BREEDING FOR PERSISTENCE IN LOTUS CORNICULATUS

M. Rebuffo and N. Altier[1]
[1]INIA La Estanzuela, 70000 Colonia, Uruguay

ABSTRACT
The objectives of this study were to develop a more persistent germplasm of birdsfoot trefoil (*Lotus corniculatus* L.) and to evaluate its potential use in Uruguay. Two cycles of phenotypic recurrent selection were done under field conditions. Eight hundred and 1600 spaced plants were established for the first and second cycle of selection. Both nurseries were visually assessed for crown rot, relative growth, plant habit and foliar diseases. The final selection of the breeding population LE 65-56 includes thirty six plants selected from sixteen elite families. This selection was more persistent and productive than the check varieties in plot evaluation. On average, LE 65-56 produced 12%, 16% and 114% more forage than cv. San Gabriel in the first, second and third year, respectively. Selecting for crown health and relative growth in the spaced plant nurseries increased persistence and forage yields in plots under cut.

KEYWORDS
Birdsfoot trefoil, persistence, crown rot, breeding

INTRODUCTION

Birdsfoot trefoil is the most widely used legume in sown pastures in Uruguay, being cv. San Gabriel the prevalent variety. Pastures based on it do not persist longer than three years. Reduction of stand density, the presence of wilted plants, and the failure of them to regrow after grazing in the second and third year are often the most visible symptoms of its lack of persistence.

Many abiotic and biotic factors, such as drought, nutrient deficiency, pests and diseases, affect persistence. Studies carried out by Altier (1994) and Chao et al. (1994) in diverse regions of Uruguay indicated that crown and root diseases have a marked incidence in the establishment, plant vigour and survival of birdsfoot trefoil. Fungi associated with the crown and root rot complex included were species of *Fusarium*, *Colletotrichum*, and *Rhizoctonia*. Henson (1962) suggested that genetic progress could be made in resistance to root diseases. Actually, Dawn is the only cultivar reported in the literature which was specifically bred for resistance to root rot (Beuselinck, 1994).

The objectives of this research were to develop a more persistent germplasm of birdsfoot trefoil and to evaluate its potential use in Uruguay.

METHODS

Breeding programme. Beginning in 1988, two cycles of phenotypic recurrent selection were undertaken under field conditions. Spaced plants were planted to a 1 m grid at La Estanzuela Research Station. In the first cycle, a total of 800 spaced plants of cultivars San Gabriel and Ganador, and a local ecotype were established. Plants were visually scored for crown rot severity, relative growth and growth habit. Crown rot severity was assessed on a four-class scale based on proportion of crown dead: 1 = 0-20%, 2 = 30-40%, 3 = 50-60%, 4 = 70-100%. Notes on foliar diseases and flowering time were also taken. In the second year, 45 elite plants from cv. Ganador and the local ecotype were selected using a multiple selection index.

For the second cycle of selection, 1600 spaced plants of 45 families and cv. San Gabriel (check variety) were grown in 1990. In the second year (1991), 16 families had significantly better persistence, growth, and tolerance to foliar diseases than cv. San Gabriel. The selection of the population LE 65-56 was based on 36 elite plants from those 16 best families, which were polycrossed for seed production.

Evaluation. The selected population LE 65-56 was compared with check varieties San Gabriel and Ganador in five experiments at La Estanzuela Research Station, on consecutive years. The experimental design was a randomized complete block with 4 replicated plots of 1.2 x 5 m. Birdsfoot trefoil was sown as pure species at 12 kg/ha in autumn. On average, the experiments were cut 4 times a year, leaving a stubble of 5 cm and avoiding reseeding. The percentage of weeds was determined by visual estimation. Visual ground-cover estimates were made at the fourth year to assess density and as an index of persistence. Adjusted means for the first, second and third year as well as total cumulative yield were obtained using Proc Mixed (REML) of SAS.

RESULTS

Breeding programme. There was an important reduction in the plant survival in both nurseries. In the first nursery the selection was done in the second year, and all plants were dead by the end of the third year. Species of *Fusarium*, *Colletotrichum* and *Rhizoctonia* appeared to be the primary causes of crown and root rot.

In the second cycle of selection, the elite families had always fewer plants showing severe crown rot (class 4) and larger proportion of plants with apparently healthy crowns (class 1) than cv. San Gabriel (Figure 1). By the end of third year, cv. San Gabriel had only 9% in class 1 and 88% of plants in class 4. On the other hand, the elite families had 34% of plants in class 1 and 49% in class 4.

The selected population is similar in type to San Gabriel, with more prostrate habit, higher growth scores and always denser stems. Elite plants had good seed production and were tolerant to foliar diseases under field conditions.

Evaluation. Dry matter (DM) yields for LE 65-56 and check varieties are presented in Table 1. The yields of San Gabriel and Ganador were similar in the first two years, declining sharply thereafter due to the loss of most of the plants. LE 65-56 was the most productive entry during the first three years of evaluation. It produced 3.64 and 4.32 t DM/ha more than San Gabriel and Ganador, respectively. In the fourth year, the estimated ground cover of San Gabriel was 40%, and for LE 65-56 83%. The latter differs from the check varieties in being semi-prostrate and having a larger crown. These characters help it to withstand defoliation and attain a better ground cover.

DISCUSSION

The spaced plant evaluation carried out over three years in each cycle of recurrent selection was effective to discriminate families for persistence. LE 65-56 shows good herbage production and persistence under cutting, compared with the check varieties. The repeatability of persistence in the evaluation plots further demonstrates the value of the procedure. However, breeding under field conditions did not discriminate for individual stresses. The importance of tolerance to crown and root rotting organisms such as *Fusarium*, *Colletotrichum* and *Rhizoctonia* in birdsfoot trefoil has been demonstrated previously (Henson, 1962). In the future, the development of cultivars with increased levels of resistance to crown and root rot would enhance

herbage production and persistence. To achieve this goal, the immediate research priorities focus on the development of standard methods for identifying and breeding resistances to specific birdsfoot trefoil diseases, which in turn should improve the efficiency of selection procedures.

REFERENCES

Altier, N. 1988. Current status of research on *Lotus* diseases in Uruguay. In International Lotus Symposium. (1., 1994, St. Louis, Mo. EE.UU.). Ed. P.R. Beuselink; C.A. Roberts. Proceedings. Columbia, University of Missouri. p. 203-205.

Beuselinck, P.R. 1994. Registration of 'Dawn' birdsfoot trefoil. Crop Sci. **34**: 540.

Chao, L., J. De Battista and F. Santiñaque. 1994. Incidence of birdsfoot trefoil crown and root rot in west Uruguay and Entre Ríos (Argentina). In International Lotus Symposium. (1., 1994, St. Louis, Mo. EE.UU.). Ed. P.R. Beuselink; C.A. Roberts. Proceedings. Columbia, University of Missouri. p. 206-208.

Henson, P.R. 1962. Breeding for resistance to crown and root rots in birdsfoot trefoil, *Lotus corniculatus* L. Crop Sci. **2**: 429-432.

Table 1
Adjusted mean dry matter yields (t/ha).

Varieties	Year 1	Year 2	Year 3	Total
San Gabriel	5.16	7.04	2.82	14.98
Ganador	4.56	6.90	2.92	14.30
LE 65-56	5.78	8.16	4.72	18.62
l.s.d. (P=5%)	1.06	1.08	1.30	3.00

Figure 1
Comparison of persistence between elite families of the second cycle of selection and check variety San Gabriel, as determined by frequency distribution of plants among four crown rot classes in the second and third year (December 1991 and 1992). Rating scale based on the proportion of dead crown.