Crop Insect Pests for 2004

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There are a number of potential insect pests that could affect Saskatchewan producers in 2004. Some insect pests are already present in an over-wintering form while others such as diamondback moth and aphid infestations will be dependant on prevailing winds during the growing season.

Grasshoppers
Grasshoppers are likely to be one of the major crop pests for 2004. There are over 600 species in North America. There are greater than 80 species present in Saskatchewan. Most of these are not considered to be economic problems for annual crops. There are 4 species that are generally considered to be the main pests (migratory, Packard, two-striped and clear winged) although there may be considerable variation as to which are the most problematic, depending on the location in the province. For instance where the migratory grasshopper (*Melanoplus sanguinipes*) may be one of the more dominant spur-throated species in southern regions, *Melanoplus dawsonii* is often more prevalent in northern regions.

Three of these pest species are of the Melanopline or spur-throated genus. The clear-winged grasshopper is of a different genus but has been responsible for serious damage historically in Saskatchewan. Pest grasshoppers have only one generation per year, and take several years of warm, dry conditions to increase to outbreak levels. The severity of grasshopper infestations is dependant on a successful build-up of populations and environmental conditions that are conducive to grasshopper populations. There have been favourable environmental conditions and a build-up of grasshopper populations over the past years resulting in severe economic infestations in many areas of the province.

The most common hopper species observed during the current outbreak for most parts of the province has been the two-striped grasshopper (*Melanoplus bivittatus*). It has two light coloured stripes down the back and solid black stripe along the outside of the large part of the hind legs – the femurs. The females of this species are some of the largest grasshoppers we see on the prairies.

General life cycle for pest species – Mating of adult grasshoppers and egg-laying occurs in the fall. Egg pods may contain 8 to 150 eggs depending on environmental factors and available food sources. Under optimum conditions females of some species can produce an egg pod every 2 to 4 days until environmental conditions become unfavorable. Under ideal conditions this may result in the production of greater than 250 eggs for an average grasshopper.

Depending on the fall conditions, embryo development continues until freeze-up. For example it has been shown that 60 to 80% of two-striped grasshopper embryo development can occur in the fall. Development resumes in the spring once temperatures reach minimum requirements. Soil temperatures will vary depending on moisture content (cooling effect) and cover (vegetative

debris or crop cover). Agriculture and Agri-Food Canada assists in estimating potential for the grasshopper hatch regionally, using developmental models and producing degree-day maps. The actual hatch dates will vary but generally occurs from late April to mid-June. Consistent warm temperatures will mean a quicker hatch whereas cooler conditions will result in a more prolonged hatch.

Although there are conditions in the winter that can have some effect on the eggs in the soil, the main effect of environment will be on the young grasshoppers once they hatch in the spring. Heavy rains and cool, humid conditions are detrimental to grasshopper development and will increase the effect of diseases that can cause mortality in populations.

There are five immature stages or instars of grasshoppers, between egg and adult. Although the most extensive feeding by grasshoppers is in the 3rd to 5th instars, this will vary depending on the number of grasshoppers and the stage of the crop. For example, high numbers of small grasshoppers on young seedlings can result in significant removal of green growth and the late feeding of adults on the flag leaf of cereals can seriously affect head filling since the flag leaf and the next leaf below are responsible for about 80% of the filling of wheat heads. Insecticide options are reduced later in the year because of the various pre-harvest intervals associated with the insecticides.

Other important pest species include the migratory grasshopper that was common in the outbreak of 1983-86, but rare in 2001-2002. Some higher populations have returned in 2003 in some areas. *Melanoplus packardii* or Packard's grasshopper is a pest of cereals, grass and alfalfa that has also been all but non-existent in the past few years but is on the increase.

An economic threshold (ET) is the level of pest pressure at which the crop damage is approximately equal to the cost of control. There are a number of variables affecting an economic threshold and therefore consideration should be given to the crop type, growth stage, crop market value, growing conditions, insect stage and cost of control. Due to these factors an economic threshold will fluctuate and should be considered as a guideline rather than an exact value. Although grasshoppers tend to exhibit feeding preferences for certain crops, under high feeding pressure, all crops are at risk. Of the five immature "instars" of grasshoppers, the third to fifth stages are generally the most destructive as they have reached a larger size and are more mobile.

The currently recommended **economic thresholds** for grasshoppers are as follows:

Cereals - The economic threshold for ranges from 8 to 12 grasshoppers per square metre depending on the specific crop. For instance durum will generally have a higher market value and therefore the lower end of the range (ie. 8 grasshoppers per square metre) would be appropriate. If feeding is on the flag leaf or head, the lower end of the ET range should be used. Feed wheat and barley would generally be at the higher end of the range whereas malt barley would have a lower economic threshold. Oats is not a preferred food source for grasshoppers although oat crops have been completely destroyed by the insects. If there is a choice between spring wheat and oats the grasshoppers will tend to eat the wheat first. Also if oats are the sole food source, research has shown that egg-laying is reduced.

Flax – Grasshoppers do not prefer flax foliage and therefore are not generally a serious problem early in the season when there is more lush green growth for the grasshoppers to choose from. However at the green boll stage the economic threshold for flax is only 2 grasshoppers per square metre. Not only are the green bolls preferred over the rest of the plant, grasshopper feeding has a more direct effect on crop yield.

Lentil – As with flax, grasshoppers do not generally consume lentil foliage. By flowering and the developing pod stage however the economic threshold for lentil crops is 2 grasshoppers per square metre. The insects selectively feed on the green succulent pods and therefore have a more direct effect on yield.

Canola – Canola is not a preferred crop for grasshoppers and often weed hosts may be more affected. Results of grasshopper feeding studies on canola suggest that the economic threshold for this crop is greater than 13 grasshoppers per square metre. Canola appears to be most susceptible to economic damage when the plants are very young and later in the podding stage. Research has shown that *B. napus* varieties have more trouble compensating from grasshopper feeding than do *B. rapa* varieties. *B. juncea* varieties appear to recover best out of the three.

"Non-Pest Species" - The majority of species of grasshoppers fit into what are generally considered as non-pest species. However on dry years when pastures and roadsides have reduced green growth the non-pest species can cause serious damage to annual crops. They generally have a life cycle that requires 2 years to complete. They over-winter in immature or adult stages. The following characteristics are usually indicative of non-pest grasshoppers:

- Present as adults early in season (any seen before May 25)
- Knobs at tips of antennae
- Red, yellow or orange wings
- Any that sing loudly while sitting
- Any that "crackle" when they fly

Grasshopper forecasts – Saskatchewan Agriculture, Food and Rural Re-vitalization conducts an annual grasshopper survey in the fall with the intent to provide producers and crop protection companies with an indication of the risk of grasshopper population levels in the province. Surveys conducted in neighbouring provinces also provide better information for border areas and ignores political boundaries. A.A.F.C., Saskatoon produces inter-provincial maps depicting insect pest populations on a prairie wide basis.

Data from over 2,400 sites were combined to produce the 2004 Forecast Map for Saskatchewan. The grasshopper egg hatch and early development started slow in 2003 but accelerated with the high temperatures in June and July. This resulted in the majority of the grasshopper species that have an annual life cycle, reaching the adult and reproductive stage by the end of July or early August. Therefore there was sufficient time for successful egg laying under ideal environmental conditions in August and September. Throughout the course of the growing season populations of grasshoppers reached economic levels in many crops often on more than one occasion, requiring multiple control operations.

For Saskatchewan in 2004 the risk of severe grasshopper infestations appears to be greatest in a wide band running diagonally from the northwest to the southeast. However there are also several areas of severe risk identified in the area south of this band. High populations have also been identified across the border in southwest Manitoba. Economic infestations are even affecting some areas in the east central and northeast regions where they have rarely been a problem historically.

There are natural biological enemies of grasshoppers in the form of predators, parasites and disease. Natural enemies of grasshoppers increase more slowly than the grasshopper populations and may take years to have a significant effect. These include egg predators such as some fly species (including bee flies), blister beetles, ground beetles and crickets. The effect of these predators varies but in some cases there has been as much as 80% egg mortality in localized areas. Egg parasites (e.g. wasps) lay eggs within newly laid grasshopper eggs and provide some natural control. For example 5-40% of eggs destroyed in a 1985 egg survey. Predators and parasites of nymph and adult grasshoppers include spiders, robber flies and birds. Flies (Flesh flies, robber flies, muscoid flies, tangled vein flies) have been shown to kill 5 to 25% of grasshoppers each year. Diseases affect grasshoppers in moist years - infection was low in 2003.

Parasites such as threadworms and diseases including fungi (e.g. *Entomophaga grylii*), and microsporidia (e.g. *Nosema locustae*) also have an effect on grasshopper populations. Diseases have been shown to kill from 2% to 80% of grasshoppers. Grasshopper outbreaks were stopped by disease in 1961 and in the late 1970s, but the effect is often just a reduction. The fungal disease *E. grylli* kills grasshoppers in warm, moist weather. They die clasping vegetation. In 2002 and 2003, the rate of kill by this fungus was lower than usual. Spores are present in soil and litter, and could kill significant numbers of grasshoppers in 2004 if rain allows germination.

Another parasite is the red grasshopper mite (*Eutrombidium locustarum*). This is a parasite that has been frequently observed by producers as the mites are fairly easy to see when attached to grasshoppers. They increase in numbers under dry conditions but the mite rarely kills the grasshopper, just reduces movement.

Management and control – Prevention in the form of cultural or non-chemical management strategies are of most use during years of lower grasshopper populations and may be in the form of planting less preferred crops such as oats or peas as part of a rotation or as a guard crop. Efficient weed control can essentially starve out young hoppers as they are not capable of moving great distances to acquire food. Adult females will tend to lay eggs near a potential food source so the early instars do not have to go far. This may be accomplished through conventional fallow or chemical fallow.

In outbreak situations insecticide control is the only method to effectively deal with grasshopper populations. There are some other measures and considerations that can be used to assist in managing populations.

Trap crops, seeded earlier and used to entice young grasshoppers into a smaller area of a field before the main crop emerges, is a strategy intended to concentrate the grasshopper distribution and thereby reduce insecticide use while still providing adequate control of grasshopper populations.

Canola is not a preferred host crop for grasshoppers but young canola plants have been severely damaged by migratory, two-striped and clear-winged grasshoppers. Infestations of greater than 15 grasshoppers per square metre have caused significant damage. This will depend on the stage of the plant and thickness of the stand. Generally grasshopper infestations and therefore, control measures will be largely confined to field edges in canola.

Peas and oats are not preferred crops for grasshoppers and egg-laying (biotic) potential tends to be reduced. However if there is a lack of food choices and the weather is hot and dry, both crops will suffer significant damage. These crops may reduce the effect of hoppers when used as guard strips around more preferred crops.

Controlling field margins will often be adequate in field crops, especially in lentil and canola if the stand is dense resulting in a humid "micro-environment" within the crop. This will reduce costs as compared to full field insecticide applications and will also reduce negative impacts on beneficial insects in the field.

Controlling grasshoppers in hay has not been considered to be economically viable in most years. However if dry conditions have reduced pasture growth as well as forage reserves hay, including annual crops to be used as greenfeed gain in value. A rough estimate for an economic threshold for grasshoppers in crops to be used as greenfeed has been suggested at 20 grasshoppers per square metre or higher. Insecticides used for this purpose must be registered for the specific crop. Preharvest intervals become very important to consider in the case of feed since there is generally a shorter time before animal consumption than harvesting of grain.

Other comments:

- All of the registered grasshopper products reduce numbers sufficiently to protect crop. 100% kill is not necessary.
- It is important not to spray too early in the year that grasshoppers are still hatching (the egg is not killed by spray or bait).
- Control usually begins the first or second week of June, but damage must be apparent and severe to warrant treatment.

- Effects of tillage as a management strategy:
  - Eliminates green plants and therefore potential food for newly hatched grasshoppers
  - Little effect on egg viability
  - Increases risk of erosion and reduced soil moisture
  - Cultivation immediately after harvest will discourage grasshoppers from laying all their eggs in the field
  - Tillage should be considered as a last resort for 'hot spots' where use of insecticides are not allowed – e.g. buffer areas around water

Wheat Stem Sawfly

The resurgence of wheat stem sawfly has resulted in considerable economic damage for wheat producers on the Great Plains – both in Canada and the United States. Environmental conditions, specifically dry weather cycles and tight wheat rotations are the primary factors contributing to increased sawfly populations. Warm, sunny, calm weather following spring rains will result in wider dispersal of the insect within a field or to adjacent fields. Excessively wet conditions tend to be detrimental to both sawfly and parasite populations and activity. Spring wheat is the primary host for wheat stem sawfly in Sask.

Life Cycle –

May	June	July	Aug.	Sept.
Larvae pupate	Adults emerge, mate and lay eggs	Egg-laying continues and larval feeding commences	larval feeding continues	Larvae over-winters

Currently the wheat stem sawfly is over-wintering within the wheat stems as larvae in a long, thin, brown transparent cocoon. Larvae are buffered from temperature extremes in their location at or below the soil surface. Pupae will not be formed until the following May.

There is only one generation per year. However, there is evidence that very high springtime temperatures may induce the larvae back into a resting stage and the generation may take two years to complete.

After completing development and escaping from the pupa, adults chew and push through the plugged stem, emerging from mid-June to early July. The males emerge first, with female emergence commencing a few days later. They tend to remain near the area where they emerge because they are weak fliers. If cool, wet weather occurs during emergence, the period of emergence is extended. Wet conditions also assist in softening the plug in the stem allowing for easier emergence of the adult sawfly. After mating the adult female lays eggs in the plant stem, but does not actually feed on the plant. The primary purpose of the adult is reproduction. A healthy adult female may lay up to 50 eggs, usually only one egg per stem. Other females may lay eggs in the same stem, but only one larva will survive per plant. The first egg to hatch is cannibalistic on any other eggs present in the same stem.

After the egg hatches within the stem, the larvae feed upward, boring through the nodes for a month or longer. As the plant starts to senesce (ripen), allowing sunlight to filter through the stem, the larvae respond by moving toward the bottom of the stem and turn around. With head now upwards, the larvae cut a groove around the entire inside of the stem generally less than one inch or 25 mm above the ground. Moisture content of the plant appears to be a cue at this point since it appears that the larva will not cut a stem unless moisture content is below 50 per cent. The cut weakens the stem so it falls over easily making it difficult to harvest, resulting in yield loss. Heavy winds, rain and other factors contribute to increased lodging that can be even more apparent in thin stands. Attempts to harvest the fallen plants often result in considerable equipment damage and increased fuel costs.

Monitoring and Management

Considerations for the current year:

When they emerge in late June and the first week of July, a sweep net can be used to sample for adult sawflies. An average of two females for every 10 sweeps corresponds to about 12 per cent stems cut in the sample area. Four sawflies in 10 sweeps results in about 23 per cent cut stems. Pesticide application is not recommended, even if a high number of adults are observed in the field, as there is no guarantee that egg deposition has not already occurred. There have been some reports of an apparent reduction in sawfly damage as a result of chemical control for grasshoppers but this is more by chance than design.

Monitor the field again in late-July. While the crop is still green, infested stems may appear with regions of mottled discolouration and concentration of darker areas near the nodes. Split the stems lengthwise to determine if a sawfly larva is present and feeding on the stem. This will provide some insight with respect to sawfly damage in the field prior to crop maturity. If several stems split in late-July contain a larva (i.e. four to six larvae per 10 stems split), consider swathing the crop. Once kernel moisture drops below 40 per cent, early swathing can help to salvage infested stems before they fall and become more difficult to pick up with a combine. Even if a field is heavily infested, most wheat heads can be recovered if producers swath the crop early to create a more harvestable windrow. This requires judgment as swathing too early can result in low-test weights, reduced yields, and downgrading. Conversely, a high percentage of stems could already be toppled over if the swathing operation is performed too late. If swathing is not economically or operationally feasible, combine the field as soon as grain moisture is low enough to bin the seed.

Considerations for the next year:

There are no established economic thresholds for wheat stem sawfly, however, producers are recommended to implement management strategies if 10 to 15 per cent of the stems were cut the previous year. With conditions conducive to successful over-wintering, a field with this level of damage could produce enough adults to increase cutting levels to 70 per cent or greater in the following year.

The most effective way to reduce damage from the wheat stem sawfly is through the incorporation of resistant cultivars and/or crops. Barley is not normally a host for the sawfly. Oats and broadleaf crops such as canola, flax and alfalfa are not susceptible to wheat stem sawfly. If wheat is to be grown as part of a current rotation, solid stem wheat varieties should be grown as they are considered to be more resistant to sawfly damage.

Select a resistant variety such as AC Eatonia or AC Abbey, and remember that a resistant variety will sustain damage in certain years or in certain environments. If seed source is an issue, spread out resistant variety as much as possible by seeding borders (trap cropping) of fields to the resistant variety.

Solid stemmed varieties are filled with pith, especially in the lower parts of the plant. This inhibits development and slows the movement of the larvae within the stem, resulting in increased larval mortality. One research study indicated that larval mortality was about 28 per cent in hollow stems and about 67 per cent in solid stems. Although past reports suggested

durum wheat varieties were rarely attacked, some durum varieties appear to be as susceptible as some spring wheat varieties.

Producers should consider potential loss as a result of sawfly feeding versus the loss from growing a lower yielding cultivar. Currently registered sawfly resistant varieties tend to be lower yielding or have lower protein than hollow-stemmed varieties. However, it should be noted that AC Abbey does have good yield and AC Eatonia does have good protein. An additional consideration for solid-stemmed varieties is that they tend to better withstand the drought conditions that often coincide with sawfly outbreaks. If mixing varieties, the same wheat class should be used to prevent downgrading. Other traits should be similar between the varieties grown such as maturity and height in order to reduce variation when harvesting.

Generally it appears that less soil disturbance will result in more adult emergence. However, tillage operations can contribute to soil erosion and, therefore, producers should consider this option carefully, especially in lighter soil.

Delayed planting of wheat may be of some benefit to reduce sawfly damage, but yield and quality may also be affected. Late seeding can result in reduced yield and may expose the crop to early frost. This management strategy has been recommended only in cases where there is a high risk of wheat stem sawfly and a susceptible variety is being sown.

Although native grasses may act as hosts for the sawfly, actual outbreak situations do not appear to originate in these areas. Burning infested stubble has been considered as a possible strategy. This may help reduce larval numbers, but it is not recommended as a good agronomic practice and will also greatly reduce beneficial parasites. Burning or mowing of grassy field borders or ditches is also not recommended due to the severe impact on beneficial parasites residing in these areas. Overall, the negative effects of burning far outweigh any benefits.

An integrated management approach using all of these management strategies will likely be necessary over a long term because it may take several years to bring populations of the wheat stem sawfly down to acceptable levels. Ideally, the strategy should be a community commitment since isolated attempts to manage sawfly populations will always be affected by populations in neighbouring fields.

Aphids

Aphids were a common insect problem in many areas of the province in 2003. Although most reports of economic infestations were from pea crops in the eastern half of the province, there were also high numbers of aphids in fields in the southwest and the northwest. Although in some cases infestations of this “new” pest may have been a result of curiosity, prompting producers to scout for, and consequently find aphids, in many situations the populations required insecticide control.

Associated with the widespread infestations in peas were inquires with respect to aphids in other crops. This has not a common Saskatchewan problem (except perhaps for canaryseed) and there is not a lot of current economic threshold information available on aphids. The following guidelines are based on research and communication with researchers and entomologists in agriculture departments (Federal (A.A.F.C., Provincial and State (U.S.D.A)) from Saskatchewan, Manitoba and North Dakota.

General Considerations – All Crops

Being soft-bodied, aphids are very sensitive to physical disturbance. A heavy rain or severe wind can dislodge aphids and reduce their numbers in a crop. Regular monitoring is essential in identifying changes in population densities.

Since aphids suck plant sap the sap has to be actively flowing for the purpose of filling seeds. If seed filling is complete and the crop ceases to be lush and actively growing, aphids will change to a winged form and migrate to other greener crops.

Timing and necessity of insecticide applications: These are generally the most commonly asked questions and all crops should be treated on a case by case basis. Application of insecticide too early will be unlikely to provide a yield response. Late application would have no beneficial result and will be an unnecessary expense as the aphids cannot damage crops that have completed seed filling. Research has shown that the best result from insecticide application for economic infestations of aphids on peas is at late flowering to early pod. From this stage until soft dough there will be a gradually diminishing yield response by the plants as a result of insecticide application. Although vulnerability will differ depending on the crop and environmental conditions this appears to be a reasonable guideline for aphids in most crops.

High numbers of aphids feeding at the bases of flowers and developing pods may result in abortion of flowers and reduced filling and possibly fewer seeds per pod. However if there is sufficient moisture the plants can compensate for some of the fluid loss to the aphids. Aphids will more adversely affect a crop under moisture stress.

Beneficial insects can play a major role in managing aphid populations. Aphids have many predators, including ladybird beetle adults and larvae, ambush bugs, minute pirate bugs, and hover flies. Several species of tiny wasps lay their eggs in aphid nymphs, killing the nymph and forming shiny pearl-like aphid "mummies", from which the adult wasp emerges. In humid conditions an entomophthoran disease can kill large numbers of aphids. These natural control agents may not be effective in reducing large infestations, but when aphid numbers are around threshold levels, bio-control may be a better alternative than insecticides. Because of their rapid ability to increase numbers, aphids have been known to rebound to high levels several weeks after insecticide application. Regular monitoring for these beneficial insects, as well as for the aphids, is important and can save considerable expense and labour.

Aphids have specific host crop preferences. Although some may feed on more than one crop, not all aphids will attack all crops.

Economic Thresholds for Aphids:

Contributing factors affecting the economic thresholds: market value of the crop, cost of control, moisture conditions, crop stage.

Field Peas - There are a number of reasons to consider a higher threshold than the current 2 to 3 per 20 cm plant tip. A more current threshold could be considered to be in the 9 – 12 range or even higher if there are good growing conditions or the crop is further advanced in pod filling.

Lentil - Information on aphids in lentil from North Dakota suggest an ET with 3 qualifiers:

30 to 40 aphids per 180 degree sweep **and** few natural enemies are present **and** aphid numbers do not decline over a 2 day period.

Canaryseed – based on U.S. and Australian research the current recommendation for considering insecticide application for aphids on canaryseed is:

10 to 20 aphids on 50% of the stems

Cereals (e.g. wheat barley) - 12 to 15 aphids per stem prior to soft dough

Canola – More than one species of aphid can attack canola and their location of feeding differs. Green peach and another species will feed mostly on leaves and are therefore not as important as the turnip aphids that cluster on stems during flowering and early podding. As a guideline researchers have suggested that if 10 to 20% of the stems have clusters of the turnip aphids, control is likely warranted.

Resources for Insect Pests in Saskatchewan

Factsheets on insect pests are available at the SAFRR booth during Crop Production week and are available at Rural Service Centres throughout the province.

The forecast maps are displayed at the booth. A limited number of colour copies will be available at Rural Service Centres and can always be viewed on the SAFRR website: www.agr.gov.sk.ca under Crops / Integrated Pest Management / Insects.

Copies of the 2004 Guide to Crop Protection listing the most current information on insecticides, economic thresholds and monitoring tips, are also available at the SAFRR booth and Rural Service Centres.