Best Management Practices

WIND STRIPS

Strong winds on unprotected cropland can damage crops and degrade and erode soil. In most cases, wind can be managed, if not controlled. One strategy is to plant wind strips, which are narrow strips of annual cereals planted between rows or beds of wide-row tender crops.

This factsheet explains the impact of wind erosion on soil health and productivity, explores options for wind control, describes types of wind strips, and offers planning, design, and maintenance tips.

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.

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How wind erosion affects soil health and productivity

Winds blowing across large, open, unprotected fields will move soil – within the field and also off the field into ditches, roads and field borders. Under the right conditions, even clay soils will move. Soil organic matter and crop inputs often move offsite with the soil particles. Wind erosion poses additional risks to soil health, including loss of tilth, structural degradation, and reduced water-holding capacity.

Wind can damage crops as well. Fine and very fine sand particles or muck suspended by wind can bury or expose seeds and bulbs and damage stems and fruit, which allows the entry of disease organisms.

Wind erosion occurs when strong winds blow over a smooth, exposed, loose and dry soil surface Depending on conditions, the wind speeds required to start the erosion of mineral soils vary between 25 and 50 km/hr measured at 30 cm (1 ft) above the soil surface. Soil particles between 0.1 and 0.5 mm diameter (e.g. fine and medium sands) are the first to move.

Sand-blasting of young tomato transplants can cause irreversible damage – from the entry of disease organisms to as much as a 50% loss in yield due to whole plant damage.

Without control, you can't win with wind – because you risk losing topsoil, soil health and your crop!

WIND EROSION AND MINERAL SOILS

Wind erosion reduces the quantity and quality of soil within a field. The process of wind erosion is: **detachment → transport → deposition.**

Dirty snow on cropland is an indicator of wind erosion during the winter months.

Soil particles move by saltation, soil creep or suspension.

Saltation is the movement of soil particles from a series of short bounces along the surface. Particles remain close to the ground as they bounce. This accounts for a majority of total soil movement. Saltating particles bouncing on the surface can dislodge larger particles. This can produce soil creep, or the collision can send smaller particles into suspension (especially fine and some medium sands) that can be carried in the wind.

Soil creep occurs when soil particles are dislodged and roll or slide along the soil surface. Soil creep accounts for the movement of particles up to 1.0 mm in diameter (i.e. medium and coarse sands).

Suspension is the movement of dust-sized soil particles (less than 0.10 mm in diameter) or very fine sand and silt particles) parallel to the soil surface.

Wind can move the soil in many different ways. Saltation is the main mechanism by which soil moves around a field. Both saltating and suspended soils cause crop damage and move the fine soil particles off a field.

WIND EROSION AND ORGANIC SOILS

Peat or muck (organic) soils are much less dense than mineral soils and are more easily eroded by wind. Although organic soils are often moist during the year, freshly worked and exposed organic soils can dry quickly. Dry, loose particles are at risk of becoming suspended in light to moderate winds.

Peat or muck soils are highly susceptible to wind erosion.

OTHER SOIL HEALTH PROBLEMS

Degraded soil structure

A soil's physical properties affect its susceptibility to wind erosion. A poorly structured, bare, recently tilled soil is highly susceptible to wind erosion even though the soil surface is rough. The effect of wind erosion on poorly structured soil is especially pronounced when the soil is dry.

Soil structure damage by wind erosion is caused by the collision of suspended soil particles with those still on the surface. The impact from the suspended particles breaks down the soil aggregates. Over time or under extreme conditions, the wind can remove soil particles and topsoil completely, resulting in exposure of the subsoil. Subsoils have weak soil structure and are poor growing media.

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Sandblasting

Sandblasting of growing plants is unique to wind erosion. It causes yield and quality losses. Plants vary in their tolerance, with small grains being relatively tolerant of abrasion. Corn, soybeans and mature alfalfa have a moderate tolerance, vegetables have a low to very low tolerance, and seedling alfalfa and sugar beets have a very low tolerance. Seedlings are usually the most affected by sandblast and in some situations re-seeding may be required.

Climate change adaptation

Global climate change has already shown signs of changing weather and a predicted increase in storm events. The frequency of wind storms will likely increase, as will the extent of wind damage. Growers will need to have preventive measures in place, i.e. a wind control system governed by best management practices.

Open and unprotected croplands with sandy soils are most prone to wind erosion. If you can see soil material moving, it is estimated that up to 5 tonnes/acre are being lost.

These onion sets have been gradually exposed over several days due to soil loss from wind erosion.

Wind control options

In most cases, wind can be managed, if not controlled, through three general strategies: altering wind speed and movement near the ground, protecting the soil surface, and moderating the damage that wind causes. Regardless of which strategy or combination of strategies you choose, it is always far more effective to employ several types of best management practices (BMPs) in a system.

Sometimes treed windbreaks are not the answer. Growers of high-value horticultural and specialty crops often want wind abatement systems that don't take up as much valuable cropland, are flexible from year to year, and are effective within the year of establishment. Growers using wind strips see this BMP as meeting these requirements.

Wind strips provide flexible wind protection for high-value land. They can also be used either in combination with windbreaks or as a transitional measure until tree windbreaks are large enough to provide sufficient protection.

Fall-planted cereal rye wind strips protect newly established tomato transplants. The wind strips also modify the microclimate, holding warmth resulting in air temperature increase of 1 to 2° C. Later in the season as the wind strip dies down, the remaining residue helps to hold soil moisture and modify soil temperatures during the heat of summer.

TYPES OF WIND STRIPS

Wind strips come in many forms:

- **In-crop:** solid stand or rows of wind barriers within protected crop (e.g. barley and onions or carrots in muck soil)
- **Narrow strips (on beds):** single row or row on each bed edge (e.g. cereal rye and processing tomatoes)
- **Wide strips (on beds)**: full bed-width strips of cereals (e.g. cereal rye and green peppers)
- **Widely spaced strips:** 2–10 ft. wide strips of winter cereals between multiple rows or beds of vegetables (e.g. cereal rye and melon crops)
- **Annual field buffer:** wide buffer of cereals planted on headlands or other field edges (e.g. oats and carrots).

IN-CROP WIND BARRIERS

Barley is often broadcast or planted in rows to provide early season protection for sensitive crops from wind erosion and crop damage.

In-crop wind barriers can be broadcast or drilled and then controlled with selective herbicides as needed. These young onions are protected by strips of barley that were drilled and then controlled to provide adequate protection and minimal competition with the young onion crop.

NARROW STRIPS

Single-row narrow strip wind strips established in the fall will provide adequate protection from wind and sandblasting for processing tomato crops until canopy closure in the following spring.

The cereal rye is killed with a herbicide. It is important that the kill is slow to ensure that the residue stays upright, providing the most wind protection possible.

Narrow wind strips can take many forms. They can be planted as distinct rows (left) or created from a fall-planted full field cover crop (right). They provide wind protection and help to reduce compaction from field equipment during the growing season.

WIDE STRIPS (ON-BED)

Wide on-bed wind strips (0.9–1.5 m or 3–5 ft wide) can provide early season protection from wind and drying conditions for a broad range of transplanted vegetable crops, including cucumbers, melons, fresh-market tomatoes and peppers.

WIDELY SPACED WIND STRIPS

Widely spaced wind strips can be designed to do double-duty. A winter cereal like rye can be drilled throughout the field in the fall to provide overwinter protection as a cover crop. In the spring, tillage or a selective herbicide treatment can be used to create wide wind strips before planting fresh-market crops.

Widely spaced wind strips provide protection for crops like green pepper from wind erosion, sandblasting and drying conditions on the ground. They are also used by growers as harvest alleys and for in-season traffic for field sprayers and irrigation equipment.

ANNUAL FIELD BUFFERS

Annual field buffers planted on headlands of vegetable fields – like this headland planting of oats in carrots (left) or another headland of oats in a processing tomato field (right) – will protect the field and crop from wind and water erosion, runoff and soil compaction, and reduce the risk of spray drift.

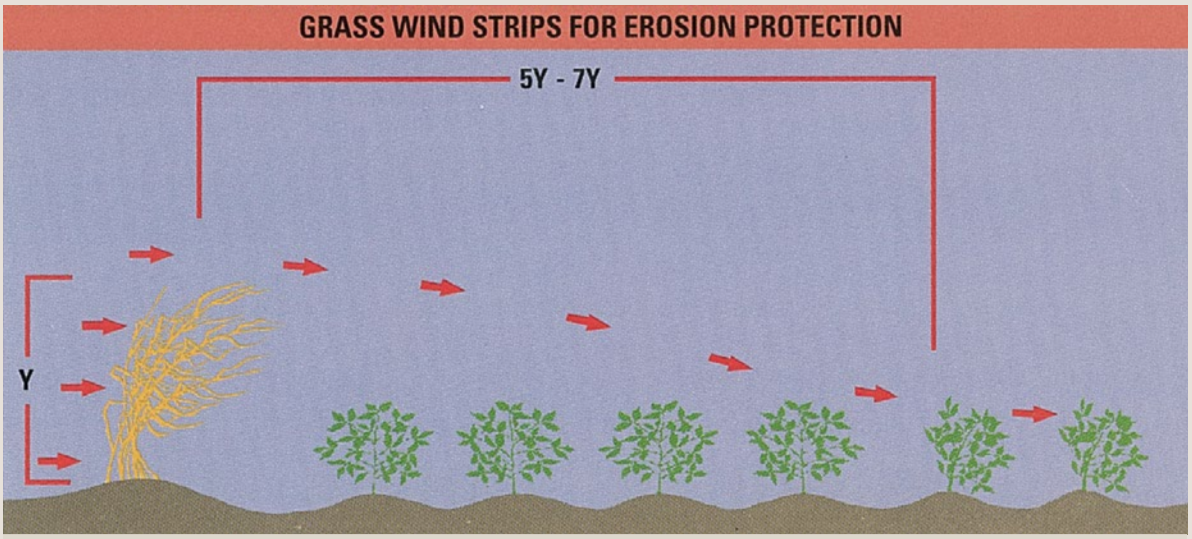
Why vegetative wind barriers are effective

LIVING SNOW FENCE EFFECT

Living plant root systems hold the soil in place, which helps to prevent erosion. Plant roots and associated microbes generate exudates that act as glue in the soil and hold the particles together. These larger, aggregated particles are less susceptible to erosion.

WIND DEFLECTION

Research with tree windbreaks has shown that trees protect or deflect wind for a distance equal to 10 times the height of the trees. However, grass wind strips are more flexible and will tend to bow or bend down a bit under the wind pressure, reducing the protected distance to approximately seven times the height of the grass wind strips. The maturity of the plant material or the stiffness will modify the protected area.



Tall, stiff grasses or cereals can deflect wind and protect growing plants up to seven times the height of the plants in the wind barrier.

SOIL MOISTURE RETENTION

Reduced wind speeds during the growing season reduce the risk of moisture loss from soil (evaporation) and crops (transpiration). Better moisture conditions translate into higher yields, better product quality, reduced requirements for irrigation during low-moisture conditions, and reduced wind erosion.

EARLIER MATURITY

Research has shown that slightly warmer aboveground temperatures can lead to earlier maturity of vegetable crops such as tomato with the use of wind strips.

PESTICIDE DRIFT REDUCTION

Vegetated wind strips modify near-ground wind speeds and patterns. Reduced wind speeds and turbulence will help to reduce off-site, downwind pesticide spray drift from cropland applications.

WILDLIFE HABITAT

Vegetative wind strips will increase escape cover and the amount of habitat edge. This edge will improve the quality of wildlife habitat for edge-loving species such as pheasants and quail as well as grassland songbirds.

BENEFICIALS AND BIODIVERSITY

Many beneficial insects and other predatory arthropods need permanent cover, especially grasses, to survive the winter. Vegetated wind strips can provide space and cover for beetles, spiders, and parasitic wasps over winter. This allows them to re-enter cropped areas sooner and in greater numbers.

QUICK EFFECTIVENESS

Annual cereal or perennial grass strips provide immediate cover to sensitive crops – whereas, field treed windbreaks may take up to 10 years before providing adequate protection.

DESIGN FLEXIBILITY

One of the key advantages of vegetative wind strips is the flexibility of design – especially when choosing annual plants. Growers can alter number of rows, seeding density, and spacing between barrier rows to adjust to equipment and production needs.

NURSE CROPS FOR TREED WINDBREAKS

Cereal cover crops can be ideal nurse crops for treed windbreaks until the tree seedlings become established.

Growers confirm research findings of earlier maturity dates for crops like tomatoes and seed corn when protected by wind strips.

Although treed field windbreaks provide thorough protection from wind and sandblasting, the impact may take up to 10 years to take effect. The benefit of cereal or grass wind strips can be realized in the year they are established.

The design and layout of annual cereal wind strips can be altered to fit the requirements of crops in rotation.

Making them work

PLANNING CONSIDERATIONS

- **Space requirements –** as with buffer strips, windbreaks and erosion control structures, these erosion control BMPs take up valuable crop acreage
- **Operational challenges –** wind strips can be obstacles to field operations in terms of equipment dimensions and maneuverability
- **Weed control –** control products and application need to be considered to ensure no loss of efficacy
- **Disease concerns –** reduced air movement can lead to higher humidity and concerns about longer periods of leaf wetness leading to more disease. Wind strips can be mowed or knocked down as the season progresses and the wind erosion threat is reduced, to allow for better air circulation.
- **Frost –** reduced air movement in early season due to wind strips can make a field more frost-prone under specific conditions. However, moist soils under sunny conditions will accumulate heat that may be enough to overcome the overnight cold temperatures. Wind strips can be managed through mowing or by increasing air movement during frosty conditions, e.g. helicopter, tractor movement through field.

DESIGN GUIDELINES & TIPS

- The protected area can be estimated by taking the height of the planted vegetation and multiplying it by a factor of 5–7.
- To ensure optimal wind protection, spacing between strips (not within row) should not exceed 12 times the expected height of the herbaceous wind strip. Adjust wind strip spacing to accommodate width of farm equipment and to reduce trampling of the grasses.
- When two or more rows are required to achieve the required porosity and to avoid gaps, the rows should be spaced no more than 0.9 m (3 ft) apart.
- Strips should be planted perpendicular to the prevailing winds (during the season of greatest risk) in order to slow and disperse the wind.
- Herbaceous cover can be composed of perennial or annual vegetation, growing or dead.

Strips should be planted perpendicular to the prevailing winds.

Suitable barrier plants must satisfy several criteria:

- easily established and fast-growing or have long-lasting stalks that will remain standing over winter
- stiff, erect form
- non-spreading rooting habit
- tolerant of herbicide drift
- lodge-resistant
- tolerant of climatic extremes – wind, cold, heat, saturation and drought.

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.

- Publication 811, *Agronomy Guide for Field Crops*
- Publication 611, *Soil Fertility Handbook*
- *Soil Erosion – Causes and Effects*, Factsheet 12-053 **omafra.gov.on.ca/english/engineer/facts/12-053.htm**

Best Management Practices Series

- *Buffer Strips*
- *Controlling Soil Erosion on the Farm*
- *Cropland Drainage*
- *Establishing Tree Cover*
- *Field Crop Production*
- *Soil Management*

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

- #15, *Soil Management*
- #16, *Managing Nutrients in Growing Crops*
- #17, *Use and Management of Manure*
- #18, *Horticultural Production*
- #19, *Field Crop Production*

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

Agricultural Information Contact Centre
Ph: 1-877-424-1300
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ADDITIONAL RESOURCES

Guide to Agricultural PM10 Best Management Practices. **www.azdeq.gov/environ/air/plan/download/webguide.pdf**

Nature Resources Conservation Service: Conservation practices standard. Cross Wind Trap Strips. **www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263186.pdf**

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

Technical Coordinators: H.J. Smith, Ted Taylor

Editorial Coordinator: Alison Lane

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