Salt Tolerance of Tepary, Navy, and Backcross Beans as Expressed by Yields Over Several Seasons

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INTRODUCTION

Navy beans (Phaseolus vulgaris) grow poorly in arid regions, in part due to its extreme sensitivity to salt. Yet tepary bean (P. acutifolius) is indigenous to the Sonoran Desert where arid conditions, including high saline water and soils, are often a problem. The presence of tepary in this climate suggests that it possesses mechanisms for surviving in a semi-arid climate, and perhaps in saline conditions. If tepary has greater salt tolerance than navy, it could provide germplasm to increase salt tolerance of navy. The objective of this study was to compare yields of tepary, navy, and a backcross between the two in fields with different salt levels. This information should indicate the salt tolerance of tepary relative to navy, and the possibility of transferring any salt tolerance from tepary to navy.

PROCEDURE

Beans were planted in fields with different salt levels in Safford, Arizona, for three consecutive years (1985, 1986, and 1987). Two tepary (P. acutifolius Gray) accessions, brown and white (original seed from W. D. Hood of Coolidge, AZ), and navy (P. vulgaris L. 'Fleetwood') were used all three years, whereas a backcross between a tepary and navy was included only in the last two years. Tepary and backcross germplasm used in each planting originated from the previous year's planting. Navy seed was obtained from Sunseeds for most plantings.

Soil salinity differences were present in fields due to historical usage of irrigation water with different salt levels. Soil salinity in fields ranged from 3 to 7 mmhos/cm for high salt and from 7 to 12 mmhos/cm for very high salt over all three growing seasons, with highest salt levels at harvest. Fields were pre-irrigated with the proper water sources, fertilized as recommended for common beans, and treated with a pre-plant herbicide, Treflan. 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 in all seasons for both salt levels. In 1985 the two tepary beans and navy were planted on June 28. In 1986 tepary and navy beans were planted on April 24, and the backcross on July 2. In 1987 all four genotypes were planted on June 26. Fields were cultivated by hand and irrigated as needed to prevent plant stress.

All plants were harvested on November 6 (130 DAP) in 1985; navy and tepary were harvested on August 27 (127 DAP), and the backcross on October 17 (107 DAP)in 1986; and tepary and the backcross were harvested October 15 (112 DAP) and the navy on November 17 (145 DAP) in 1987. Harvest dates were determined by pod dryness. Bean plants were removed from field, threshed, cleaned and dried. Once sufficiently dry, seeds were weighed for yield determinations. Yield means and standard deviations were calculated.

RESULTS AND DISCUSSION

White and brown tepary beans displayed the most salt tolerance, followed by the backcross. The navy displayed very little salt tolerance. These responses were observed at all salt levels in all seasons.

Yields were larger at high salt levels than they were at the very high salt levels in 1985 and 1986 for all bean accessions. In 1987, seed yields still were larger at high salt levels than at very high salt for navy, but the reverse was true for the two tepary beans; the backcross yields were very similar at both salt levels. For all years navy had

no yield at very high salt and little at high salt. Tepary yields in 1985 declined by 67% for brown and by 60% for white beans at very high compared to high salt. Similar results occurred in 1986 with tepary yield declines of 60% in both brown and white. However, tepary yields in 1987 had a 17% increase in brown and a 41% increase in white at very high compared to high salt. The backcross yields declined by 95% at very high compared to high salt in 1986 but were very similar between the two salt levels in 1987.

When comparing yields over seasons, responses differed depending on salt levels and genotypes. At high salt, yields for each given genotype showed no significant differences over the three seasons. Although navy and backcross yields appeared lower in 1987 relative to previous years, standard deviations were so great that means are not different. At very high salt, yields were the same all three years for navy. However, increases in yields were noted each year for both tepary and backcross beans at very high salt. These increases may be due to selection for increased salt tolerance since beans planted each year were ones from the previous year's harvest. In the last season, tepary actually yielded higher at very high than high salt.

Use of yield data comparisons over several seasons indicates that tepary tolerates salty conditions better than navy and that mechanisms for increased salt tolerance may be selected as indicated by the backcross and seasonal responses.

Table 1. Mean yields (kg/ha) of tepary, navy, and backcross beans from three seasons at two levels of salt in Safford, AZ.

	1985[z]		1986		1987	
Genotype	Very High	High	Very High	High	Very High	High
Brown Tepary	848±379	2572±651	904±252	2270±70	2397±387	2056±315
White Tepary	733±291	1811±866	1010±482	2548±623	2879±500	2043±296
Navy	0±0	170±210	0±0	230±306	0±0	42±36
Backcross	--	--	30±49	554±495	240±21	237±130

[z] Beans not oven-dried this year.