10-23-2000

Dry fall leads to field fires

John E. Sawyer
Iowa State University, jsawyer@iastate.edu

Dry fall leads to field fires

Abstract
The hot temperatures and dry conditions this fall resulted in tinder dry crops and residue. As a result several accidental field fires occurred across Iowa. What makes these fires noteworthy is that crops were so dry that fires flashed quickly and burnt standing corn and soybean, and even soybean stubble. These fires have lead to questions about potential nutrient and crop dry matter losses. The April 10, 2000, ICM newsletter articleEstimating losses when cornstalk fields are accidentally burnt, pages 30-31, detailed issues related to organic matter loss and burnt cornstalks, but not to soybean stubble or standing corn and soybean.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

Dry fall leads to field fires

The hot temperatures and dry conditions this fall resulted in tinder dry crops and residue. As a result several accidental field fires occurred across Iowa. What makes these fires noteworthy is that crops were so dry that fires flashed quickly and burnt standing corn and soybean, and even soybean stubble. These fires have lead to questions about potential nutrient and crop dry matter losses. The April 10, 2000, ICM newsletter article Estimating losses when cornstalk fields are accidentally burnt [1], pages 30-31, detailed issues related to organic matter loss and burnt cornstalks, but not to soybean stubble or standing corn and soybean.

Additional information for burnt corn and soybean fields

As mentioned in the previous ICM newsletter article, of the major nitrogen (N), phosphorus (P), and potassium (K) mineral nutrients, only N is volatilized and lost when plant material burns. Phosphorus and K remain and return 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 photographs, burning of plant material was 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 did not burn and kernels on the ears were blackened on the outside, but except for some tip kernels the ears were intact and grain did not burn. In unharvested soybean fields, results were similar, with more soybean grain burnt than corn. Nutrients and organic matter in the unburnt ears and grain are returned to the soil and not removed as would be normal with grain harvest.

Estimating the potential for nutrient and organic matter 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 taken from several ISU research studies). 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 field burns than at maturity.

The estimate of nutrient losses can be adjusted up or down for yields higher or lower than those of the examples given in the tables. These 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, 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 very small (long term, approximately 10 percent of the carbon in crop residue remains as soil organic matter). With the advent of carbon trading, cornstalk consumption for energy production, and cornstalk bedding, perhaps values will become standardized for crop residue and carbon. Additionally, loss of surface residue may be a short-term issue in some fields for erosion control.

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.

Also, in fields where unharvested soybean were 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. Soil sampling next year for the late spring soil nitrate test or taking corn leaf greenness readings (SPAD chlorophyll meter readings) can help confirm the corn N needs in the burnt areas.

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 for high- and low-fertility examples.

	Relative fertility level			
	High	**Low**	**High**	**Low**
Plant part	**% of total dry matter**		**Dry matter weight, lb/acre**	

Grain	48	46	7,680	4,410
Stalks	22	22	3,550	2,113
Leaves	10.6	10.8	1,710	1,042
Sheaths	5.3	6.0	855	579
Husks	4.3	4.6	694	444
Shanks	1.5	1.4	242	135
Cobs	7.5	8.2	1,210	791
Tassels	0.5	1.0	81	97
Lower ears	0.5	0.2	81	19
Silks	0.2	0.2	32	19
Total	100	100	16,135	9,650

Corn yield for high fertility is 161 bu/acre and for low fertility is 93 bu/acre.

Table 2. Nutrient concentration and content in corn plant parts for high- and low-fertility examples.

	Nitrogen				**Phosphorus**				**Potassium**			
	Relative fertility level				**Relative fertility level**				**Relative fertility level**			
	High	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	High	Low
Plant part	**% N**		**lb N/acre**		**% P_2O_5**		**lb P_2O_5/acre**		**% K_2O**		**lb K_2O/acre**	
Grain	1.44	1.73	111	76	0.69	0.34	53	15	0.50	0.41	38	18
Stalks	0.43	0.41	15	8.7	0.14	0.05	5.0	1.1	0.90	0.48	32	10
Leaves	1.80	1.50	31	16	0.69	0.16	12	1.7	2.05	0.96	35	10
Sheaths	0.64	0.54	5.5	3.1	0.37	0.09	3.2	0.5	1.74	0.96	15	5.6
Husks	0.36	0.34	2.5	1.5	0.21	0.05	1.5	0.2	1.32	0.72	9.2	3.2
Shanks	0.50	0.63	1.2	0.9	0.18	0.09	0.4	0.1	1.68	1.44	4.1	1.9
Cobs	0.33	0.45	4.0	3.6	0.11	0.09	1.3	0.7	0.62	0.88	7.5	7.0
Tassels	0.97	1.20	0.8	1.2	0.50	0.09	0.4	0.1	1.70	0.71	1.4	0.7
Lower												

ears	2.04	1.77	1.6	0.3	0.87	0.39	0.7	0.1	3.00	1.79	2.4	0.3
Silks	3.50	3.30	1.1	0.6	0.87	0.69	0.3	0.1	2.57	2.45	0.8	0.5
Total	--	--	173	112	--	--	78	20	--	--	146	57

Corn yield for high fertility is 161 bu/acre and for low fertility is 93 bu/acre.

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

Plant part	% of total dry matter	Dry matter weight	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	(%)	(lb/acre)	%			lb/acre		
Grain	29	2,420	6.3	1.49	2.4	152	36	58
Stems	17	1,419	0.6	0.14	0.5	9	2	7
Pods	11	918	0.9	0.23	2.4	8	2	22
Leaves	28	2,337	2.1	0.39	1.3	49	9	30
Petioles	15	1,252	1.0	0.21	1.2	13	3	15
Total	100	8,345	--	--	--	231	52	133

Soybean yield at approximately 46 bu/acre. Leaves and petioles include those fallen.

This article originally appeared on pages 175-177 of the IC-484(23) -- October 23, 2000 issue.
