Organic Research and Extension

SASKATCHEWAN
BEST ORGANIC MANAGEMENT PRACTICES: FARMERS' PERSPECTIVES

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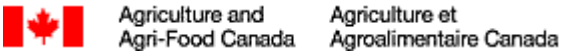

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Table of Contents

INTRODUCTION

Best Organic Management Practices (BOMPs) were developed from interviews with over 30 long time organic producers who shared their expertise with us. The producers chosen for this project were identified by their certification associations as excellent organic producers that have been organic for 10 to 20, and in some cases longer than 30 years. Other producers were recognized as outstanding based on their history within the organic sector and long term dedication to organic farming practices. At least ten producers were interviewed in the following soil zones: the brown, dark brown and black soil zones.

Each producer was asked a series of questions about their production techniques as well as what advice they would give to new and transitioning producers. Long term producers have developed an organic management system that works for them, often based on trial and error. Their knowledge of organic production is often supported by scientific research. Here we have combined best farm practices with the recommendations of current and historic scientific literature to develop these best organic management practices.

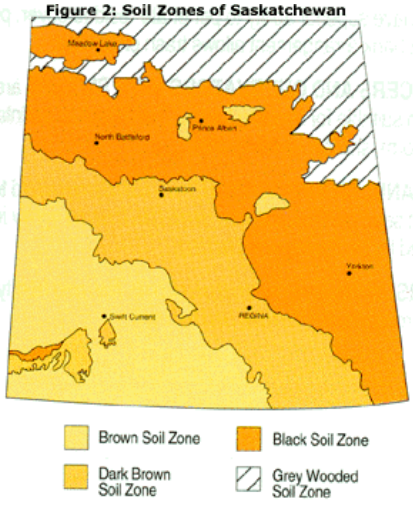
Land Use Groups and Soil Zones

The PFRA recently published a land resource review titled *Prairie Agricultural Landscapes*. The review separated the prairies into five major groups with 15 subgroups described as Land Practice Groups (LPGs). The LPGs were created based on the unique nature of farming practices in the area, linked to climate, soils, landscape and economics. When the BOMP project was first initiated the producers were grouped by the LPG that corresponded to their land location. We believed that separate Organic Management Practices could be developed for the LPGs.

Organic production methods within each LPG were examined to identify differences and similarities. We found that organic producers did not separate in the way that conventional producers had, rather, cropping systems were largely distinguished by crop rotation and soil building techniques involving green manures. These practices were closely linked with soil zone. So, for this analysis we grouped producers according to the brown, dark brown and black/gray soil zones.

For the most part soil zones integrate weather patterns and climatic conditions with soil organic matter contents in Saskatchewan. The black soils have slightly shorter growing seasons and higher moisture levels than the brown soil zone. The dark brown soils usually have growing season and moisture levels somewhere between the brown and black. Climatic variations result in crop selection differences for each soil zone. Soil texture plays a bigger role in production methods. Soil texture influences when a producer can till, the types of tillage methods used and often the frequency of green manure crops. Producers develop production methods suited to the climate and soil texture of their farms.

Figure 2: Soil Zones of Saskatchewan



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HEALTHY SOIL

Organic producers and scientists both generally agree that soil health is the key to success in an organic farming system.

Many producers assess soil health qualitatively. They look for a dark rich colour with good organic matter throughout, and an earthy smell. The earthy smell indicates that soil microorganisms are active, which is vital to soil health.

Some producers take note of the wildlife that is attracted to the field while it is being worked. Birds can be a good indication of earthworms and other beneficial organisms. According to Kirby McCuaig, long time organic producer from Eastend, a healthy ecosystem has "frogs in the water and hawks in the air". These are strong indicators, as frogs are particularly sensitive to water pollution, and the health of hawks as top predators, indicate that lower levels in the food chain are functioning.

As the crop grows, producers note the colour of the leaves and the health along the root system. Pale green to yellowing leaves, for instance, may indicate low nitrogen levels. Very dark green in leaves and slow growth may be an indication of overall low nutrient levels. Red and purple tones often indicate a plant under stress and of course dead spots on the leaves also indicate stress.

Symptoms of disease and low levels of nutrients can be similar. If the symptoms occur over a wide area in the field, soil or tissue testing may be beneficial.

The weeds growing in the field can also provide an indication of which nutrients are available in the soil. Weeds require the same nutrients as crop plants, but may need them in slightly different amounts. The weed may show nutrient deficiency symptoms earlier than the crop, or may be able to compete well with the crop when the weed requires less of a limited nutrient.

Specific examples of weeds as indicators include foxtail barley doing well in saline areas and legumes such as vetches and medics doing well in low nitrogen soils. Pigweeds and lamb's-quarters often indicate fertile soils.

Soil Fertility

Soil fertility includes aspects of chemistry, physics and biology. Fertile soils have sufficient chemical nutrients for plant growth. The macronutrients (called that because they are needed in larger amounts) nitrogen, phosphorus, potassium, calcium, and sulphur, and several micronutrients are essential to soil fertility.

Nitrogen is most commonly limiting to plants, though it is abundant in the air. Rhizobium associated with legumes can fix nitrogen from the air into a form that the legumes can use. A few free living microbes can also fix nitrogen.

Phosphorus, potassium, and calcium are minerals that move into the soil from the underlying rock.
Fortunately, each of these elements is abundant in most Saskatchewan soils. Sulphur is also primarily a rock based mineral, though volcanoes and air pollution can supply sufficient airborne sulphur in some areas. In grey wooded soils, sulphur may be limiting.

When products are removed from the farm ecosystem – when grain or hay or meat is sold, nutrients are removed from the soil. Nitrogen is removed in largest quantity, but fortunately, it can be replaced from the air. Although our soils are generally rich in the other essential macronutrients, some may eventually need to be replaced.

Fertile soils have good soil structure, and are easily tilled. They allow good penetration and absorption of moisture.

Biological fertility is also important. Microbes cycle chemical nutrients, making them available through the breakdown of plant residues and animal wastes. They form symbiotic relationships with plants that increase the amount of soil that plants are able to search for nutrients. They provide a biological diversity that reduces the impact of disease organisms. They also exude chemical compounds that glue small soil particles together, reducing the potential for soil erosion.

Soil Tests

Soil testing may be needed to get a perspective on the soil nutrients and fertility levels. Soil analysis is extremely useful during transition because it provides a base line on soil nutrient, organic matter, and pH levels. A number of labs in Canada and the United States provide analysis of soil and plant tissue. Most soil test results include major nutrient levels. They might include micronutrients, often at an additional cost.

Martin Meinert collects soil samples near Eastend, SK. Photo by Brenda Frick

Laboratories that focus on mineral analysis typically provide fertilizer recommendations for conventional producers. A few are beginning to consider recommendations that are not based on chemical fertilizer inputs. Organic producers can benefit from soil testing. Monitoring long term changes in soil fertility allows producers to adjust soil management strategies, such as green manuring, crop selection, and overall crop rotations.

The experienced producers we talked with used one or more of the following soil testing services:

1. **ALS Laboratory Group** tests soil samples to assess the levels of a number of minerals, including "macronutrients" like nitrogen, phosphorus, potassium, sulphur, calcium, and micronutrients like copper, iron and zinc. These tests measure the pool of nutrients that can be extracted using standard chemical solutions. These tests generally also include the pH, organic matter, and cation exchange capacity. For more information see http://www.chemex.ca/Environmental/DivisionProfile.aspx

2. **Western Ag Innovations Inc.** assesses fertility using a Plant Root Simulator probe. The PRS probes are placed in the soil for a set period of time, and the flux of nutrients across a membrane gives a measure of the nutrients available to the plant. PRS probes give a good estimate of the soil's potential for releasing nutrients to the plants. For more information, see http://www.westernag.ca/innov/index.php

3. **Kinsey's Agricultural Services** is a U.S.-based laboratory which uses the Albrecht system to analyze soil samples. They test for base saturation, cation exchange capacity, organic matter, and nutrient levels. The

Albrecht and Kinsey recommendations are based on crop history, fertilizer preferences, and type of operation, i.e. conventional or organic. For more information, see http://www.kinseyag.com/

4. **Soil Foodweb Canada, Inc.** measures the biodiversity of soil and provides information on the type and quantity of bacteria, fungi, nematodes and other soil organisms. It suggests optimal levels for different crop types, and offers suggestions on how to increase the activity of different soil fractions. For more information, see http://soilfoodweb.com/

5. **No tests.** Some experienced producers do not purchase regular soil tests. They gauge soil health on the yields they receive, and other measures mentioned above, such as crop health, weeds, birds, soil colour, smell and so on.

It is important for all soil tests that soil samples be collected, stored, and shipped according to the instructions provided by the laboratory. It is especially important when soil biology is considered, as soil organisms can die, or multiply rapidly between collection and analysis, and this may invalidate the results.

Several expert producers suggested that transitioning farmers spend the extra money on soil testing, especially in the third year of transition and then the first two years of organic status. This can provide the producer with a much better understanding of the nutrient status in their fields. Based on these soil samples the new organic farmer can then decide if soil amendments are required or if good rotations and lots of green manure will work just as well.

Rotations are Key

Producers often consider their rotation as the most important way that they nurture the health of their soils. A rotation is simply a planned sequence of crops. Crops differ in their timing, in their competitive ability, in their requirements of water, nutrients and heat, and in their susceptibility to diseases and pests. By rotating crops with differing characteristics, resources can be used more effectively, and sustainably.

An amazing wealth of scientific literature suggests that crop rotations are much more beneficial than monocultures, resulting in higher and more stable yields and environmental benefits. The more variable the rotation, the more benefits the rotation generally has.

The sequence of crops must be carefully selected to be well-adapted to the fertility level of the soil while avoiding potential disease and pest pressures that have built up in the previous crop or crops.

The timing of the crop, whether it is an annual, a winter crop or a perennial, changes the way the crop is managed and the way it functions in the soil. The timing of tillage, crop's susceptibility to disease, and the crop's use of nutrients and water impact the soil. The amount and quality of crop and weed residues on the surface and within the rooting zone establish the basis for future biological activity.

Experienced producers recommend that rotations be planned around the health of the soil. Crops that remove large amounts of nitrogen, for instance, should be balanced with crops that supply nitrogen. Crops that require tillage should be balanced with crops that build soil organic matter.

Crop rotation is also an excellent tool for weed management. When different crops are grown, different weed management practices are used. Changing the management system avoids selecting for weeds that are adapted to that management practice.

For example, if a producer consistently uses the same types of crops, for

instance, consistently tilling in late April, seeding annual crops in mid May, harrowing in early June and combining in late August, she or he creates windows of opportunity for weeds. In this case, consistency allows weeds that emerge in mid June, compete strongly and drop seeds by mid August to thrive and increase.

Each type of management practice is a disturbance that favours one weed species over another. If the disturbance pattern is varied, for instance if annual crops are rotated with winter crops and perennials, then different species are disadvantaged at different times, and none is given free reign. This results in a more diverse weed community, but one in which problems are not constantly building to epidemic proportions.

Diversity in the weed community can be beneficial in that it increases the variety of food and shelter available to beneficial organisms. For instance, parasitic wasps that prey on pest insects often need nectar sources from very small flowers, like those of stinkweed or pigweed. Weeds break the monoculture of crops, and thus discourage egg laying of crop specific insects. They can act as an understory to help shade the ground, and encourage the activity of soil organisms.

Rotations are also crucial to insect and disease management. Many insects and diseases are specific to a single crop or crop type. By taking years away from a specific crop type, insects and diseases are not able to increase to dramatic levels. For instance, ergot in cereal grains can be reduced by years out of cereals. Ascochyta in lentils can be reduced by years away from lentils. Similarly wheat midge or wheat stem sawfly can be reduced by years away from wheat.

The use of rotations is a way to bring diversity to a field, over time. Diversity over space is also valuable. Smaller fields, different crops in different fields, shelterbelts, natural areas, grassed waterways, and border strips all add to the diversity that fosters beneficial organisms and a healthy ecosystem.

Experienced producers recommend using a flexible rotation to respond to changes in the weather, markets, disease pressures, and to contamination from GMOs. Most producers indicated that their rotation changed significantly when they made the transition to organic. They consider a rotation to be a work in progress that will change as the soil changes and as the producers learn more about their soil. They suggested that organic producers take notes throughout the growing season, take soil samples every couple of years and spend time in the winter months learning how their farming techniques can be improved.

Rotations for Brown Soils

The brown soil zone of Saskatchewan has the longest growing season and tends to be much drier than the other soil zones. The producers we interviewed had soils that tended to be lighter in texture ranging from sandy loam to clay loam. Concerns about depleting moisture and encouraging erosion played a dominant role in determining rotation. Some producers reported crop rotations of five years before putting in a green manure was necessary, but a legume was grown in about year three. Depending on the soil conditions and precipitation, longer rotations may be possible.

Yellow clover is commonly used as a plow down in this soil zone, but great care must be taken since yellow clover uses a large amount of soil moisture to grow. It also must be worked into the soil with the proper equipment.

The following provides three possible rotations for brown soils:
1 - Green manure, cereal, pulse.
2 - Green manure, cereal, flax, pulse.
3 - Green manure, cereal, green manure, flax.

ROTATIONS FOR DARK BROWN SOILS

The producers interviewed in this soil region had sandy loam to clay loam soils, but unlike in the black soil, producers did not vary rotation according to soil texture. Based on the interviews, three basic rotations appeared to be most common to this soil type and climate.

4 year rotations:
- Cereal, pulse, oilseed, green manure.
- Cereal, pulse, cereal under-seeded to clover.

5 year rotation:
- Oilseed, cereal, pulse cereal under seeded to clover.

ROTATIONS FOR BLACK SOILS

A farmer's rotation is largely based on soil type and climatic conditions. Black and grey soils tend to remain wet longer and have fewer frost free days than other soils in Saskatchewan. Alfalfa is commonly used in a black soil rotation. The producers surveyed had clay to clay loam soils and sandy to sandy loam soils

Sandy Soil

1 - Cereal such as wheat, barley or oats, under seeded to clover or alfalfa.
2 – Clover or alfalfa plow-down as green manure. Some producers will leave the alfalfa for two years if they have livestock, or will leave the legume go to seed in the second year as a cash crop.

Loam, Clay or Clay Loam Soil

As above for year 1 and 2
Year 3 and 4: cereals such as wheat, barley or oats; oilseeds, typically flax; legumes, typically pea or lentil.

The more northern producers were not as likely to grow peas or lentils but will grow cereals for two or three years. Livestock producers may also extend the alfalfa crop a couple of years for feed.

Rotation study at Agriculture and Agri-Food Canada's Scott Research Farm showing several series of crop sequences. Photo source: Stewart Brandt

Soil Organic Matter

Experienced producers felt that building organic matter was the key for maintaining good water holding capability and soil tilth.

Soil organic matter is the component of soil that includes plant and animal remains that are in different stages of decomposition and the related soil organisms such as fungi, nematodes, and bacteria. Organic matter is not only a product of residues worked into the soil from year to year, it is a product of plant and animal decomposition over thousands of years. Organic matter is the result of climate and vegetation that existed before the land was broken, and is influenced today by management strategies such as growing green manures and straw residue management. Research suggests that on average, intensive cultivation practices in the past reduced organic matter levels by 40% from levels seen in native prairie.

Soil organic matter is often divided into four fractions: fresh organic matter, such as fallen leaves; decomposing organic matter; stable organic matter; and living organisms. Although living organisms such as fungi, bacteria, earthworms, and living

roots comprise less than 5% of the soil's organic matter, they do most of the work in nutrient cycling and breaking down organic matter (Ingham et al., 2000).The soil biological community has greater numbers and diversity than the communities above the soil, and it can weigh from 1100 to 14,000 kg/ha. That is a similar weight as 2 to 28 yearling steers!

As the amount and typesof soil organic matter increases so does the biodiversity of soil microorganisms.

Fresh organic residue, which includes plant, animal, and other organic material that has just been added to the soil, comprises less than 10% of the soil (Ingham et al, 2000). The actively decomposing and stable organic matter fractions each generally comprise a third to half of the organic matter.

When fresh plant material is added to the soil the micro organisms begin to break it down. The active, partially decomposed organic matter holds nutrients in the soil for the growing plant. Stabilized organic matter is the final product in the decomposition process. It helps provide structure to the soil resulting in good aeration and water holding capability.

The balance of carbon to nitrogen (C:N ratio) in plant residues has an important impact on the soil biology. When bacteria digest organic material in the soil they will use about 5 grams of carbon for each gram of nitrogen or in a ratio of 5:1 (Foth, 1990). Fungi can use up to 20 g of carbon per gram of nitrogen. If the C:N ratio of residues is greater than 20:1, then nitrogen is not released for crop growth. The microorganisms struggle to find enough nitrogen and will temporarily absorb it from the soil, making it unavailable to plants. Cereal straw has a C:N ratio of 70:1.

If the residue has a C:N ratio less than 20:1, then the plant material is decomposed quickly and nitrogen is released into the soil. Legumes, such as peas and alfalfa have a C:N ratio <20:1. Over 100s of years of decomposition, the stable organic matter, or humus, ends up having a C:N ranging between 8:1 and 15:1. This organic matter is very stable. Greater organic matter allows the retention of more nitrogen in the soil and fosters the activity of soil microbes.

Soil Biology Can Be Encouraged

Green manures were identified by expert farmers as one of the ways they maintained the life in the soil. Other methods included using animal manure and straw residue, selecting good rotations, and reducing tillage.

Organic producers recommended that all straw, including flax straw, be worked back into the soil to return as many of the nutrients as possible. This increases the soil's organic matter and provides beneficial micro-organisms with habitat and food. Slow decomposition of straw may indicate a lack of soil organisms.

Incorporation of legumes causes a shift in microbial populations towards greater metabolic activity as well as an increase in organic matter and microbial biomass C and N. It is very important for producers to have a well rounded rotation to create a balanced soil ecosystem.
Tillage is another important factor that affects soil micro-organisms. Most organic producers try to keep the number of tillage operations to a minimum and try to keep some type of cover on all fields throughout the growing season. Green manures provide cover and prevent soil from drying out. They also provide fresh vegetative material that is the base of the food web of the soil organisms. Black fallow is not recommended in an organic system. It increases the risk of erosion and kills many of the soil organisms.

Green Manures Build Soil

The experienced farmers all agreed that using green manures in the crop rotation

was vital to sustaining a healthy soil and controlling weeds A green manure is a crop worked into the soil to provide nutrients and organic matter to the soil organisms, and ultimately to subsequent crops. It typically does not involve harvesting a crop for sale. Often, the green manure is a legume that fixes nitrogen, and is incorporated into the soil at the beginning of flowering.

Green manure incorporation at University of Manitoba organic field plots. Photo by Brenda Frick

Producers recommended a green manure every second, third or fourth year. This reduces the number of profitable acres, but the benefits are considered worthwhile. The types of green manures in Saskatchewan vary depending on climate, soil type, and producer preference.

Producers highly recommend sweet clover in all regions of Saskatchewan. Sweet clover is typically planted with a cereal in the first year. Sweet clover growth is limited in the first year, but it grows vigorously in the second year, fixing nitrogen and suppressing weeds. Sweet clover residues have allelopathic (toxic) effects in following crops.

Sweet clover is susceptible to the sweet clover weevil, which can cause significant damage and even death of the crop. Growing sweet clover in the same area for several years in a row increases the chances of weevil moving into the field.

Sweet clover produces abundant growth, and thus requires lots of water. When water levels are low, early termination of the sweet clover may be helpful. Plowing sweet clover down can require heavier equipment. Most of the producers said a heavy disk or regular disk was required. Use of heavy equipment can cause excessive drying of the soil.

Where water is abundant, alfalfa and red clover are popular perennial green manures. Field pea and faba bean are effective annual green manures. Where moisture is limiting, chickling vetch, black medic and black lentil are important alternatives.

The amount of nitrogen made available by various green manure crops depends on growing conditions, especially moisture and proper inoculation.

Many of the expert producers we talked to preferred a mixture of plants for green manure. A variety of plants creates a diverse environment and some producers feel that feeding the soil is
like feeding livestock – a good balance is desirable. It is not uncommon for an organic producer to seed leftover lentils, peas, and oats together to create a more diverse plow down. Some farmers report that they mix all of the leftover seed from their bins. This is a good way to use up seed. As one farmer stated, "by seeding all the leftover seed, you won't be tempted to leave your green manure as a cash crop when it looks really good half way through the season".

Where water was available, primarily in the black and grey wooded soils, some experienced producers used cereals, either alone or with legumes, for green manure. Although cereals do not fix nitrogen, if turned under as they begin to flower, they can make nitrogen available to following crops. They also provide abundant carbon to the soil, building a

more stable organic matter. The more common cereal green manures are oats, wheat, and fall rye.

Other green manure crops are possible. Buckwheat and oilseed radish have been used by some producers to improve phosphorus availability. Both crops secrete acids from their roots, thus making phosphorus more soluble, and thus more available to the plant. When these crops decompose, the phosphorus that they took up is retained in the active fraction of the soil.

Weeds are another excellent source of green manure. Most weeds do not fix nitrogen, but they can make nitrogen available to following crops. The risk in a weed green manure, sometimes called a green fallow, is in not being able to terminate the weeds before they set seed.

GREEN MANURES: BROWN SOILS

Farmers in the brown soil zones used chickling vetch, lentils, and black medic as green manures. Many used sweet clover as a green manure when moisture was less limiting. Producers in the brown soil tend to terminate sweet clover early, according to moisture availability.

GREEN MANURES: DARK BROWN SOILS

Farmers in the brown soil zones used lentils, peas, faba beans, sweet clover, fall rye, and buckwheat for green manures. Sweet clover was often the green manure of choice, because it produces a large amount of plant material and it can compete well with the weeds.

GREEN MANURE FOR BLACK SOILS

The farmers in the black and grey soils often chose peas, lentils, alfalfa, oats, fall rye, wheat, red clover, and sweet clover. They cite alfalfa as a great crop for bringing nutrients found deeper in the soil to the surface, and for making clay soils mellower.

Manure and Compost

Manure is an excellent organic fertilizer. The use of manure is highly regulated by organic standards. Producers should check with their certifying bodies to assure that their practice meets organic standards.

Many livestock producers use manure to build soil fertility. We found that manure is generally used in one of three forms:

a) deposition by fall or winter grazing of crop land,

b) application of manure that has not been composted according to organic standards,

c) organic composted manure.

At this point, the organic standard requires that the application of raw manure (any that has not been composted to standard) needs to be at least 90 days before the harvest of a crop if the harvested material does not come in contact with the soil, or 120 days before the harvest of a crop where the harvested material is in contact with the soil. Manure should be applied at an appropriate time of year to allow decomposition and at an appropriate point in the rotation.

Fresh manure should be applied under cool conditions and should be incorporated within hours to minimize gaseous losses of nitrogen.

In most cases a producer will age manure for several years before putting it on the field. Often manure is applied in a green manure year of the rotation.

Composting manure can take it one step further. Composting is a process that can be described as "the aerobic decomposition of organic matter to produce a humus-like product called compost" (Saskatchewan Agriculture and Food).

Microorganisms, especially fungi, are involved in the decomposition of manure and convert manure into the stable compound of humus, which is a dark colour and has an earthy smell (Saskatchewan Agriculture and Food). But developing rich compost that will add to the soil ecosystem requires more effort than simply piling manure and waiting for microorganisms to do their work.

Composting generally requires some amount of effort and machinery to maximize the humus-producing potential of manure. To meet compost standards, the farmer must regularly turn the compost for aeration and to manage the temperature and moisture in the pile. Few of the producers interviewed had the time or equipment for composting manure to meet the standard.

Composted manure loses volume in the composting process. Large amounts of manure become small piles of compost. During decomposition, CO_2 and water are lost to the atmosphere. This results in a 50 to 70% reduction in volume and a 40 to 80% reduction in weight (Saskatchewan Agriculture and Food).

Different manures and bedding types can be used for composting purposes. The type and age of animal, the bedding used, and the diet of the animal will all affect the nutrients available in compost (Saskatchewan Agriculture and Food).

Balancing the proportion of carbon and nitrogen is critical for proper composting and conservation of nutrients. Poultry litter, for example, is typically moister than other types of manure and decomposes quickly. If there is an insufficient amount of bedding (which is a carbon source), ammonia odors may become an issue (Saskatchewan Agriculture and Food). Testing compost will help determine if any adjustments in bedding or diet are required.

Careful planning is required when considering composting animal waste on farm. The location of compost sites is important to avoid risk to groundwater and nearby water sources. Ideally a site should be "slightly sloped, clay-lined and have berms and runoff control structures" (Saskatchewan Agriculture, Food and Rural Revitalization, 2005).

Few farms have enough livestock to provide manure or compost for all their cultivated acres. One strategy is to use compost or manure only on hill tops or other areas in the field that may need a fertility boost. Compost may be spread more thinly as an inoculant of microorganisms to promote the soil biology instead of using it as a nutrient source.

Freshly turned composting manure. Photo by Brenda Frick

If manure is imported, minimizing the distance for transport will significantly reduce consumption of fossil fuels and help to keep production costs down.

Enclosing livestock and collecting, transporting and spreading compost or manure can be costly and inefficient. Some producers simply allow livestock to graze crop land in the fall or winter, or green manures through the summer. This method greatly reduces the use of fossil fuels and puts the fertilizer straight onto the field. It also makes use of urine that is a rich source of nutrients that is generally untapped in solid manure composting systems.

Nutrient Amendments

Some producers use amendments that were applied to the seed as an inoculant, to the green plant as a foliar spray, or to the soil. There is very little reliable third party research available on the use of organic amendments. These products should be used cautiously.

When considering any input, it is best for producers to check with the Canadian Permitted Substances List (PSL) and their certifying body to make sure the input is approved for organic production. Finding the input on the Organic Materials Review Institute (OMRI) list is not enough. It is wise to test a new product in the field before committing a large acreage and a significant amount of money. The simplest system is to apply the product to part of the field and leave untreated test strips beside the treated area. Markers or stakes should be used so treatments can be compared throughout the season.

Seed Inputs

Rhizobial inoculants are commonly used with legumes to improve nitrogen fixation. Some producers believe that after years of inoculation, and because they have created an environment in the soil that favours the bacteria responsible for nitrogen fixation, they do not require these seed inoculants. Some feel that legume may have better colonization of the root if the inoculant is applied on or immediately below the seed.

Some expert producers used *Penicillium bilaiae* to improve the crop's ability to access phosphorus.

Additional products include mycorrhizal fungi, humates, and other microbial products. Response to these products can vary depending on the crop, the cultivar of the crop and management history. Careful monitoring of crop response is recommended.

Foliar Applied Inputs

A few producers use inputs that can be sprayed onto the plant while it is growing. Foliar sprays are commonly used to reduce risk of disease, and in some cases control disease. Often the intent is to feed beneficial organisms that may reduce pathogens. Some foliar sprays may also be used on stubble in the fall to provide micro-organisms that will speed up the breakdown of the stubble.

Soil Applied

A few of the experienced farmers used soil amendments. Some of these, such as sulphur, rock phosphate, calcium, gypsum and trace minerals were applied after soil tests indicating low or imbalanced nutrient levels. Others, such as molasses and microbial enzymes, were used to improve soil biology.

TILLAGE

Soil erosion and loss of soil quality resulting from tillage is a concern for organic and conventional farmers alike. A common perception is that organic producers use too much tillage. Tillage is often a part of the organic producers' practice, but experienced producers use tillage judiciously.

Once land has been broken, tillage is generally used for one of three purposes:

- seed bed preparation
- weed suppression
- incorporation of crop residues or green manures

Tillage with a cultivator or harrow is commonly used in the spring to prepare the seed bed and to control weeds. Farmers that use disc seeders reported less cultivation in the spring because the disc seeders killed weeds while they seeded. Some producers used light tillage with harrows for weed control before and after crop emergence.

As a rule, organic farmers no longer use black fallow with tillage throughout the growing season. This sort of fallow has been replaced with green manure or green fallow. This increases cover, reduces tillage, and reduces erosion compared to black fallow. Green manures are generally tilled to kill the plants and return their nutrients to the soil. The amount of tillage required to gain these soil benefits is unclear. For perennial green manures on heavier land, a heavy disk may be required to kill the plants effectively.

Organic producers were asked if their tillage operations had increased or decreased since they made the transition to organic. In general, they replied that the types of tillage had changed. Often they moved to lighter, and more residue conserving tillage. When a producer first makes the transition to organic production, there is often an increase in the number of tillage operations used for weed control. Farmers reported a decrease in mid to deep tillage operations as their knowledge increased. They also noticed a reduction in weed pressure.

In the last few years many organic producers have started to experiment with reduced tillage techniques. Some are seeding directly into stubble, with no tillage for 2 or 3 years of a 4 or 5 year rotation. Reduced tillage techniques are limited in organics by fertility and weed management. Green manures are crucial for soil fertility. Tillage has usually been considered the only method of terminating green manures in organic production. The usual recommendation is for 70% worked into the soil with the remainder above ground to protect the soil, trap snow and create water pathways. Perennial weeds, such as Canada thistle, are most easily controlled through tillage.

Tillage Can Be Reduced

Most organic producers felt that no-till methods have their place, but they are skeptical that they can achieve an entirely no-till organic farming system. Often they feel the most limiting factor for no-till organic is the need to incorporate green manures. Recently, researchers and producers have challenged the belief that tillage is needed for green manure termination, considering methods such as blading, mowing and rolling.

Nobel blade cultivator breaks the connection between root and shoot, but leaves stubble standing. Photo by Brenda Frick

The wide blade (or Noble) cultivator is a tillage tool that results in minimal soil disturbance and leaves residues standing. One producer indicated that this was an effective way to terminate green manures while reducing the risk of erosion. In addition, standing residues make good snow traps.

Jill Clapperton, then of the AAFC Lethbridge Research Station, suggested that mowing was as effective as tillage incorporation for terminating green manures for both weed suppression and nitrogen benefit. Matthew Wiens at the University of Manitoba showed that alfalfa mulch laid on the soil surface provided significant nitrogen benefit to wheat plants.

The Rodale Institute has had excellent results with the crimper-roller as a tool to break the stems of green manure plants and push them into contact with the soil. In recent trials at the University of Manitoba, Martin Entz has found that rolling was effective at terminating several green manures.

When residues are not incorporated there is concern that nitrogen may be lost to the air rather than trapped in the soil. Conversely, the residues may be slower to decompose, improving their nitrogen supplying ability to subsequent crops. They may also reduce moisture loss from soil surfaces.

Organic producers who continue to use tillage minimize erosion potential by understanding what the soil requires and by reducing tillage operations as much as possible. Tillage types and timings are determined by soil conditions, climatic and weather conditions, and the type of equipment that the farmer owns. Generally, more tillage is used in black soils, where weed pressures are higher, and where there is less concern with drying out the land.

TILLAGE FOR BROWN SOILS

The experienced producers in the brown soil zone included those that use direct seeding and those that use pre-seeding tillage. They advise:

- Every year is different and you have to work with that.
- The weather is a big part of determining what type of tillage will be used. Try to avoid seeding when the wild oats are coming out of the ground- wait until you see two to three different flushes of wild oats, then work the soil and seed right after.

Direct seeding

- Don't do any tillage prior to seeding; instead wait for spring and use a disk seeder or an air seeder with shovels to kill the winter annuals.
- As soon as the tractor can get in the field, at the end of April, start seeding. This will beat most weeds. Approximately 10 days after seeding and before the crop comes up, use a rotary hoe. This gives the crop some time to get ahead of the weeds.

Tillage before seeding

- Work the land early in the spring; if weeds grow, rod weed or work again just before seeding in May.

Quack grass cultivator (right) pulls quack grass rhizomes from the soil. Photo by Brenda Frick

Tillage for Dark Brown Soils

Direct seeding

- Delay all field operations until the soil is warm and the weeds are showing, and then harrow.
- Use a rotary hoe and rod weeder in place of preseeding tillage operations
- With zero till, perennial weeds ca take over.

Tillage before seeding

- Pre-till in the fall with a disk or double disk to work in organic matter, and then in the spring work with a medium duty cultivator.
- Where there is hard pan, get out early in the spring to work the soil. If the soil is hard after the winter, use the heavy cultivator, as shallow as possible. If the soil is not hard, use the tine harrows. Always be careful not to work it too much and thus cause erosion. Working this type of field early in the spring helps to encourage the weeds to grow so that they can be managed by seeding time. In some years, tillage up to four times may be necessary

Tillage for Black soils

Timing and working with nature is very important. The amount and types of tillage depend on soil temperature and moisture, the number and size and growth stage of the weeds, and the type of crop.

- Don't seed too early
- Don't work the soil when it is wet because it will kill the soil micro-organisms.

Direct seeding

- Use only a single cultivation prior to seeding, and then just before the crop comes up, rodweed. If further weeds germinate, use a harrow.
- Direct seed into pea or cereal stubble
- Seed with a disc after 15th of May with no pre-seeding tillage

Tillage before seeding

- Lightly cultivate with tine harrows as soon as the land is dry enough and soil is warm. Set harrows aggressively so that the rocks are brought to the surface and soil cracks are closed. This conserves moisture and encourages the weeds to germinate so they can be controlled at seeding
- If there is abundant moisture and the intended crop is weakly competitive, do several tillage operations before seeding, depending on weed emergence.
- If the field was worked in the fall, work again in the spring once the soil has warmed up. Work the soil 2 to 3 times prior to seeding depending on the year and possibly skim after seeding.
- Seed early. Pull the cultivator with the seed drill behind.

SEEDING

Seeding is a time when planning and reality come together. Weather often determines when to seed, what equipment to use, and sometimes even what to seed. Ideally, seed is planted so that it will emerge in a relatively weed free environment and have the most vigorous start possible. Weeds that are present when the crop emerges will be much more competitive with the crop than those that emerge after the crop is established. Seeding rate and seeding depth may be determined in part by losses that are expected from tillage around the time of crop emergence.

The type of equipment used to put the seed in the ground will determine how effective the crop can be at competing early in the season. For many producers it is not feasible to buy new equipment, therefore it is important to consider what can be done to give the crop the best advantage.

When to Seed

The following provides recommendations of expert farmers about timing of seeding. Some of the recommendations are contradictory, reflecting the different approaches and different environments of the producers who made them.

- During wet years seed whenever you can get in the field, and during dry years seed as early as possible.
- Ideally, work the land when the moon is waning (appearing smaller), and then seed when the moon is waxing (appearing bigger). It is important to note the phase of the moon but it is not always possible to seed with it.
- Wait until the wild oats are germinating
- Temperature is important, don't seed before May 15th unless it is really hot and dry.
- White poplar buds in the bush indicates the soil is ready for seeding.
- When the berry trees are blooming seeding should start; try to be finished by the first of June. Watch and work with Mother Nature.
- Seed when there are leaves on the trees.
- When seeding early, watch soil conditions and moisture; when seeding late, watch weeds.

Crop Selection

Producers chose crops based on a number of factors, including previous crops in rotation, soil fertility, weed control, markets and crop type. The experienced producers suggested the following criteria in choosing varieties more suitable to organic production:

- New varieties bred for disease resistance
- Varieties that grow well in the area and are adapted to soil and climatic conditions
- Heritage varieties because they have not been bred for high input farming.
- Varieties that give high quality: oil seed varieties with taste quality, wheat with high protein and oats with plump seeds

- Varieties that are in demand with buyers and can be sold into the organic market; varieties that are in demand with consumers

- Crops that produce viable seeds for the next year

- Taller varieties with more straw for increased biomass and varieties with large seed size for easier cleaning

Producers identify the following characteristics as suited to organic production: good competition in the early growth stages, taller varieties with lots of straw, disease resistance, and seed that can be saved on farm. By saving seed, some producers feel the variety will become better suited to the climate and soil of their region. Many producers commented that heritage varieties are better suited to organic production because they were not developed with chemical and fertilizer inputs. Heritage varieties, for the most part, were developed under organic conditions. Many producers found that they performed well, and yielded well under organic management.

The following are the varieties that producers in this survey used:

- Wheat – *Red Fife (heritage variety), AC Intrepid, AC Splendor, CDC Teal, AC Cora*

- Oats – *Calibre, Derby, AC Cadillac, AC Assiniboia, Furlong*

- Spelt – *Spring and Fall*

- Rye – *Prima*

- Flax – *Vimy, Norli*Barley – *AC Oxbow, Manley, CDC Gainer, AC Metcalfe, and Harrington*

- Peas – *Princess, Eclipse, Majoret, Trapper, CDC Sonata*

- Lentils – *Green French, Indianhead, Red lentil*

Researchers have found some varieties perform better under organic conditions. These are generally considered more competitive, and have often been seeded after some pre-emergent tillage.

- Black soils – Wheat: *Red Fife (under drought conditions), CDC Go, Park*

- Dark brown soils - Wheat: *Red Fife*

  Barley: *CDC Cowboy*

  Oat: *Morgan*

  Pea: *4010*

Comparing wheat plots at University of Alberta. Photo by Brenda Frick

Seed Quality

Experienced producers generally did not consider it necessary to routinely use certified seed. Some suggested it was important only when it was time to renew the seed.

Approximately half of the experienced producers considered it very important to get organic seed. Others felt that it was somewhat important, but that getting good quality seed of known varieties was more important.

All producers stated that it was very important to use seed saved on their own farms. Some felt it was very important to have heritage varieties; others were less concerned.

Experienced producers were concerned with seed quality. All had seed cleaned, and most had it tested for germination and disease.

Seeding Rate

Higher seeding rates can increase the crop's ability to cover the ground, and thus use the resources in an area. This leaves less space and other resources for weeds. Heavy seeding rates also allow for some seedling mortality from post emergent weed controls such as harrowing.

Organic sources frequently recommend seeding at 125 or 150% of the rate recommended for conventional production. The experienced producers in our study increased their seeding rate from 5% to 100% over conventional rates. A majority of them increased seeding rates 30% to 50% for most crops.

Scientific studies confirm the advantage of higher seeding rates on organic farms. On farm trials with cereals and pulses show higher yield and lower weed pressure when seeding rates were increased to 1.25 to 2 times conventional rate. Increasing seeding rate becomes more important under conditions of higher fertility when weeds may be more competitive. Annual legumes used as green manures had greater biomass and less weed pressure when seeded at 1.5 times the conventional rate or higher.

Seeding Equipment

The seeding equipment used by a producer can affect crop emergence. Seeder row spacing and type of opener (affecting spread of seed) determine ground cover. Some seeding equipment can provide weed control while seeding. Organic producers favour different types of seeding equipment. Their preferences are recorded below:

- Air seeder, because there is less soil disturbance. Uses 10 inch row spacing because of the density in the row and likes to seed 2 - 3 inches deep.
- If it's dry, likes a hoe drill; if it is wet likes a press drill. If there is lots of trash likes to seed with a disk.
- Uses a disk seeder, when it is a wet spring but if it is a dry year will use a press drill.
- Double disk press drill with 6 inch spacing most useful for summerfallow or plow down fields and really good for small seeded crops. Hoe drill with packers on the back, is used mostly for sowing into stubble rotations and peas.
- Valmar spreader for seeding alfalfa and sweet clover.
- With the press drill you can crisscross the field to cover the ground, with 6 inch spacing.
- Prefers the press drill and will rod weed and harrow afterwards.

- Will use a disk seeder with no preseeding field work. Then about every six years uses a moldboard plow with press drill behind to seed. Does this to rejuvenate the soil.

- Cereals are seeded with a disk because of the scattered seed pattern. For any of the other crops use a hoe drill, because the seed spacing is close and the packing and the depth can be controlled.

WEEDS

Weed management can prove to be very intimidating for new organic and transition farmers. Fields can easily become overrun with weeds. The weeds that organic producers identify as the most difficult to control are wild oats, wild mustard, thistles, and quack grass.

Several studies have found that organic fields share the same weeds as other farms. Several factors are more important in determining the weed community, including year, environmental variables such as soil or ecozone, soil texture and management factors such as the presence of perennial forages in the rotation.

Canada thistle growing in flower. Photo by Brenda Frick.

Researchers found the most common weeds on organic farms to be wild mustard, lamb's-quarters, Canada thistle and redroot pigweed. Other common weeds included green foxtail, wild oats, wild buckwheat, Russian thistle, stinkweed and bluebur.

In the Black soil zone, most producers describe similar weed problems before and after transition to organic. Most have more wild mustard than when they were conventional. Some report less wild oats now that they are organic.

In the Dark Brown soil zone, producers again identify a greater problem with wild mustard. Several also mention Canada thistle, pigweeds and stinkweed as more problematic.

In the Brown soil zone, producers reported more wild mustard, wild oats and Canada thistle. Several reported fewer problems with kochia.

It is interesting that organic farmers found fewer wild oats in Black soils and more wild oats in Brown soils after transitioning to organic. A reduction in wild oats may be associated with delayed seeding. Wild oats frequently germinate early, and are eliminated by pre-seeding tillage. More producers in the Brown soils than in the Black soils are moving to early direct seeding.

As discussed previously, tillage can be a powerful weed management tool, especially before seeding or after green manure. Although many producers wish to limit tillage, weed control issues may reduce their ability to do so.

Canada thistle was important in all soil zones. Late fall tillage is often seen as one of the most effective strategies against Canada thistle. Traditionally, repeated tillage, roughly monthly from harvest, or from the time the thistle flowers, until freeze up has been recommended. At flowering the thistle has the greatest

proportion of nutrients aboveground. After each tillage event, the thistle mobilizes nutrient reserves to rebuild aboveground biomass. Repeated tillage depletes the thistle reserves, weakening the plant as it goes into winter. Tillage just prior to a killing frost, or spiking just after a killing frost is very effective.

Some producers find that mowing Canada thistle can be an effective alternative to tillage, particularly just before a rain. Some producers find the best time for tillage or mowing of Canada thistle is during the new moon.

Canada thistle can be significantly reduced by at least three years of alfalfa. The repeated mowing and competition from the alfalfa again deplete the thistle's reserves, starving it out. Unfortunately, quack grass is not controlled by inclusion of alfalfa in the rotation.

Wild mustard flowering above Red Fife crop. Photo by Brenda Frick

Wild mustard can be a very challenging problem for organic producers. Before the advent of 2,4-D, wild mustard was a severe problem throughout the prairies. Long term dormancy and rain-triggered germination means that additional plants can emerge after any control measure. Wild mustard is strongly competitive, but can be somewhat misleading. What appears to be a solid yellow carpet at flowering may still allow a vigorous crop underneath.

In Crop Treatments

"First come, first served" is a concept that often applies to plants, with weeds that emerge before the crop gaining more of the resources and thus having much more effect on the crop than weeds that emerge later. For this reason, farmers frequently use tillage before or during seeding.

A second window of opportunity for weed control exists after seeding but before the crop emerges.
Rod weeders, harrows (tine and diamond), or cultivators are used up to 4 days after seeding, but before crop emergence. This practice is often called skimming. It dislodges small weeds, leaving them to dry out on the surface, or it buries them. This sort of skimming is most effective for small seeded weeds emerging above the crop seedlings. Deep seeding and careful monitoring of germination and emergence increase the chances of success.

Many crops can be harrowed after emergence. Harrowing loosens soil and buries plants. Most cereal crops are tolerant of harrowing in the 2 to 4 leaf stage. Peas are tremendously tolerant of harrowing. Best success is with small shallow weeds, using 2 or 3 passes of the harrows, to obtain approximately 70% burial.

Tall weeds, such as wild mustard and wild oats can overtop short crops like flax and lentil. Some producers clip the weeds above the canopy of the crop. If simply cut, the weeds will regrow, but if they are shredded by the operation, the weeds can be severely damaged. Research suggests that this clipping does not greatly improve the yield of the crop below the weed

canopy, but that weed seed set can be substantially reduced.

It's useful to match the crop to the soil and weed conditions, for example, growing aggressive crops under conditions of higher fertility and weed pressure and less competitive crops under lower fertility and weed pressure.

Harrowing field peas. Photo by Brenda Frick

Farmer Favourites for Weed Control

The organic producers identified the following as ***successful weed control practices***:

- Growing alfalfa, sweet clover or fall rye to suppress weeds
- Use of solid crop rotations
- Seeding at a heavier rate
- Delayed seeding
- Spiking in the fall to control quack grass
- Spiking thistles after a good frost in the fall
- Work the thistles every new moon

The organic producers also identified practices that they had attempted, but found to be ***less successful***:

- Rod weed in the spring before seeding
- Harrowing at the wrong time, or without enough care
- Not monitoring carefully enough
- Deep tillage in light soil

INSECTS

The experienced producers interviewed rarely felt they had serious insect problems. The most commonly mentioned insects were grasshoppers, but these were only problematic in dry cycles.

Most producers try to create a healthy environment with lots of diversity so that natural mechanisms will provide some control of pest insects. Insect problems were less severe if the soil and crops were healthy. Specific recommendations were given for some insects:

- Wheat midge: delay seeding, select resistant varieties, spelt is more resistant than wheat
- Lygus bug: delay seeding
- Sawfly: cultivation and crop rotation
- Aphids: keep an environment where predators such as lady bugs flourish
- Grasshopper: use pea or alfalfa border, use tillage to avoid egg laying, seed early, use foliar sprays including sugar

Often farmers take a philosophical approach to insects and accept that many things are out of their hands. They try their best to not worry too much and simply do the best that they can.

DISEASE

Several producers reported no disease problems at all and they attributed this to a strong rotation and a soil with a lot of activity of micro-organisms. They see diversity and a healthy environment as being the keys to success as an organic producer.

As with insects, many disease issues are strongly influenced by the weather and are therefore very difficult to combat. The experienced farmers recommend the following measures to reduce specific diseases:

- Rust: rotation, variety selection
- Mildew: hydrogen peroxide seed treatment, rotation
- Ergot: hydrogen peroxide seed treatment, rotation, soil fertility and good organic matter
- Smut: hydrogen peroxide seed treatment, tillage, rotation
- Ascochyta: variety selection, rotation, compost tea
- Fusarium: rotation, variety selection

It is very important that organic producers always check with their certifying body prior to applying any product to their field or their seed.

Ergot in rye. Photo source: http://www.gov.mb.ca /agriculture/ crops/insects/fad64s00.html

HARVEST

Whether they straight-cut or swath, producers have three main goals at harvest: to gather the most high quality grain possible, to remove as many weed seeds as possible, and to leave residues to trap snow and build soil.

It's very important that organic farmers remove as little crop residue from their fields as possible. The straw of any crop provides value to the soil in the form of additional biomass, soil cover to retain moisture in the fall months, and the return of soil nutrients trapped in the straw. If the straw is chopped and left in the field, microorganisms are able to break down this crop residue and return nutrients such as phosphorous back to the soil.

Farmers had these specific recommendations for harvest:

- Straight cut whenever possible to provide better quality seed.
- A stripper header that goes on the combine strips the head of its seed and leaves all the straw standing for snow catch. It can be used on cereals and flax.
- A lifter guard on the swather really helps with cutting peas, lodged crops, and crops with sawfly damage.
- Combine on the dirty side so weed seeds are harvested at the same time. Turn the wind down so the weeds don't blow out the back, and then clean the weeds out in the yard. The screenings can be feed to livestock or composted.
- Pick up the chaff and compost it or feed it to cattle.
- A pre-cleaner on the auger for taking some of the small weeds out while moving grain from the truck to the bin reduces the chance of heating

and gives a quick clean before entering the bin.

- An aeration fan in the bin improves seed quality.

- If possible have more small bins. Grain from one field can go in one bin. It helps in management and in marketing.

- Chop up the crop so that the straw can be worked back into the soil easily.

- Don't burn flax straw; use the chopper on the combine to break it up and then work it into the soil.

- During the dry years, use a spreader for the straw. This helps to keep the trash a little longer on the surface to hold a little more moisture.

Combining Red Fife. Photo credit: Marc Loiselle

TRANSITION

The three years of transition is typically the most difficult time period for a conventional farmer who wants to move into organic farming. During this time producers have to wean themselves off their dependence to chemicals and fertilizers. Some producers told stories of sleepless nights throughout the spring when they would normally be spraying, and great mental turmoil during the summer months when the weeds were most visible.

A transition to organic farming is not an easy step and it requires a change in mind set and philosophy about farming. Some farmers suggest that the transition in the mind takes longer than the transition of the land. The learning curve is huge because new practices such as green manures, healthy rotations, mechanical weed control, organic fertility management and erosion reduction all become important. One producer compared the transition into organics to climbing stairs with each year another step. Knowledge base and experience grow as you climb.

The transition period is important. It gives time for the soil to become free of chemicals and fertilizer residues left over from conventional farming practices. It is a time during which soil fertility, and weed control should be the top priority. And it is the period when farmers adapt to a new record keeping system.

How farmers make the transition largely depends on the type of farms they have. A grain producer that has livestock may find the shift easier since forages can be easily incorporated into an organic system. A producer without livestock may find it harder to incorporate legume green manures into a rotation, since they bring no direct revenue.

Transition is an economically vulnerable time. Ammonia fertilizer and chemical bills are eliminated, but diesel bills may be

higher. Certification costs can be significant. Yields may be reduced and there is rarely a premium for transitional products.

Often, organic producers find that they like the new working environment. They have more responsibility to learn what the soil needs and through this knowledge, they can regain control over their businesses. Many producers stated that although transition was difficult, organic farming made them feel empowered.

General Transition Advice

When entering into transition, it may be worthwhile for a producer to break the field into smaller sections, about 40 to 50 acres in size. A buffer strip can protect an organic producer from chemical drift and at the same time provide access to the entire field. Better access to a field will provide better weed management. A producer will be able to monitor weed outbreaks and at the same time have access for equipment when tilling or mowing weeds is required.

Expert organic farmers give this advice to new and transitioning organic farmers:

- The most important thing is to believe in organic farming. If you are not committed to the change it will be extremely difficult.
- Don’t listen to the chemical farmers who tell you that you are doing it wrong.
- Talking with an established organic producer in the area can provide some insight into what you can expect in the first couple of years and can help to explain the importance of putting green manure in as your fertilizer.
- Research. Buy a couple of books and join a certification association where you can talk to other organic farmers.
- Get involved with your certification association and go to meetings, conferences and workshops. Learn as much as possible.
- Have a plan with a long term strategy, and make sure legumes are a part of the plan.
- Try splitting fields in half. One half will be a green manure or weed manure and the other half can be a cash crop. The halves can be switched each year. This will allow for better monitoring of the field, weeds, and soil fertility.
- Realize that you are going to have to be more management intense per acre. You need to spend more time watching and thinking than you did before.
- You have to do what is good for the land, not just what is best for your pocket book.
- Don't expect big yields to begin with and don't feel bad about your weeds.
- Try to learn to why the weeds are there and how they can best be managed.
- Always give back to the soil through green manures, stubble, residues, and rotations.
- Alfalfa and sweet clover can be great tools during transition. They provide biomass and nutrients that other crops can’t supply.
- It is very important to know your markets. Know who you are selling to and ask for references from all buyers.
- Economics is important. You can make a small farm more viable, and there is greater potential for profit with fewer acres.

Transition on Brown Soil

Lentils, peas and chickling vetch are great crops to seed during the transition period as green manure plow downs. It is important to have a plan for the 3 years of transition, figure out how many acres each year can be seeded to green manure, and seed the rest to cash crops. It is a good idea to talk with an established organic producer in your area who can provide some insight into what you can expect in the first couple of years and help to understand the importance of putting green manure in as your fertilizer. One producer suggested splitting fields in half. One half will be a green manure or weed manure and the other half can be your cash crop. Then in the second year flip the sides and in the third flip them again. This would allow for monitoring of the field, what types of weeds are most abundant and for assessing the soil fertility.

Transition on Black Soil

Smaller fields may help the transition. Buffers of alfalfa or clover could be seeded within the field to make small fields about 40 to 50 acres in size. These buffer strips could then be mowed during the season to act as pathways. Smaller fields are easier to manage during transition and the pathways allow the producer an opportunity to see more of the field during the year. Weed outbreaks can be found and dealt with more efficiently when the field size is smaller.

During the transition years, weed management is vital. Weeds that get out of control will cause major yield loss and increased tillage for several years afterwards.

During dry years, fall stubble should be left over the winter to collect snow fall and to keep the soil moist longer during the spring.

Transition on Dark Brown Soil

Producers in the dark brown soil zone encouraged the extensive use of legumes as a crop and as a plow down. Yellow clover is a popular plow down in this soil zone, as is alfalfa. It is very important to manage the perennial weeds like thistle and quack grass. Working the soil in the fall with a deep tillage cultivator after the first frost is an excellent way to kill perennials. Producers stressed the importance of working on fertility right away in the first 3 years of transition. Weed pressure must be considered. Putting land into hay crops is another way to transition.

Learning from other farmers at an organic field day. Photo by Brenda Frick

Tillage Recommendations for Transition

Expert farmers made the following recommendations about tillage during the transition years:

- Understand your soil, and till accordingly.
- Replace black fallow with a weed fallow to reduce weeds and improve fertility.
- For some soils, especially those that are heavy, working deeper, and flipping the soil can improve aeration and help with fertility and weed control.
- Fall tillage of heavier soils can help prepare the soil for seeding earlier in the spring.
- Till in different directions in different years.
- Keep tillage to the minimum needed for weed control.
- Don't use a tandem disc if the soil structure is fragile.
- Avoid tilling light soils in dry years. This can cause erosion.
- Use tillage after the first frost to kill Canada thistle and quack grass.
- Harrow cereals when they are about 4 inches high, but don't go faster than 3 miles/hour. If you have wild millet (green foxtail), you have to harrow even slower and you must be ready to harrow as soon as you see it coming out of the ground.

INTEGRATING LIVESTOCK

Some of the producers we interviewed used their livestock as an integral part of the crop rotation. During the transition years, alfalfa and other forages help build organic matter and fertility. It is easier to dedicate land to long term perennial soil building crops if they have the economic return of also being livestock feed. Alfalfa and sweet clover are especially good for transition as both give excellent weed control and have deep soil building root systems.

Several producers fenced around land that was once strictly crop land in order to incorporate the livestock further into their rotations. By fencing crop land, a farmer has the ability to allow his animals to graze weeds and crop stubble left after harvest. It also provides additional land for the livestock to graze during the winter months. By incorporating livestock grazing on crop land, additional nutrients are added to the soil through urine and manure. Some producers are very strategic and will feed their animals in locations throughout the field that have been identified as low in nutrients or prone to erosion.

Producers reported that chaff collection during harvest offers both increased weed control and another source of feed. Another benefit associated with the integration of livestock is the ability to utilize screenings as a source of feed. The combination of livestock within a grain farm worked as well for producers of grass fed animals as it did for those that were grain fed.

Housing

Most livestock producers we talked to have beef cattle. Throughout the summer, the majority of the herd is left in the pasture to graze. Most producers have some native pasture and some seeded pasture. The seeded pasture is mostly crested wheat, brome grass, some alfalfa, and other grasses.

During winter months the cattle are provided with grain, hay, and access to the pasture. Grass fed cattle remain in the pasture and are fed bales all winter long. Most producers suggest giving the cows a little extra grain during breeding and just before the end of the pregnancy. Quality feed like whole oats, barley, and in some cases, screenings were most commonly given.

The producers indicated that good straw and some form of wind break is important during the winter months for most animals. Space is another important factor in the winter months. If animals are housed in pens that are too small, disease and sickness, such as lice, pneumonia and scours, will result.

Cattle on summer pasture. Photo by Brenda Frick

Livestock Health

The basis of good herd health is to have well adapted animals, and to provide them with good feed and care. Most producers culled hard in their early years, so that their stock was more hardy and resistant to the problems in their area.

The health of a herd can often be correlated to the food they eat and the care they receive. Common problems that may arise are scours, lice, pneumonia, navel rot, foot rot and parasites. Producers report that these types of problems were very minimal in organic herds and most producers found it was best to wait to see if the animal would recover on its own. Only when it became apparent the animal was not going get any better, would producers provide antibiotics. Once an animal has been treated with anything not certifiable, it must be tagged and sold as a conventional animal.

Vaccinations are allowed under most organic certifications, but it is best to check with your certification association to see what types of restrictions, if any, are applied to vaccinations. Of the 11 producers interviewed, 6 gave their breeding herd an eight-way vaccination, while the others gave no vaccination at all.

One producer felt it was important to give his heifers a shot of vitamin A, D, and E if they were going to become breeding stock. Another producer would occasionally use hydrogen peroxide in the water system if scours became apparent. Some certifiers may not allow hydrogen peroxide; therefore, it is best to check before administering any to your animals.

Salt and minerals should always be provided for livestock, but it is important that the types used are accepted for organic production. The expert producers recommended that a good sea salt and a mineral block with trace minerals be used.

Parasites, both internal and external, can be an issue for livestock. However, most organic producers said parasites were not a big problem in their cattle. When parasites were seen in a herd, several producers used diatomaceous earth in the feed and/or sprinkled it on the backs of the animals. They would then provide the herd with lots of space. Wood ash may be an alternative to diatomaceous earth.

It is an important principle in organic livestock production that animals be allowed natural, not synthetic, treatments and humane management. Treatments that are deemed necessary must be done in a manner that reduces stress wherever possible.

Weaning generally occurs within the first year of the calves' lives. Most producers weaned the calves by simply separating the mother from the baby. In some cases, the mother would be put out to pasture while the calf remained in the corral. Weaning can cause the calf some stress which could then result in weight loss and sickness. However, livestock producers have not reported this as a problem. They simply tried to make the separation as stress free as possible. It was suggested that the cow and calf be brought into the corrals from the pasture and fed grain and hay for a few days prior to separation. This would allow the calf an opportunity to eat grain with its mother and therefore reduce the stress of food change.

Castration also generally occurs in the first year. The two methods most commonly used for castration are rings and surgical removal. Ring castration can be done at basically two different times. When a calf is less than a week old, a very small ring is used for castration. A larger ring can also be used when the calf is about a year old. Castration done surgically most often occurs when the calf is six to eight weeks old.

Backgrounding and Finishing

Backgrounding an animal for the meat market basically requires weight gain and growth. Most of the producers indicated that they provided the market animals with hay, grain and pasture until they reached a weight of about 900 lbs. The types of grain feed were peas, oats, and screenings. Hay and pasture was still a very important part of the ration. The only exception to this is grass fed beef. In that case, they simply stay on pasture and hay until they reach the desired market weights.

Finishing a grain fed animal on-farm was done in basically the same manner as backgrounding. The big difference was the introduction of a high energy feed like barley. Good quality hay, water, and feed are important parts of this process. A finished animal's weight can range from 1100 to 1400 lbs depending on the buyer. Always check with the buyer or slaughter facility for any specific requirements.

SUMMARY

Organic farming is always a work in progress. Ideally, organic farmers come to understand the ecology of their land and how to work with it. This requires a systems approach, observing a multitude of details, but considering how they fit into the big picture. This can be a challenging task, and most approach it with profound humility. Although the farmers we talked to were enthusiastic about sharing their knowledge with us, they were quick to deny that they were "experts". Perhaps this is because there are always new challenges.

Despite the challenges of transition, most farmers found that organic production empowered and motivated them to become better managers, and they found that farming was more fun than it had been.

Best methods varied from region to region, from farmer to farmer and from year to year. Part of the challenge of becoming an organic farmer is learning to read the land and revise "the plan" to accommodate conditions as they arise. That being said, it was also important to know when to "stay the course", not abandoning rotations, for instance, when some commodity prices are high.

Farmers often find their most valuable resources are other organic farmers. We hope that this summary of farmer perspectives will be helpful background to you in your continuing search for sustainability.

ADDITIONAL RESOURCES

A variety of groups provide information that organic producers valued:

The Saskatchewan Organic Directorate, www.saskorganic.com, has a production manual:
Organic Farming on the Prairies

The Organic Agriculture Centre of Canada provides extensive materials online at www.oacc.info

The Canadian Organic Grower, www.cog.ca maintains an impressive lending library. Of special note are the following COG publications:

Gaining Ground: Making a Successful Transition to Organic Farming

Organic Field Crop Handbook

Organic Livestock Handbook

Provincial governments provide extension materials online:

Getting started in organics
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10031

Additional web based resources
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/bdv8488#research

Organic crops:
http://www.agriculture.gov.sk.ca/crops_organics

http://www.gov.mb.ca/agriculture/organic/

Organic livestock:
http://www.agriculture.gov.sk.ca/Livestock_Organics

In Saskatchewan, help is available at the Agriculture Knowledge Centre at 1-866-457-2377