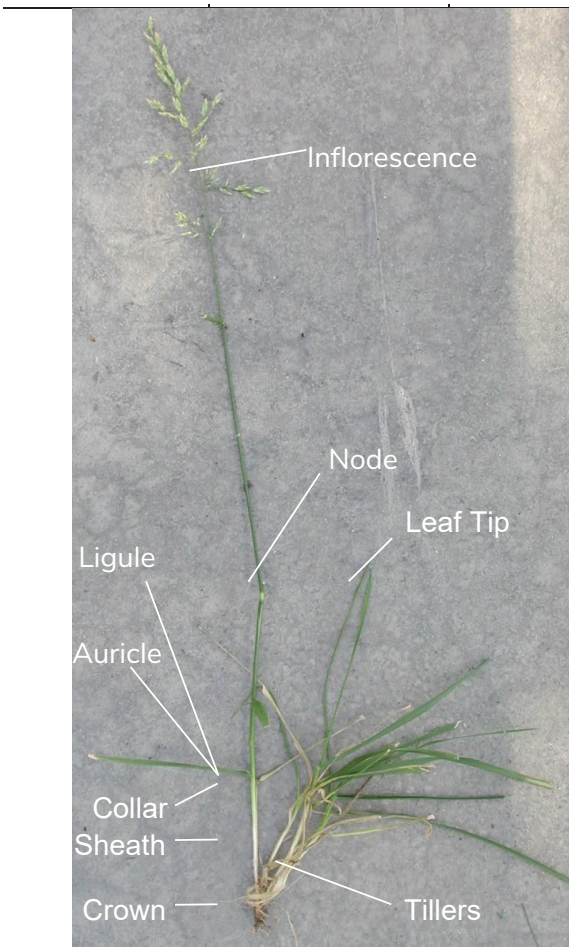
Vernation





Growth Habit

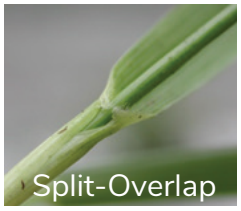




Auricle

Leaf Tip

Sheath



Collar

Weedy Grass Seedheads

(With major identifying vegetative characteristics)

Smooth Crabgrass (A)
Digitaria ischaemum
(Rolled; Ligule a membrane w/hairs)

Barnyard Grass (A)
Echinochloa crusgalli
(Folded; No ligule or auricle)

Goosegrass (A)
Eleusine indica
(Folded; Compressed leaf sheaths)

Annual Bluegrass
Poa annua
(Folded; Tall membranous ligule; bunch-type)

Annual Rye (A)
Lolium multiflorum
(Rolled; Clasping auricles; bunch type)

Quackgrass (P)
Elytrigia repens
(Clasping auricles; aggressive rhizomes)

Orchardgrass (P)
Dactylis glomerata
(Long membranous ligule; bunch-type)

Yellow Foxtail (A)
Setaria pumila
(Rolled; ligule a fringe of hairs)

Bermudagrass (P)
Cynodon dactylon
(Aggressive stolons, ligule a fringe of hairs)

Field Paspalum (P)
Paspalum leave
(Ligule a membrane w/hairs; rhizomes)

Identification of Perennial Grass Weeds

Species	Growth Habit	Vernation	Ligule	Auricle	Sheath	Leaf Blade	*Inflorescence*
Smooth Brome *Bromus inermus*	Strongly rhizomatous	Rolled	Short, membranous	Absent	Round, distinctly closed near top	Wide, blue-green color. Often with "Watermark"	Panicle
Orchard-grass *Dactylis glomerata*	Bunch Type	Folded	Distinct, long, membranous Often toothed	Absent	Compressed and closed at base	Wide, tapers to acute point. Furrowed at midrib	Panicle
Quackgrass *Elytrigia repens*	Erect stems. Strongly rhizomatous	Rolled	Short, membranous	Distinct, long, and clasping	Lower is pubescent, upper is hairy	Sharply pointed. Gray-green color, sparsely pubescent	Spike with 4-7 flattened spikelets
Timothy *Phleum pratense*	Bunch Type Lower internodes form haplocorm (enlarged bulb)	Rolled	Membranous	Absent	Round, smooth, overlapping	Long, flat, blue-green color, tapered, scabrous at margins	Dense Panicle
Rough Bluegrass *Poa trivialis*	Stoloniferous	Folded	Distinct, membranous	Absent	Senescing sheaths resemble onion skin	Boat shaped leaf tip	Panicle
Bermuda-grass *Cynodon dactylon*	Stoloniferous	Folded; some rolled bio-types	Fringe of hairs	Absent		Gray-geen color, short, flat, narrow, pointed	3-10 spikes in a whorl
Nimblewill *Muhlenbergia schreberi*	Stoloniferous Roots at lower nodes	Folded	Short, membranous	Absent	Mostly glabrous, loose, open at stem	Often wavy in cross section	Slender panicle resembles a spike
Field Paspalum *Paspalum laeve*	Rhizomatous	Rolled	Tall, membranous with hairs	Absent	Can be rough, hairy at base	Rough margins, with prominent white midrib	Spike with alternating spikelets
Johnson-grass *Sorghum halepense*	Strongly rhizomatous	Rolled	Distinct, membranous, notched with hairs	Absent		Rough margins, with prominent white midrib	Large open Panicle, often purple

Sedges

Yellow Nutsedge

False Green Kyllinga

Species	Growth Habit	Vernation	Leaf blade	Inflorescence
Yellow Nutsedge *Cyperus esculentus*	Erect stems. Strongly rhizomatous. Tubers.	Leaves in 3 vertical rows. Stems are triangular in cross section	Greenish-yellow color	Spikes. Each flower in the axil of a single bract (the glume)
False Green Kyllinga *Kyllinga breviolia*	Strongly rhizomatous. Forms dense matts in turf. No tubers.	Leaves in 3 vertical rows. Stems are triangular in cross section	Green. Narrower compared to yellow nutsedge	Globular inflorescence. Each flower in the axil of a single bract

Other Monocotyledonous Weeds

Wild Garlic – *Allium vineale*
Wild Onion – *A. canadense*
(Garlic has hollow leaves, onion has flat leaves)

Spring Beauty – *Claytonia virginica*
(White flowers with 5 petals. Leaves have a distinct, grooved midrib)

Forage Crops and Livestock

CATEGORY 2

Alfalfa Leaf and Stem Diseases and Their Management

Mark Sulc

Department of Horticulture and Crop Science

Many different pathogens can attack alfalfa leaves and stems, resulting in defoliation that may lead to reduced yield and forage nutritive value. Common foliar diseases of alfalfa include common leaf spot (*Pseudopeziza medicaginis*), Leptosphaerulina leaf spot (*Leptosphaerulina briosiana*) often referred to as "lepto", spring black stem and leaf spot (*Phoma medicaginis*), summer black stem and leaf spot (*Cercospora medicaginis*), and Stemphylium leaf spot (Stemphylium spp.); however, other leaf and stem diseases exist in alfalfa stands.

In a study conducted over four years in Iowa, Ohio, Wisconsin, and Vermont, foliar diseases in alfalfa caused yield losses in 22 of 48 growth cycles, with an average yield loss of 19% in the 22 affected harvests (Nutter et al., 2002). In Ohio, yield losses ranged from 3 to 23%, averaging 9.6% with 3 out of 10 harvests having statistically significant yield losses. Although some varieties have been shown to have resistance to specific foliar diseases, that information is not readily available and is not regularly evaluated. Alfalfa growers must rely on other methods for minimizing yield and nutritive value losses to these foliar diseases.

One of the most important management tactics being promoted for reducing the impact of foliar diseases is cutting management. It is believed that a more frequent harvest schedule reduces losses caused by foliar diseases, such as with a 4-cut system in which alfalfa is cut every 30-day, as is common on dairy farms in Ohio. As the harvest interval is lengthened, there is a higher probability of foliar diseases becoming more severe and causing defoliation leading to yield and nutritive value losses.

Controlling potato leafhopper outbreaks is also important to minimizing foliar disease in alfalfa. I have observed severe foliar damage from Lepto and other leaf diseases in alfalfa when the potato leafhopper was not controlled. The combination of potato leafhopper and foliar disease damage can reduce crude protein content of the forage.

Fungicides for Alfalfa

In recent years several fungicides have been registered for use in alfalfa and other forages to control various foliar and stem diseases (Table 1). These fungicides belong to either the respiration inhibitors classified as carboxamides, which are target site of action **Group 7** fungicides, or the respiration inhibitors called the quinone outside inhibitors (QoI) or strobilurin fungicides, which are target site of action **Group 11** fungicides. Two fungicide products registered for alfalfa, Priaxor and Pristine, are premixes of a **Group 7** and a **Group 11** fungicide. It is important to rotate the use of fungicide groups in order to prevent resistance from developing in the fungal populations to these fungicides. A gradual or total loss of disease

control may occur if applications of fungicides from the same group are repeated in the same fields. Kocide (copper hydroxide) is an inorganic fungicide of the Group M1, having multi-site activity with a broad spectrum of disease control. It is a preventative contact fungicide that should be applied before the fungus infects the plant. Studies show that it has not been very effective in controlling foliar diseases in alfalfa. But it might have a role when used in rotation with other fungicides to extend the useful life of the other fungicides before resistance in the fungal populations develops. Read the fungicide labels for specific recommendations for resistance management and application requirements.

Table 1. Fungicides registered for use on alfalfa in Ohio.

Product	Group	Anthracnose	Common leaf spot	Downy mildew	Lepto leaf spot	Powdery mildew	Rhizoctonia & stem blight	Rust	Sclerotinia crown and stem rot	Spring black stem & leaf spot	Stagnospora leaf spot	Stemphyllium leaf spot	Summer black stem & leaf spot	PHI (days)	Rate (fl ozs/Acre)	Max applications/season	Max rate/season (ozs/Acre)
Endura	7		X		X	S			S	X				14	6.5	3	19.5
Fontelis	7					X			X					14	12-24	2	48
Headline EC **Headline SC**	11	X	X	X	X	X	X	X		X	X	X	X	14	6-9	3	27
Priaxor	7, 11	X	X	X	X	X	X	X		X	X	X	X	14		3 *	20.7
Quadris	11	X	X	X	X	X	X	X	X	X	X	X	X	14		3	46.5
Pristine	7, 11	X	X	X	X	X	X	X	X	X	X	X	X	14	12-18	3	54
Kocide 2000* **Kocide 3000***	M1				X									0	1.5 lb 0.75 lb		3.2 lb 3.7 lb

S = suppression only.

* Application rate in lbs/acre.

Alfalfa Fungicide Results in Other States

Trials in Wisconsin with several fungicide products and treatments applied to alfalfa on 30-day cutting intervals demonstrated that fungicide application infrequently resulted in significant increases in forage yield or a positive return on investment (Smith et al., 2017). However, with the advent of reduced lignin alfalfa managed on longer cutting intervals (35- to 40-day intervals), the data suggests there is a higher likelihood of a positive return on investment to fungicide treatment.

Studies conducted over six years in Iowa with six fungicide products demonstrated that the first harvest of the year provided a higher probability of a yield response to foliar fungicide application than in later summer harvests (Lang and Pecinovsky, 2018). Although fungicide treatments improved the visual ratings of leaf retention, the fungicide applications showed

little improvement in forage nutritive value. The authors of those studies also concluded that copper hydroxide treatments did not perform as well as the other fungicides they tested. Timing of fungicide application was also evaluated and the authors suggested that fungicides be applied to alfalfa in the spring when it is at a 6 to 8 inch canopy height and in the summer when it is at a 5 to 6 inch canopy height.

Alfalfa Fungicide Results in Ohio

Two experiments were conducted with foliar fungicides on alfalfa at the Western Agricultural Research Center near South Charleston, OH. In the first study, Headline was applied to an established alfalfa stand at 6 oz/acre once during each of the first three growth cycles in 2013 and 2014 (Table 2). The second study was conducted on an established stand of alfalfa maintained on either a 28-day or 35-day cutting schedule in 2018 and 2019; Priaxor was applied at 6.9 oz/acre once during each of the first three growth cycles in 2018 while in 2019 it was applied to the first, second, and last growth cycles of the season (Table 2).

Table 2. Forage yield advantage from fungicide application in established alfalfa stands at South Charleston, OH. In 2018 and 2019, fungicide application was made to alfalfa maintained on a 28-day or 35-day harvest interval. Bolded values indicate statistically significant fungicide effect ($\alpha = 0.05$).

Year	Product	Cut 2	Cut 1	Cut 3	Cut 4	Cut 5	Annual Total
		Dry matter yield increase (tons/acre)					
2013	Headline	**0.10**	**0.32**	**0.32**	**0.20**		**0.94**
2014	Headline	0.06	0.09	0.20	0.07		0.43
2018	Priaxor, 28-day	**0.25**	**0.27**	**0.23**	0.03	-0.02	**0.76**
2018	Priaxor, 35-day	0.14	**0.29**	**0.10**	0.01		**0.54**
2019	Priaxor, 28-day	0.20	0.09	0.13	0.05	0.03	0.49
2019	Priaxor, 35-day	0.08	0.13	0.10	0.06		0.37
Average		0.14	0.20	0.18	0.07	0.01	0.59

There was a statistically significant effect on forage yield in 9 of 31 comparisons across the four years. One of the nine significant comparisons occurred in a growth cycle when the fungicide was not applied, indicating a carryover effect from the previous growth cycle (Cut 4 in 2013). Visual differences were evident in these trials, with the fungicide treatment showing less foliar disease and a deeper green color. Even the stubble after cutting had a greener color.

We hypothesized that fungicide treatment would provide a greater benefit when cutting intervals were delayed. But this does not appear to be the case so far, in that the advantage for fungicide has been similar if not numerically greater in the 28-day cutting schedule versus the 35-day cutting schedule within each year (Table 2).

Only 29% of the comparisons showed a statistically significant effect on yield in the Ohio studies (Table 2), but the trend was consistent for the fungicide treatment to be numerically higher in yield than the plots receiving no fungicide. We considered the annual cost of fungicide application to be $53/acre each year for three applications: $15/acre for the product plus $8/acre application cost in the spring, then $15/acre for the product only in the two summer applications because it was combined with insecticide treatment for potato leafhopper. If alfalfa hay is priced at $200/ton, the breakeven yield improvement for the fungicide application would be 0.27 ton/acre ($53/acre cost divided by $200/ton). If alfalfa is priced lower at $150/ton, the breakeven yield improvement would be 0.35 ton/acre. Therefore, in every year, the three fungicide applications would have provided a positive return on the investment, as the yield improvement ranged from 0.37 to 0.94 tons/acre with an average of 0.59 tons/acre on an annual basis.

Nutritive value of the forage was assessed in 2013 and the Headline treatment resulted in a slight improvement in relative forage quality (+12 RFQ units) and higher crude protein content (+1.6 CP units). This would add to the return on investment for the fungicide treatment. Forage nutritive value results are still being processed for the 2018 and 2019 samples.

Summary

Foliar diseases reduce alfalfa yield in Ohio and can reduce forage nutritive value. Fungicide applications have been shown to provide a consistently positive response in alfalfa yield and return on investment on an total annual yield basis, but the yield improvement is not always statistically significant. Timing of application, weather conditions, and fungal inoculum load can affect the response. There is a low probability of return on investment to fungicide applications made in late summer during the last growth cycle of the season. Further work is needed to determine if two versus three applications per season would provide similar returns on investment, which might help extend the time before fungal population resistance to the fungicides develops in the field.

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Managing External and Internal Parasite Resistance in Livestock

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Internal and external parasites can have negative effects on animal health and cause serious production losses. The use of antiparasitic drugs to treat and control infestations of external and internal parasites in cattle, sheep and goats is an effective way to help manage animal health. As the livestock industry has utilized several different classes of drugs to control parasites, resistance to those drugs by the parasites has emerged, and will continue to be a major impact on the livestock industry. Careful use of these antiparasitic drugs, along with management changes, monitoring of treatment results and the use of alternative control methods can help extend the efficacy of the available antiparasitic drugs on the market.

In terms of external parasite resistance in cattle, sheep, and goats that may impact producers in Ohio, the parasite most commonly observed with resistance is the cattle Horn fly. Horn flies feed primarily on the backs of cattle, out of the reach of the head and tail of the animal. Horn flies gather by the hundreds or even thousands on each bovine and take 20-40 blood meals per day. Severe infestations can cause major production losses from weight loss and anemia. Horn flies reproduce in fresh manure, and during an Ohio summer 5-10 generations of flies can be produced, dependent on the weather. Horn flies can also travel 5-7 miles to find cattle to feed on.

With the advent of pyrethroid-impregnated fly tags in the 1980s, horn fly control became very convenient and effective. After several decades in use, however, resistance to these tags has emerged within horn fly populations across the United States. The presence of the R (resistant) gene in horn flies was increased during the use of DDT early in the 20th century, wiping out large populations of susceptible flies, and it is thought that the method by which horn flies became resistant to DDT is similar for that of pyrethroids. A case of resistant horn flies is typically defined as a failure to reduce horn fly numbers to less than 150 flies per animal two weeks after treatment. Several strategies can be utilized to maximize horn fly (as well as other major fly pests) control while preserving the effectiveness of the approved fly kill products on the market. Fly tags should be applied to the animals most susceptible to production losses, which includes young and growing calves. Tags should be applied only when fly populations are more than 200 flies per animal, and at or near the peak of fly season. Utilization of back rubbers and dusters with organophosphate or pyrethroid compounds can help complement tag fly control. The use of horn fly traps can also help reduce fly numbers on growing cattle. Keeping a population of cattle untreated for horn flies helps maintain a population of flies that are susceptible to the available treatments (Refugia), diluting the population of resistant flies. Annual rotation in the compounds used in fly control tags will also decrease the amount of resistance from horn flies, as well as the use of single compound tags (i.e. no combination pyrethroid/organophosphate tags). The use of pour-on fly control during periods of heavy infestation can also cut down on fly numbers. If cattle are being fed a ration, the use of feed-through insect growth regulators can help control those flies that depend on manure for their life cycle. For flies that breed in combinations of manure and spoiled feed, removal of spoiled feed and areas of pastures and lots heavily contaminated with manure can also reduce fly numbers.

The emergence of resistant internal parasites in sheep and goats is a major industry issue, and this problem is also starting to be recognized in the cattle business. *Haemonchus contortus*, or the Barber Pole worm, is the parasite of most concern to sheep and goat producers, due to dramatic increases in multidrug resistant *Haemonchus* across the US. The overuse of anthelmintic drugs, annual rotation to different anthelmintics, use of blanket treatment protocols, and other mismanagement has led to the current state of anthelmintic resistance.

Haemonchus is a voracious blood feeder that attaches itself to the wall of the abomasum and takes a blood meal via a small tooth on its head. It has a direct life cycle, with worm larvae deposited on feces onto pasture, maturing and subsequently being eaten by another susceptible host. Barber Pole worms can detect the periparturient hormone rise in pregnant sheep and goats and release large numbers of eggs to be deposited on pastures prior to the birth of lambs or kids. Resistance by Haemonchus to the various approved anthelmintic drugs is widespread and growing due to misuse of these drugs.

Control of *Haemonchus contortus* (and other internal parasites) in sheep and goats can be maintained via

several management and treatment methods. The use of blanket deworming protocols, where every animal receives a dose of deworming drug, is a practice that should be eliminated. All blank deworming achieves is ensuring all worms on the farm are exposed to the drug, leaving only resistant worms behind. Instead, the concept of refugia should be employed, where only part of the herd or flock is treated. This leaves a susceptible population of worms behind to dilute the population of any resistant worms created by the treatment. Refugia in sheep and goats can be easily implemented by the use of FAMACHA scoring, which monitors the level of anemia via observation of the conjunctiva of the eye. Only the most anemic animals are treated under this system, sparing healthy animals from a dose of dewormer. This system treats only the most infested animals, which also are typically carrying 80% of the entire farm worm load anyway. This system also allows a producer to cull these animals instead of treatment, to further cut the use of anthelmintics on the farm. The drug used to deworm sheep and goats on any given farm should not be rotated to a different class annually, as this will contribute to resistance to multiple drug classes. Instead, careful use of a single type of drug should be utilized. In case of resistant worms, the use of combination treatments, with two different drugs administered at the same time, should also be considered. The use of combination treatments can dramatically cut worm numbers, if it is used carefully within a FAMACHA system that also monitors efficacy. It is critical to maintain a Refugia when using combination treatments, to dilute any multidrug resistant worm loads left after treatment. Efficacy can best be monitored by the use of Fecal Egg Count Reduction tests. This test consists of taking a fecal sample, examining for number of egg larvae via Stoll's or McMaster's methods, and treating the sheep or goats at the same time. The test is repeated around 14 days later to determine the number of eggs present, with around 95% reduction of larvae considered to be ideal.

Administration of deworming agents in sheep and goats should be via the oral route, as this presents the drugs right to the area of the body where the worms are typically located in the gastrointestinal tract. Topical applications of these drugs in sheep and goats are absorbed poorly, and injectable agents can have very long slaughter withdrawals (especially moxidectin). Removing sheep and goats from feed for 24 hours prior to oral deworming agents helps keep drug levels in the gut at higher levels for longer periods of time. Placing the tip of the drenching gun at the back of the tongue in sheep and goats helps facilitate the deposit of the drugs into the rumen and not directly into the abomasum.

In cattle, the emergence of resistant Cooperia worms is alarming, and is present in approximately 70% of US operations per Dr. Ray Kaplan at the University of Georgia. Ostertagia, the abomasal worm of cattle, is also beginning to become resistant to available anthelmintic drugs. The use of blanket treatment protocols in addition to poor application of drugs and lack of refugia is creating resistance in cattle. There are multiple approved methods to deliver anthelmintic agents to cattle, including oral drench, feed-based, injectable and topical applications. Oral and injectable formulations provide the best efficacy against worms, with topical applications providing more challenges. Topical deworming agents are absorbed at different rates, and can be affected by hair length, skin conditions and weather. It is also critical that topical applications of anthelmintics be completely applied to the top of the animal. Observation of efficacy of anthelmintic drugs in cattle is also critical. Cattle should have fecal exams performed to determine if worm burdens are actually a problem, prior to the use of deworming agents. If an issue is discovered the careful use of drugs in selected susceptible animals should be employed. Monitoring of success of treatment for internal parasites in cattle should also be utilized. While Fecal Egg Count Reduction tests are fairly accurate in sheep and goats, the use in cattle is more difficult to interpret. Eggs are shed in lower numbers in cattle, in larger volumes of manure, so sensitivity of the FECRT is lower in this species. Producers should work with their veterinarian to develop post treatment monitoring programs to determine if their anthelmintic program is working.

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American Consortium for Small Ruminant Parasite Control

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Asian Longhorned Ticks in Ohio

VME-1035
Veterinary Preventive Medicine
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Q: What are Asian longhorned ticks?

A: The Asian longhorned tick (*Haemaphysalis longicornis*; ALHT) has been introduced to the United States and can be found in Ohio. ALHT females can reproduce without mating and lay up to 2,000 eggs, which allows them to quickly establish large populations. They have been reported on more than two dozen species including sheep, goats, horses, cattle, chickens, dogs, cats, and humans. Among wildlife species, ALHT are most commonly reported on deer and raccoons.

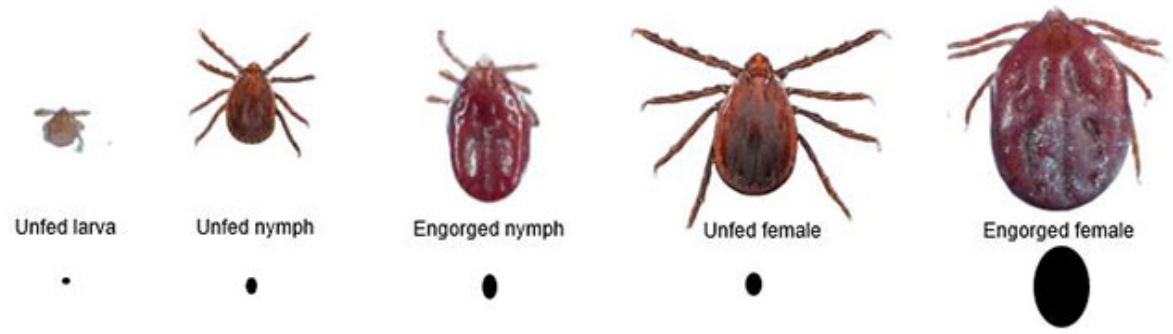

Figure 1. Asian longhorned tick life stages and relative actual size. Photos of unfed ticks by Centers for Disease Control. Photos of engorged ticks by Jim Occi, Rutgers, Center for Vector Biology.

Q: Can they make humans or animals sick?

A: Livestock may become heavily infested with large numbers of ALHT causing distress that can lead to decreased production and growth, aborted or still births, and death. These ticks may also transmit bovine theileriosis causing anemia in cattle, which can be

fatal. Few other animal or human pathogens have been reported in ALHT populations in the U.S. and they have not yet been linked with cases of human disease. However, these ticks have demonstrated the capability to acquire and transmit several human and animal pathogens in other countries and in the laboratory.

Q: What should I look for?

A: Regularly check your animals for ticks by scratching and feeling around the ears, shoulders, groin, armpits, and anus of your animals. ALHT appear small, brown, and plain (lacking color pattern) when unfed but may appear grayish when engorged with blood. Unfed adults are roughly the size of sesame seeds but can swell to the size of a pea when engorged. Juvenile stages (larvae and nymphs) are so small they may go unnoticed or resemble tiny, fast-moving spiders. All three life stages can occur at the same time, but nymphs are most active in the spring followed by adults in the summer and larvae in the fall. ALHT can also be active in winter. Although many ticks can look alike to the naked eye, the following suspicious tick encounters are characteristic of ALHT:

- observing unusually high numbers (hundreds to thousands) of ticks or little "spiders" on animals or equipment
- being swarmed by ticks upon entering a field
- observing clusters of ticks on the tips of vegetation (may look like clumps of seeds)

Q: How can I prevent ticks?

A: Keep grass and weeds short. Clear brush from feedlots and pastures. Talk with a veterinarian about tick prevention for your animals. Prevent tick bites on yourself by wearing tick repellent, long sleeves, and pants, and by tucking pants into socks to limit access to your skin. Perform a thorough tick check whenever you return from the outdoors. Remove all ticks immediately by grasping the tick close to the skin with tweezers and pulling gently upwards. If bitten, save ticks for identification, mark your calendar, monitor yourself for any signs of illness, and contact your healthcare provider. For more information on tick safety, visit the Ohio Department of Health website.

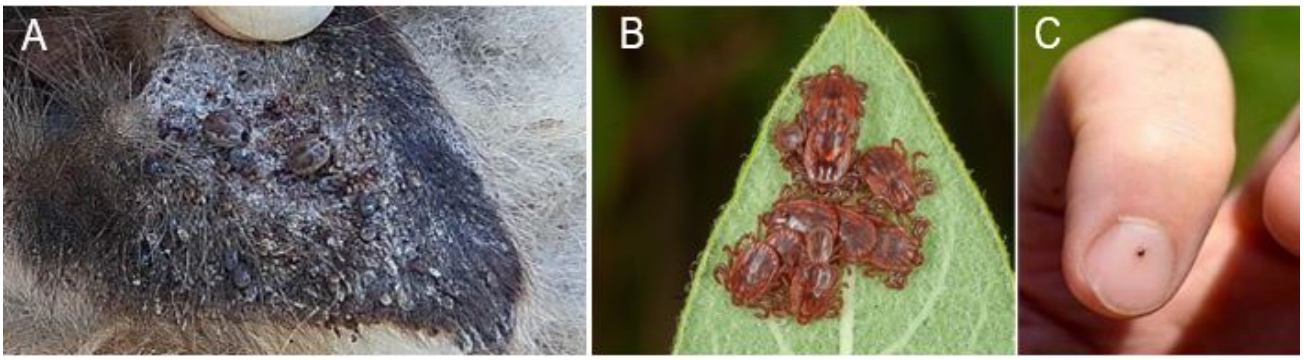

Figure 2. (A) Sheep's ear infested with ALHT larvae, nymphs, and adults. Photo by T. Rainey, Hunterdon County Health Services, N.J. (B) ALHT females and nymphs clustered on vegetation. Photo by Jim Occi, Rutgers, Center for Vector Biology. (C) Unfed ALHT nymph on fingernail. Photo by M. Greenwood, Yale.

Q: What should I do if I see ticks?

A: If you see ticks that resemble ALHT or experience any suspicious tick encounters, please submit ticks to The Ohio State University for identification. Send an email to ticks@osu.edu for instructions. Immediately report large numbers of ticks on livestock to ODA's Division of Animal Health by calling 614-728-6220.

An integrated pest management strategy is needed to manage ALHT that includes biosecurity, scouting, animal treatment, and pasture management.

Biosecurity: Check new stock thoroughly for ticks prior to introduction to your farm.

Scouting: Check for ticks when working animals or prior to moving them to a new pasture.

Acaricides (Animal Treatment): Treat animals for ticks based on scouting, examination findings, or based on pasture tick history. Livestock producers should work with their veterinarian to develop a tick control program. The American Veterinary Medical Association states no products in the United States are currently labeled for use against ALHT. However, several approved isoxazoline-class drugs for small animals and permethrin-class drugs for large animals have worked well against ALHT. Practitioners and producers are advised that use of these products for ALHT constitutes extra-label use and should be supervised by a veterinarian.

Pasture Management: ALHT thrive in mature or overgrown pasture grass. If ALHT are found, pastures can be mowed or harvested for hay, haylage, and baleage. Based on research, it is unlikely ALHT can survive at the moisture content of stored forages making this a potential option for producers, but this has not yet been studied. ALHT

may survive at the edges of bales stored on the ground where moisture levels are high, potentially attaching to animals when they feed. Removing tall vegetation in a pasture will allow more sunlight penetration, resulting in a less optimal tick habitat. Rotational grazing strategies also reduce tick habitat.

Application of pesticides to pasture for tick control may be necessary. Several pesticides labelled for general tick control are available and can be applied to pastures. Because these products need to contact the tick to be effective, be sure that the product reaches the soil's surface. Eggs are resistant to pesticide application and will hatch when conditions are optimal. If a pasture treatment is applied, scout for emergence of ALHT larvae or reintroduction of ticks in the following weeks. Most pesticides do not have a long residual effect so a second application—per the label instructions—can be applied to control emergence of larvae, minding any pollinator protections on the label. Currently there are no approved pesticides labelled to control ticks on annual cereal grains, cover crops, legumes, or corn used for grazing or making stored forage.

When using pesticides, remember that the label is the law. Please read, understand, and follow all label guidelines for use of pesticides to control ticks.

Resources

Centers for Disease Control and Prevention, "What You Need to Know About Asian Longhorned Ticks–A New Tick In the United States" at cdc.gov/ticks/longhorned-tick/index.html.

Ohio Department of Health, "Tickborne Diseases in Ohio" at odh.ohio.gov/wps/portal/gov/odh/know-our-programs/zoonotic-disease-program/resources/tickborne-diseases.

USDA Pest Alert, "Asian Longhorned Tick (*Haemaphysalis longicornis*)" at aphis.usda.gov/publications/animal_health/alert-asian-longhorned-tick.508.pdf.

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Ohioline

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Fruit and Vegetable Crops

CATEGORY 3

Photo Credit: Robert Nathan Garlington

Some Thoughts on Monitoring Key Field and Specialty Crop Insect Pests
-Jim Jasinski, Professor Dept. of Extension, IPM Program
-Amy Raudenbush, Dept. of Entomology

Integrated Pest Management is celebrating its 50th anniversary in 2022 as a science based approach to manage pests (insects, weeds, diseases) in crops. The main principles of IPM follow the process of scouting or monitoring, identification, use of thresholds, selecting proper actions or mitigations and evaluation of any specific action.

In this brief article about insect monitoring, different types of traps for different kinds of pests will be covered. Most of what is presented here has been learned and passed down through research and years of field trials from experienced specialists to be used by practitioners; either growers interested in better managing their crops or extension educators helping growers learn the monitoring process.

When first starting to monitor for a pest it can be a little daunting to choose between different trap types and different lure manufacturers, trap location, timing, etc.; how can they be certain which is "best" for their situation? Only experience and comparison can lead you to choose the right combination for your farm.

Below are listed a handful of the most common insect pests monitored annually by Ohio State University personnel. Next to each pest are some guiding comments about how to select the trap and lure, where and when to deploy the trap, and most importantly, how to translate trap catches into making the correct management decisions. If there is a pest you are interested in monitoring that is not listed below, contact your local Extension educator to see what recommendations exist.

Field Crops
Western bean cutworm – Recommended trap is an all green bucket trap paired with a Trece Pherocon lure. Traps are placed at the edge of corn fields starting June 15 and checked weekly for captured pests. Trap data are reported to OSU who produce and share a weekly report of activity across the state through the CORN newsletter, including any treatment recommendations. Traps are removed September 1 for the season.
Instructional Video: https://youtu.be/qGjpwtfkObM

European corn borer – Recommended trap is the Trece sticky wing trap paired with a Hercon lure; most commonly used is the IA strain but some growers also use NY strain. Traps are placed next to corn fields but over grassy areas around May 1 and checked weekly for captured pests. Trap data are reported to OSU network who produce and share a weekly report of activity across the state through the CORN newsletter, including any treatment recommendations. Traps are removed September 1 for the season.

Black cutworm – Recommended trap is the Trece sticky wing trap paired with a Trece Pherocon lure. Traps are placed in at the edge of corn fields around April 15 and checked weekly for

captured pests. Trap data are reported to OSU network who produce and share a weekly report of activity across the state through the CORN newsletter, including any treatment recommendations. Traps are removed June 15 for the season.

Fall armyworm – Recommended trap is all green bucket style trap paired with Hercon Luretape. Traps are placed at the edge of corn fields starting August 1 and checked weekly for captured pests. Trap data are reported to OSU network who produce and share a weekly report of activity across the state through the CORN newsletter, including any treatment recommendations. Traps are removed September 30 for the season.
Instructional Video: https://youtu.be/X1jvQxx_fpc

Articles containing insect activity updates on field crops can be found here:
https://agcrops.osu.edu/newsletter/corn-newsletter

Vegetable & Fruit Crops
Brown Marmorated Stink Bug – Recommended trap is a Trece Pherocon dual clear sticky panel trap paired with a Trece Pherocon stink bug dual lure. The trap is attached to a wooden post ca. 4' above the ground and deployed at the edge of a wooded area adjacent to a crop field starting August 1. Traps are checked weekly with pest numbers reported to the OSU trapping network which generates flight activity graphs. Articles are also posted on the VegNet blog site including any treatment or scouting recommendations. The only crop with a threshold is apples, otherwise increased activity should lead to increased scouting in host crops. Traps are removed October 1.
Instructional Video: https://youtu.be/PVtY-c92ZdM

Spotted wing Drosophila – Recommended trap is Scentry SWD jar trap paired with Scentry SWD lure. Traps are placed either in wooded edge next to cash crop or at the edge and interior of cash crop. Traps are checked weekly with contents of captured insects carefully sorted to identify SWD adults from bycatch. Threshold is one fly to initiate season long control program once fruit becomes ripe until fruit is no longer harvested. Traps are checked weekly with pest numbers reported to the OSU trapping network which generates flight activity graphs. Articles are also posted on the VegNet blog site including any treatment or scouting recommendations.
Instructional Video: https://youtu.be/z9IeuYECnJk

Corn earworm – Recommended trap is either the Scentry Helithis trap or Hartstack wire mesh trap paired with the Hercon Luretape lure. Traps are placed next to sweet corn fields prior to silking with the bottom of the trap at the same height as the corn ears. Traps are checked weekly and treatment schedule is determined based on the number of moths caught per night and the temperature during that period. Trap should be moved to fresh silking sweet corn throughout the season. Traps are checked weekly with pest numbers reported to the OSU trapping network which generates flight activity graphs. Articles are also posted on the VegNet blog site including any treatment or scouting recommendations. Traps are removed by October 1.
Instructional Video: https://youtu.be/X1jvQxx_fpc

European corn borer – Recommended trap is the Scentry Heliothis mesh trap paired with a Hercon lure; most commonly used is the IA strain but some growers also use NY strain. Traps are placed next to corn fields but over grassy areas around May 1. Traps are checked weekly with pest numbers reported to the OSU trapping network which generates flight activity graphs. Articles are also posted on the VegNet blog site including any treatment or scouting recommendations. Traps are removed September 30 for the season.
Instructional Video: https://youtu.be/X1jvQxx_fpc

Squash vine borer – Recommended trap is the Scentry Heliothis mesh trap paired with a Trece Pherocon lure placed at the edge of a cucurbit field starting June 1. Traps are checked weekly; if a distinct peak in late June or early July is seen, direct treatment to the base of the plants is recommended. Traps are checked weekly with pest numbers reported to the OSU trapping network which generates flight activity graphs. Articles are also posted on the VegNet blog site including any treatment or scouting recommendations. Traps are removed September 15 for the season.
Instructional Video: https://youtu.be/KIHeMtkF98Y

Curious to see all the pests monitored for in Fruit and Vegetable Crops? Take a look here https://u.osu.edu/jasinski.4/pestvisualization/ and here https://u.osu.edu/vegnetnews/.

Trapping supplies can be purchased at several locations online including Great Lakes IPM, IPM labs, AgBio, ISCA Technologies, Gemplers and others.

For monitoring Corn earworm, European corn borer, Black cutworm, Fall armyworm, Squash vine borer

For monitoring spotted wing Drosophila

For monitoring Brown Marmorated Stink Bug

Nursery and Forest Crops

CATEGORY 4

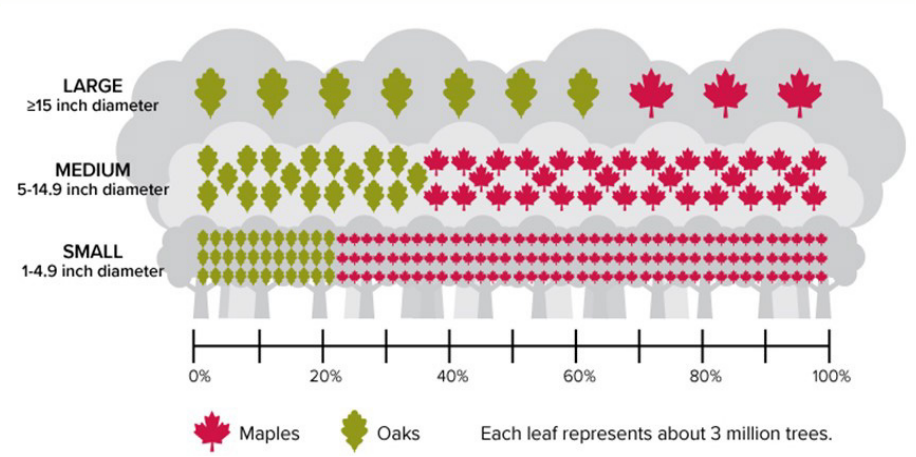
Pesticide Safety Education Program, Ohio State University Extension

Help us keep OAK in our FUTURE

Why is oak so important?

Oaks are important for so many reasons. They are well adapted to Southeast Ohio growing conditions and are long-lived providing stability to our woodlands. In addition they:

- produce acorns which are a key food for many wildlife species, from songbirds to white-tailed deer
- provide many other important habitat benefits for wildlife
- grow timber used to produce many valuable forest products like barrels, flooring, cabinets and furniture
- sustain our local economy by providing jobs and income for woodland owners
- enhance the many recreational benefits, like bird watching and hunting, that our forests provide



Relationship between oak and maple (mostly red maple) populations in 17 counties in Southeast Ohio, the priority forest area for oak management. Source: Thomas Albright. 2018. USDA Forest Service, Northern Research Station, Forest Inventory and Analysis. 2017 FIA Ohio Data.

Why are we concerned?

Oaks still dominate our woodlands in Southeast Ohio, but we are starting to see a concerning trend. When these large canopy oaks die or are harvested they are often replaced by species other than oak. Typically, the replacement trees are shade loving species like red maple which become established under oak canopies and deprive smaller oaks of the light that they need to survive and compete (see graphic above).

Shelterwood is an example of a type of harvest that can help to establish young oaks.

Why is oak in jeopardy?

Young oaks are a bit like Goldilocks. Too much light from heavy cutting like clearcutting and they often lose the battle to light loving species like tulip-tree. Too little light from no cutting or "select cutting" and they lose to shade loving species like red maple.

When young oaks get "just the right amount" of light from partial canopies they can grow large "carrot-like" roots (see picture right). These roots give them the ability to sprout and grow rapidly after cutting and other disturbances like fire.

What "oak friendly" solutions are available?

Over the past few decades with the help of researchers we've uncovered some "oak friendly" practices that can help to encourage young oaks. Tools like prescribed fire (see picture left), herbicides and cutting can be used to remove low shade from trees growing under the main canopy which can help young oaks get started. Once these young oaks develop deep tap roots, proper timber harvests (e.g. shelterwood harvest, see photo front) can be designed to allow them to grow into the canopy.

What can YOU do?

If you would like to enhance oaks in your woods be sure to **contact your State Service Forester** at the Ohio Department of Natural Resources who will help you to:

- evaluate your situation
- develop a plan of action for your woods
- determine if you are eligible for funding or other assistance
- provide recommendations to help you to leave an oak legacy for the future

The future of oak is in our hands

The Ohio Department of Natural Resources receives funding assistance from the United States Department of Agriculture in the delivery of certain programs. In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age or disability. For more information visit: https://www.fns.usda.gov/usda-nondiscrimination-statement

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Greenhouse Crops

CATEGORY 5

Photo Credit: thetravelnook

CFAES

Important Diseases of Greenhouse Floral Crops

Francesca Peduto Hand, Associate Professor

The warm, humid, and virtually wind-free greenhouse environment is very suitable to the development of many plant diseases. Plant material from multiple sources is constantly introduced in the greenhouse constituting a risk for pathogens introduction. With so many crops overlapping during the short production season, there is often no time allowed for the reduction of pathogen populations. High host density can also translate in easy transmission of disease from sick to healthy plants.

1 // Gray mold, caused by the fungus *Botrytis cinerea*, is the most common disease of greenhouse ornamentals. Depending on the host and the conditions under which the crop is grown, this disease can either be a common nuisance or an economic disaster.

Symptoms may include leaf spots, flower blights, bud rots, stem cankers, stem and crown rots, cutting rots and in extreme cases, plant death. Necrotic tissues are an excellent substrate for the prolific sporulation of the fungus, that when conditions of high relative humidity prevail, appears as a fuzzy gray mold.

Disease is favored by cool temperatures (72 to 77°F), relative humidity at or above 85%, little or no air circulation, and free moisture on the leaf surface. Proper sanitation and manipulation of the greenhouse environment can successfully reduce the impact of this disease.

Sanitation practices before, during, and after each cropping cycle are the first important step to achieve good control. Petals falling from hanging basket plants may encourage the growth of the fungus on plants at ground level. Senescing flowers, leaves and infected plant material should be removed from the greenhouse so that they are not a source of inoculum for the rest of the house. Infected plant material should not be allowed to sit in trash cans within the house as the fungus will continue to grow and sporulate on the dead and dying tissue. Subsequent opening and closing of the trash cans will produce enough air movement to release spores out into the greenhouse.

Maintaining an environment that that will not permit the fungus to grow and sporulate is essential for control. To this extent, excellent control can be achieved by keeping the relative humidity below 85%. Proper plant spacing is important to allow better air circulation and to reduce relative humidity within the

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u.osu.edu/handlab

Fuzzy gray sporulation of Botrytis on senescent vinca tissue (left) and white sporulation of downy mildew on the underside of stock leaves (right).

plant canopy. Formation of free moisture on plant surfaces should be avoided, so fans should be used to provide good air movement above the canopy. Overhead watering is discouraged, as the water droplets will cause the spores to become airborne, allowing for further infections to occur.

A variety of fungicides are available to control gray mold in the greenhouse. However, because some Botrytis populations have developed resistance to certain chemicals, it is recommended not to rely on the use of a single chemical or on multiple chemicals with the same mode of action (check label for FRAC number).

2// Downy mildews are some of the most destructive diseases of ornamental crops. They attack a wide variety of bedding ornamentals, including impatiens, pansy, snapdragon, salvia, as well as cut flowers, including scabiosa and stock.

Downy mildew symptoms can vary greatly depending on the host where they develop as well as the stage of the disease, and may include small chlorotic spots on upper side of leaves (early infections – subtle, may pass unobserved), more extensive bronze to brown lesions on upper side of leaves (often angular-shaped), leaf curl, wilting, stunting, and flower and leaf drop. Severe infections can also lead to plant death. Beneath the upper leaf lesions, a white to gray fuzzy growth will occur when high relative humidity conditions are met.

Downy mildews are very difficult to control once established so every effort should be made to prevent the disease and its introduction into the greenhouse. Always purchase disease free plants from reputable sources. Inspect plants regularly for signs and symptoms of disease and remove suspected plants immediately to prevent pathogen spread. Infected plants, plant debris, and soil should be removed from the greenhouse by placing into closed containers, then buried or burned.

Keep relative humidity below 85% by venting and heating in order to stop germination of spores and decrease sporulation rate on infected plants. Reduce leaf wetness with proper plant spacing that ensures air circulation. Because spores are disseminated via water splash, it is important not to use overhead irrigation.

Several fungicides are available to control the disease and should be applied preventively for maximum

Chlorosis and necrotic leaf spot symptoms caused by the Impatiens Necrotic Spot Virus (INSV)

efficacy. Keep in mind that if sporulation is observed on the leaf underside, control will be difficult to impossible. Many fungicides that provide excellent control when applied preventively will not work curatively.

3// Impatiens Necrotic Spot Virus, or INSV is the most important virus in the floriculture industry. INSV has a broad host range, though it is most commonly encountered in impatiens, begonias, petunias, snapdragons, cyclamen, cineraria and gloxinia. INSV can infect vegetables along with ornamental bedding plants, but will not infect roses or poinsettias. The western flower thrips is a large cause of its spread. The virus can be transmitted in just 30 minutes of an adult feeding on the host plant.

INSV will produce necrotic and chlorotic concentric rings on the leaf surface. The terminal flower buds could also be necrotic. While these are two key symptoms, there are many more that could be produced as a result of this virus. These include stunting, wilting, necrotic spotting, chlorosis, stem death and generally poor flowering. Because of this wide array of symptoms, it is nearly impossible to know for certain that you are dealing with INSV without diagnostic testing.

The first step to proper disease management in the greenhouse is an accurate diagnosis. Immunostrips are available to specifically test for INSV on-site by a grower. Alternatively, you can send a plant sample to a diagnostic clinic for further molecular testing. Plants found to be positive for INSV should be removed, along with any weeds and hobby plants surrounding or inside the greenhouse. Weeds and hobby plants can harbor INSV as well as the western flower thrips and can distribute the disease in mechanical methods such as pruning. The same pair of pruning shears used to cut an infected plant as an uninfected plant will further the spread of INSV. Because INSV can infect some herbs and vegetables such as lettuce, spinach and basil, these plants should not be grown in the same greenhouse as flowering bedding plants. Eliminating any virus-infected stock in the greenhouse will greatly diminish the chances of infection in marketable materials.

All incoming plants should be inspected for symptoms and thrips before incorporating the new plants with the current stock. Applying the exclusion principle, this method will prevent an invasion of the pathogen where it was not previously.

Fumigation

Photo Credit: James Louden

CATEGORY 6

Pesticide Safety Education Program, Ohio State University Extension

Soil Fumigation Additional Training Requirement

Any applicators who are applying soil fumigants are required to complete U.S. EPA approved training. This training is in addition to requirements for the Ohio Private Pesticide Applicator License.

Below is the front page of the web-based training required for licensed Ohio applicators who are planning to use the following soil fumigants: methyl bromide, chlorpicrin, chloropicrin, and 1,3-dichloropropene, dazomet, and meta sodium and meta potassium.

The website is *www.fumiganttraining.com*

Information about training for other products is available at:
www.epa.gov/pesticides/reregistration/soil_fumigants

PURDUE UNIVERSITY

PURDUE EXTENSION

E-66-W

Stored Product Pests

Department of Entomology

STORED GRAIN INSECT PEST MANAGEMENT

Linda J. Mason and John Obermeyer, Extension Entomologists

Direct-feeding damage by insects reduces grain weight, nutritional value, and germination of stored grain. Infestations also cause contamination, odor, mold, and heat-damage problems that reduce the quality of the grain and may make it unfit for processing into food for humans or animals. Commercial grain buyers may refuse to accept delivery of insect contaminated grain, or may pay a reduced price.

Kinds of Stored Grain Insects

Several species of insects may infest grain in storage. The principal pests that cause damage are the adult and larval stages of beetles, and the larval stage of moths (For aid in identifying stored grain insects, see page 6 of this publication). All may be a problem by their presence, either alive or dead, in grain that is to be processed for food.

Stored-grain insects are known as "internal feeders" if they feed within the kernels, otherwise they are referred to as "external feeders." The granary weevil, rice weevil, lesser grain borer, and larvae of the Angoumois grain moth are internal feeders. External feeders (or "bran bugs") that feed on grain dusts, cracked kernels, and grain debris without entering the kernel, include Indianmeal moth, sawtoothed grain beetle, red and confused flour beetles, flat grain beetle, and cadelle. Other species, such as the foreign grain beetle and hairy fungus beetle, feed on molds or fungi growing on grain stored at excessive moisture levels.

Preventative Measures Before Binning

Grain Bin Clean-up: Newly harvested grain may become infested when it comes in contact with previously infested grain in combines, truck beds, wagons, other grain-handling equipment, augers, bucket lifts, grain dumps, or grain already in the bin. Insects may also crawl or fly into grain bins from nearby accumulations of old contaminated grain, livestock feeds, bags, litter, or any other cereal products. Insect infestations can be prevented with good management practices. Where appropriate, the following guidelines should be used two or more weeks before grain is placed in bins:

1) Brush, sweep out and/or vacuum the combine, truck beds, transport wagons, grain dumps, augers, and elevator buckets to remove insect-infested grain and debris.

2) In empty bins, thoroughly sweep or brush down walls, ceilings, ledges, rafters, braces, and handling equipment, and remove debris from bins.

3) Remove all debris from fans, exhausts, and aeration ducts (also from beneath slotted floors, when possible).

4) Remove all debris from the storage site and dispose of it properly according to area, state, and/or federal guidelines (this debris usually contains insect eggs, larvae, pupae, and/or adults, all ready to infest the new grain).

5) Remove all debris and vegetation growing within ten feet of the bins (preferably the whole storage area).

6) Examine area to determine if rodent bait stations are required, and use if needed. Be sure to follow all label directions.

7) Spray cleaned area around bins with a residual herbicide to remove all undesirable weedy plants.

8) Inside bins, spray wall surfaces, ledges, braces, rafters, and floors with one of the following residual insecticides to the point of runoff: Tempo®, malathion, Storcide II, chlorpyrifos-methyl. Outside, spray the bases and walls up to 15 feet above the bases, plus the soil around the bins.

9) If the grain is expected to remain in the bins for at least a year, fumigate the area beneath the slotted (drying) floors with a formulation of chloropicrin according to label directions (only certified applicators may purchase and apply). Chloropicrin, available in several sizes of containers as CHLOR-O-PIC and QUASAR, is a liquid formulation which, when applied to the bin floor, forms a gas that is 5 times heavier than air. Chloropicrin is a restricted-use product that is extremely toxic to all living organisms; follow label directions for application and personal protection information.

10) If newly harvested grain and/or insect-free grain must be added to grain already in storage, the latter must be fumigated with either aluminum phosphide or methyl bromide (only certified applicators may purchase and apply). (If doing this, omit step 9.)

Preventative Measures <u>During</u> Binning

Grain Protectants (Table 1). It is recommended that a grain protectant be applied to grain that will be in storage for one or more years. Grain protectants are insecticides registered for application to whole grain to protect against insect infestations while the grain is in storage. Grain protectants kill insects as they crawl about or feed on treated grain and/or grain fragments. These formulations are generally applied to grain as it is being augured, loaded, or turned into storage facilities. <u>Do not</u> apply grain protectants before high temperature drying because extreme heat will result in rapid volatilization and reduced residual qualities of the pesticide. Grain protectants applied to 13% moisture grain will have a greater residual life than grain at 15% or greater moisture. Grain protectants, when applied according to label directions, can be sold or fed immediately after application.

Preventative Measures <u>After</u> Binning

Top-Dress: Some grain protectants may be applied as a surface treatment ("top-dress" or "cap off") to the grain mass already in storage to control "surface feeders" such as the Indianmeal moth larva (Refer to Table 1). Remove any webbing that may already exist (produced by the larvae) before applying the top-dress treatment. Raking the product into the top few inches of leveled off grain will increase the likelihood that the larvae will be controlled. **Caution**: legal tolerances

Table 1. Grain Protectants Approved for Stored Grain in Indiana

Insecticide*	Commodity	Comments
Bacillus thuringiensis (B.t.)	Corn (field and popcorn), wheat (small grains), sorghum, soybeans, peanuts, birdseed, crop seed, tobacco	May be used on empty grain bins, but best if used as a top-dress treatment to prevent or control lepidopterous pests such as Indianmeal moth and almond moth larvae.
pirimiphos-methyl (Actellic)	Corn (field and popcorn), sorghum	Can be used as either a grain protectant or top-dress treatment, not both. Is effective on all stored grain insect pests.
malathion	Corn, wheat (small grains), barley, sorghum, rye	Can be used for bin wall treatments, top-dress, or a grain protectant, Read and follow label directions so that legal tolerances are not exceeded. Do not use for Indianmeal moth control.
chlorpyrifos-methyl	Wheat (small grains), sorghum	Can be used for bin wall treatments, top-dress, or a grain protectant for only the crops listed. **Removed from market. Existing stocks only.**
pyrethrins and piperonyl butoxide	Corn, wheat (small grains), sorghum	These products are registered primarily to control exposed Indianmeal moth adults and larvae. There is no residual activity.
diatomaceous earth/silicon dioxide	Corn, buckwheat, wheat (small grains), sorghum, soybeans, rice, rye, seed grain	These products kill insects by scratching the body surface and causing dehydration. Grain buyers may be reluctant to purchase grain treated with DE because of a possible lower grade, reduced flowability, reduced test weight and increased wear on grain moving equipment. Its use as an empty bin treatment, especially beneath the slotted floor, shows promise.
deltamethrin combined with chlorpyrifos-methyl (Storcide II)	Wheat, barley, oats, sorghum, rice	This product can be used for empty bin application as well as grain. May not be used on corn.
DDVP	Area above stored corn, grain, peanuts, soybeans	This product is a non-residual space treatment that can be used in empty grain bins and in the headspace of full bins. Primary targets: adult moths.
methoprene	Empty storage bins, barley, birdseed, cereal grains, corn, popcorn, oats, peanuts, rice, sorghum, wheat sunflower, grain products	This is an insect growth regulator and will not kill adult stages. It will only prevent immature life stages from becoming adults. May be applied as top-dressing.

*Always read and follow label instructions.

can be exceeded for a specific insecticide if applied as both a grain protectant and a top-dress treatment; check the label.

No-Pest Strips: Dichlorvous impregnated strips (DDVP) may be hung in the open space of the grain bin during the spring, summer, and fall months to control flying insects such as the adult Indianmeal moth. Suspend one strip per 1,000 cubic feet of air space. The strips may or may not have to be replaced during the summer depending on the amount of air transfer in the open space.

Control Measures <u>After</u> Binning

Any time the grain is at or above 55°F, it should be inspected every two weeks for insect activity. Stored grain pests are generally inactive at temperatures below 55°F. Even if insects appear active only on the surface of the grain, use a grain probe or other sampling device and determine the extent of infestation within the grain mass. Insects collected should be identified before chemical treatment is considered. Knowing what insect species is infesting stored grain can provide important information on the grain condition and what should be done about it. Grain that is infested with insects does not automatically make it "weevily!" Grain should only be graded weevily if it contains an internal feeding insect. The Federal Grain Inspection Service (FGIS) has set the following standards for grain that is graded "infested." Notice the emphasis that is placed on weevil (internal feeders).

Federal Grain Inspection Service Standards for Grain that is Graded "Infested"

Grain 1000 g Sample	Number and Type of Insects
Wheat, triticale, rye	• 2 or more live weevils • 1 live weevil and 1 other live insect injurious to stored grain, or • 2 other live insects injurious to stored grain
All other grains	• 2 or more live weevils • 1 live weevil and five other live insects injurious to stored grain, or • 10 other live insects injurious to stored grain

The most common stored grain insect pests may be grouped by their feeding habits. Listed below are appropriate management strategies for these groups. Remember, correct identification is imperative. Samples may be sent to the Plant and Pest Diagnostic Laboratory, LSPS – Room 101, 915 W. State Street, W. Lafayette, Indiana 47907-2054, for insect identification.

Internal Feeders

Weevils and Lesser Grain Borer

The only options with weevily infested grain is to feed it as is, sell it at a discounted rate, or fumigate it. All fumigants are classified as restricted use products. Farmers desiring to fumigate their own grain must attain two levels of certification: Private applicator and Category 7d. Otherwise, a certified and licensed commercial applicator must be hired. Fumigants are **extremely hazardous** for the user and must be applied in strict accordance with instructions listed on the product label and any accompanying instruction manuals, etc. Fumigants for use in farm storage bins are registered as either "liquid under pressure" or "solid formulations." Regardless of the formulation, fumigants become effective when they change to a gas form, and settle down through the grain mass. Refer to Table 2 (page 4) for list of registered fumigants for use in Indiana.

The grain bin should be air-tight and all openings sealed before fumigation. Best conditions for treatment are a calm day with grain temperatures at or above 65°F. Success depends on the concentration of the fumigant, grain temperature, and length of time the fumigant is in the bin. The minimum exposure period is generally 72 hours. After fumigation, the grain must be aerated for at least 48 hours, or until the gas concentration level is below that listed on the fumigant label. All labeling information regarding safety in handling and proper application techniques must be followed when making application. Specific safety equipment such as the use or availability of self contained breathing apparatus and specialized instruments to measure gas concentrations are now required.

Remember that although a successful fumigation does drastically reduce the insect pest population, it offers no residual effect. The grain becomes immediately susceptible to reinfestation once the gas is evacuated (approx. 72 hrs).

External Feeders

There are several management options available for control of "bran bugs" other than fumigating. Management decisions will vary depending on the insect species and numbers present, your storage facilities, and how quickly you want to move the grain.

Indianmeal Moth

The caterpillar (larva) is a surface feeder and stays in the top 3-6 inches of the grain mass feeding on fines while creating a webbing. For control refer to PREVENTIVE MEASURES <u>AFTER</u> BINNING.

Foreign Grain Beetle and Hairy Fungus Beetle

These beetles are fungus feeders and are present in the grain mass because of moldy grain. Correcting aeration and/or moisture problems on the surface or within the grain mass and removing the out-of-condition grain will control this problem. Pulling grain out the center of the bin (collection of fines), cleaning the remainder of the grain mass as it is being moved, and conditioning (drying and cooling) the grain will provide a bin unsuitable for these mold feeders.

Sawtoothed Grain Beetle, Red and Confused Flour Beetles, Flat Grain Beetle, and Cadelle

These secondary feeders infest bins because of the availability of grain dusts, cracked kernels, and grain debris. These pests can be distributed and feeding throughout the grain mass or localized because of a collection of fines, such as in the core of the bin where fines collect at binning. They

Table 2. Fumigants* Approved for Stored Grain in Indiana

Insecticide*	Commodity	Comments
aluminum phosphide Sold as: Detia, Fumitoxin, Gastion, Gastoxin, Phostek, Phostoxin, Quick Phos	Corn (field and popcorn), wheat (small grains), sorghum, soybeans	This is the most common fumigant used in grain bins. The solid tablets or pellets break down to gas when exposed to the atmosphere (moisture) and releases phosphide gas.
carbon dioxide Sold as: Carbon dioxide	Corn, wheat (small grains), sorghum, soybeans	This requires the use of specialized equipment (CO_2 generator) and air tight bins. Fumigation may take 10 or more days.
magnesium phosphide Sold as: Fumi-cel, Magtoxin	Corn (field and popcorn), wheat (small grains), sorghum, soybeans	This fumigant is normally not used for stored grain fumigation. It releases phosphide gas much faster than aluminum phosphide which may endanger the applicator or hinder even gas penetration throughout the grain mass.
methyl bromide Sold as: Brom-O-Gas, Meth-O-Gas	Corn (field and popcorn), wheat, sorghum	Recirculation is necessary when using this fumigant. MB is colorless and odorless.
*All fumigants are **Restricted Use Products** and cannot be purchased or applied unless the applicator is certified and has either a Private Applicator Permit or a Commercial Applicator License.		

will also feed on the dusts and damaged kernels created by internal feeders; if this is the case then the only control option is fumigation.

A grain bin of whole undamaged kernels is the key to preventing the secondary feeders. This may require running the grain through a cleaner or aspirator while moving the grain from one bin to another. This will not only remove the fines, but dead and live insects as well. Applying a grain protectant (see Table 1) while moving this grain would be a sound management practice. Refer to PREVENTIVE MEASURES BEFORE BINNING for proper preparation of the grain bin.

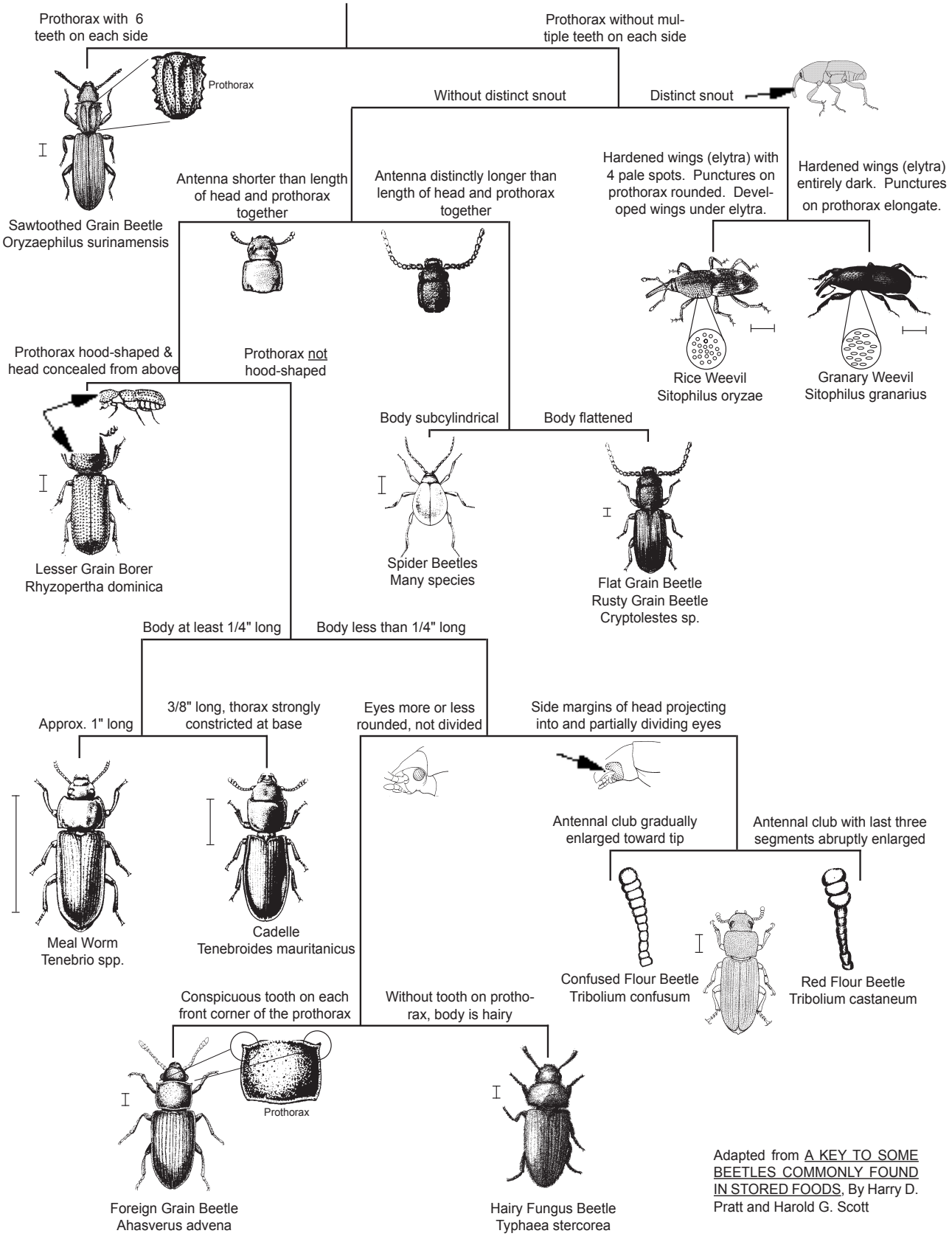
Continued Stored Grain Pest Management

All grain producers having grain in on-farm storage need to maintain a good management program that includes proper grain-handling, regular grain inspections, and pest control. An excellent reference publication on grain management is Purdue Extension Publication AE-90, Managing Grain for Year-Round Storage, G.H. Foster and B.A. McKenzie <http://www.ces.purdue.edu/extmedia/AE/AE-90.html>. Other materials are available at <http://extension.entm.purdue.edu/grainlab/>.

READ AND FOLLOW ALL LABEL INSTRUCTIONS. THIS INCLUDES DIRECTIONS FOR USE, PRECAUTIONARY STATEMENTS (HAZARDS TO HUMANS, DOMESTIC ANIMALS, AND ENDANGERED SPECIES), ENVIRONMENTAL HAZARDS, RATES OF APPLICATION, NUMBER OF APPLICATIONS, REENTRY INTERVALS, HARVEST RESTRICTIONS, STORAGE AND DISPOSAL, AND ANY SPECIFIC WARNINGS AND/OR PRECAUTIONS FOR SAFE HANDLING OF THE PESTICIDE.

Revised 5/2010

A PICTORIAL KEY TO BEETLE PESTS OF STORED GRAIN COMMONLY FOUND IN INDIANA



Adapted from A KEY TO SOME BEETLES COMMONLY FOUND IN STORED FOODS, By Harry D. Pratt and Harold G. Scott

Notes:

CATEGORY 7

Specialty Uses

Photo Credit: Chrissy Kaminski

Herbicides for Aquatic Applications

Eugene Braig, Ohio State University Extension

Table 1. Comprehensive list of herbicide chemical names approved for aquatic applications within Ohio and some generalizations regarding effectiveness and use restrictions. *See individual brand labels for details.* Updated by Eugene Braig, Ohio State University Extension, October 2021.

Chemical name[1]	Absorption	Selectivity[3]	Water-use restrictions[4]
Copper (copper sulfate and copper chelates)	Contact	Broad	Minimal
Sodium carbonate peroxyhydrate	Contact	Broad	Minimal
Carfentrazone-ethyl[2]	Contact	Broad	Moderate
Diquat dibromide	Contact	Broad	Moderate
Endothall (monoamine or dipotassium salt)	Contact	Broad	Moderate
Flumioxazin	Contact	Broad	Moderate
Glyphosate	Systemic	Broad	Minimal
Imazamox[2]	Systemic	Broad	Moderate
Fluridone	Systemic	Selective	Moderate
Topramezone[2]	Systemic	Selective	Moderate
Bispyribac[2]	Systemic	Selective	Extensive
Florpyrauxifen-benzyl[2]	Systemic	Selective	Extensive
Imazapyr	Systemic	Selective	Extensive
Penoxsulam[2]	Systemic	Selective	Extensive
Triclopyr	Systemic	Selective	Extensive
2,4-D	Systemic	Selective	Extensive

1. Many listed active ingredients will also be present in products designed for terrestrial applications. Only brands specifically approved and labeled for aquatic applications may be applied to surface waters or their shorelines.
2. New patents, each with only one manufacturer's brand available as of spring 2019.
3. See label of each brand for detail on weed species controlled or partially controlled.
4. Use restrictions may refer to domestic water (including human consumption) and distance to water intakes; swimming; recreational fishing and fish consumption; livestock watering; irrigation of turf, greenhouses/ornamentals, and food crops; aquaculture; etc. Some use restrictions may be very broad (e.g., irrigation) while some can be very specific (e.g., crawfish farming). Those active ingredients described here as "minimal" are restricted for very few use categories or have very brief (or no) periods of restricted time before an intended use can resume. "Moderate" may effect more use categories, have longer waiting periods, or require concentrations of active ingredient fall below a moderate threshold before use resumes. "Extensive" implies effects on several use categories, prolonged periods of non-use, or concentrations of active ingredient that must fall below a very restrictive threshold (sometimes as low as 1 ppb) before use resumes; some are classified as "do not use" on waters intended for some uses. Non-active ingredients (incorporated adjuvants, etc.) can vary among products and may affect use restrictions. Applicators must read and understand any given product's use restrictions prior to application.

Table 2. Comprehensive list of contact herbicide chemical names approved for aquatic applications within Ohio (with a few representative brands) and some generalizations regarding target organisms controlled. *See individual brand labels for details.* (Also, see footnote 3 below.) Updated by Eugene Braig, Ohio State University Extension, October 2021.

- **Carfentrazone-ethyl** (e.g., Stingray): misc. floating and emergent plants.
- **Copper sulfate**[1, 2] and **copper chelates**[1, 2] (a vast many: e.g., Cutrine brands, Captain XTR, EarthTec, etc.): mostly algae (some submersed).
- **Diquat dibromide**[1, 2] (e.g., Reward, Weedtrine-D, Aquastrike [endothall blend], etc.): submersed plants and some filamentous algae.
- **Endothall**[1, 2] (e.g., Aquathol brands, Cascade, Hydrothol, Evac Biocide, Aquastrike [diquat blend]): submersed plants and some algae.
- **Flumioxazin**[2] (e.g., Clipper, Pond-Klear, Propeller, Flumigard, etc.): misc. submersed and free-floating plants, especially duckweeds and watermeal.
- **Sodium carbonate peroxyhydrate**[1, 2] (e.g., GreenClean, Pak 27, Phycomycin, etc.): near-surface and shallow algae.

1. For additional information, see:

   Lynch, W. E. Jr. 2009. Aquatic control of aquatic plants: Agriculture and natural resources fact sheet A-4-09. Ohio State University Extension, Columbus.

2. Term of patent has expired and many brands may be available. Shop competitively, considering product labels for concentration of active ingredient and appropriate application methods.
3. Karmex is no longer approved for aquatic applications. Many long-time pond owners want to apply Karmex to water, and many long-time retailers even still recommend it. *Do not apply Karmex to or near surface water!*

Table 3. Comprehensive list of systemic herbicide chemical names approved for aquatic applications within Ohio (with a few representative brands) and some generalizations regarding target organisms controlled. *See individual brand labels for details.* Updated by Eugene Braig, Ohio State University Extension, October 2021.

- **2,4-D**[1, 2] (e.g., AquaKleen, Navigate, Aquacide, Sculpin G, Weedar 64, etc.): specific plant species such as Eurasian watermilfoil, coontail, and limited effectiveness on waterlilies.
- **Bispyribac** (e.g., Tradewind): misc., esp. floating and submersed.
- **Fluridone**[1, 2] (e.g., Sonar, Avast, Whitecap, etc.): primarily submersed and some free-floating plants.
- **Glyphosate**[1, 2] (e.g., Rodeo, Aquamaster, AquaPro, Shore-Klear, Eraser AQ, etc.): emergent and some floating-leaved plants.
- **Imazamox**[1] (e.g., Clearcast): very broad effectiveness, including several submersed invasives.
- **Imazapyr**[1, 2] (e.g., Habitat, Arsenal, Imazapyr E Pro 2, etc.): emergent (esp. grasses) & some floating weeds.
- **Penoxsulam** (e.g., Galleon): emergent and some floating weeds.
- **Florpyrauxifen-benzyl** (e.g., ProcellaCOR EC): select emergent and submerged weeds, especially watermilfoils.
- **Topramezone** (e.g., Oasis): Select submersed, floating, and emergent species including several grasses.
- **Triclopyr**[1, 2] (e.g., Renovate, Garlon 3A, Navitrol, Element 3A, Vastlan, etc.): selective effectiveness similar to 2,4-D.

1. For additional information, see:

   Lynch, W. E. Jr. 2009. Aquatic control of aquatic plants: Agriculture and natural resources fact sheet A-4-09. Ohio State University Extension, Columbus.

2. Term of patent has expired and many brands may be available. Shop competitively, considering product labels for concentration of active ingredient and appropriate application methods.

Pesticide Calculation Challenge - Solutions

Calculating Area, Rates and Tank fills Mary Ann Rose, Pesticide Safety Education Program

1. How many acres are in a field that measures 385 feet long by 225 feet wide?

Total area = Length x Width 385 ft^2 x 225 ft^2 =86,625 ft^2
Convert sq. ft. to acres: 86,625 ft^2 ÷43,560ft^2/A = 1.98 A or approximately 2 acres

2. How many gallons of herbicide product do you need to mix a full tank? Tank capacity = 1200 gals; spray volume = 15 GPA; product rate = 1 pt/A; tractor speed = 14 MPH

acres sprayed = 1200 gallons ÷ 15 GPA = 80 acres
product needed = 80 acres x 1 pint/A x 1 gallon/8 pints = 10 gallons herbicide

3. You are using a postemergence herbicide and the label recommends adding a non-ionic surfactant at 0.25% v/v. How many gallons of surfactant do you need for 800 gallons of tank mix?

product needed = 800 gallons x 0.0025 = 2 gallons surfactant

4. How much water will you need to transport to the field to mix on-site and spray 225 acres if your sprayer is calibrated to apply 12 GPA?

water needed = 224 acres x 12 GPA = 2700 gallons water

5. You are spraying herbicide in 3' bands in rows that are 8' apart. If your field is 2 acres, how many acres are actually treated?

% treated area = 3' ÷ 8' = 0.375
actual treated acres = 0.375 x 2 = 0.75 acre

6. How much Ambush 25W do you need to treat 15 acres if the rate is 1/8 lb. active ingredient per acre?

amount of product needed = 1/8 lb ai/A ÷ 25% ai = 0.5 lb/A
total needed = 15 acres x 0.5 lb/A = 7.5 lbs Ambush 25W

7. Calculate how much Dicamba herbicide is needed for an 800-gallon tank fill. The rate is 0.5 lb. dicamba acid per acre and the formulation is 4 lbs. ae/ gallon. You are calibrated to deliver 12.5 GPA.

acres treated = 800 gal capacity ÷ 12.5 GPA = 64 acres
amount of product per acre = 0.5 lbs ae/a ÷ 4 lbs. ae/gal = 0.125 gallons per acre
amount of product for 800 gal tank fill = 64 acres treated x 0.125 gal/A = 8 gallons

PESTICIDE SAFETY EDUCATION PROGRAM EVALUATION

1. Date_____

2. County_____

3. County of residence_____

4. # of acres owned, rented or worked_____

5. # acres owned, rented or worked where pesticides are applied_____

6. Have you improved your pesticide use practices as a result of pesticide education programs that you have attended over the years?

Please rate how strongly you agree with the following statements:

As a result of Pesticide Applicator Training over the years:	Strongly Agree	Agree	Neutral	Disgree	Strongly Agree	Not Applicable to me
I have improved personal safety practices.						
I have improved practices to protect the environment.						
I have improved pesticide handling practices (mixing, loading, storing, applying).						
I get better control from pesticide applications.						
I use pesticides more cost effectively.						
The next three questions refer only to today's training:						
I have learned how to control pests, diseases, or weeds more effectively.						
I am better informed about how to apply pesticides safely.						
This program brought me up to date on current pesticide-related topics, issues, or regulations.						

7. What is the most important thing you learned today?

8. What topics related to pesticides were not covered today that you would like to know more about?

9.Please make additional comments concerning this training on the back of this page.

Thank You!