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Economic and Soil Quality Impacts from Crop/Rangeland Residue Burning

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For decades farmers have practiced burning wheat, barley, corn stubble, CRP and rangeland. This practice has proved to be an inexpensive and effective way of managing excess straw or corn stalks as well as controlling weeds, diseases and pests. On rangeland and CRP, prescribed burning helps reduce fuel loads and prevents catastrophic fires. Burning CRP helps rejuvenate plant health and manage pest issues like the black grass bug or other insects as well as weeds.

There are several economic and cultural reasons why producers burn their stubble, orchard fodder and rangeland, but excess burning could jeopardize the long term quality of the soil, affect profitability and encourage more stringent government regulation.

CROP RESIDUE

Crop residue is one of the most important factors for healthy soils. Crop residue, if left, can provide a protective layer for soil erosion by wind or water, can increase the organic matter and water holding capacity of the soil, and can provide "feed and forage" for earth worms. When crop residue is burned all of those benefits are lost, plus other damage is done. Without residue on the soil surface, the ground is now susceptible to erosion and organic matter is depleted. There are also major air quality issues from burning crop residue.

SOIL PROPERTIES AFFECTED BY RESIDUE BURNING

Recent research (over the last 30 years) has shown that, although there may be some short-term benefits to crop residue burning (ease of tillage, seeding, and other field operations; weed and pest control; cost-savings; etc.), there is a slow, steady and sure reduction in soil health (microbial activity, carbon and nitrogen pools, soil physical conditions, etc.) that will eventually result in reductions in productivity that cannot be overcome with increased additions of mineral fertilizers (Fasching, 2001).

The same research that demonstrates the short-term benefits of occasional crop residue burning also shows the negative long-term effects. Long-term soil chemical and nutrient effects include:

- Significant reduction in total C and N pools from burning (which directly reduces productivity)
- Increased C:N ratio under residue retention which increases and maintains higher microbial activity, ensuring more rapid organic matter (OM) decomposition and nutrient release to soil
- Decreased extractable carbon and polysaccharides (readily-assimilated carbon sources for microbes)
- Decreased soil ammonium levels
- Decreased available soil P

Research has also shown that long-term crop residue burning has negative impacts on soil physical conditions such as:

- Increased erodibility (reduced aggregate stability from lower soil organic matter (OM) levels, increased exposure of the soil surface to wind and water erosion)
- Increased soil density (loss of soil structure, reduced porosity)
- Decreased water intake and water and nutrient retention (reduced porosity, reduced soil OM)

A general review of the literature indicates that no measurable negative effects are associated with occasional and short-term burning (7 to 15 years), but that prolonged burning (>15 years) results in a significant loss of soil health and function, and

ultimately, crop productivity. What may, at first, be attractive as short-term benefits, eventually become long-term cost increases in soil nutrient and crop production management (Fasching, 2001; Skidmore et al., 1986).

THE VALUE OF LOST ORGANIC MATTER AND NUTRIENTS

In the long run, the costs associated with the loss of organic matter and nutrients from burning stubble exceed its benefits. Studies have shown that the amount of organic matter and nutrient content from 2,000 lbs of wheat straw before burning is 826 lbs of carbon (C), 22 lbs of nitrogen (N), 2.7 lbs of phosphate (P2O5), 29 lbs of potash (K2O), and 2.2 lbs of sulfur (S) (Heard et al., 2006).

The products of burning stubble are gases and ash. After burning the stubble, most of the nitrogen (98%), carbon (91%) and sulfur (68%) stored in the stubble and fodder are consumed in the fire. Lesser amounts of phosphate (11%) and potash (17%) are also lost. These nutrients remain in the ash or are lost in the smoke and particulate matter that drift away from the field (Table 1).

CONTACT NRCS FOR TECHNICAL HELP AND ASSISTANCE

The NRCS promotes sound conservation practices to help make those transitions from burning residue to leaving residue. Practices such as residue management no till, mulching, cover crops, conservation crop rotation, and many others are all alternative to burning. The NRCS provides technical and financial assistance to landowners to help with these and many other types of projects. The NRCS has Farm Bill Programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP) that can help implement some of those conservation practices. Please contact your local NRCS office to learn more about improving your soil health.

Table 1. Nutrients and value of those nutrients lost from burning 2,000 lbs of wheat straw.

	Element/ Nutrient	Amount
Nutrients present in 2,000 lbs of wheat straw	N	22 lbs
	P	6.2 lbs
	K	3.5 lbs
	S	2.2 lbs
	Carbon	826 lbs
Nutrients lost in burn	N	22 lbs
	P	0.7 lbs
	K	0.6 lbs
	S	1.5 lbs
	Carbon	749 lbs
Percent Loss	N	98%
	P	11%
	K	17%
	S	68%
	Carbon	91%
Value of lost fertilizer and straw	N @ $0.60/lb	$12.96
	P @ $0.50/lb	$0.35
	K @ $0.52/lb	$0.31
	S @ $0.91/lb	$1.37
	Straw $/ton	$40.00
	Total	**$54.99**

REFERENCES

Agronomy e-Updates, Factors to Consider Before Burning Wheat Residue, Kansas State University Extension, K-State Extension Agronomy e-Updates, Number 305, July 8, 2011

McVay, K.A. 2003. Value of Crop Residue, Kansas State University Department of Agronomy. MF-2604.

Heard, J., Cavers, C. and Adrian, G. 2006. Up in Smoke --Nutrient Loss with Straw Burning. Better Crops, Vol 90 (2006, No 3.).

Skidmore, E.L., Layton, J.B., Armbrust, D.V. and Hooker M.L. 1986. Soil Physical Properties as Influenced by Cropping and Residue Management. Soil Science Society of America Journal, Vol 50, No. 2, March –April.

Fasching, R.A. 2001. Burning-Effects on Soil Quality. Agronomy Technical Note No. 150.16. USDA NRCS, October.