DEVELOPMENT OF DROUGHT-RESISTANT BEAN GENOTYPES FOR ECUADOR

Esteban Falconí[1,2], Jose Pinzón[2], and James D. Kelly[1].

[1]Crop and Soil Sciences, Michigan State University, East Lansing, MI. [2]Instituto Nacional de Investigaciones Agropecuarias, Quito, Ecuador.

Introduction:

In Ecuador, the major bean production areas are subject to intermittent drought. The rainfall pattern throughout the year is bimodal, allowing farmers to produce two crops. However, total precipitation and the irrigation systems do not always provide the minimum water requirements for the crop. Consequently, bean genotypes with improved water use efficiency should be considered as the more suitable and practical strategy to help stabilize production. The objective of this research was to identify drought tolerant genotypes with commercial seed characteristics from a cranberry bean population of inbred backcross lines (IBLs) developed using the method described by Bliss (1993).

Materials and Methods:

A population of 26 IBLs, developed in Michigan State University (Roman-Aviles and Kelly, 2005) was studied in Tumbaco, Ecuador (0o 12' S; 78o 24' W; 2330 masl). The IBLs were grown under two water regimes to identify the potential new sources of drought resistance in large seeded Andean beans. The IBL population was derived from the cross of lines C97407*2/Negro San Luis (NSL). The recurrent parent (C97407) had a cranberry seed type, whereas the donor parent (NSL) was a medium-sized black-seeded genotype identified as drought resistant genotype. Both treatments were irrigated prior to flowering and, subsequently, the irrigation was suspended in one treatment to create water stress conditions. The irrigated treatment received a total of 359 mm of water, while the treatment under water stress received 309 mm of water. Analyses of variance (ANOVA) of the yield under the two water regimes, geometric mean (GM), and seed quality were utilized to identify superior genotypes under Ecuadorian growing conditions.

Results:

The ANOVA showed statistical differences among the IBLs for both water treatments. The top yielding genotype was the NSL parent in both water treatments (2648 kg/ha and 4259 kg/ha and a GM = 3358 kg/ha), followed by the local cultivar Mil Uno. Based on GM, six IBLs surpassed 2000 kg/ha, which were superior to the recurrent parent C97407 (Table 1). Three IBLs showed good seed quality with a score of 3, whereas the recurrent parent C97407 had seed quality score of 5. The drought intensity index (DII) for the experiment was moderate at 0.36.

Table 1. Geometric means, yield under non-stress, yield under stress conditions, seed quality, and 100 seeds weight of the IBL population evaluated in Tumbaco, Ecuador. 2005.

	Genotypes	GM	Water Regimes		Seed quality (1-9)[2]	100 seeds weight
			Stress	Non-stress		
	IBLs	----------	Kg/ha	----------		(g)
*[1]	C03131	2235	1746	2860	5	48
	C03122	2142	1637	2803	5	53
*	C03102	2078	1722	2508	4	52
	C03110	2055	1698	2488	6	55
	C03160	2032	1485	2780	4	49
*	C03121	2028	1606	2560	3	56
	C03163	1985	1672	2358	4	54
	C03127	1797	1544	2091	6	47
*	C03155	1792	1530	2098	3	52
*	C03151	1746	1297	2349	3	45
	C03149	1558	1306	1859	6	41
	C03157	1523	1225	1894	4	53
	C03161	1466	1295	1659	5	45
	Parents					
	NSL	3358	2649	4259	NA[4]	41
	C97407	1861	1414	2448	5	49
	Checks					
	Mil Uno	2395	1866	3073	NA	62
	L88-63[3]	2017	1435	2835	NA	19
	MEAN	**1893**	**1521**	**2364**		**48**
	LSD (0.05)		**346**	**574**		**4**
	CV (%)		**13.9**	**14.9**		**4.6**

[1] Selected genotypes; [2] Scale from 1 to 9, where 1 is the best quality and 9 is the worst. [3] Drought resistant line (Frahm, 2004): [4] Comparisons performed only among cranberry seed types.

Conclusions:

Based on yields under irrigated and rainfed conditions and seed type, genotypes C03102, C03121, C03131, C03151 and C03155 were selected. The first three genotypes exhibited higher yields than the recurrent parent and the last two genotypes exhibited an improved seed quality. The IBL method for developing drought-resistant lines suitable for Ecuadorian conditions and markets is promising, given the difficulty of generating commercial seed types through single crosses. The drought resistant-lines selected from the IBL population need to be tested in different environments in the Ecuadorian Highlands to confirm drought resistance. The selected IBLs with high levels of drought resistance, but lacking desirable seed quality characteristics can be utilized in single crosses with local cultivars to improve the drought resistance of large red mottled types as part of overall breeding strategy to improve drought tolerance of common beans in Ecuador.

References:

Bliss, F. 1993. Breeding common bean for improved biological nitrogen fixation. Plant Soil. 152:71-79.

Frahm, M., J.C. Rosas, N. Mayek-Perez, E, Lopez-Salinas, J. Acosta-Gallegos, and J. D. Kelly. 2004. Breeding beans for resistance to terminal drought in lowland tropics. Euphytica 136:223-232.

Roman-Aviles, B. and J. D. Kelly. 2005. Identification of quantitative trait loci conditioning resistance to *Fusarium* root rot in common bean. Crop Science. 45 :1881-1890.