TECHNICAL NOTES

U. S. DEPARTMENT OF AGRICULTURE SOUTH DAKOTA SOIL CONSERVATION SERVICE

WOODLAND NO. 23 Sheridan I. Dronen June 3, 1983
Forester

Field Windbreaks

Attached are two technical notes Series No's. 190-LI-2, Determining The Effect Of Field Windbreaks And Wind Barriers On Wind Erosion (Soil Blowing) On A Given Field, and 190-LI-3, Examples Of Methods Of Controlling Wind Erosion On A Given Field With And Without Windbreaks And Wind Barriers, prepared by David Hintz, National Windbreak Forester.

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Attachments

File under: WOODLAND

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J. R. DRONEN

TECHNICAL NOTE

Subject: ECOL SCI - FORESTRY

Series No.: 190-LI-2

Reference: DETERMINING THE EFFECT OF FIELD WINDBREAKS AND WIND BARRIERS ON WIND EROSION (SOIL BLOWING) ON A GIVEN FIELD

Date: JANUARY 1983

DIST:
N (GERALD M. DARBY, ES; ROBERT E. HARTUNG, ES)
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SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

DETERMINING THE EFFECT OF FIELD WINDBREAKS AND WIND BARRIERS ON WIND EROSION (SOIL BLOWING) ON A GIVEN FIELD

Problems have occurred in regard to visualizing the effects that field windbreaks and wind barriers can have on wind erosion (soil blowing) in a given field. The following information is presented to illustrate and clarify the wind erosion control benefits which can be attributed to field windbreaks and wind barriers.

Wind Erosion Control

To illustrate the effect of windbreaks or wind barriers on a given field, let's assume the following:

Field size = 160 acres
I = 86 (WEGS-3, 4, or 4L)
K = 1
C = 30
V = 500 pounds 1/

Prevailing Erosive Wind Direction = 0° or from due North.
The Soil Loss Tolerance (T) is assumed to be 5 Tons per acre per year.
Water Erosion Losses within this field are assumed to be insignificant.

NOTE: To determine allowable wind erosion losses, subtract your water erosion losses from (T). In this example, the water erosion losses are assumed to be zero. Therefore, the allowable soil loss for wind = T - 0 or 5 - 0 = 5 Tons.

On any field there is an area on the windward side where soil loss is within T. The width of this area is determined by surface resistance to wind erosion. Surface resistance is the interaction of soil texture, ridge roughness and surface residue.

Using this information, assume that through the use of the wind erosion equation or appropriate tables, the I of 86, K of 1 and V of 500 will protect approximately a 160 foot width of field. The soil losses within this 160 foot width of field would be within (T). Figure 1 illustrates the width of field considered protected by surface resistance.

1/ Flat small grain equivalent.

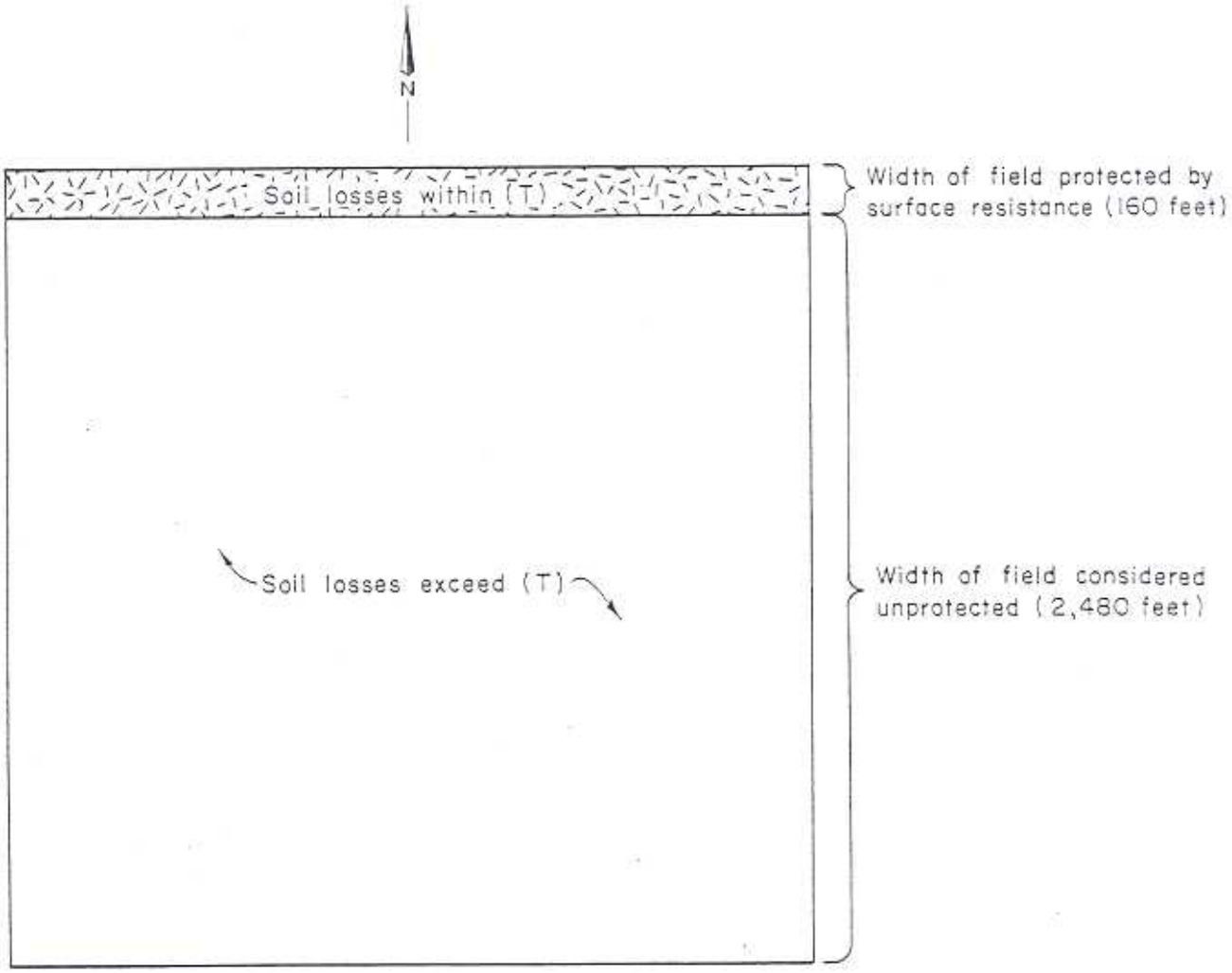

Figure 1 WIDTH OF FIELD PROTECTED BY SURFACE RESISTANCE

The point within the field where it would be desirable to introduce the first windbreak or wind barrier would be approximately 160 feet from the north edge of the field. The windbreaks or wind barriers should run east to west. See Figure 2.

If it is decided to use tree windbreaks and if they reach 50 feet in height at 20 years of age, it would take four (4) field windbreaks to protect this field. In determining the spacing interval between the first windbreak and the second windbreak, use 500 feet (the distance considered protected by a windbreak is ten times the height at 20 years) plus 160 (width of field protected by surface resistance) or 660 feet. The spacing interval between the second and third windbreak and all other windbreaks is also 660 feet. The 660 feet divided into 2,480 feet (total width of the field minus 160 feet) indicates that four windbreaks are needed to adequately protect the field. See Figure 2.

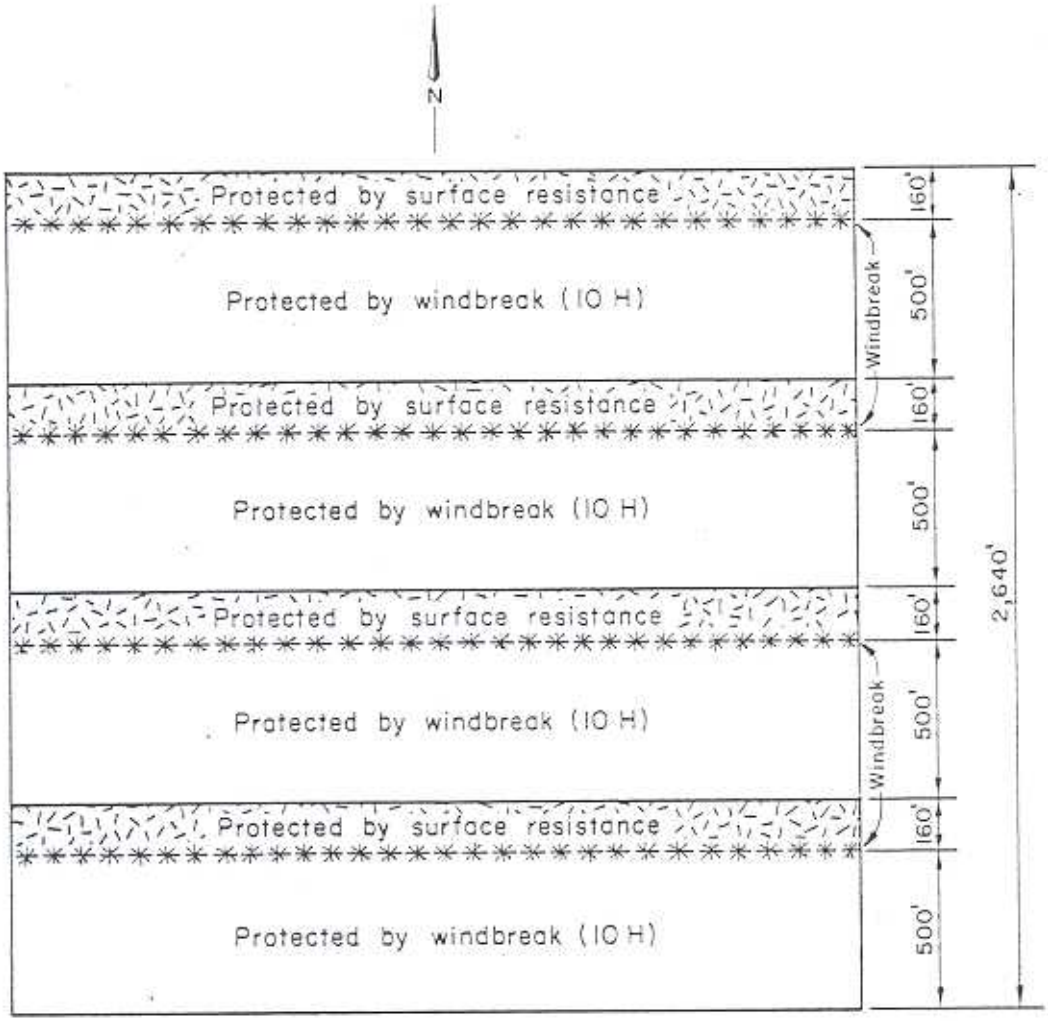

Figure 2 ORIENTATION AND SPACING OF WINDBREAKS

If it is decided to use perennial grass or annual crop barriers with an effective height of 3½ feet instead of tree windbreaks, the first barrier should be placed at approximately 160 feet from the north edge of field. The spacing interval between the first and second and all remaining barriers is 35 feet (10 times 3½ feet) plus 160 feet (width of field protected by surface resistance) or approximately 195 feet. If 195 feet is divided into the 2,480 feet of field, it would indicate that thirteen (13) barriers would be needed to protect the entire field. See Figure 3.

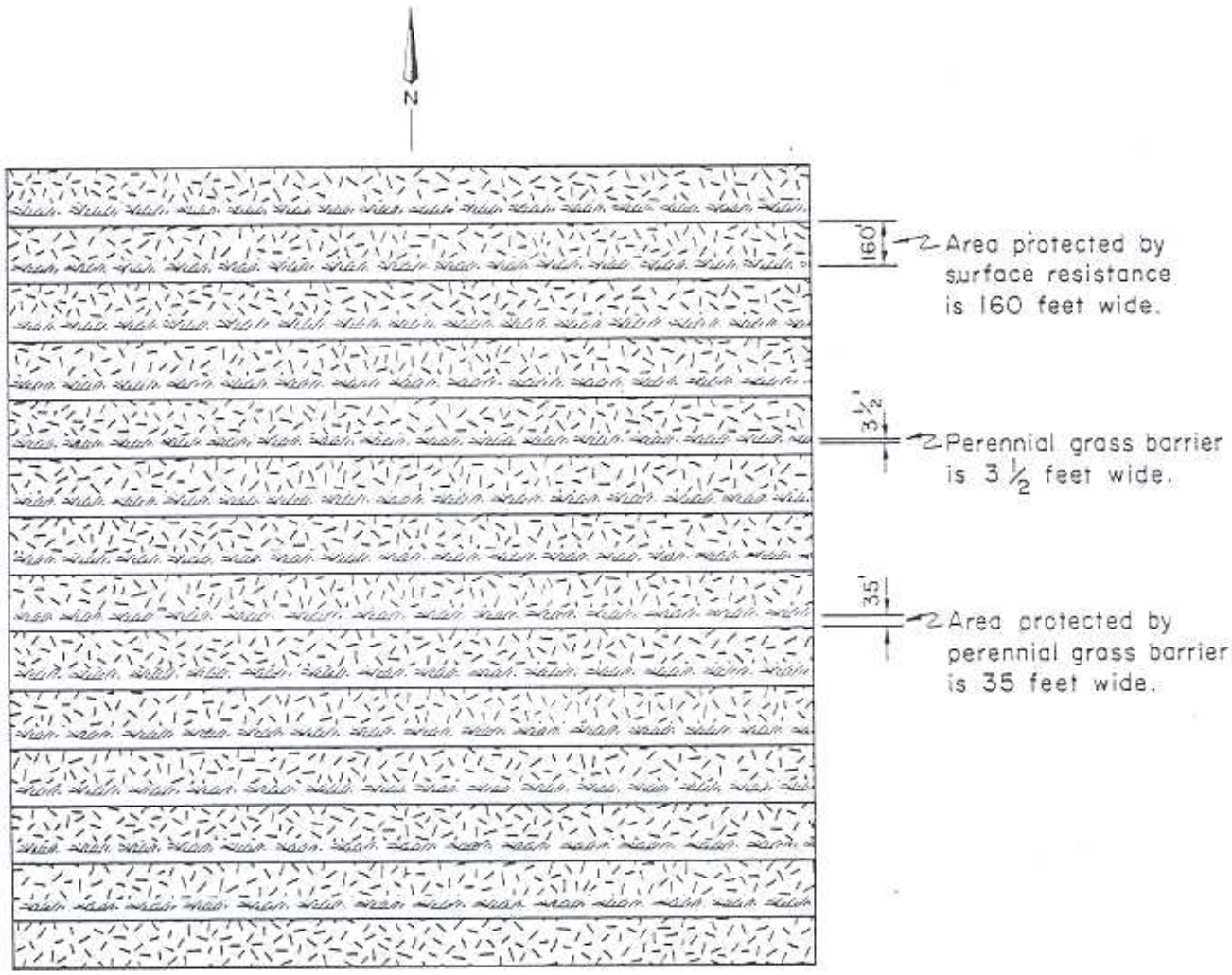

Figure 3 ORIENTATION AND SPACING OF GRASS BARRIERS

Note that in Figures 2, 3 and 4 the introduction of each windbreak or wind barrier reinstates the basic width of field that is considered protected by surface resistance (160 feet). In the situation where tree windbreaks were used, there is a 300 percent increase in the amount of field protected by surface resistance. When the wind barriers are used, there is a 1,300 percent increase in the amount of field protected by surface resistance. This readily shows the value of introducing wind erosion control practices which are capable of stopping the wind erosion process. It also shows why they must be considered wherever adequate residues are not present to protect the soil from blowing.

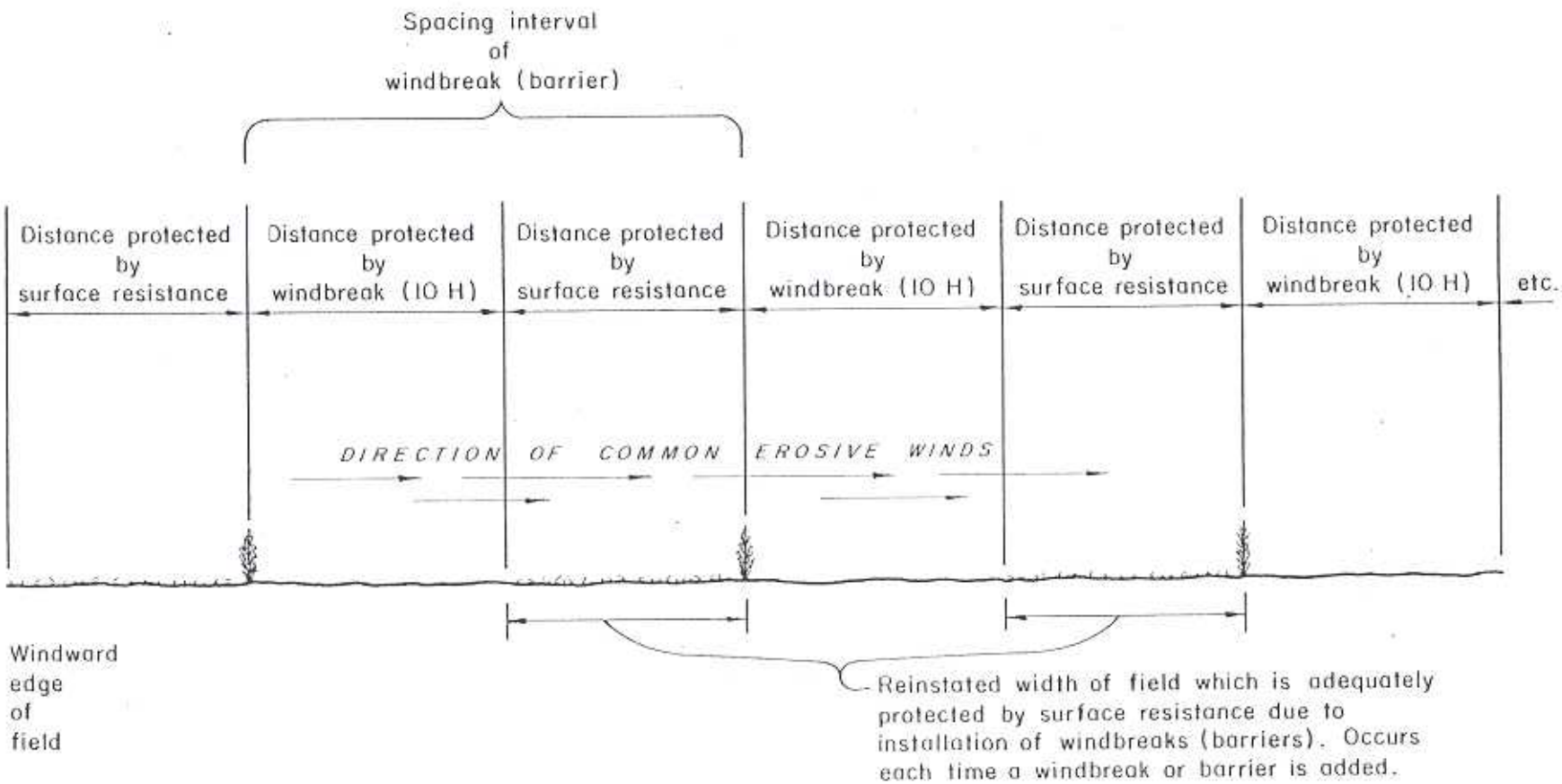

Figure 4 CROSS SECTION ILLUSTRATING BASIC PRINCIPLES OF WINDBREAKS AND WIND BARRIERS FOR THE CONTROL OF WIND EROSION

The principles illustrated in Figures 1 through 4 will remain the same in all areas of the country. The distance protected downwind from a windbreak or wind barrier is always considered to be 10H along the prevailing wind direction. Whenever windbreaks and wind barriers cannot be planted perpendicular to the direction of erosive winds, adjustments are necessary for wind direction and preponderance factors. Methods for making these adjustments are contained in Field Office Technical Guides. The width of field considered protected by surface resistance will vary constantly and will be affected by kind of crop grown, kind of residue, texture of the soil, tillage practices and C or climatic factors. Methods for determining the protected width of field are also contained in the Field Office Technical Guide. When determining protected field widths, it should be remembered that the soil loss from a given field is a combination of the wind and water erosion losses.

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TECHNICAL NOTE

Subject: ECOL SCI - FORESTRY

Series No.: 190-LI-3

Reference: EXAMPLES OF METHODS OF CONTROLLING WIND EROSION ON A GIVEN FIELD WITH AND WITHOUT WINDBREAKS AND WIND BARRIERS

Date: JANUARY 1983

DIST:
N (GERALD M. DARBY, ES; ROBERT E. HARTUNG, ES)
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NOTE:

This technical note is a followup to MNTC Technical Note Ecological Sciences 190-LI-2, Determining the Effect of Field Windbreaks and Wind Barriers on Wind Erosion (Soil Blowing) on a Given Field, January 1983. Technical Note MNTC 190-LI-2 should be reviewed prior to reading MNTC 190-LI-3.

EXAMPLES OF METHODS OF CONTROLLING WIND EROSION ON A GIVEN FIELD WITH AND WITHOUT WINDBREAKS AND WIND BARRIERS

Where low residue crops are grown on soils with a severe wind erosion potential, field windbreaks or wind barriers have often been the only measure used for wind erosion control. Their use in conjunction with other wind erosion control methods is generally poorly understood. Also, the results of using field windbreaks or wind barriers are rarely compared to other alternatives.

Figure 1 presents nine different alternatives where the various wind erosion control methods can be used alone or in combination to keep potential soil losses within T for a 160 acre field. The Existing Situation illustrates the basic field with an I of 86, K of 1, C of 30 and V of 500 pounds. The prevailing erosive wind direction is due north (0°) and the water erosion losses are insignificant.

NOTE:

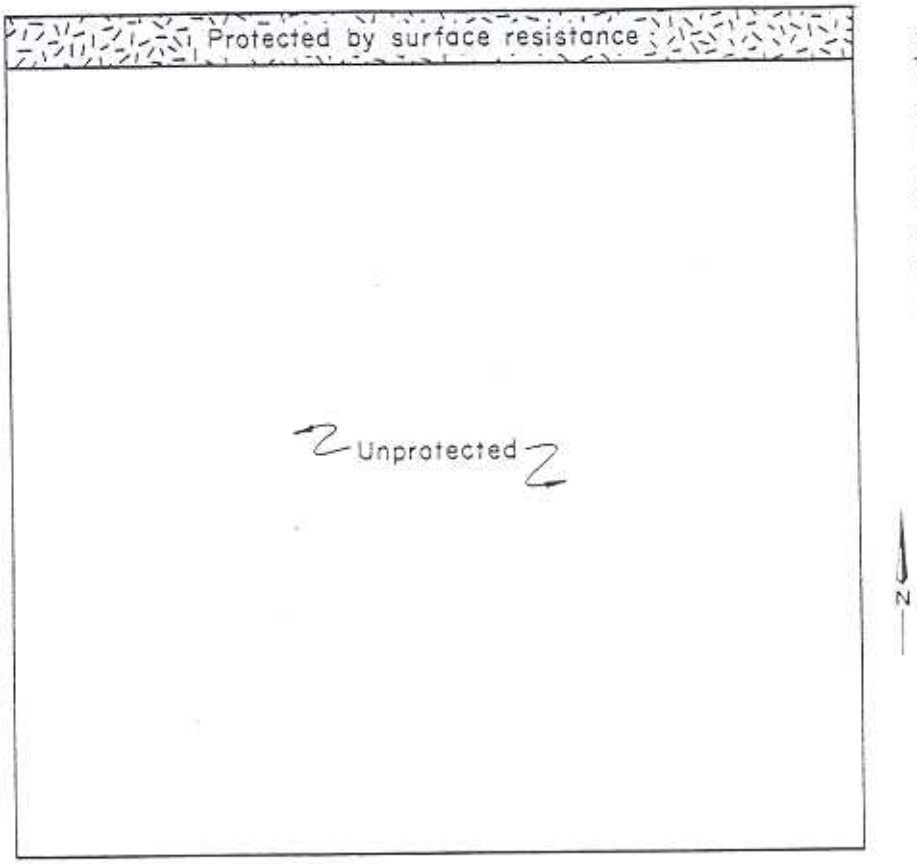
The nine alternatives illustrated in Figures 1 and 2 do not represent all the wind erosion control practices that can be used alone or in conjunction to obtain the desired results. These are presented to stimulate the thought processes to consider all possible practices and combinations of practices that could be used on a given field.

Figure 1. BASIC INFORMATION FOR THE EXISTING SIUTATION AND ALTERNATIVES 1 THROUGH 9.

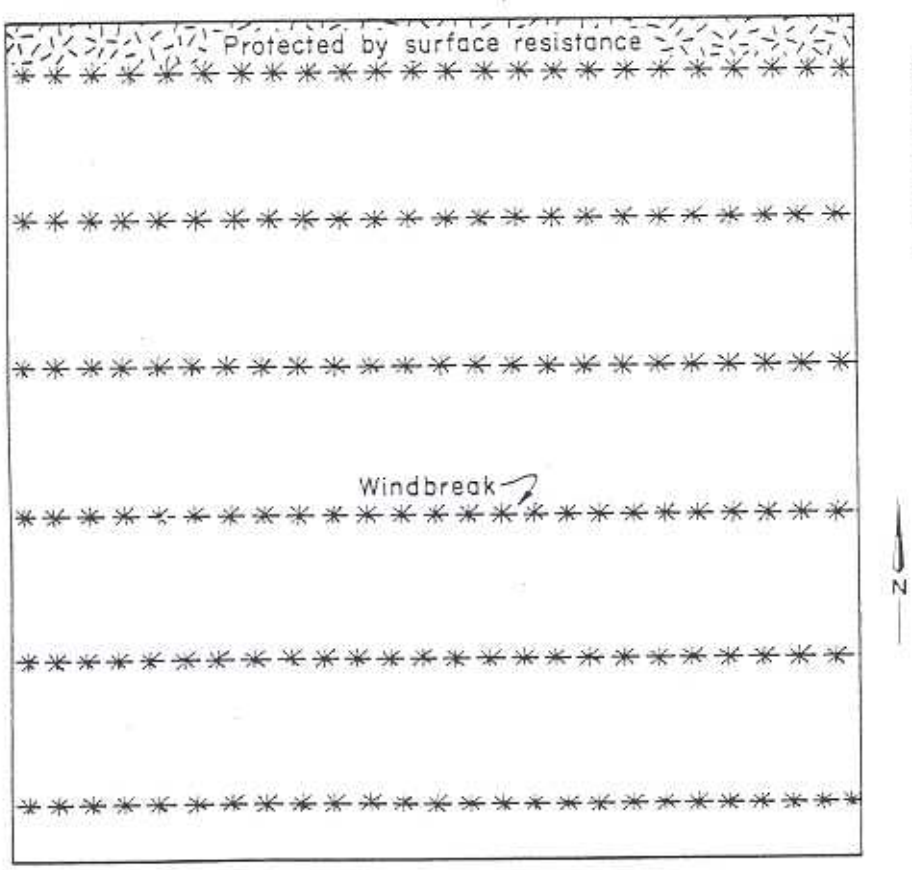
- Field Size = 160 Acres
- I 2/ = 86 (WEG 3, 4, 4L)
- K 2/ = 1
- C 2/ = 30
- V 2/ = 500 Pounds 1/
- Water erosion losses are insignificant.
- Prevailing erosive wind direction is due north or 0°.
- Five Tons per acre per year is the allowable soil loss to wind and water erosion.

1/ Flat small grain equivalent--could be any crop with residue amounts equivalent to 500 pounds per acre of flat small grain residue.

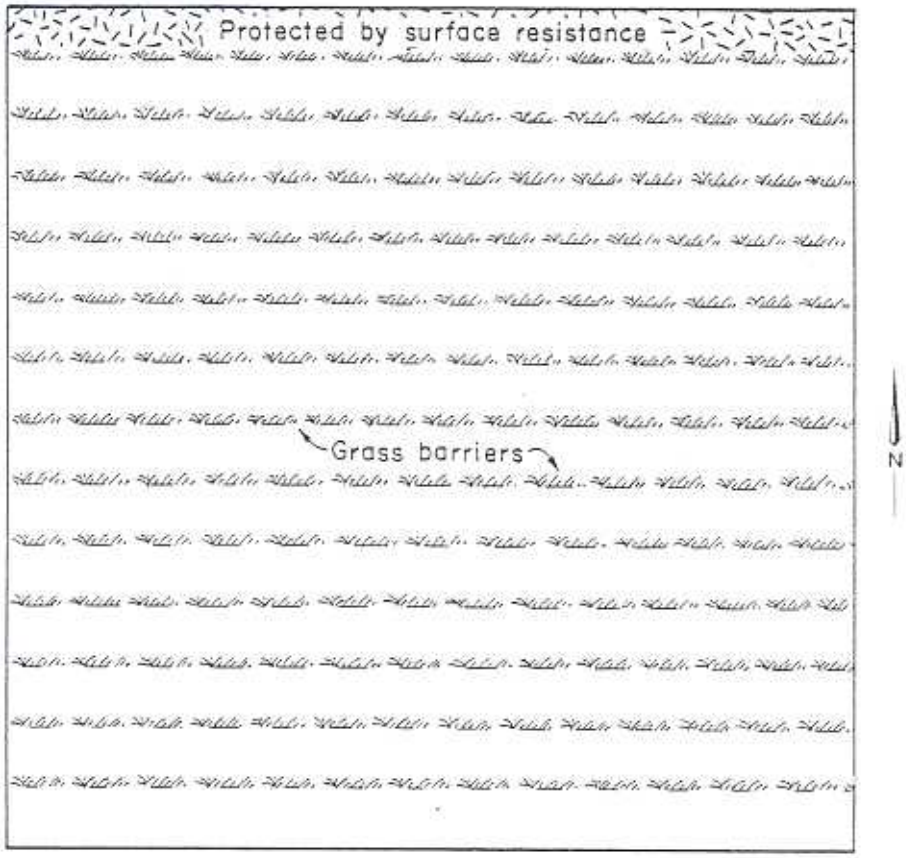
2/ Factors of the wind erosion equation.



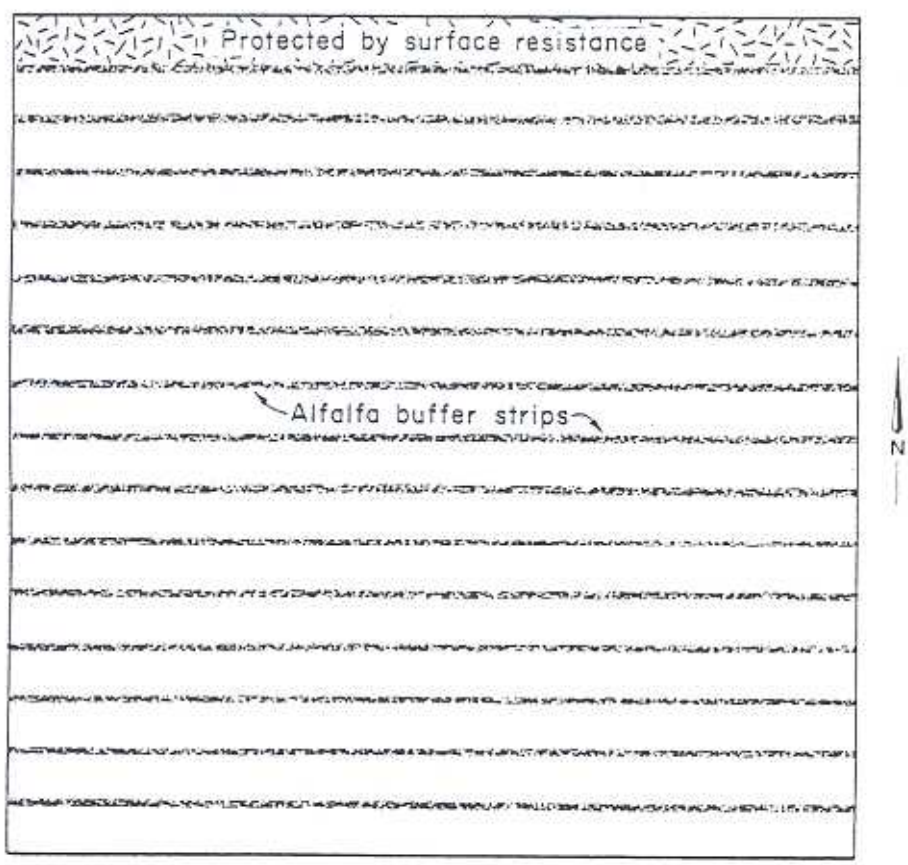
Existing Situation. Basic field with no windbreaks, strips, buffers or barriers. Field width protected by 500 lbs./ac. of residue--160 ft. Soil loss on the remainder of the field averages approximately 15T/Ac./Yr. It would take approximately 1,000 lbs./ac. of residue to protect this field without any additional practices.



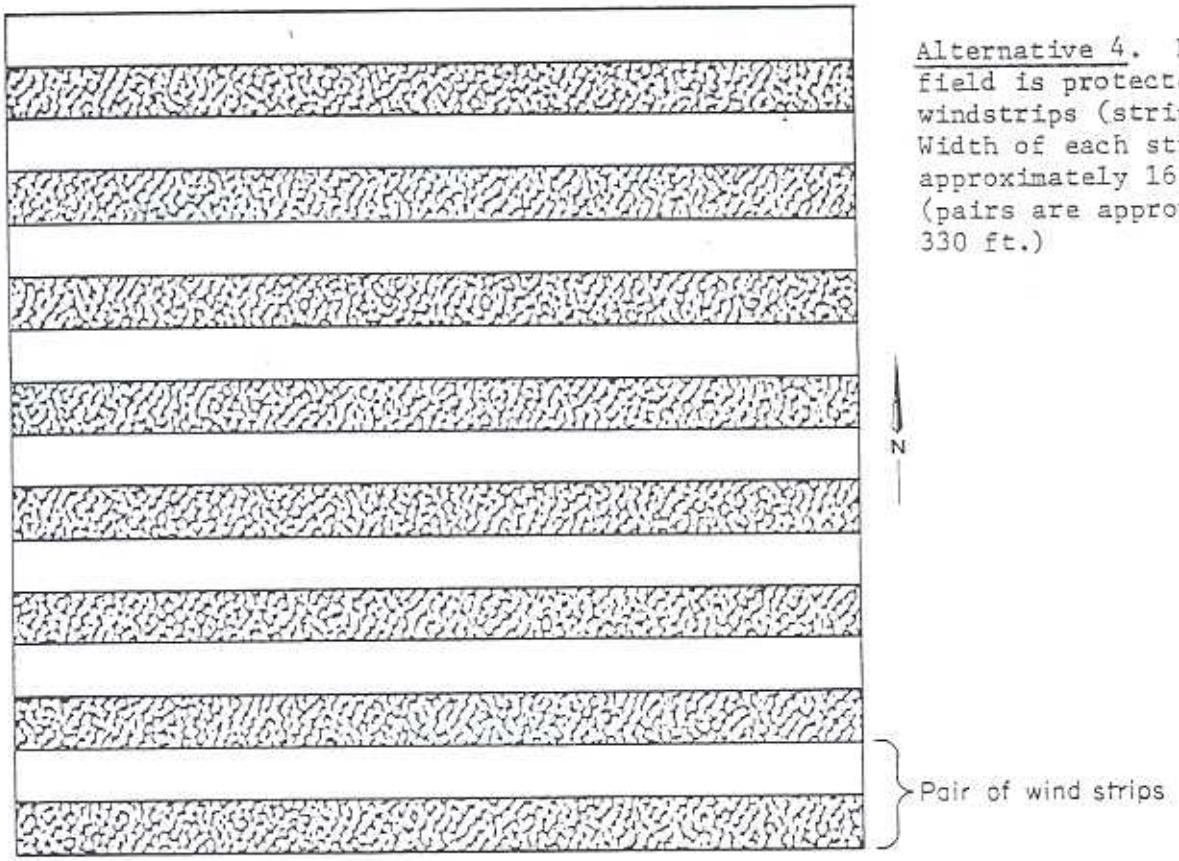
Alternative 1. Entire field is protected with six 30 ft. high windbreaks spaced at approximately 460 feet apart (10H + 160). Soil loss within 5T/Ac./Yr. over the entire field.



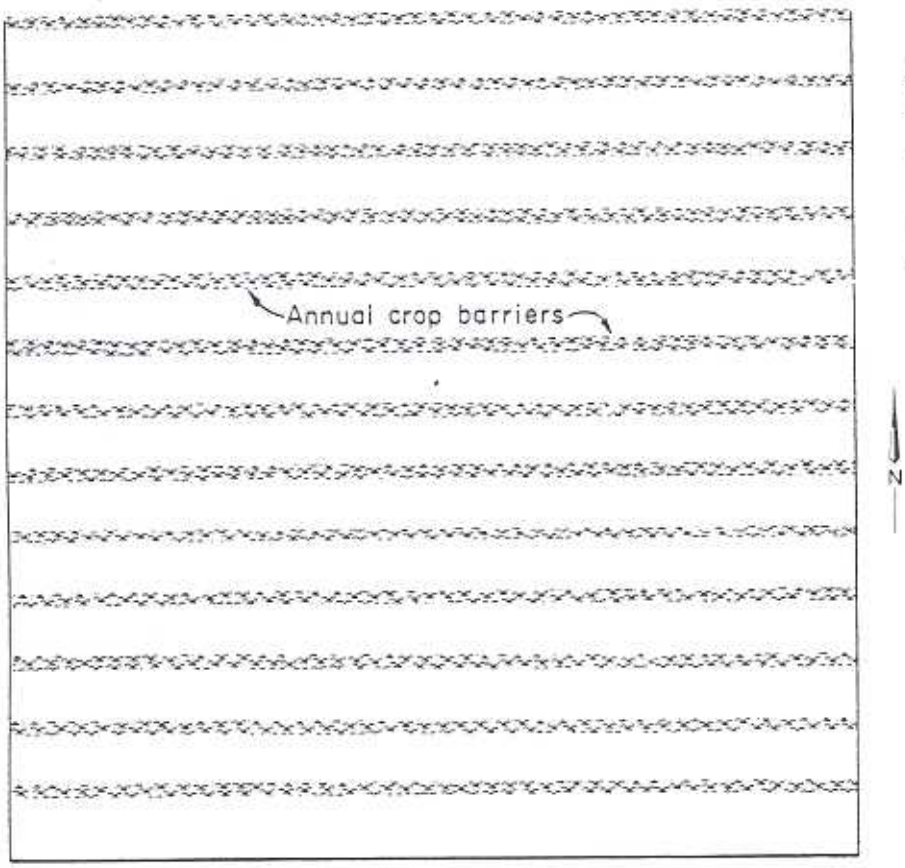
Alternative 2. Entire field is protected by 13 perennial grass barriers 3½ ft. high and 3½ ft. wide. Spacing interval between barriers is approximately 195 ft. (10H + 160).



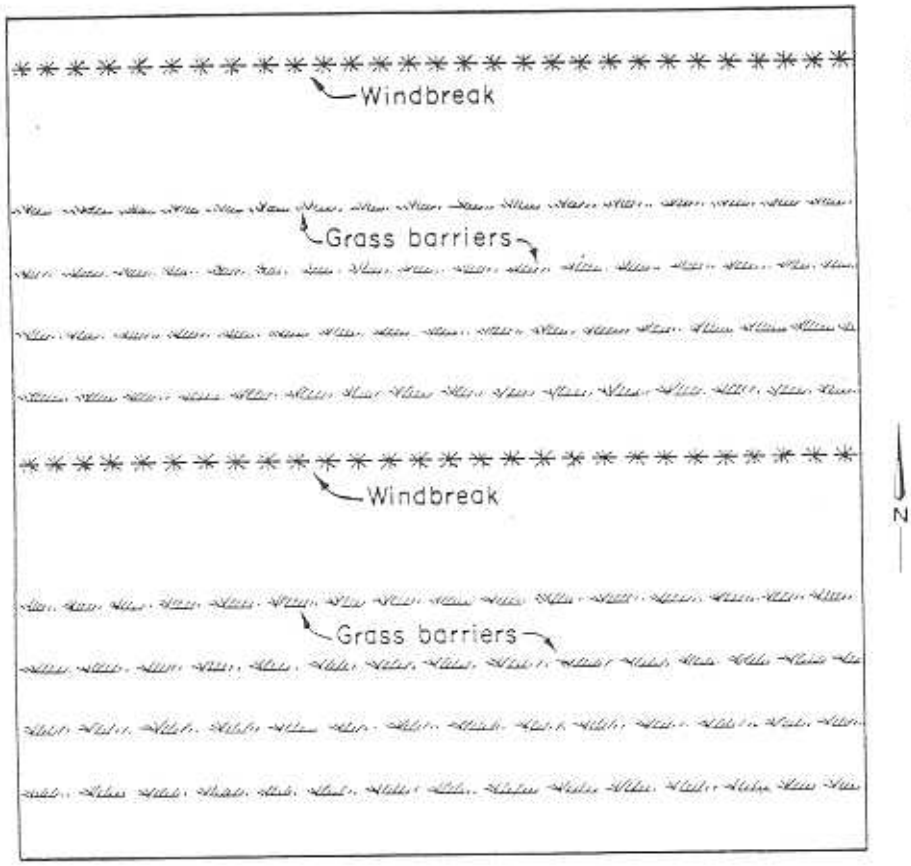
Alternative 3. Entire field is protected by 15 alfalfa buffer strips (minimum of 12 ft. wide). Spacing interval between buffer strips is 172 ft. (160 + 12).



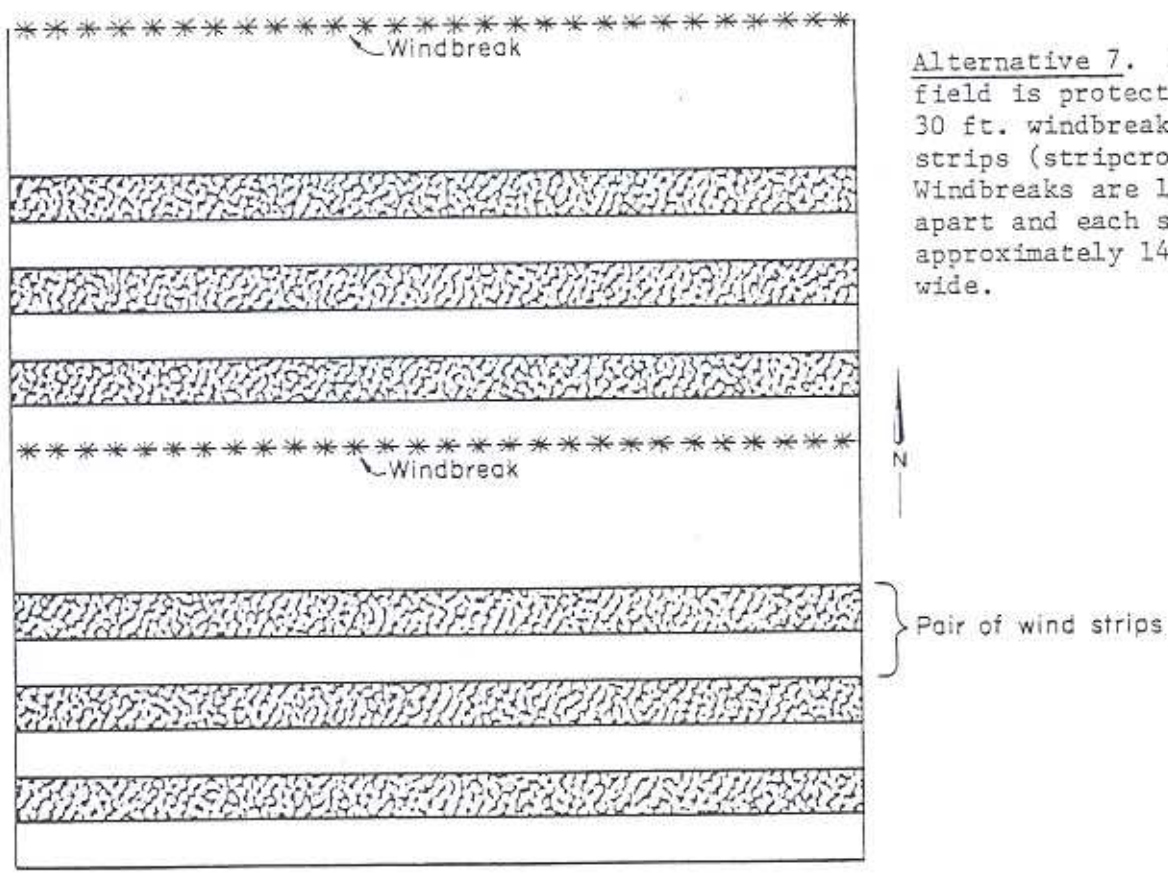
Alternative 4. Entire field is protected by 16 windstrips (stripcropping). Width of each strip is approximately 165 ft. (pairs are approximately 330 ft.)



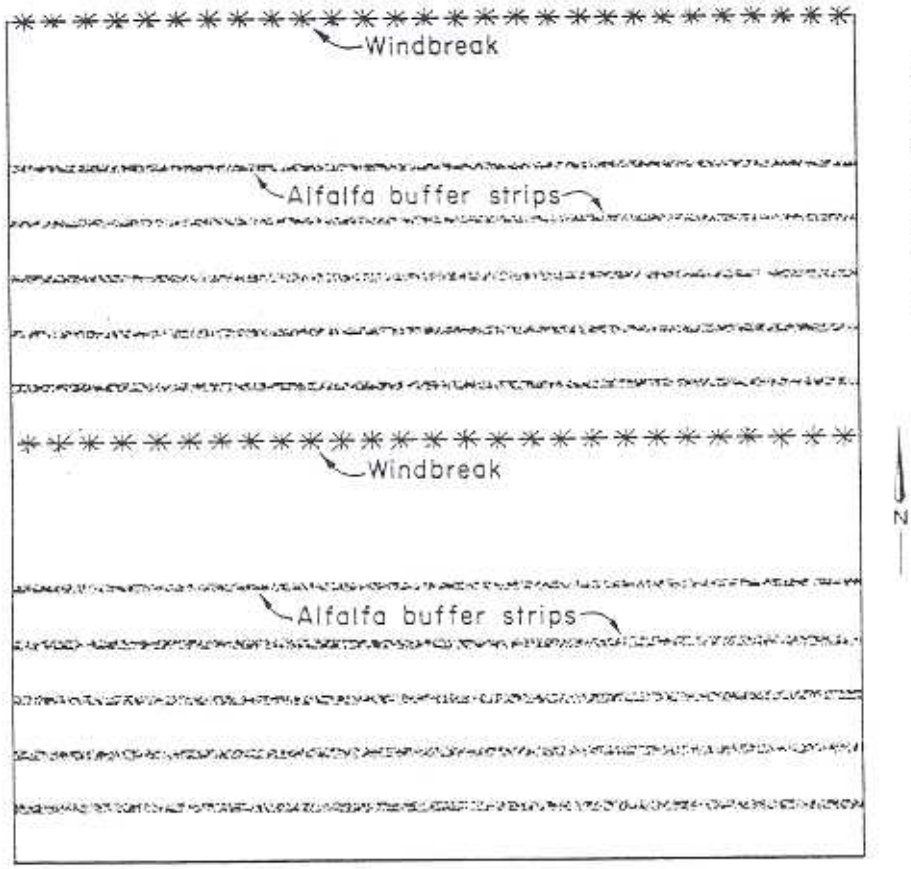
Alternative 5. Entire field is protected by 13 (4 ft. high) annual crop barriers. Spacing interval is approximately 200 ft. (10H + 160). Width of annual crop (corn) barrier is approximately 12 ft. (minimum).



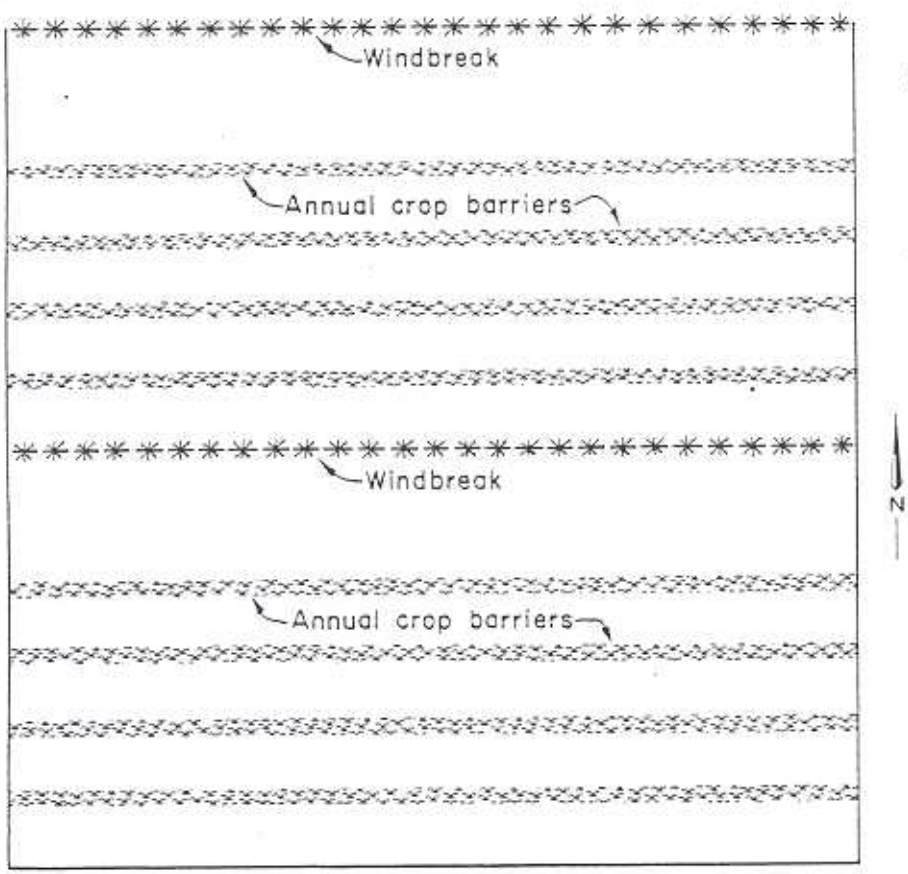
Alternative 6. Entire field is protected (within allowable loss) by two 30 ft. windbreaks and eight 3½ ft. high and 3½ ft. wide perennial grass barriers. Windbreaks are 1,240 ft. apart; grass barriers approximately 195 ft. apart (10H + 160).



Alternative 7. Entire field is protected by two 30 ft. windbreaks and 12 strips (stripcropping). Windbreaks are 1,320 ft. apart and each strip is approximately 143 feet wide.



Alternative 8. Entire field is protected by two 30 ft. windbreaks and ten 12 ft. (minimum) alfalfa buffer strips. Windbreaks are 1,320 feet apart. Buffer strips are approximately 172 feet apart (160 + 12).



Alternative 9. Entire field is protected by two 30 ft. windbreaks and eight 4 ft. high annual crop barriers (12 ft. wide strips of corn). Windbreaks are 1,320 ft. apart. Annual crop barriers are approximately 215 ft. apart (10H + 163 + 12).

Igure 2.

	Land out of Production due to Acres of Field In:						Acres of Field Protected By: 1/					
	Windbreaks (Acres) 2/	Perennial Grass Barr'ers (Acres)	Strip Cropping	Buffer Strips	Annual Crop Barriers	Total Acres	Windbreaks	Perennial Grass Barriers	Strip Cropping	Buffer Strips	Annual Crop Barriers	Surface Resistance
xisting ituation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
lternatives												
-Windbreaks only	6	NA 7/	NA	NA	NA	6	102	NA	NA	NA	NA	58
-Grass barriers only	NA	2.8	NA	NA	NA	2.8	NA	28	NA	NA	NA	132
-Buffer strips only	NA	NA	NA	0	NA	0	NA	NA	NA	11	NA	149
-Strip cropping only	NA	NA	0	NA	NA	0	NA	NA	80 3/	NA	NA	80 4/
6-Annual barriers only	NA	NA	NA	NA	0	0	NA	NA	NA	NA	41 6/	119
5-Windbreaks & grass barriers	2	1.7	NA	NA	NA	3.7	36	17	NA	NA	NA	107
7-Windbreaks & strip cropping	2	NA	0	NA	NA	2	36	NA	104	NA	NA	20
8-Windbreaks & buffer strips	2	NA	NA	0	NA	2	36	NA	NA	7	NA	117
9-Windbreaks & annual barriers	2	NA	NA	NA	0	2	36	NA	NA	NA	25 5/	99

1/ All figures rounded except Grass Barriers.
2/ Single Row Field Windbreak 16.5 ft. wide
3/ Growing Crop Strips
4/ Fallow Strips
5/ Includes 6 ac. of land in annual crop.
6/ Includes 9 ac. of land in annual crop.
7/ NA--practice does not apply to situation or alternative

Figure 2 compares the various alternatives. A wide variety of useful information can be obtained from this table. For instance, perennial grass barriers can take as much land out of production as windbreaks, annual crop barriers can take up to three or more times as much space as windbreaks and perennial grass barriers, and narrow buffer strips composed of alfalfa or another hay crop can be very effective in controlling wind erosion. Small numbers of windbreaks, when used with other practices, can provide landowners with a wide variety of crop options that would not normally be available. Essentially the low residue crops could be grown in the protected zone provided by the windbreaks. Higher residue crops in conjunction with other practices could be grown on the remainder of the field.

It becomes evident, that in situations where adequate crop residues are not available to control wind erosion, it will be necessary to subdivide the field by using a variety of crops and/or wind erosion control practices. Therefore, it is best to use a systems approach to the solving of wind erosion problems. All of the wind erosion control practices that can be used in an area should be considered. Their use as a sole means of soil protection or in possible connection with other practices should be evaluated. If this approach is used, an effective wind erosion control system can be designed to fit any situation.

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