Lotus Newsletter (1989). Volume 20, 15-19

THE POTENTIAL OF *Lotus corniculatus* FOR U.K. AGRICULTURE

M.J. BULLARD AND T.J. CRAWFORD

Department of Biology, University of York, Heslington, York YO1 5DD, U.K.

INTRODUCTION

Previous studies with *L. corniculatus* have produced conflicting results concerning the suitability of this plant for U.K. agriculture (e.g. Davies, 1969; Charlton, 1973). Consequently it is not at present utilised commercially to any great extent, although some cultivars are available (e.g. Empire and Leo). For example approximately 200 - 500 Kg of seed is supplied each year, principally to horticulturalists (G.S. Taylor, pers.comm.).

Recently, however, a number of 'alien' forms of *L. corniculatus* have been reported growing in the U.K., West Germany, Denmark and Holland (Bonnemaison and Jones, 1986; D.A. Jones, pers.comm.) that exhibit different growth characteristics, and are potentially better adapted to local conditions than are the cultivars that are presently available. The origin of the aliens is not known, but it is probable that they were introduced to North Western Europe in undefined seed mixtures. In addition native Norwegian plants have been found (Jones, 1988) that appear to exhibit some interesting traits, such as a tolerance to saline conditions.

The general aim of this D. Phil. project is to assess the agricultural potential of *L. corniculatus* in U.K. conditions, with the view of eventually introducing a 'suitable' type into the U.K. agriculture. The work will involve investigations into the growth and yield characteristics of the plant material available, and some 'traditional' plant breeding work (using keel colour as a genetic marker).

PRELIMINARY RESULTS

A large-scale, long-term field assessment was set up in April 1989 in order to compare dry matter production (DMP) and growth habits of fourteen accessions of *L. corniculatus*, and also to measure the degree of variability within those types. White and Red clover (*Trifolium pratense* and *T. repens*) were also included so that a comparison could be made between the potential forage species and two species that are already in use.

The experiment was conducted at two sites. The sites were chosen to represent two environmental extremes in which *L. corniculatus* might be grown. The 'Askham' plot represented good quality agricultural land whilst the 'Tree Nursery' was flooded for a long time in the winter, baked dry in the summer, and completely overgrown with weeds at the initiation of the work. The two sites were approximately 2m X 10m in dimension.

The fourteen bird's-foot trefoil accessions and two clovers were planted as spaced plants and randomised conforming to a balanced lattice square design. The following plant types were used:

CODE	TYPE	ORIGIN
BP1	alien	Bolton Percy, Yorks
BP2	alien	Bolton Percy, Yorks
EA	alien	Etton
NO	native	Nottinghamshire
NF	native	Norfolk
FP	native	Flamborough, Yorks
SQ	native	Smaws Quarry, Yorks
NG	native	Nigardelen, Norway
GN	native	Gaupne, Norway
OD	cv. Odenwalder	Germany
LE	cv. Leo	U.S.A.
EM	cv. Empire	U.S.A.
UN	cv. of unknown origin	
FR	cv. Franco	Italy
RC	red clover cv. Granta	
WC	white clover cv. Huia	

Three harvests were taken during the 1989 growing season. A day before the first two harvests, measuements of growth habit were taken (data not presented).

At each harvest, plants were cut to 5cm. At the first cut in June many of the plants had come into flower but none had set seed. At the second and third cuts, in August and October respectively, many plants had set seed, but no evidence of pod dehiscence was found. Cut plant material was placed in an over at 70C for 48 hours and the dry weights recorded.

Yield results for the 1989 season are presented in tables 1 and 2. Initial analysis indicated that yields at the Askham site were significantly higher than those at the Nursery. Data for the two sites were therefore further analysed independently.

That all accessions performed better at the Askham site is not a surprise - the site was chosen so that the plants would give an indication of their maximum potential yield. At this site the seasonal total for Huia white clover was far higher ($P<0.05$) than that of any other accession. However, the cultivars Empire, Franco and 'unknown' did not yield significantly less than Granta red clover.

Of potentially greater importance was the performance of the plants at the Nursery. Of the two sites this represented land on which L. corniculatus is more likely to be grown. These results were very encouraging. The cultivars Leo, Empire and Franco were not inferior to either clover, suggesting that low yield may not preclude the use of L. corniculatus in U.K. agriculture. The usefulness of these plants does, however, very much depend on their ability to survive a U.K. winter, and no firm conclusions can be made until next spring. It is likely that cultivars of southerly lattitude, such as Franco, will not fair too well. Also it must be remembered that the plants were grown singly, and their behaviour may be very different when grown in a sward.

At both sites the alien plants significantly outyielded most native accessions, and achieved similar yields to many of the cultivars. Thus they may useful aquisitions to the breeding programme.

Characteristics other than vegetative production are of importance in the selection of a suitable forage plant. A desirable variety will ideally not only grow well but will produce a large amount of seed at a predictable time.
A problem encountered with many cultivars of L.corniculatus is seed indeterminancy, i.e. the inability to set all seed at the same time (Seaney & Henson, 1970). This reduces the harvestable yield of the crop and thus reduces its value. Pod dehiscence compounds the problems of indeterminancy, and has been cited as the main reason that has limited the widespread adoption of L. corniculatus as a forage crop (Williams, 1988). Other work in progress at the moment includes a detailed assessment of the seed yielding characteistics of eighteen accessions.

Some crosses between the Norwegian accessions and the U.K. aliens have been conducted using keel colour as a genetic marker. A light-keeled (recessive) plant was surrounded by dark-keeled (dominant homo- or heterozygote) plants. Seed were removed from the central, maternal plant, and the progeny grown. Dark-keeled progeny will be the result of cross-fertilisation. These will be studied to assess the degree to which characteristics of agronomic importance may be incorporated into the plants (see Ramnani, 1979).

We anticipate that further work will involve mixed and pure sward assessments of the most promising accessions, a continuation of the work already in progress, and an investigation into the nutritive qualities of the accessions grown in U.K. conditions.

Whilst conducting this work we are collecting as many types of L. corniculatus as possible, and would be grateful to receive any seed fellow workers may think useful. In addition, comments and critiscisms of our work are welcome

ACKNOWLEDGEMENT
This D. Phil. research project is funded by the Ministry of Agriculture, Fisheries and Food, U.K.

REFERENCES

BONNEMAISON, F. & JONES, D.A. (1986). Variation in alien *Lotus corniculatus* L. 1. Morphological differences between alien and native British plants. Heredity, **56**, 129-138.

CHARLETON, J.F.L. (1973). The potential value of birdsfoot trefoils (*Lotus* spp.) for the improvement of natural pastures in Scotland. I. Common birdsfoot trefoil (*L. corniculatus* L.). J. British Grassld. Soc. **28**, 91-96.

DAVIES, W.E. (1969). The potential for *Lotus* ssp. for hill land in Wales. J. Br. Grassld. Soc. **24**, 264-270.

RAMNANI, A.D. & JONES, D.A. (1984). Inheritance of the brown keel tip character in Lotus corniculatus L. Bangladesh J. Bot. **13**, 52-59.

SEANEY, R.R. & HENSON, P.R. (1970). Birdsfoot trefoil. Adv. Agron. **22**, 119-157.

WILLIAMS, G.H. (1988). L'interet des lotiers: un possible renouveau (revue bibliographique). Fourrages. **116**, 329-345.

TABLE 1

DRY MATTER PRODUCTION (DMP) (g) OF FOURTEEN ACCESSIONS OF BROAD-LEAF BIRD'S-FOOT TREFOIL, RED AND WHITE CLOVER AT THE TREE NURSERY SITE

CODE	1ST CUT	2ND CUT	3RD CUT	TOTAL
BP1	2.7	9.7	6.7	19.1
BP2	2.9	7.4	3.7	14.4
EA	1.8	8.9	9.1	19.8
NO	0.9	6.5	1.7	9.1
NF	1.3	8.9	2.8	12.9
FP	0.9	6.2	3.8	10.9
SQ	1.0	6.4	3.2	10.8
NG	0.8	6.2	0.7	7.7
GN	0.2	4.2	0.4	4.8
OD	2.3	8.5	4.6	15.4
LE	3.5	12.3	10.2	26.1
EM	2.3	12.5	12.4	27.2
UN	3.1	10.2	6.2	19.5
FR	2.7	12.8	13.1	28.5
RC	5.2	17.4	7.4	30.0
WC	2.2	17.8	13.3	33.3
5% LSD	0.9	4.8	N.S.	11.3

TABLE 2

DRY MATTER PRODUCTION (DMP) (g) OF FOURTEEN ACCESSIONS OF BROAD-LEAF BIRD'S-FOOT TREFOIL, RED AND WHITE CLOVER AT THE ASKHAM BRYAN SITE

CODE	1ST CUT	2ND CUT	3RD CUT	TOTAL
BP1	9.7	56.2	89.7	155.7
BP2	8.2	52.2	82.1	142.5
EA	4.1	37.8	72.8	114.7
NO	3.2	46.5	36.9	86.6
NF	4.8	39.7	58.7	103.2
FP	4.0	41.0	55.3	100.4
SQ	5.6	37.8	48.1	91.5
NG	2.5	39.0	4.3	45.8
GN	1.7	34.9	6.2	42.8
OD	7.4	48.7	83.4	139.5
LE	7.6	52.1	75.8	135.4
EM	6.2	61.8	92.9	161.0
UN	11.3	51.4	109.4	172.0
FR	5.3	55.8	101.4	162.5
RC	15.0	76.1	111.3	202.4
WC	11.0	88.5	249.3	348.8
5% LSD	2.8	12.0	35.2	43.3