PARTITIONING AND PARTITIONING RATE TO SEED YIELD IN DROUGHT-STRESSED AND NON STRESSED DRY BEAN GENOTYPES[1]

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Introduction. Different physiological and morphological traits have been used to evaluate drought resistance in crops. Some measurements require costly equipment and specialized hand labor. However, the evaluation of larger number of genotypes needs measurements that are easy to determine and that can explain the biological bases of adaptation and yield of cultivars in drought prone environments. Plant traits that can help to evaluate the proportion of photosynthates that are partitioned to seed yield might contribute to the selection of more efficient genotypes. Therefore, the objective of this study was to analyze the contribution of supplemental irrigation to seed yield and to determine the changes observed in above ground biomass, harvest index, growth duration and daily seed yield rate accumulation of dry bean genotypes under rainfed and rainfed plus supplemental irrigated conditions.

Materials and Methods. The study was conducted at the Research Station of Sandovales, Aguascalientes, Mexico (22° 09' N, 102° 18' W, 2000 masl) during three years. Field trials were established on June 27 in 2001; July 2 in 2002 and July 14 in 2003. Forty nine dry bean genotypes were tested, mostly belonging to the Durango and Mesoamerica races (4). Bean genotypes were from different breeding programs and 'G' accessions from the CIAT bush core collection (2). An experimental triple lattice design was utilized with two 6 m row plots and 0.76 m apart. The trials were grown under two soil moisture treatments: rainfed and rainfed plus supplemental irrigation. Supplemented plots received a light irrigation of 30 mm twice during the reproductive period. Daily precipitation was recorded from a near climatological station during the growing season. Traits recorded in each plot included days to maturity, seed yield and total aerial biomass (leaves and roots excluded). Harvest index (seed yield/total aerial biomass) and the daily rate of seed yield accumulation (seed yield/days to maturity) were estimated (5).

Results and Discussion. Accumulated rainfall during the crop cycle varied in the experimental site from 270 in 2001 to 324 mm in 2003. As expected, the rainfed crop never had enough moisture to met evaporative demand and crop growth was restricted during the whole cycle. In addition, temporary drought periods of different duration occurred each year, mainly during the reproductive period (data no shown). The uneven distribution of rainfall increases the risk for production in the area, since around 60 to 65% from the total rainfall during the cycle occurs in the vegetative period and only 35 to 40% occurs during the reproductive period (3). Average from all genotypes, lowest yield and shortest crop cycle were observed in 2002, results due to the occurrence of terminal drought. Under rainfed plus supplemental irrigation average from years and cultivars, seed yield, above ground biomass, harvest index and the rate of daily seed yield accumulation were 1014 and 1742 kg.ha^{-1}, 58.7 % and 11.3 kg.ha^{-1}day^{-1}, respectively. Whereas in the rainfed plots the observed values for those traits were, 624 and 1171 kg ha^{-1}, 52.1 % and 7.0

kg.ha^{-1}.day^{-1}, respectively (Table 1). Of those traits, biomass and the rate of partitioning were enhanced by supplemental irrigation and as a consequence seed yield raised an average of 390 kg ha^{-1}.

Outstanding genotypes under drought-stressed conditions such as G13637 and G842 achieved high yield via biomass accumulation and efficient partitioning, the former genotype being earlier by five days. Average seed yield of these two genotypes under rainfed conditions was 1223 kg.ha^{-1}, as compared to 782 kg.ha^{-1} of Pinto Villa a cultivar well adapted in the region.

On the other hand, genotypes with low above ground biomass and low rates of daily seed yield accumulation resulted in poor yielding genotypes. The opposite was true in the supplemented treatment where high yielding genotypes, such as G13637 and G22923, displayed large above ground biomass and a high rate of seed yield accumulation. These two genotypes showed similar growth cycle and an average seed yield of 1700 kg ha^{-1}. A high base yield potential under favorable conditions has been suggested to contribute to higher yields under stress (1). It is important to notice that the genotype G13637 (apetito) showed the best performance under both water treatments, suggesting that biomass accumulation and partitioning towards the developing seeds are key physiological factors in the adaptation to the semiarid conditions observed in the test site.

Table 1. Average seed yield, above ground biomass accumulation, harvest Index (HI), rate of yield accumulation (RYA) and days to maturity of 49 bean genotypes grown under two moisture conditions during three years at a semiarid location in Mexico.

Year/treatment	Seed yield kg ha^{-1}	Biomass kg ha^{-1}	HI %	RYA kg ha^{-1} day^{-1}	Days to Maturity
		Rainfed			
2001	622	1316	47.0	6.9	90.1
2002	364	766	49.8	4.4	82.0
2003	886	1432	59.5	9.7	91.6
Mean	624	1171	52.1	7.0	87.9
		Supplemented			
2001	1141	2206	51.3	12.6	90.8
2002	678	1309	53.3	8.0	84.8
2003	1223	1432	71.5	13.4	91.1
Mean	1014	1742	58.7	11.3	88.9

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