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PERFORMANCE OF LUCERNE CULTIVARS RESISTANT TO BLUE-GREEN LUCERNE APHID IN NEW ZEALAND

M.W. DUNBIER, W.M. KAIN, and K.B. McSWEENEY

*Crop Research Division, DSIR, Christchurch, Soil and Field
Research Organisation, MAF, Palmerston North and
University of Canterbury, Christchurch*

Summary

Three lucerne (*Medicago sativa*) cultivars ('CUF101', 'UC111' and 'UC112') selected for resistance to *Acyrtosiphon kondoi* in California were tested in glasshouse and field trials in the 1976/7 season. They showed a high level of resistance in glasshouse trials, and field grown plants caused a slower rate of aphid reproduction and had significantly fewer aphids than the standard cultivars ('Wairau', 'Saranac' and 'Washoe'). Dry matter production of resistant and standard cultivars was not significantly different at either Flock House or Lincoln.

INTRODUCTION

The blue-green lucerne aphid (*Acyrtosiphon kondoi*) (subsequently BGLA) was first recorded in New Zealand in late 1975, and by autumn of 1976 had spread through much of the country. A programme to provide BGLA resistant cultivars was initiated in 1976 following similar work in California (Lehman *et al* 1975, Nielson *et al* 1976). This paper reports a preliminary evaluation of the aphid resistance and agronomic performance of BGLA-resistant lucerne selections from California. A local breeding programme has been started also.

MATERIALS AND METHODS

Small quantities of seed of three lucerne cultivars, 'CUF101', 'UC111' and 'UC112' selected for resistance to BGLA were obtained from Dr W.F. Lehman, University of California, Davis. They have been evaluated in glasshouse and field trials over the 1976/7 season. 'CUF101' was derived from 'U.C. Cargo' by selecting plants for field resistance to BGLA (Nielson *et al* 1976), and has recently been released as a commercial cultivar (Lehman, pers comm). 'UC111' is a reselection from 'CUF101' parents, and 'UC112' was reselected from UC102 which, like 'CUF101' was field selected for BGLA-resistance from 'U.C. Cargo'. 'Wairau', 'Saranac' and 'Washoe' were also used in these trials.

GLASSHOUSE TRIALS

Single rows of 25 germinated seeds of 'Wairau', 'Washoe', 'Saranac' and 'CUF101' were planted in each of a series of flats in

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December 1976. The plants were grown under natural light, and the temperature was maintained at c. 22°C. When the cotyledons were fully expanded (4 days after sowing) eight flats were inoculated with about five mixed-age BGLA per plant, and re-inoculated at the same rate one week later. Two flats were uninoculated and aspirated daily to keep them free of aphids. Plant heights were measured 17 days after sowing and the dry weights of the plants (tops) were recorded from one infested and one control flat when the experiment was terminated 30 days after sowing. Apart from the dry weight data the experiment was analysed as a randomised complete block with each flat being a replicate.

To assess colonisation on seedlings mixed-age field populations of alate and apterae were inoculated at two rates onto flats containing one row each of 'Wairau', 'Saranac', 'Washoe', 'CUF101', 'UC111' and 'UC112'. Aphids were collected with an aspirator from 5 randomly chosen plants per row 24 hours after inoculation and counted.

FIELD TRIALS

Field trials comparing six cultivars (Table 3) were established at Lincoln and Flock House. The Lincoln trial had four replicates with plots 1.4 x .91 m and was sown in October. Plots were harvested for dry matter yield twice, and 10 10cm stem tips were taken for aphid counts six times during the autumn. Mean number of aphids per stem was analysed after square root transformation and the Californian lines compared with standard cultivars. Plots were established at Flock House by planting at 20cm centres. Plot sizes were 2 x 4 m and there were four replicates. The plots were harvested for dry matter yield three times. At Flock House 15 stems from different plants of 'Wairau', 'Saranac', 'CUF101' and 'UC112' were sleeved and inoculated with 20 apterous adult BGLA per plant and after 8 days live nymphs were counted.

RESULTS

Glasshouse trials

Comparisons in Table 1 show that in the controls 'CUF101' initially grew faster than the standard cultivars, but when the experiment terminated the dry weights were nearly equivalent. In the flats infested with BGLA there were marked cultivar differences. Within 'CUF101' about 60% of the seedlings appeared completely resistant (cf 52% in Nielson *et al* 1976) and the remainder were severely stunted with almost no elongation above the cotyledonary node. In the standard cultivars infested plants did not grow but produced almost as many leaves as the equivalent control plants. This suggests that stunting was a major symptom of BGLA damage. However a purple or bronze discoloration of cotyledons and leaves of infested seedlings indicates some disturbance of the plants' metabolism, suggesting that a phytotoxin may be produced by aphid attack.

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TABLE 1: Mean height and mean dry weight of tops of plants

Cultivar	Plant height (mm) 17 days after sowing		Total dry weight (mg) 30 days after sowing	
	Control	Infested	Control	Infested
'Wairau'	77	12	21	3
'Washoe'	78	14	22	3
'Saranac'	74	12	17	5
'CUF101'	103	50	22	19
LSD .05	46.3	4.3	6.8	7.6
Comparison: standard versus resistant cultivars	N.S.	**	N.S.	**

N.S. = not significant; ** significant $P < 0.01$

Table 2 shows that 24 hours after inoculation the numbers of aphids per plant were lower on the Californian lines than on the standards at the lower inoculation rate. The difference between standards and Californian lines was highly significant. At the high inoculation rate however, this difference was not significant. These data indicate a colonisation difference between the standard and resistant cultivars.

TABLE 2: Mean aphid numbers per plant 24 hours after being inoculated at 2 rates in glass house at Lincoln.

Cultivar	Inoculated at low rate	Inoculated at high rate
'Wairau'	3.93	8.13
'Saranac'	5.07	7.20
'Washoe'	4.47	5.93
'CUF101'	1.40	6.80
'UC111'	3.27	4.80
'UC112'	3.20	6.33
LSD .05	1.44	2.98
Comparison: resistant versus standard cultivars	**	NS

Field trials

Results from the field trials are shown in Tables 3 and 4. The Californian BGLA-resistant lines produced as much dry matter as the standard cultivars at Lincoln and Flock House. At Lincoln the Californian lines had significantly fewer aphids per stem than the standard cultivars, were more upright, recovered more quickly after cutting and grew actively in autumn after the standard cultivars became dormant.

Table 5 shows that when BGLA were confined on field-grown lucerne plants they produced fewer nymphs on the Californian lines than on the standards, indicating that some antibiosis factor (Painter 1951) may be involved.

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TABLE 3: Comparison of herbage production of cultivars resistant and susceptible to BGLA: DM yield kg/ha, 1976/6 season

	Cultivar						LSD .05
	'Wairau'	'Saranac'	'Washoe'	'CUF101'	'UC111'	'UC112'	
Flock House Total 3 cuts	4830	4739	3549	4816	4403	4501	642
Lincoln Total 2 cuts	6197	5898	5364	6009	6119	6345	666

TABLE 4: Aphid numbers/stem (back transformed means) on field plots, Lincoln

Cultivar	Sampling date 1977						Overall
	March 21	March 25	April 1	April 7	April 14	April 22	
'Wairau'	5.8	7.7	17.6	14.4	14.7	8.9	11.1
'Saranac'	5.4	5.7	18.7	7.2	6.5	4.6	7.5
'Washoe'	11.5	4.4	9.9	3.2	2.9	1.4	4.9
'CUF101'	4.7	1.5	3.3	1.1	0.3	0.5	1.6
'UC111'	3.1	1.7	1.4	0.9	1.7	0.8	1.3
'UC112'	4.3	2.5	1.7	0.4	0.2	0.4	1.0

Comparison: standard
vs resistant cultivars

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TABLE 5: Nymph numbers on resistant and susceptible cultivars: field counts

Cultivar	Young produced per stem
'Wairau'	36
'Saranac'	26
'CUF101'	14
'UC112'	11
LSD .05	9.2

DISCUSSION

Seedlings of lucerne cultivars selected for resistance to BGLA in the U.S.A. were resistant to severe infestations in the glasshouse here.

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In the field trials aphid numbers were not high and plants were not severely affected by aphids. However, there were significantly fewer aphids on resistant cultivars than on standard cultivars, indicating that the mature plants were also resistant.

This shows it is likely that the same BGLA biotype(s) is present in N.Z. as in the U.S.A. and indicates that these cultivars could be used commercially to minimise aphid damage in this country and serve as a source of resistance in a breeding programme.

The agronomic evaluation of these Californian lines is at present preliminary. They grew vigorously in the seedling year both at Lincoln and Flock House. Californian cultivars previously tested have also shown good seedling growth and have recovered quickly after cutting. They have also grown more actively in the autumn and spring than standard cultivars. These breeding lines however have only a low level of resistance to bacterial wilt (*Corynebacterium insidiosum*), and this will probably preclude their widespread adoption in this country.

At Lincoln plants with BGLA resistance similar to the Californian lines have been selected from better adapted cultivars including 'Wairau', 'Saranac' (bacterial wilt resistant) and 'Washoe' (bacterial wilt and stem nematode resistant).

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