5.5 TILLAGE

A management file contains separate input lines for planting, cultivating, and other tillage operations. The development of a management input file begins with the RWEQ INPUT FORM (APPENDIX A-2). Multiple tillage operations are listed on this form (*e.g.* Table 5.1.2.2). It is only necessary to enter the date, residue and growing crops, and tillage implement if the default (generic) values for roughness, ridges, and residues are acceptable.

Tilling a soil is a common method of controlling weeds, erosion, and preparing a seedbed. In the process of preparing a seedbed the surface crust is disturbed and large stable soil aggregates (clods) are broken into smaller aggregates. When these aggregates are smaller than 0.84 mm in diameter, they are susceptible to erosion by wind.

Tillage information is incorporated into RWEQ through the **DOABLE SCREEN** in the **Operation/Irrigation Data** window. These inputs are stored in the management file.

5.5.1 What is a tillage file?

RWEQ uses external files to input default (generic) values to describe a tillage implement. APPENDIX C-1 is a listing of the implements, filenames and the data associated with the implement. These data include random roughness, ridge spacing, ridge height, % of the standing residue not flattened by the tillage operation, and % of the flat residue not buried by the tillage operation. A tillage file contains these five numbers.

5.5.2 What is the source of available tillage information?

Since soil aggregation is not usually described, photos of different roughness conditions and the corresponding random roughness values are in Figure 5.5.2. Farmers are a major source for input data; they are knowledgeable of the ridge height and spacing generated by their implements on their soil. The farmer can also estimate the % of the flat residue that is still on the soil surface and the % of the residue that continues to stand after the tillage operation. With this information a tillage file may be customized for unique situations or for a specific region.

5.5.3 Using tillage information in the DOABLE SCREEN

Any tillage information may be input through the **DOABLE SCREEN.** Under the **Operation/Event** column press F9 to enter the **Operation/Irrigation Data** window. After the operation is selected the question is asked “Operation Modifies Roughness”. If “No” is toggled, values cannot be overwritten. If “Yes” is toggled, the random roughness and the ridge spacing, height and orientation may be modified.

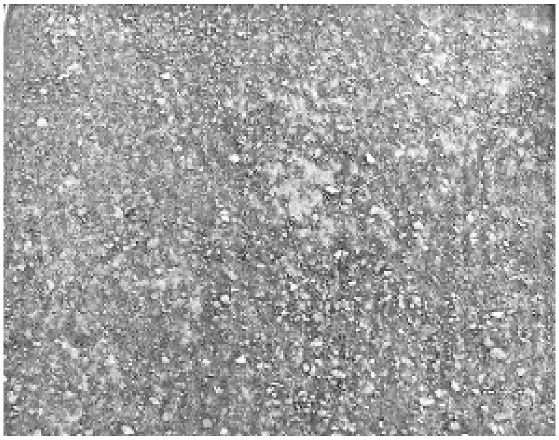
5.5.4 Using a tillage input file

If an implement is used frequently, a tillage file for that implement may be developed, saved and added to the choice list.

5.5.4.1 **Developing a tillage input file** For illustration purposes, the development of a tillage input file for a rotary hoe is shown. This implement is used on moist soils to roughen the soil surface or to aid in seedling emergence after a rain.

Fryrear, D.W., Ali Saleh, J.D. Bilbro, H.M. Schomberg, J.E. Stout, and T.M. Zobeck. 1998. Revised Wind Erosion Equation (RWEQ). Wind Erosion and Water Conservation Research Unit, USDA-ARS, Southern Plains Area Cropping Systems Research Laboratory. Technical Bulletin No. 1. Internet address: http://www.csrl.ars.usda.gov/wewc/rweq.htm

Figure 5.5.2

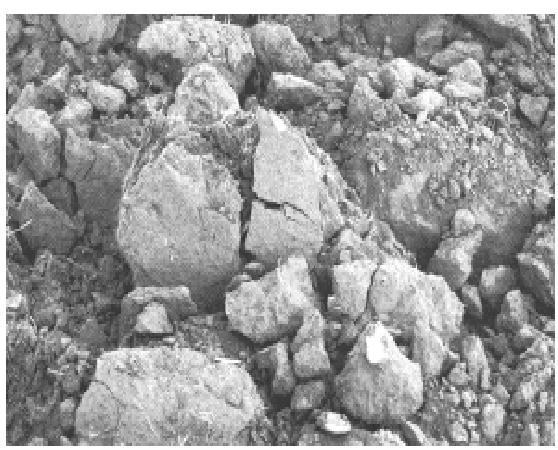


RR = 0.23

RR = 0.53

RR = 0.95

RR = 1.14



RR = 2.52

The random roughness for a rotary hoe varies for different regions of the country but generally is similar to a spike harrow (RR=0.4).

This implement has minimal effect on ridge roughness. If the previous implement was a deep furrow drill with the rows 14" apart and ridges 3" high, the rotary hoe may leave ridges 14" apart and 2.5" high. The ridge height and spacing of the previous implement must be considered to properly input the rotary hoe.

The rotary hoe is normally not used when residues are standing. Again, the spike harrow values come close to describing the effect of a rotary hoe on residues.

5.5.4.2 **Creating and saving a tillage file** From DOS at the C:\RWEQ97> prompt type **EDIT ROTARY_H**. (There is an 8 character limit on the file name.) The file consists of one column of the 5 values (bolded) as shown below.

Random roughness, *inches* (assume spike harrow)	**0.4**
Ridge spacing, *inches* (previous implement- deep furrow drill)	**14**
Ridge height, *inches*	**2.5**
% Flat retained (assume spike harrow)	**80**
% Standing (assume spike harrow)	**0**

After five data values are entered, select SAVE from the FILE menu and EXIT the editor.

5.5.4.3 **Adding a tillage file to the choice list** To add a new tillage filename to the RWEQ choice list you *must* exit the RWEQ program. A new tillage file can be added to the choice list from DOS. At the C:\RWEQ97> prompt, type **EDIT RWEQ.CLS**. Find "*Operation" in the listing. At the end of this line press <enter>. Type the new tillage filename (*e.g.* **ROTARY_H**). Select SAVE from the FILE menu. The new version of RWEQ.CLS is saved. Select EXIT from the FILE menu to exit the editor.

5.5.5 **Example of influence of tillage and soil roughness on erosion estimates**
Tillage implements modify soil roughness. A tillage operation may result in *random* roughness over the entire soil surface. *Oriented* roughness is expressed as the ridge height and spacing produced by the implement.

5.5.5.1 **Random roughness** To illustrate the impact of random roughness on erosion, the client file BIGTEX is used to estimate erosion for six random roughness values.

Table 5.5.5.1. Estimated erosion using BIGTEX.MAN and W\TX23005.DAT on a 320-acre field with different levels of random roughness. Ridge height and ridge spacing are set to zero for each operation to eliminate oriented roughness effects.

Random roughness, *in*	0	.25	.40	.75	1.05	1.60
Erosion estimate, *t/ac*	53.5	24.2	17.6	9.3	5.6	1.9

As the random roughness increases, estimated erosion decreases. While a little random roughness has a major impact on erosion, the small aggregates associated with a random roughness of 0.25 are readily decayed by rainfall.

5.5.5.2 **Oriented roughness** To illustrate the effect of oriented roughness BIGTEX is used. The ridge spacing remains 20 inches while the ridge height is varied from 2 to10 inches. Ridge height/spacing ratios usually do not vary less than 1 to 4 but for this example they vary from 1 to 2.

Table 5.5.5.2. Estimated erosion using BIGTEX.MAN and W/TX23005.DAT on a 320 acre field with different ridge heights. Random roughness is set to zero and ridge spacing is 20 inches.

Ridge height, *in*	0	2	4	6	8	10
Erosion estimate, *t/ac*	53.5	42.6	30.5	23.8	19.5	17.2

There is an 20% reduction in soil erosion when going from a flat surface (ridge height = 0) to a surface with 2 inch ridges. The reduction is 43% when going from the flat surface to 4 inch ridges. The 6 and 8 inch ridges further reduce erosion. The benefit of soil ridging is more pronounced if there is a dominant wind direction in the weather file because the magnitude of the impact of soil ridges is partially controlled by the variations in dominant wind direction.

5.5.5.3 **Ridge direction** To illustrate the effect of ridge direction BIGTEX.MAN and W\TX23005.DAT are used. For this weather file the preponderence values for January through April are 1.0 to 1.5. These values indicate the lack of a dominant wind direction. Any system that is directionally sensitive such as tillage or windbarriers is not as effective as nondirectional systems.

Table 5.5.5.3. Estimated erosion with BIGTEX.MAN and W\TX23005.DAT on a 320 acre field with two ridge orientations.

Ridge orientation, *deg.*	0	90
Erosion estimates, *t/ac*	8.0	7.1

5.5.6 **Decay of soil roughness**

To illustrate the decay of soil roughness by weather, the TEST-LIS.MAN is used with four weather files on a 160-acre circular field. This management file begins with a lister operation. The K’ and K” values from the tabular output are combined in Table 5.5.5. The increase in the K’ and K” values over the 25 erosion periods indicate the impact of rainfall on roughness decay.

Table 5.5.6.

		HI22516.DAT		IL14834.DAT		WA24157.DAT		TX23005.DAT	
		K′	K″	K′	K″	K′	K″	K′	K″
1	01/01/1990	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.04
2	01/16/1990	0.05	0.05	0.02	0.02	0.02	0.02	0.01	0.04
3	01/31/1990	0.05	0.12	0.03	0.08	0.02	0.02	0.02	0.02
4	02/15/1990	0.07	0.15	0.04	0.09	0.03	0.03	0.02	0.02
5	03/02/1990	0.10	0.18	0.10	0.05	0.04	0.04	0.02	0.07
6	03/17/1990	0.13	0.21	0.12	0.07	0.04	0.04	0.03	0.07
7	04/01/1990	0.16	0.24	0.14	0.09	0.05	0.05	0.05	0.05
8	04/16/1990	0.19	0.27	0.17	0.12	0.06	0.06	0.05	0.06
9	05/01/1990	0.20	0.28	0.21	0.16	0.07	0.07	0.17	0.07
10	05/16/1990	0.21	0.30	0.26	0.21	0.08	0.08	0.21	0.12
11	05/31/1990	0.22	0.30	0.33	0.29	0.09	0.09	0.27	0.17
12	06/15/1990	0.23	0.31	0.41	0.36	0.10	0.10	0.34	0.24
13	06/30/1990	0.27	0.28	0.49	0.50	0.11	0.11	0.38	0.28
14	07/15/1990	0.29	0.29	0.60	0.60	0.11	0.12	0.43	0.33
15	07/30/1990	0.30	0.30	0.67	0.67	0.12	0.12	0.47	0.37
16	08/14/1990	0.32	0.32	0.73	0.73	0.13	0.13	0.51	0.42
17	08/29/1990	0.32	0.33	0.79	0.76	0.13	0.14	0.55	0.47
18	09/13/1990	0.33	0.33	0.83	0.80	0.14	0.14	0.59	0.51
19	09/28/1990	0.32	0.39	0.84	0.82	0.15	0.15	0.63	0.55
20	10/13/1990	0.33	0.40	0.85	0.83	0.15	0.15	0.66	0.59
21	10/28/1990	0.36	0.43	0.86	0.84	0.16	0.16	0.67	0.60
22	11/12/1990	0.40	0.46	0.87	0.85	0.17	0.17	0.68	0.61
23	11/27/1990	0.45	0.46	0.87	0.87	0.18	0.18	0.64	0.64
24	12/12/1990	0.49	0.49	0.87	0.87	0.19	0.19	0.64	0.65
25	12/27/1990	0.49	0.50	0.87	0.87	0.19	0.19	0.64	0.65
Annual rainfall,mm			1781		871		407		440
Rain days			165.5		103.4		111.8		49.4
EI			N/A		25.48		150		1613
Total erosion,t/ac			49.7		16.7		0.2		33.6

The impact of soil roughness on soil erosion is influenced by the climatic conditions. While Hawaii has over 4 times the rainfall of Big Spring, Texas and over 3 times the number of rain days, the impact on soil deterioration is not as evident because the rainfall erosive energy (*EI*) is not available in the weather file. Consequently, the decay of soil roughness is not represented by this weather file.

Joliet, Illinois has twice the rain of Big Spring, Texas and essentially all the benefits of soil roughening were gone by September.

Spokane, Washington has slightly less rain, more than twice the number of raindays and a tenth of the rainfall erosive energy of Big Spring, Texas, and soil roughness was still a major factor in reducing soil erosion in December. Part of the difference in erosion is undoubtly due to less wind movement.