

Research on Lotus spp. in Rio Grande do Sul, Southern Brazil.

Nilton R. Paim - Departamento de Plantas Forrageiras e Agrometeorologia - Faculdade de Agronomia da UFRGS. Caixa Postal, 776.  
90001 Porto Alegre, RS - Brasil

Species of Lotus were introduced in Southern Brazil in 1940's. A breeding program with Lotus corniculatus L. was started in 1955 at the Experimental Station of São Gabriel of the Secretary of Agriculture of the State of Rio Grande do Sul. The program started using 500 selected plants from an old stand grown at the Experimental Station, considering vegetative vigor, late flowering and adapted to grazing and cutting. These 500 plants were cloned and evaluated. From 1955 to 1965 plants were selected, polycrossed in a nursery and the progenies tested. The best clones were used to compose a synthetic variety. This variety was denominated "São Gabriel". It is a bunch type variety with early growth, fast establishment, and high forage production, with similarity to European types of birdsfoot trefoil. (POLI & CARMONA, 1966).

Since the release of this cultivar the use of birdsfoot trefoil in association with white clover (Trifolium repens L.) and ryegrass (Lolium multiflorum Lam.) was greatly increased. It is difficult to know exactly the area of natural grassland improved or cultivated with this variety in the State of Rio Grande do Sul, but it is estimated to be not less than 100.000 ha. The São Gabriel cultivar is an important forage legume in other southern states, as well in Uruguay and Argentina.

The São Gabriel cultivar was tested in northern Alabama (USA), by HOVELAND et al. (1982) as a pure stand, and produced over 6,500 Kg.ha<sup>-1</sup> in the fourth year after establishment. In contrast, red clover (Trifolium pratense L.) yielded over 5,600 Kg.ha<sup>-1</sup> the third year, but complete stand losses occurred by the fourth year. (BURNS, 1984).

Several researches have been done with this cultivar since it was released, mainly on mixtures, with grasses fertilization, management and comparisons with other birdsfoot trefoil cultivars.

In a comparison between cvs. São Gabriel, French, Ecotype of Kentucky, Dawn and Empire, in the year of establishment, cv. São Gabriel

because of its higher growth rate permitted three harvests compared to the others with only two harvests. The total dry matter yields obtained were: 5,735, 3,620, 2,966, 2,770 and 2,659  $\text{kg}\cdot\text{ha}^{-1}$ , for cvs. São Gabriel, Franch, Ecotipe of Kentucky, Rawn and Empire, respectively. (PAIM et al. 1973).

A study of management with cultivar São Gabriel, under greenhouse conditions, with cut at three growth stages (vegetative, pre-inflorescence emergence and flowering) and two stubble heights (3 and 6 cm), was conducted by ARAUJO & JACQUES, (1974a and b). Dry matter yields increased as the growth stage advanced from vegetative to flowering. The tall stubble (6cm) resulted in higher dry matter yields than the short stubble (3 cm) for plants that had more than one cut (vegetative and inflorescence emergence); the opposite occurred with plants harvested just one time at flowering. However, the residual cutting of the plants harvested at flowering growth stage produced higher yields when cut at 6 cm stubble as compared with a short stubble (3 cm).

The number of axillary buds and crown tillers was higher with the tall stubble and there was a positive correlation between these morphological characteristics and dry matter accumulation. They concluded that clipping at an advanced growth stages resulted in higher dry matter yields of São Gabriel birdsfoot trefoil and that there was a tendency for higher dry matter accumulation with a 6 cm height of cutting as compared with 3 cm stubble, height. It was also concluded that a tall stubble preserved a greater amount of plants parts involved with the regrowth of cv. São Gabriel (axillary buds, crown tillers, and axillary tillers), influencing the vigor of regrowth and dry matter yields. São Gabriel birdsfoot trefoil showed a continuous growth of crown tillers, a different behavior as compared to others cultivars in others environments. It was also observed a positive correlation between total available carbohydrate (TAC) and total nitrogen stored in the roots and stem bases, and the vigor of regrowth and dry matter yields of São Gabriel birdsfoot trefoil. The roots were the main storage organ of TAC and total nitrogen. The São Gabriel showed an evident fluctuation of TAC reserves, which clearly indicates a cyclic trend of accumulation and utilization of carbohydrates reserves.

A field trial to study improvement techniques of natural grassland by liming (0 to 4 t/ha), fertilization and establishment of mixtures

of grasses, white clover and São Gabriel birdsfoot trefoil was conducted by LOBATO & BARREATO (1973). They observed an increase in legumes production, forage protein content and protein yield, and a decreasing yields of native pastures and weeds, as the amount of lime increased, in the first year. At the second year white clover was the dominant species, representing 60% of the total dry matter produced when 2 and 4 mt of lime were applied. At lower liming levels birdsfoot trefoil produced about 20% of the total dry matter (OLIVEIRA & BARRETO, 1976).

An another experiment conducted by MOOJEN & SAIBRO (1981) testing several mixtures of cool-season annual forage grasses and legumes and São Gabriel birdsfoot trefoil, submitted to two cuttings regimes, four and six-week intervals they, observed that São Gabriel birdsfoot trefoil benefited notably from the six-week cutting interval, in terms of dry matter, digestible dry matter and crude protein yields.

A grazing trial with pastures mixtures including one with italian ryegrass, white clover cv. Yi and birdsfoot trefoil cv. São Gabriel, concerning average daily liveweight gain, liveweight gain per hectare, changes in the botanical composition, crude protein content and in vitro organic matter digestibility was conducted by QUADROS & MARASCHIN (1987). The italian ryegrass + white clover + birdsfoot trefoil mixture promoted daily liveweight gain of 1,018 Kg and 531 Kg of liveweight gain per hectare, in a period of 146 days, with a grazing pressure of 6% (B.W.). The crude protein content and in vitro organic matter digestibility, were high enough to justify the above average animal performance.

The São Gabriel birdsfoot trefoil produces reasonable amounts of seed, easily harvested with a combine machine. An experiment conducted by ACEVEDO et al. (1979), during three years, combining grazing and deferments periods for seed production permitted the following conclusions: the seeding rates (4, 8, 12, 16 and 20 Kg.ha<sup>-1</sup> of seeds) had no effect on seed production, but the deferment by the end of october produced 164,8 Kg.ha<sup>-1</sup> of seed and was the best period for closing the pasture for seed production. Without grazing produced 99,0 Kg.ha<sup>-1</sup>, deferment of end of setember 66,3, end of august 63,6, and of the end of november 33,8 Kg.ha<sup>-1</sup> of seed.

The main weakness of São Gabriel birdsfoot trefoil is the lack of persistence under severe grazing. It will not produce and persist unless an adequate stubble height and enough axillary buds and tillers

for regrowth are maintained. So the breeding efforts are to maintain the characteristics of early growth, high forage production with good quality and seed production of São Gabriel, and select for a viney type of plants with more persistence. Trying to get information in this direction a research was done by CAROSO et al. (1981) comparing progenies of twenty two maternal line selections with one line selected in Alabama from São Gabriel, AT-1 and six american cultivars: Carroll, Dawn, Ecotipe of Kentucky, Missouri - 20, Vega II and Virginia - 10. These material were evaluated for yield, quality and persistence traits in a period from march of 1978 to may of 1979. The following parameters were evaluated: average initial and final number of plants/m, mean percentage of the reduction in number of plants, mean height growth rate of plants, in cm/week, average total dry matter yield in g/m of row, mean percentage of crude protein and mean percentage of in vitro digestibility of dry matter. The analysis of variance showed statistical significance ( $P < 0.05$ ) for all parameters evaluated. Some significant correlations were found between pairs of observations. The analysis of covariance showed a negative and non-significant regression coefficient ( $b = -0.24$ ), ( $P > 0.05$ ), between initial number of plants and total dry matter yield. The lines of São Gabriel produced more forage dry matter than the american cultivars. The american cultivars showed higher values of crude protein content and in vitro dry matter digestibility than the São Gabriel lines. The percentage of reduction in number of plants was higher in the São Gabriel lines than in the american cultivars.

In the state of Rio Grande do Sul there are approximately 300.000 ha of flat land, poorly-drained soil some of it used under a rotation system of paddy rice and grazing of the pastures that reestablishes after the rice's harvested. Concerning this area some research with Lotus uliginosus Schkuhr. was started in the southern states. From a diploid population were selected forty-two clones that were polycrossed in a nursery and evaluated for different morphological, physiological, quantitative, qualitative and phenological characteres. (CAROSO et al. (1982). The progenies were tested in association with annual ryegrass (Lolium multiflorum Lam. and with individual lines in comparison with cv. Maku (tetraploid from New Zealand). The diploid progenies were sensible to ryegrass competition and the establishment was unsatisfactory. In the second year, during a dry period, the plants died and could not

be adequately evaluated. In another trial cv. Maku differed significantly ( $P < 0.05$ ) in the initial number of plant/m in relation to the progenies. In relation to height growth rate in cm/week and mean height of plant in cm, cv. Maku differed significantly ( $P < 0.05$ ) from all the progenies; being the highest. The mean total dry matter yield results in  $\text{Kg. ha}^{-1}$  and flowering in days after seeding, were significantly different for the treatments (Duncan  $P < 0.05$ ). Cv. Malu was the latest of all to flower and produced a similar amount of dry matter compared to the best of the diploid progenies (MONTEIRO & PAIM, 1982).

In a nother research two hundred plants of Lotus corniculatus and two hundred of Lotus uliginosus Schkuhr. (from Cv. Maku selected for early flowering) were studied for average height growth rate (GRH), diameter (GRD) and perimeter (GRP), dry matter production (DM), seed production (SP) and flowering initiation (FI). The method of plant choice was the stratified mass selection. Three procedures were used for selection: the first, the empiric choice of plants based on data, second, the utilization of a selection index computed by the multiplication of  $\text{DM} \times \text{SP}/\text{FI}$ , third, was by a selection index too. A balance of data was made using the main variance components to GRH, GRD, GRP and DM. Then the index was computed by multiplication of  $(\text{GRH}_b + \text{GRD}_b + \text{GRP}_b + \text{DM}_b) \times \text{SP}/\text{FI}$ . The selected plants were evaluated relative (Progeny test) to dry matter production, flowering initiation, initial number of plants, final number of plants, height of plants at the first cutting, crude protein content and in vitro dry matter digestibility. The results showed that the plants choice based in selection index permitted a better discrimination among similar plants. The progenies of L. corniculatus and L. uliginosus presented variability for a majority of the estimated characteristics. The two procedures using a selection index for choice of plants were similar in results, since the same plants were selected by them. (OLIVEIRA, 1987).

#### References

- ARAUJO, J.C. de & JACQUES, A.V.A. 1974a. Influência do estágio de crescimento e da altura de corte sobre as reservas de glicídios e nitrogênio total de cornichão (Lotus corniculatus L.) Rev. Soc. Bras. Zoot. 3(2):123-137.

- ARAUJO, J.C. de & JACQUES, A.V.A. 1974b. Características morfológicas e produção de matéria seca de cornichão (Lotus corniculatus L.) colhido em diferentes estádios de crescimento e a duas alturas de corte. Rev. Soc. Bras. Zoot. 3(2):138-147.
- ACEVEDO, A.S.; OLIVEIRA, O.L.P. de & MACEDO, W. dos S.L. 1979. Efeito da densidade de semeadura e da época de diferimento da pastagem na produção de sementes de cornichão (Lotus corniculatus L.) cv. São Gabriel. Anais da XVI Reunião Anual da S.B.Z., Curitiba, 15 a 19 de julho, 1979. p. 244.
- CAROSO, G.F.; PAIM, N.R. & PRATES, E.R. 1981. Avaliação da produção e persistência de progênies e cultivares de Lotus corniculatus L. Pesq. Agropec. Bras., Brasília, 16(3):341-346.
- CAROSO, G.F., PAIM, N.R. & MARKUS, R. 1982. Avaliação de clones de Lotus corniculatus Schkuhr., em blocos de policruzamentos. Pesq. Agropec. Bras., Brasília, 17(4):617-622.
- HOVELAND, C.S., HOALAND, R.L., HARRIS, R.R. & MCGUIRE, J.A. 1982. Birdsfoot trefoil in Alabama. Auburn Agric. Exp. Stn. Bull. 537. Cited by BURNS, J.C. 1984. Environmental and management of legumes based forage systems in the Southern United States. Proceedings of a Trilateral Workshop Held in Palmerston North, New Zealand, April 30 - May 4, 1984. p.129-137.
- LOBATO, J.F.P. & BARRETO, I.L. 1973. Comportamento de consorciações de gramíneas temperadas com leguminosas quando implantadas em pastagem natural submetida a preparo superficial do solo, sob o efeito de quatro doses de calcário e dois métodos de semeadura. Rev. Soc. Bras. Zoot. 2(2):131-149.
- MONTEIRO, I.D. & PAIM, N.R. 1982. Teste de progênies de policruzamento de Lotus corniculatus. I. Em mistura com azevém anual. II. Em linhas individuais e com a cultivar Maku. Pesq. Agropec. Bras., Brasília, 17(10):1483-1489.
- MOOJEN, E.L. & SAIBRO, J.C. 1981. Efeito de regimes de corte sobre o rendimento e qualidade de misturas forrageiras de estação fria. Pesq. Agropec. Bras., Brasília, 16(1):101-190.
- OLIVEIRA, J.C.P. 1987. Avaliação de plantas e progênies de Lotus corniculatus L. e Lotus uliginosus Schkuhr., Porto Alegre, UFRGS. Faculdade de Agronomia. 1987. 106 p. Tese de Mestrado.
- OLIVEIRA, O.L.P. de & BARRETO, I.L. 1976. Efeito de calcário e método de semeadura no comportamento de espécies forrageiras temperadas no melhoramento de pastagem natural. Pesq. Agropec. Bras., Ser. Zootec. 11:49-56.
- PAIM, N.R., BARRETO, I.L. & JACQUES, A.V.A. 1973. Avaliação de espécies e cultivares do gênero Lotus. Anais da X Reunião Anual da SBZ, Porto Alegre, RS, 16 a 20, julho, 1973. p. 306-307.

- POLI, J.L.E.H. & CARMONA, P.S. 1966. Sinopse dos ensaios da Estação Experimental de Forrageiras de São Gabriel de 1941 a 1965. Porto Alegre, Secretaria da Agricultura, Estado do Rio Grande do Sul. 212 p. (Boitem Técnico, 5).
- QUADROS, F.L.F. de & MARASCHIN, G.E. 1987. Desempenho animal em misturas de espécies forrageiras de estação fria. *Pesq. Agropec. Bras.*, Brasília, 22(5):535-541.