FURTHER DEVELOPMENTS WITH *LOTUS* SCREENING IN THE U.K.

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Introduction

The initial objectives in assembling a small collection of *Lotus* species and varieties at North Wyke Research Station, Devon and commencing to screen them on an acid (pH 5.4), low-phosphate status (P<10 ppm) site were described in *Lotus Newsletter 1991*, pages 37-39. When planning low-input, sustainable grassland systems, white-clover based technology may provide a solution on the better soil types, though it is increasingly evident that regular inputs of lime and phosphate will be needed, particularly under high rainfall conditions. In such circumstances, as well as on all poorer soils, *Lotus* species may provide a better option.

The programme of *Lotus* assessment at North Wyke will be developed to include investigation of productivity and persistence under grazing. However, before attempting the grazing experiment, a small-plot experiment to investigate the influence of four possible companion grasses on *Lotus* performance was planned and sown in 1991. This article reports some quality determinations on material from the screening trial in 1991, together with the 1992 yield data. In addition, yield data from the first cut of the companion grass experiment are reported.

As mentioned in the earlier Newsletter report, North Wyke Research Station is situated in S.W. England and has a mild maritime climate. Mean air temperature in January is 4.5°C and in July 15.3°C. Average rainfall is 1035 mm, with approximately 200 rain days. The soil is a poorly drained, seasonally water-logged silty clay loam (pelostagnogley).

Initial Screening Trial - 1991 Quality Data

The establishment of this trial and the 1991 yields were reported in the *Lotus Newsletter 1991*, 37-39. *Lotus* samples from Cut 2 (31 August 1991) for the five best yielding cultivars were analysed for digestibility (predicted from pepsin/cellulase solubility) and N content (acid digestion followed by colorimetric assay). The data appear in Table 1, and show that at this cut (8 weeks regrowth) both of the *L. uliginosus* cvs. and the *L. tenuis* were of lower (P<0.001) digestibility than the two *L. corniculatus* cvs. tested. However, *L. corniculatus* cv. Cascade had the lowest nitrogen concentration (P<0.001).

Table 1. *Lotus* quality data at Cut 2 (31 August), 1991.

Species	Cultivar	DOMD†	N (g kg^{-1})
L. uliginosus	Maku	0.515	39.7
	Marshfield	0.540	36.3
L. corniculatus	Cascade	0.619	29.2
	Norcen	0.656	36.1
L. tenuis	Blenheim	0.536	33.4
	s.e.d. (8 DF)	0.0083	1.34
	Level of significance	***	***

† digestible organic matter fraction in the dry matter.

Initial Screening Trial - 1992 Yield Data

The screening trial was continued in 1992, the third year since sowing in 1989. Growing conditions were dry and sunny for the first part of the 1992 season, though dull and moist from July onwards. Cuts were taken from this experiment on 16 June and 17 September 1992. Fresh herbage yields were recorded on the plot-harvester, and two sub-samples collected. The first sub-sample was dried in a forced-draught oven at 85°C to determine the dry matter (DM) content of the herbage, and the second subsequently sorted to determine the proportion of *Lotus* and grass in the sample. Table 2 shows the comparative yields of *Lotus* DM at Cuts 1 and 2, as well as the annual total yields of combined forage in the same rank order as the 1991 data were displayed.

Table 2. DM yields of *Lotus* species and varieties, 1992 (t ha^{-1}).

Species	Cultivar	*Lotus* DM Cut 1	*Lotus* DM Cut 2	Annual DM Yield *Lotus*	Annual DM Yield Total†
L. uliginosus	Maku	1.64	0.71	2.35	10.79
	Marshfield	0.70	0.63	1.33	8.17
L. corniculatus	Cascade	0.65	0.59	1.24	10.51
	Norcen	0.21	0.36	0.58	9.94
L. tenuis	Blenheim	1.23	0.43	1.66	9.97
L. corniculatus	Empire	0.18	0.43	0.61	9.35
L.c. ssp. *arvensis*	Kalo	0.56	0.67	1.23	9.14
L. corniculatus	GA-1	0.19	0.47	0.66	8.71
	AU-Dewey	0.10	0.36	0.45	9.03
	Fergus	0.22	0.81	1.03	9.34
	s.e.d. (18 df)	0.353	-	0.482	-
	Level of significance	**	NS	*	NS

† includes grass and other plant DM.

With a few exceptions, yields of *Lotus* forage declined since 1991, though with the good grass growing conditions for Cut 2, the total annual yields were above those of 1991, so that the general percentage legume contribution fell to 10-20% of DM. As in 1991, top forage yields came from *L. uliginosus* cv. Maku. There was marked improvement in the ranking of *L. tenuis* cv. Blenheim and *L. corniculatus* ssp. *arvensis* cv. Kalo.

Companion Grass Experiment - 1992

This experiment was sown in July 1991, with the two *Lotus* and the four companion grasses listed in Table 3. Perennial ryegrass (*Lolium perenne*) in UK is generally too competitive and densely tillered to form stable associations with birdsfoot trefoil, so these possible alternative grasses were chosen. The *Lotus* was sown at 10 kg ha^{-1} and the grasses at either 2 or 4 kg ha^{-1}, excepting *Festuca pratensis* which was sown at 3 or 6 kg ha^{-1}. Appropriate quantities of grass and inoculated *Lotus* seed were thoroughly mixed, broadcast on to a harrowed seed-bed and rolled in, using a layout of 3 randomised blocks of plots 1.5 m x 5.0 m, with all factorial combinations of *Lotus* variety, grass species and grass seed-rate. Data from the first cut, taken on 11 June 1992 are shown in Table 3.

Table 3. *Lotus* performance when grown with four companion grasses at two seed-rates. Sown July 1991, cut 11 June 1992.

Comparisons:	*Lotus* DM (t ha^{-1})	Sown grass DM (t ha^{-1})	Legume contribution (%)	Total DM yield (t ha^{-1})
L. corniculatus cv. Leo	3.35	0.90	73.0	4.61
L. uliginosus cv. Maku	1.00	0.98	43.6	2.48
s.e.d. (23 df)	0.127	0.128	2.51	0.216
Phleum pratense cv. S.48	1.64	1.55	42.8	3.53
Agrostis capillaris cv. Muster	2.34	1.44	52.9	3.99
Festuca pratensis cv. Senu	2.26	0.70	57.0	3.71
Poa pratensis cv. Asset	2.48	0.06	80.5	2.96
s.e.d. (11 df)	0.179	0.181	3.55	0.305
High seed-rate (4 or 6 kg ha^{-1})	2.02	1.08	52.7	3.53
Low seed-rate (2 or 3 kg ha^{-1})	2.33	0.80	63.9	3.57
s.e.d. (23 df)	0.127	0.128	2.51	0.216

These data show that, as anticipated, *L. corniculatus* established more rapidly than *L. uliginosus* resulting in higher yields of *Lotus* DM ($P<0.001$) and, because there was no compensatory effect on grass yield, higher overall yields of forage ($P<0.001$) at this first cut. *Phleum pratense* depressed *Lotus* DM yield ($P<0.001$); *Poa pratensis* gave the lowest sown grass yield ($P<0.001$) and overall forage yield ($P<0.05$) but consequently the highest ($P<0.001$) legume contribution to yield. The higher level of companion grass seeding depressed *Lotus* DM yield ($P<0.05$), raised grass DM yield ($P<0.05$), lowered the legume contribution ($P<0.001$), but had no overall effect on total forage yield. It remains to be seen whether *L. uliginosus* will yield more highly when fully established next year, and whether the higher yielding companion grasses and the higher seed-rates will have an adverse effect on the longer term performance of the *Lotus*.

Future Research

The plots of the screening trial will not be harvested after 1992, but it is anticipated that the companion grass experiment will provide valuable information through 1993 and 1994. It is planned to sown the swards for the grazing assessment during 1993, for an experiment to run through 1994 and 1995. Grazing will involve contrasts between sheep and cattle, probably in rotational systems with differing criteria for moving the stock on. Inevitably sward carrying capacity will be low, but properly researched guide-lines for managing grass-*Lotus* associations could provide a valuable alternative to white clover-based technology for marginal land situations.

Any reader who would like to offer comment on the design of the grazing experiment is invited to write (or FAX (+44) 837 82139) to the second author.

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