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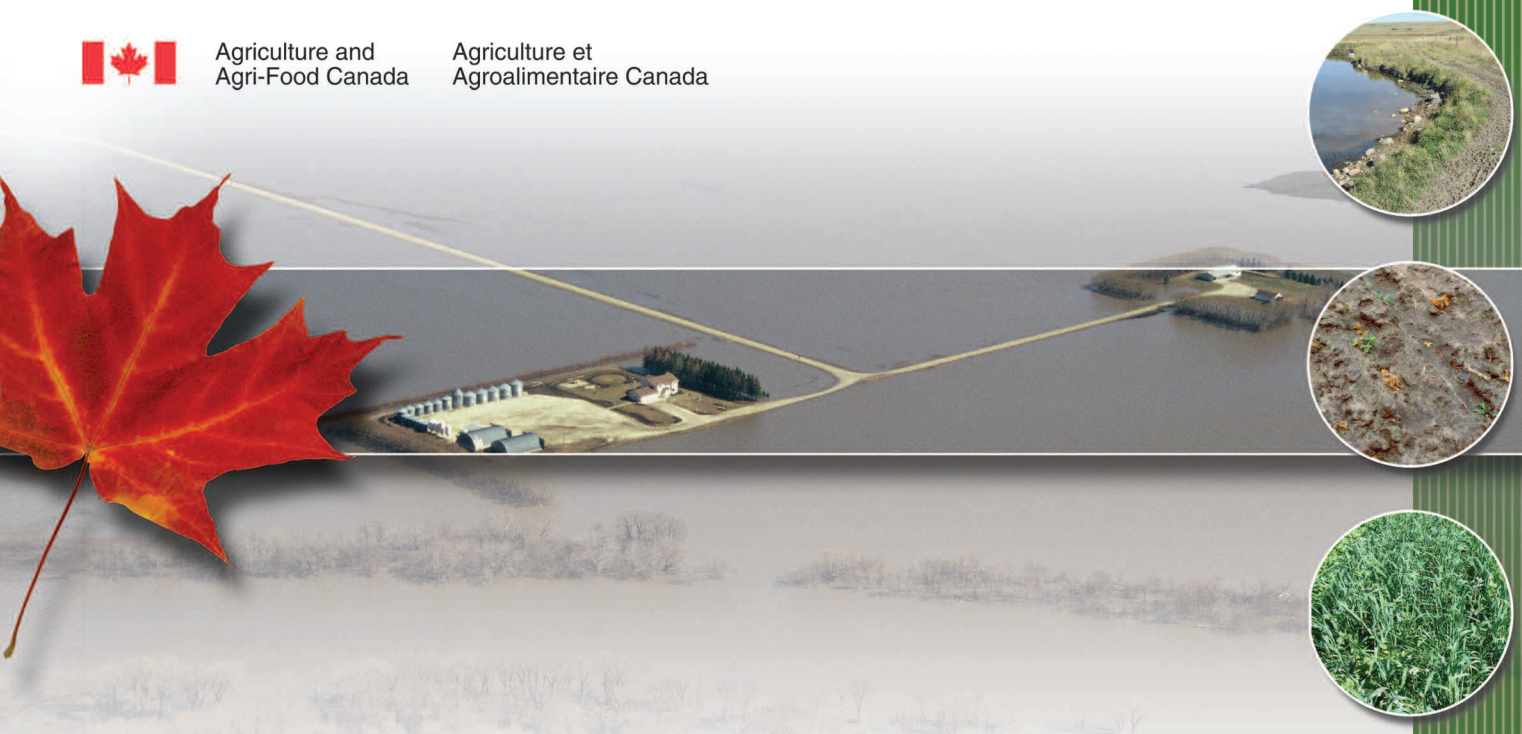

Managing Wet Soils

Canada

Managing Wet Soils

While drought is a common challenge faced by many of Canada's agricultural producers, flooded and waterlogged farmland can be just as big a problem. Saturated soils result in fields that cannot be accessed or worked, resulting in delayed seeding and lost cropping opportunities. The problem is most likely to arise when high soil moisture levels in the fall are followed by heavy spring rains or rapid snowmelt.

Agricultural land inundated by floodwaters.

Because wet soils are slow to warm up, seeds may germinate poorly and plant root systems may be stunted, leading to the possibility of inadequate nutrient uptake. Similarly, plants that develop shallow root systems due to excess spring moisture will be unable to extract deeper soil water if conditions are dry later in the growing season.

In areas where plant growth has begun, flooding can drown the crop. Waterlogging causes oxygen starvation in the root zone, which may lead directly to death or low productivity due to underdeveloped root systems. Some plant species, such as alfalfa, are much more susceptible to saturated conditions than others.

The immediate and lasting impact of excess soil moisture depends largely on the soil texture of the land. Coarse and medium-textured soils drain faster than clayey soils and are much less affected by saturated conditions. In medium and fine textured soils, excess moisture can have a number of longer-term impacts on soil properties and plant growth unless practices are implemented to help manage and mitigate the effects.

Some of the challenges wet soils present can be managed through the use of beneficial management practices (BMPs). BMPs are science-based farm practices that minimize environmental risk while ensuring the long-term sustainability of the land and the economic viability of the producer.

An important BMP for management of wet soils is the use of cover crops. Cover crops are plants grown alone or in mixtures for erosion protection, improvement of soil structure, management of plant nutrients, or the suppression of pest populations.

Even after floodwaters have receded, wet soils can pose significant management problems for producers.

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Cette publication est aussi disponible en francais
sous le titre *L'assèchement des sols saturés d'eau*

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Impacts of Excess Soil Moisture

Compaction occurs when pressure from farm equipment on the surface of wet soils forces air out of pore spaces in the soil. Wet soil has much less resistance to compaction than dry soil and, as a result, will compact to a greater density under pressure.

The most common cause of compaction is the force of farm machinery on the soil, and the potential for compaction is greatest when the soil is just dry enough to work without getting equipment stuck. Research indicates that 80 per cent of compaction occurs on the first pass. Dual wheels, low pressure tires or large flotation tires help reduce surface compaction. However, any vehicular traffic on a waterlogged field will cause subsoil compaction – the heavier the load, the greater the impact.

Compaction impedes root growth and the movement of water and air through the soil. In order for roots to grow, they must widen the surrounding pores by exerting a pressure greater than the compressed soil. Restricted access to air and nutrients exposes roots to several simultaneous stresses.

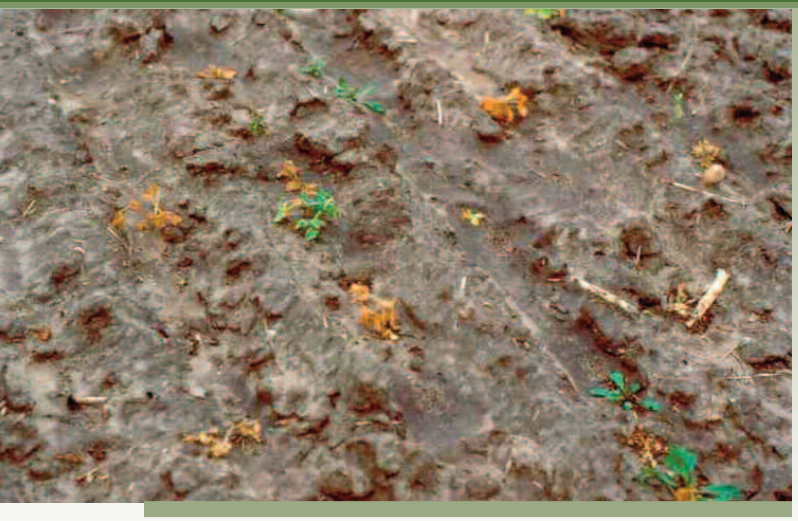
Beneficial Management Practice: Patience is the best solution when it comes to reducing the risk of compaction. That is, wait for the soil to dry before entering the field. Also, the inclusion of cover crops in rotations can improve soil structure and help reverse the effects of past compaction.

Reduced nutrient availability and nitrogen loss can occur when nitrogen gas, nitrous oxide, nitric oxide, and ammonia are released through biological and chemical reactions in the soil. When soils are waterlogged and deprived of oxygen, several species of microorganisms have the ability to obtain their oxygen from nitrates and nitrites with the accompanying release of nitrogen gas and nitrous oxide. Physical losses of nitrogen can also be a concern when anhydrous ammonia is applied to wet soils. The cooling effect of anhydrous can cause freezing of soil on the knife, leading to a wider furrow and poor soil coverage of the fertilizer band. As a result, significant amounts of ammonia may be lost to the atmosphere in the form of gas.

Wet soils have much less resistance to compaction from farm equipment than dry soils

Wet conditions can lead to a reduction in beneficial microbial populations, making it difficult for some plants to take up phosphorus. Nitrogen-fixing species may also be affected. Although the availability of most micronutrients is not directly affected by saturated soil conditions, anything that restricts healthy root growth can cause nutrient deficiencies.

Beneficial Management Practice: Nutrient losses can be minimized by good nutrient management practices. Soil-testing to determine the amount of fertilizer needed to satisfy crop requirements – along with well-timed application – are key elements of optimal fertilization. Application of variable fertilizer rates according to soil type, or split applications, can lower the risk of losing nutrients by avoiding over-application and minimizing the amount of time the fertilizer is in the ground. Inoculation of legume crops is particularly important in wet conditions when nitrogen-fixing populations may be much reduced.



Wet soils are conducive to the spread of fungal diseases such as "damping off".

Pests can show up in the form of weeds, insects and disease problems in flood years and in subsequent years. Flood-year weeds will vigorously compete with crops – taking advantage of stunted crops and areas of bare soil to grow to maturity – and new weed problems may emerge the following year. Weed seeds carried into fields by floodwaters may not have germinated in time to be noticed during the growing season and may have a chance to establish.

Flood years can also affect the natural balance of insect populations and produce conditions favourable for particular insect pests, especially those adapted to wet conditions. Similarly, many fungal and bacterial disease organisms may emerge in wet conditions.

Beneficial Management Practice: Mechanical and chemical methods need to be considered in both the flood year and subsequent years to manage weeds. Cover crops in the fallow period can effectively compete with weed growth. Wet conditions are also particularly conducive to the spread of fungal diseases which may go unnoticed at first in areas where they are not common. Consequently, new or different methods may be required to control insect and disease pests in wet years.

Crusting occurs when waterlogged soil structure breaks down to form a dense layer on the soil surface which clogs pores, reduces infiltration of water and air, and has the potential to impede the emergence of seedlings.

Surface crusts are usually broken by harrowing prior to seeding. On some soils, however, mechanical disruption may leave clods on the field, creating a reduction in seed-to-soil contact after planting.

Beneficial Management Practice: Cover crops and crop residue retention can help prevent the formation of surface crusts by improving the structure and organic content of the soil.

Pasture damage can occur when waterlogged pasture land is grazed. The harm caused by animal hooves generally leads to a reduction in pasture productivity, soil compaction, changes in the composition of forage species, and the creation of bare ground that is vulnerable to weed invasion.

Outbreaks of anthrax can also occur during periods of wet weather. The bacteria can grow rapidly in wet alkaline soil conditions, and then form spores when the soil dries. Changes in soil moisture, flooding and drying, can lead to a build-up of anthrax spores on pastures. Livestock producers who suspect an anthrax infection in their animals should contact a local veterinarian immediately.

Beneficial Management Practice: The most effective way to manage wet pasture land is to stop grazing it until it dries out enough to support the grazing impact of livestock. For severely damaged land, re-seeding may be necessary.

Erosion and runoff generated by floodwaters can damage soils and result in downstream deposits of sediments, nutrients, pesticides, and other pollutants.

Beneficial Management Practice: The best protection from erosion is the implementation and establishment of control measures such as grassed waterways, reduced tillage, residue management, and runoff diversions.

Salinity may occur in very wet years when water tables are higher than normal, causing salts in the subsoil to dissolve and rise to the surface. The introduction of salts to the root zone can severely reduce the yields of salt-sensitive crops.

Beneficial Management Practice: Salt levels can be checked with a simple soil test. The surface (0-15 cm deep) is most important, but with more sensitive crops, the 15-30 cm depth may also have an effect. If salinity is a potential problem, select salt-tolerant varieties of plants.

Damage to pasture from animal hooves is compounded when soils are wet.

Cover Crops

Cover crops are an attractive option for producers facing flooded or very wet soils in the spring, and can be a useful alternative to summer fallow. Cover crops are often spring cereals, which are relatively inexpensive to seed, competitive with fall weeds, and killed by winter freezing. Farmers are also beginning to use fall-seeded crops such as winter wheat, fall rye and winter triticale to achieve an economic return the following year. Nutrients absorbed by cover crops are recycled into the soil through decomposition and become available to the subsequent crop. A cover crop can help address many moisture-related issues on the farm, including:

- Erosion control – A cover crop protects soil susceptible to wind and water erosion. It is typically planted later in the growing season to provide enough leafy top growth to protect the soil. It may be planted just before a fallow year or following crops that leave little residue cover, such as potatoes and pulses.
- Compaction – After a cover crop is incorporated or desiccated, the decomposing biomass provides organic matter to the soil which increases microbiological activity and improves soil structure.
- Infiltration – Root channels from a cover crop will improve soil structure and create pathways for water movement.
- Crusting – Growing cover crops provides an increase in organic matter content, infiltration and aggregate stability that will reduce the risk of soil crust formation.
- Weeds – Cover crops during the fallow period reduce competition from weeds.

Cover crop – species mixture of vetch, radish and oats.

Different species of cover crop have qualities that make them useful in different situations. For instance, legumes and pulses host nitrogen-fixing bacteria, while deep-rooted crops can scavenge nutrients from the subsoil and create root channels that improve drainage and infiltration. Crops that grow rapidly prevent nutrient losses from the soil and help suppress weed growth. Crops that differ from the current income-producing species may help break pest and disease cycles.

Because the choices and respective benefits of cover crops vary greatly, you should consult your local agricultural specialists to select appropriate cover crops for your area.

For more information, visit the Agriculture and Agri-Food Canada Web site at www.agr.gc.ca

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