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TURF INSECTS: Invasive European Crane Flies in New York State

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Synopsis:

Common name - European crane fly and "Common" crane fly
Scientific name - *Tipula paludosa* and *Tipula oleracea*
Classification (Order: Family) - Diptera: Tipulidae
Life stages - Egg, Larva (4 instars), Adult
Feeding style - Chew with mandibulate mouthparts
Name of damaging life stage - Larva (maggot, leatherjacket)
Habitat of damaging life stage - Top layer of the soil and soil surface
Affected habitats - All grass systems
Affected plant tissues - Roots, crowns, stems, foliage
Geographic origin - Native to western Europe and established in North America

In a Nutshell:

- First detected in 2004, two species of crane flies of European origin are continuing to spread across NY and the Northeast U.S.
- Larvae are maggots that feed on below- and above-ground tissues of grasses, while adults are short-lived and resemble giant mosquitoes.
- All grass systems are susceptible habitats, including golf courses, sports fields, home lawns, sod farms and pastures.
- As there are dozens of native and non-damaging species of crane flies that occur in grassy habitats, an accurate species identification is important.
- Best management depends on early detection in areas of new establishment, scouting to confirm the need for intervention, reducing moisture at the time of egg deposition, and targeting with insecticides.

Natural History

Life stages - Egg, Larva, Pupa, Adult. Immature ECF are maggots that pass through four developmental stages, or instars, before they pupate into adults. The overall size of the body increases with each successive molt, up to about 1 inch long when fully grown. Larvae are grey to dull brown in color, with small anal papillae that adorn the rear end and a poorly defined head capsule that is retractable on the front end. The larvae are the damaging life stage, commonly referred to as "leatherjackets" (although this may actually refer to the exuvium left behind when the adult emerges from the pupa). The adults of both species resemble giant mosquitoes, about 1 inch long, but they do not feed and are non-damaging.

Habits - The majority of the crane fly lifecycle is spent in the larval stage. Active larvae inhabit the thatch layer, soil surface, and top 2-3 inches of the soil. They feed on grass tissue both below- and above-ground, including root hairs, roots, crowns, stems and foliage. Even in winter, larvae will not descend very far in the soil profile. Pupation occurs in the top two inches of the soil. Pupae wriggle to the surface so the adult fly can emerge. The empty pupal cases (exuviae, or the "jackets" of the leatherjackets) look like small grey-black twigs protruding from the turf where they can be spotted on low-mown grass such as golf course playing surfaces. The adults mate and start to lay eggs immediately after emergence. They do not feed, are non-damaging and may persist for a couple weeks. Females lay eggs onto the soil surface. Eggs are sensitive to moisture and require wet conditions to hatch and survive. Early stage larvae also do best under moist conditions, but once they are third and fourth instars they are quite tolerant of drought. Overall, mild winters and cool summers will probably favor crane fly populations. Other turf conditions such as thatch buildup, poor drainage and regular irrigation will likely favor crane fly survival and population buildup.

Seasonal cycle - *Tipula paludosa* completes one generation a year, with the emergence of adults occurring over a period of 2-3 weeks in September and early October. Adult females will emerge, mate and lay most of their eggs all within the first day of their brief reproductive lives, even though adults may persist for several days. Each female will deposit up to 200-300 black eggs at or near the soil surface; these eggs will hatch into larvae in about 10 days. Larvae usually achieve third instar by the time cold temperatures force them to overwinter. Most damage is attributed to the feeding of rapidly growing fourth instars in spring. By early to mid June, larvae have achieved their maximum size and move 3-5 cm deep in the soil. They remain in a relatively non-feeding and inactive state until pupation.

While the biology of *T. oleracea* is quite similar to *T. paludosa*, certain differences mean that management has to be tailored to the specific species. A major difference is that *T. oleracea* completes two generations a year, emerging in two peaks, one in spring (early May in western NY) and the other in autumn coinciding with *T. paludosa* but being much less synchronous than the spring window. The larvae of *T. oleracea* never enter an inactive summer stage like *T. paludosa*. Larvae overwinter as fourth instars and pupation occurs in early spring. Adult *T. oleracea* differ from *T. paludosa* in being more capable fliers, with females laying eggs over the course of a few days.

Distribution - Both species are native to Europe but have now established in three geographic areas of North America: the Pacific Northwest (British

Columbia, California, Oregon, Washington), eastern Canada (Newfoundland, Nova Scotia, Quebec), and the eastern Great Lakes (Massachusetts, Michigan, Ontario, New York). In NY, invasive crane flies were detected for the first time in 2004, at that point limited to Erie and Niagara counties. By the end of 2012, *T. paludosa* had been detected in 11 counties of western and central NY, while *T. oleracea* had become more widespread, being detected in 19 counties of western and central NY, plus Albany, Nassau and Suffolk counties. Based on these observations, there were probably two separate areas of establishment, the western Erie Canal corridor (both species) and Long Island (*T. oleracea*).

Diagnosis

Species identification - Crane fly larvae are legless and wingless maggots with poorly defined head capsules. They should not be confused with turf-infesting caterpillars that have prolegs and well-developed head capsules. Aspects of the anal papillae are useful for distinguishing them from common and non-damaging native species. In the larval stage, *T. oleracea* and *T. paludosa* are indistinguishable.

As adults, both invasive species can be distinguished from most of our native crane flies based on wing pattern. The leading edge of the wings has a smoky band adjacent to a whitish band, with no other patches or spots common to many native species. The two invasive species can be differentiated based on distance between the eyes, number of antennal segments, genitalia (males) and wing length (females). Nevertheless, a specialist should be called upon to make or confirm the identification as there are dozens of native crane fly species that inhabit grassy habitats in NY and none has ever been linked to turfgrass injury.

Affected habitats - All grass systems are susceptible habitats. This includes both high- and low- maintenance turf, from golf courses and sports fields, to home lawns and school grounds. It also includes production systems such as sod farms, pastures and certain crop-rotations. All grass species should be considered acceptable hosts. The most favorable habitats are those where moisture is not limiting for the persistence of eggs and development of early-stage larvae, which are drought susceptible. There is no known protective role for endophytic grasses against crane flies. Generally, *T. oleracea* is more a problem on golf course putting greens and low-cut turf, and *T. paludosa* more an issue on higher cut turf.

Injury recognition - Five categories of damage have been observed: nuisance populations of adult flies and larvae in suburban settings, thinning damage to home lawns, scalping damage to golf course putting greens, thinning and die-back on golf course fairways and rough, and vertebrate predation due to skunks and birds. In addition, larvae can survive harvest, transport and installation of sod meaning that movement of infested material is a threat of new establishments and range expansion.

Due to the relatively synchronous emergence of local adult populations, homeowners in suburban settings have experienced nuisance swarms of adults. Adults will settle on the sides of buildings, window screens and landscaping plants, and the public may mistake them for giant mosquitoes. In fact, the first reports of invasive crane flies for both Long Island and the Rochester area were made by homeowners. High larval densities may also act as nuisance populations as rain showers can wash them off sloped lawns and amass them as piles of maggots in culverts.

On affected home lawns and golf course fairways, root pruning leads to white grub-like damage. The disruption of the rooting zone promotes rapid die-off when the injured turf is drought-stressed. Another expression of injury on home lawns is extreme thinning due to surface feeding. Early to mid-May is when injury is most likely to be expressed by *T. paludosa* because large larvae are feeding rapidly as they approach the end of development. On affected golf course putting greens, foliar feeding by *T. oleracea* larvae on crowns and leaf blades causes damage akin to black cutworms. Larvae will reside in aerification holes or in self-made burrows from which they emerge to forage, scalping quarter-sized circles on the playing surface.

Management

Sampling and monitoring - To detect the presence of invasive crane flies, the leathery pupal cases can be monitored on tees, greens and fairways where they protrude from the low-mown turf. At times of peak emergence the adults are abundant and highly visible as they flit about low in the grass. Adults may also congregate during the day on the sides of buildings, sliding doors, window screens and fences. Because adults lay eggs so soon after emergence, they do not move far from the sites where larvae developed. Therefore, sites with abundant adults, larvae or pupal cases should be monitored as an indication of sites where eggs of the next generation are likely to be laid. If a crane fly infestation is suspected, send adults, larvae or pupal cases to a specialist for proper identification. Observations on the abundance of those life stages could help diagnose the problem.

If signs of insect activity and turfgrass injury suggest leatherjackets, core sampling is the best way to detect and sample larvae. Take samples with a cup cutter and rip apart the core to look for larvae. Traditional soap-based disclosing solutions are not effective at driving larvae to the surface. Certain insecticides such as pyrethroids and carbamates, however, will reveal the presence of larvae because many will die on the surface. This approach is most effective when soil water content is high and insecticides can readily penetrate the soil surface.

Decision-making - Control tactics should be directed against the larvae because adults are hard to target and short-lived. Depending on the overall health of the turf, suggested thresholds are 15-50 larvae/sq. ft. Autumn populations are likely to surpass these thresholds, but it is important to keep in mind that leatherjackets can suffer very high mortality between late autumn and early spring due to winter stress and predation by birds and other vertebrates. Vigorous turf can therefore support relatively high population levels in autumn.

Intervention - Because of their relative sensitivity to dry conditions, careful manipulation of soil moisture levels may be a key cultural tactic to reduce populations. Some strategies might be to regulate the timing and frequency of irrigation, particularly during the oviposition period, to better drain chronically infested areas and to allow the sward to dry (i.e., avoiding irrigation) in autumn. Maintaining a vigorous stand that is more tolerant to infestation might also alleviate problems.

The two main control windows for insecticides are late autumn and early spring. Since adults of both species emerge during a similar window in September, small larvae of both species would be susceptible to preventive

insecticides. Therefore a late autumn preventive application is recommended if populations of both species occur at the same site. Timing should be after peak emergence of adults in order to overlap the period of egg hatch and first instars.

Otherwise, curative applications for *T. paludosa* can be made in early spring after scouting has assessed populations or once feeding damage is detected. *Tipula oleracea* is probably not susceptible during this window because it pupates early in spring and insecticides are not active against pupae.

The aforementioned control windows, unfortunately, do not coincide with other turfgrass pests. The arrival and spread of these exotics thereby represents a worrisome new economic burden for turfgrass managers. To identify the best chemistries for invasive crane fly control in NY, a series of field efficacy trials has been conducted against *T. paludosa*. Based on consistency and efficacy, a range of chemistries is acceptable for preventive fall control, including bifenthrin, carbaryl, imidacloprid, indoxacarb and trichlorfon. Among the best products for curative spring control are carbaryl, imidacloprid and trichlorfon.

In addition to registered chemical insecticides, a registered biological control option is Beauveria bassiana, an entomopathogenic fungus. The entomopathogenic nematode, Steinernema carpocapsae, is a biological alternative that has been promoted elsewhere.

Regional Considerations

Although imminent threats for all regions of NY, neither species yet occurs throughout the whole state. Because of its more restrictive dispersal behavior, *T. paludosa* in particular may have a fairly restricted range at present. Both species are currently unknown from the Adirondacks and from the St. Lawrence River Valley.

In North America, both species have established in three geographic regions: Pacific Northwest, eastern Canadian Maritimes and the eastern Great Lakes/Northeast. Beyond NY, in the eastern US *T. paludosa* is established in the states of MI and ME; *T. oleracea* in the states of MA, MI, NJ, OH and PA. There are certain control products labeled for ECF control in other states, but not in NY. These include the active ingredients clothianidin, dinotefuran and thiamethoxam.

Links to More Information

www.nysipm.cornell.edu/factsheets/turfgrass/default.asp
www.ipm.ucdavis.edu/PMG/r785301411.html
www.whatcom.wsu.edu/cranefly/

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