Best Management Practices

CONTOUR FARMING AND STRIP CROPPING

Long, sloping cropland with medium-textured soils such as loam and silt loam are very susceptible to erosion by water. When tillage is performed up and down slopes, soil is put at even greater risk by tillage erosion.

Erosion risk can be reduced by implementing one or more of the following goals in your cropland management system:

- building soils – by adding organic amendments, incorporating green manures, growing forages or crop rotation
- covering soils – with crop residue, permanent cover or cover crops
- reducing disturbance – with no-till or reduced tillage
- reducing slope length – farming on the contour, with or without strips, reduces the impact of slope length on the risk of erosion.

This factsheet focuses on the last bullet – reducing slope length. It explains how contour farming and contour strip cropping work and provides tips and case studies.

THE ROLE OF HEALTHY SOIL IN A CHANGING CLIMATE

Agriculture and climate are directly linked – anything that has a significant effect on our climate will influence farm production. Greenhouse gas (GHG) emissions and climate change are global concerns, and agriculture can be part of the solution.

BMPs that improve soil health can also help lower GHG emissions, reduce phosphorus loss from fields to surface water, and improve resilience to drought or excessively wet conditions. Healthy soil – an essential component of a healthy environment – is the foundation upon which a sustainable agriculture production system is built.

OFA Ontario Federation of Agriculture
Ontario
Canada

Why farming up and down slope is a problem

On many farms, due to the shape of the field or the nature of the slopes, there are fields where cropping and tillage operations have always been up and down the slope. In most cases, this is not good for soil health.

TILLAGE EROSION – Severe tillage erosion can lead to other forms of degradation including accelerated erosion by water, low moisture availability, increased bulk density, lower fertility, and very poor crop productivity. If the eroded area follows a uniform pattern in the field – as when most of the knolls and upper slopes are degraded – then contour strip cropping may work. Otherwise, it is not uncommon for irregularly shaped eroded areas to be retired to trees or other permanent cover.

WATER EROSION – On sloping cropland, moving water can lead to the erosion of soil particles. Sheet erosion is the removal of uniform layers of soil by water. Erosion caused by concentrated flow forms rills. When the rills develop into channels large enough to prevent crossing by farm machinery, these channels are known as gullies. The risk of runoff and erosion increases with slope steepness (grade) and slope length. See the BMPs for Soil Health Diagnostic Infosheet *Water Erosion*.

RUNOFF AND WATER QUALITY – Excess water from storm and erosion events can carry cropland sediment, attached nutrients, soil organic matter and nutrients in solution into adjacent surface waters. These nutrients can contribute to excessive aquatic plant and algal growth (eutrophication). When the nutrients become limiting, the vegetation dies. The resulting decomposition of this vegetation can consume dissolved oxygen in the water to the point that it can cause a fish kill.

Why contour farming works

Contour farming (otherwise known as contour cropping and tillage) is the practice of cultivating and planting crops at right angles to the natural slope of the land to slow the movement of water and reduce soil loss.

Tilling up and down long steep slopes increases the risk of erosion by tillage and water.

When farming on the contour, rows are perpendicular to the slope. The small ridges formed by tillage and planting operations reduce the speed of water movement over the soil and encourage infiltration into the seedbed.

Switching to cross-slope tillage will substantially reduce the risk of erosion.

Contour strip cropping refers to growing crops in a systematic arrangement of strips along the contours and across a sloping field. It has all of the advantages of contour farming (cropping and tilling) as well as providing different forms and levels of soil cover.

CONTOUR STRIP CROPPING – the growing of equal widths of alternating crops along the contour of a sloping landscape – is more effective at reducing erosion and runoff than contour farming.

Including alternating strips of increased soil cover – with more intense vegetation such as grasses and legumes or increased residue – will reduce erosion by detachment, reduce soil particle transport in the more intensely vegetated strip, and intercept eroded soil particles from the more intensely cultivated strips.

STRIP CROPPING – is a cropping system where crops with different growth patterns, canopies, stem and foliage patterns, growth rates and root systems (e.g., row crops vs. forages) are grown in alternate strips across the dominant slope and not along the contour. The crop strips provide a variety of barriers to runoff and protect the soil during the growing season.

CONTOUR FARMING AND SOIL HEALTH

The soil health advantages from contour strip cropping can be compounded if several best management practices (BMPs) can be integrated into the cropping system. In addition to reducing slope length, consider:

- **using no-till to reduce disturbance**
- **planting cover crops to keep otherwise bare soils covered, and**
- **rotating crops with forages or green manures to increase soil organic matter levels and build soils**

LESS SOIL MOVES DOWNSLOPE – The rate of tillage erosion is reduced with any cross-slope cropping and tillage practices, as less soil is carried downslope for long distances. See the BMPs for Soil Health Diagnostic Infosheet *Tillage Erosion*.

SHORTER SLOPE LENGTH – Farming on the contour breaks up long continuous slopes on the field. The impact is a reduction in the rate that water can flow downslope. This will reduce the risk of soil detachment and movement as overland flow is always blocked by a pattern of ridges and crops positioned across flow paths.

INFILTRATION VERSUS RUNOFF – Sloped cropland is cultivated and wide strips of crops are grown at right angles to the slope and along lines of consistent elevation. Rainwater infiltrates into the soil, reducing soil losses from surface erosion. This can be achieved by means of furrows, crop rows, and wheel tracks across slopes (as opposed to up and down slopes), all of which act as reservoirs to catch and retain rainwater, thus permitting increased infiltration and more uniform distribution of the water.

Considerations for contour farming

SOIL HEALTH PLAN AND OVERALL SOIL CONSERVATION SYSTEM

Switching from up-and-down-slope farming to contouring is a big decision. Growers considering the switch are often dealing with an ongoing erosion or soil health problem, and/or about to make several improvements to their entire operation.

Complete a soil health plan or other form of soil conservation plan to establish the nature and extent of the problems and the range of options to address them. More often than not, this entails the integration of several complementary BMPs and not just a change in direction.

In large, steeply sloping fields, it may take several BMPs to tackle the soil challenges that exist there. Contouring will reduce tillage and sheet erosion, but erosion control structures (e.g., grassed waterways) may be required for channelized flow if draws and washouts (i.e., large rills and gullies) are found in the field.

SPECIALIZED EQUIPMENT OR PROFESSIONAL ASSISTANCE

In the recent past, design and layout of contour farming systems – especially strip cropping – required tools such as contour gauges or levels. Today, growers may have the ability to utilize their GPS equipment to develop topographic maps and subsequently GPS guidance equipment to guide them along a contour.

Farmers can use readily available GPS technology and software to develop contour maps and to guide operations along established contours on sloping land.

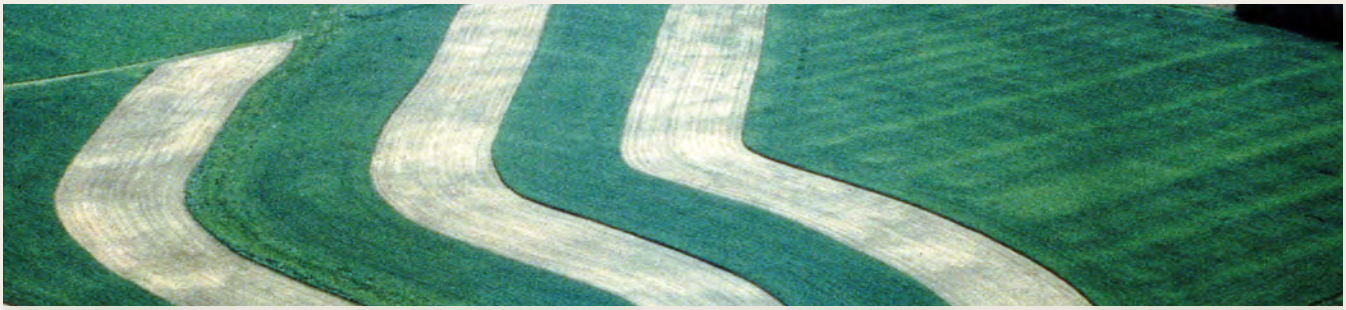
FIELD SIZE, SHAPE AND SLOPE

Field size and shape can pose limitations to contour farming design options. Large square fields with long simple slopes are more suitable to contour strip cropping, whereas long rectangular fields may be more suitable for cross-slope strip cropping. Complex sloped areas (with short slopes in several directions) may not be suitable for any type of contour farming. Severely sloped fields should be considered as candidates for perennial systems or retirement to trees.

Long rectangular fields may be more suitable to cross-slope rather than contour strip cropping.

CROP ROTATION

More cover means more erosion control. Forages provide the most cover. Cover crops are the next best choice, followed by cereals. There are several key factors to consider when planning a crop rotation. All agronomic crops are suited to contour farming and strip cropping. Alternating row crops with solid stand crops (e.g., cereals) or forages is the most effective pattern for erosion control on sloping lands.



In this photo, the green strips are alfalfa/hay. The light-coloured strips are row cropped (corn/soybeans/wheat rotation). After three years, these alfalfa/hay strips will be rotated into corn/soybeans/wheat. The lighter (row crop) strips would then be planted to alfalfa/hay.

SOIL HEALTH

Soil texture, soil organic matter level, and condition of topsoil should be considered. Soils with poor health may require other complementary BMPs to make the contour farming option work more effectively. BMPs that increase the level of organic matter, cover the soil, or reduce disturbance are key here.

Soil with poor soil structure cannot be fixed with contouring. Complementary BMPs such as adding organic amendments will improve soil health and help make contour farming work.

See these titles in the BMPs for Soil Health Factsheet series: *No-Till, Residue Management, Winter Cover Crops* and *Adding Organic Amendments.*

Tips that make contour farming and strip cropping work

- ✓ Determine if more than one key contour line will be needed if you encounter steep or irregular slopes.
- ✓ Use a contour gauge or GPS guidance equipment to assist in establishing and planting along the contour.
- ✓ To avoid having to lay out new key contour lines every year, establish a narrow permanent strip of grass along each key contour line, or save the key contour lines electronically using your farm equipment's GPS guidance hardware and software.
- ✓ Include grassed field borders or headlands to collect inter-row runoff and to control sheet and rill erosion at field edges.
- ✓ On long slopes, pair contouring with reduced tillage, terraces, strip cropping, and/or contour buffer strips.
- ✓ Watch for concentrated (channelized) flows in draws during storm events. Erosion control structures such as grassed waterways or water and sediment control basins (WASCoBs) should be considered as part of the soil conservation system.
- ✓ Maintain a 0.5–1% grade along rows. The following slope-length limits should be considered when planning for contour farming:

LAND SLOPE (%)	MAXIMUM SLOPE LENGTH
1–2	120 m (400 ft)
3–5	90 m (300 ft)
6–8	60 m (200 ft)

With alternating crops, contour strip cropping requires an adjustment to scheduling field operations.

It is important to include grassed field borders to prevent erosion of the soil on the edges of the fields.

Case studies

STRIP CROPPING

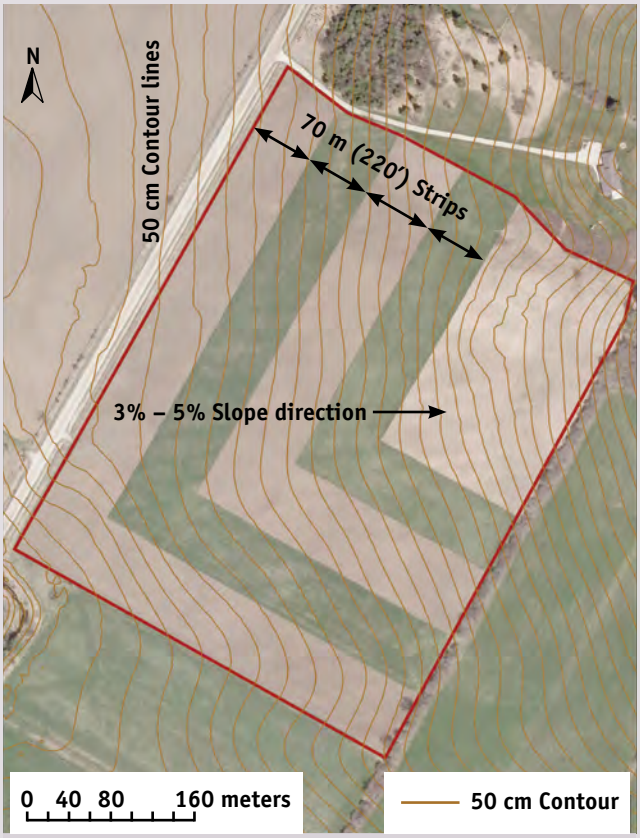
Strip cropping, particularly contour strip cropping, is best suited to landscapes with long, uninterrupted, uniform slopes. Such landscapes are not common in Ontario, but as today's farming practices trend towards larger and larger fields, opportunities to interrupt slope lengths with contour or cross-slope cropping practices are rising. The following Wellington, Oxford, and Huron County examples illustrate how this approach might be applied on Ontario fields.

Wellington County – Strip Cropping

This case study field has 3–5% slopes that cause surface runoff to flow overland from the field's southwest corner to its northeast corner. The landowner has worked this field in 70 m (220 ft) wide crop strips, in an L-shaped pattern, to try to interrupt the downward flow of runoff water. The extreme northeast corner of the field has been planted to hay to further protect that area from erosion.

While the rectangular L-shaped strips do not exactly follow the field's contour, this layout is more convenient for machinery operation and it does help interrupt the downslope flow of water, reducing the erosion potential. When some of the strips are planted to a permanent crop such as hay, they can trap eroded sediment from the upslope worked strip, keeping it from leaving the field.

Planting row crops such as soybeans in strips with a perennial crop as shown here, instead of one uniform field planting, can encourage eroded soil to settle out at the boundaries of these different cropping zones. This reduces the chance of sediment loss moving beyond the field edge.



Strip cropping was applied to this case study field with 3–5% slopes in Wellington County. Planting rotational crops in strips, such as grain corn and soybeans as is shown here, as opposed to one uniform field planting, can encourage eroded soil to settle out at the boundaries of these different cropping zones. This reduces the chance of sediment loss moving beyond the field edge.

Oxford County – Contour Cover Crop Strip

In this case study, very little residue remained on the field following fall soybean harvest. Strips of fall rye were planted in the fall along the contour, likely with the aid of GPS guidance equipment. By spring, these strips were well-established and could potentially slow runoff enough to trap sediments eroding from the more vulnerable areas of the field.

When ready to plant this year's crop, the land manager simply worked up the field as normal, including the cover strip areas. While this approach did not provide the full erosion protection of a field planted entirely to cover crops, the strategic placement of the cover crop in strips on the contour helped maximize the erosion control effectiveness of the overwintering fall rye.

Overwintering cover crops planted on the contour the previous fall can provide erosion protection and act as a sediment trap in the event of heavy spring rains.

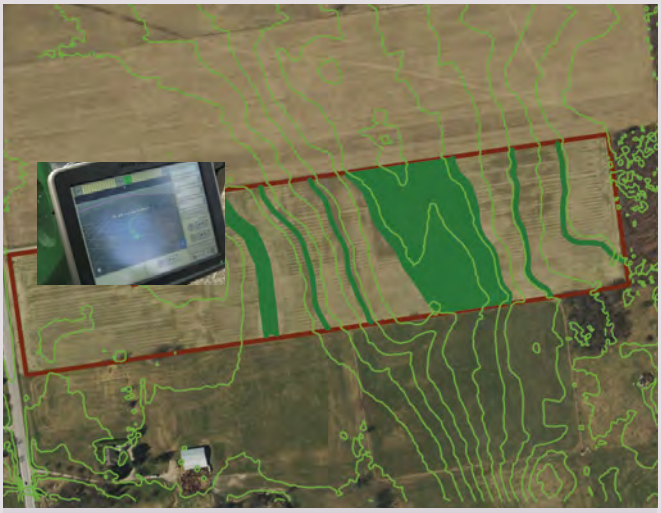
These contour cover crop strips were temporary, allowing the field to be worked normally when planting the new crop the following spring.

Huron County – Contour Cover Crop Strip

The non-growing season is the time of year when cropped fields generate the most runoff and see the greatest sediment and phosphorus loss. With the optional GPS and mapping technology available on today's farm equipment, it is relatively easy to lay out and plant temporary, or even permanent, contour strips on farm fields.

This Huron County case study saw the landowner plant an oat cover crop over the entire field following winter wheat harvest. The oats would die naturally over winter. Similar to the Oxford County example described earlier, this landowner immediately followed the planting of oats with planting a series of strips of winter rye on the contour and in vulnerable (erosion-prone) areas of the field. GPS equipment, available on the tractor, guided the fall planting of these contour strips of winter rye.

The rye was burned down with herbicide the following spring in advance of planting the year's soybean crop. These growing strips provided an added barrier to slow down overland spring runoff moving downslope, and also supplied living roots to help protect the soil from erosion in the early spring.



Strips that closely follow a field's topographic contours can be easily established with the aid of today's GPS and machine-guidance equipment when the proper prescription maps are prepared.

For more information

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Many sources of supplementary information are available.

Below are some suggestions to get you started. Most can be found online at **ontario.ca/omafra** or ordered through ServiceOntario.

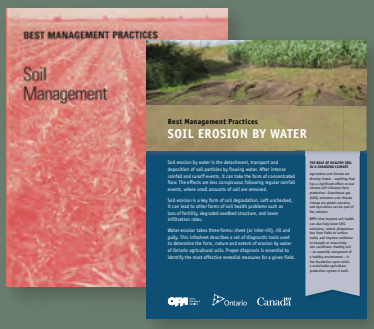
- *Agricultural Erosion Control Structures: A Design and Construction Manual,* Publication 832
- *Drainage Guide for Ontario,* Publication 29

Best Management Practices Series

- *Cropland Drainage*
- *Field Crop Production*
- *No-Till: Making It Work*
- *Soil Management*

Environmental Farm Plan (4th ed.) and EFP Infosheets

- #15, *Soil Management*
- #19, *Field Crop Production*
- #21, *Stream, Ditch and Floodplain Management*



Inquiries to the Ontario Ministry of Agriculture, Food and Rural Affairs

Agricultural Information Contact Centre
Ph: 1-877-424-1300
Email: ag.info.omafra@ontario.ca
Web: ontario.ca/omafra

ORDER THROUGH SERVICEONTARIO

Online at ServiceOntario Publications – **ontario.ca/publications**

By phone through the ServiceOntario Contact Centre
Monday–Friday, 8:30 am–5:00 pm
416-326-5300
416-325-3408 TTY
1-800-668-9938 Toll-free across Ontario
1-800-268-7095 TTY Toll-free across Ontario

ACKNOWLEDGEMENTS

This factsheet was developed by the OMAFRA Soils Team: Adam Hayes (Chair), Doug Aspinall, Andrew Barrie, Sebastien Belliard, Dave Bray, Christine Brown, Adam Gillespie, Christoph Kessel, Kevin McKague, Jake Munroe, Deanna Nemeth, Nicole Rabe, Jim Ritter, Daniel Saurette, Stewart Sweeney, Ted Taylor, Anne Verhallen

Research and Writing: Ann Huber, Don King, Margaret Ribey, Soil Research Group (SRG)

Technical Coordinators: H.J. Smith, Ted Taylor

Editorial Coordinator: Alison Lane

Design: Neglia Design

AF157
ISBN 978-1-4606-9346-9 (Print)
ISBN 978-1-4606-9348-3 (HTML)
ISBN 978-1-4606-9350-6 (PDF)

BMPs for Soil Health Factsheet Series:

Adding Organic Amendments

Buffer Strips

Contour Farming and Strip Cropping

Cover Crops and Manure Application

Crop Rotation for Vegetable Crops

Cropland Retirement

Erosion Control Structures

Field Windbreaks

Inter-Seeding Cover Crops

Mulch Tillage

No-Till for Soil Health

Perennial Systems

Pre-plant Cover Crops

Residue Management

Rotation of Agronomic Crops

Soil Remediation

Subsurface Drainage

Wind Strips

Winter Cover Crops

BMPs for Soil Health Diagnostic Infosheet Series:

Cold and Wet Soils

Contaminated Soils

Droughtiness

Excessive Fertility

Low Fertility

pH Extremes

Salinity

Soil Erosion by Water

Subsidence

Subsurface Compaction

Surface Crusting

Tillage Erosion

Wind Erosion