Kansas State University Agricultural Experiment Station and Cooperative Extension Service

KANSAS CROP PESTS

Sunflower Moth

The sunflower moth, *Homoeosoma ellectellum*, is the most serious pest of commercial sunflowers in the central Great Plains. It is well adapted to exploiting commercial sunflowers grown in synchronous monocultures where large fields of plants develop and flower all at the same time. The oversized flowers of commercial varieties may host hundreds of larvae, and their feeding damage permits infection by *Rhizopus,* a fungus that requires physical injuries to infect the plant. Without timely treatment, it can result in total yield loss over a large acreage. Losses from this pest, commonly known as the head moth, have deterred growers from incorporating sunflowers into rainfed crop rotations where the plant is a natural fit.

Figure 1. Adult sunflower moth

Identification

The adult sunflower moth is grayish, ⅜ to ⅝ inches (8.0 to 12.0 mm) long. It rests with wings clasped tightly to the body, giving the moth a slender cigar shape (Figure 1). Eggs are difficult to observe in the field because they are normally laid at the base of florets within the flower disk. The newly hatched larva is pale yellow but soon darkens to shades of brown or purple with longitudinal white stripes and a light-brown head capsule (Figure 2). Dark frass granules and tangled mats of webbing on flower faces indicate larval activity within the flower head (Figure 3).

Life History and Behavior

The sunflower moth is a migratory pest that breeds year-round in northern Mexico and moves northward annually with successive generations. Migration is facilitated by seasonal weather patterns that prevail across the southern Great Plains during midsummer and generate southerly winds that are ideal for transporting airborne insects over long distances. The reproductive success of earlier generations probably affects the numbers of moths in each annual migration. Under warm conditions, the moths can complete a generation in 30 days. Kansas can experience secondary generations of local origin following the initial migration, especially in years when wild sunflowers are locally abundant and early blooming fields where moths are not controlled can serve as a source of infestation for later planted ones.

Figure 2. Larva of sunflower moth

Figure 3. Infested sunflower head showing webbing and larvae

Adult sunflower moths are primarily nocturnal and probably orient to the smell of blooming flowers, although they may also enter sunflower fields before blooms open. Mating pairs often can be observed on the flowers (Figure 4). Sunflower pollen stimulates oviposition and most eggs are laid in flowers during the early stages of bloom, usually

Figure 4. Mating pair of sunflower moths

at the base of individual florets. Early-stage larvae feed almost exclusively on pollen; later instars feed on tissues of the receptacle and developing seeds, often leaving trails of webbing as they move across the face of the flower. Mature larvae descend from flower heads on strands of silk to pupate in crevices in the soil or under crop residues. Although some larvae might survive the Kansas winter in a dormant state, observations suggest that the majority of late-generation moths emerge in October and attempt a return migration south.

Wild host plants include *Helianthus annuus*, coneflower, and similar flowers with small blooms that often lack sufficient resources to support the complete development of a single sunflower moth larva. Larvae must eventually move to other flowers on natural host plants, exposing them to predation. In wild sunflowers, 50 percent or more of sunflower moth larvae may be parasitized by wasp parasitoids that attack them and other caterpillar species. By contrast, cultivated sunflowers are no longer a natural host plant; their large size represents a huge food supply capable of supporting the development of many larvae, while at the same time providing a refuge from parasitism. Research has shown that because most wasp parasitoids are unable to search such large flowers, they abandon them. Many species probably do not possess ovipositors long enough to reach larvae that burrow deep within the receptacle. Certain parasitic flies of the family Tachinidae are slightly more successful because they deposit live larvae able to penetrate the flower in search of a host. Although biological control may contribute to suppression of sunflower moth in wild host plants, parasites and predators cannot prevent economically damaging infestations in commercial fields.

Management

Successful management of sunflower moth hinges on rigorous monitoring of individual fields and prompt insecticide application once threshold numbers are detected. The goal is to kill adults and early instar larvae before physical injury to the flower occurs that can permit fungal infection (Figure 5). Fortunately, early instar larvae remain vulnerable to contact insecticides for several days before causing damage because of their pollen-feeding habits and mobility on flower faces. Later instar larvae feed more aggressively and bore into the receptacle where they can avoid insecticide, creating multiple infection sites for *Rhizopus* fungi that can quickly rot the head (Figure 6). *Rhizopus* infections can invade vascular tissues and become systemic within upper plant parts, inhibiting seed fill.

Early-planted fields typically suffer the most damage from migratory flights in Kansas. Fields planted in early July or those that bloom after August 10 are less likely to develop economic infestations. They may still be affected by second-generation moths that emerge from patches of wildflowers or adjacent early-planted fields where the pest has not been adequately controlled. Geographically, average moth pressure tends to decrease from eastern to western Kansas, reflecting prevailing paths of summer winds.

Scouting

Because migratory moths can appear in large numbers virtually overnight, scouting should begin as soon as the first flowers open and continue every 24 to 48 hours until pollen shed is complete in a majority of plants. Because moth migrations are spotty and each field has its own unique developmental schedule, it is not advisable for growers to follow the management decisions of neighbors. There is no substitute for scouting individual fields. Fields that have been sprayed should be revisited to determine the efficacy of treatment as soon as the re-entry interval expires. The treatment threshold is one to two moths per five plants. Projected crop value can be used to elect the low or high end of this range. Moths usually rest underneath leaves in the daytime and fly up when disturbed. If moths are abundant, they will be apparent during the day. If marginal numbers are present, scouting should be conducted an hour after sunset when moth activity on flowers reaches its peak. Use a flashlight to count the moths on a series of 20 flower faces in at least five locations in the field.

Figure 5. Infested sunflower head showing Rhizopus infections developing around larval bore holes

Figure 6. Advanced head rot by Rhizopus

Trapping

Historically, sunflower moth activity has also been monitored with commercially available pheromone traps that attract and capture male moths. Traps are best placed on T-posts above canopy level at least 10 rows into the field on north and south sides, with at least four traps per field. Trapping should begin as plants enter the R-5.1 stage (ray petal emergence) and trap catches monitored daily through the R-5.8 stage (80 percent pollen shed). Insecticide applications should be considered whenever pheromone traps average four moths per trap per day. If trap catches average fewer than four per day, field scouting is justified to determine whether the action threshold has been reached. Trap catches averaging less than one per day usually have resulted in noneconomic infestations. However, it is questionable whether the information provided by trapping is sufficiently useful to justify the additional labor it requires, especially when certain outcomes dictate manual scouting before a decision can be made. Strong winds can lead to 'passive catch' of other moth species that may be difficult to distinguish from sunflower moths once they are stuck to glue in the trap. In addition, doubts have been raised about the persistence of the pheromone lure under Kansas field conditions that typically involve high temperatures and strong winds.

Treatment

If moths are above threshold, an insecticide treatment should be applied once the majority of blooms have opened and begun shedding pollen (stage R-5.1). Most failures to obtain control result from delayed treatments. The objective of an early application is to kill female moths before they lay eggs, and young larvae while they are still feeding on pollen and before they bore deep into the head. Diamide insecticides are an exception in that they do not have contact activity and thus do not kill adult moths, although they are effective against larvae. Scouting should continue after an early treatment as additional applications may be required when moth pressure is heavy. Whereas some growers opt to spray automatically at R-5.1, the advantage of scouting is the possibility that treatment can be avoided if moths remain below threshold, or delayed until later in the flowering cycle when blooms are fully expanded, increasing the chance that a single application will suffice.

Once flower disks are fully expanded or significant numbers of larvae have entered, treatment is far more effective when applied directly into the flower faces. This is best accomplished in aerial applications by flying each pass from an easterly direction, rather than back and forth over the field. Use of a ground rig, although more time consuming, permits more effective application of insecticide in a larger volume of water to provide better coverage. Organophosphate materials have somewhat better residual activity than pyrethroids, whereas the latter have repellent properties, but both can lose their efficacy quickly under Kansas summer field conditions. Several new formulations combine active ingredients with different modes of action (organophosphate + pyrethroid, or organophosphate + neonicotinoid) to increase efficacy. However, recent observations suggest rising levels of resistance to organophosphates may be evolving in sunflower moth populations.

Pollinator safety

The need to control pests on a crop in bloom raises concerns about potential impacts on pollinators. Sunflower growers also should be aware that most insecticide applications against sunflower moth carry a hidden cost in terms of yield reduction. Although commercial varieties have been bred to be self-compatible, and hence less pollinator-dependent, studies have shown that cross-pollination by insects improves seed weight and oil content. Insecticide should be applied in the early morning or late evening when pollinators are not flying. Evening is preferable because this permits overnight dissipation of material before pollinators return to the field. However, the requirement for low-wind conditions is a priority that may trump this concern. Because of their repellency, pyrethroids tend to be safer for bees than organophosphates, provided bees are not sprayed directly. Dusts and wettable powders tend to be more toxic than solutions and emulsions, and microencapsulated insecticides are especially hazardous. Studies suggest that diamides, a new class of insecticides that disrupt insect muscle contraction, have a high degree of safety for pollinators. Diamides act as ryanodine receptor modulators to paralyze insect muscles and must be consumed by the insect to reach their active site. As of 2012, both Bayer and Dupont have registered diamide insecticides for use on commercial sunflowers in Kansas (Belt and Prevathon, respectively). Preliminary trials indicate that good levels of control can be achieved with these materials without endangering bees. Growers and applicators should refer to the most recent edition of the K-State Research and Extension publication, *Sunflower Insect Management*, MF814, for a table of registered materials and application rates.

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