

BREEDING FOR "TRUE" SALT TOLERANCE

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Traits imparting agronomically acceptable levels of salt tolerance in the field ("true" salt tolerance) have never been adequately defined for alfalfa. Several cultivars exist with purported salt tolerance, but no results from replicated field tests have been reported in the literature to substantiate those claims. Standard procedures for evaluating salt tolerance published by the North American Alfalfa Improvement Conference involve laboratory and greenhouse testing in environments very different from field conditions and have not been shown to indicate levels of field salt tolerance.

Results from studies conducted at W.L. Research in Bakersfield, California, along with published results from numerous public institutions, indicate that field salt tolerance is a multifactorial trait determined by such morphological and physiological factors as chloride ion exclusion, rooting morphology and growth rate, and resistance to root anoxia and soil borne pathogens. These traits interact and are of differing importance depending on the stage of development of the alfalfa plant (germination, emergence, seedling growth, maturity) and the particular edaphic and climatological environment. Because of large edaphic variability in field situations, it is very difficult to select for all interacting traits at the same time. Alternatively, recurrent selection for each trait in the laboratory, greenhouse, or salt boxes is difficult because of poor correlations with results under actual field conditions. Recently, alfalfa breeders have been using a combination of techniques where germination salt tolerance and seedling salt tolerance are selected for using laboratory and greenhouse screening techniques, and mature plant salt tolerance is selected for using field techniques. However, salt tolerance is inevitably measured as germination, seedling survival, or yield; traits which could be affected as much by the other factors in the screening environment as by the salt concentration.

If the above challenges can be properly overcome, some possible breeding strategies include: 1) recurrent selection for one trait at a time followed by recombination after each selection cycle, 2) sequential selection through each growth stage for resistance to the trait(s) of importance for each growth stage, and 3) index selection, scoring each plant for each trait at each growth stage. Because the heritabilities of most of the traits and genetic correlations between the traits are unknown, it is impossible at this time to determine the most efficient method of breeding for field salt tolerance in alfalfa.

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