

HERITABILITY OF SEED YIELD IN COMMON BEAN UNDER IRRIGATED AND DROUGHT STRESSED CONDITIONS

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Common bean in Mexico is usually grown under unfavorable climatic (i.e. water stressed) and soil conditions (low fertility and organic matter content). In the highlands, common bean is exposed to intermittent drought caused by breaks during the rainfall season. Both genetic and management options are available to alleviate those problems. Genetic options are less costly and easy to adopt by the farmers, but progress is difficult to attain and modest goals should be stated in regard to the enhancement of yield potential under stress. This research was conducted with the aim of identifying superior recombinant families under stress and to determine the heritability of yield under irrigated and drought stressed conditions.

The study was conducted at three locations in Central Mexico: Sandoval, Aguascalientes (22°10' N latitude, 1912 masl), Texcoco, state of Mexico, (19°29' N latitude, 2240 masl) and Zacatepec, Morelos (18°42' N latitude, 917 masl). Ninety eight F_{4.7} families and the two parents from which the families were derived were tested under two moisture conditions: irrigated and rainfed. At Zacatepec, irrigation was provided to the stress treatment until the beginning of flowering, thus simulating terminal drought. Both parents were developed for rainfall conditions, Bayo Victoria for the semiarid highlands and Bayo Mecentral for the subhumid highlands. Data were taken on phenology, biomass and seed yield; here, only data on yield is presented. Variance components for seed yield were obtained from the site analysis. Estimates of variance components were substituted to obtain estimates of heritability (Molina, 1992).

In all sites parents showed differential response in seed yield under both moisture conditions (Table 1). Bayo Victoria was superior to Bayo Mecentral in the two highland locations but showed poor adaptation in Zacatepec, where Bayo Mecentral proved to be well adapted. In this last site, no family resulted superior in yield to Bayo Mecentral under terminal stress conditions. In the highland environments, there were families significantly superior to both parents (Table 2) and few of them were among the top yielders at the two locations. The results obtained at the highland sites suggest complementarity between the parental cultivars utilized.

The heritability values for seed yield ranged from low to intermediate and were relatively similar between stress and non-stress conditions. Lowest h^2 values were found at Texcoco, where other factors in addition to moisture treatments affected the crop, i.e. a severe attack by rust (*Uromyces appendiculatus* var. *appendiculatus*).

The intermediate heritability estimates obtained for yield are in agreement with those of previous studies conducted under stressed and-nontressed conditions (Singh, 1995, Schneider *et al.* 1997). In a breeding program aimed at drought resistance, selection for yield under stress conditions might be delayed until advanced generations, while in early generation other traits of

simpler genetic control must be considered for selection. In spite of the families that resulted outstanding in the two highland sites, drought resistant genotypes are unlikely to be widely adapted because of the strong genotype by environment interactions due to the prevalence of differential constraints in addition to drought stress.

Table 1. Average seed yield (g/m^2) and heritability (%) of 98 families and two parents under two moisture regimes at three locations of central Mexico.

Location	Zacatepec, Mor.		Texcoco, Mex.		Sandoval, Ags.	
	Stressed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated
Families						
Average (n=98)	98.7	165.0	45.0	93.6	54.6	109.2
Range	32-166	54-275	11-119	16-199	13-99	57-193
Parents						
Bayo Mecentral	157.0	216.0	46.0	117.0	47.0	83.0
Bayo Victoria	53.0	123.0	50.0	110.0	77.0	151.0
H^2	0.54	0.46	0.06	0.26	0.40	0.38

Table 2. Top yielding families (g/m^2) under drought stress at three locations of central Mexico.

Location	Zacatepec, Mor.	Texcoco, Méx.	Sandoval, Ags.
Family			
BM X BV-92	107.9 (36)	60.0 (2)	99 (1)
BM X BV-38	92.5 (55)	58.0 (4)	92 (2)
BM X BV-33	112.5 (27)	67.0 (1)	82 (3)
BM X BV-40	104.4 (42)	59.0 (3)	72 (4)
BM X BV-70	110.0 (24)	39.0 (18)	72 (5)
Average (n=98)	98.7	45.0	54.6

() = Rank among lines in each location.

References

- Molina, G.J.D. 1992. Genética de poblaciones y cuantitativa (algunas implicaciones en genotecnia). AGT Editor, México. pp. 267-279
- Singh, S.P. 1995. Selection for water stress tolerance in interracial populations of common bean. *Crop Sci.* 35:118-124
- Schneider, K.A., R. Rosales-Serna, F. Ibarra-Pérez, B. Cazares-Enriquez, J. A. Acosta-Gallegos, P. Ramirez-Vallejo, N. Wassimi, and J.D. Kelly. 1996. Improving common bean performance under stress. *Crop Sci.* 37: 43-50