Breeding Oat for Resistance to Environmental Stress

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Temperature stress is the major abiotic factor affecting oat (Avena sativa L. and A. byzantina K. Koch.) growth and development, and therefore, the major factor delineating the area of adaptation of the crop. In general, winter oat is grown in areas with relatively mild winters and warm summers while spring oat is grown in areas with relatively colder winters and cooler summers. Oat production in the winter-spring transition zone is especially risky because low temperature stress may cause winter injury or winterkilling of winter oat, and heat stress during post-juvenile growth and development may severely reduce the grain yield and quality of either winter or spring oat crops. In addition to low tolerance to temperature extremes, oat has a higher water requirement than the other small grain crops. Heat and drought effects usually are confounded, and specific losses are difficult to measure. Although few data on practical yield losses are available, severe levels of heat or drought or both obviously cause large reductions in the quantity or quality of oat grain or both. Perhaps the more subtle heat and drought stresses that frequently occur during the grain-filling period in more normal seasons cause even larger economic losses to oat growers over a period of several years.

Violent wind and rain storms also may cause severe damage to an oat crop by causing lodging (flattening) of the plants. Lodging may inhibit grain filling if it occurs before physiological maturity and there will be additional grain losses during harvesting operations. The risk of lodging increases with soil fertility level, and growers experience intangible losses because they are compelled to practice suboptimal fertilization of oat.

Oat tolerance to the above abiotic stresses can be improved through breeding and selection, but the task is difficult because of many complex genetic and physiological relationships. Improvement is further complicated by the practical need to develop genotypes with complex combinations of genes for resistance or tolerance to stress plus all the additional genes necessary in a commercially useful cultivar. The breeder must evaluate large numbers of genotypes because of the low probability of finding a plant with all the required genes. Unfortunately, rare, elite genotypes may be missed because most plant selection and progeny testing presently must be done in the