

Genetic Gains and Stability for Germination Salt Tolerance in Alfalfa

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ABSTRACT

Improving the germination salt tolerance of alfalfa will help this crop endure both increasingly saline irrigation water and salt build-up in the soil. Seven previous cycles of selection for salt tolerance at germination plus the parental line, Mesa-Sirsa, were evaluated for percentage germination under various levels of NaCl solutions. Germination improved linearly from the earliest to the latest cycle of selection. Germination salt tolerance can be improved through recurrent selection techniques.

INTRODUCTION

For alfalfa to successfully emerge and become established, seeds must show high vigor under stressful conditions and germinate completely. A breeding program was initiated by Dr. Albert Dobrenz and colleagues to improve germination with a variety of saline field conditions. Current research is attempting to determine whether the germination salt tolerance characteristic can be maintained through other generations of seed production. This is important if salt-resistant cultivars are to be increased and released to growers.

MATERIALS AND METHODS

Every year from 1979 to 1986, alfalfa plants of the Mesa-Sirsa line were germinated using salt levels designed to eliminate 99% of the NaCl-vulnerable population. The selected plants represent the Syn 1 generation. From these plants, Dr. Steve Smith developed a Syn 2 generation, all grown in the same year (1986) and under the same environmental conditions. The seed of Cycles 1 through 7 Syn 2 were used to evaluate percentage germination under 0, -1.1 and -1.7 MPa NaCl.

Fifty seeds were placed on solution-soaked (5 ml) filter paper in petri dishes. Four replications of each treatment were kept in an unlighted growth chamber at 25 degrees C during the test period. Germination, defined as protrusion of the radicle from the seed coat, was measured every day over a 10 day interval. Analysis of variance was performed after arcsine transformation of the data.

RESULTS AND DISCUSSION

Analysis of variance showed no significant differences in percentage germination between the germplasm sources in both the 0 MPa and -1.1 MPa NaCl media. This indicates that breeding for the ability to sprout under salt stress does not detract from germination under normal conditions. At -1.7 MPa NaCl, a steady, progressive increase in percentage germination occurred through the cycles of selection (Figure 1).

The original parent line, Mesa-Sirsa, showed only 8% germination. Cycle 1 Syn 2 showed 13% germination, and Cycle 7 Syn 2 exhibited 93% germination, with a linear relationship apparent between the intermediate cycles. Figure 1 shows a significant difference between the cycles, in terms of performance under saline conditions. The results also indicate that germination salt tolerance is a heritable characteristic that can be maintained through a generation of seed production. Syn 3 seed of each cycle is being grown out by Dr. Smith and will be further evaluated for germination characteristics.

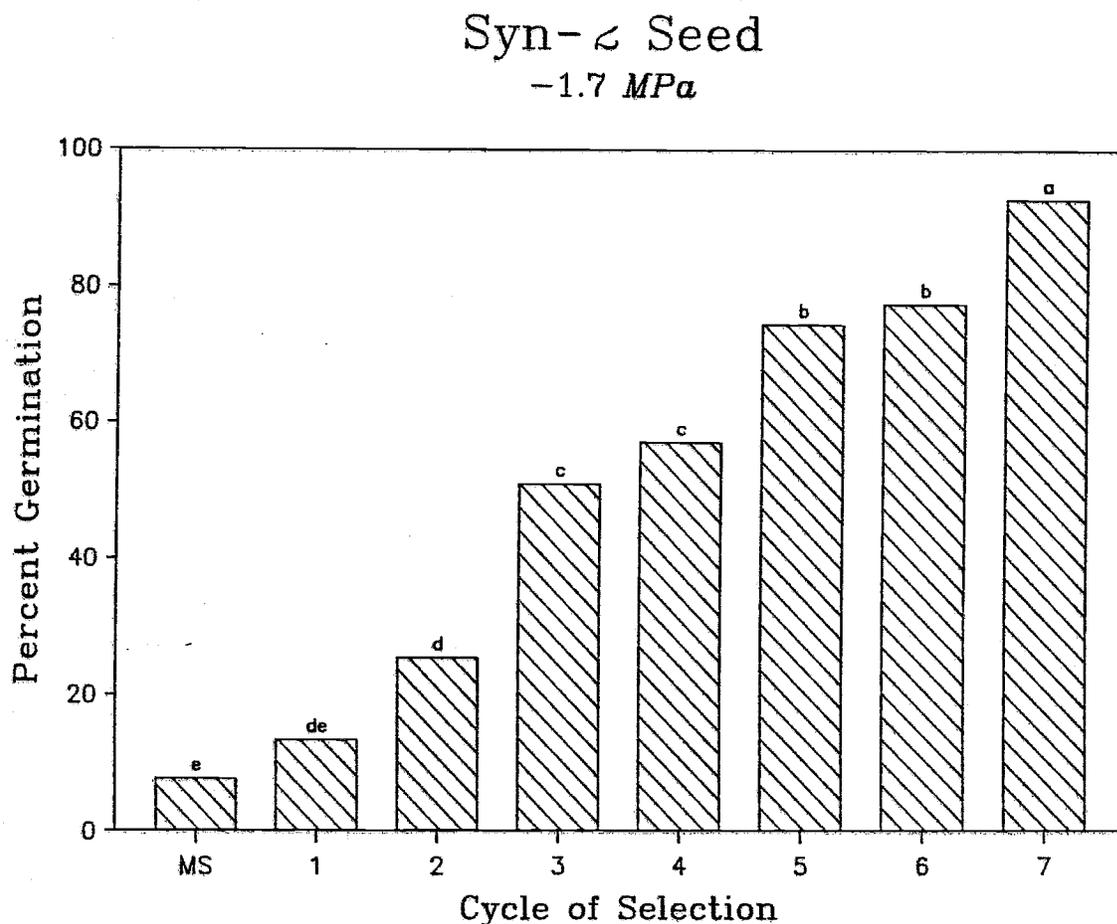


FIG. 1 Percent germination of Mesa-Sirsa and seven cycles of recurrent selection for salt tolerance at -1.7 MPa NaCl.