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Publication No. 896

October, 1953

Agriculture Canada

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SOIL DRIFTING

ITS CAUSES AND CONTROL

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DEPARTMENT OF AGRICULTURE
OTTAWA, CANADA

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The green grain approaching heading on either side of the trash-covered fallow strip indicates the season is about midsummer. The summerfallow has been tilled twice, yet the stubble remains on top of the ground and still quite erect. Such careful summerfallow practice provides adequate trash cover, good weed control and moisture conservation.

SOIL DRIFTING—ITS CAUSES AND CONTROL

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In the period between 1930 and 1940 wind erosion devastated many large areas of agricultural land in Western Canada. Homes were abandoned and suffering was widespread. It became apparent to farmers, townspeople, and legislators that soil drifting was a serious national problem. Agricultural scientists and farmers sought improved methods of field husbandry to protect the soil. Strip farming, surface tillage, and trash cover came into fairly general use and proved very helpful in the control of soil drifting. Of great assistance also was the fact that a series of relatively wetter years ensued. Although there has been considerable local drifting every season general wind erosion over the entire prairie area has not occurred during subsequent years.

When the urgency of soil drifting control is less acute many farmers are inclined to adopt a complacent attitude and do not take proper precautions to hold their soil. In many areas strip farming has been discontinued and has been replaced by large blocks of "black" summerfallow. Often these are smoothed down to fine texture by overworking. On only a small percentage of the summerfallow of the prairies is sufficient care exercised in the preservation of trash cover. Constant vigilance must replace complacency if the challenge of soil drifting is to be met.

CAUSES

Exposed Soil

Soil drifting is caused by the action of wind on exposed soil. Smooth, unprotected surfaces are the most susceptible. A wind velocity of 15 m.p.h. at one foot height will cause drifting on a field where the soil particles are small and there is no protection. The particles which are most susceptible to drifting are those below 1/50 of an inch in diameter. Particles larger than 1/25 inch are quite stable because of weight. It is difficult to till soil without having a large proportion of particles within the susceptible size ranges. Hence tillage must be conducted so that protection will be provided for the small sized soil grains.

It requires a relatively strong wind to initiate drifting on a field for the first time. This is because of surface crusts and the natural tendency of the fine material to sift down and receive protection from the large clods. However once a field has drifted and a certain amount of dune material has accumulated, it requires much less wind velocity to bring about soil drifting. When the soil from a field begins to drift it continues until all the susceptible-sized materials are blown away or until the wind stops. Soil on a field that has blown badly has lost the very fine particles which act as cementing agents when the soil is wet, to form the larger aggregates.

Improper use of Tillage Implements

Often fields are predisposed to soil drifting by improper tillage practices. One of the most common and most serious mistakes is the operation of one-way disk implements improperly adjusted, at a high rate of speed, or too deeply.

Figure 1.—Buried fences, barren fields, blocked roads, and abandoned homes are the travelling companions of soil drifting. A recurrence of such catastrophes can be prevented only by following approved methods of soil drifting control.

Figure 2.—A good trash cover on summerfallow is the best possible insurance against soil drifting.

These implements should be operated as shallow as possible consistent with good weed kill and never faster than 3-3½ M.P.H. When pulled too fast they pulverize the soil—if too deep, they bury the trash.

The disk harrow and spike-tooth harrow usually cause excessive soil pulverization and should rarely be used for tillage where there is danger of soil drifting. These implements are sometimes useful in emergency control measures.

Surface packers (rollers, crowfoot packers, cultipackers) are not recommended because they break up clods and flatten down stubble and trash. However subsurface packers, which are designed with more widely spaced Vee-wheels, have proved useful to firm the seedbed after spring seeding; such packers do not pulverize the soil excessively.

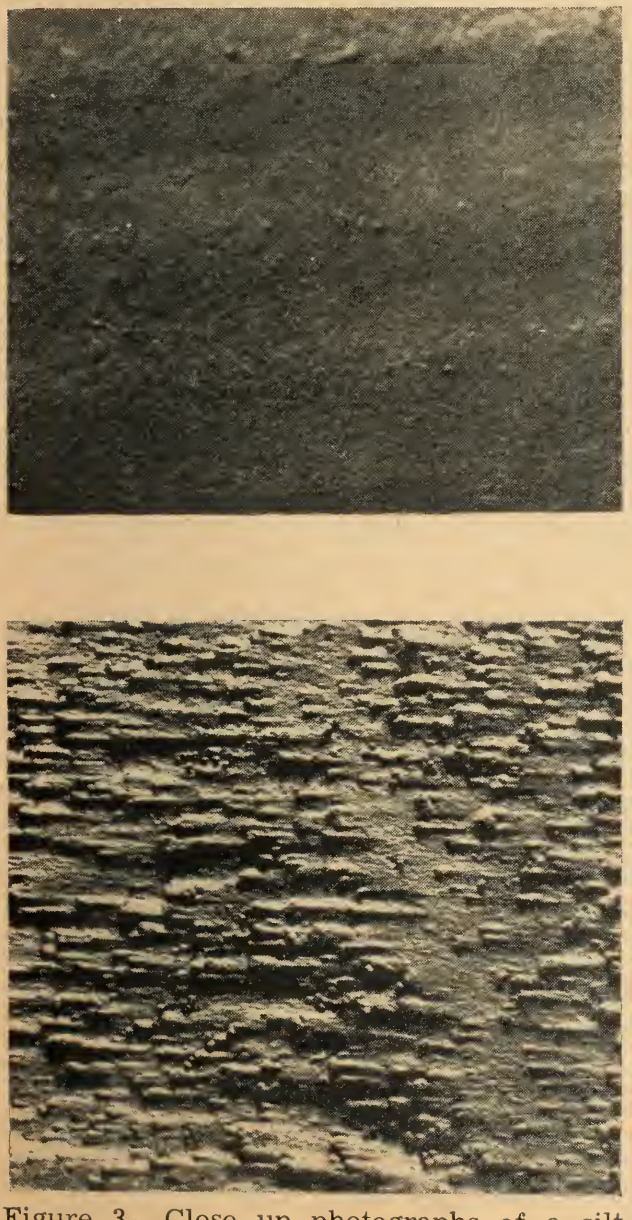

Figure 3.—Close up photographs of a silt loam soil before and after exposure to wind until soil removal ceased. Note in the lower photo that the only fine soil remaining lies on the protected leeward side of the small lumps.

Photo—Courtesy of Dr. W. S. Chepil, Kansas State College, Manhattan, Kansas.

Tillage of Dry Soils

Soil should be tilled under the proper moisture conditions. Agricultural soils slake down most seriously when tilled in a slightly moistened condition such as after a light shower of rain and hence cultivation at this time should be avoided. If at all possible tillage should be done when the soils are fairly wet because greatest clod formation takes place at this time.

On medium- and fine-textured soils it is better to cultivate when they are very dry than when they are only slightly moist. However, tillage of sandy soils when they are very dry is not recommended.

Stubble Burning

Stubble should never be burned. Crop residues are the most important insurance available against soil drifting. Sometimes extra effort will be required to prepare a seedbed on land carrying a very heavy stubble but this can always be accomplished without burning. Straw spreaders and cutters are useful additions to the combine when crops are heavy. Burning destroys the protective cover and hence the wind velocity at the ground surface is greatly increased.

Unprotected Knolls

In several prairie regions where the land is rolling or hummocky the knolls are very susceptible to wind erosion. Most of the top soil has been lost from a large percentage of these knolls and the high-lime subsoil is exposed giving a whitish color to the surface. These so-called "limey knolls" are especially vulnerable to soil drifting. Frequently large fields have blown badly because drifting has begun on the exposed knolls. Once drifting begins the abrasive and bombarding action of the particles from the knolls, if wind continues, causes soil from all over the field to begin moving. These knolls and other focal points such as dunes should receive special attention. If trash cover is not adequate they should receive an application of straw or manure. In many cases a farmer would be well advised to seed them permanently to grass.

CONTROL

Preservation of Vegetative Residues

Crop and weed residues, usually referred to as trash cover, are the most practical means of protecting soil against wind erosion. This vegetative material is much more effective than a cloddy structure because clods break down into erodible particles under weather agencies. The stubble from an average grain crop will prevent almost any soil from blowing throughout the summerfallow period if it is carefully preserved on top of the ground.

Figure 4.—The combination of strip farming and surface tillage to preserve trash will "windproof" almost any agricultural soil.

Tall stubble is more effective in reducing the wind velocity than the same weight of short stubble. This emphasizes the importance of tilling the field in such a manner that the stubble remains erect. Stubble incorporated with the soil is not nearly so effective as when it is left on top. Furthermore, as stubble gradually decomposes on top of the ground following usual surface tillage methods, certain sticky substances are liberated which provide cementing material to bind the small soil particles together into aggregates which will resist soil drifting.

Proper Choice and Use of Tillage Implements

The blade-type implements have been used very successfully to combat wind erosion especially in the drier parts of the prairies. Their use is recommended. Blade cultivators reduce the weight of the trash cover about 10 per cent per stroke.

Field cultivators, such as the duckfoot, do a good job of weed control and also are fairly effective in maintaining crop residues on the surface. Heavy-duty cultivators work well in heavy trash cover and also penetrate firm soil readily and maintain a constant depth. The rod weeder is a good implement to use for the next stroke following the use of a cultivator.

The one-way disk is a valuable implement if properly handled but often its misuse has contributed to soil drifting. Carefully operated one-ways reduce the trash cover by about 50 per cent per stroke; one-ways operated too deeply are much more severe. Wide level diskers are misused even more than standard one-ways by being operated at excessive speeds.

Following a heavy crop the one-way may be used for the first tillage operation on the summerfallow with subsequent strokes by the blade cultivator or the duckfoot cultivator and rod weeder. If a satisfactory weed kill can be obtained it may be better to use the blade cultivator for the first stroke since this implement works best when used before rather than after machines which turn the stubble under. The one-way should not be used as the only tillage implement for the summerfallow. If only a light stubble covers the land at the beginning of the summerfallow year the one-way should not be used.

What About Plowing?

When there is no vegetative cover for protection deep plowing will sometimes turn up sufficient lumps to "wind proof" the soil. This treatment is most applicable to medium textured soils. There seems to be little advantage in plowing a heavy clay soil or a light sandy soil; both break down very quickly into small particles which are subject to erosion. Thus plowing has been discontinued completely in many areas in favour of surface tillage.

Strip Farming

Strip farming has been helpful in controlling soil drifting. However to be most effective strips must be used in conjunction with other control measures, particularly the preservation of trash cover. A strip width of 10 to 20 rods has been found most satisfactory. Wherever practical, strips should be laid out at right angles to the direction of the prevailing winds.

Seeding Down to Grass

Grass is nature's cover for the prairies and provides adequate protection against wind erosion. It has been observed also that newly broken sod does not drift for a few years. Thus it has been reasoned that crop soils would be less subject to erosion if they were retired to grass periodically. Experiments conducted in the drier parts of the prairies show that fields which have been down to grass for three or four years and then broken are more resistant to blowing because the roots of the grass tend to bind soil particles into larger aggregates. As soon as these grass roots decompose the soil is again vulnerable to wind erosion. Short-term grass rotations do not appear to have much promise for wind erosion control in the semi-arid prairie area. However in the moister regions, such as the black soil zone, where grass is more readily established and grows more vigorously the prospects are better.

One some marginal lands drifting is frequently a serious problem and these fields should be retired permanently to grass.

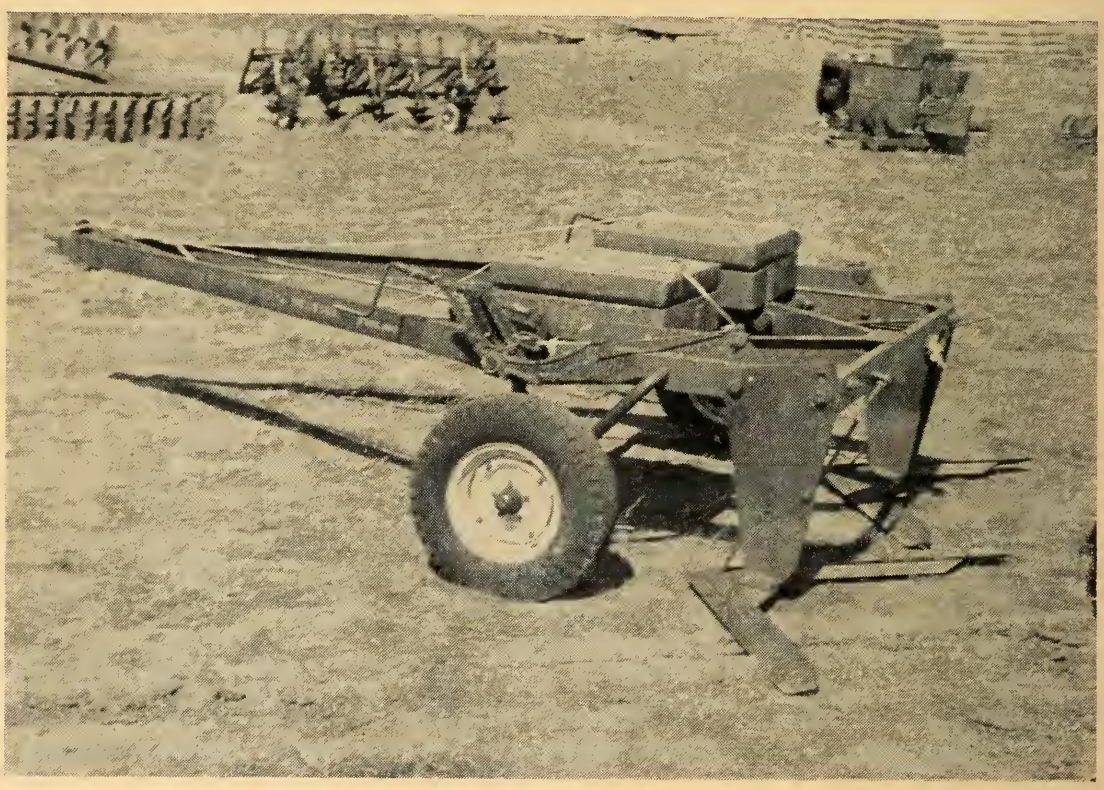

Figure 5.—Blade cultivators are the most effective implements available for preserving the crop residues on the surface of the soil.

Figure 6.—Windbreaks, strip farming, trash covers, and grass all combine on this farm to provide pleasant surroundings and stable fields.

Cover Crops

Cover crops have proved valuable in controlling soil drifting in several widely separated areas of the prairies. The recommended practice is to seed oats or wheat on the summerfallow at about half a bushel per acre. The date of seeding should be about August 1 so that ample growth will be made to protect the soil through the autumn, winter and early spring. Earlier seeding provides more growth than is necessary and hence impoverishes the soil of moisture. Experiments in the foothills region and the black soil zone of Alberta and on the Regina plains have shown that cover crops provide adequate soil drifting control and in most years do not reduce the yield of the crop the following season. In the drier parts of the prairies cover crops are not practical because they use up more moisture than is usually replenished by the winter and spring precipitation. Under such conditions a distinct reduction in yield commonly occurs.

Corn seeded in rows two rods apart has provided some protection against soil drifting and has been very effective in trapping snow on fallows to increase the moisture supply.

Shelterbelts

Shelterbelts are an effective means of reducing wind velocity and hence soil drifting. Their use is recommended wherever practical.

EMERGENCY CONTROL METHODS

Listing

In years of very light crop or for other reasons there may be little trash cover and hence summerfallows will be bare and very susceptible to wind erosion. Such fields may be "windproofed" by deep listing which will turn up some large aggregates and provide furrows to trap any soil which begins to

Figure 7.—This unprotected field was drifting very badly but was stabilized for several months in the Chinook belt by this thorough listing job.

move. It is important to space the furrows sufficiently far apart that the ridges are flat on top. Peaked ridges are much more susceptible to blowing. The plowing of furrows at intervals of a few feet throughout an unprotected area or one that is actually drifting is similar to listing in effectiveness although not usually so long lasting. Listing is so effective and so easily done that it seems wise to advise that every field which appears to be in danger of drifting should be listed and wherever drifting gets beyond control by other measures, listing should be done.

Listing on Frozen Soil

In the Chinook belt often fields are blown bare of snow and soil drifting occurs in the winter when the soil is frozen. This can be controlled by "listing" with a one-way disk with all but every fifth disk removed and the hitch adjusted. Chisel plows may also be used to advantage if equipped with 2-inch chisel points.

Spreading Straw or Manure

Soil drifting may be readily controlled by spreading manure or wet straw on the soil. This method is especially applicable to small focal points such as dunes along fence rows or limey knolls where drifting is likely to begin.

Ridging With Cultivator or Spike Tooth Harrow

If action is taken as soon as a field begins to blow, the drifting often can be stopped by roughening the surface with a cultivator. This implement will usually bring up a few clods and allow the fine material to sift down into the protection of the larger particles. A stroke with a spike tooth harrow may temporarily halt soil drifting on a field and give time for more permanent methods to be applied. These methods should not be used if the soil is very dry.

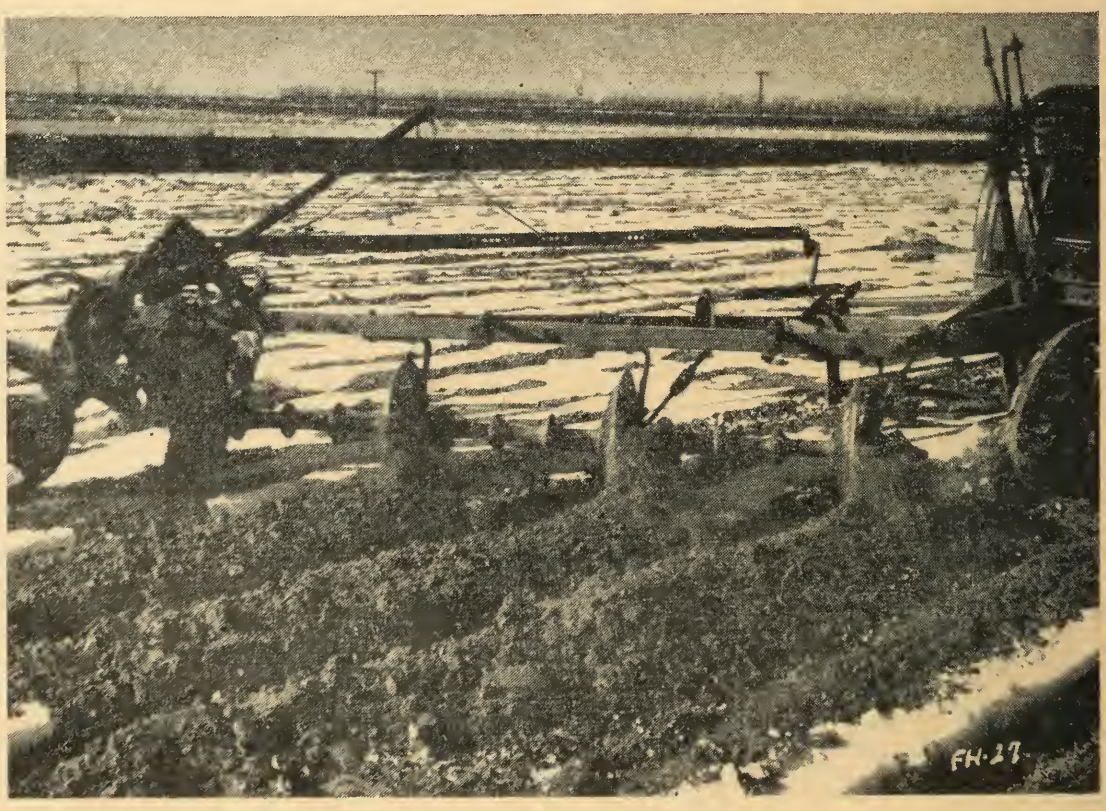

Figure 8.—A "frozen soil" lister can be readily fashioned from a one-way disk. This implement is very effective in stopping winter drifting.

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CONCLUSION

Wind erosion causes serious depletion of Canada's greatest national resource —the soil. Much of this loss occurs unnecessarily because known principles of soil conservation are not applied. Thoroughly proved methods of soil drifting control have been worked out for almost all situations. In one large area in southern Alberta, which is subjected to more wind than any other agricultural region of Canada and also has a very erodible soil, soil drifting formerly was serious every year but now has been virtually eliminated. This is the area where strip farming originated and where blade cultivators were developed. Similarly, practical methods of wind erosion control can be applied to the entire prairie area.

ACKNOWLEDGMENT

The Field Husbandry Staffs of the Experimental Stations at Swift Current, Saskatchewan and Lethbridge, Alberta read the manuscript and made numerous helpful suggestions. The departmental publications no. 568, Soil Drifting Control in the Prairie Provinces and no. 819, Soil Moisture, Wind Erosion and Fertility of Some Canadian Prairie Soils have been referred to freely in the preparation of this bulletin.

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1953.