

Cultivar and Germplasm Release

RELEASE OF 'BEJUCO-90 DÍAS' AND 'ARBUSTO' VELVETBEAN CULTIVARS¹

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The legume velvetbean [*Mucuna pruriens* (L.) DC.] is used in the tropics as a cover crop to control erosion, fix nitrogen, and increase soil organic matter, and as a smother crop to control weeds (Harrison et al., 2004; Buckles, 1995). Velvetbeans can also be used as forage (Muinga et al., 2003). In a field experiment conducted in Alabama, a crop rotation that included velvetbean significantly reduced populations of the phytopathogenic nematodes *Meloidogyne* spp. and *Heterodera glycines*, and significantly increased the seed yield of soybeans [*Glycine max* (L.) Merr.] (Weaver et al., 1998). Based on results from field experiments conducted in Zimbabwe, Pengelly et al. (2003) concluded that velvetbean and lablab (*Lablab purpureus*) were among the most promising legumes for use in rotation with maize (*Zea mays* L.). When these legumes were included in the rations of cows, both meat and milk production increased.

At present, farmers in Puerto Rico do not have a source of seed of velvetbean varieties that are well adapted to local growing conditions. In recent years, research has been conducted by University of Puerto Rico graduate students to evaluate the performance of velvetbean cultivars Bejuco-90 Días and Arbusto. Seed of both cultivars were originally obtained from the Educational Concerns for Hunger Organization, North Fort Myers, Florida (<http://www.echonet.org/content/SeedBank/550>).

Botanical Description

The Arbusto cultivar has a determinate growth habit whereas the Bejuco - 90 Días cultivar has an indeterminate growth habit. The growth, development and flowering dates of both cultivars are insensitive to photoperiod when planted in Puerto Rico at different planting dates. The Arbusto cultivar tends to flower 55 to 60 days after planting, whereas the Bejuco-90 Días cultivar flowers 75 to 80 days after planting. The Arbusto cultivar generally matures about three months after planting. The Bejuco-90 Días cultivar usually reaches maturity 10 to 14 days later than the Arbusto cultivar. Both cultivars have purple flowers and produce grey-brown mottled seed. The 100-seed weight of the Arbusto cultivar ranges from 60 to 65 g whereas Bejuco-90 Días has a 100-seed weight ranging from 65 to 70 g.

Tolerance to Pests and Diseases

No significant pest or disease problems were observed in the trials planted at the Isabela and Lajas Substations or at the farm trials conducted in northwestern Puerto Rico.

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Production

Seed density trials were conducted at the Isabela Substation to identify appropriate production practices for seed production of the determinate Arbusto and indeterminate Bejuco-90 Días velvetbean cultivars (Carlo-Acosta, 2009). The velvetbean cultivars were planted at three within-row distances (0.15 m, 0.3 m, 0.45 m) and a spacing of 0.6 m between rows. The experimental designs were randomized complete blocks with four replications. The experimental units were three rows 5 m in length. The experiments were planted in January and May 2008. The experiments were conducted without the use of fertilizer, pesticide or supplemental irrigation. Data were analyzed by using an analysis of variance (ANOVA), and means were compared by using Least Significant Differences ($p < 0.05$).

The determinate velvetbean cultivar Arbusto produced a mean seed yield of 828 kg/ha in the January planting and 971 kg/ha in the May 2008 planting (Table 1). The indeterminate velvetbean cultivar Bejuco-90 Days produced a mean seed yield of 1,943 kg/ha in the January planting, and 2,805 kg/ha in the May 2008 planting (Table 1). The determinate velvetbean flowered at 57 days after planting for the January planting and at 72 days after planting for the May 2008 planting date. The indeterminate velvetbean flowered at 55 days after planting for the January planting, and flowered 88 days after planting for the May 2008 planting. Both velvetbean cultivars produced approximately 80% of canopy cover at flowering. There was no significant effect of plant density on seed yield, days to first flower, or on percentage cover at flowering.

TABLE 1.—*Mean of seed yield, days to flowering and canopy cover in the spacing trials for the determinate 'Arbusto' and indeterminate 'Bejuco-90 Días' velvetbean lines planted at Isabela, Puerto Rico, in January and May 2008.*

Plant density	Determinate 'Arbusto'		'Bejuco - 90 Días'	
	Jan. 2008	May 2008	Jan. 2008	May 2008
	Seed yield (kg/ha)			
60 cm × 15 cm	756	951	2,131	2,780
60 cm × 30 cm	871	1,117	1,996	2,544
60 cm × 45 cm	858	844	1,702	3,090
Mean	828	971	1,943	2,805
L.S.D. (0.05)	NS	NS	NS	NS
	Days to first flower			
	Jan. 2008	May 2008	Jan. 2008	May 2008
60 cm × 15 cm	57	73	57	89
60 cm × 30 cm	56	76	54	87
60 cm × 45 cm	57	67	55	88
Mean	57	72	55	88
L.S.D. (0.05)	NS	NS	NS	NS
	% canopy cover at flowering			
	Jan. 2008	May 2008	Jan. 2008	May 2008
60 cm × 15 cm	77	75	91	88
60 cm × 30 cm	78	93	81	84
60 cm × 45 cm	80	81	78	88
Mean	78	83	83	86
L.S.D. (0.05)	NS	NS	NS	NS

Mean hundred-seed weight of the determinate Arbusto velvetbean was 60 g in the January planting, and 63 g in the May 2008 planting. Mean hundred-seed weight of the indeterminate Bejuco-90 Días velvetbean was 69 g in the January planting, and 68 g in the May 2008 planting. At the lowest plant density (60×45 cm), approximately 25 kg of seed would be needed to plant 1 ha of the determinate and indeterminate velvetbeans.

During 2007 and 2008, on-farm trials were conducted on 20 citrus farms in the central mountain region of Puerto Rico to evaluate the performance of jack bean [*Canavalia ensiformis* (L.) DC.], velvetbean, cowpea (*Vigna unguiculata* (L.) Walp.) and sunn hemp (*Crotalaria juncea* L.) as cover crops (Carlo-Acosta, 2009). The determinate velvetbean cultivar Arbusto was preferred by the greatest number of farmers because of its ability to produce canopy cover in a short period of time, because of its productive biomass and because of an absence of competition with the citrus trees. In more favorable environments Arbusto produced > 2,000 kg/ha of biomass at 120 days after planting (Table 2). The determinate velvetbean flowered at 67 days after planting and produced an average canopy cover of 85% at 12 weeks after planting (Table 2).

The indeterminate velvetbean cultivar was not favored by the citrus farmers because of its aggressive growth and pods that can be mistaken for a weed locally known as 'pica pica'. However, research conducted at the Lajas Substation indicates that the indeterminate cultivar Bejuco-90 Días has potential as a forage crop. Two field experiments were conducted at the Lajas Substation to evaluate agronomic performance and nutritional value of silage produced from intercropping velvetbean with maize (Sandoval-Centeno, 2008). The experiments were planted in September 2005 and February 2006. The velvetbean cultivar Bejuco-90 Días was planted in association with maize (cv. Mayorbela 05) at different intervals (the same date of planting as maize and one, two and three weeks after the maize planting). A control treatment of maize in monoculture was also included in the trial. Biomass samples taken at 75 days after planting were used to evaluate botanical composition (maize, velvetbean and weed dry weights); chemical composition [% crude protein (CP), non-digestible fiber (NDF) and acid detergent fiber (ADF)]; silage fermentative characteristics (pH and organic acids); and aerobic stability of the silage at 45 days after ensiling. At 75 days after planting, the maize monoculture produced an average biomass of 11.7 t/ha, whereas the velvetbean and maize planted at the same planting date, and the velvetbeans planted one and two weeks after the maize produced > 13 t/ha of biomass (Table 3). Approximately one-third of the total biomass was produced by the velvetbean when the velvetbean and maize were planted on the same day and when the velvetbean was planted one week after the maize. These treatments had the highest levels of CP in 2005 (10 and 9.3%) and in 2006 (7.4 and 6.8%). In contrast, the maize monoculture treatments had mean CP of 5.5% in 2005 and 2006. Concentrations of NDF and ADF were lower with interplanting at 0 and 7 d compared to maize monoculture (Table 4). The intercropping of maize and velvetbean had no significant effect on pH and acetic and lactic acid concentrations of the silage. Sandoval-Centeno (2008) concluded that planting velvetbean and maize on the same date, or planting velvetbean one week after maize increased the yield and nutritive value of the forage and permitted the production of good quality silage. Therefore, the intercropping of velvetbean and maize constitutes a viable alternative for use in feeding systems for milk production in Puerto Rico.

Uses

Both Bejuco-90 Días and Arbusto velvetbean cultivars can be used as a green manure or cover crop. The Arbusto cultivar should be used when intercropping in plantings of fruit trees or bananas (*Musa acuminata* Colla). The Bejuco-90 Días cultivar should be used when planted in monoculture as a cover or smother crop. The Bejuco-90 Días cultivar should be used for forage production.

TABLE 2.— Mean plant population, days to flower, percentage cover after planting and biomass at 120 days after planting of the determinate ‘Arbusto’ velvetbean planted in 20 on-farm trials in northwestern Puerto Rico.

Growing season and municipality of the on-farm trial	Plant population (1,000 pl/ha)	Days to first flower	% Cover after planting			Biomass at 120 days (kg/ha)
			Week 6	Week 9	Week 12	
June-Oct. 2007						
Moca	92.4	63.0	25.0	55.5	79.5	1,064
Adjuntas	71.4	85.0	22.0	42.5	70.0	596
Lares	82.0	62.0	44.5	66.0	85.5	950
Isabela	100.1	80.0			80.0	1,504
Mean	86.5	72.5	30.5	54.7	78.8	1,029
Jan.-May 2008						
San Sebastián	66.7	75.0	29.0	60.5	84.5	2,241
San Sebastián	113.8	86.0	40.5	82.0	100.0	2,214
San Sebastián	107.4	62.0	75.0	97.5	100.0	2,540
San Sebastián	40.4	61.0	48.0	78.0	93.0	1,631
San Sebastián	109.8	66.0	68.5	87.5	97.5	2,372
Mean	87.6	70.0	52.2	81.1	95.0	2,200
July-Nov 2008						
Las Marías	49.1	94.0	75.0	95.0	100.0	2,714
Las Marías	70.4	52.5	77.5	97.5	100.0	2,417
Las Marías	75.1	59.0	85.0	100.0	100.0	2,712
Las Marías	27.7	55.0	37.5	55.0	55.0	1,913
Las Marías	50.7	71.0	35.0	50.0	60.0	1,807
Mean	54.6	66.3	62.0	79.5	83.0	2,313

TABLE 2.—(Continued) Mean plant population, days to flower, percentage cover after planting and biomass at 120 days after planting of the determinate ‘Arbusto’ velvetbean planted in 20 on-farm trials in northwestern Puerto Rico.

Growing season and municipality of the on-farm trial	Plant population (1,000 pl/ha)	Days to first flower	% Cover after planting			Biomass at 120 days (kg/ha)
			Week 6	Week 9	Week 12	
Aug.-Dec. 2008						
Maricao	88.4	61.0	42.5	55.0	67.5	852
Maricao	50.1	60.0	35.0	47.5	52.5	2,367
Maricao	85.7	60.0	72.5	94.5	100.0	2,069
Maricao	93.8	59.0	87.5	100.0	100.0	1,642
Maricao	86.4	59.0	92.5	100.0	100.0	2,965
Mean	80.9	59.8	66.0	79.4	84.0	1,979

TABLE 3.—Mean composition of biomass samples of velvetbean 'Bejuco-90 Dias' harvested at 75 days after planting in field experiments conducted at the Lajas Substation during 2005 and 2006.

Treatment	Dry weight (ton/ha)			
	Maize	Velvetbean	Weeds	Total
Velvetbean and maize planted on the same day	8.8	4.5	0.0	13.3
Velvetbean planted 7 d after planting maize	10.0	3.3	0.3	13.6
Velvetbean planted 14 d after planting maize	10.5	2.4	0.3	13.2
Velvetbean planted 21 d after planting maize	10.5	1.3	0.6	12.4
Maize monoculture	10.9	—	0.8	11.7

TABLE 4.—Mean crude protein, non-digestible fiber (NDF), acid detergent fiber (ADF) of biomass samples of velvetbean 'Bejuco-90 Dias' harvested at 75 days after planting in field experiments conducted at the Lajas Substation during 2005 and 2006.

Treatment	Crude protein			
	2005	2006	NDF	ADF
Velvetbean and maize planted on the same day	10.0	7.4	56.9 d ¹	41.5 d
Velvetbean planted 7 d after planting maize	9.3	6.8	57.7 c	43.7 c
Velvetbean planted 14 d after planting maize	7.4	6.5	60.5 b	48.3 b
Velvetbean planted 21 d after planting maize	6.9	6.1	61.8 a	48.6 b
Maize monoculture	5.5	5.5	62.1 a	50.6 a

¹Means in the same column with different letters differ at $P < 0.05$ based on Least Significant Differences.

Availability of Seed

The University of Puerto Rico Agricultural Experiment Station seed program at the Isabela Substation will maintain foundation seed stocks of Bejuco-90 Dias and Arbusto velvetbean. Small amounts of seed for research may be requested by contacting the Department of Crops and Agroenvironmental Sciences. Plant variety protection will not be sought for these cultivars.

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