

Research Note

YIELD STABILITY OF DETERMINATE AND INDETERMINATE RED MOTTLED BEANS^{1,2}

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Red mottled beans are grown in the Dominican Republic with practices that range from irrigated relatively high input production in valleys to low input rain-fed production on hillsides. Thus, a successful red mottled variety needs to perform predictably over a wide range of environmental conditions. A comparison of the performance of large-seeded determinate lines with smaller-seeded indeterminate lines in the Dominican Republic indicated that indeterminate lines had greater yield stability (Beaver et al., 1985). In order to avoid confounding effects between growth habit and seed size, this study was designed to measure the effect of growth habit on yield stability for a group of red mottled bean lines of similar seed size.

A split-plot arrangement of a randomized complete block with four replications was used. Whole plots consisted of blocks containing either fifteen determinate or fifteen indeterminate red mottled bean lines of similar seed size. The entries in the trial were red mottled breeding lines from the University of Puerto Rico and lines from the Pompadour landrace collection. Sub-plots were single rows, 1 m long with 10 seed planted per row. Spacing between rows was 0.5 m in the Dominican Republic and 0.76 m in Puerto Rico. In the Dominican Republic, the trial was planted at the following locations and times: San Cristobal (southern coastal plain at 40 m above sea level) in December 1990; Vallejuelo (southwestern valley at 600 m above sea level) in September 1991; and Manoguayabo and Arroyo Loro (southwestern valley at 400 m above sea level) in December 1991. In Puerto Rico a trial was planted at the Isabela Substation (northwestern coastal plain at 150 m above sea level) in January 1990; January 1991; October 1991; January 1992 and October 1992. Sprinkle irrigation was used at Isabela and San Cristóbal and furrow irrigation was used at the other locations that were irrigated. An analysis of variance combined over environments was conducted. The effects of location were considered random and the effects of growth habit and genotype were considered fixed. Seed yields of lines were compared by using Least Significant Differences ($P < 0.05$). Regression analyses were used to estimate yield stability over environments (Eberhart and Russell, 1966).

Mean seed yield of environments varied from 1,040 to 1,895 kg/ha. As a group, the indeterminate lines yielded more than the determinate entries. Four of the indeterminate lines (Pompadour G, Pompadour T, 8858-28 and 8953-6) had mean yields

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TABLE 1.—Mean hundred seed weight, seed yield and yield stability characteristics of determinate and indeterminate red mottled beans grown in nine environments in Puerto Rico and the Dominican Republic.

Growth habit Line	Hundred seed weight	Seed yield	Regression coefficient	Deviation mean square	Coefficient of determination
	----- g -----	----- kg/ha -----			
<i>Determinate</i>					
8738-3B	32.0	1506	0.60	93537	0.32
PC50	37.2	1479	0.28	478747*	0.02
8857-67	40.3	1458	1.64	76569	0.80
Jose Beta	47.0	1442	0.63	179249*	0.21
8738-5B	29.3	1431	0.89	87849	0.51
8738-4B	36.4	1336	0.32	36577	0.24
Indiana Roja	38.3	1295	0.44	235272*	0.09
Pompadour N	32.1	1288	0.36	197293*	0.07
8738-8B	32.1	1284	0.61	194789*	0.19
8738-12B	42.1	1266	0.48	192318*	0.12
8738-1B	41.6	1265	0.26	102046	0.07
8738-7B	39.6	1245	0.26	174103*	0.04
9811-55	32.6	1191	0.86	265723*	0.25
Pompadour checa	41.2	1149	0.11	98612	0.02
Pompadour F	34.8	1140	0.44	199956*	0.10
Mean	37.1	1318			
<i>Indeterminate</i>					
8858-28	46.8	1922	2.04	284993*	0.63
Pompadour G	36.4	1830	1.45	250593*	0.50
Pompadour T	32.8	1811	0.91	550067*	0.15
8953-6	42.3	1781	1.50	230386*	0.53
8953-9	31.4	1736	0.90	56873	0.62
8953-1	38.2	1650	1.12	76822	0.66
8953-3	51.6	1593	2.18	139423*	0.80
8953-15	49.0	1593	1.72	173110*	0.67
Pompadour K	32.4	1572	1.07	37456	0.78
8856-12	45.8	1541	1.31	291805*	0.41
8856-61	40.6	1529	1.90	221583*	0.66
8953-2	48.0	1516	1.74	140459*	0.72
Pompadour V	34.7	1507	0.95	127436	0.45
8953-10	42.5	1493	1.30	132735	0.60
8953-12	39.4	1392	1.73	218802*	0.62
Mean	40.8	1631			
LSD (0.05)		273			

*Significant at 0.05 probability level.

which were significantly greater than that of 8738-3B, the highest yielding determinate line (Table 1). White et al. (1992) also found indeterminate common bean lines to yield more than determinate large-seeded beans when tested at five locations in Colombia.

Farmers in the Dominican Republic will need more productive bean cultivars as management practices improve and the threat of bean golden mosaic virus diminishes. Using recurrent selection, Beaver and Kelly (1994) developed indeterminate red mottled breeding lines that yielded more than determinate check varieties. With the exception of 8857-67, all of the determinate lines had regression coefficients with values less than one (Table 1). On the other hand, only three of the fifteen indeterminate lines had regression coefficients less than unity. The indeterminate red mottled breeding lines 8856-61, 8953-3 and 8858-28 had both high mean yields and regression coefficients ≥ 1.9 , all of which indicates increased seed yield response to higher yield environments. Among the determinate lines, 8857-67 had the best performance in the higher yield environments. These lines may be best suited for irrigated production in the valleys of the Dominican Republic. The results of the yield stability analysis demonstrate that red mottled bean lines can be selected for adaptation to environments with different levels of productivity.

Indeterminate lines 8953-1, 8953-9 and Pompadour K had the most desirable combination of yield stability characteristics based on relatively high mean seed yields, coefficients of regression near unity and minimum deviations from regression. These lines may be appropriate for environments in the Dominican Republic that have low yield potential or variable climatic conditions. Among the determinate lines, 8738-5B, 8738-3B, 8738-4B and Pompadour checa had regression coefficients < 1 and minimum deviations from regression. Line 8857-67 was the only determinate line that combined a relatively high mean seed yield with a regression coefficient > 1 and minimum deviations from regression. White et al. (1992) also reported finding both determinate and indeterminate large-seeded beans with desirable yield stability characteristics.

The results of this research are in agreement with those of White et al. (1992), who concluded that common bean lines with indeterminate growth habits may have greater potential than determinate lines for yield improvement of larger-seeded beans without loss of yield stability. Some seed yield gain may also be realized by exploiting genotype \times environment interaction and recommending bean genotypes for specific production regions in the Dominican Republic.

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