

## Protocol for monitoring adult and immature Wheat Midge (*Sitodiplosis mosellana*)

### Adult Monitoring in Season

**Timing:** Inspect wheat fields for midge in late June and early July as wheat heads are emerging, as females lay eggs on developing wheat heads. Scout in the evening (after 8:30 pm) when female midges are most active. On calm evenings when it is warm (at least 15°C), adult midge can be observed in the field, laying their eggs on wheat heads.

**Location and Method:** Midge populations can be estimated by counting the number of adults present on 4 or 5 wheat heads. The quality of the population estimate increases when midge numbers are counted for additional wheat heads. Inspect the field daily in at least 3 or 4 locations during the evening to estimate midge density and ensure that insecticide application is timed correctly (**IF economic thresholds are surpassed**). The wheat midge parasitoid, *Macroglanes penetrans*, will be present in wheat crops about 4 to 5 days after the wheat midge adults first appear. Parasitoids search out wheat midge eggs to parasitize. Follow insecticide label instructions to protect these beneficial insects.

Presence or absence of wheat midge can be determined after the peak flight period by inspecting developing kernels for larvae. At this point, there is no effective management option to protect against yield loss.

**Pest Management:** Consider applying insecticide to manage wheat midge populations if population densities exceed the recommended economic thresholds. To maintain **optimum grain grade, the economic threshold is 1 adult midge per 8 to 10 wheat heads** during the susceptible stage. **To prevent yield loss, the economic threshold is 1 adult midge per 4 to 5 heads (Elliott et al. 2011\*)**. At this level of infestation, wheat yields will be reduced by approximately 15% if the midge is not controlled. The economic threshold to maintain optimum grade is lower than the economic threshold to maintain yield.

Varieties of midge tolerant wheat are available. Visit [www.midgetolerantwheat.ca](http://www.midgetolerantwheat.ca) for more information. Do not apply insecticide to manage wheat midge in fields where midge tolerant varieties are grown.

\*Elliott, B., O. Olfert, S. Hartley. 2011. Management practices for wheat midge, *Sitodiplosis mosellana* (Gehin). *Prairie Crops and Soils Journal* 4: 8-13.

## Larval Monitoring

The size of the overwintering population of wheat midge can be estimated and is used to predict risk to wheat crops in the subsequent growing season. The Saskatchewan Ministry of Agriculture and Alberta Agriculture and Forestry follow the protocol described below to estimate the size of overwintering populations and produce provincial and regional forecast maps. The regional forecast map is posted annually by the Prairie Pest Monitoring Network.

**Timing:** Monitoring for larval cocoons is conducted in the fall, after wheat crops have been harvested.

**Method:** Collect soil cores using a soil-corer with an inside diameter of 2.54 cm, inserted into the soil to a depth of 15 cm. The resulting soil core, which has a surface area of 5.06 cm<sup>2</sup>, is the basic sampling unit. Randomly select three locations in each harvested wheat field and take five cores at each location (n = 15 cores per field). Place individual cores into labelled plastic bags and store the samples at 2°C until they can be processed. Use the wet sieve method described by Doane et al. (1987\*) to separate cocoons and larvae from the soil in the sample. Count each wheat midge life stage. Dissect the larvae and cocoons to determine if they are parasitized. Parasitized midge will not survive to the adult stage. The number of viable midge in soil cores is used to estimate wheat midge risk between growing seasons.

\*Doane, J.F., O. Olfert, M.K. Mukerji. 1986. Extraction precision of sieving and brine floatation for removal of wheat midge, *Sitodiplosis mosellana* (Diptera: Cecidomyiidae), cocoons and larvae from soil. *Journal of Economic Entomology* 80: 268-271.

## Wheat Midge Biology

**Host Plants:** All conventional wheat varieties are susceptible to wheat midge, but some are more seriously affected than others. In 2018, 28 midge tolerant wheat varieties were available for use across all classes of wheat and durum as a varietal blend (VB), which consist of 90% of a midge tolerant variety and 10% of a susceptible variety. The 10% refuge is required to prevent midge from developing resistance to midge tolerant varieties and protect the viability of the *Sm1* gene. The refuge also helps protect populations of midge parasitoids by ensuring that low midge numbers persist to support parasitoid populations.

Although wheat midge attack other members of the grass family, including barley, couch grass, intermediate wheat grass, and rye, infestations on these plants are usually not serious enough to warrant control.

### **Identification, Life Cycle, and Damage:**

Adult: The female midge is a tiny, fragile fly about 3 mm long with a salmon pink or orange coloured body (Figure 1A). The male is smaller. The head is light brown with two large black eyes. Legs are light brown and antennae are dark brown. Wings are dusky and fringed with hairs. Adult midges emerge from the pupal stage over a 5 to 6 week period, from mid-June to mid-July. This is about the time when wheat heads are emerging from the sheath and are beginning to flower.

During the day, the midge remains within the humid crop canopy. During warm ( $>15^{\circ}\text{C}$ ), calm (wind speed is less than 10 km/h) evenings, females lay eggs on wheat kernels singly or in groups of 3 to 5. Female midges live for 4 to 5 days and lay eggs on wheat kernels prior to or at anthesis.

Eggs: Wheat midge lay tiny, orange-coloured eggs (Figure 1C) that are barely visible to the human eye. Plants are most vulnerable to attack if the eggs are laid during the time the heads are about one-half emerged from the boot to half-flowering.

Larvae: Eggs hatch in 5 to 7 days. After hatching, larvae crawl to the surface of developing kernels and feed for 2 to 3 weeks. Newly hatched larvae are white. Mature larvae are oval-shaped and are orange-red in colour (Figure 1B). Larval feeding causes kernels to shrivel and affects kernel development; some kernels may be aborted. Developing kernels must be carefully inspected to determine if damage is occurring. Mature larvae remain in the wheat head, enclosed in a transparent skin, until activated by rain or damp weather conditions. At this time, larvae drop to the soil surface, burrow down into the soil (5 to 10 cm deep) and overwinter in a resting stage enclosed in cocoons which are smaller than canola seeds (Figure 1D).

Pupa: If the soil conditions are suitably moist, larvae will leave their cocoons and pupate near the soil surface in the spring. Pupal development requires about 2 weeks, depending on temperature and other abiotic conditions and emergence of new generation adults is synchronized with development of wheat heads. If soil conditions are not wet enough or there is no spring rain, pupation will not occur and larvae will remain in a resting stage for another year (or for multiple years), until conditions are appropriate.

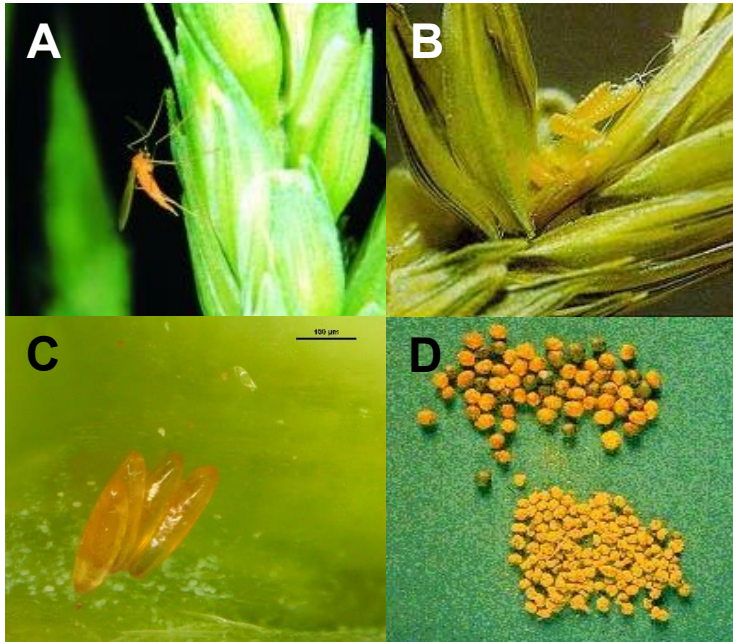


Figure 1. Adult wheat midge (A); larval wheat midge on the outside of a kernel (B); four wheat midge eggs (C); and a comparison of the size of wheat midge cocoons (bottom) and canola seed (top) (D). Images courtesy of AAFC-Saskatoon Research and Development Centre, except for C (courtesy of Dr. Tyler Wist).