

Lifecycle:

One generation per year on the Canadian prairies.

Egg: Eggs are laid in batches within pods and overwinter in the soil (Fig. 1). The most common economic pest species of grasshoppers lay eggs that individually measure ~2 mm long.

Nymph: All grasshoppers develop through five nymphal instar stages (Fig. 2). Nymphs have short wing buds rather than wings extending the length of the abdomen (Figs. 2, 3). Scouting should always target early instar nymphs as they are less mobile, have yet to consume the bulk of the vegetation needed to become adults, and are more susceptible to foliar-applied insecticide IF control is warranted.

Adult: Adult pest species range in size from 20-80 mm in body length with females generally being larger than male counterparts. Adults are highly mobile and comparatively more difficult to manage using chemical control owing to their propensity to fly and greater mass. Late summer in-field adult counts are valuable and used to help assess relative risk since grasshopper densities and species diversity, if measured using standardized monitoring methods, are used to help forecast next year's grasshopper numbers.



Figure 1. Grasshopper eggs (tentatively identified as two-striped or *M. bivattus*) exposed in soil near Carman MB in 2010. Photo: John Gavloski.



Figure 2. Life stages of clear-winged grasshopper (*C. pellucida*) including egg, first-fifth instar nymphs and adult (L-R). Photo: AAFC-Saskatoon-Ralph Underwood.



Figure 3. Fifth instar nymph of (tentatively identified) migratory grasshopper (*M. sanguinipes*). Photo: AAFC-Saskatoon - Jonathon Williams. Note: each unit represents 1 mm so nymph is ~16 mm long.



Figure 4. Various developmental stages of two-striped grasshopper (*M. bivittatus*) featuring an early and late instar nymph (top and left, respectively) plus adult (right). Photo: John Gavloski.

Damage:

Grasshoppers are defoliators. Economically damaging species include:

- Migratory (*Melanoplus sanguinipes*)
- Clear-winged (*Camnula pellucida*)
- Two-striped (*Melanoplus bivittatus*)
- Packard's (*Melanoplus packardii*)
- And more recently Bruner's grasshopper (*Melanoplus bruneri*)

Nymph and adults that mature by mid-summer defoliate but nymphal stages have yet to consume a lifetime's worth of feeding so scouting and in-field monitoring must be synchronized to the onset of egg hatch and continue from that point onwards. Sweep-net sampling will help detect and retain early instar nymphs (to help assess instar stage and possibly species) but the economic threshold for grasshoppers is applied by performing in-field counts of nymphs and adults in a 1-metre by 1-metre area which is replicated several times to generate a valid estimate of density.

In addition to defoliating valuable leaf matter, grasshopper can clip seedlings and seed heads and have been observed to preferentially feed on developing seeds within panicles or pods.

SCOUTING STEPS and ECONOMIC THRESHOLDS

Grasshopper Scouting Steps:

- Review grasshopper diversity and photos of nymphs, adults, and non-grasshopper species to aid in-field scouting and accurately apply thresholds for grasshoppers.
- Access the PPMN's Grasshopper Monitoring Protocol to help implement in-field monitoring. Measure off a distance of 50 m on the level road surface and mark both starting and finishing points using markers or specific posts on the field margin.
- Start at one end in either the field or the roadside and walk toward the other end of the 50 m, making some disturbance with your feet to encourage any grasshoppers to jump.
- Grasshoppers that jump/fly through the field of view within a one-meter width in front of the observer are counted.
- A meter stick can be carried as a visual tool to give perspective for a one-meter width. However, after a few stops, one can often visualize the necessary width and a meter stick may not be required. Also, a hand-held counter can be useful in counting while the observer counts off the required distance.
- At the endpoint, the total number of grasshoppers is divided by 50 to give an average per meter. For 100 m, repeat this procedure.

Thresholds:

- Compare counts to the following damage levels associated with pest species of grasshoppers:
 - 0-2 per m² - None to very light damage
 - 2-4 per m² - Very light damage
 - 4-8 per m² - Light damage
 - 8-12 per m² - Action threshold in cereals and canola
 - 12-24 per m² - Severe damage
 - 24 per m² - Very severe damage

For lentils at flowering and pod stages, >2 per m² will cause yield loss.

For flax at boll stages, >2 per m² will cause yield loss.

- More practically, the following thresholds are offered but, in the event of additional crop stress (e.g., drought), the use of "may be required" versus "control usually required" requires careful consideration:

Control	FIELD Grasshoppers / m²	ROADSIDE Grasshoppers / m²
Control not usually required	0-6	0-12
Control may be required	7-12	13-24
Control usually required	13+	25+