

AGRI-FACTS

Practical Information for Alberta's Agriculture Industry

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Use of Fertilizers, Manures and Pesticides for Sustainable Farm Management

Optimum crop production depends on inputs of commercial fertilizer and herbicides. Today's technology-based agricultural practices have had a huge effect on increased food production across the prairies. Generally, the economic effects of increased production have been very positive; however, the ecological effects are not always as positive.

Background

Commercial fertilizers and animal manure are used to increase crop yields and to replace soil nutrients removed with harvested crops. Both have been valuable in reversing the trend of declining soil productivity and soil nutrients. Research across western Canada has clearly shown that added fertilizer not only increases crop yields, but also builds soil organic matter when more crop residue and root matter are returned to the soil.

The management and use of fertilizers, manure and pesticides vary widely across Alberta due to the wide range of soil and climatic conditions. For example, the Brown soil zone has an average growing season precipitation of about 125 to 150 mm, a high evapotranspiration potential and a fairly long growing season. In the Dark Brown soil zone, the average growing season precipitation is about 175 to 200 mm, with moderately high evapotranspiration potential. In the Black soil zone, the average annual precipitation is approximately 250 mm, with moderately low evapotranspiration potential. In the Gray Wooded soil

zone, the average annual precipitation is approximately 150 to 200 mm, with a lower evapotranspiration potential and shorter growing season.

With the use of fertilizers, livestock manure and herbicides comes the increasing environmental concern over potential contamination of soils, surface water and groundwater. A number of new and ongoing research studies by Alberta Agriculture and Rural Development, and Agriculture and Agri-Food Canada are being conducted across Alberta to address various concerns.

A number of important lessons have been learned from previous and ongoing research across Alberta. With practical knowledge, producers can take a very proactive approach now to minimize the potential negative effects when utilizing fertilizers, various manure types and pesticides on their farms.

Producers can take a proactive approach to minimize potential negative effects

Nitrogen and nitrates

Nitrogen (N) in various fertilizers and manure is converted by soil microbes to nitrate-nitrogen ($\text{NO}_3\text{-N}$), the form that plants take up. Nitrate is negatively charged and is not held by soil particles. Therefore, higher levels of nitrate in soil combined with excess rainfall or irrigation can result in leaching through the soil root zone into groundwater.

High nitrates in soil occur when manure or commercial fertilizers are applied in spring before significant crop uptake has occurred during the growing season or when applied at rates greater than crops require. Some of the suggested ways to minimize the potential for nitrate leaching include the following:

- Soil test to determine soil nitrate-nitrogen levels; then, use the information to determine the optimum nitrogen fertilizer and/or manure application rates. Select a realistic target crop yield and apply the nitrogen to meet (similar to average) crop requirements.
- Take all sources of nitrogen into account, including nitrogen from previous manure applications, N in crop residue and previous pulse crop or legume plowdown.
- Areas of each field that have uniquely different soil types or management history may require different fertilizer management. These unique areas should also be soil sampled separately from the rest of the field and managed separately.

Optimize nitrogen application method and timing:

- Band or side-band N fertilizer instead of broadcast-incorporation to maximize crop efficiency of uptake and minimize N fertilizer losses for annual crops.
- Apply split N fertilizer applications on hay and pasture land.
- Apply split N fertilizer applications for longer season irrigated crops grown on sandy soils using fertigation (fertilizing through irrigation equipment).
- When manure or N fertilizer is applied in fall, wait until late fall when surface soil temperature is < 7 C.
- Consider the use of new, slow release N fertilizer products to minimize the amount of nitrate-nitrogen in the soil.

Shift to direct seeding

The shift to direct seeding to minimize soil disturbance and maintain as much significant crop residue cover as possible on the soil surface has a number of sustainable benefits to producers and the environment:

- Reduced soil disturbance results in less rapid soil organic matter breakdown, resulting in increased soil organic matter levels and improved soil structure, leading to improved soil quality.
- Improved soil organic matter levels and improved soil structure result in reduced soil moisture loss and increased water infiltration rate, therefore reducing surface runoff of water.

- Improved soil moisture conditions can reduce the need for land to be summerfallowed. Summerfallowed land has a higher risk of nitrate leaching, a higher occurrence of soil salinity and a greater risk of soil erosion.
- Weed seeds are less likely to germinate and grow on the undisturbed soil surface, reducing annual weed problems and potentially reducing the need for herbicides.
- Less fuel is needed for field operations with direct seeding, which reduces greenhouse gas emissions and is a cost saving for the producer.
- Continual soil cover protects soil from wind and water erosion, which greatly reduces the risk of soil and nutrient movement into surface waters.

Effective use of crop rotations

The use of diverse crop rotations can be beneficial to combat some weeds, crop diseases and insects. Growing a range of cereal, oilseed, pulse and forage crops will result in the use of a wide range of herbicides from different groups, which will reduce the potential for herbicide-resistant weeds to develop.

Diverse rotations with different crops can disturb weed populations to help keep weed populations in check. Some diseases and insect pests can also be kept in check with diverse crop rotations.

Always avoid growing the same crop two years in a row on the same land to minimize pest problems and reduce the need for crop protection chemicals (herbicides, fungicides, insecticides).

The inclusion of legumes in the crop rotation will reduce the need for nitrogen fertilizer application. The nitrogen-fixing ability of legumes generally means that no N fertilizer is needed for crops such as alfalfa, sweet clover, pea, chickpea and lentil. In the year following an annual legume, plant-available nitrogen is added to the soil as legume residues break down, reducing or even eliminating the need of N fertilizer.

The N from the legume residue is released slowly over the next growing season; therefore, there is less risk that nitrate will accumulate, which can reduce the risk of nitrate leaching.

Reduced N fertilizer requirements will reduce the amount of energy needed to manufacture and transport the fertilizer to the farm, thereby reducing greenhouse gases and conserving energy.

Use livestock manure wisely

Livestock manure is an excellent fertilizer and must be viewed and managed as a resource rather than as a waste:

- Soil testing is critically important to allow good nutrient management planning. By determining nutrient levels in soil, producers can match nutrient levels in manure and balance them with crop nutrient requirements. This practice will lead to reduced problems of nutrients entering surface and groundwater.
- Use conservative rates of manure application to avoid leaching and runoff problems.
- When applying manure, always stay a safe distance away from surface water bodies.

There is increasing concern about phosphorus (P) from agricultural lands causing problems with surface water contamination. Phosphate leaching into groundwater is rarely a problem as P is normally not mobile in soil and does not leach. Generally, P is attached to soil particles and other soil elements such as calcium, iron and aluminum.

However, P can be carried with sediments into surface water. Contamination of surface water from urban waste is a concern. Runoff from agricultural lands can also be a serious potential problem. Ensuring that water and wind erosion do not occur on farms will go a long way toward minimizing contamination of surface waters in Alberta. The shift to direct seeding has played a strong role in minimizing soil erosion and movement of sediments into surface waters in Alberta.

Pesticide residues

Pesticides in surface waters in Alberta are also of increasing concern, and routine monitoring of surface waters over the past 15 years for pesticides has indicated there are problems. Fortunately, most detected herbicides have been below the current water quality guidelines for aquatic life and drinking water.

It is thought that the primary means of herbicide transport into surface waters is by wind and water movement of sediments from fields. Soil conservation efforts, such as reduced tillage and direct seeding, can go a long way toward minimizing this transport mechanism. When using soil-applied herbicides in the fall, keep a good trash cover to minimize soil erosion and water runoff from fields.

Leaching of herbicides into shallow groundwater has been identified as a concern on irrigated land. Leaching will occur when excess water moves through the soil before herbicide breakdown has occurred. Herbicides with the greatest risk of leaching are soluble and have a longer half life (resist breakdown).

To minimize herbicide leaching, producers should pay particular attention to herbicide solubility and rate of breakdown:

- Consult the Alberta Agriculture *Crop Protection* book, Agdex 606-1 (commonly called the Blue Book), to select herbicides with lower solubilities and more rapid breakdown.
- Select herbicides with lower solubility when farming on sandier soils with higher leaching potential on irrigated land or soils in higher rainfall areas.

To avoid pesticide contamination of water at point source, producers are strongly advised to use a nurse tank to fill a sprayer. Using a nurse tank will avoid the problem of back-siphoning from a sprayer tank into a water source.

Herbicide spills during tank fill can also contaminate water sources. To prevent this potential problem, add the concentrated pesticide product to the tank at a distance away from the water source.

These tips are intended to stimulate thought and discussion concerning how agricultural cropping practices can be made more sustainable for many generations. With continued research and development of practical knowledge, Alberta producers can continue to take a very pro-active approach to minimize the potential negative effects when utilizing fertilizers, various types of manure and pesticides on their farms.

It is critically important that agricultural cropping systems be complementary to maintaining healthy productive ecosystems, which are essential to human well-being.

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