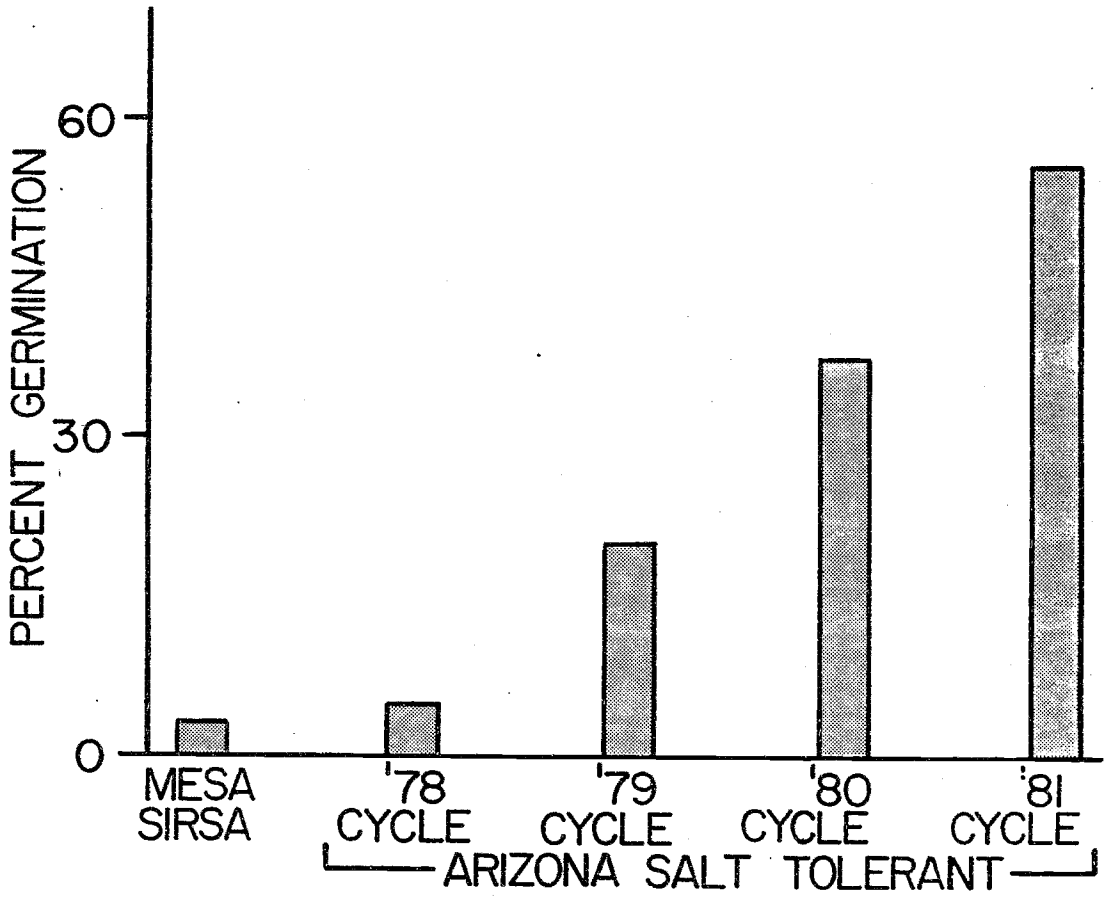

Figure 1. Germination percentages for 'Mesa Sirsa' and the 1978, 1979, 1980 and 1981 Arizona salt tolerant alfalfa. Germination was accomplished at 25 C with 13,500 ppm NaCl.

Relationship Between Germination Salt Tolerance and Drought Tolerance in Alfalfa

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Summary

Five alfalfa germplasm sources representing a wide range of tolerance to NaCl during seed germination were tested for ability to germinate under polyethylene glycol (PEG)-induced drought stress conditions. Germination of all germplasms decreased as the osmotic potential of the germination solutions decreased from -3 to -9 bars. AZ Salt Tolerant 1981, the most salt tolerant germplasm tested, exhibited the highest germination in the PEG solutions. The results suggest a strong positive relationship between the ability to germinate in highly saline conditions and under low soil moisture situations.

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Researchers at the University of Arizona have developed a series of germination salt tolerant alfalfa lines through a mass selection breeding program. The original selections were made from the cultivar 'Mesa Sirsa'. After four cycles of selection, germination in NaCl solutions with an osmotic potential of -12.5 bars was nine times greater than the original source population, Mesa Sirsa.

One of the effects of salts on seed germination is to lower the osmotic potential of the germination media. This creates a physiological drought condition for the germinating seed, making it more difficult for the seed to absorb water from the surrounding media, a situation closely resembling low soil moisture. A study was initiated in 1982 to determine if selection for germination salt tolerance had any effect on the ability of alfalfa seed to germinate under laboratory simulated drought conditions.

Seed of each of the four Arizona Salt Tolerant cycles (1978, 1979, 1980, and 1981), as well as Mesa Sirsa, were germinated at 26°C on filter paper disks saturated with distilled water and polyethylene glycol (PEG) solutions ranging from -3 to -9 bars osmotic potential. PEG is an inert, high molecular weight compound that has no biological effect on the seed. It lowers the osmotic potential of the germination media, mimicking drought conditions, but does not penetrate the seed coat or directly inhibit the physiological processes involved in seed germination.

The germination results for each germplasm were calculated as a percentage of their germination in distilled water since inherent differences in percent germination existed among the germplasm sources. Germination of all germplasm sources decreased as the osmotic potential of the germination media decreased from -3 to -9 bars (Table 1). The general trend of the results indicate that as salt tolerance increased so did the ability to germinate in PEG. AZ Salt Tolerant 1981, the most salt tolerant of the material tested, had the highest percent germination in PEG. Conversely, Mesa Sirsa and AZ Salt Tolerant 1978, the two germplasms least tolerant of salt, showed the poorest germination in the PEG solutions.

The results suggest that there is a strong association between ability to germinate in highly saline conditions and low moisture conditions. Successful selection for increased salt tolerance during germination appears to result in greater drought tolerance as well. Studies are currently under way to examine the relationship between salt tolerance and drought tolerance during the seedling and mature plant growth stages in alfalfa.

Table 1. Adjusted[1] percent germination of five alfalfa germplasm sources in polyethylene glycol solutions.

Germplasm	Germination (% of Control) Osmotic Potential (bars)			
	-3	-5	-7	-9
Mesa Sirsa	77.0	18.8	1.1	0.0
AZ Salt Tolerant 1978	37.9	15.7	1.1	0.5
AZ Salt Tolerant 1979	78.7	48.4	9.0	1.1
AZ Salt Tolerant 1980	72.7	59.0	20.9	2.1
AZ Salt Tolerant 1981	93.3	62.6	29.1	11.7

[1]Germination percentages are calculated as percent of the control germination in distilled water.

Tissue Culture of Salt Tolerant Alfalfa

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SUMMARY

Work is currently in progress to evaluate the potential of plant tissue culture as a technique for selecting salt tolerant alfalfa. Preliminary results indicate that low levels of sodium chloride (Ψ = -6 bar) stimulate growth of both highly selected germplasm and the controls. At this stage of research, there appears to be little difference in response to salt between selected material and the unselected controls.

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Plant tissue culture techniques show great promise as tools for plant selection and breeding, especially considering space, time, and money limitations currently imposed on research. At this time, research is needed to positively correlate the results of artificial selection in both field studies and in vitro plant cultures.