

Tolerance of Tepary and Navy Beans to Different Salt Levels in Irrigation Water

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INTRODUCTION

Navy beans (*Phaseolus vulgaris*) are the classic example of a salt-sensitive vegetable crop. However, tepary beans (*Phaseolus acutifolius*) are adapted well to the arid southwest, where high levels of soil salinity often occur. The objective of this study was to determine how different levels of salt in irrigation water affect tepary and navy beans. Three parameters were measured to evaluate plant responses to salt: stand counts, transpiration and yield. Yields determined which beans were more salt tolerant, whereas stand counts and transpiration were considered as possible indicators of salt tolerance.

PROCEDURES

Three bean types (teparry, navy and a backcross between the two) were planted in two fields with different water sources containing different levels of salts on April 8, 1988 at the Maricopa Agricultural Research station in Maricopa, Arizona. Both the white tepary (PI 1440-790) and the backcross were obtained from R.C. Pratt (Ohio State University). The navy cv 'Fleetwood' was donated by Sun Seeds of Eden Prairie, MN.

Soluble salts in the water sources were 2,200 ppm for the high-salt and 800 ppm for the low-salt field. Soil samples taken at a 6 inch depth were analyzed at Lengyel's Agricultural Consulting Service in Phoenix, AZ for Na, Cl, Na/Ca ratio and total soluble salts (Table 1). The fields were irrigated with the appropriate water source 8 days prior to planting and 22 days after planting (DAP). From that time on, the fields were irrigated on a weekly basis. Fields were fertilized prior to planting with a 16-20-0 fertilizer at the rate of 280 kg/ha. Seeds treated with the fungicide Thiram were planted 15 cm apart, with a four-row cone planter in beds on one-meter centers, oriented in an east-west direction. A randomized complete block design was used for each field with 4 replications.

Stands were counted 12, 33, 60 and 91 DAP. A steady state porometer was used to record diurnal transpiration rates on June 10, 63 DAP. Readings were taken every 2 hours from 6 AM till 6 PM, on the lower surface of expanded leaves of 3 plants per cultivar in the center two rows of each plot. Beans from the two center rows of the plots were threshed, cleaned and dried for 4 days at 35°C. Once the beans were sufficiently dry, seeds were weighed for yield determinations. All data were analyzed with an analysis of variance statistical program.

RESULTS AND DISCUSSION

The overall stand counts were greatest for the tepary and lowest for the backcross at both salt levels, except at 60 and 91 DAP in the high-salt. For low-salt, stand counts increased until 33 DAP and then were maintained. For high-salt, stand counts increased until 33 DAP and then decreased during the rest of the season. Overall stand counts tended to be higher in low-salt than in high-salt.

Transpiration rates were comparable in high-salt and low-salt. The low-salt field showed differences between genotypes at almost all times with no consistent patterns. At high-salt, tepary appeared higher than the backcross, which was higher than navy, except at first two samplings. Transpiration rates appear different between the genotypes and follow a diurnal pattern of increasing during midday and decreasing after that time.

At both salt levels, yields were significantly different between genotypes. Navy had no yield in either field and the backcross yielded only in the low-salt field. The tepary had higher yields at low-salt compared to high-salt, and overall had the highest yield.

In conclusion, tepary appeared most tolerant to salt based on yields, followed by the backcross and the navy. Stand counts early in the season consistently indicated the increased tolerance of tepary, compared to the backcross and the navy. Transpiration did not consistently indicate the increased salt tolerance of tepary.

Table 1. Soil analysis, Maricopa 1988.

	APRIL 8		AUGUST 26	
	LOW	HIGH	LOW	HIGH
SOLUBLE SALTS (ppm)	1,100	1,365	825	2,785
Na/Ca	1/3	1/3	5/1	9/1
SODIUM (ppm)	245	302	355	841
CHLORIDE (ppm)	56	136	116	416

Table 2. Stand Counts (% of seed planted) of three bean types irrigated with two salt levels at different times after planting.

GENOTYPE	DAYS AFTER PLANTING			
	12	33	60	91
	<u>LOW SALT</u>			
TEPARY	74	81	86	79
BACKCROSS	33	62	60	53
NAVY	58	76	71	69
	<u>HIGH SALT</u>			
TEPARY	70	76	50	42
BACKCROSS	24	53	48	42
NAVY	47	72	57	48

Table 3. Yields (kg/ha) of three bean types irrigated with two salt levels.

GENOTYPE	YIELDS (Kg/ha)	
	LOW SALT	HIGH SALT
TEPARY	477 a ^z	311 a
BACKCROSS	14 b	0 b
NAVY	0	0 b

^z values followed by different letters within a column are significantly different at the 5% level.

