TESTING ALFALFA VARIETIES FOR SALINITY TOLERANCE

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Salinity is an important problem throughout irrigated regions as well as the dryer rain-fed regions where alfalfa is grown. Breeders have foreseen the need for increased salt tolerance and demonstrated commitment to development of salt tolerant alfalfa varieties. However, most testing has been under laboratory, growth chamber or greenhouse conditions. It is to be expected that the more complex, multiple stress conditions in grower's fields represent challenges that necessitate field testing since salinity affects soil condition, early germination and stand establishment, as well as subsequent crop yield, with both toxicity and osmotic effects (Lauchli and Grattan, 2007). In this ongoing research, our objectives have been to compare greenhouse—based studies with field responses to salinity-stress. At Fresno State University over two years, we determined the relative salt tolerance of 19 alfalfa varieties in seed germination (Phase 1), emergence in soil (Phase 2) and mature plant response to salinity after establishment (Phase 3) under greenhouse and laboratory conditions, utilizing a mixed saline solution common to California's Central Valley. Field yield response (Phase 4) will be determined in 2014-16. All three greenhouse methods indicated significant varietal differences in salinity tolerance. The average germination percentage of varieties decreased to 41% at 12 dS/l of salinity (EC_w), with EC50 of 28-31 of the most tolerant lines to 6-9 dS/l for the sensitive lines. Salinities above 8dS/m (EC_w) substantially reduced alfalfa emergence in soil emergence tray tests. For mature plants established before saline treatments, the relative shoot dry matter yield decreased significantly when the EC_w was > 5 dS/m. Tolerant varieties had a shoot dry weight relative yield of 36 to 54% even at the highest salinity treatment (15 dS/m) whereas sensitive varieties yielded only 9% to 16% of controls at 15 dS/m. For most varieties, Na^+ and Cl^- concentrations in shoots steadily increased and K^+ decreased as salinity increased. However, the most tolerant varieties exhibited relatively little increase in Na^+ and Cl^- (and decrease in K^+) in shoot tissue, indicating that toxic ion exclusion and K^+ discrimination (vs. Na^+) may be key tolerance mechanisms to consider. A three year standard field yield test with applied EC_w of 5.5 dS/m showed normal yield levels, indicating that historical Maas-Hoffman salinity tolerance threshold of 2 dS/m ECe may be underestimating the native salinity tolerance of modern alfalfa varieties. The large varietal differences in greenhouse salinity tolerances need to be confirmed in field yield trials.

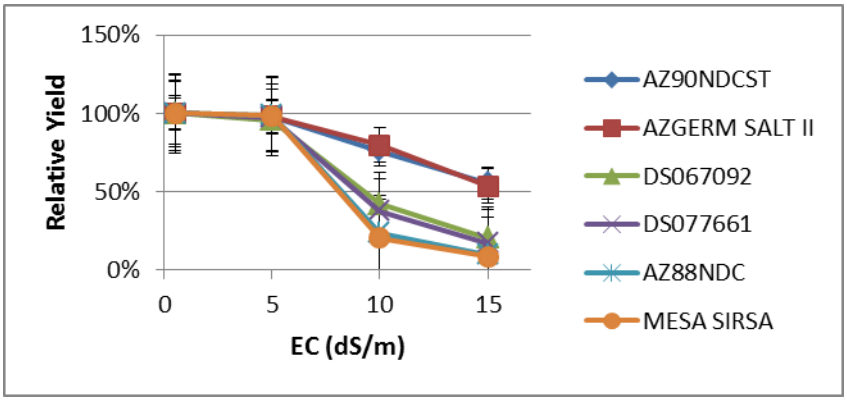

Figure 1. Relative shoot biomass yield for selected varieties of alfalfa. Data are for the seventh (final) harvest.