Direct Seeding

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Crop Rotations in Direct Seeding

Crop rotations are essential in direct seeding systems. An effective crop rotation is required to reduce diseases, insect pests and weeds. It can also help in managing crop residue. Many possible crop rotations exist, so to make the most of the possible benefits, be flexible when selecting a crop rotation system.

Not only do crop rotations make direct seeding work better, direct seeding also makes some crop rotations work better by conserving moisture or by providing varying crop residue environments for next year's crops. Therefore, crop rotations and direct seeding are complementary.

Long-term Rotations

The benefits of longer term rotations can include the following:

- fewer herbicide-resistant weed species
- more breaks in disease cycles
- better soil structure
- less erosion.

Forages in long-term rotations can be very effective in reducing disease, insect and weed problems. Several years of forages can provide a break in some disease and insect cycles, and help to control perennial and annual weeds as long as the forage stand is healthy and vigorous. Weed control is improved if the forage crop is harvested as hay or silage since the weed seeds are often not yet viable at haying or silaging time.

The longer the forage cycle, the lower the cost of switching into and out of forages in that rotation. On the other hand, when the forages include legumes, particularly alfalfa, the marginal benefit to succeeding crops decreases after the alfalfa stand is three years old. Thus, six years of alfalfa followed by six years of annual crops may not be as beneficial to annual crop production as three years of alfalfa followed by three years of annual crops, which is then repeated, as long as there is no soil erosion when converting from alfalfa to annual crops.

Short-term Rotations

Short-term rotations usually involve only annual crops, such as cereals, oilseeds, pulses, vegetables and specialty crops like borage or caraway. Sometimes annual forages, such as cereal silage or greenfeed crops, may be part of a short-term rotation. Annual forages are used to control weeds or reduce nutrient levels in fields with excessive nutrients.

Rotating cereal grains with broad-leaved crops, such as oilseeds or pulses, allows weeds to be controlled with herbicides from different herbicide groups, reducing the risk of developing herbicide resistance. This type of rotation can also break the cycles of most diseases, except for those diseases that remain dormant in the soil or persist on crop residues for long periods.

Short-term rotations have been shown to have beneficial effects on all crops in the rotation. For

example, wheat or barley grown after peas or canola usually performs better by 10 to 20 per cent (ranging from 0 to 50 per cent) than a cereal grown after a similar cereal crop. Other studies have shown an 11 to 34 per cent yield advantage when growing canola after a cereal compared to canola after canola.

Alternating long-season crops with short-season crops can improve weed control because pre-seeding and in-crop herbicides can be applied earlier or later in the spring. Also, a short-season crop may be harvested early enough to allow the seeding of winter wheat or fall rye, which can take advantage of early spring moisture. Fall dormant-seeded canola usually matures earlier the next year, which may also allow seeding of fall or winter cereals.

With annual crop rotations, it is important to monitor herbicide use, since some herbicides have residuals that can affect the next year's crop.

Forages in Rotations

Forages can be included in rotations in several ways. Hay, pasture, grass seed crops and timothy or alfalfa for compaction can be grown in rotations for varying lengths of time. All these crops can be direct seeded into stubble from annual crops, with or without annual cover crops. The moisture in direct seeded fields will allow these small-seeded crops to be seeded near the soil surface for better germination and emergence.

Removing forages in a direct seeding rotation is more difficult than seeding forages into annual crop stubble. Options for removing forages depend on the type of forage stand.

A broad-leaved forage crop can usually be treated with glyphosate and some broad-leaved herbicides before seeding the next crop. They can then be treated with an in-crop broad-leaved herbicide. Growing a cereal crop after a broad-leaved forage allows the use of several herbicides to control regrowth. If canola is grown after the forage crop, then clopyralid (Lontrel) can be used. Peas should not be seeded after alfalfa.

A grass forage stand can usually be removed by applying glyphosate in the fall or spring. Spraying in the late summer or early fall will help reduce moisture loss in the next spring. However, the grass will regrow. It may not start regrowing until after the next crop is seeded, making a pre-seeding herbicide application ineffective in controlling the grass regrowth. Seeding a glyphosate-tolerant crop allows follow-up applications to control the grass as it regrows in the crop.

A broad-leaved crop should be seeded after the grass to allow the use of some grassy herbicides that will hinder grass regrowth. If a grassy weed herbicide is not used, then oats is recommended as it is the most competitive with any regrowth. Growing oats works best if the grass is sprayed in the spring rather than late in the previous fall. With this approach, the oats have more time to out-compete the grass because regrowth of spring-sprayed grass occurs later in the season.

Removing a mixed forage stand is more difficult because in-crop control of the regrowth requires herbicides that control both grassy and broad-leaved perennials. Some of the grassy weed herbicides suppress perennial grasses, but a pre-harvest or pre-seeding application of glyphosate is needed for more effective long-term control.

Annual crops seeded directly into forage stubble often produce lower yields, particularly if the forage is killed just before seeding. Killing the forage just before seeding reduces seed bed soil moisture, resulting in poor germination. In addition, the soil microbes temporarily tie up nitrogen as they decompose the forage roots and straw. Eventually, the nitrogen is released for subsequent crop growth, but this may not happen significantly until the second year of annual crop growth. For this reason, direct seeding an annual nitrogen-fixing pulse crop into grass stubble can produce good yields provided the grass regrowth is well controlled and soil moisture is adequate.

Direct seeding an annual crop into a legume forage stand is less problematic from a fertility perspective because legumes fix nitrogen, and most of this nitrogen will become available later in the growing season. However, in the early part of the growing season, nitrogen will still need to be added for the new crop.

Direct seeding into a forage stand usually results in fewer annual weeds than does tilling the stand and seeding into it. For more information on forages in rotation, see *Removing Forages from the Rotation in a Direct Seeding System*, Agdex 519-17.

Annual Legumes and Pulse Crops in Rotation

Annual legumes or pulses can give significant benefits to succeeding crops. They provide a nitrogen benefit that can replace 10 to 15 kg of nitrogen per hectare. They also provide an additional benefit, which is usually larger than the nitrogen benefit, by reducing weed and disease problems and improving soil tilth.

Summerfallow in Rotations

Many studies have shown that summerfallow decreases soil organic matter content and soil quality in most situations. In direct seeding and reduced tillage systems, the moisture conserving aspects of summerfallow are not as significant, because direct seeding conserves moisture by reducing evaporation, increasing infiltration and reducing runoff. Thus, direct seeding allows summerfallow to be used less often.

Effects of Crop Rotations

Disease control

Stubble or soil-borne diseases, such as sclerotinia and virulent blackleg, are reduced when two or three years of non-host crops are planted and host weeds are controlled. Leaf and stem diseases of cereals are also reduced by rotating host crops. Rotations do not affect air-borne diseases as much.

Some diseases, such as root rot, may decrease under direct seeding due to improved soil structure and soil health. Other diseases may increase under the moister and cooler conditions in direct seeded fields. However, crop yield increases due to the extra soil moisture can sometimes offset losses due to these diseases, and rotations can help to control the diseases.

Weed control

Weeds such as Canada thistle can be reduced in perennial forage crops cut for hay or silage. Dandelions may increase in forage stands if the stand is thin. Wild oats are often reduced after a forage stand has existed for several years and are reduced even more when an annual crop is direct seeded into forage stubble, since the soil has not been disturbed much for seeding.

Crop rotations allow herbicides from different herbicide groups to be used for weed control, reducing the risk of herbicide resistance and allowing problem weeds to be controlled.

Insect pest control

Many insects are mobile and can invade fields from the edges. Rotations reduce the impact of insect pests that are less mobile. Rotations may also reduce insecticide costs if you can spray the field edges to control invading insect pests.

Soil fertility

Both legume forage and pulse crops can increase the amount of nitrogen available for subsequent crops. In the case of forage legumes, the additional nitrogen can last for more than one year. When grass forage stubble is seeded to an annual crop, nitrogen applications may be required until the forage residue decomposes enough to release nutrients for plant growth.

Crop residue

Residue impacts from different crops are not greatly different, but some effects should be noted.

Low residue crops, like annual silage crops, canola or flax, in a rotation may be beneficial in wetter, cooler conditions. The lower residue levels may allow the soil to warm up sooner next spring, permitting earlier seeding of a longer season crop.

Higher residue levels increase moisture conservation, which can be very useful for shallow seeded crops. To get uniform germination, the crop residue must be spread evenly behind the combine.

Soil quality

The effect of different annual crop rotations on soil quality is not well known. Forages in rotation do improve soil quality.

In a general sense, improved crop yields due to good crop rotations also enhance soil quality because additional residue as straw and roots will be added to the soil. Improved yields also mean better erosion protection of the soil surface by growing plants.

Including pulses or legumes in a rotation is likely to increase crop yields with fewer shortages of nitrogen at critical times of the year. Deep-rooted legumes such as alfalfa also bring up micronutrients from deeper in the soil, eventually making them available to crops in future years through decomposition. Alfalfa can often continue to grow well in dry years since it can access moisture from deeper in the soil.

Environmental implications

Crop rotations that include pulse crops and legumes will reduce energy consumption in a major way since they do not require nitrogen fertilizers while they are growing and often add nitrogen to the soil for succeeding crops. With the increased costs of energy and of fertilizers of all types, reducing fertilizer requirements is a very significant aspect of crop rotations.

Growing perennial crops in rotations also reduces energy consumption due to fewer seeding requirements for perennials compared to annual crops. Both pulse crops and legumes within rotations will improve and reduce the carbon footprint and the energy footprint of various crops.

Crop rotations also improve the biodiversity of a farm by providing diverse habitats for various birds and other species that live on the farm.

Revenue

Rotating crops allows varying sources of revenue to even out the price highs and lows. For example, when grain prices are low, forage seed prices might be high. When canola is low, hay prices may be high. In a wet year when peas and canola get root rot, silage may perform quite well. When legume grass seed production is low due to excessive moisture, wheat, hay and grazing yields may be very good. Crops such as alfalfa, peas and chick peas do not require nitrogen input costs, and forages can reduce herbicide costs.

Time management

A diverse rotation that includes crops like winter wheat, fall rye, dormant-seeded canola, silage and hay can help spread out the workload. These different crops spread out seeding dates, herbicide application windows and harvesting dates.

Growing a greater variety of crops requires increased management skills in production, harvesting and marketing. However, more crops in the rotation can provide many rewards for that management.

Flexibility

It is important to be flexible in your crop rotations. Flexibility means adapting your rotation to the weed, disease and insect situations on your farm. As these situations change, your rotation should change to achieve the maximum benefit.

It is also useful to respond to market forces and prices by adjusting your rotations slightly. If market prices are favorable for cereals, you may have a predominantly cereal rotation, such as wheat, barley and canola. If prices for pulses are good, you may switch to barley, peas, wheat and canola. The peas can help wheat protein in the following year. If forage seed prices are good, you might extend your forage seed crop for one year.

However, the price difference must be large enough to offset the disadvantages of rotations that don't give you all the soil and crop benefits you want. It is also important to remember that prices can change by the time you have product to sell, unless you have hedged them in.

Summary

Crop rotations are a vital part of direct seeding systems. Rotations maximize the benefits of moisture conservation and reduce the impacts of diseases, weeds and insect pests.

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Factsheets in the Direct Seeding Series are also available through Alberta Agriculture's website www.agriculture.alberta.ca