DRY FALL CONDITIONS CAN LEAD TO FIELD FIRES

John E. Sawyer, Professor, Department of Agronomy, Iowa State University

This article is an update of an ICM News article originally written in the fall of 2000. Hot temperatures and dry conditions can result in tinder dry crops and residue. As a result accidental field fires can occur. What makes these fires noteworthy is that crops can be so dry that fires flash quickly and burn standing corn and soybean, and even soybean stubble. These fires lead to questions about potential nutrient and crop dry matter losses. The ICM News article *Estimating losses when cornstalk fields are accidentally burnt*, detail issues related to organic matter loss and burnt cornstalks, but not soybean stubble or standing corn and soybean.

Additional information for burnt corn and soybean fields. As mentioned in the previous ICM News article, of the major nutrients commonly fertilized in Iowa, nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) mineral nutrients, only N and S are volatilized and lost when plant material burns. Phosphorus and K remains and returns to the ground with ash. However, P and K could be blown from the field site during or after the fire if ash leaves the field.

From accounts of individuals and looking at field photographs, burning of plant material is often variable in both extent of area impacted and magnitude of plant material loss (see photos). In cornfields that were not harvested, some of the lower stalk material may not burn and kernels on the ears may be blackened on the outside, but except for some tip kernels the ears remain intact and grain does not burn. In unharvested soybean fields, results of fires are similar, with more soybean grain burnt than with corn. Nutrients and organic matter in the unburnt ears and grain is returned to the soil and not removed as would be normal with grain harvest.

Estimating the potential for nutrient losses. First, you must determine what plant parts or residues were burnt. Only the fraction of those components burnt should be accounted for as lost. Tables 1–3 show example dry matter and nutrient content for various corn and soybean plant parts at maturity (data from several sources). By crop maturity, much of the plant nutrient content has been transferred to the seed or lost from the matured plant tissues, so the seed component typically has the largest nutrient content of the various parts. These tables can be used to evaluate and sum the dry matter and nutrient constituents lost. If plant material falls to the soil surface, as commonly occurs by and after maturity (especially for soybean leaves and petioles), then some may have decomposed, be unavailable to a fire, or been too damp to fully burn. Also, after maturity the nutrient concentrations decline as the plant material weathers with rainfall (especially K and nitrate). Therefore, the nutrient concentrations in plant tissues may actually be lower when a harvested field burns than at plant maturity.

The estimate of nutrient losses can be adjusted up or down for yields higher or lower than the examples given in the tables. Such estimates can be calculated from the assumptions of percentage of total dry matter for each plant part and the listed nutrient concentrations. This adjustment is not exact because dry matter and nutrient concentrations change with yield level,

and for the petiole/leaf drop that occurs in soybean, but it should provide a reasonable estimate for production fields with adequate fertility.

Assigning a value to lost organic matter. There are no standard values for crop residue or soil organic matter. And compared with organic matter levels in soils, the amount that would normally remain after residue decomposition from one crop is quite small. With the advent of carbon trading, cornstalk consumption for energy production, and cornstalk bedding and co-feeding for livestock, cornstalk values can be obtained to estimate value.

In unharvested cornfield areas, unburnt grain that falls to the ground will contain dry matter that can offset burnt cornstalks. The dry matter of grain is approximately the same as the dry matter of vegetative material. For soybean, it is more difficult to determine the amount of burnt vegetative dry matter offset by grain that falls to the ground due to leaf and petiole drop that occurs over time as soybean matures, and due to variable burnt soybean grain.

Additionally, loss of surface residue may be a short-term issue in some fields for control of erosion. Use of cover crops, if there is time for establishment, can aid in erosion control.

If a burnt cornfield is in continuous corn, then loss of crop residue can actually reduce the N fertilization need of the next corn crop. This occurs because of less corn residue available for microbial degradation and less N used in residue processing. In studies with different levels or corn residue harvest, N fertilization rates were reduced by 20 lb N/acre with 30 percent stover removal and 40 lb N/acre with 80 percent stover removal. Therefore, the effect of a field fire could be less N application need for the following corn crop, not more.

What about the effect on N need when corn follows soybean? A large reason corn rotated after soybean needs less N fertilization compared with corn after corn has to do with differences between the crops in the amount of residue, relative N concentration, and timing of residue decomposition. This is more important (especially on a short-term basis) than simply the return or loss of soybean residue in a field. Research conducted at the University of Wisconsin showed that when soybean residue was removed after harvest from an area, the N need of the following corn crop was essentially the same as in areas where the residue was left (and similar where the soybean residue was doubled). Therefore, a suggestion is to not apply extra N for corn that will be planted next year in a burnt soybean field.

In fields where unharvested soybean was burnt, if much of the seed did not burn but instead fell to the ground, then significant amounts of N are returned to the soil. This return would reduce the fertilizer N need for the next corn crop. However, the proportion of seed burnt or not burnt can be quite variable. Soil sampling next year for the late spring soil nitrate test (LSNT) or crop N stress sensing can help confirm the corn N fertilization need in burnt areas. In a small study in 2002-2003 where soybean seed was hailed out at harvest time in 2002 (estimated 35-45 bu/acre soybean grain yield on the ground), the next-year corn crop had an economic optimum N rate at 50 lb N/acre compared to 120 lb N/acre where the soybean crop had been harvested (corn yield approximately 220 bu/acre). The LSNT test values were higher where the

soybean seed was hailed out, but not up to the critical test level. These results show that N will become crop-available from soybean seed that reaches the ground.

Summary. There is no one answer to the question, what is lost when my field burns? Evaluation of each field is required to arrive at the best estimate. Also, as is often the case, entire fields do not burn but only irregular areas, thus an estimate of the affected area, as well as the crop or residue components lost, is required.

Table 1. Corn dry matter composition at maturity.

Plant Component	Dry Matter	Dry Matter Weight
	% of Total	lb/acre
Grain	55	11,282
Stalks & Sheaths	23	4,806
Leaves	11	2,240
Shank & Husk	4	821
Tassel	0	52
Cob	7	1,472
Total	100	20,673

Equivalent corn grain yield at 210 bu/acre (15% moisture).
M. Boyer thesis, 2013.

Table 2. Nutrient concentration and content in corn plant parts at maturity.

Plant Component	Nitrogen		Phosphorus		Potassium	
	% N	lb N/acre	% P_2O_5	lb P_2O_5/acre	% K_2O	lb K_2O/acre
Grain	1.23	139	0.61	68	0.43	49
Stalks & Sheaths	0.42	20	0.12	5.7	1.09	52
Leaves	1.08	24	0.23	5.1	0.77	17
Shank & Husk	0.57	4.7	0.12	1.0	0.90	7.4
Tassel	0.52	0.3	0.08	0.04	0.21	0.1
Cob	0.35	5.1	0.06	0.8	0.68	10
Total	---	193	---	81	---	136

Equivalent corn grain yield at 210 bu/acre (15% moisture).
M. Boyer thesis, 2013.

Table 3. Soybean dry matter, nutrient concentration, and nutrient content in plant parts.

Plant	% of Total	Dry Matter						
Component	Dry Matter	Weight	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	%	lb/acre	- - - - - - - % - - - - - - -			- - - - - lb/acre - - - - -		
Grain	29	2,630	5.8	1.24	2.2	153	33	58
Stems	17	1,543	0.7	0.14	0.5	10	2	8
Pods	11	998	1.1	0.23	2.4	10	2	24
Leaves	28	2,540	2.1	0.39	1.3	53	10	33
Petioles	15	1,361	1.0	0.21	1.2	14	3	16
Total	100	9,072	---	---	---	241	50	139

Soybean yield at approximately 50 bu/acre (13% moisture). Leaves and petioles include those fallen as plants mature.

Several publications/data sources.

Figure 1. Aerial view of burnt corn and soybean fields.

Figure 2. Burnt standing cornfield.

Figure 3. Burnt standing soybean field.