TRAIT CORRELATIONS IN CLIMBING BEANS.

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Introduction:

The most outstanding characteristic of climbing beans is their high yield potential compared to more commonly grown bush beans. Climbing beans have been an important component of traditional societies in Central America and the Andes for centuries. More recently, climbing beans have become important in certain areas of Africa. The principal limitation to the expansion of climbing bean technology into new areas has been the lack of new varieties. Most currently-available climbing beans come from high-altitude areas of Central and South America and do not grow well in lower elevations or hotter climates. An urgent need exists for climbing bean varieties that are adapted to lower elevations (800 to 1800m) and resistant to the diseases encountered there. The objective of this research was to test for mid-altitude adapted climbing beans.

Plant Materials:

Data was collected on two yield trials of I) 55 accessions from Rwanda, Mexico and the CIAT Core collection; and II) 55 advanced Andean breeding lines from CIAT. Both experiments were planted in Darien (1450 masl) and Palmira (1000 masl) during the rainy seasons in semesters 2001A and 2000B, using randomized complete block designs and two repetitions each. In all experiments, G685 and G2333 were used as visual checks. The genotypes were all planted at a low density of 10 plants per meter of linear row, where plots consisted of a single 2m row with 1.2 m between rows and vines were supported on bamboo and wire trellises at an approximate height of 2.0 m above the ground. Data collected included yield per plant (Y/P), pods per plant (P/P), grain per plant (G/P), 100 seed weight (100s), days to flowering (DF), days to maturity (DM) and harvest index (HI) based on stem and pod weight. Agronomic adaptation (AA) and climbing ability (CA) were evaluated on 1 to 9 scale (where 1=good and 9 = poor). The scale for climbing ability is an expanded scale compared to the accepted values for growth habit scale, which go from I to IV. Plant height (PH), raceme length (RL), number of pods per raceme (NP), pod length (PL), number of vines per guide (NV) and internode length at a height of one meter above the ground (IL) were evaluated for two plants per row and averaged to produce plot values.

Results and Discussion:

Yield, yield components and agronomic adaptation were higher on average in Darien then in Palmira for both groups of genotypes. The check varieties, G685 and G2333 and G2337 performed much better in Darien than in Palmira, indicating their lack of heat tolerance and adaptation to lower elevations. Palmira was a warmer and less hospitable location for climbing beans, and therefore a good site for selecting heat tolerance in climbing beans. Meanwhile, Darien was an ideal mid-elevation site where there was good performance by a wide range of germplasm. In both trials, there was significant correlation between traits (Table 1). As expected, climbing ability was correlated with both plant height and internode length. Climbing ability was evaluated

visually on a whole-plot basis and was a rapid and accurate substitute for quantitative phenotypic measurements that are time consuming and must be taken on a per plant basis. Yield per plant, yield components, such as pods per plant and the visual evaluation of agronomic adaptation were correlated with climbing ability in the germplasm study in Darien but not always in Palmira. In the advanced breeding lines there was less variability for climbing ability than in the germplasm trial so differences in yield were not correlated with this factor but rather with agronomic adaptation. Days to maturity was correlated with climbing ability (and its components). The majority of the climbing beans in both environments matured in 100 to 120 days from planting. For both experiments, significant correlations across sites were seen between a genotype's 100 seed weight, climbing ability, plant height, days to maturity and internode length in Darien and Palmira, showing that these traits have medium to high heritability. Yield, pods per plant and agronomic adaptation were not correlated between sites, indicating that these traits, as expected, have lower heritability.

In conclusion, we have seen significant correlations between traits associated with climbing ability. To address this, we developed several scales for agronomic adaptation and climbing ability that will be useful for the selection of breeding lines without time-consuming phenotypic measurements of plant height, internode length, etc. The sensitivity of climbing beans to genoytpe x environment interaction will have to factored into our breeding program for climbing beans. We are dealing with the issue of specific adaptation by using a parallel selection system over several sites.

Table 1. Correlation values (r) between traits in (I) 55 accessions from Rwanda, Mexico and the core collection and (II) 55 advanced Andean breeding lines grown in two sites Palmira (P) and Darien (D) in 2001A.

Characteristic	Site	P/P	P/P	Y/P	Y/P	CA	CA	PH	PH	DM	DM	IL	IL
Trial		I	II	I	II	I	II	I	II	I	II	I	II
Pods per plant	P	1.000	1.000	0.161	0.626	0.167	-0.252	-0.124	0.112	-0.142	-0.104	0.009	0.015
(P/P)	D	1.000	1.000	0.690	0.871	-0.347	0.007	0.170	0.165	0.273	-0.260	0.252	0.059
Yield per plant	P			1.000	1.000	0.088	-0.157	-0.076	0.252	-0.110	-0.190	-0.074	0.157
(Y/P)	D			1.000	1.000	-0.539	0.010	0.296	0.189	0.475	-0.337	0.448	0.127
Climbing Ability	P					1.000	1.000	-0.845	-0.352	-0.580	-0.094	-0.710	-0.327
(CA)	D					1.000	1.000	-0.596	-0.076	-0.626	-0.136	-0.772	-0.220
Plant Height	P							1.000	1.000	0.441	-0.194	0.649	0.700
(PH)	D							1.000	1.000	0.237	0.043	0.722	0.107
Days to Maturity	P									1.000	1.000	0.301	-0.227
(DM)	D									1.000	1.000	0.398	0.006
Internode length	P											1.000	1.000
(IL)	D											1.000	1.000
Correlation between sites		0.204	0.108	-0.092	0.072	0.803	0.212	0.397	0.169	0.527	0.341	0.534	0.289