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EVALUATION OF *Centrosema rotundifolium* FOR SAND-SOIL SAVANNAS IN EASTERN VENEZUELA

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Abstract

An evaluation of a collection of amphicarpic *Centrosema rotundifolium* showed considerable variability among the six accessions tested, regarding above- and below-ground seed production. Dry-season forage yields were very low but rainy-season yields reached acceptable levels. Contents of crude protein, P and Ca were intermediate to high (CP and P) or low (Ca). Three accessions are suggested for on-farm testing in association with grasses in order to explore the plant persistence implications of belowground seed production under practical conditions. Furthermore, the potential of this amphicarpic species for the conservation of sandy soils deserves attention.

Keywords: Amphicarpy, dry-matter production, seed production, crude protein, phosphorus, calcium

Introduction

Centrosema rotundifolium Mart. ex Benth. is one of the four-amphicarpic species of the important tropical genus *Centrosema*. It is a little-known, perennial, trailing species which mainly because of three factors was considered worthwhile of evaluation for the sand-soil savannas in Eastern Venezuela: (1) amphicarpy (the phenomenon that a plant is able to produce both above-ground and below-ground seeds) because of which *C. rotundifolium* has been suggested to have the potential of being a particularly persistent legume (Schultze-Kraft et al., 1997); (2) its adaptation to acid, low-fertility soils such as the oxisols in the Colombian Llanos Orientales (Schultze-Kraft et al., 1994); and (3) its origin – sand soils of semiarid to dry-subhumid Brazil (Schultze-Kraft et al., 1990) – according to which the species should be adapted to similar environments in Eastern Venezuela such as the Mesa de Guanipa, Anzoátegui.

Material and Methods

The evaluation experiment was conducted during 1995-97 at the FONAIAP research station Centro de Investigaciones Agropecuarias del Estado Anzoátegui (CIAE-Anzoátegui) in El Tigre, Anzoátegui state, Venezuela (8°51' N, 64°12' W, 265 masl) on a very sandy (87% sand) and acid (pH 4.9) oxisol with low cation exchange capacity and low base saturation. The climate is semiarid with a mean annual temperature of 26.5 °C and a mean precipitation of 1040 mm/year distributed from May to November.

The germplasm used was a *C. rotundifolium* collection provided by the Centro Internacional de Agricultura Tropical (CIAT), Colombia, comprising six accessions, viz. CIAT 5260, 5283, 5521, 5721, 25120, and 25148. The experimental design was RCB with four replications. Seeds were sown 1995 into 7.5-m^2 single-row plots with a basic fertilization consisting of P_2O_5, K_2O, MgO, and S (50, 50, 20, and 16 kg/ha, respectively); since there was no appropriate rhizobium inoculum available, a starter dose of 20 kg N/ha was also applied. At the end of the establishment phase, twelve weeks after sowing, soil cover and flowering intensity were assessed. Subsequently and during the first dry season, all ripe aboveground seeds were collected by periodic hand-picking (1-2 times/week). At the middle of the dry season, a destructive harvest of underground seeds was performed in two replications by sieving the 0-5 cm soil layer of the whole plot. During the subsequent rainy season such "destructed" plots recuperated completely from seed remnants in the soil and from tuberous-root regrowth meristems. Dry-season dry matter (DM) forage production was assessed on the basis of two 0.25-m^2 samples/plot five months after a standardization cut at the beginning of the subsequent dry season. Rainy-season DM forage production was measured during the subsequent rainy season by performing two 8-week interval cuts after a standardization cut at the onset of the rainy season. Material of both cuts was used to determine crude protein (%N x 6.25), phosphorus and calcium contents in whole plants. Statistical treatment consisted of analysis of variance and the Duncan test of significance.

Results and Discussion

Establishment and seed production (Table 1). All accessions established well and did not show any nutrient deficiency or disease symptoms, or any major damages by insects. With a mean of 70%, soil cover 12 weeks after sowing was satisfactory and only the difference between the highest (CIAT 25148) and the lowest (CIAT 25120) covers was significant. The range of flowering intensity was wide (3-54%), the most prolific (and earliest) flowering accession being CIAT 25120. Both above- and below-ground seed production varied considerably. Accessions with low aboveground seed yields tended to have high belowground yields and vice-versa (e.g. CIAT 25148 and 25120, respectively). On average, seed production belowground was more than three times higher than aboveground.

Forage production and contents of crude protein and minerals (Table 2). With a mean yield of 107.2-kg/ha dry season forage production was low. It varied considerably among accessions but only the difference between the highest and lowest production (CIAT 5620 and CIAT 25120, respectively) was statistically significant. Rainy-season production did not show any major differences though accession CIAT 5620 tended to be superior. Likewise, with values around the respective means of 23.5%, 0.41%, and 0.60, there were no significant differences among accessions regarding crude protein, P, and Ca contents (except for the highest and lowest Ca values).

Discussion and conclusions In comparison with the perennial *C. pubescens* (Ferguson et al., 1990) the seed production potential – mainly belowground – of *C. rotundifolium* is very high. Whereas forage production during the dry season is very low, rainy-season DM yields are close to those of other *Centrosema* species reported from the same site by Flores (1986). The crude-protein values of *C. rotundifolium* are in line with those of other *Centrosema* species (Lascano et al., 1990); the P contents are considerably higher and the Ca contents lower than the suggested respective critical values for near-maximum production (Salinas et al., 1990). The collection tested showed only a moderate degree of variability. For the El Tigre conditions, accessions CIAT 5260, 5721, and 25148 (eventually even a mixture of them) are suggested for on-farm testing of *C. rotundifolium*/grass associations under grazing. Such studies should also clarify the relationship between belowground – grazing independent? – Seed production and legume persistence. It is furthermore suggested to explore the potential of *C. rotundifolium* for soil conservation (e.g. sand dune stabilization).

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Table 1 - Soil cover and flowering intensity of a *Centrosema rotundifolium* collection at the end of the establishment phase, subsequent above-ground seed production, and below-ground seed harvest during the dry season

Accession (CIAT No.)	Soil cover (%)	Flowering intensity (above-ground) (%)	Seed yield (kg/ha)	
			Above-ground	Below-ground
5260	63 ab	19 bc	567 a	894 ab
5283	68 ab	8 cd	382 ab	822 ab
5521	70 ab	3 d	63 bc	907 ab
5721	77 ab	14 bcd	204 ab	1267 a
25120	54 b	54 a	571 a	611 b
25148	87 a	26 bc	9 c	1208 a
Mean	69.8	20.4	299	952
S.E.	6.4	3.3	293	318

a,b,c,d: Values within a column followed by the same letter do not differ significantly at P<0.05 (Duncan test)

Table 2 - Forage production of a *Centrosema rotundifolium* collection during the dry and rainy seasons, and contents of crude protein, phosphorus and calcium in entire plants (means of two 8-week rainy-season cuts)

Accession (CIAT No.)	Forage yield (kg DM/ha)		Crude protein (%)	P (%)	Ca (%)
	Dry season*	Rainy season**			
5620	184.0 a	2418	22.5	0.43	0.63 a
5283	68.7 ab	2223	23.4	0.39	0.62 a
5521	128.7 ab	2203	23.9	0.45	0.52 b
5721	170.7 a	2392	23.8	0.42	0.59 ab
25120	16.7 b	2088	23.8	0.42	0.59 ab
25148	74.3 ab	2142	23.6	0.40	0.64 a
Mean	107.2	2244	23.5	0.41	0.60
S.E.	99.0	358	1.1	0.11	0.11

a,b,c,d: Values within a column followed by the same letter do not differ significantly at P<0.05 (Duncan test); in columns without letters, there are no statistically significant differences.

* 5-month production

** Cumulative production of two 8-week cuts