CanHELP: A COMPUTER PROGRAM TO ASSIST IN DESIGNING ON-FARM EROSION CONTROL PRACTICES

J. M. W., Black[1] and D. G. Smith[2].

ABSTRACT

CanHELP is a computer program designed to assist in the selection of site-specific erosion control practices. The program uses the Wind Erosion Equation and the Universal Soil Loss Equation. Realistic use of CanHELP requires that the user select input variables carefully and have a good working knowledge of the erosion equations.

CanHELP consists of three main components; a soils database, and separate routines to estimate both wind and water erosion. The soils database stores information on the input variables for the erosion equations. The wind erosion routine estimates the amount of crop residue on the ground surface during the critical wind erosion period and calculates potential wind erosion. Average erosion from hillslopes is estimated using the water erosion routine. Graphs and on-screen calculations may then be used to select suitable conservation practices.

CanHELP will be distributed by PFRA once documentation is complete.

INTRODUCTION

CanHELP is an MS-DOS[tm] program designed to assist in the selection of on-farm erosion control practices using the Wind Erosion Equation (Woodruff and Siddoway, 1965) and The Universal Soil Loss Equation (Wischemier and Smith, 1978). The program operates on IBM[tm] compatible microcomputers having a minimum of 192 KB of memory. An EGA or VGA

---

[1]PFRA, 1901 Victoria Avenue, Regina, S4P 0R5.

[2]PFRA, Box 1088 Swift Current, Saskatchewan, S9H 3X3.

MS-DOS is a trademark of the Microsoft Corporation.

IBM is a trademark of International Business Machines.

monitor is required to display graphics and a 1.2 MB (5.25 inch) or 1.44 MB (3.5 inch) disc drive is required to operate the program if a hard disc drive is not available.

CanHELP is intended for use primarily by professionals and technicians working together with farmers to develop conservation plans for erosion control. It may also have utility in universities and technical colleges which teach courses in soil management and conservation.

The planner estimates soil movement as a result of wind and water erosion under existing management practices. Screen graphics and calculations may then be used to help select suitable conservation practices. Realistic use of CanHELP requires that the user select input factors very carefully and have a good working knowledge of the Universal Soil Loss Equation (USLE) and the Wind Erosion Equation (WEQ). The USLE and the WEQ have not been adequately tested on the Prairies so estimates of soil movement using CanHELP should not be considered to be accurate. Experience in the USA with these equations indicated that they are sufficiently precise to compare management practices for the selection of conservation measures.

CanHELP is an adaption of a program written by Teton Computing Services for the Soil Conservation Service in Montana. Adaptions allow the planner to select the "critical wind erosion period" i.e. the time at which serious wind erosion may be expected. CanHELP will be distributed by PFRA in the spring of 1990 once documentation is complete.

THE WIND EROSION EQUATION

The WEQ integrates the important factors affecting wind erosion and provides and estimate of long term average annual wind erosion from an area. The equation is:

$$E = f(IKCLV)$$ (Woodruff and Siddoway, 1965)

where: E is long term average annual soil movement in t/ac

I is a soil erodibility factor

K is a surface roughness factor

C is a climatic factor

L is unsheltered fieldwidth

V is a vegetative cover factor

The equation is not a simple mathematical relationship and cannot be solved on a calculator. The I, K and C factors are multiplied together but the effects of L and V involve more complex functional relationships with the other factors. Values ascribed to factors are those pertaining at the critical wind erosion period. The WEQ uses imperial units only.

THE UNIVERSAL SOIL LOSS EQUATION

The USLE estimates long term average annual soil erosion for a crop rotation due to sheet and rill erosion form hillslopes as a result of summer precipitation. The USLE is:

A = R K L S C P (Wischemier and Smith, 1978)

where: A is the average annual soil erosion in t/ac
R is a rainfall and runoff factor
K is a soil erodibility factor
L is slope length factor
S is a slope steepness factor
C is a cover and management factor
P is a support practice factor which accounts for the effects of special conservation practices on water erosion.

Variables may be expressed in both imperial and metric units. CanHELP uses imperial units throughout.

CanHELP

The CanHELP program has three main components, a soil database, and separate routines to estimate both wind and water erosion. The program concentrates on wind erosion estimation but does not provide limited assistance for conservation planning to control water erosion.

Soil Database (CanHELP Option 1)

The soil database contains estimates of variables for use in calculating erosion. Data retained for a soil series or association consists of:

Soil ID: A user defined alphanumeric value used to identify a series or association.

Main Name: Soil series or association name.

Capability Class: Canada Land Inventory agricultural capability class.

I Erodibility: The soild erodibility factor for the WEQ

WEG: Wind erodibility group for the WEQ.

T Tons: Soil loss tolerance.

K: The USLE soil erodibility factor.

Slope Length: Average slope length in feet.

Slope Steepness: Average slope steepness in percent.

The record may also contain information on up to two sub-dominant soils. Data may be entered into the database from the computer keyboard or a suitably configured file may be employed.

The database contents may be printed (Option 2 of CanHELP) for use in the erosion routines. Information from the database specific to a farm unit may be printed for inclusion in a report to the producer (Option 3). The soil data file is not accessed directly from the erosion routines.

The Erosion Routenes (Option 4)

The erosion routines consist of three worksheets. The first worksheet is used to enter producer information, the legal location of the parcel in question, variables for the erosion equations, and the estimated soil "tolerance" to erosion (T). Input variables may be chosen following field inspection, from the soil database (Option 1), or may be selected from 'pop-up' windows which appear on the screen when the cursor enters specific fields.

The Wind Erosion Worksheet estimates the amount of crop residue on the ground surface during the critical erosion period using a "balance sheet approach" and then calculates potential wind erosion for each year

of the rotation. Residues remaining in the fall are estimated and carried over for up to two years. Tillage, decomposition, weed growth, and residue after harvest are included in calculations. Most crops and tillage implements used on the Prairies can be accommodated.

Data is entered into the worksheet in sequential order starting with the amount of residue remaining from previous crops at April of the first planning year. Tillage operations and the fraction of residue left after each pass are entered together with the effects of overwinter and summer residue decomposition.

CanHELP can be used to estimate wind erosion at any critical period by the selection of a suitable monthly C factor and by considering the effect of tillage at the appropriate time. The wind erosion worksheet is shown in Figure 1. Area 'AA' is used to enter any tillage prior to the critical wind erosion period; area 'BB' is used for tillage after the critical period. For example, in most of the Prairie region tillage operations in April (including seeding) would be listed in area 'AA' because wind erosion will most likely occur in May or June. A typical worksheet for a wheat - fallow rotation in the Brown Soil Zone of Saskatchewan is shown in (Figure 2).

```
CLIMATE
SUMMER GROWN CROP
YIELD/ACRE
RESIDUE/UNIT YIELD
LBS RESIDUE
OVER-WINTER LOSS
RESIDUE @ APRIL

                AREA AA

K-RIDGE ROUGHNESS
RESIDUE @ EROSION
SGE @ EROSION
WIND LOSS (TONS)

                AREA BB

OVER-SUMMER LOSS
FALL GROWTH (LBS)
RESIDUE @ FALL
(ESC)=SAVE, (F3)=CALC, (F6-F7)=GRAPH, (P)=PRINT, (PgDn)= TO RAIN SHEET  ..
```

FIGURE 1. THE WIND EROSION WORKSHEET

CLIMATE	100	100	100	100	100
SUMMER GROWN CROP	S/F	FI S/WHEAT			
YIELD/ACRE		25			
RESIDUE/UNIT YIELD		60			
LBS RESIDUE		1500			
OVER-WINTER LOSS		.80			
RESIDUE @ APRIL	1200	627			
H/D CULTIVATOR	.75				
AIRSEEDER		.70			
COIL PACKER		.90			
K-RIDGE ROUGHNESS	0.8	0.8	0.8	0.9	0.8
RESIDUE @ EROSION	900	395			
SGE @ EROSION	1517	774			
WIND LOSS (TONS)	0.9	11.6			
FIELD CULTIVATOR	.80				
SPRAY	.95	.95			
OVER-SUMMER LOSS					
FALL GROWTH (LBS)	100	100			
RESIDUE @ FALL	784	1525			

WIND ROTATION AVERAGE FOR 2 YEARS IS 6.3 TONS, THIS IS) T.
<ESC)=SAVE, <F3)=CALC, <F6-F7)=GRAPH, <P)=PRINT, <PgDn)= TO RAIN SHEET

FIGURE 2. A COMPLETED WIND EROSION WORKSHEET FOR A WHEAT-FALLOW ROTATION IN THE BROWN SOIL ZONE OF SASKATCHEWAN

After estimating potential erosion for existing practices the worksheet can be used to evaluate the effects of alternative tillage practices on wind erosion by adding or deleting operations in the worksheet. Two graphs may be viewed which show the relationship between soil loss and, (1) surface crop residues and, (2) unsheltered fieldwidth for three levels of crop residue (Figure 3). The effects of stripcropping and shelterbelts are accommodated by adjusting the unsheltered fieldwidth. Calculations and graphs lead the planner towards a solution which is related to the expected soil "tolerance" to erosion.

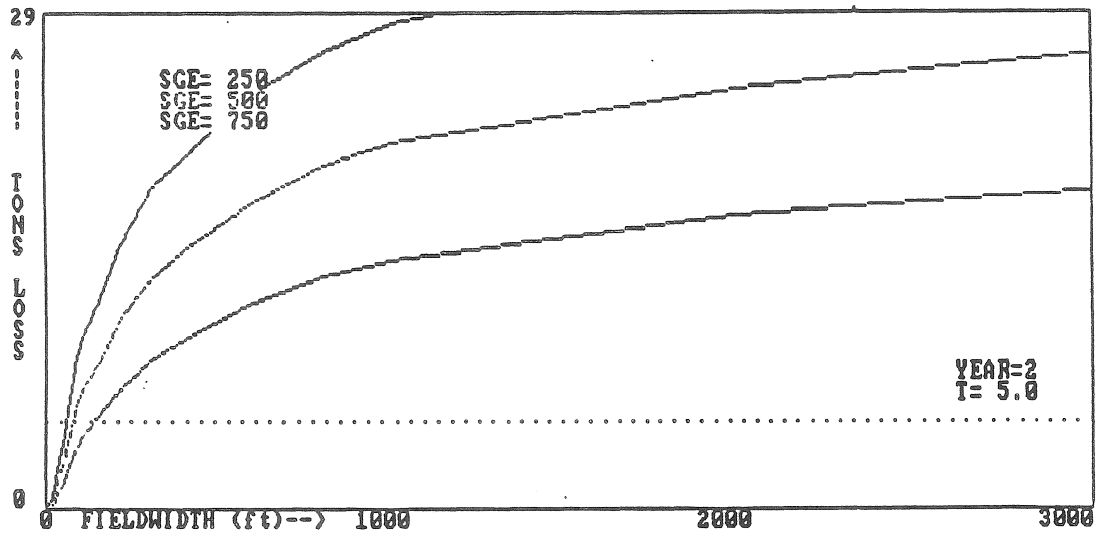

FIGURE 3. THE RELATIONSHIP BETWEEN ESTIMATED WIND EROSION AND UNSHELTERED FIELDWIDTH FOR THREE LEVELS OF SMALL GRAIN EQUIVALENT

The Water Erosion Worksheet is much simpler to use than that for wind erosion. The R and K factors for the USLE are input directly from the first worksheet as are the slope length and percentage. The planner is asked to name the rotation and to specify the USLE P and rotational C factors. The crop residue balance sheet in the wind erosion worksheet provides an estimate of crop residue levels in the spring. This value can be used to select a suitable C factor from tabulated values listed in the program documentation.

Once the C and P factors have been entered CanHELP calculates the LS factor and estimates potential water erosion. The program then suggests a C factor which would reduce water erosion to tolerable levels and displays the estimated wind erosion for the parcel.

In most situations on the Prairies wind erosion is more of a problem than water erosion. In cases where the maintenance of crop residue is selected to control wind erosion the recommended residue levels will usually provide sufficient protection against water. In these circumstances the water erosion routine in CanHELP would be employed to confirm that water erosion is the lesser problem and to confirm the adequacy of proposed measures to control all erosion.

CONCLUSIONS

CanHELP is a useful tool in the design of on-farm conservation practices. The program will be used by PFRA in Saskatchewan and Manitoba.

REFERENCES

Wischemier, W. H. and Smith, D. D. 1978. Predicting Rainfall Erosion Losses - A Guide to Conservation Planning. USDA Handbook #537. Washington D.C. 58pp.

Woodruff, N. P. and Siddoway, F. H. 1965. A Wind Erosion Equation. Soil Sci. Soc. Amer. Proc 29 (5):602-608.