IMPROVEMENT OF THE SYMBIOTIC INTERACTION BEAN-RHIZOBIA

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INTRODUCTION

Crop legumes as the common bean (*Phaseolus vulgaris* L.) have been used extensively in agriculture over the past century, mainly for maintaining soil fertility. The low fertility has a negative impact on the legume-rhizobia symbiotic relationship reducing the ability of rhizobia to form nodules with optimal N_2-fixing capacity. The symbiotic fixation of nitrogen (SNF) provides an ecologically acceptable alternative to the high applications of nitrogenous fertilizers, and an economic alternative to the limited access to these fertilizers of the developing countries. Inoculation is required to increase yield through N_2 fixation and to reduce the external inputs. There is an important genotypic variability associated with SNF potential and amount of N_2 fixed, that emphasizes the need to explore the potential of indigenous rhizobial strains for improving the symbiotic performance of the common bean. The objective of this work was to identify common bean germplasm useful to improve SNF potential.

MATERIAL AND METHODS

Thirty six common bean populations and breeding lines from the MBG-CSIC collection were screened for their nodulation in glasshouse hydroponic-culture and in field to isolate the rhizobial strains. The reference rhizobial for the hydroponic culture was *Rhizobium tropici* CIAT 899. Plants were harvested at the flowering stage, between 42 and 47 days after sowing. Shoot, nodule and root components were separated and dried at 70 ºC for 2 days to constant weight and each fraction were weighted. The evaluation in field were carried out in two years and four locations, Pontevedra (42º 25'N, 8º 38'W 20 masl), Xinzo (42º 5'N, 7º 43'W, 620 masl), Ponteceso (43º 16'N, 8º 44'W, 400 masl) and Lalin (42º 40'N, 08º 07'W, 552 masl) arranged as a randomized complete block design with two replications. At flowering stage, five plants were collected and for each individual plant, the shoot was separated from the root and the number of nodules and the nodule and shoot dry weight were measured after drying at 80 ºC. At maturity, yield components were measured and rhizobial strains were isolated from root nodules.

RESULTS AND DISCUSSION

There was a wide variation associated with SNF potential and there were differences in the interaction nodulation-bean in different environments. In the hydroponic screening the landraces PHA-0704, PHA-0125, PHA-0227, PHA-0019, PMB-0127, PHA-0194, PHA-0191, PHA-0623 and PHA-0593 constituted a group with a significantly high growth with mean values of 10.49 ± 2.44 g shoot dry weight plant^{-1}. The highest nodule biomass was found in PHA-0704 (> 300 mg nodule dry weight plant^{-1}), PHA-0019, and PMB-0121 (> 100 mg nodule dry weight plant^{-1}). The variation in nodule mass per plants resulted from large variation in nodule number per plant. The field data indicate that the landraces PHA-0704, PHA-0019, and PHA-0155 and PHA-0704, PHA-0719, PHA-0593, PHA-0623 and PMB-0121 had a good shoot dry weight and nodule dry weight respectively. The accessions with high nodule biomass in field displayed the highest yield values also. PHA-0719, PHA-0593, PHA-0623 and PHA-0157 had a high yield in different soil environments. This variability emphasizes the need to explore the potential of indigenous rhizobial strains for improving the symbiotic performance of *P. vulgaris*. The existence of genetic variation in SNF among bean landraces opens a real possibility for enhancing N_2 fixation through selection and breeding. These results indicate that the accessions PHA-0704, PHA-0719, PHA-0593, PHA-0623 and PMB-0121 could be incorporated into programs of genetic improvement, having an important role in the future of the agriculture. In addition, the genetic analysis of the different rhizobia isolates of the different soils environments has been starting.

Table 1. Characteristics of the common bean accessions studied in hydroponic culture and field trials.

Accession	**Hydroponic culture**		**Field trials**		
	Shoot biomass (g plant^{-1})	**Nodule biomass (g plant^{-1})**	**Shoot biomass (g plant^{-1})**	**Nodule biomass (g plant^{-1})**	**Yield (g plant^{-1})**
ALMONGA PMB-0222	6.71	0.097	18.13	0.103	7.82
ALUB.ENFESTA PMB-0127	9.84	0.116	13.90	0.084	9.03
ANDECHA PHA-0704	16.75	0.318	25.00	0.400	16.14
BELUGA PMB-0190	4.76	0.013	12.42	0.076	8.55
BOLITA PMB-0225	5.50	0.052	17.82	0.117	10.62
BORLOTTO PHA-0719	6.86	0.011	14.15	0.688	26.54
CERRILLOS PHA-0929	6.56	0.128	14.85	0.142	6.28
GANXET PHA-0593	8.92	0.085	15.50	0.563	16.57
GANXET PHA-0623	9.10	0.050	16.00	0.613	27.89
PEREGRINA PMB-0121	7.90	0.188	12.60	0.550	35.97
LINEX PMB-0244	4.03	0.016	14.07	0.047	9.46
MATHERHORN PMB-0220	2.59	0.037	15.05	0.049	8.39
MONTCALM PMB-0214	5.63	0.015	14.63	0.039	6.20
PALOMA PHA-0930	4.17	0.085	14.20	0.080	13.01
PHA-0006	4.52	0.030	13.33	0.063	10.84
PHA-0019	9.99	0.207	25.23	0.122	10.21
PHA-0118	7.04	0.126	14.83	0.058	11.26
PHA-0122	2.96	0.015	7.84	0.029	3.52
PHA-0125	10.98	0.075	14.77	0.024	9.13
PHA-0126	8.25	0.131	12.51	0.015	13.14
PHA-0148	4.56	0.037	16.43	0.020	8.54
PHA-0152	4.65	0.002	9.60	0.020	14.69
PHA-0155	7.64	0.037	21.03	0.007	7.23
PHA-0157	5.17	0.002	10.24	0.020	33.76
PHA-0179	8.26	0.132	13.98	0.031	17.16
PHA-0180	4.42	0.013	8.83	0.100	11.67
PHA-0190	5.53	0.010	19.50	0.048	6.76
PHA-0191	9.18	0.064	11.28	0.034	6.80
PHA-0194	9.40	0.019	18.28	0.028	14.29
PHA-0200	5.47	0.001	9.34	0.020	13.38
PHA-0203	7.81	0.129	20.34	0.177	7.47
PHA-0208	5.71	0.039	10.50	0.100	10.44
PHA-0220	8.20	0.019	13.47	0.200	13.57
PHA-0222	3.10	0.020	7.68	0.320	16.65
PHA-0227	10.27	0.121	12.41	0.047	5.55
PHA-0246	7.34	0.006	12.70	0.127	10.39

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