

Using the method of Eberhart and Russell to estimate productive adaptability and stability for three cultivars of *Lotus tenuis* on restrictive environments of the Flooding Pampas

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The Flooding Pampas is extended for over six million hectares in the Buenos Aires Province, being the main zone where extensive beef cattle breeding systems are carried out. Its topography and edaphic characteristics define strong restrictions for agriculture, being economic and bio-physic productivity highly related to grassland community growth, which has few forage legume species for building a quality forage resource. The edaphic heterogeneity determinates an herbage species community mosaic, including typical characters of highlands, medium lands, non saline and saline – alkaline lowlands (communities A, B, C and D, respectively; León, 1975). This natural design acts like a very strong environmental filter for growth and development of both exotic and native forage species, limiting pasture sowing and consequently, beef production is hardly affected. *Lotus tenuis* is a forage legume which has been successfully widespread along Flooding Pampas. This species is exotic and has high capability to tolerate environmental stresses like alkalinity and saline conditions (Montes, 1986; Stofella *et al.*, 1998). The goal of this work was to estimate adaptability and productive stability for three cultivars of *L. tenuis* in actual beef cattle systems of the Flooding Pampas. This study was carried out on two ranches: one located to 20 km away from Labardén (36° 57' OS ; 58° 6' OW), Gral. Guido and other located to 15 km away from Chascomús (35° 34' OS 58° 01' W), from April 2006 to May 2008. The experimental site chosen at each ranch consisted on a ca. 1 Ha plot, with high degree of environmental heterogeneity (topographic, pH, phosphorus and organic matter gradients, table 1). Cultivars Chajá (**Ch**), Esmeralda (**Es**) and Pampa INTA (**Pm**) were used. The sowing was performed by a intertill seed drill on April 2006, using 40 cm inter-row spacing and a seed rate of 6 kg ha⁻¹, establishing a two years X two sites (macro-environments) X three cultivars X four replicates X three sub plots (micro - environments) design along the environmental gradient defined by ranges of pH, electric conductivity (EC), phosphorus, organic matter and nitrates (Table 1). The experimental unit consisted on a six rows width X 100 m long plot, from which three 1 m² sub-samples of aerial green matter were taken (clipping with hand-scissors, leaving a 3 cm - high remnant herbage) on December and May in order to estimate cool and warm season production of

Dry Matter, respectively. After every sampling a ‘cleaning’ cut was applied using high cattle rates. The samples were fractioned in Lotus (L), Grasses (G) and Dicots (D), then dried at 60°C at stove and finally, weighted in analytic scale. Data were analyzed by R statistic software, using the model, $Y_{ij} = \mu_1 + \beta_1 I_j + \delta_{ij}$, which defines stability parameters that may be used to describe the performance of a cultivar over a series of environments. Y_{ij} is the cultivar mean of the i^{th} cultivar at the j^{th} environment, μ_1 is the i^{th} cultivar mean over all environments, β_1 is the regression coefficient that measures the response of the i^{th} cultivar to varying environments, δ_{ij} is the deviation from regression of the i^{th} variety at the j^{th} environment, and I_j is the environmental index. (Eberhart and Russell, 1966). Indexes of both adaptability and stability are defined as follows : $\beta_1 = 1$, cultivar adapted to widest range of environments; $\beta_1 < 1$, cultivar adapted only to low aerial primary productivity environments; $\beta_1 > 1$ cultivar adapted only to high aerial primary productivity environments; $d^2=0$, maximum stability; $d^2 > 0$, low to high stability, where d^2 is the estimate of the variance. Average Dry Matter production of *L. tenuis* for each season, standard error, adaptability and stability estimates are showed (Table 2). Average percentage of *L. tenuis* dry matter in samples was over 25,9 % and 11,1 % on first and second year of study, respectively. Significant interactions ($p < 0.05$) between years, sites and micro environments were found for dry matter production and 12 environmental index were made up taking into account this information.

Table 1. Ranges of pH, EC (electric conductivity), P (phosphorus), OM (organic matter), NO₃ (nitrates) from each site.

Variable	Range
pH	9,02 - 9,61
EC (mmohs)	2,48-3,08
P (ppm)	7,23-10,98
OM (%)	3,05-4,44
NO ₃ (ppm)	3,78-4,33

Table 2. Average dry matter production of *L. tenuis* ± standard error related to growing season and cultivar. Average crossing years and sites. b: regression coefficient estimate. d^2 : variance of regression estimate. *: Significant regression at 5 %. 1: regression using 6 environmental indexes.

Season	Cultivar	Forage Production of <i>L. tenuis</i> (Kg DM/Ha)	β_1	d^2
Cool (Winter – Spring)	Ch	241.6 ± 20.4	0.94 *	18.9
	Es1	326.9 ± 25.4	1.45 *	20.54
	Pm	286.7 ± 15.4	0.94 *	7.38
Warm (Summer – Fall)	Ch	192.5 ± 37.1	0.81 *	37.43
	Es1	433.6 ± 57.4	1.43 *	32.14
	Pm	210 ± 35.7	1.01 *	3.12

Our results suggest that selected cultivars have distinctive attributes: *L. tenuis* cv. Chajá produces more aerial dry matter on winter – spring than does on summer - fall and is better adapted to low productivity environments but has also low stability. *L. tenuis* cv Esmeralda has got its maximum dry matter production on warm season and is better adapted to high productivity environments but with lowest stability on winter-spring. *L. tenuis* Pampa INTA has a higher production of aerial dry matter during winter-spring, being much more plastic and stable than other cultivars.

References

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