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Dr. Doug Karlen's Presentation – Balancing Biomass Production, Soil Health, and Fertility Needs

By Margaret Ribey

When considering how much residue to remove there are several factors that come into play. Erosion potential, soil health, water resource allocation and, potential temperatures next spring, seedbed quality and seedling environment all need to be considered. Dr. Karlen presented many studies of residue management and yields and suggested proper levels of residues for certain systems and then discussed the nutrient balance and nutrient replacement economics of a residue removal system

A concern of many producers is how residues influence the following years crop. Dr. Karlen presented studies investigating how residue levels were influencing yields. The systems that were put forth: no removal, 50% removal, and 90% removal in conventional, no-till systems, and a conventional twin row system. The treatments that resulted in large yield reductions were no removal and the twin row planting. This result can be mainly attributed to both the conditions of the following years spring and seedling germination. No removal and twin rows leave a large amount of residue on the surface which maintains lower soil temperatures and increases moisture in the spring. Also, once the seedlings start emerging from the soil their growth can be impeded by large chunks residue. Stand uniformity can become an issue with poor establishment. This can lead to other issues such as weeds, disease, etc.

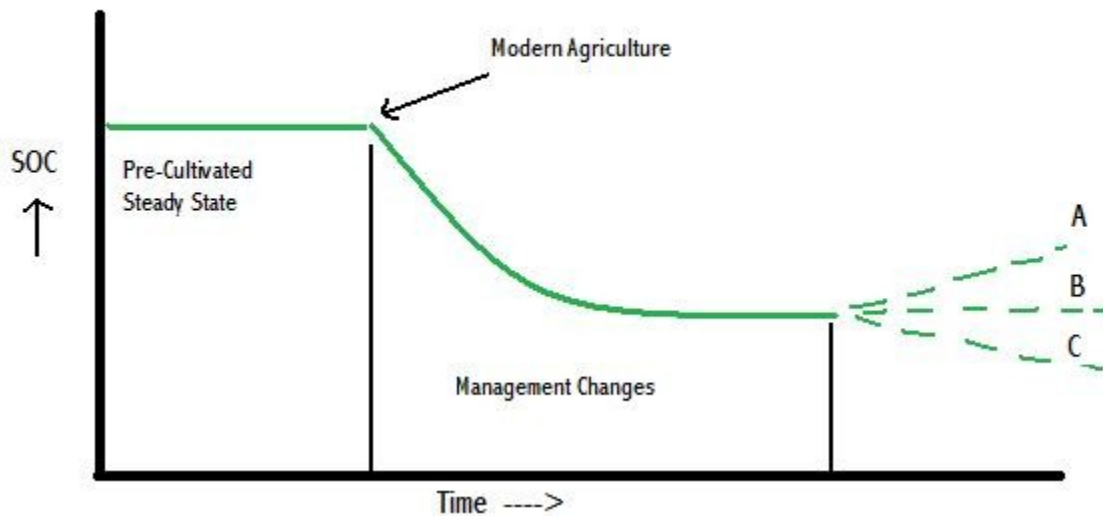
After presenting this information, Dr. Karlen suggested some levels of removal that are acceptable under certain cropping systems. For corn that yields 140-150 bu/ac, acceptable removal rates can be 1-4 ton/ac. For corn yields under 140-150 bu/ac, Karlen strongly advises against removing residues. However, values for residue removal for corn yields over 180 bu/ac have yet to be determined. For a wheat system, it was suggested that if you are getting wheat yields less than 60 bu/ac than straw should be left on the surface. More specifically, if your system includes continuous corn and mouldboard plowing, Karlen suggests that at least 3.38 ton/ac of residue should be left on the surface to maintain organic matter levels. This is because the mouldboard plow and continuous corn system results in depleted nutrient reserves and accelerated breakdown on organic matter if measures are not taken to maintain organic carbon. Also, Karlen added that 1.39-0.77 ton/ac should be left on the surface to protect against water and wind erosion. In a continuous corn, no-till system the numbers are much less because the soil organic matter levels are higher than a plowed system and the soil structure is less prone to wind and water erosion. The values Karlen presented to maintain organic matter, and to reduce water and wind erosion in a no-till system were: 2.34, 0.29, and 0.06 ton/ac, respectively.

Other interesting values that were presented by Karlen were the nutrient values associated with residue removal. In corn stover, nitrogen concentration ranged from 20-36 lb/ac (average 25.5 lb/ac), phosphorus concentration 1.4-5.5 lb/ac (average 3 lb/ac)

and potassium concentration 24-45 lb/ac (average 35 lb/ac). Karlen continued the presentation by introducing residue removal economics. The value of N, P, and K removed with corn stover per acre is approximately \$36.87 or \$18.06/ton when corn stover is removed. If 4 ton/ac of stover is removed, then you would be removing \$72.24/ac of nutrients. Considering that doesn't include time, equipment, transportation, and subsequent nutrient applications to make up for the nutrients removed, the \$35/ton farmers are being offered for their stover is not looking like a lucrative choice.

Lastly, Karlen then discussed the idea of soil quality assessment to avoid soil degradation. The factors that are assessed are total organic carbon, total nitrogen, pH, soil test phosphorus, and soil test potassium. When considering all these factors a value of 1-1.5 ton/ac of residue can be removed from non-erosive land while still maintaining the soil carbon balance. In general, short term residue harvests can have positive and a few negative effects on the production system as a whole. However, long term residue harvests (9-20 years) can have excessive damage to the soil including large reductions in soil organic carbon, humic acid, and decreased nitrogen mineralization potential. Responsible removal rates and the addition of other beneficial soil practices (cover crops, manure application, etc) will allow for some profits to be made from residue harvest in the short term (Figure 1). However, excessive removal will only end up costing the farmer not only in nutrient replacement costs but overall depletion of soil health.

Figure 1: Soil Organic Carbon (SOC) levels over time and the projections into the future with alternative farming practices.



A: addition of cover crops, green manure, innovative technologies, increased efficiencies

B: lesser tillage

C: Nothing but removal