PHYSIOLOGICAL AND GROWTH RESPONSES OF *PHASEOLUS VULGARIS* AND *P. ACUTIFOLIUS* WHEN GROWN IN FIELDS AT TWO LEVELS OF SALINITY

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Common beans (*P. vulgaris*), one of the most salt sensitive vegetable crops, are difficult to grow in arid regions where irrigation water frequently contains salt. Yet tepary beans (*P. acutifolius*) are indigenous to arid regions of the Sonoran Desert where they have been cultivated for centuries. The presence of tepary in these regions suggests that it has some salt tolerance mechanisms. Salt tolerance in tepary has been suggested (2,3), although studies designed specifically to determine its salt tolerance are few (1,4). Our objectives were to compare salt tolerance of tepary, navy, and a backcross, and to evaluate physiological mechanisms as useful indicators of salt tolerance at different times during the season.

Procedures

Navy bean (*Phaseolus vulgaris* L. cv Sanilac), tepary bean (*Phaseolus acutifolius* Gray, PI 440790), and a backcross between the two were planted in Safford, AZ, on July 2, 1986 in two fields with salt levels of 10.8 mmhos/cm (very high) and 6.5 mmhos/cm (high) as sampled at 15 cm at harvest. Stand counts, transpiration (LI-1600 steady state porometer), water potential (PMS pressure bomb), and soluble solids (hand held refractometer) were measured at 27, 63 and 91 days after planting (DAP). Plants were harvested on October 17 and November 24, 1986, depending on dryness. Seeds were dried at 68°C and weighed for yield determinations. Means and standard deviations were calculated.

Results and Discussion

Seed yields were higher for tepary than for navy or backcross beans when grown in high or very high salt (Table 1). However for all beans, seed yields decreased as salt increased from high to very high, with decreases of 100, 95 and 68% for navy, backcross and tepary, respectively.

Stand counts were different for genotypes at all DAP and salt levels (Table 2). However, only in very high salt at 63 and 91 DAP, did these counts indicate yield differences. The backcross demonstrated better ability to survive than the navy. Stands were lower in very high than high salt at all sampling dates for all genotypes. Stands decreased more between 27 and 63 DAP than between 63 and 91 DAP.

No differences in transpiration were observed between genotypes for any DAP or salt levels, due to large variability (Table 2). Transpiration tended to be higher for tepary than other genotypes at 27 DAP, but this response was not apparent at 63 or 91 DAP. A higher transpiration for tepary corresponds to significant responses found in other studies (Goertz, unpublished data). Large differences between transpiration in high and very high salt fields were not observed.

Water potentials were different between genotypes only at 27 DAP, with no differences at 63 or 91 DAP (Table 2). However differences noted in water potentials of genotypes did not correspond closely with yield differences.

No large differences were observed in water potentials between high and very high salt.

Soluble solids showed differences between genotypes only at 27 DAP, when higher for tepary than for navy and the backcross (Table 2), and thus showed some similarity to yield responses for different genotypes. In most cases, soluble solids appeared higher at very high than at high salt.

In summary, tepary was more salt tolerant than navy or the backcross based on yields. The backcross tended to have more salt tolerance than navy, although this difference was not significant. At 27 DAP transpiration and soluble solids gave some indication of salt tolerance. By 63 and 91 DAP, few parameters measured gave good indications of salt tolerance except for stand counts in very high salt. Other parameters could not be compared at very high salt due to plant death. Water potentials never gave good indications of salt tolerance.

Table 1. Seed yield (kg/ha) for navy, backcross, and tepary beans grown in fields with high and very high salt (Safford, AZ, 1986).

Genotype	High Salt	Very High Salt
Navy	318 ± 156	0 ± 0
Backcross	554 ± 495	30 ± 49
Tepary	2583 ± 433	826 ± 264

Table 2. Stand count, transpiration, water potential, and soluble solids at 27, 63, and 91 days after planting (DAP) for navy, backcross, and tepary beans grown in fields with high and very high salt (Safford, AZ, 1986).

Genotype	Stand Count (%)		Transpiration (ug H_2O cm^{-2} s^{-1})		Water Potential (-MPa)		Soluble Solids (%)	
	High[z]	Very High	High	Very High	High	Very High	High	Very High
				27 DAP				
Navy	60±3	7±4	12.3±2.6	--	1.5±0.2	--	15.7±0.9	--
Backcross	73±10	46±14	12.0±2.6	11.8±1.6	1.1±0.3	1.3±0.1	15.0±1.5	14.7±1.7
Tepary	70±17	48±9	13.8±2.8	14.6±3.6	1.2±0.1	1.2±0.1	17.3±1.6	18.3±1.0
				63 DAP				
Navy	48±7	0±0	10.7±2.3	--	0.8±0.4	--	15.4±1.3	--
Backcross	63±7	10±6	10.8±2.7	--	0.9±0.4	--	16.0±2.0	--
Tepary	55±12	38±11	9.3±2.3	11.3±2.5	0.7±0.1	0.9±0.2	16.1±2.0	17.5±1.6
				91 DAP				
Navy	43±4	0±0	10.7±3.3	--	1.0±0.3	--	14.9±1.3	--
Backcross	56±12	6±7	11.2±3.9	--	1.1±0.3	--	14.9±1.5	--
Tepary	48±8	36±11	9.9±1.5	8.8±1.2	1.1±0.3	1.1±0.2	14.2±1.5	15.2±1.8

[z]Salt levels: High (6.5 mmhos/cm), Very high (10.8 mmhos/cm).

References

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