WIND EROSION EQUATION
(MANAGEMENT PERIOD METHOD)
USE OF MICROSOFT EXCEL SPREADSHEET

Developers

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- **Purpose -** This technical note provides the background and basic instructions to use the Wind Erosion Equation (WEQ) Microsoft Excel spreadsheet computer version. To operate the equation the user will need to have a good understanding of Part 502 of the National Agronomy Manual (NAM). The user will need a computer with at least a 486/33 or better; Windows, 95, 98; NT, or XP, MS Excel version 7.0 or better; 64 meg of RAM or better; and a copy of the current WEQ excel spreadsheet. Currently this is **WEQv8.02.xls.** However, versions are updated from time to time. Check on the NRCS eFOTG website for the current version. The excel program can be obtained at the following website:

  http://www.nrcs.usda.gov/techncial/efotg

- **Background -** In the late 1980s a computer version of WEQ was developed for the UNIX based 3b2 computers. It was developed to run a management period method calculation in a fraction of the time a long hand version could be done. Circular No. 2 (amendment to the NAM) came out Sept. 12, 1997. It added an adjustment for irrigated fields by lowering the I factor for irrigated soils and reducing Erosive Wind Energy (EWE) for surface wetness. It also added an adjustment for random roughness (RR), and a way to interpolate the Climate (C) factors. The new WEQ module in FOCS was not able to compute the Circular No. 2 changes and therefore not used in the field. The Wind Erosion Prediction System (WEPS) model is due to be released in the near future. The WEQ excel program was created to fill the gap and incorporate Circular 2 changes.

- **General –** To use the management period method of the wind erosion equation, the user needs to have a good understanding of Part 502 of the National Agronomy Manual (NAM). The State Agronomist will set up the wind climate data, crop data and operation (tillage) files. Cropping systems developed on the model can be saved and used as templates for future use by the client or for new planning.

- **Irrigated Circles -** Many irrigation circles are planted in a circular pattern. To estimate wind erosion on fields planted and/or tilled in a circular pattern, two estimates need to be made. The first estimate should be made after selecting a NS tillage direction and the second should be made using an EW tillage direction. The average of the two estimates is the correct soil loss value.

- **Definitions -** The first worksheet in the WEQ spreadsheet (**Instr**) has most of the column headings defined and an explanation of the information required for the spreadsheet to run. Please print a blank worksheet (**Res Wks**) and the calculation sheet (**Calc**) before reading the **Instr** sheet. Please read the **Instr** sheet before starting.

- **Crop Templates –** A number of crop templates have been built for most of the major crops. They can be found on worksheets contained in the program. Each one is labeled on a worksheet tab at the bottom of the program. The desired crop template can be copied from the appropriate crop worksheet then pasted to the residue worksheet (**Res Wks**). When pasting the crop scenario on to the Res Wks, always paste using the paste special function.

- **Circular Reference Bug -** There is a circular reference bug in the sheet. As you enter data for the first time you may have an error caution appear on your screen and tell you there is a circular formula error in the sheet. **DO NOT PANIC** and call for help! Just close the warning box when it pops up and continue to add the data needed for the run. The error warning will stop when the first harvest is entered.

Using the Current WEQ Excel Spreadsheet Step by Step

This is a step by step process to show how to use the program. Start the step by step process after reading the **Instruc** sheet (the tab at the bottom of the WEQ Excel spreadsheet).

Step 1 - Fill in the **Producer**, **Planner**, **Location** (Farm Unit or Sec., Town., Range), **Tract**, **Field**, and **Crop Rotation** cells. These cells are optional. The program will run without them being filled in.

The cells in the remaining steps are required and must contain the necessary data for the program to run properly.

Step 2 - Use the pull down menu to select the **Climate Data Station**. The climate data is pulled from the **Climate** worksheet (see the tab at the bottom of the worksheet). Each county has an established Climate Data Station and will select it here.

Step 3 - Fill in the **C Value** for the county**, Field Width** of short side of the field (ft)**, Tillage Direction** (EW or NS, use pull down menu)**, Length/Width Ratio** (number equal to or greater than one, use pull down menu), **Field Direction** of long side of the field (EW or NS, use pull down menu)**, Irrigation** (Y/N, use pull down menu)**,** and **Soil "I"** (use pull down menu).

Step 4 - Determine the **Wind Erodibility Group** (WEG) from the FOTG soils section, and fill in the number (1-7 or 4L, use pull down menu).

Step 5 – The **1/1/2000** date appears on the first line of worksheet (on the same line with **"Start Rotation"**). The year of the date on this line may be changed but shall always start with a 1/1/xxxx. Start the first management period on January 2, xxxx with an **Over winter loss** (decomposition of crop residues) operation when a summer crop is being used. Go to the **Operation Date** column on row 13. Put in the date **1/2/xxxx**. Next place the cursor in the **Crop** column next to the date and click in the box to activate the pull down menu. Select the crop (from the pull down menu) whose residue is decomposing. Move to the **Operation** column. In cell C13, click for the pull down menu and select the **Over winter loss, fragile (F) or non-fragile (N) operation** (see NAM Part 503 Subpart E, table 1 & 2, for definition). This process is repeated using correct dates until all tillage operations, planting operations, and harvests are completed. As you select the planting operation change the crop to the new crop beginning with the planting operation.

Step 6 - The next date after planting will be the end of the first 15-day growth period. The date can be entered as a formula. In the blank date column A, type **=**, then point and click on the cell just above, then type **+15**, then hit the return key. This will enter a formula that tells the computer, to type the date above and add 15 days. All growth periods are 15 days except winter wheat or other winter crops, which have a 60-day growth period over winter (see the **Crop** table for details). The 15-day date formula can be copied down for the number of growth periods for the crop planted. Next, in the **Crop** column click and select the growing crop name with a number next to it. Continue to select a series of growth periods. Example: **Bean 15**, **Bean 30**, **Bean 45**, **Bean 60**, and **Bean 75** can be copied and moved at the same time to the **Crop Name** column of the **Res Wks**. This must be done using the **paste special** function. Select the Crop Tab and find the correct series of grow names, highlight them and copy them. Change back to the **Res Wks** sheet, place the cursor in the first cell under **Crop** (column B)

where crop growth begins, right click and click on **paste special**, then select the radio button for **value** under the paste section, and click OK. In the **Operation** column enter (click and select) **"Grow"** for all the growth periods. **"Grow"** can be pasted in the first cell and then copied down the sheet (**Res Wks**) as needed**.** All growth series of data can be copy from the tables in groups and the **paste special** function used to paste only the **values** to the **Res Wks**. If you copy and paste normal you will lose the formatting in the cells.

Step 7 - Enter the Harvest **date**, the harvested **crop name** (without a number extension), and the word "**Harvest**" for above ground crops or "**Harvest, root crop**" for root crops in the **operation column**.

Step 8 - Enter the **date** of any post harvest tillage**, crop name,** and the name of the **operation.** Repeat step 5, 6, 7, and 8 for any additional crops in the rotation. 100 management periods can be used in each calculation. If more are needed try removing lines where there is no erosion. An example would be to reduce the number of operations of **"Grow"** to just what is needed to take erosion to zero for the rest of crop growth period.

Step 9 - End the crop rotation with a **12/31/xxxx date,** last harvested **crop name**, and the **End Rotation** operation.

Step 10 - Enter any **irrigations** for the periods listed. Enter the **number** of irrigations in each management period. Keep in mind the stage of growth and the consumptive use of the crop during the management period.

Step 11 – In the **Flat Res.** column on each line of the run enter the percentage of residue that is flat on the ground. For example enter **0** when the crop residue is 100% standing (no flat residue), and 100 when all the residue is flat (as after a heavy inversion tillage operation). Example, if 60% of the residue is standing after a tillage, then enter 40 or 0.4 and hit the return key. The number appears as a percent.

Step 12 - Finally, adjust any **yield values** that are different than the default yields in column G-H. You can change the yield by 50% up or down by using the drop down menu in the **Yield Adjustment** column (F).

Example

Iam Windy farms, tract 123 on an irrigated circle (field 1) of continuous corn for grain. The soil has an unadjusted "I" factor of 56. The circle field has a diameter of 2640 ft, and is near Guymon, OK. The "C" factor is 100. The grower tills and plants in a circular pattern. Iam plants corn on 5/1 and harvests 10/15. In the spring the field is chiseled with straight points on 3/15. On 4/5 the circle is disk again with a primary tandem disk operation. Then, on 4/15 the field is cultivated with a field cultivator and planted on 5/1 with a 30 in double disk planter. His average yield is 200 bushels/acre.

Step 1 - **Fill in**: producers name, planner's initials, FO location, tract no. field no., and crop rotation in the rotation box.

Step 2 - Select the climate data station of **Garden City, KS** from the pull down menu.

Step 3 - Put **100** in the "C" value box, **2640** feet in the field width box, **NS** for the tillage direction, length/width ratio is **1.0**, field direction is **NS**, irrigation is **Y**, and soil I is **56**.

Step 4 - WEG is **5**.

Step 5 - On the first line of the table (cell A12), make sure the date of **1/1/2000** is there and the operation of **"Start Rotation"**. On the second line of the table, (cell A13) enter **1/2/2000**, select **Corn, grain, high yield** from the pull down menu in the crop column, select **Over winter loss N** in the **operation** column. On the next line enter the first tillage on **3/15/2000**, copy **Corn, grain, high yield** from the cell above, select **Chisel, straight points N** from the **Oper** pull down menu. Enter **4/5/2000** on the next line, copy the **Corn, grain, high yield** for the crop column and select **Disk, Tandem, Primary N** in the operations column**.** Enter **4/15/2000** and copy **Corn, grain, high yield**. Select **Cultivator, field, sweep, 9-16"N** for the operation. Enter **5/1/2000**, **Corn, grain, high yield** and **Planter, DD opener, 30 in sp N**.

Step 6 – Start the growing period with the date 5/15/2000. Select **Corn, grain 15** through **Corn, grain 75** from the pull down menu in the crop column. Select **Grow** in the **Operation** column and copy down to match the **Crop** column.

Step 7 - Enter the harvest date **10/15/2000**, select the crop **Corn, grain, high yield** and select **Harvest**.

Step 8 - End the run by entering **12/31/2000**, select **Corn, grain, high yield** then select the **End Rotation** operation.

Step 9 – Estimate the number of irrigations needed for each period in the crop rotation. The number of irrigations is determined by the number of times that irrigation water will wet the soil surface in the given management period.

Step 10 - Go down the **Flat Res** column and estimate the **percent flat residue for each period of the crop rotation**. Start with the **Harvest** operation. Approximately 80% of the residue is standing after harvest. Enter 20 at harvest and then estimate the flat residue for the remaining periods. Make sure all period entries has a percent flat residue number entered in column E.

Step 11 – The yield for the corn crop is 200 bu/ac. Use the pull down menu in column F and select 0.5 to increase the yield in column G to 200 bu/ac. This increases the 133 bu/ac to 200 bu/ac.

Results – The erosion rate for the circle system is 4.0 t/ac with the tillage set in the NS direction while the soils loss is 4.2 t/ac with the tillage set in the EW direction. Therefore, the average of the two is 4.1 and that becomes the soils loss for the field.

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Producer:		Climate Data Station:	KS, GARDEN CITY	Tract:		Field:	
Planner:		Field Width (Ft.):	2640	Tillage Direct (NS/EW):	NS	Irrigated? (y or n):	Y
Crop Rot:		Field Direction (NS/EW):	NS	Length/Width Ratio:	1.0	Wind Erodibility Group:	5 (1-7)
Location:		Adjusted Soil "I":	56	Site "C" Value:	100		
Average Annual Wind Erosion (t/ac):	4.0	Yrs in Rotation:	1.0	Sum Period Erosion:	4.0	(tons/ac)	

Crop and Operation Management Records/Residue Calculations (green and dry)

Operation Date (date)	Crop (name)	Operation (name)	No. of Irr./Period (#)	Flat Res. (%)	Yield Adjustment (%)	Yield (units/ac)	Ridge Height (in)	Ridge Spacing (in)	Est. Res Retention (fact)	Est. Res. Dry Matter (lb/ac)	Est. Ground Cover (%)	SGe Dry Residue (lb/ac)	Green Dry Matter (lb/ac)	SGe Green Growth (lb/ac)	Random Roughness (in)
1/1/00	-	Start Rotation		20%	-	- -	1	30	0.40	11172	100	7959	0	0	0.40
1/2/00	Corn, grain, high yield	Over winter loss N		20%			1	30	0.80	8938	100	6353	0	0	0.30
3/15/00	Corn, grain, high yield	Chisel, straight points N		80%			3	30	0.60	5363	83	2984	0	0	1.00
4/5/00	Corn, grain, high yield	Disk, tandem, heavy, primary op. N		100%			1	13	0.25	1341	38	627	0	0	0.70
4/15/00	Corn, grain, high yield	Cultivator, field, sweeps, 9"-16" N		100%			2	30	0.70	938	28	430	0	0	0.50
5/1/00	Corn, grain, high yield	Planter, DD opener, 30 in sp N	1	100%			1	30	0.85	798	25	362	0	0	0.40
5/15/00	Corn, grain 15	Grow	1	100%			1	30	1.00	798		362	1	3	0.40
6/1/00	Corn, grain 30	Grow	1	100%			1	30	1.00	798		366	150	389	0.40
6/15/00	Corn, grain 45	Grow	1	100%			1	30	1.00	798		372	500	1214	0.40
7/1/00	Corn, grain 60	Grow	1	100%			1	30	1.00	798		393	2500	4988	0.40
7/15/00	Corn, grain 75	Grow	1	100%			1	30	1.00	798		401	4000	7376	0.40
10/15/00	Corn, grain, high yield	Harvest		20%	50%	200 bu/ac	1	30	1.00	11172	100	7959	0	0	0.40
12/31/00	Corn, grain, high yield	End Rotation		20%			1	30	1.00	11172	100	7959	0	0	0.40

Corn / Cotton / Sorghum / Wheat / Soybeans / Peanuts / Rotations / Res Wks / Calc / Crop / Oper / Climate / V

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H20 =IF(A20="","",IF(F20=0,1,IF('WEQ Tab'!G30>1,1,'WEQ Tab'!G30)))

NRCS - WEQ CALCULATIONS, Version 8.01

Producer:		Planner:		Location:		Tract:	Field:
Crop Rotation:		Climate Data Station:	KS, GARDEN CITY			Site "C" Value:	100
Tillage Direction (NS/EW):	NS	Length/width ratio:	1	Field Direction (NS/EW):	NS	Field Width (Ft.):	2640
Irrigation (Y or N):	Y	Soil "I": 56		Wind Erodibility Group:	5 (1-7)	TWF:	2 (see instr.)
Sum Period Erosion (t/ac):	4.0	No. Yrs in Rotation:	1.0	Av. Annual Wind Erosion:	4.0 (t/ac/yr)		

Calculations and Output

Mgt Periods Dates Begin	End	Irr. No. of (#)	Soil "I" (t/ac)	Ridge Roughness Dev. (deg)	Ht. (in.)	Sp. (in.)	"Krd" (factor)	Random Roughness "Krr" (factor)	Unsheltered Distance Dev. (deg)	Prep. (factor)	WED (factor)	"L" (ft)	SGe "V" (lbs/ac)	Erosion "E" (t/ac)	EWE (%)	"IF" (%)	Loss (t/ac)	days in mngt period	BEGIN DATE WIND DIRECTION	ADJUSTED WIND DIRECTION	DIRE DEV
1/1	01/02/00	0	38	90.0	1	30	0.95	0.69	90.0	2.1	1.020	2693	6999	0.0	0.2	1.00	0.00	1	0	0	
1/2	03/15/00	0	38	90.0	1	30	0.95	0.99	90.0	2.1	1.020	2693	6353	0.0	19.0	1.00	0.00	73	0	0	
3/15	04/05/00	0	38	90.0	3	30	0.82	0.58	90.0	2.4	1.020	2693	2984	0.0	8.4	1.00	0.00	21	0	0	
4/5	04/15/00	0	38	90.0	1	13	0.96	0.44	90.0	1.7	1.030	2719	627	5.5	4.3	1.00	0.23	10	0	0	
4/15	05/01/00	0	38	90.0	2	30	0.85	0.99	90.0	1.7	1.030	2719	430	18.8	6.9	1.00	1.30	16	0	0	
5/1	05/15/00	1	38	90.0	1	30	0.95	0.69	90.0	2.2	1.020	2693	362	14.8	5.2	0.86	0.66	14	180	180	
5/15	06/01/00	1	38	90.0	1	30	0.95	0.99	90.0	2.2	1.020	2693	365	23.4	6.3	0.88	1.30	17	180	180	
6/1	06/15/00	1	38	90.0	1	30	0.95	0.69	90.0	2.4	1.020	2693	755	7.7	6.5	0.86	0.43	14	180	180	
6/15	07/01/00	1	38	90.0	1	30	0.95	0.99	90.0	2.4	1.020	2693	1586	0.9	7.4	0.88	0.06	16	180	180	
7/1	07/15/00	1	38	90.0	1	30	0.95	0.69	90.0	2.1	1.020	2693	5381	0.0	3.0	0.86	0.00	14	180	180	
7/15	10/15/00	1	38	90.0	1	30	0.95	0.99	90.0	2.1	1.020	2693	6999	0.0	20.1	0.98	0.00	92	180	180	
10/15	12/31/00	0	38	90.0	1	30	0.96	0.99	90.0	2.5	1.015	2680	6999	0.0	12.5	1.00	0.00	77	180	180	
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