Fact Sheet Series 23-1

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Organic Management of Fall Armyworm *Spodoptera frugiperda* (JE Smith)

Summary

- In 2021 the upper Midwest experienced an unusual fall armyworm infestation.
- Fall armyworms can be devastating for corn and also feed on a variety of grasses.
- The only organic management option in northern regions is well-timed foliar sprays of *Bt* or Spinosad. These treatments are most effective in early larval stages, so timing is critical.
- Pest monitoring programs can assist with management decisions, including updates from the University of Wisconsin-Madison at https://ipcm.wisc.edu/wcm/ and University of Missouri's fall armyworm monitoring network (https://ipm.missouri.edu/pestMonitoring/faw/index.cfm).

INTRODUCTION

In 2021, the upper Midwest saw an unprecedented fall armyworm infestation. Fall armyworm is a highly invasive and destructive pest that can be devastating to corn. It is not usually a concern this far north; however, in 2021 some growers in Wisconsin experienced economic issues, while growers in regions to the south, including Indiana, experienced even greater losses (1,2).

Many factors affect the level of damage induced by pest populations each year including insect migration patterns and weather conditions (3). It is possible that the 2021 infestation was a rare occurrence and will not impact future years. However, some researchers have suggested that if northern locations begin to experience warmer winters, fall armyworm could become a more frequent pest (1,4).

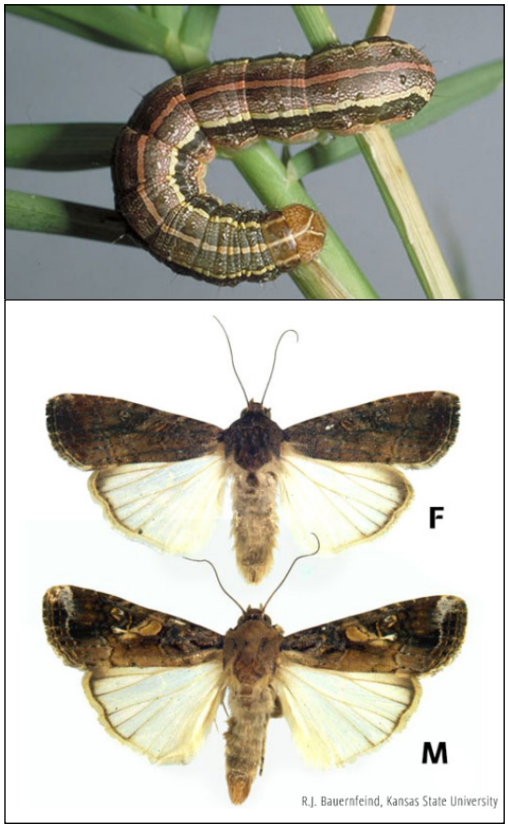
Pest monitoring networks can often provide early alerts about fall armyworm populations to help assist with management decisions. This fact sheet will cover organic management of fall armyworm with a focus on organic corn production.

APPEARANCE

The fall armyworm moth has forewings that are mottled with dark gray and light gray while the hindwings are silver-white (3,5). In males, each forewing has a white patch at the tip. Fall armyworm eggs are dome shaped and about 0.4mm in diameter (6). They are laid in masses, commonly of 100-200 eggs, usually in a single layer attached to foliage; however, they can be deposited in layers.

Newly hatched larvae are only a few millimeters long and greenish in color with a black head that changes to orange over time (6). Full grown larvae are around 1 to 1.5 inches long and can be light tan or green to black with 3 thin yellow stripes running down their length. On either side of their body is a thicker brown stripe next to a yellow stripe about the same width as the brown one. A distinguishing feature of older armyworm larvae is an inverted "Y" on their head.

Fall Armyworm Identification



Top: Fall armyworm larvae (damaging stage). Bottom: adult female (F) and male (M). Image credit: Integrated Pest Management, University of Missouri. Available at: https://ipm.missouri.edu/pestmonitoring/faw/identification.cfm

LIFE CYCLE

Fall armyworm cannot survive cold temperatures. Therefore, they only overwinter in the southernmost states, including Texas and Florida (1). In the spring and summer, fall armyworm moths begin to migrate

northward. After a few generations, fall armyworm can reach as far north as the upper Midwest and Canada, which typically happens mid to late summer. Usually, they reach the upper Midwest too late in the season for concern, but this is not always the case.

Female armyworm moths usually deposit eggs when they are 4 to 5 days old but can do so for up to 3 weeks (6). Eggs are usually laid in masses of 100 to 200 in a single layer attached to foliage, with a preference for whorl-stage corn (7), and each female lays an average of 1500 eggs over her lifetime.

The speed of development and the number of generations that occur in a specific area both depend on the temperature. During hot summers, the eggs hatch in 2 to 3 days but can take up to 10 days (6,7). Newly hatched larvae are too small to do much damage, but older larvae are highly destructive. In hot weather, larval development takes around 14 days while in cooler fall temperatures it can last 30 days. The pupal stage can extend from 8 days in hot weather to 30 days in cooler weather. Adults live for about 10 days on average but can survive up to 21 days. Overall, the length of their life cycle ranges from 30 days in hot summers to 60 days in the spring and fall, and even longer where they overwinter.

Considerations for Wisconsin

- If fall armyworms arrive late in the season, they may only last one generation before it is too cold for their survival
- Late season cooler temperatures could prevent fall armyworm eggs from hatching or slow down their development, which could make them vulnerable to control measures for a longer period of time before they reach their most destructive stages (1)

SYMPTOMS AND EFFECTS

Fall armyworm has a range of host plants but prefers grasses including field corn and sweet corn and also feeds on alfalfa, buckwheat, barley, oats, clover, millet, ryegrass, Sudangrass, soybean and wheat (6).

Larvae consume foliage and while newly hatched larvae don't cause much destruction, older larvae cause extensive damage. On corn plants they can feed deep in the whorl, leading to a pattern of perforations in the leaves. They also feed in tassels and ears, including eating through the side of the ear (7). Older larvae leave behind ragged looking corn plants, which may resemble hail damage, or sometimes only ribs and stalks remain. They also can limit further plant growth by burrowing into the growing bud.

SCOUTING AND MONITORING

It is recommended to start scouting for fall armyworm when corn is at whorl stage either using blacklight or pheromone traps for moths, or when damaged plants are first seen (3,6,7). If either is found, then look for eggs and larvae. Larvae can be found on leaves, sometimes deep within the whorl, on tassels, and ears. Fall armyworms are cannibalistic, so usually only 1-2 older larvae occupy a single plant. If there is fall armyworm damage on plants but no larvae are present, it is possible that they have pupated, and the infestation may be over. Sampling 20 plants in 5 areas or 10 plants in 10 areas is suggested to determine the proportion of plants affected.

Pest monitoring programs can assist with management decisions by providing early information about fall armyworm populations. Updates from the University of Wisconsin-Madison can be found at Wisconsin Crop Manager news (8) at https://ipcm.wisc.edu/wcm/ (you can also sign up for their newsletter on the website). There are also monitoring networks specific to fall armyworm in more southern states, including the University of Missouri's fall armyworm monitoring network (9) available here: https://ipm.missouri.edu/pestMonitoring/faw/index.cfm.

Leaf Damage on Corn due to Fall Armyworm

Photo credit: Paul Choate, University of Florida (6). Available at: https://entnemdept.ufl.edu/creatures/field/fall_armyworm.htm

ORGANIC MANAGEMENT

If fall armyworm populations are above threshold levels (greater than 15% of plants infested with larvae), control measures are recommended (7). The only management option for organic production systems in northern regions is well-timed biological foliar sprays. Bacillus thuringiensis (Bt) products are commonly used and spinosad is another option. If targeting fall armyworm, these products can be used at any time of year and at any crop stage. Treatment is most effective when fall armyworms are in early larval stages, so timing of the application is critcal. Optimal timing can be achieved through scouting and monitoring.

Bacillus thuringiensis (Bt)

Bt is a bacterium that occurs naturally in soil. *Bt* spores produce compounds that are toxic to insect larvae if the larvae ingest them (10,11). They are not harmful to humans and other mammals, are practically non-toxic in birds and fish and have little-to-no toxicity to

non-target insects including many beneficial insects. The strains *Bt aizawai* or *Bt kurstaki* act against moth and butterfly caterpillars and are recommended for fall armyworm. They are most effective against young larvae. These sprays have a short residual time in the field, with half-lives of 1-4 days on foliage. For effective fall armyworm management, it is recommended to have the product on foliage as the larvae are emerging. For further information on applying *Bt* products, refer to product labels or consult your agricultural extension agent.

It is important to note that instances of fall armyworms showing field resistance to *Bt* corn have been documented, including in the US (12,13). The same type of toxin that results from using a *Bt* spray can also be present in a *Bt* corn hybrid, depending on the hybrid and the specific product used. This raises the concerns that fall armyworm could begin to develop resistance to *Bt* sprays over time.

Spinosad

Spinosad is made by a soil bacterium and can be toxic to insects that come into contact with it or ingest it (14). It has low toxicity in people and other mammals and is practically non-toxic to moderately toxic to fish and birds. It is moderately toxic to earthworms and highly toxic to bees, but studies suggest that after the spray has dried it is no longer toxic to honeybees or other beneficial insects. It lasts a bit longer in the field than *Bt* products, with a half-life on foliage of 2-16 days. For further information on applying spinosad, refer to product labels or consult your agricultural extension agent.

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The OGRAIN (Organic Grain Resource and Information Network) program is housed in the Organic and Sustainable Agriculture Research and Extension Program within the University of Wisconsin-Madison Department of Plant Pathology under the leadership of associate professor Dr. Erin Silva. OGRAIN provides resources and support for new, transitioning, and experienced organic grain farmers throughout the upper Midwest. We host a variety of events, support a producer listserv (join by emailing join-ograin@lists.wisc.edu) and provide educational materials at https://ograin.cals.wisc.edu/. To contact us, email Erin at emsilva@wisc.edu, or call (608) 890-1503.