

Grasshoppers: Life Cycle, Damage Assessment and Management Strategy

Clear-winged Grasshoppers

Insect Life Cycle

Host plants

The clear-winged grasshopper (*Camnula pellucida*) is mainly a grass feeder. Economic damage is primarily to cereals, especially wheat and barley. Clear-winged and migratory grasshoppers have together destroyed areas of range grass and hay almost entirely.

The nutritional qualities of the chief food plant can affect longevity and egg production of grasshoppers. Kentucky blue grass is one of the best foods for high survival and egg production. Western wheatgrass is one of the worst foods for grasshoppers and could be a factor that limits distribution of this grasshopper on the Prairies. It may be the only green grass available to attract females at egg laying time.

Spring appearance

If the previous fall was warm, eggs of the clear-winged grasshopper will be the last of the pest grasshopper species to hatch. They hatch in late May to early June. The embryos of this species undergo a maximum of 50 per cent of their total development before winter. The other pest species can complete more of their development in the fall and consequently need less time in the spring to complete pre-hatch development.

Overwintering

Clear-winged grasshopper eggs are laid in the fall and hatch the following spring. Each female lays an average of eight egg pods (about 175 eggs) usually in unbroken sod. The short vegetation of dry, mowed roadsides and sparse, over-grazed pastures is especially favored for egg deposition. Males are conspicuous at egg laying sites; their undersides become bright yellow during the mating and egg laying period. They stake out a territory and wait for females to come to oviposit.

Number of generations

As with all of Alberta's grasshopper pests, clear-winged grasshoppers have one generation per year.

Natural enemies

Next to weather, natural enemies are the grasshopper's most important population control factor. In some localized areas natural enemies may cause even more mortality than the weather.

Some enemies attack when grasshoppers are still in the soil awaiting spring. Others attack nymph and adult stages.

Predators - Among the most important egg predators are bee flies, blister beetles, ground beetles and crickets. Common field crickets eat the eggs and may destroy up to 50 per cent of the eggs in some areas. Bee flies and blister beetles deposit their eggs in the soil near

grasshopper eggs. When the larvae of these egg predators hatch, they locate the egg pods and feed upon the eggs. If bee flies and blister beetles are abundant, they may destroy up to 80 per cent of eggs in a localized area.

Spiders, some wasps and many birds feed on grasshoppers and consume large numbers of nymphs and adults. Their effect on the total grasshopper population is not known.

Parasites - A few other insects, such as the tiny wasps of the genus *Scelio*, parasitize eggs just after they have been laid. The young parasitic larvae complete their development within the eggs in time to emerge as adults and parasitize the eggs of the next generation of grasshoppers. They may destroy from 5 to 50 per cent of the grasshopper eggs.

Parasites of nymphs and adults include flesh flies, tachinid flies and tangled-veined flies. Fly larvae burrow into the grasshopper when they contact it on the ground. Other fly larvae are deposited on or into the grasshopper's body by the female fly. The maggot then feeds inside the grasshopper and eventually kills its host as the maggot leaves the body. This group of insects may parasitize up to 60 per cent of the nymphs and adults.

Threadworms attack grasshoppers if the young worms encounter a grasshopper or if grasshoppers eat threadworm eggs. Threadworms overwinter in soil and lay their eggs on the soil or on vegetation.

Pathogens - The fungus, *Entomophthora grylli*, can effectively control grasshoppers under warm, humid conditions. This fungus may occasionally reach epidemic proportions. The disease leaves the corpses of its victims clinging to the stems of plants.

The microsporidian parasite, *Nosema locustae*, is an effective enemy of grasshoppers. A grasshopper becomes infected if it eats contaminated vegetation or a diseased grasshopper. A grasshopper population infected with this organism may be reduced by as much as 60 per cent in one year. It also reduces the number of eggs laid and restricts the movement of individuals and thus affects grasshopper populations. Perhaps this organism's greatest potential as a biological control agent, however, is for reducing food consumption.

Since most of the natural enemies of grasshoppers are already widespread, it is unlikely that they could be used to prevent grasshopper outbreaks over extensive areas. Nevertheless, natural enemies do control localized grasshopper infestations and hasten the decline of grasshopper outbreaks.

Poultry - During the depression, some farmers successfully used turkeys to control grasshoppers. In years when grasshoppers were plentiful, the turkeys were simply released into fields. This resulted in a secondary benefit: the turkeys required little supplemental food since grasshoppers provided a plentiful high quality protein diet.

Other birds - Gulls, hawks, crows, meadowlarks, crowned larks, lark buntings, desert horned larks, shrikes, curlews, killdeer, partridges and cranes are all predators of grasshoppers. Many birds scratch up the egg cases, and have been credited with clearing from 5 to 150 acres of grasshopper pods. Birds, especially gulls and meadowlarks, are credited with stopping some infestations in the early part of the century. This is more likely to happen if a habitat provides food and refuge for the birds. Farm habitat can be made more attractive to birds and so encourage predation of insect pests.

Vertebrates other than birds - Most animals are opportunists; they will eat what is nourishing and available to them. Mice, rats, shrews, gophers and badgers all eat grasshoppers and their egg pods. Coyotes, skunks, lizards, snakes, toads, bobcats and kit foxes eat nymphs and adults.

Damage Assessment

Economic importance

Clear-winged grasshopper has been on average, the most economically important species of grasshopper in Canada, although over the years its importance relative to other species has changed gradually. The first record from the Prairie Provinces was from Saskatchewan in 1800. Clear-winged grasshoppers did not become abundant, however, until about 1900 when road-building, drainage and cultivation in southern Manitoba created favorable breeding sites and greatly increased the abundance of suitable food plants. In recent years there has been a marked decrease in the intensities of outbreaks in Manitoba. This may be related to changes in agricultural practices that have reduced populations of certain grasses.

Damage description

Damage to cereal crops is generally concentrated near field margins and is caused when hatchling grasshoppers move out of egg beds into field edges; damage to grasslands tends to be more evenly distributed. Damage to cereals includes leaf notching and stripping but is most costly when stems are severed just below the heads of maturing or mature crops. When grasshopper numbers are extremely high and natural plant hosts in short supply, grasshoppers will consume or attempt to consume any plants or plant products that they come upon during their migrations in search of food.

Sampling and monitoring methods

Walk through the infested area and estimate the number of grasshoppers per square metre as they jump in front of you. A sampling 'T' will likely improve your estimate. The 'T' consists of a metre-long measuring stick, carried by a handle so that a square metre can be visualized at crop height. Walk and carry the 'T' just above the crop.

Late summer and fall surveys of grasshopper adults have been carried out by agriculture fieldmen in Alberta since 1932. Grasshopper forecast maps are produced yearly from data collected in about 1,700 townships.

Spring surveys of grasshoppers and grasshopper eggs are also conducted in years when high grasshopper numbers are expected. In this way, improved estimates are obtained for time of hatch, population density and the effects of predators and parasites.

Economic thresholds for grasshoppers:

	Number of grasshoppers/m ²	
	Field	Roadside
Control not usually required	0 - 6	0 - 12
Control may be required	7 - 12	13 - 24
Control required	13+	25+

Management Strategy

Effects of weather

Population size is primarily determined by weather. Outbreaks are usually preceded by two to three years with hot, dry summers and open falls. Dry weather increases the probability of egg survival, hastens spring hatch, and promotes nymphal development and adult feeding. Open falls allow grasshoppers more time to feed and lay eggs. Cool, wet weather increases egg mortality by promoting fungal diseases, retards nymphal development, reduces the numbers of eggs laid by delaying sexual maturity and reduces the activity of grasshoppers at all stages.

Cultural practices

Tillage - Cultivation is probably the most effective cultural practice available to farmers for the reduction of grasshopper populations. Tillage controls grasshoppers primarily by eliminating the green plants on which grasshoppers feed.

However, tillage is of little value for the sole purpose of physically destroying grasshopper eggs or exposing them so that they dry out or are eaten by birds and other insects. Excessive tillage may also increase the risk of soil erosion.

Tillage to eliminate weeds from summer fallow fields during late summer and early fall will discourage female grasshoppers from depositing their eggs in these fields. Grasshoppers seldom lay eggs in clean summer fallow even when it has a heavy cover of trash. Similarly, thorough cultivation of fields immediately after harvest will help discourage grasshoppers from laying all their eggs within the field.

Complete spring tillage before grasshoppers hatch to eliminate all green growth on stubble fields that are to be in summer fallow. If no food is available when grasshoppers hatch, they will starve to death because they are unable to move long distances to find food. Early tillage will also give good weed control and conserve moisture at no extra cost.

Trap Strips - If grasshoppers are present when tillage operations begin, elimination of all green plant material in a field will probably not achieve adequate control. Once grasshoppers have fed and developed to the second stage of growth (second instar), they usually are mobile enough to move to adjacent crops when their food supply becomes exhausted. Use trap strips in these fields to collect grasshoppers into a relatively small area where quick and economical control will be possible with a minimum of insecticide.

To make strips, cultivate a black guard strip 10 m wide around the outside of a field. Leave an uncultivated green strip at least 10 m wide before resuming cultivation. Repeat the process as often as necessary to produce additional trap strips. All green vegetation must be eliminated between the trap strips if they are to be effective. The black guard strip will ensure that grasshoppers promptly move into the trap strips to feed.

The effectiveness of trap strips can be improved considerably by seeding them to wheat, barley or oats several weeks before tillage begins. Trap strips should have adequate vegetation to feed even the largest of grasshopper populations for three to five days.

Migration of young grasshoppers from the cultivated guard strips to the trap strips may take several days. Once the migration is complete, the trap strips and a 10 m strip of adjacent crop should be treated with insecticide. Apply the highest recommended rate of insecticide to ensure adequate control.

Before cultivating the trap strips, allow three days to assess the effectiveness of the insecticide. If adequate control is not achieved after three days, treat the trap strip again. When grasshoppers have been eliminated from the trap strip, it should be possible to complete tillage without fear of displacing large numbers of grasshoppers into adjacent crops.

Summer fallow that is not properly managed can be a major source of grasshoppers. Many cases of growers applying insecticides six or seven times to a field border are a direct consequence of improper grasshopper control on summer fallow.

Early seeding - Seed crops as early as possible. Older plants can withstand more grasshopper damage than younger plants that are not well established. Although early seeding may not totally prevent crop damage, damage will be reduced and more time will be available to apply insecticides. Also, crops that are seeded earlier will mature earlier and migrating grasshoppers are not as likely to be attracted to them.

Crop rotation - Whenever possible, avoid seeding cereals on stubble fields heavily infested with grasshoppers. Seed cereals only on stubble fields where soil moisture is adequate and where one or more applications of an insecticide over the entire field is economical.

Canola seeded with an in-furrow application of a granular insecticide may be a suitable alternative to cereals where grasshopper infestations are light.

Roadside vegetation management - Certain of our common roadside weeds, such as stinkweed, alfalfa and dandelion, are nutritious food plants for nymphs and adults. Such plants promote high survival and egg laying. Western wheatgrass on the other hand, is one of the poorest food plants.

Packard's Grasshoppers

Insect Life Cycle

Host plants

Because Packard's grasshopper (*Melanoplus packardii*) prefers herbs to grasses, it causes little damage to range land, but will damage field and garden crops and legume pastures. It feeds on leaves, stems and flowers of many plants. Cereals and alfalfa are heavily attacked.

Overwintering

Females lay one to several egg pods in grain fields or along roadsides, mostly in August and September. Each pod contains about 20 eggs. The egg stage overwinters.

Spring appearance

Eggs hatch between early May and mid July, depending upon temperature and moisture conditions. Nymphs, which are green or fawn colored, molt through five nymphal instars before becoming adult in three to seven weeks. In cooler seasons, development is slowed and nymphs persist into the fall.

Number of generations

There is one generation per year.

Natural enemies

See clear-winged grasshopper.

Damage Assessment

Economic importance

Packard's grasshopper occurs in the four western provinces. It is the second most important species of grasshopper in Alberta, and the third most important in Saskatchewan where it has comprised 12 per cent of the total grasshopper population. It tends to be associated with the migratory grasshopper, *M. sanguinipes*, and tends to occur especially in stubble fields and in light soil areas. Packard's grasshopper has caused considerable damage to fall rye and winter wheat.

Management Strategy

See clear-winged grasshopper

Two-striped Grasshoppers

Insect Life Cycle

Host plants

Two-striped grasshoppers (*Melanoplus bivittatus*) feed on grasses and broad-leaved plants. The broad-leaved plants are necessary for maximum growth. They prefer the lush growth around edges of streams, marshes and cultivated fields. Hosts include weeds and most crops, especially alfalfa and vegetables, and occasionally trees and shrubs. They were first noted in large numbers in 1932 after broad-leaved weeds became common on the Prairies.

Overwintering

This species overwinters in the egg stage. Drift ridges of soil in abandoned fields that suffered severe wind erosion are favored egg laying sites. Other areas include heavier textured soils along roadsides, closely cropped pastures, fence rows, ditch banks, prairie sod and field margins, but not cropped fields.

Air temperature must be above 20°C and soil moisture between 10 and 20 per cent for egg deposition to occur. Forty to 100 eggs are laid per pod; only two or three pods are laid by each female during August and September.

Spring appearance

First instar nymphs appear in late May to early June.

Number of generations

There is one generation per year.

Natural enemies

The two-striped grasshopper has a greater number of natural enemies of the egg stage than have the clear-winged or migratory grasshoppers. The nymphs and adults are attacked by at least 12 species of insect parasites, two mermithid nematode species, three microbial pathogens and by various birds, small mammals and parasitic mites. Insect parasites are most abundant two or three years after an outbreak. There are various records of heavy mortality from fungus disease to which the two-striped grasshopper seems particularly susceptible. Red mites have infested up to 100 per cent of a population; however, about eight per cent is a more normal figure. Their effect on these grasshoppers is unknown.

Damage Assessment

See clear-winged grasshopper.

Management Strategy

See clear-winged grasshopper.

Migratory Grasshoppers

Insect Life Cycle

Host plants

The migratory grasshopper (*Melanoplus sanguinipes*) is one of the most destructive pests in western Canada. Outbreaks can lead to costly losses for grain growers. This species attacks both field and garden crops, especially cereals, tomato, celery, onion and carrot.

Overwintering

Females lay pods of about 25 eggs in stubble and wheat fields, between clumps of grass or in other patches of dry soil during August and September. The eggs of this species and others in the genus *Melanoplus* can complete up to 85 per cent of their embryonic development before winter.

Spring appearance

Eggs hatch between early May and mid July, although the date depends upon temperature and moisture conditions in both spring and the preceding fall. Watch for signs of hatching in stubble fields and along roadsides and pastures where adults were seen in August and September.

Number of generations

As with all of Alberta's pest grasshopper species, migratory grasshoppers have one generation per year.

Natural enemies

See clear-winged grasshopper

Damage Assessment

Economic importance

The migratory grasshopper is normally the most numerous pest grasshopper species in Western Canada and is often injurious to cereals.

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