Soil
FACTSHEET

BRITISH COLUMBIA | Ministry of Agriculture

Order No. 641.220-1
Revised December 2015
Created September 2000

Estimating Crop Residue Cover for Soil Erosion Control

INTRODUCTION

Soil erosion has been recognized as a problem in the Peace River Region of British Columbia. Erosion control of fields is within the ability of most producers through crop residue management.

Rapid spring snowmelts (or winter chinooks) and intense summer rainstorms can seriously erode bare, smoothly cultivated fields. Fields that have a rough surface of clods and stubble will resist eroding, but a standing stubble is the most resistant to erosion.

CROP RESIDUE

To achieve maximum resistance to wind and water erosion, much of the stubble should be anchored to the soil upon entering winter. Flat stubble provides protection against raindrop impact, but provides little protection for snowmelt runoff or wind erosion.

To provide effective protection, the soil should have 30% to 50% of its surface covered by residues, preferably anchored. An uncultivated field or chem-fallowed field will have residue covers of 80 - 90%, eliminating the risk of erosion. Uneven distribution of residues can be reduced by combine attachments, which blow the crop residue over a wide area; or through light harrowing operations. The even distribution of crop residue is especially important for the efficient operation of no-till drills.

ESTIMATING CROP RESIDUE COVER

Visual estimates of crop residue cover are often misleading when compared to actual residue measurements. Accurate and simple field procedures can be used to measure the crop residue over, or estimates based upon crop yields, tillage operation, and field operations can be made to determine what management is required to achieve the various levels of residue cover.

1. Field Measurements

There are two field procedures which provide good estimates of crop residue cover.

a) Meter Stick Method

A meter long stick marked into 25 equal segments, may be used to measure crop residues. The stick is placed at right angles to crop rows, beginning at one row. Percent crop residue cover is measured by counting the number of marks that lie directly over a piece of residue, and multiplying by four.

To avoid estimation errors, the observer must look straight down at each mark, take measurements on the same side of the stick, and count only undecomposed crop residue. If there is doubt about the residue measurement, then do not count it. (See Figure 1 (4 direct hits x 4 = 16%)).

A minimum of 10 measurements should be made randomly through a field to obtain a field average. Headlands and field entry areas should not be measured. Concentrations of crop residues such as in chaff rows should be measured separately as to their percent residue cover. The area that these rows occupy in a field should be estimated, and then be used to correct the inter row area of the field, although the finer residue may not offer the same protection as stubble. A sample calculation follows:

Inter row area - 37% cover over 75% of field

Chaff row - 53% cover over 25% of field

$$0.37 \times 0.75 = 0.28$$
$$0.53 \times 0.25 = \underline{0.13}$$
$$0.41$$

or 41% crop residue cover for the entire field.

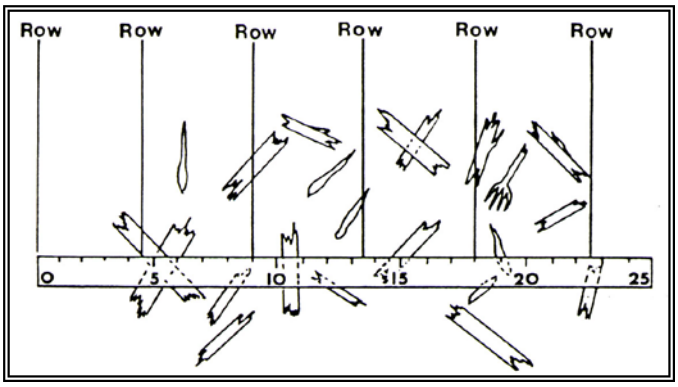

Figure 1 The Meterstick method of measuring Crop Residue Cover

b) Line-Transect Method

Also known as the line-point method, this procedure is similar to the meter stick method. A 50 foot measuring tape or 1/8 inch diameter nylon rope marked at one foot (12 inches) intervals (by knots or paint, etc) is stretched diagonally at 45 degrees across the crop rows. The tape or rope must be stretched tautly, and therefore must be anchored at both ends. The line must start at a row and end at a row. Percent crop residue cover is measured by counting the number of marks that intersect crop residue, and multiply by two.

A minimum of 4 to 5 measurements should be made randomly through a field to obtain an average.

This method is not as portable as the meter stick method, but allows the user to measure larger areas. More than 5 measurements may be made if there are some wide swings in the results. The advantage is the chaff row areas are likely to be included in the estimates and there is no need to compensate for them.

Both the meter stick and line-transect methods appear to be comparable in their results, providing a reasonably accurate estimate of residue cover.

2. Calculation Method

The calculation of crop residue cover relies on tabular and graphical information to estimate the crop residue cover that should remain following the field operations. It is useful for planning field operations to achieve a desired residue cover. Often buried residue is exposed by subsequent tillage

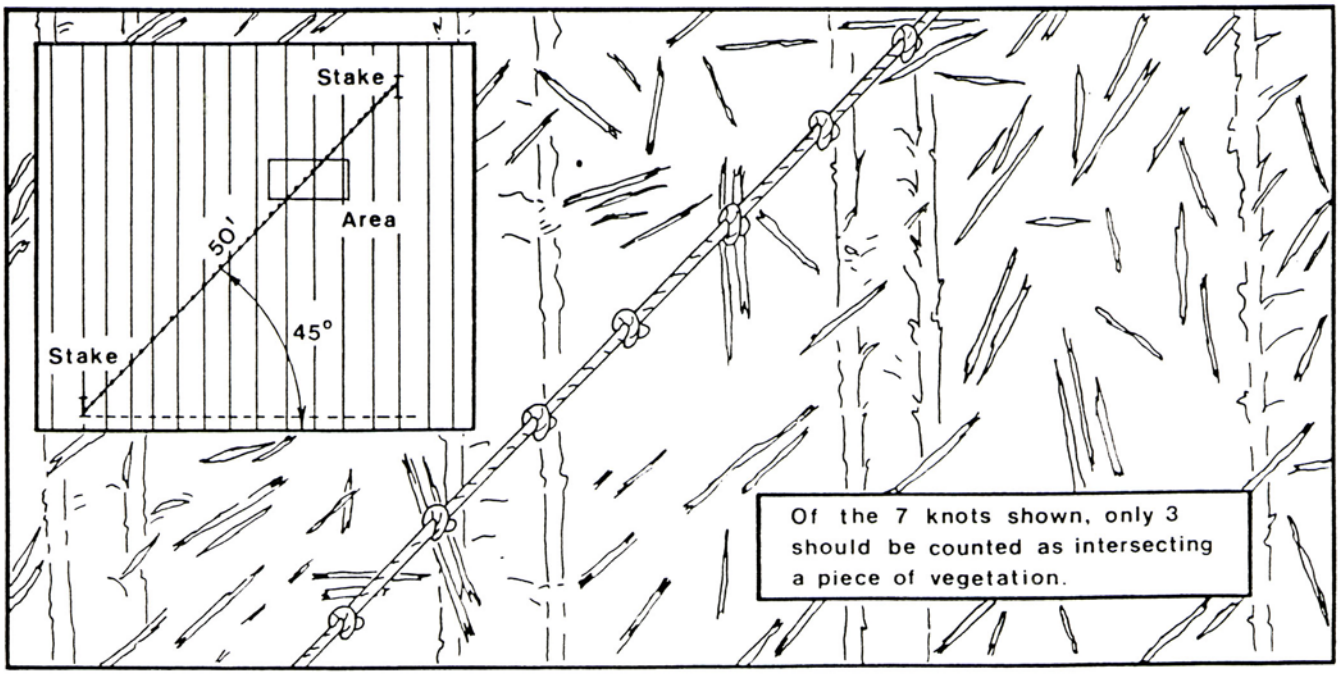

Figure 2 Overview (inset) and close-up of the line-transect method. (Source: Illinois Cooperative Extension Service)

which cannot be accurately estimated by tabular data. However, this residue is laying flat and does not offer much protection from wind or snowmelt runoff, thus the tabular method may be reasonably accurate in its estimation of effective residue cover.

Crop residue to grain yield ratios are a useful guide to estimate the remaining crop residue after harvest. Table 1 shows the relationship of several major crops in the Peace River region.

Table 1 CROP RESIDUE PRODUCTION FROM YIELDS*

CropYield Bushel/acre	Crop Residue kg/ha				
	Wheat, Oats, Rye	Barley	Canola	Flax	Pea
10	1080	520	1200	700	670
15	1620	780	1800	1050	1005
20	2160	1040	2400	1400	1340
25	2700	1300	3000	1750	1675
30	3240	1560	3600	2100	2010
40	4320	2080	4800	2800	2680
50	5400	2600			
60	6480	3120			
70	7560	3640			

* Adapted from Second Annual Western Provincial Conference on Rationalization of Water and Soil Research and Management; and Alberta Agriculture Land Management Plan; and Manitoba Agriculture, Factsheet *"Crop Residue Management"* Oct. - 1984 - Agdex 672

Crop residue cover calculated on a weight basis, can be converted into percent (%) ground cover by using the Crop Residue Conversion Chart in Figure 3.

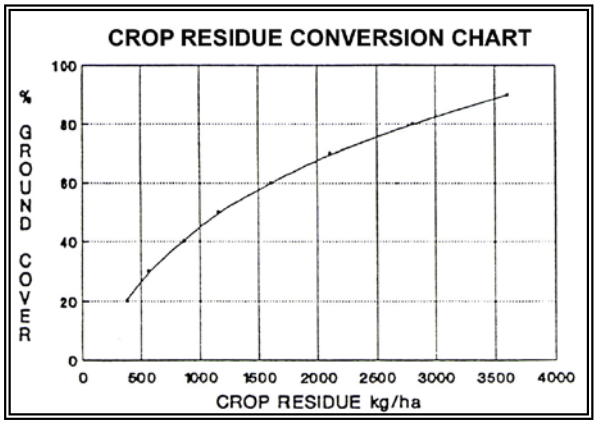

Figure 3 Crop Residue kg/ha (Thousands)

(Adapted from USDA Handbook #537
Man, Soil Facts Agdex 872
Gregory, J.M. Trns. of ASAE 1982)

Table 2 indicates the reduction of crop residue from each equipment operation, and are used in combination with the original crop residue volumes in Table 1.

Table 2 CROP RESIDUE AFTER FIELD OPERATIONS

Field Operation	Residue Remaining after each operation*
Harrow	0.90
Harrow packer	0.80
Coil packer	0.95
Field cultivator	0.80
Field cultivator with harrows	0.60
Wide blade cultivator	0.90
Rod weeder	0.90
One way disc	0.50
Tandem or offset disc	0.50
Chisel plow (straight shovel)	0.75
Chisel plow (twisted shovel)	0.60
Moldboard plow	0.10
Fertilizer injection	0.80
Airseeder - knife opener	0.85
Disk drill (double disc)	0.85
Hoe drill	0.75
Weathering (winter or summer)	0.80
Baling	0.50
Grazing	0.70

*Fragile residues will break down and decay rapidly; lower values by 0.1 for canola, flax and peas.

+ This table was adapted from Alberta Agricultures Land Management Plan - Level 1; "Residue after Tillage and Winter Table; and Purdue University Co-operative Extension Services" Agronomy Guide AX-269

CALCULATING RESIDUE COVER

Examples of how to calculate crop residue cover are shown below using data from Tables 1 and 2, and Figure 3.

1. Fall Cultivation

(Residue cover going into winter)

Barley stubble residue from 60 bushel/acre yield. Using Table 1 and Figure 3:

60 bu/ac = 3120 kg/ha (approx. **85%** cover)

a) Four fall tillage operations

2 disc and 2 chisel plow

3120 kg/ha Initial Residue	X	0.5 Tandem Disc	X	0.5 Tandem Disc	X	0.75 Chisel Plow	X	0.75 Chisel Plow	=	439 kg/ha Remaining Surface Crop Residue

439 kg/ha = **25%** residue cover
(estimated from Figure 3)

b) Three fall tillage operations

1 disc and 2 chisel plow

3120 kg/ha Initial Residue	X	0.5 Tandem Disc	X	0.75 Chisel Plow	X	0.75 Chisel Plow	=	878 kg/ha Remaining Surface Crop Residue

878 kg/ha = **38%** residue cover

c) Two fall tillage operations

2 chisel plow

3120 kg/ha Initial Residue	X	0.75 Chisel Plow	X	0.75 Chisel Plow	=	1755 kg/ha Remaining Surface Crop Residue

1755 kg/ha = **62%** residue cover

d) One fall tillage

1 fertilizer injection

3120 kg/ha Initial Residue	X	0.80 Fertilizer Injection	=	2496 kg/ha Remaining Surface Crop Residue

2496 kg/ha = **75%** residue cover

CULTIVATION FOR SUMMERFALLOW

Barley stubble residue from 60 bu/ac = 3120 kg/ha (approx. **85%** cover)

3120 kg/ha Initial Residue	X	0.75 Chisel Plow	X	0.80 Winter Weatheri ng	X	0.60 Cultivator with Harrow	X	0.80 Summer Weatheri ng	x	0.60 Culitvator with Harrow	=	439 kg/ha Remaining Surface Crop Residue

Entering 1st winter, residue cover = 2340 kg/ha = **73%** residue cover

Entering 2nd winter, residue cover = 539 kg/ha = **28%** residue cover

SUMMARY

From the preceding calculations it can be seen that reduced tillage can easily meet the 30 to 50% criteria and effectively reduce the risk of erosion. Summerfallow or 4 or more primary tillage operations result in less than 30% crop residue cover.

FOR FURTHER INFORMATION CONTACT
Phone: 604.556.3001
Toll Free: 1.888.221.7141

MINISTRY OF AGRICULTURE
1767 Angus Campbell Road
Abbotsford, B.C. V3G 2M3