Protocol for Monitoring Alfalfa Weevil (*Hypera postica*)

Timing:

Monitoring for alfalfa weevil is typically completed in mid to late May, with increased scouting frequency in June, coinciding with the time of the highest potential for damage. Crop monitoring determines if and when control measures should be undertaken. Degree day models can provide producers with guidelines on when to start monitoring for alfalfa weevil. Alfalfa weevil adults are active above 9°C, and about 160 degree days (base temperature 9°C) are needed from egg laying to egg hatch (Table 1). Monitoring should commence well before the number of second instar larvae peaks at about 220-240 degree days. If economic thresholds are surpassed, control should be initiated before numbers of third instar larvae peak at about 260-280 degree days.

Table 1. Predicted degree day accumulations for peak numbers of alfalfa weevils.

Stage or Event	Degree Days (base 9°C)*	Weevil Activity
Egg hatch	155-167	
Instar 1	176-206	Light leaf feeding
Instar 2	218-243	Light leaf feeding
Instar 3	260-280	Major leaf feeding
Instar 4	306-331	Major leaf feeding

* Peak alfalfa weevil developmental times from Harcourt (1981) and Beauzay et al. (2013)

Field sampling:

Sweep net sampling: Perform 5-10 sweeps with a 38 cm diameter sweep net in a 180° arc at several locations within the field. Ensure that sweeping is done across various terrain features (e.g., knolls, dips, and flat areas). Count the number of larvae in each sweep and calculate the average number of larvae per sweep.

Shake-bucket method: The shake-bucket method can potentially give a better estimate of first and second instar larvae as these larvae are often tightly tucked into stem terminals and may not be captured by sweep net sampling. To do this, collect at least 30 stems at random from 5-6 locations in the field while walking in a zig-zag pattern. Put the 30 collected stems into a bucket. Shake the stems vigorously to dislodge the larvae from the plant material and so that the larvae fall into the bucket. Count the number of larvae in the bucket and calculate the number of larvae per stem.

Terminal damage assessments: Collect 30 stems from the field by randomly selecting stems from 5-6 locations in the field while walking a zig-zag pattern. Examine the stem terminals of the collected stems for feeding damage caused by larvae (i.e., pinholes and defoliation; Fig. 1). Use the number of stems with damage and the total number of stems collected to calculate and estimate of the percentage of stems with damaged terminals in the field.

Figure 1. Alfalfa weevil damage to the terminal leaves of alfalfa plants.

Economic thresholds:

Economic thresholds for alfalfa weevil vary with the alfalfa crop type (hay or seed), the advising body, and the measurable unit.

Alfalfa hay:

In hay fields, forage losses can be economic if one or more of the following are noted:

- 20-30 larvae per sweep occur when 12% leaf loss is acceptable, or
- 50-75 larvae per sweep when 30% leaf loss is acceptable, or
- 56 larvae per stem at peak of larval population for a return on treatment costs.

Controls in alfalfa hay fields should be applied if:

- 25-50% of the leaves on the upper one-third of the stem show damage, or
- 50-70% of the terminals are injured, or
- 1 larva per stem for a 30 cm crop height, 2 larvae per stem for a 40 cm crop height, and immediate action is required if there are 3 larvae per stem, regardless of the crop height.

Early cutting of the first growth of alfalfa or insecticide treatment will reduce alfalfa weevil populations. If the hay crop value is high and weevil injury is seen or 2 or more larvae per stem reappear in regrowth after cutting, insecticide application may be necessary if a second cut is anticipated.

Alfalfa seed:

In alfalfa seed fields, the economic thresholds for chemical control are:

- 20-30 third or fourth instar larvae per 180° sweep, or
- 35-50% of the foliage tips showing damage.

Thresholds increase with the height of the alfalfa and decrease in drought conditions.

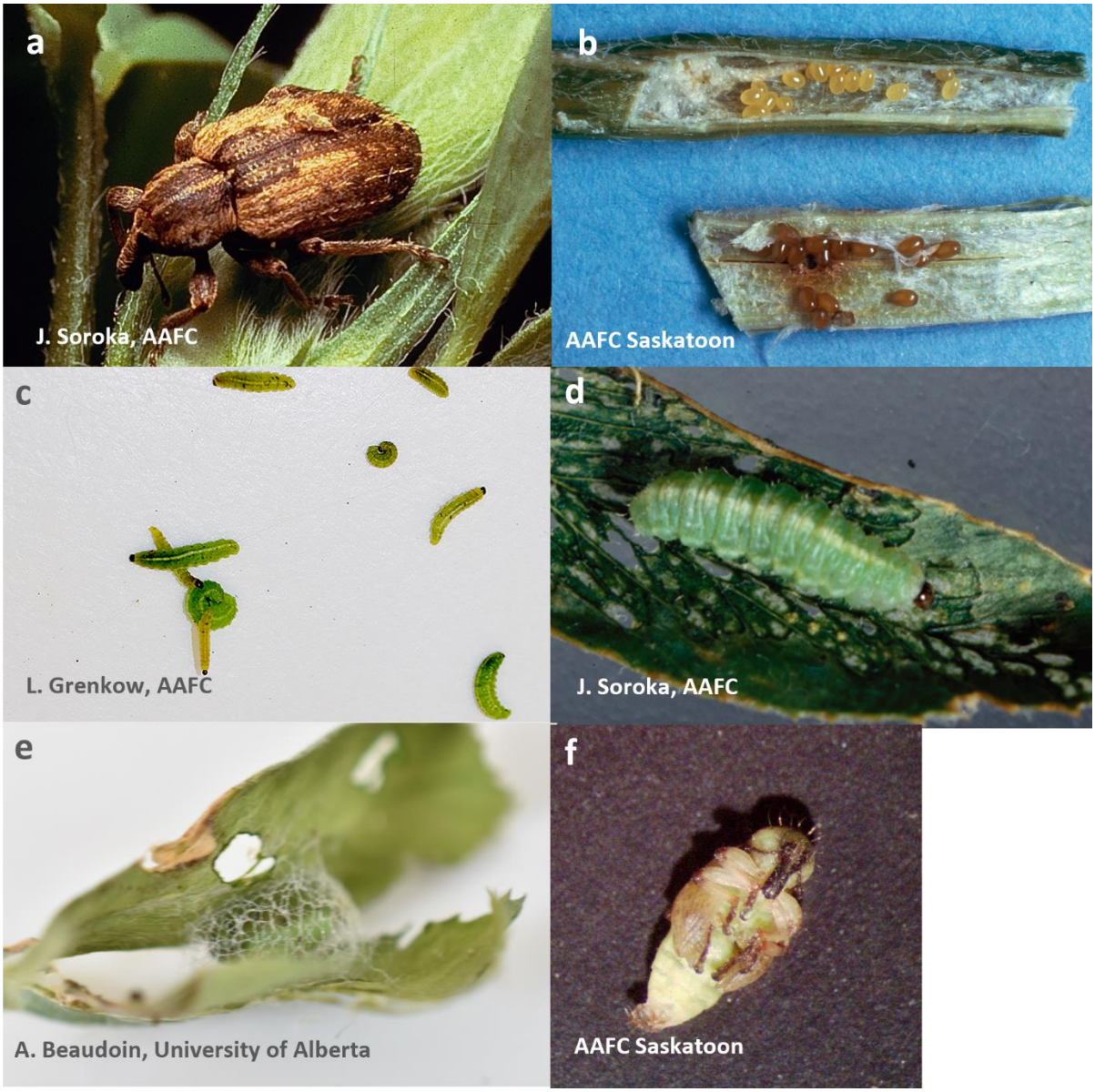

Figure 2. Alfalfa weevil growth stages: a) adult; b) newly (top) and older (bottom) laid eggs; c) second, third, and fourth instar larva; d) fourth instar larvae; e) pupal cocoon; f) pupa.

Alfalfa Weevil (*Hypera postica*) Biology

Background:

Alfalfa weevil (*Hypera postica* Gyllenhal, Coleoptera: Curculionidae) was first found in Canada in southeastern Alberta and southwestern Saskatchewan in 1954, but it wasn't until about 40 years later that it became a noticeable pest in alfalfa fields in other parts of Saskatchewan and into Manitoba. The weevil is now present in most alfalfa seed-producing areas of the prairies.

Host plants:

Alfalfa, when harvested for high-quality hay or seed production, serves as the primary host for the alfalfa weevil. They prefer alfalfa but will feed on sweet clover, true clovers, and vetches.

Identification, life cycle, and damage:

Adult: Adult alfalfa weevils are oval-shaped brown snout beetles with a distinct, dark, narrow stripe down the back, 6-7 mm in length (Fig. 2a). A distinctive snout extends from the front of their head, which contains their chewing mouthparts. It overwinters as an adult within alfalfa crowns or crop debris in or near alfalfa fields.

Eggs: In the spring, gravid female alfalfa weevils lay eggs in clusters of 5-20 eggs per cluster (800-2000 eggs total) in alfalfa stems (Fig. 2b). When laid, the oval eggs are creamy yellow in colour, and darken to brown just before hatching, which occurs 4-21 days after egg-laying.

Larvae: Larvae pass through four growth stages or instars (Fig. 2c). The first instar is about 1 mm long and light yellow or tan in colour, with a darker head. The second instar is yellowish-brown with the head darkening to black, while the third and fourth instars measure up to 9 mm long, are bright green with a shiny black head capsule, and have a white stripe down the center of their backs (Fig. 2d). Larvae may be observed on leaves when feeding or nestled among new leaf or flower bud growth. The larvae have a characteristic curled `C` position when feeding and drop to the ground when disturbed. Larval development takes 3-4 weeks, and peak larval activity/damage occurs from mid-June to early July.

Pupae: The late fourth instar larvae spin lacy white cocoons attached to plant crowns or surface debris (Fig. 2e), within which pupation takes place (Fig. 2f, pupa). The pupal period lasts 1-2 weeks, after which new adults appear.

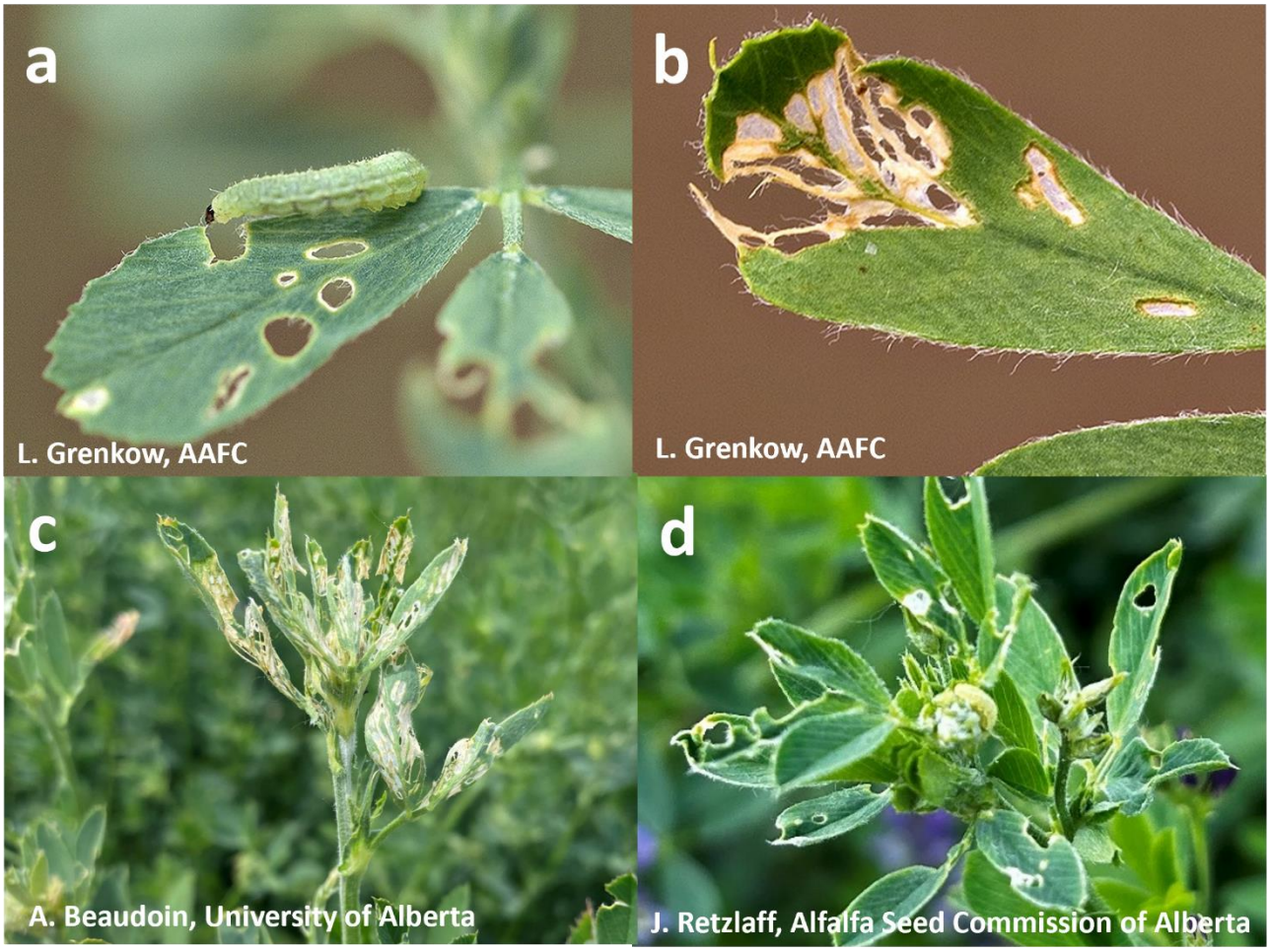

Figure 3. Alfalfa weevil injury to alfalfa: a) leaf notching, b) skeletonization of a leaf, c and d) injury to stem tips.

Damage:

Both adult and larval alfalfa weevils are foliage feeders, however adult stages do not usually cause economic damage. Adults chew round holes in leaves or notches along leaf edges (Fig. 3a), while newly emerged larvae feed on the stem interior for 3-4 days, then move up the plant to feed on the growing plant tips and opening leaf buds, where they feed, concealed, for some time. Older larvae feed on interveinal areas of fully expanded leaves (Fig 3b), and heavy feeding can result in shredded leaves, with only stems and midribs remaining. Alfalfa weevil feeding on developing buds and the skeletonization of leaves can stunt growth of alfalfa plants, reduce hay biomass and cause flower loss, reducing seed formation (Fig. 3c-d). Heavy feeding can give an alfalfa field a silvery, frostlike sheen (Fig. 4). Alfalfa weevil feeding is especially damaging to seedling alfalfa hay and seed crops.

Figure 4. Alfalfa weevil injury to an alfalfa field where plant growth is stunted, blooming is reduced, and plant tips have turned silvery-white.

Parasitoids:

Several small wasps parasitize alfalfa weevil larvae and adults. One of these wasps, *Bathyplectes curculionis* (Thomson), (Fig. 5a-c), parasitizes alfalfa weevil in Alberta, Saskatchewan, and Manitoba. The impact of parasitoids on overall alfalfa weevil numbers is likely to be negligible as populations of the parasitoids may be reduced by early insecticide usage.

Figure 5. Alfalfa weevil parasitoid, *Bathyplectes curculionis* (Thomson); a) adult wasp parasitizing alfalfa weevil larva; b) wasp; c) pupal cocoon.

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