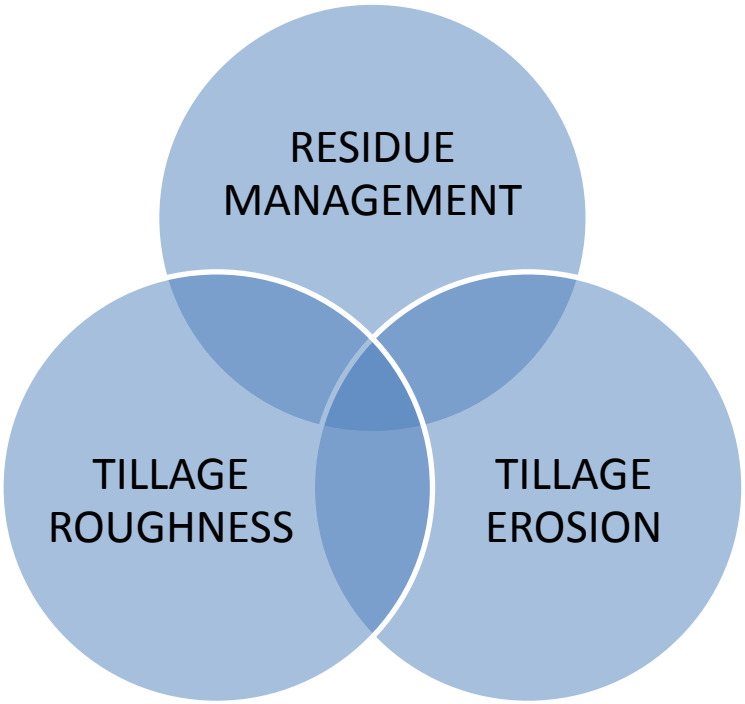
# Crop Residue and Tillage Roughness Management

## *Introduction*

Crop residue that is retained on the soil's surface can act as a shield from the erosive effects of rainfall and runoff. It can reduce the erosive power of rainfall that can dislodge soil particles. The micro-dam effect of residues on runoff will also assist in retaining dislodged particles within the field. Tillage practices have a large impact on crop residue and how it is distributed vertically across the tillage depth. Some forms of tillage, if done too deeply or too quickly, can bury all residue to a depth even greater than that of the tillage depth. Microbial decomposition is then reduced (because the majority of microbial activity occurs at the soil's surface) and the transformation of residues into stable organic matter known as humus is delayed. Humus is the term given to sequestered carbon that contributes to improved soil structure, drainage, moisture and nutrient retention.

There are three important aspects of soil management that have the potential to enhance soil conservation efforts within agricultural fields: residue management, tillage roughness, and tillage erosion. This factsheet covers the first of these two areas. For more information on tillage erosion, see the factsheet *Reducing Tillage Erosion in Potato Production*.



# *Straw Management at Grain Harvest*

Residue management within a crop rotation system can only provide soil conservation benefits when producers are moving from a grain crop to a row crop (such as potatoes). Management of the grain residue starts with the grain harvest. Every effort should be made to distribute straw and chaff across the cutting width of the combine. This is usually done with a straw chopper which is located to the rear of the combine.

The percentage of residue left on the soil surface can have a huge impact on reducing the level of soil erosion within a field. Figure 1 shows straw coverage from a small grains crop varying from 25% to 90%. Figure 2 depicts the reduction in soil loss that results from increased levels of surface residue. A 30% level of crop residue is desired to significantly reduce soil losses. Much more than 30% may result in negative effects on insects or diseases or become impractical depending on cultural practices. Residues may originate from the harvested crop or be artificially applied such as through the use of a hay mulch.

**Figure 1. Post-harvest residue levels from a small grain crop (wheat)**
**(ref: Conservation Tillage Systems and Management, 1992)**

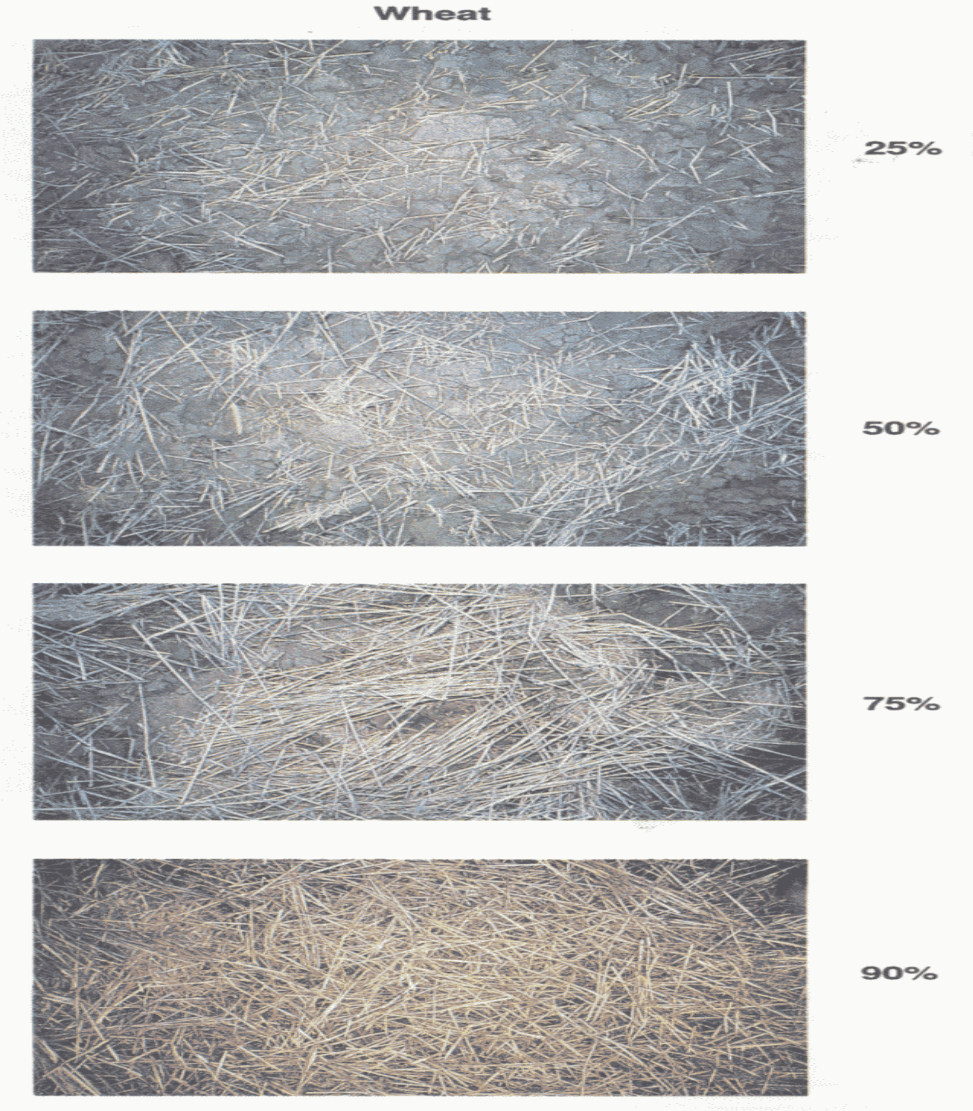
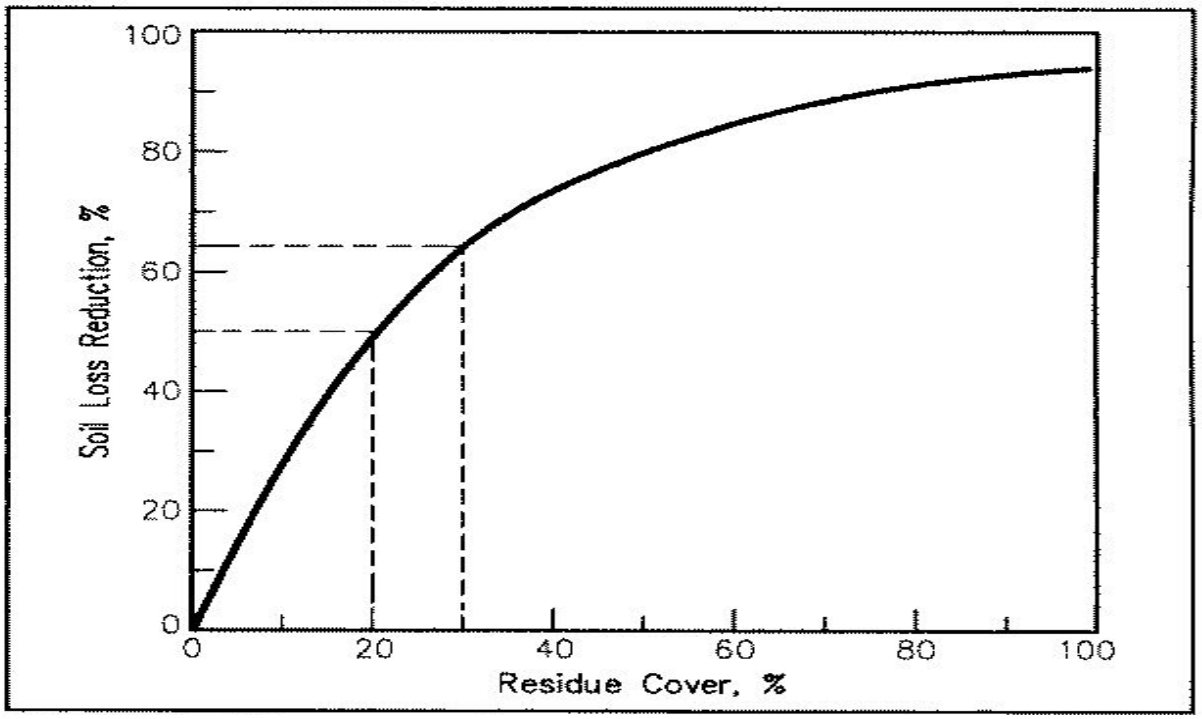


**Figure 2. Residue cover has a major impact on soil loss reduction.**
**(ref: Conservation Tillage Systems and Management, 1992)**




## *Spring Tillage of Fall Straw*

The speed, depth and number of tillage passes can also change the amount of residue available to mitigate water erosion. Given that the majority of water erosion occurs during the spring and summer months, the amount of residue still present after planting can have a big impact on the erosive effects of subsequent rainfall.

Figure 3 depicts residue amounts left following the use of various tillage implements after a grain crop and entering into a potato production year. Residue levels represent a typical field slope and grade with the primary tillage (at a depth of 15 cm [6 in] or greater) performed in the fall. Figure 4 represents the potential soil loss during the growing season as it relates to the previous fall's tillage method.

## *When Surface Roughness Plays a Role*

It is believed that fall tillage is being carried out more and more frequently, as a result of the increasing use of new technologies and the earlier completion of the potato harvest in some fields. If fall tillage can be done in a manner that encourages more surface residue and a rougher surface across the contour of the slope, then increased erosion protection may result. The amount of residue from the previous crop (for example potatoes) may be so low that increased surface roughness due to higher ridge heights may be the only option to combat water erosion.

**Figure 3. Relative Effects of Tillage Implements on Surface Residue from Rotational Crops in Potato Production (calculated using RUSLE)**

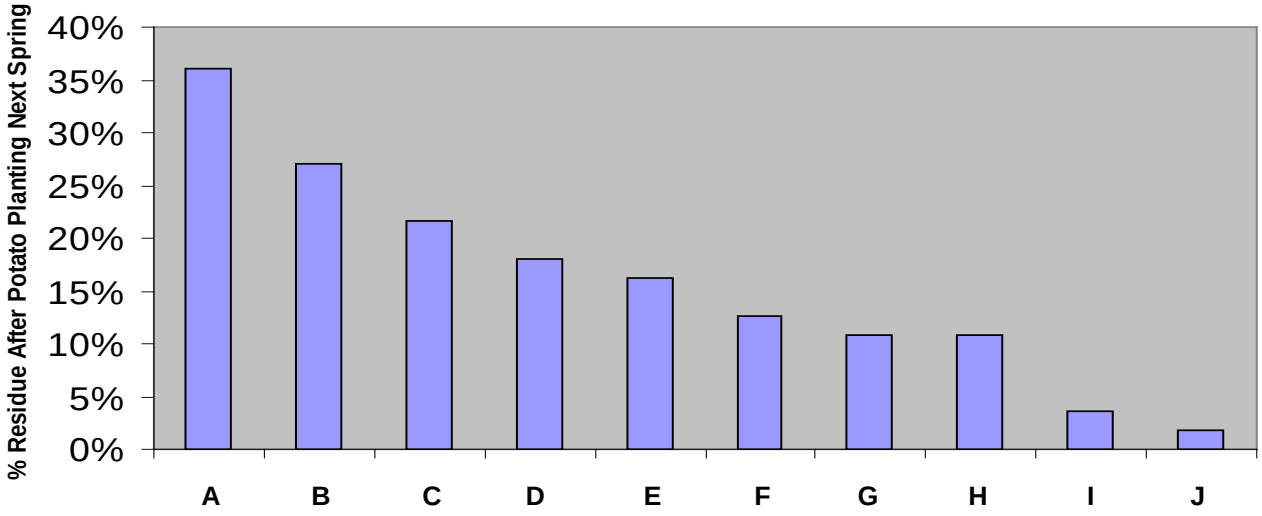
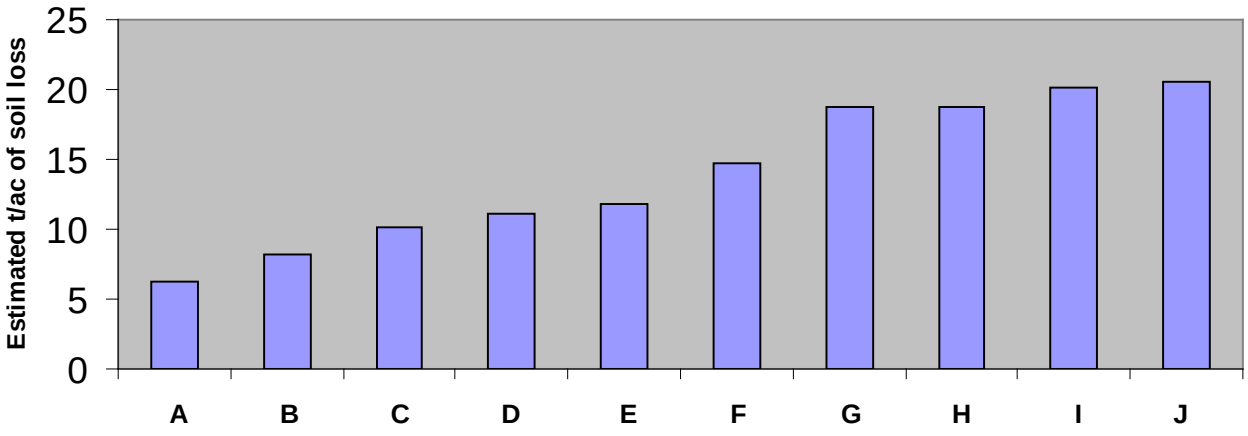



**Figure 4. Relative Rates of Erosion June – September as a Result of Residue Management Potato Production Year (calculated using RUSLE)**




**A No fall tillage**
**B para fieldplow**
**C field cultivators with sweeps or shovels 15 – 30 cm (6 – 12")**
**D V rippers/subsoiler 30 – 35 cm deep, 50 cm spacing (12 – 14" deep, 20" spacing)**
**E coulter chisel plow with sweeps**
**F coulter chisel plow with spike points**
**G offset disk primary cutting with 22.5 cm (9") spacing**
**H tandem disk primary cutting with 22.5 cm (9") spacing**
**I coulter chisel plow with shovels**
**J moldboard plow**

A very common tillage implement used in the fall to prepare for row crop production the following year is the moldboard plow. The moldboard plow moves the greatest amount of soil when compared to other tillage implements. As such it tends to bury a lot of residue. Fall tillage with the moldboard plow is intended to prepare the soil to dry earlier the following spring. It is therefore done differently in the fall than in the spring. If fall tillage is absolutely necessary, every effort should be made to plow leaving a rough surface, with as high a ridge as possible.

The Kverneland plow company has developed the concept of "Residue Inversion Management (RIM)" (see Figure 5). The furrow slices created by each pass with the moldboard plow are lain in stacks one upon the other. To conduct this form of plowing, all trash burying accessories must be removed from the plow. The cutting width of each moldboard is narrowed to 30 – 35 cm (12 – 14 in) and the normal working depth is only 15 – 20 cm (6 – 8 in). As well, ground speed is reduced to obtain a furrow height greater than 15 cm (6 in). The combined effort of retaining residue cover and maximizing furrow height is depicted in Figure 6 which shows the impact of residue and tillage roughness on erosion rates.

**Figure 5. A cross-section illustrating RIM plowing (RIM = residue inversion management, source : Kverneland)**

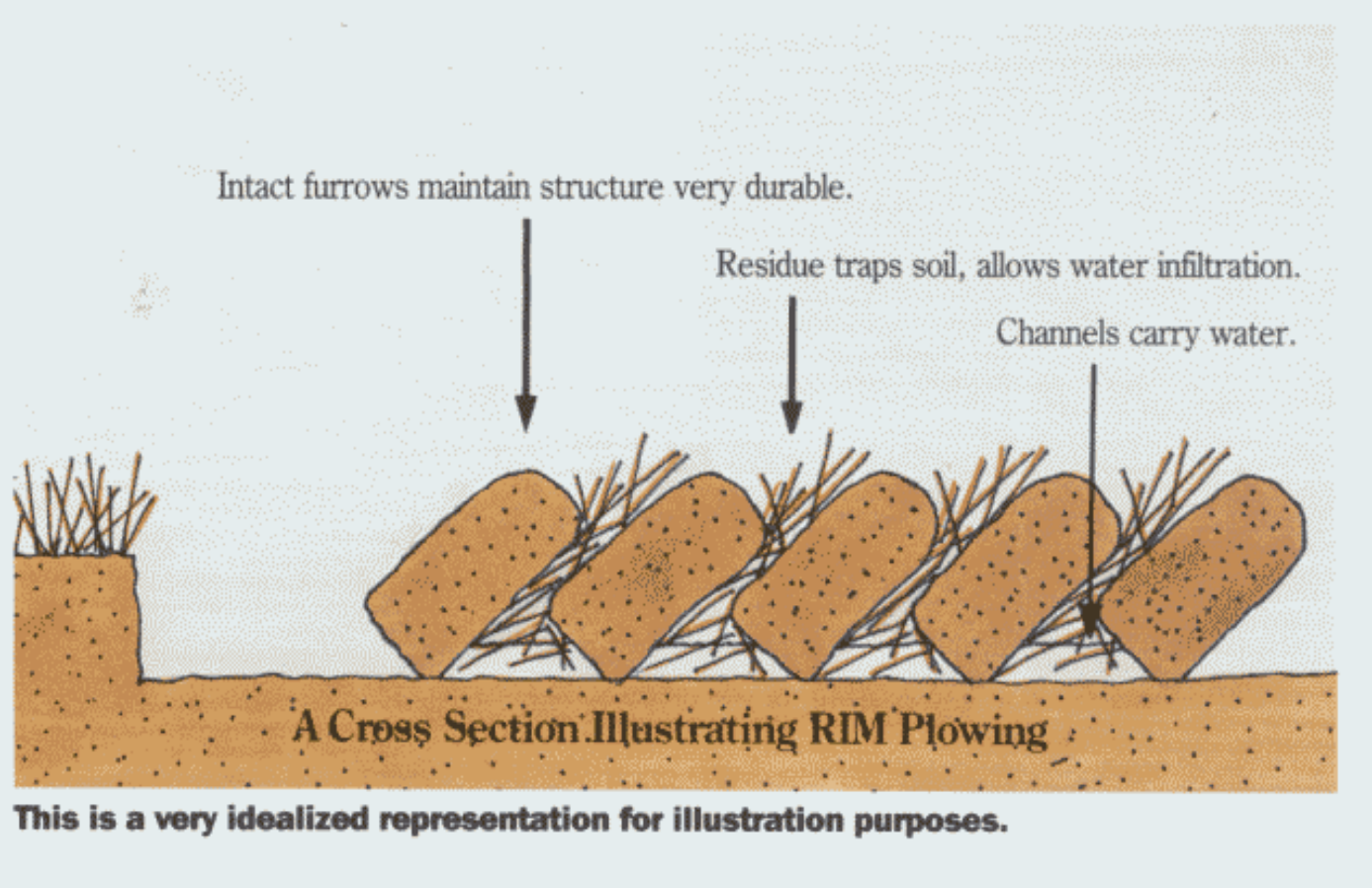
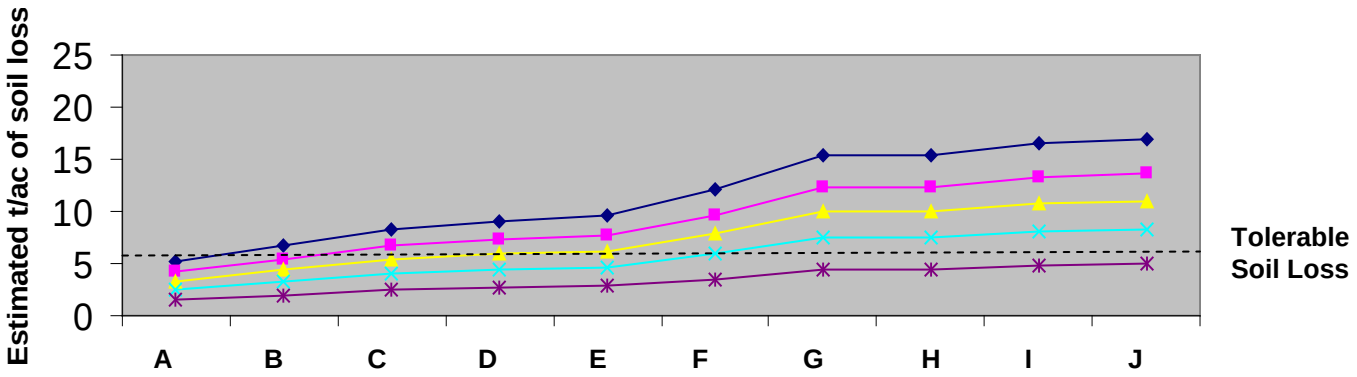


**Figure 6. Relative Rates of Erosion June – September as a Result of Residue Management and Contouring during the Potato Production Year (calculated using RUSLE)**

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**Type of Fall Tillage & Ridge Heights**

**---♦--- <5cm (< 2”) ---■--- 5-7.5cm (2-3”) ---▲---7.5-10cm (3-4”) ---x--- 10-15cm (4-6”) ---ж--- >15cm (> 6”)**

## *Summary*

Residue management, tillage roughness, and tillage erosion are three important areas related to soil management that have the potential to enhance soil conservation efforts in agricultural fields. Practices such as the use of a straw chopper during harvest and the use of a tillage implement other than the moldboard plow, will increase the amount of surface residue present between and into the next growing season. Practices that will increase ridge height and thus create “rougher” fields will also reduce soil losses due to erosion.

## *References*

Conservation Tillage Systems and Management, Midwest Plan Service, 1992.

Guidelines for the use of the Revised Universal Soil Loss Equation (RUSLE) ver 1.06, J Galetovic, Aug 1998.

Tiessen, K.H.D. *Reducing Tillage Erosion in Potato Production*. http://www2.gnb.ca/content/dam/gnb/Departments/10/pdf/Agriculture/Erosion-e.pdf