Crop Residue: Trash or Treasure?

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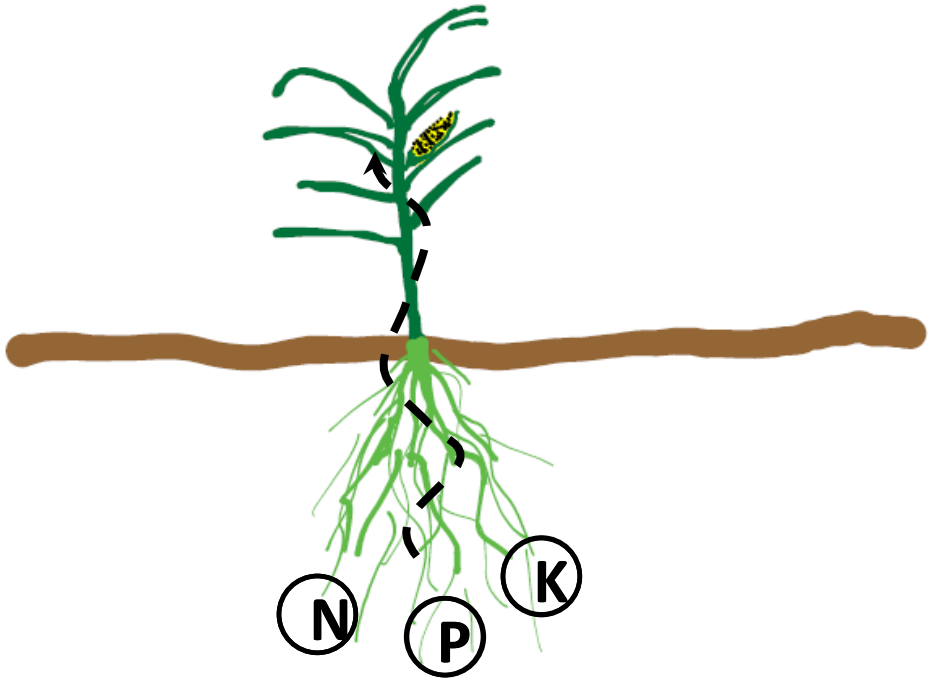
Wisconsin Crop Management Conference
January 14, 2015

Overview

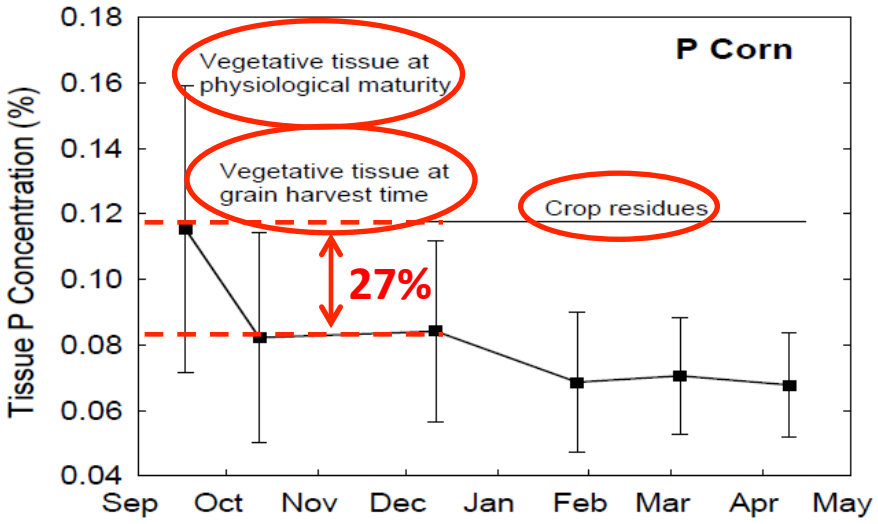
- Nutrient value of residue
- Implications of OM and soil health
- Water management and soil erosion impacts

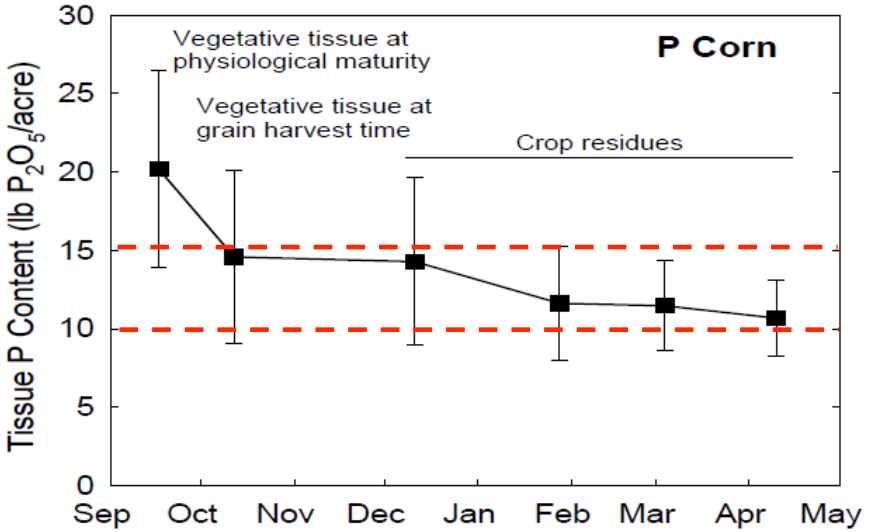
Plant Nutrient Uptake

- Nutrients are taken up by plants from the soil
- Harvested plant portions will export nutrients away from the field



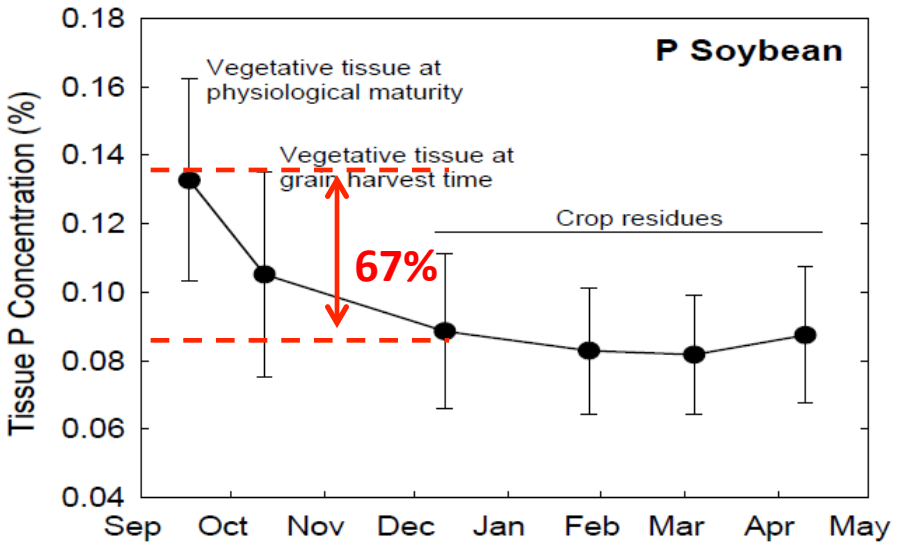
Phosphorus in Corn Plant Tissue

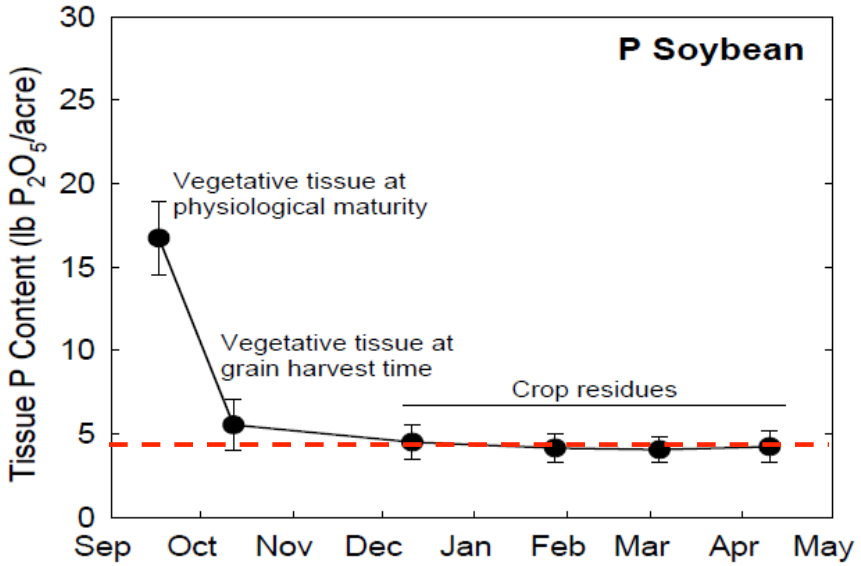




Source: Mallarino et al., 2011

Phosphorus in Soybean Plant Tissue

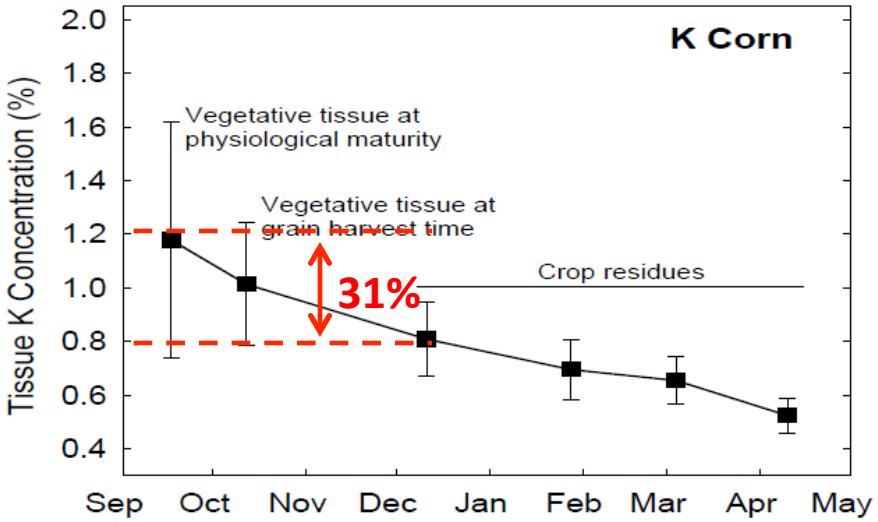


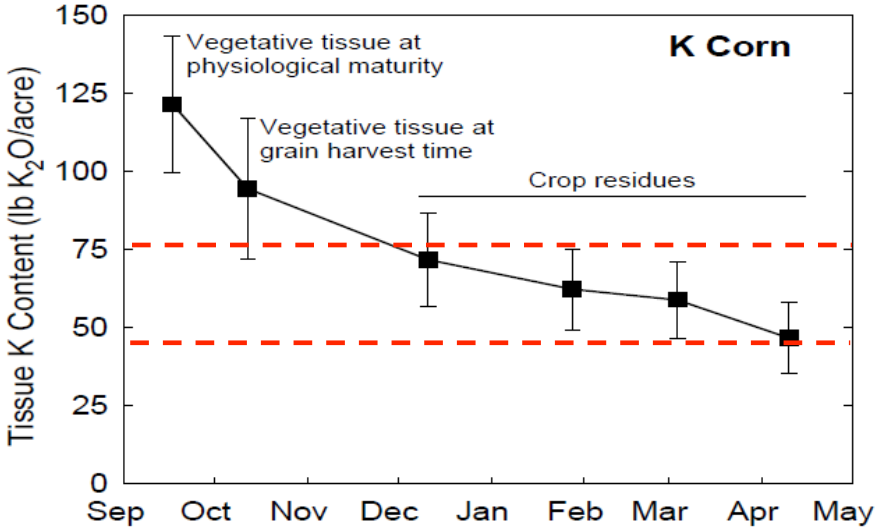


Source: Mallarino et al., 2011

Potassium in Corn Plant Tissue

10 X more K than P in corn tissue

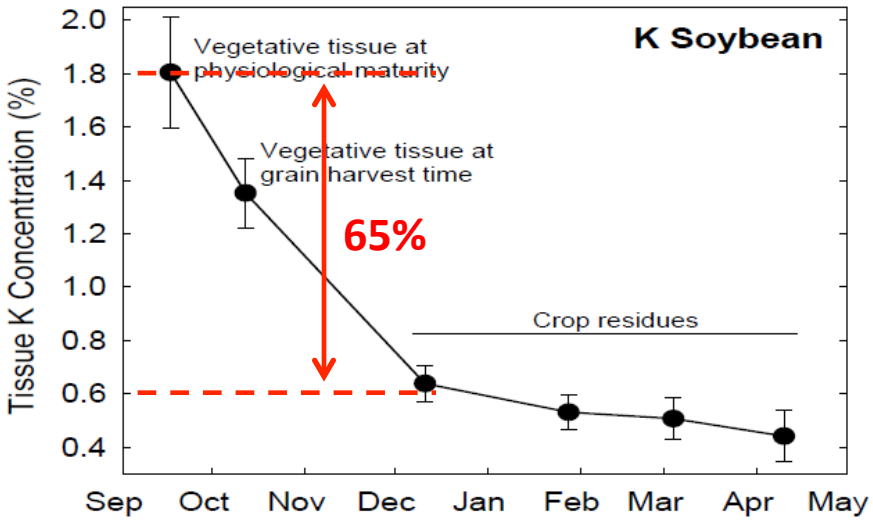


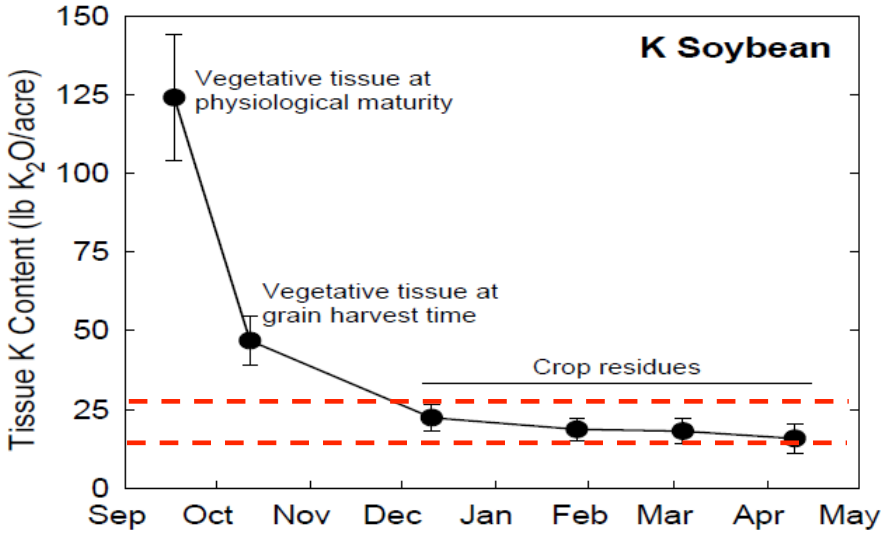


Source: Mallarino et al., 2011

Potassium in Soybean Plant Tissue

10 X more K than P in soybean tissue





Source: Mallarino et al., 2011

$$$ Value of Residue

	Crop		
	Corn Stover	**Soybean Straw**	**Wheat Straw**
Fert. Equiv.	---------- *$/ton* ----------		
Nitrogen	7.89	8.34	8.75
P_2O_5	2.84	2.38	3.41
K_2O	18.93	17.11	24.13
Total Cost	29.66	27.83	36.29

Source: Lang, 2002; Laboski et al., 2014; Rankin, 2014

Corn Residue Harvest Study

Three Years After Stover Harvest

		Soil Parameter (0-6”)		
Location	**Harvest Rate**	**Organic Matter**	**Phosphorus**	**Potassium**
	----- % -----	----- % -----	---------- ppm ----------	
Arlington	0	3.58 a	69.4 a	142.3 a
	50	3.43 a	71.3 a	124.2 b
	100	3.48 a	77.3 a	122.9 b
Lancaster	0	2.29 a	20.3 a	90.9 a
	50	2.24 ab	17.6 ab	78.7 b
	100	2.20 b	15.8 b	73.9 b

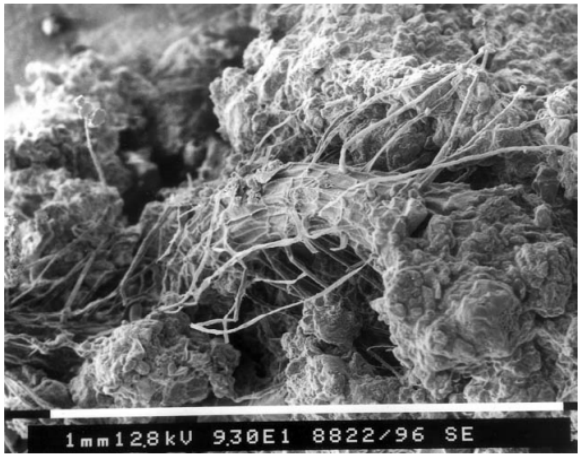
Nutrient Value of Residue

- P and K concentrations in plant residue decrease after the crop reaches maturity, but considerable amounts of nutrients remain
- In general, K is present in larger concentration in the tissue; however, it can move out of the tissue faster than P
- Other nutrients present in the crop tissue

Soil Organic Matter and Soil Health

- Organic matter is key for soil health (i.e. soil physical, chemical & biological properties)

- Plant residues and other OM feed the soil biology

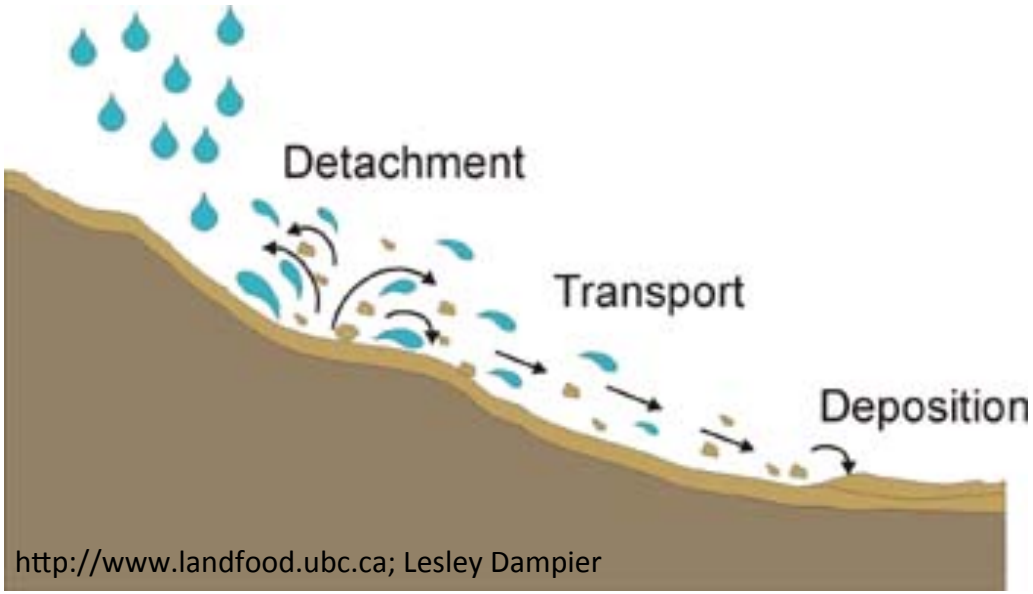


Source: Rasse et al., 2005

Ten Years of Conventional versus Zone Tillage

Source: Gugino et al., 2009

Soil Erosion



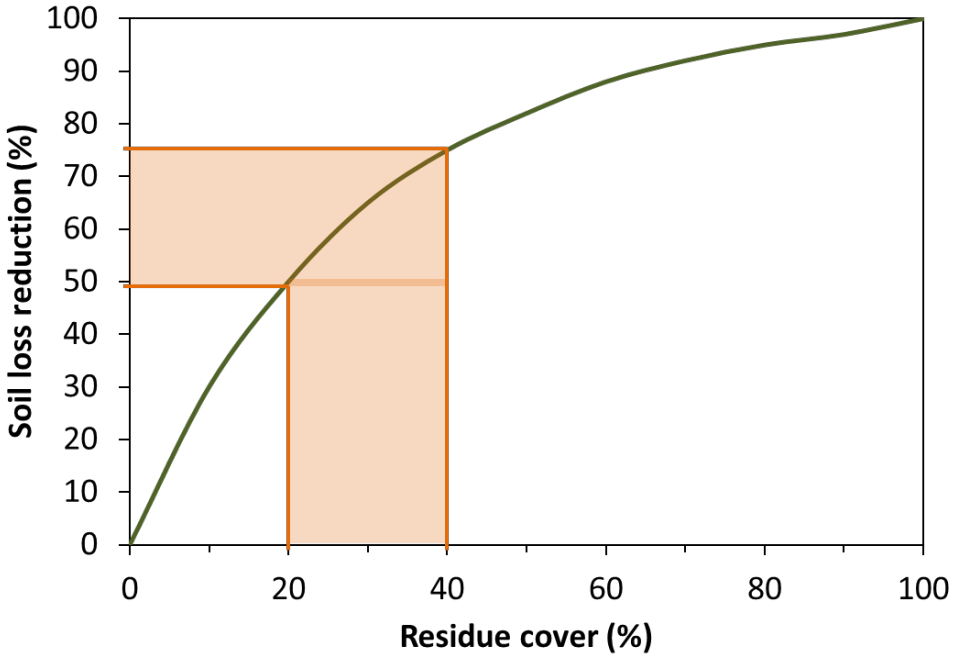
http://www.landfood.ubc.ca; Lesley Dampier

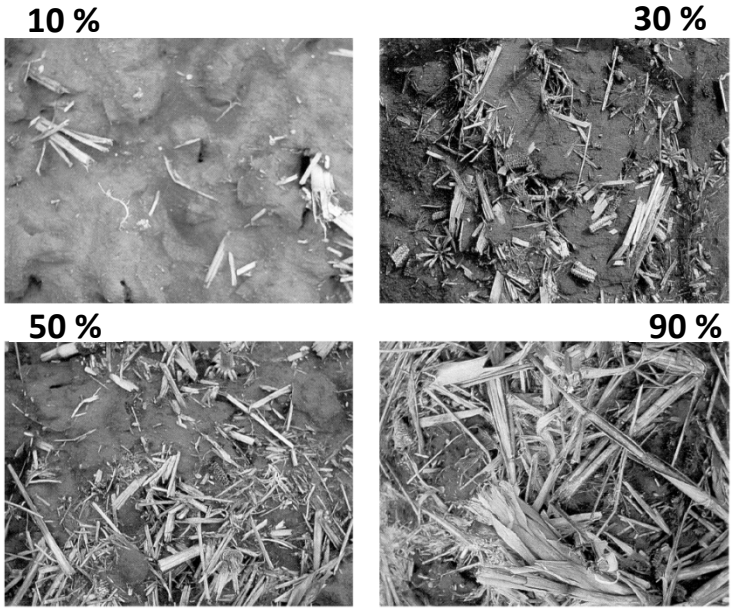
Universal Soil Loss Equation (USLE)

Soil loss (ton/acre) = R x K x LS x C x P

R = erosive force of rainfall and runoff (amount & intensity)
K = soil erodibility
LS = slope length & steepness
C = vegetative cover & management
P = Erosion control practices

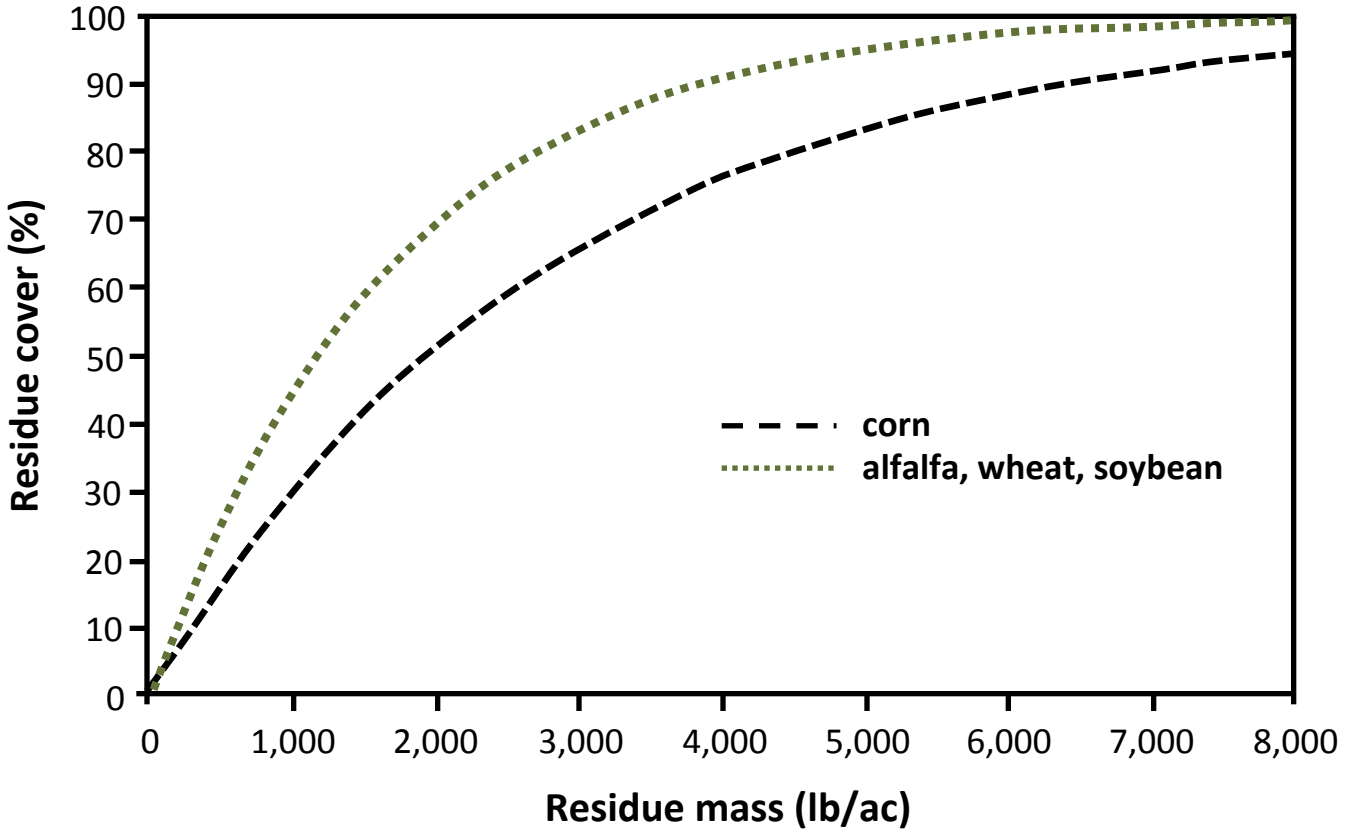
Crop Residue on Soil Surface & Erosion





Source: Purdue University AT-269-W

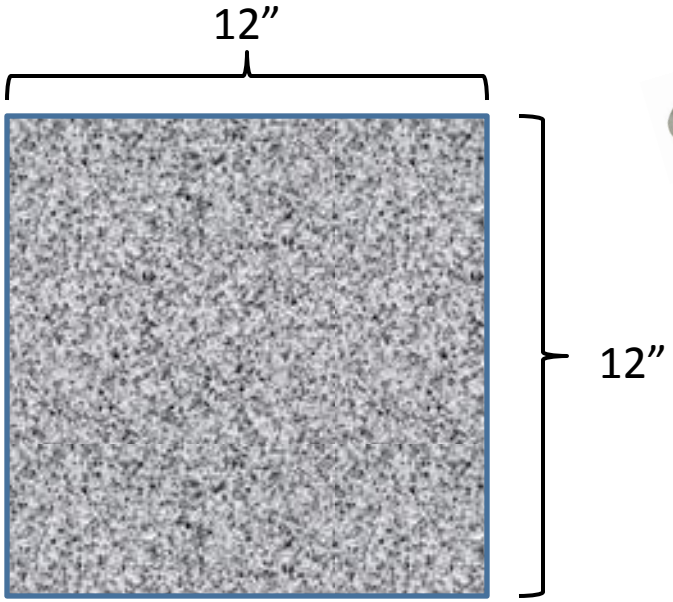
Residue Amount & Surface Cover



Source: Univ. of Nebraska, https://water.unl.edu/cropswater/reduceneed

“Allowable” Amount of Soil Erosion

- What does a “T” value of 5 tons/ac/yr looks like?
  - 5 tons soil/acre = 3.7 ounces soil/ft^2




One teaspoon

- One ton of soil in the optimum nutrient range has about (10 ppm N, 20 ppm P, and 130 ppm K):
  - 2.0 lb Nitrogen
  - 9.0 lb P_2O_5
  - 31 lb K_2O

Plant Residues & Water Flow in Soil

Source: Gardner and Hsieh, 1959

Water Management & Soil Erosion

- Plant residues play a vital role for water management in soils
- Erosion can be significantly reduced by having >30% surface residue
- Soil hydraulic properties (e.g. water infiltration and evaporation) can be enhanced with proper plant residue management strategies

Closing Remarks

- Crop residues are a valuable resource
- Value can be estimated from fertilizer replacement costs, but other benefits such as erosion control, impact on soil hydraulic properties, and additions to SOM pools should be considered
- Management of crop residues (e.g. harvest, tillage, etc.) determines benefits obtained in the short- and long-term

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