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PLANTING WHEAT SEED DAMAGED BY SPROUTING BEFORE HARVEST

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High quality seed is essential for establishing productive stands of wheat. Seed should have high germination percentage, test weight, and purity. The absence of any of these attributes likely will cause poor emergence of seedlings and low yields of grain.

Weather conditions during maturation greatly affect seed quality. Moderate temperature, moisture, and sunshine promote growth of large, viable kernels that are excellent seed for establishing the next season's crop. However, weather conditions are sometimes unfavorable during maturation of the seed crop and can affect seed quality directly and indirectly. Indirect effects, such as high humidity that favors development of disease organisms, are well known and have been studied in considerable detail. Direct effects of weather are less well known but can lower seed quality considerably. Preharvest sprouting caused by moist conditions is a direct effect of weather that has occurred in Kansas in recent years.

Frequent rains and high humidity after wheat is ripe occur before harvest in Kansas in several years during each decade. As the wheat ripens and continued moist conditions delay harvest, the grain can sprout in the head (preharvest sprouting). The extent of preharvest sprouting depends on the duration and severity of moist conditions, the stage of ripening of the grain, and the inherent level of dormancy of the variety. Sprouting begins as the kernels absorb moisture and swell, which activates a number of enzymes that break down starch, proteins, and other constituents for respiration and growth. The seedling roots and leaves then split the seed coat and grow from the embryo (germ), giving the

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upper canopy of fields a green appearance if moist conditions continue.

Seed that is sprouted extensively is rare in trade channels. It is unsightly, the protruding roots and leaves detach easily during handling, and it does not survive storage. Slight sprouting is more common in Kansas and, when the problem is widespread, causes growers to question the suitability of the grain for seed. Kernels that are only slightly sprouted may be weathered and nonvitreous and have a low test weight because of swelling. These conditions give them a poor appearance; however, their usefulness as seed is not known.

Widespread preharvest sprouting in central and south central Kansas in 1989 enabled extensive tests of the suitability of weather-damaged wheat for seed. Samples of hard red winter wheat were obtained from certified seed producers, and their kernel characteristics and performance as seed were determined.

Procedures

Samples of wheat seed that contained 12% moisture and were cleaned to certification standards of the Kansas Crop Improvement Association were evaluated for sprouting damage. Seedlots that had visual signs of sprouting (split seed coat, extended seedling root, or low test weight) were tested by the standard falling number method approved by the American Association of Cereal Chemists. The falling number, the time in seconds for a plunger to fall through a slurry of flour, is high for sound wheat and low for sprouted wheat, in which the viscous starch has been broken down to simple sugars. Twenty-five seedlots of 10 varieties that had a range of sprouting damage were identified; results are presented for seedlots of four varieties that had low, moderate, and severe sprouting.

Test weight of the seedlots was determined by methods of the Federal Grain Inspection Service, and kernel weight was measured by counting the number in 100g of air-dried samples. Germination of four replications of 200 kernels from each seedlot was determined after harvest by prechilling at 41°F for 5 days and incubating on moistened, heavy paper at 59°F for 7 days. Germination was measured again after accelerated aging; seedlots were subjected to 104°F for 72 hours before prechilling and incubating, Emergence of seedlings was evaluated in a greenhouse by planting four replications of 25 kernels from each lot at depths of 1.25, 2.5, 3.75, and 5.0 inches in masonry sand, which was moistened as needed. Emerged seedlings were counted weekly.

Ability of the seedlots to establish a stand and produce a crop of wheat was determined on a Geary silty clay loam. Seedlots that had been stored at 12% moisture and room temperature for 27 months were planted 1.5 inches deep in 2-foot-long plots containing 100 seeds in three rows. Emergence was counted daily after planting until no more

seedlings emerged during autumn. Grain was harvested in late June with a plot combine, air-cleaned, and weighed at 14% moisture to determine yield.

All experiments were in randomized complete block designs with four replications of treatments. Data were analyzed statistically by the general linear model method.

Table 1. Falling number, test weight, kernel weight, and germination after harvest and after accelerated aging of four wheat varieties with three levels of preharvest sprouting.

Variety	Sprouting level	Falling number	Test weight	Kernel weight	Germination	
					After harvest	After aging
		seconds	lbs/bu	mg/kernel	%	
Abilene	Low	432	61	32	96	78
	Moderate	270	62	33	96	78
	Severe	100	60	31	90	78
Karl	Low	352	58	32	99	98
	Moderate	213	60	33	94	76
	Severe	65	56	33	96	76
Mesa	Low	403	60	29	97	76
	Moderate	290	60	31	95	56
	Severe	129	59	32	86	47
TAM 200	Low	319	59	34	97	92
	Moderate	106	60	32	94	74
	Severe	65	59	30	97	76
LSD (0.05)		19	1	1	2	6

Results

Seedlots that had low levels of preharvest sprouting (high falling numbers) were sound for planting as indicated by their high test weights, kernel weights, and germination percentages (Table 1). Falling number decreased from an average of 376 seconds in the seedlots that had low sprouting damage to 90 seconds in seedlots that had severe damage. Test weight and kernel weight varied among the seedlots within each variety but had little relationship to the level of sprouting. Germination of all seedlots was high after harvest. Accelerated aging had little effect on seedlots of two varieties that had little sprout damage but decreased the germination of two other varieties with similar damage. However, germination of moderately or severely sprouted seedlots of all varieties was reduced by accelerated aging.

Seedling emergence was usually high from seeds with low sprouting damage planted 1.25 or 2.5 inches deep (Table 2). Emergence from the same depths was reduced significantly by severe sprouting of three varieties; however, in all cases, it was adequate to form a productive stand. Two varieties with low sprout damage emerged well but two emerged poorly from 3.75 inches, and most varieties that had sprout damage emerged sparsely at that depth. All seedlots had poor emergence from 5 inches regardless of sprout damage.

Seedling emergence differed little among seedlots in the field, with averages ranging only from 68% for sound seed to 59% for severely sprouted seed (Table 2). Grain yields were similar at all sprouting levels with averages of 81 bu/a for plants from sound seed and 77 bu/a for plants from severely sprouted seed.

Discussion

Preharvest sprouting of wheat is an occasional problem in Kansas that rarely exceeds the level found in our seedlots. The visual appearance, test weight, and kernel weight of the samples showed that the level that we considered severe was actually slight compared with the extent of sprouting of susceptible wheats in some environments. As mentioned, seed that is sprouted extensively is uncommon in trade channels in the state.

Wheat that sprouted at a level considered severe for Kansas still met benchmarks of 56 lbs test weight and 85% germination and, after being stored, produced an excellent stand and yield. Seed that has suffered preharvest sprouting but meets the benchmark requirements and does not have exposed seedling roots or leaves that might be damaged can be regarded as acceptable for planting under normal conditions. The results suggest that sprouted seed does not perform as satisfactorily as sound seed when planted deeply and also might be affected more by other adverse conditions such as a poor seedbed or unfavorable weather,

Wheat seed that is sprouted extensively does not survive storage for longer than several months. Seed that we con-

Table 2. Seedling emergence from four planting depths in sand in the greenhouse and seedling emergence and grain yield in the field of four wheat varieties with three levels of preharvest sprouting.

Variety	Sprouting Level	Emergence					Grain yield
		1.25 in	2.5 in	3.75 in	5.0 in	Field	
		%					bu/acre
Abilene	Low	87	84	73	29	62	82
	Moderate	84	67	20	2	70	95
	Severe	77	65	19	5	44	73
Karl	Low	98	94	12	8	69	79
	Moderate	90	80	25	0	73	67
	Severe	84	82	18	0	70	78
Mesa	Low	89	73	24	0	78	95
	Moderate	87	48	40	20	68	87
	Severe	70	43	18	0	57	81
TAM 200	Low	89	72	68	1	63	68
	Moderate	89	73	58	1	63	80
	Severe	84	67	26	0	66	77
LSD (0.05)		9	15	28	21	17	26

sidered severely sprouted performed well after 27 months of storage under favorable conditions, but viability could fall rapidly under unfavorable conditions. In any case, germination should be determined before planting seed that has been stored.

Conclusions

1. Seedlots that have suffered preharvest sprouting at the level that might occur in Kansas are acceptable for planting if they meet standards for test weight and germination and do not have exposed seedling parts.
2. Sprouted seed may not perform well when planted under adverse conditions.
3. Germination of seed should be measured before planting, especially if it has been stored.

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