Beelines

2019 Saskatchewan Honey Production Survey

Background

Every beekeeping year appears to have its own peculiarities, with 2019 being no exception. Early beekeeper reports across the prairies indicated that honey production would be below average and that the northern beekeepers had a more reduced crop than their southern neighbours. To come to a better understanding of honey production in the province, the annual honey production survey was open for response from Sept. 24 to Oct. 11, 2019. The honey production survey was requested by the Ministry of Agriculture and was sent through the Saskatchewan Beekeepers Development Commission, the Saskatoon Bee Club and the Regina and District Bee Club.

Beekeepers were asked to provide their number of colonies, number of nucleus colonies going into winter, total honey production in pounds or total number of barrels (200L drums) produced, per cent of their average crop and to list which three factors affected their crop most significantly. Personal information and location were not requested to ensure privacy.

Analysis

Data were reviewed and duplicate entries or errors were removed from the data set.

Beekeepers were separated into three different groups depending on the number of colonies. The groups were as follows:

1. Over 1,000 colonies;
2. From 100 to 999 colonies; and
3. From one to 99 colonies.

All calculations, except for per cent of total production, were calculated for all colonies and the three different size groupings of beekeepers. Per cent of total production was calculated for all beekeepers, but not broken down by operation size because the group of beekeepers with less than 100 colonies had too many missing data points for analysis of this question.

Honey produced by beekeeper was standardized into kilograms of honey. If drums/barrels of honey were reported, the number of drums/barrels were multiplied by 630 pounds/drum to produce total pounds of honey. Pounds of honey produced for all beekeepers was then divided by 2.2 pounds per kilogram to give total kilograms of honey produced per beekeeper.

Calculations

- Total honey produced = sum of all beekeepers' production.
- Total colonies = sum of all reported production colonies.
- Total nucleus colonies = sum of all reported nucleus colonies.
- The proportion of nucleus colonies = nucleus colonies / full sized colonies X 100.
- Average honey production per colony = total honey produced / total colonies.
- Per cent of reported normal production = the sum of ([per cent of reported honey produced / 100 X number of colonies for the individual beekeeper / total number of colonies sampled]) for each individual beekeeper).

Because of similarities in beekeeper's responses to the question about the year's three largest impact factors and the request for additional comments about the season, their responses were combined for analysis. These data were ranked by the number of mentions by beekeepers reported.

Results

A total of 62 beekeepers with 57,496 colonies responded to the survey. This represents six per cent of beekeepers but 50 per cent of the total estimated number of colonies in the province.

The number of beekeepers reporting according to size of operation was fairly similar across size groups, with 23 (36 per cent), 22 (35 per cent) and 18 (29 per cent) for the operations with more than 1,000 colonies, from 100 to 999 colonies and less than 100 colonies respectively. Conversely, the number of colonies for each reporting size of operation varied greatly with 48,197 (83.8 per cent), 8,992 (15.6 per cent) and 307 (0.5 per cent) colonies in operation with more than 1,000 colonies, from 100 to 999 colonies and less than 100 colonies respectively (Table 1).

There was a total of 18,534 nucleus colonies put into winter in 2019. The breakdown of number of nucleus colonies by size of operation followed a similar pattern to the number of full sized colonies, with operations with over 1,000 colonies, between 100 and 999 colonies and less than 100 colonies reporting 17,048, 1,370 and 116 nucleus colonies respectively. As a proportion of nucleus colonies wintered compared to full sized colonies, the group of all beekeepers have 32.3 per cent, the group with the most colonies have 35.3 per cent, the middle sized group has 15.2 per cent and the smaller scale beekeepers have 37.9 per cent prepared for the winter. (Table 1).

When controlled for the number of colonies, honey production was reported to be 83 percent of normal. Total honey produced by responding beekeepers was 4,602,334 kg (10,125,135 pounds) with an average of 80 kg per colony (176 pounds per colony). By the operation size, the total production followed a similar pattern to the total number of colonies with operations with 1,000 colonies or more producing 4,071,031 kg (8,956,268 pounds), 100 to 999 colonies producing 517,527 kg (1,138,559 pounds) and less than 100 colonies producing 13,775 kg (30,305 pounds) of honey. The average production per colony was 84.5 kg (186 pounds) per colony for beekeepers with over 1,000 colonies, 57.6 kg (127 pounds) for beekeepers with between 100 and 999 colonies and 44.9 kg (99 pounds) for beekeepers with less than 100 colonies (Table 1).

Table 1: Responses of beekeepers by size of operation

	All Beekeepers	More than 1,000 Colonies	100 to 999 Colonies	1 to 99 Colonies
Number of Beekeepers Responding (per cent of respondents)	62 (100%)	23 (36%)	22 (35%)	18 (29%)
Number of Colonies (per cent of reported)	57,496 (100%)	48,197 (83.8%)	8,992 (15.6%)	307 (0.5%)
Number of Nucleus Colonies	18,534	17,048	1,370	116
Proportion of Nucleus Colonies to Full Sized Colonies in per cent	32.2%	35.3%	15.2%	37.9%
Total Honey Produced in kilograms (kg) (pounds)	4,602,334 kg (10,125,135 pounds)	4,071,031 kg (8,956,268 pounds)	517,527 kg (1,138,559 pounds)	13,775 kg (30,305 pounds)
Average Kilograms Honey Produced per Colony (pounds per colony)	80 kg per colony (176 pounds per colony)	84.5 kg per colony (186 pounds per colony)	57.6 kg per colony (127 pounds per colony)	44.9 kg per colony (99 pounds per colony)
Percent of Normal Production Controlled by Number of Colonies	83.0%	-	-	-

There were a lot of common characteristics between the issues that beekeepers faced across the province. The most commonly stated factors affecting the crop and other notes of interest from the season were:

1. Weather – drought in the spring, rain during the canola bloom.
2. Bee health – rebuilding from winter loss, high levels of varroa mites.
3. Swarming and other queen issues.
4. Availability of canola – reduced amount planted, poor germination resulting in extended bloom period and the honey flow ending early in some areas.

Discussion

Although 62 respondents to the survey appears low at six per cent of total registered beekeepers, the total number of colonies, 57,496, represents approximately 50 per cent of total estimated number of colonies in the province. This level of participation should provide a good estimate of honey production in the 2019 season, and allow for some comparison between the operation size groups. The apparent disconnect between the low number of beekeepers responding and the much higher proportion of colonies is a reflection that commercial beekeepers manage the majority of bees within the province. Extra encouragement should be given to improve the response rate to increase the accuracy of the survey, but this is especially true for small scale beekeepers.

The proportion of nucleus colonies to full sized colonies demonstrates that beekeepers are actively planning to replacing colonies lost over the winter and/or are planning to make increase for the next year. Beekeepers with over 1,000 colonies made a bigger proportion of nucleus colonies to full sized colonies, than the beekeepers with between 100 and 999 colonies. This may reflect the extra costs associated with potentially replacing more colonies in the event of loss in a larger operation. The small scale beekeepers had the highest proportion of nucleus colonies to production colonies, however there is a potential outlier in that one beekeeper in this group wintered 20 full sized colonies and 50 nucleus colonies, perhaps planning on an increase for the next season. With the removal of the one potential outlier the proportion of nucleus colonies to full sized colonies drops to about 22 per cent.

On average, beekeepers reported honey production is down across the province by 17 per cent from their operation's average. The beekeepers in the 1,000 plus colony group produced the most honey and the most honey per colony, followed by the middle sized group producing the second most honey and honey per colony, and the small scale beekeepers producing the least honey and honey per colony. While it is expected that honey produced increases relative to the total number of colonies in each comparison group, it is not necessarily expected that the production per colony would follow the same trend.

There are a few potential explanations for the increase in honey as the operation size increases:

1. The beekeepers with the most colonies made a much larger percentage of nucleus colonies than beekeepers in the middle group. These nucleus colonies may not make a lot honey; however, they often make some honey that would be counted in the total honey production of the operation. This in turn would increase the apparent production per full sized colony.

2. Many small scale producers with less than 100 colonies have less experience than their larger scale counter parts. In a season with the reported difficult weather conditions, experience in knowing how to deal with different conditions can make a large difference in the final crop.

3. Some of the smaller scale beekeepers indicated that they were making increase and splitting their colonies, these colonies would not be as large during the honey production period and the resultant honey crop would also be lower. This could also be true for the mid-sized beekeeping group who winter fewer nucleus colonies. To make up the overwinter losses, instead of using nucleus colonies from the previous season, this group may need to weaken their production colonies in order to make back their production numbers, thus reducing strength and ultimately honey production.

Weather was the most often cited factor affecting honey crops in 2019; however, weather and bee health are often cited as having effects on honey crop. These two factors can often affect each other too. Poor weather can result in increased disease issues like nosema, and chalkbrood or poor mating conditions for queens, all of which negatively affect colony performance. Canola availability was also reported as an issue, in part this was caused by poor bee foraging conditions during the canola bloom, however, some beekeepers also indicated that farmers were planting less canola.

One weakness faced by the survey was that no location information was collected. This data was omitted to preserve anonymity, however, its lack reduced the ability to determine similarities and differences between areas.

Conclusions

The 2019 honey production season was a tough one for many of Saskatchewan beekeepers. The average reported honey production was 80 kg per colony, which beekeepers reported was 83 per cent of their average crop. Many factors affected the reduced crop across the province including weather, bee health and canola availability. Saskatchewan's beekeepers appear to be continuing to plan for the future by ensuring there are many nucleus colonies available for the 2020 season.

Pollinator Plants and Planting in Saskatchewan

The Why, Where and How of Preserving, Maintaining and Creating Pollinator Habitats

Introduction

In recent years, there has been increased concern and interest in pollinators. The concerns originated from challenges to honey bees sparked interest in other bees, pollinators and their importance to the global ecosystem. Pollinators are important in agricultural systems as well as natural ecosystems. Habitat protection, enhancement and creation can be a benefit to pollinators and may have other benefits to producers and the environment.

What

This publication is designed to provide the Who, What, When, Where, Why and How to support pollinators. While the general guidelines are likely to have use in neighboring locations with similar climatic conditions, the species list suggested is designed for maximum applicability to the grassland, aspen parkland and boreal transition areas of Saskatchewan.

Who

The information is primarily aimed at farmers and land managers with the desire to protect pollinator habitat and place plant cover on cultivated, disturbed or managed land areas of one acre (~1/2 ha) or more. This could include field crops, ranchers, highways and infrastructure construction and rural municipalities. Other land managers such as acreage owners, developers and gardeners are also likely to find this document useful. Any management planning document or plant mix cannot be everything to all people, but the goal has been to be fill most applications for many people within Saskatchewan. If the recommendations or plant lists do not work for your specific scenario it should at least provide you some guidance or starting point to explore further. Orchard managers for instance, may have more need for long-term pollinator habitat than annual crop producers. They may opt to use more permanent pollinator habitat such as trees and shrubs, rather than annuals or short lived perennials.

Figure 1: Bumble bees are some of the best wild pollinators. They are robust and tolerant of poor weather, active throughout the whole growing season and throughout the day, and are generalist able to make use of and pollinate most cultivated flowering plants. Here a Northern Amber bumble bee (top) and a Hunt bumble bee (bottom) bee forage on sanfoin and cicer milk vetch, forage plants that are excellent for pollinators.

Why pollination benefits producers

The benefits of pollinators can be significant to some flowering crops. For fruits such as haskap (*Lonicera caerulea*) one hundred per cent of the fruit crop is dependent on insect pollination (Frier S.D. et. Al. 2016). In this scenario, it is absolutely essential to have pollinators present when the shrubs are flowering. For a more common field crop, such as canola, the benefits are less, but still significant. Generally, canola is wind pollinated, but estimates suggest a twenty per cent yield increase with adequate pollinators (Scott-Dupree C. et al. 1995). Other crops such as faba beans (*Vicia faba*) can have yields increased from twenty percent to eighty per cent by insect pollination (Free, J.B. 1970).

For producers whose yield gains don't come cheap, providing habitat for pollinators by converting some marginal farm land may be worthwhile. On crop rotations that include flowering plants, providing habitat in marginal or edge locations has been shown to increase yields and result in net positive income, despite the decrease in cropped area up to eight per cent (Pywell R.P. et. Al. 2016). For production of canola, research in north west Alberta has shown that increasing the area that is uncultivated up to thirty per cent provided a net benefit in yield and profit (Morandin L.A. and Winston M.L. 2005, Morandin L.A. and Winston M.L. 2006).

Figure 2: Pollinators benefit producers by increasing crop yields. On canola that is primarily wind pollinated, having ample pollination can increase yield on average twenty per cent.

Why pollinator habitat works

Land managers can support pollinators that benefit them by providing habitat. Research supports that adding floral resources attracts bees, increases wild bee abundance and diversity and increases pollination services in adjacent fields (Venturini, E.M. et al 2017). Landscape diversity, floral richness and nectar availability are linked to species richness and abundance of bumble bees, butterflies and other wild pollinators in agroecosystems (Potts S.G. et. al. 2009). Diverse fields of flowers also support significantly greater season-long bee abundance (Carson B.D. et al 2016). As little as three per cent of cropland in marginal areas set aside for wildlife and pollinators can significantly increase yields in adjacent pollinator dependent crops (Venturini, E.M. et al 2017). Higher densities of bumble bee colonies, great crop pollinators, can be found in landscapes with high amounts of semi-natural vegetation and pollinator managed field margins (Redhead J.W. et al. 2016). Since most wild bees forage less than 800m and many less than 200m (Zurbuchen A. et al. 2010), providing some pollinator habit in every quarter section is likely needed to allow most pollinators to reach adjacent crops.

Figure 3: Early season wildflowers such as prairie crocuses (Anenome patens) and willow (Salix sp.) are critical forage for early season bees such as this Haltictid and Bumble bee.

Why pollinator habitat benefits more than pollinators

Depending on the type, location and arrangement, pollinator habitat may serve many benefits beyond supporting pollinators. Natural insect enemies such as predators and parasitoids can benefit from pollinator habitat (Landis D.A., Wratten S.D. and Gurr G.M. 2000). These beneficial insects can provide some pest control and may decrease reliance on insecticide for neighboring crops. The benefits often ascribed to perennial crops and shelterbelts can come from pollinator habitat too. Some of these benefits include reduced wind and water erosion, increase water infiltration, snow capture, buffer against invading weeds, wildlife habitat, livestock forage, landscape beautification and aesthetic values.

Pollinator habitat can also be placed in awkward field corners like edges or around wetlands within seeded crops. Planting in this way could reduce seeding costs by decreasing double-seeded acreage (Gregg N et.al. 2007).

When

Deciding when to plant is an important consideration. Generally, planting for introduced forages should happen in the spring of the year. Soil temperatures and moisture are most likely to allow germination and seed establishment at this time. Depending on location within the province this is usually late April to the end of May, for cool season plants. Warm season plants generally require soil temperatures of 10 C before they will germinate. These conditions usually occur between mid-May and mid-June. Moisture conditions are best when soil can be formed into a ball when rolled in the hand.

Dormant seed planting can occur late in the fall when soil temperatures fall below 5 C. Many of our native species need to go through a freeze-thaw cycle to break seed dormancy (stratification) and planting in the fall will allow for this to happen naturally. Generally, this is after Oct. 20, and could extend to Nov. 15, in the warmer, southwest corner of the province.

Also important in when to plant, is how long do you want the location to remain in the planting? If the goal is pollinator cover for two to five years, a mixture of introduced forages may be the most cost effective and easiest to establish. For planting approaching ten years or longer, native grasses, forbs and shrubs may be worth the effort and expense to establish. There is also the opportunity to add a few native species in a limited amount based on availability to a predominantly introduced mixture. Generally, start smaller with a planting and build on your successes as your experience grows.

Figure 4: Late season seeding mimics the seeding and dormancy of many of our native species. Canada goldenrod flowers in late summer and fall and the seeds produced germinate the next spring.

Most pollinator plantings will have some benefit as soon as there are flowers available. For native pollinators, it's a case of "if you build it, they will come." (Carvell, C., et al. 2004.) Local individuals will find and make use of flowers and nesting sites and will increase with the resources made available to them.

Deciding where to put your efforts in establishing pollinator habitat is important. Depending on what crops or plants you intend to grow and for how long, will help determine where to place your effort. If your farm does not use many flowering plants increasing populations of pollinators may not benefit your farm yields greatly. However, if you grow a crop during your rotation that has flowers, it's likely that increased pollinators will increase yield some amount.

On a larger landscape scale, think of what locations and habitat already exist for pollinators near you. If you already have good habitat on one side of your farm or orchard, there may be less immediate benefit to planting there. Existing high quality habitat could be wetlands, a willow filled creek, pastures, native patches or other undisturbed sites. However, if the local landscape is fully cultivated and cropped from road to field boundary, adding habitat may be a great benefit.

Figure 5: Simple and complex pollinator habitat. One location may have ample flowers while canola blooms, but provides very few resources or nesting sites due to edge-to-edge cultivation and flowering weed control.

Thinking more specifically, it may be as simple as leaving an old yard site for a local beekeeper to place an apiary (beeyard). Old yard sites offer much to beekeepers and their bees as they generally have good wind protection, water close by and vehicle access. These sites are highly sought by beekeepers and wild bees make use of the locations too. Placing planting near to these sites can support the bees and helps maintain a ready supply of hard working pollinators.

Figure 6: An example of a good beeyard adjacent to a field. The bees and beekeeper are able to make use of the tree and shrub cover to provide protection and resources for their colonies.

Numerous other locations that may be difficult to plant, harvest or access should also be considered. Patches between power poles or along utility corridors, fence lines and field boundaries, between pivot irrigation, in organic land buffer strips, or awkward field corners or edges are good candidate locations. Marginal habitat that yields poorly for annual crop production may be better served as a pollinator habitat and may actually be more profitable in the long term (Pywell R.P. et. Al. 2016). Locations with low, wet or saline areas, as well as high, dry and coarse textured soils may be a good fit too. When seeding into marginal areas, it is important to select species that can tolerate the specific conditions such as salinity, flooding or low moisture. Using pollinator habitat as a barrier between weedy road ditches, flooded locations or those subject to erosion, as wind breaks or snow catches will allow the location to serve multiple agronomic or environmental purposes.

Figure 7 Image 1: A good example of a location along a road and utility corridor that could be used for pollinator planting.

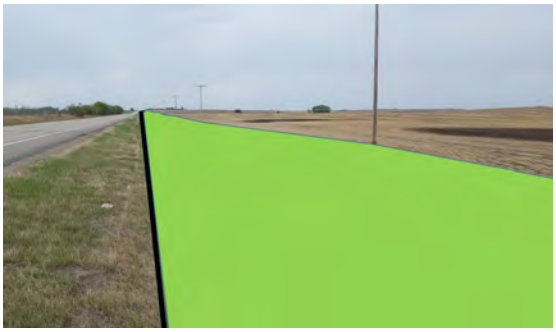

Figure 7 Image 2: A farmer is likely to decrease seeding overlap, reduce weedy encroachment from the road, and increase the population of pollinators for the adjacent farmland.

Figure 9: Harebells (Campanula rotundifolia) commonly occur in roadside ditches in native and semi-native landscapes. If they exist near you leave them and encourage flowering. They are well liked by pollinators, and despite appearing delicate, are hardy plants that bloom a long time.

Figure 10: Alfalfa is a common forage plant with seed readily available. If other seed is not readily available, alfalfa will be, reasonably priced and great for pollinators. Here a bumble bee uses it long tongue to access the nectar within an alfalfa flower.

How

The question of how to provide habitat for pollinators is perhaps the largest and potentially most complicated to answer. While the details are important, it's good to keep some simple guiding principles in mind. All pollinators need three things in order to survive: **A place to live, a place to eat, and a place to rear their young**. Approximately 70 per cent of our bee species are ground nesting, while the remainder nest in woody material or plant stems (Xerces 2019). Providing uncultivated land away from insecticide use gives living and nesting sites for ground nesting species. Providing woody material or plants with woody stems will provide for the remaining species.

Providing food for bees could be complicated also, but the second guiding principle of habitat protection is easy too: **more flowers, in more places, more often**. More flowers of different species, with different colours, shapes and sizes is better than fewer. Flower patches closer together or connected, in many locations, provides for small bodied bees that cannot fly far. As well it shortens the distance larger bees have to fly, and decreases the energy required to collect the resources they need (Carvell C. et al. 2004).

Providing flowers more often means more flowers throughout the season too. This provides continuous resources for pollinators that are active for long periods, such as bumble bees and honey bees. Mass flowering crops such as canola, while great when they last, may not provide adequate resources before and after bloom for bees with life spans longer than their bloom (Morandin L.A.and Winston M.L. 2005).

Once you've identified and preserved existing pollinator habitat the next step is to think of establishing additional habitat for pollinators. Establishing habitat will be similar to establishing perennial crops if similar species are used. This takes some preparations but perhaps the most important factor to good establishment of any crop is effective weed control and suppression before planting.

Generally speaking, introduced forage plants, native forbs and grasses are less competitive at establishment than annual or perennial weeds. For this reason, picking sites with low weed pressure is very important. If the intended site of planting has high weed pressure and the weed seed bank is expected to be large, considerable effort should be taken do decrease that seed bank. Seeking the assistance of an agronomist/agrologist with weed management knowledge is recommended if you have limited experience.

Generally, the pre-planning for weed management can include the use of summer fallow, chem-fallow, or herbicide use for management of weeds. It may be beneficial to grow an annual crop such as oats, barley or canola prior to planting. These crops are usually competitive and allow for cultural weed control as well as having numerous registered effective herbicides. This allows easy chemical weed management for a season, and planting into a cleaner seed bed the following year. Seeding should not start until perennial weeds, such as Canada thistle, are less than 10 per cent of the planned location. They cannot be sprayed out easily after your pollinator mix is planted.

If you are hoping for your site to persist for a long time, sculptured seeding may be beneficial. Sculptured seeding involves slightly modifying your seed mixture to cover a topographic, moisture or nutrient gradient across larger area.

By choosing plants suited to the specific microsites they are more likely to persist where they are planted. However, if you wish to forgo the effort of creating two or more different mixtures or do not mind reseeding more often, a different approach could be taken. You may build a mixture with a few species adapted to all conditions expected over the area, and seed at a generous rate. This should allow some proportion of the plants to be selected to each microsite.

Depending on the species, seed availability can vary widely. The introduced forages and grasses are commonly available and reasonably inexpensive to source from local locations. Native species may be more difficult and may necessitate getting seed from neighbouring locations. While some movement of seed is likely necessary, moving seed more than 500 km north, or 300 km south should be avoided. Problems with winter hardiness, vigor and disease resistance may result from larger moves. Movement east and west generally reflects changes to moisture or drought tolerance. Eastern ecotypes being more adapted to higher moisture, west more drought tolerant. In western Canada, seed from North Dakota, Montana, Wyoming and Idaho should be reasonably adapted to Saskatchewan. Sources further away may not persist. Sourcing seed that has some analysis for purity and viability is recommended and will aid in calculating final seeding rates and expected stand densities.

Putting it in the soil

Equipment for seeding small native seed species can be difficult to find in some areas of the province. Seed drills equipped for forage seed production will work well for pollinator species. Commonly recommended seeders are made by Truax, Tye, Nesbit, Brillion and John Deere Rangeland and John Deere power drills. It may be advisable to find a local producer who grows forage or grass species and contract them for seeding. A local forage specialist or forage grower may have expertise local to your area and provide contact information. If you are not able to get access to a seed drill it may be possible to seed some or all of your pollinator mix with an air seeder. The Prairie Agricultural Machinery Institute (PAMI) has developed seed tank agitators for air drills and publications #733 outlines the details of their operation for use with small or awned seed.

Seed bed prep

Most forages and native plant have smaller sized seeds which require a firm seed bed and good contact with the soil. The soil is firm enough when a footprint sinks between one quarter inch and one half inch (60 and 120 mm). Seeds generally need to be placed very shallow, between one quarter inch and one half inch depth. If no seeding depth is provided, seed should be placed no more than twice the diameter of the seed. Seeders with agitators are recommended, especially if the seed is awned. Using cracked wheat or phosphate fertilizer as a carrier may be useful in the case of many small seeds.

Hand seeding is not recommended over large areas as seed volumes will likely need to double to result in the same stand densities. However, it may be a good method over smaller areas and those with difficult access. When hand seeding it's recommended to split the volume of seed into two halves and seed in two passes of opposite directions (i.e. north to south, then east to west). Adding a carrier such as sand, cracked wheat or sawdust will allow for a visual of seed dispersal.

If watering is possible it will certainly help with germination, but this is not likely practical over larger areas. Spring planting into moist soil, or fall planting should give the seed the water they need to germinate. An early scout of the pollinator planting four to six weeks after germination should be made to determine adequate coverage and establishment. At least one good scouting trip during the growing and flowering season should be made to determine germination and establishment.

If perennial weeds outgrow and go to seed before your plot establishes, you may mow the weeds to prevent them from going to seed. Generally, this mowing can happen when weeds have grown larger than 12 inches without negative effects on the plants below (Wark D.B. et. Al. 2006). Fertilizer is not recommended for native species as they don't generally benefit, while competing weeds will make use of the fertilizer.

Maintenance of your pollinator planting will depend on other uses you may have for the location. If grazing is expected for the location, use about half the grazing pressure in the year after establishment, and monitor it carefully in successive years. If burning or mowing are planned as part of your stand maintenance, consider limiting it to one third of the area every year. Spot spraying for encroaching weeds is also recommended to limit their establishment with the pollinator plot.

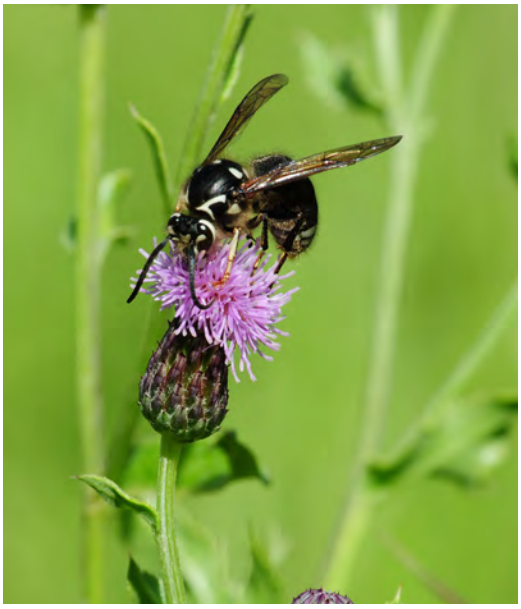

Figure 11: The nectar and pollen of Canada thistle can be attractive to pollinators, here a bald-faced hornet, but planting pollinator mix where it is well established without control is setting up for trouble. The perennial weed can re-establish from rhizomes and a heavy seed bank if not properly managed for.

Figure 12: Pick pollinator plants that are adapted to your Ecoregion. Soil zones, climate and moisture are closely associated with plant communities and will aid planting success.

Actual mix

Creating an actual seed mixture is equal parts art, science and mathematics. Because of variation in climate, location, soil conditions and expected disturbance, no one mixture will be right for every producer in Saskatchewan. The list below should include enough information on potential species so that usable mixture can be created to suit your needs.

For the purposes of pollinator planting, there are a few guiding principles and ideas that should be kept in mind. Generally, the mixture should have a three to nine pounds per acre of wildflower seeds, with four to eight pounds per acre of grass seed as a base. Generally, this will result in a stand with seventy to ninety per cent grass and thirty to ten per cent wildflowers (Nowakowski, M. and Pywell, R.F. 2016). Plantings with more grass will be easier to establish and less expensive to establish but will result in fewer flowers and less diversity. In the drier southwest corner of the province stand densities are likely to be lower than those in the cooler and moister areas of the northeast. As well if erosion or disturbance are expected to be a problem, higher planting densities may help establish and maintain the stand.

Figure 13: Differences in seed size mean that two different species of the same weight may have widely different seed counts. As well awned seeds may require special handling to allow seeds to flow.

When starting, select a handful of locally adapted grass species either from the list, or others known to local producers to work well in your area and are not too aggressive. Then, select at least one flowering plant per month of growing season, with three per month being a good goal. Some months, such as April and September, it may be difficult to find more than a few that will be suitable and available. Do the best you can and consider planting early flowering shrubs or encouraging natural willows if you have a place to do so. If you must limit your species place more emphasis on early and late flowering as these time periods are often limited in forage and important for many pollinators such as honeybee and bumblebees.

When selecting species and building seeding weight be aware of the differences in seed size, pure live seed (PLS) and differences in mixtures due to percentage of stand versus percentage by weight. Many species have widely different seed shapes and weights such that a pound of one seed may have as much as one hundred times or more the individual seeds. It is strongly recommended that an experiences agrologist, forage specialist or individuals with seed mixture experience be consulted when calculating final planting rates and mixtures. Forage seed growers, Ducks Unlimited Canada, and individuals involved with revegetation or reclamation could also be good resources. Mixture resources are also listed at the end of this document.

Online resources exist to more fully explain the seed mix calculations and provide examples. The Native Plant Society of Saskatchewan is an excellent resource and contains many documents that are likely to be useful. The Peace River Forage Association also has a good online worksheet that will aid in building a seeding mixture. Both resources are referenced following this article.

Depending on the composition of your final mixture, you may be eligible for some funding to cover part of the cost of the establishment. The Permanent Native Forage Beneficial Management Practice (BMP) and Permanent Tame Forage BMP under Canadian Agriculture Partnership (CAP) for Saskatchewan are available and worth exploring for those planning to plant for pollinators.

How the list was compiled

There are numerous plant list and mixes available with varying specificity and usefulness to Saskatchewan. The Pollinator Plant List, included with this publication, was compiled primarily from published scientific research and guidance documents on plant attractiveness, insect visitation and plant flowering dates. Provincial, state and national government agriculture organizations and conservation groups with collected information on plant characteristics were consulted. In most cases, the plants on this list are referenced by multiple reputable sources as being quality pollinator plants. This list is intentionally biased toward plants native to Saskatchewan and introduced species with a history of planting success in the province. This helps to ensure some success in planting. Many native flowering plants were excluded based on being unlikely or difficult to source, or preferring wooded or aquatic habitat. As well, other introduced species not included may be great pollinator plants but there is limited experience with them in Saskatchewan. Some mindfulness to keeping the list to a manageable length was also considered. Numerous species that are highly attractive to pollinators, such as thistles and dandelions (*Taraxacum officinale*), have been excluded based on their weediness and ability to spread into cropland. Some of the included species may be considered weedy in some situations (i.e. sweet clover, *Melilotus* spp.). Caution should be exercised when using introduced species off the list as hardiness and invasiveness may be poorly known for Saskatchewan.

A final note

If you have successes or failures in planting or with the process, or other ways to improve this document, please contact graham.parsons@gov.sk.ca or call 1-306-953-2773.

Useful resources and links

xerces.org
A wealth of information on invertebrates, pollinators, conservation and pollinator resources.

saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/canadian-agricultural-partnership-cap/environmental-sustainability-and-climate-change/farm-stewardship-program-fsp#pre-approval
Permanent Native and Permanent Tame Forage BMP funding programs available through Saskatchewan Agriculture.

beebettercertified.org/farmers
Explore marketing options potential brought on by bee friendly certification.

peaceforagetool.ca/seed-mix-calculator
A seed mix calculator and other resources available from the Peace River Forage Association.

npss.sk.ca
Native Plant Society of Saskatchewan. Link to seed suppliers and sources, reference material on planting, and other useful resources.

plants.usda.gov/java/characteristics
Native and introduced species characteristics, growing conditions and planting considerations

pollinator.org
Pollinator Partnership. Planting guides, pollination resources and educational material.

saskforage.ca/images/pdfs/Publications/Native%20Seeding%20Guide.pdf
Access to reference material and methods of seed planting and habitat planning.

Seed and Plant Sourcing links

npss.sk.ca/info-resources
Native Plant Society of Saskatchewan. Seed suppliers and sources, reference material on planting, and other useful resources.

growwildflowers.ca
Blazing Star Wildflower Seed Company, native seed sourcing from Saskatchewan, Alberta and Manitoba

prairieoriginals.com
Prairie Originals –Winnipeg

northstarseed.ca
Introduced and native seed supplier

skinnernativeseeds.ca
Skinner Native Seeds, Roblin MB

wildaboutflowers.ca/index.php
Wild About Flowers, native seed, plugs and plants. Okotoks, Alta.

brettyoung.ca
Brett Young, large supplier of tame and some native forage seed species.

dlfpickseed.ca
westcoastseeds.com

www.alclanativeplants.com/
A source for feed and plant plugs located near Calgary, Alberta

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Pollinator Plant List

Introduced, Native	Forb, Grass, Shrub	Lifespan	Species Name	Common Name	Flowering Month	Moisture	Seeds per pound	Soil texture	Ecoregion*	Salinity Level	Seed/Plant Availability
Introduced	Forb	Perennial	*Asclepias tuberosa*	Butterfly milkweed	May-Sept.	Dry to moist	70,000	Coarse to medium	MG,MMG, AP	Medium	High
Introduced	Forb	Perennial	*Astragalus cicer*	Cicer milkvetch	Jun-Sept.	Medium to moist	122,560	Medium to fine	ALL	Low	High
Introduced	Forb	Annual	*Borago officinalis*	Bee Borage	Jun-Sept.	Dry to moist	19,200	Medium	AP, BT	High	High
Introduced	Forb	Annual	*Fagopyrum esculentum*	Buckwheat	July - Sept.	Medium	20,000	Loam and fine	MMG, AP, BT	Medium	High
Introduced	Forb	Annual	*Helianthus annuus*	Annual sunflower	June - Aug.	Medium to dry	46,919	Coarse to fine	MG, MMG, AP	Medium	High
Introduced	Forb	Perennial	*Lotus corniculatus*	Birdsfoot trefoil	June - Aug.	Moist	369,840	Coarse to fine	MMG, AP, BT	High	High
Introduced	Forb	Perennial	*Medicago sativa*	Alfalfa	Jun-Sept	Medium to dry	226,800	Coarse to medium	ALL	Medium	High
Introduced	Forb	Biennial	*Melilotus spp*	Sweet clover (yellow and/or white)	Jun-Sept	Medium to dry	258,560	Coarse to medium	ALL	Medium	High
Introduced	Forb	Perennial	*Onobrychis viciifolia*	Sainfoin	June - Aug.	Medium to dry	23,800	Coarse to medium	ALL	Low to medium	High
Introduced	Forb	Annual	*Phacelia tanacetifolia*	Phacelia	June - Aug.	Medium to dry	244,944	All types	ALL	Medium	High
Introduced	Forb	Perennial	*Trifolium hybridum*	Alsike (white) clover	Jun-Sept.	Moist to medium	680,400	All types	MMG, AP, BT	Low	High
Introduced	Forb	Perennial	*Trifolium pratense*	Red clover	Jun-Sept.	Moist to medium	272,160	All types	MMG, AP, BT	Low	High
Introduced	Forb	Perennial	*Trifolium repens*	White clover	Jun-Sept.	Moist to medium	711,867	Medium to fine	MMG, AP, BT	Low	High
Introduced	Forb	Perennial	*Vicia villosa*	Hairy vetch	June - Aug.	Moist to medium	16,320	All types	MMG, AP, BT	Low	High
Introduced	Grass	Perennial	*Phleum pratense*	Common timothy	n/a	Moist to medium	1,163,200	All types	ALL	Low	High
Native	Forb	Perennial	*Achillea millefolium*	Common yarrow	May - Sept.	Dry to moist	2.5 - 2.8 million	Clay, sand	ALL	Medium	High
Native	Forb	Perennial	*Agastache foeniculum*	Blue Giant hyssop	July, Aug	Dry, well drained		Sandy			Low
Native	Forb	Perennial	*Anaphalis margaritacea*	Pearly everlasting	Jun-Sep	Moist to dry	8,200,000	Coarse to sandy	MG, MMG, AP		Medium
Native	Forb	Perennial	*Anemone canadensis*	Canada anemone	May - July	Moist		All types	ALL		Medium
Native	Forb	Perennial	*Anemone mutlifida*	Cut leaved anemone	Jun-Jul	Moist	363,000	Dry	MG		Medium
Native	Forb	Perennial	*Anemone patens (Pulsatilla patens)*	Prairie crocus, pasqueflower	Apr, May	Moist to dry		All types	ALL		Medium
Native	Forb	Perennial	*Anemone virginiana*	Tall anemone, tall thimbleweed	May-Aug	Dry to moist	dry to moist	Medium	MMG, AP, BT		
Native	Forb	Perennial	*Artemisia frigida*	Pasture sage, prairie sagewort, fringed sagewort	Aug	Medium to dry	4,536,000	Coarse, medium, fine	MG, MMG, AP		Medium
Native	Forb	Perennial	*Asclepias ovalifolia/speciosa/syriaca*	Milkweed, low/showy/common	June - Aug.	Moist to dry	271,600 low, 72,000 showy	All types	MMG, AP, BT		Medium
Native	Forb	Perennial	*Astragalus agrestis*	Purple milk vetch	June, July	Medium	120,000	Medium	ALL		
Native	Forb	Perennial	*Astragalus canadensis*	Canadian milkvetch	June, July	Moist to medium	275,000	Medium	MG, MMG	Medium	High
Native	Forb	Perennial	*Campanula rotundifolia*	Harebell, Bluebell	June - Aug.	Medium to moist	700,000 - 1.2 million	Medium to coarse	ALL	Low	Medium
Native	Forb	Perennial	*Chamerion angustifolium*	Common fireweed	June, July	Moist to dry	6,500,000	All types	AP, BT,	Low	Medium
Native	Forb	Perennial	*Chrysopsis (Heterotheca) villosa*	Hairy golden aster, harry false goldenaster	June, July	Medium	336,500	Medium	MMG, AP, BT		Low
Native	Forb	Perennial	*Dalea candida*	White prairie clover	July, Aug.	Dry	278,000	Sandy, gravelly, silty	MG, MMG,		High
Native	Forb	Perennial	*Dalea purpurea*	Purple Prairie Clover	July - Sept.	Dry, well drained	300,000	Medium to coarse	MG, MMG, AP	Low	Medium
Native	Forb	Perennial	*Echinacea angustifolia*	Narrow leaved purple coneflower	Jun-July	Well drained	128,000		MG, MMG		Medium
Native	Forb	Perennial	*Erigeron glabellus*	Smooth fleabane	July, Aug.	Medium to moist		Medium	AP, BT,		Medium
Native	Forb	Perennial	*Fragaria virginiana*	Wild strawberry	May , June	Medium to moist					Medium
Native	Forb	Perennial	*Gaillardia aristata*	Great blanket flower, brown-eyed Susan	June - Aug.	Dry	156,600 - 200,000	Coarse to med	MG, MMG, AP		Medium
Native	Forb	Perennial	*Galium boreale*	Northern bedstraw	June - Aug.	Medium to moist		Medium	MMG, AP, BT		Medium
Native	Forb	Perennial	*Glycyrrhiza lepidota*	Wild licorice	June - Aug.	Moist to medium	52,688	Medium and fine	MG,MMG, AP	Medium	Low
Native	Forb	Perennial	*Grindelia squarrosa*	Curly-top gumweed	July - Sept.	Dry		Coarse to medium	MG, MMG, AP	Medium	Medium
Native	Forb	Perennial	*Guem triflorum*	Three-flowered avens	April - June	Medium to dry	635,000 - 910,000	Medium, loam	MG, MMG, AP	Low to medium	Medium
Native	Forb	Perennial	*Hedysarum alpinum*	American hedysarum	May - Sept.	Medium to moist	104,000	Medium to coarse	MMG, AP, BT		Medium
Native	Forb	Perennial	*Hedysarum boreale*	Northern hedysarum	July	Medium		Medium to coarse	MMG, AP, BT		Low
Native	Forb	Perennial	*Helianthus maximilia*	Maximilian sunflower	July, Aug.	Dry to medium	196,360		MG, MMG		Low
Native	Forb	Perennial	*Helianthus pauciflorus*	Rhombic-leaved sunflower	Aug., Sept.	Moist		Medium to coarse	MG, MMG		Medium

Introduced, Native	Forb, Grass, Shrub	Lifespan	Species Name	Common Name	Flowering Month	Moisture	Seeds per pound	Soil texture	Ecoregion*	Salinity Level	Seed/Plant Availability
Native	Forb	Perennial	*Heterotheca villosa*	Hairy golden aster	July	Dry					Low
Native	Forb	Perennial	*Lathyrus spp*	Vetchling	June, July	Medium to moist		All types	MG, AP, BT		
Native	Forb	Perennial	*Lathyrus venosus*	Purple peavine	June, July	Medium to moist		Medium to fine	AP, BT		
Native	Forb	Perennial	*Liatris ligulistylis and punctata*	Blazingstar, meadow and dotted	July - Aug.	Medium to dry	90,700 - 185,000	Medium to coarse	MG, MMG, AP		Low to medium
Native	Forb	Perennial	*Linum lewisii*	Blue flax	June, July	Medium to moist	283,000	Medium to coarse	MG, MMG, AP	Low	High
Native	Forb	Perennial	*Mentha arvensis*	Wild mint	July	Medium to moist		Medium to fine	MMG, AP, BT		
Native	Forb	Perennial	*Monarda fistulosa*	Wild Bergamont/Horse Mint	July, Aug.	Medium		Coarse to medium	AP, MMG, MG		Medium
Native	Forb	Perennial	*Oxytropis splendens*	Showy locoweed	Jun - Aug.	Medium to dry	350,000	Medium to coarse			Medium
Native	Forb	Perennial	*Penstomen nitidus*	Smooth blue beardtongue	May, June	Dry		Medium to coarse	MG,MMG, AP, BT		Medium
Native	Forb	Perennial	*Potentilla arguta*	Tall/graceful cinquefoil	June, July	Medium to dry	4,403,800	Medium	MMG, AP, BT	Low	Medium
Native	Forb	Perennial	*Prunella vulgaris*	Common selfheal	July, Aug.	Medium to moist	668,000	fine to coarse, clay to sand			
Native	Forb	Perennial	*Ratibida columnifera*	Yellow coneflower	June - Aug.	Medium to dry	1,360,000	Fine to coarse	MG, MMG, AP		Medium
Native	Forb	Biennial	*Rudbeckia hirta*	Black eyed susan	July	Medium	1,575,760	Medium to fine	MMG, AP, BT		Medium
Native	Forb	Perennial	*Solidago spp.*	Goldenrod, Canada/Showy/Missouri/stiff	July - Sept.	Medium to moist	4,600,000 Canada 1,000,000 showy	All types	ALL		Medium
Native	Forb	Perennial	*Sphaeralacea coccinea*	Scarlet Mallow	May	Dry		Coarse to medium	MG, MMG	High	
Native	Forb	Perennial	*Symphyotrichum spp.*	Aster, many flowered/smooth/fringed/showy/purple-stemmed	Aug. - Sept.	Moist to medium		Medium to fine	MMG, AP, BT		
Native	Forb	Perennial	*Thermopsis rhombifolia*	Golden bean	May	Medium to dry	31,500	Fine to coarse	ALL	Low	Medium
Native	Forb	Perennial	*Urtica dioica*	Stinging nettle	June	Moist to medium		Medium to fine	ALL	Low	
Native	Forb	Perennial	*Vicia americana*	American vetch	May - Aug.	Medium to dry	32,833	Coarse to medium	ALL	Medium	High
Native	Forb	Perennial	*Viola canadensis*	Western Canada violet	May, June	Moist to medium		Coarse to medium	AP, BT		Medium
Native	Forb	Annual	*Zizia aptera*	Heart-leaved Alexander	June	Dry to moist		Medium	MMG, AP, BT		Low
Native	Grass	Perennial	*Andropogon gerardii*	Big Bluestem	n/a	Moist	165,000	Loam to clay	MMG	Low	Medium
Native	Grass	Perennial	*Bouteloua gracilis*	Blue grama grass	n/a	Dry to moist	827,300	Medium to coarse	MG, MMG	Medium	Medium
Native	Grass	Perennial	*Deschampsia cespitosa*	Tufted hair-grass	n/a	Moist to medium	1,636,400	Fine to medium, loam to clay	ALL	High	Medium
Native	Grass	Perennial	*Elymus lanceolatus*	Northern wheat grass	n/a	Moist to medium	154,400	Medium to coarse	ALL	Medium	Medium
Native	Grass	Perennial	*Elymus trachycaulus*	Slender wheatgrass	n/a	Moist to medium	140,000	Sandy loams	ALL	High	Medium
Native	Grass	Perennial	*Hesperostipa comata*	Needle-and-thread grass	n/a	Dry	137,857	Medium to coarse	MG, MMG, AP	Medium	Low
Native	Grass	Perennial	*Koeleria macrantha*	June grass	n/a	Med	1,567,300	Coarse to fine, sand to clay	ALL	Low	Medium
Native	Grass	Perennial	*Pascopyrum smithii*	Western wheat-grass	n/a	Med to dry	110,115	Med to fine	ALL	Med	High
Native	Grass	Perennial	*Poa palustris*	Fowl bluegrass	n/a	Medium	1,900,000	Med to fine	ALL	Low	High
Native	Grass	Perennial	*Puccinellia nuttalliana*	Nutall's alkali-grass	n/a	Medium	2,108,000	All types	ALL	High	High
Native	Shrub	Perennial	*Amelanchier alnifolia*	Saskatoon, serviceberry	May, June	Dry-moist		Medium to coarse	ALL		High
Native	Shrub	Perennial	*Cornus stolonifera*	Red-osier dogwood	May, June	Moist to wet		Medium to coarse	MG, AP, BT	Low	High
Native	Shrub	Perennial	*Crataegus spp.*	Hawthorns	May, June	Dry to moist		Coarse to fine	MG, MMG, AP	Med	High
Native	Shrub	Perennial	*Elaeagnus commutata*	Wolf willow/Silverberry	June	All types		All types	ALL	Low	Low
Native	Shrub	Perennial	*Potentilla fruticosa*	Shrubby cinquefoil	June - Sept.	Medium to dry		Medium to coarse	MG, MMG, AP	Low	High
Native	Shrub	Perennial	*Prunus pensylvanica*	Pin cherry	May	Medium to dry		Medium to coarse	AP, BT		High
Native	Shrub	Perennial	*Prunus virginiana*	Choke cherry	May	Medium to dry		All types	ALL	Low	High
Native	Shrub	Perennial	*Ribes spp.*	Currant and Gooseberry	May, June	Moist to dry		All types	ALL		High
Native	Shrub	Perennial	*Rosa acicularis and/or woodsii*	Rose, prickly or woods	June	Medium to dry		Medium	ALL		High
Native	Shrub	Perennial	*Rubus idaeus*	Wild red raspberry	June, July	Medium		All types	MMG, AP, BT	Low	High
Native	Shrub	Perennial	*Salix spp.*	Willow	April, May	Wet to medium		All types	ALL	Low	High
Native	Shrub	Perennial	*Shepherdia argentea*	Silver buffaloberry	April, May	Medium to dry		Medium to coarse	MG, MMG, AP	Low to medium	Medium
Native	Shrub	Perennial	*Symphoricarpos occidentalis*	Western snowberry	June, July	Dry to medium		Coarse to fine	ALL		High
Native	Shrub	Perennial	*Viburnum spp (edule, trilobum)*	Cranberry, High bush, low bush	May, June	Moist to wet		Medium to fine	AP, BT	Low	Medium

* Ecoregion, Boreal Transition (BT), Aspen Parkland (AP), Moist Mixed Grassland (MMG), Mixed Grassland (MG)