# BLUE-GREEN LUCERNE APHID DAMAGE TO LUCERNE SEEDLINGS-CULTIVAR DIFFERENCES

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SUMMARY: Approximately 50% of seedlings of lucerne cv. CUF101, selected in California for resistance to blue-green lucerne aphid (BGLA), proved resistant to heavy BGLA infestations in the glasshouse in New Zealand. All seedlings of cv. Wairau, cv. Saranac and cv. Washoe were severely stunted and altered in growth habit at the same level of infestation. These results for levels of resistance agree with U.S.A. results.

## INTRODUCTION

Lucerne *(Medicago sativa* L.) is an increasingly important crop in New Zealand. It is grown mostly in pure stands on approximately 200 000 ha, mainly in the eastern South Island, Hawke's Bay, and the Taupo-Rotorua area, and gives high yields of nutritious fodder that often out yields pasture by 50-100%. However, in recent years, diseases and pests such as bacterial wilt *(Corynebacterium insidiosum* (McCuIl) H. L. Jens.) and stem nematode *(Ditylenchus dipsaci* (Kuhn) Filipjev) have limited lucerne production in some areas. The release of new disease-resistant cultivars, including Saranac (resistant to bacterial wilt) and Washoe (resistant to bacterial wilt and stem nematode), is expected to overcome these problems (Dunbier *et al.,* 1976).

The blue-green lucerne aphid *(Acyrthosiphonkondoi* Shinji.) (subsequently BGLA) is thought to have originated in North-East Asia, and was reported in California in 1974 (Dickson, 1975). It was first reported in New Zealand in late 1975 (Kain *et al.,* 1976) and by late autumn of 1976 it had spread through most of the lucerne-growing areas of New Zealand.

BGLA can reduce lucerne yields, heavy infestations may cause plant death (Kain *et al.,* 1976, 1977), and hay made from such infested lucerne is likely to be of inferior quality. Although pesticides give good control (e.g., East *et al.,* 1977) they are an added cost and frequent re-application may be necessary. While there is hope for biological control (Thomas, 1977), United States experience with the spotted alfalfa and pea aphids *(Therioaphis maculata* (Buckton) and *Acyrthosiphon pisum* (Harris) ), indicates that resistant cultivars are a better basis for effective control (Sorenson *et al.,* 1972).

A small amount of seed of the BGLA-resistant cultivar, CUF101, was received from the University of California in 1977. Its origin and preliminary performance data have been described (Dunbier *et al.,* 1977). The present paper describes a glasshouse experiment on aphid damage carried out at Crop Research Division, DSIR, Lincoln during the 1976-77 season using CUF10l and three standard cultivars; Wairau, Saranac and Washoe.

## MATERIALS AND METHODS

Seeds were germinated on moist filter paper in the light at 25°C prior to sowing. Single rows of 25 seedlings of each cultivar were sown in ten flats of sterilised potting soil on 6 December, 1976. These were grown in the glasshouse under natural light at approximately 22°C.

After four days, when the cotyledons were fully expanded, the plants were inoculated at the rate of five aphids per seedling with mixed-age BGLA populations (including alates) which had been cultured on lucerne. Two control flats were not inoculated and were aspirated daily to keep them free of aphids. Infected flats were re-inoculated one week later at the same rate.

The height of the plants was measured regularly and the stage of growth scored by the technique of Wynn~WilIiams and Burnett (1977) in which a numerical value is given to the growth stage of each plant (cotyledons = 1, unifoliate leaf = 2, first trifoliate leaf = 3, etc.). The values are summed and averaged for a row. This proved to be very satisfactory for young seedlings. Plants from one control and one aphid-infested flat were harvested at the conclusion of the experiment and total dry weights (top and root) were recorded.

Except for the dry weight, the results were analysed as a randomised complete block design with each flat considered as a replicate.

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## RESULTS AND DISCUSSION

In the controls, cultivar CUF101 initially grew faster than the s-standards (Fig. 1) but, at the conclusion of the experiment, the dry weights were nearly equal (Fig. 2). The aphid-infested plants behaved differently. Both height and dry weight of the standard cultivars were significantly reduced ($p< 0.05$), with all plants showing effects of the aphid infestation. CUFl0l behaved quite differently from the others, with two distinct groups in its stem length and dry weight distributions. About half the plants grew as well as the controls and were indistinguishable from them, but the remainder resembled the infested plants of the standard lines (Figs. 1 and 2). In contrast, the distribution of growth stage scores (Fig. 3) shows little difference as a result of aphid infestation in susceptible or resistant cultivars. Thus, aphid-infested susceptible seedlings develop leaves at about the same rate as uninfested or resistant ones.

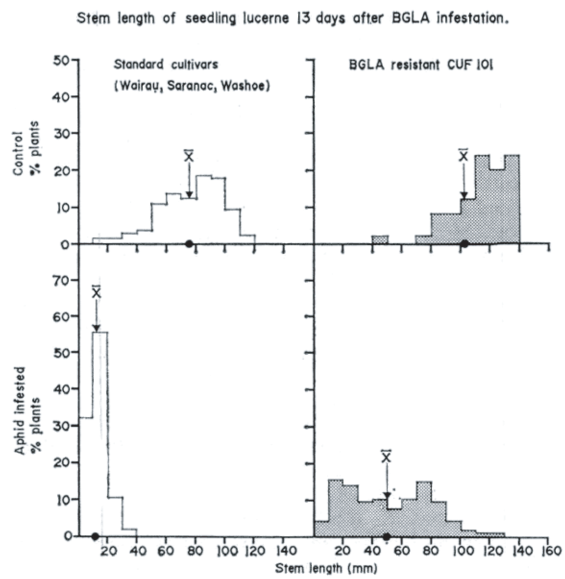


FIGURE 1. *Distributions of stem lengths of seedling lucerne* 13 *days after BGLA infestation.* $\overline{X}$ *denotes the mean of the distribution.*

However, the growth habits of all susceptible plants were considerably altered by the presence of aphids. They were severely stunted with poorly developed, distorted leaflets, reduced petioles, and a purple-bronze discoloration of the cotyledons. The resistant CUF101 individuals were indistinguishable

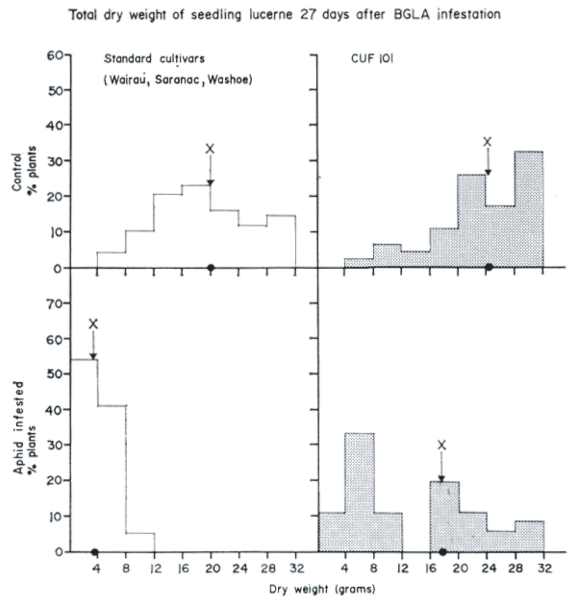


FIGURE 2. *Distributions of total dry weight of seedling lucerne 27 days after BGLA infestation* $\overline{X}$ *denotes the mean of the distribution.*

from the controls. Susceptible plants also produced more shoots .than the controls and resistant CUFl0l plants. The former had up to seven small, poorly developed shoots by the conclusion of the experiment, while few of the latter had more than one shoot which was well developed.

CUF101 had larger cotyledons and early leaves than the standard cultivars, which meant that they were subjected to a lower initial aphid pressure (aphids/ gram fresh weight). However, this factor is probably of minor importance, because, in the absence of factors inhibiting aphid reproduction, aphids multiply according to the amount of plant material available to them in such seedling experiments (Wynn-Williams and Burnett, loc. cit.).

The results, particularly the altered growth habit, suggest that the damage is not a purely physical effect and that some toxic substance produced in the BGLA-lucerne interaction is interfering with the metabolism of the susceptible lucerne host plant. The observed resistance rate of approximately 50% shown by cultivar CUF101 agrees with the 52% of Nielson *et al.* (1976). This suggests that the BGLA biotype(s) present in New Zealand behave, in virulence at least, similarly to the biotype(s) discovered in the U.S.A.

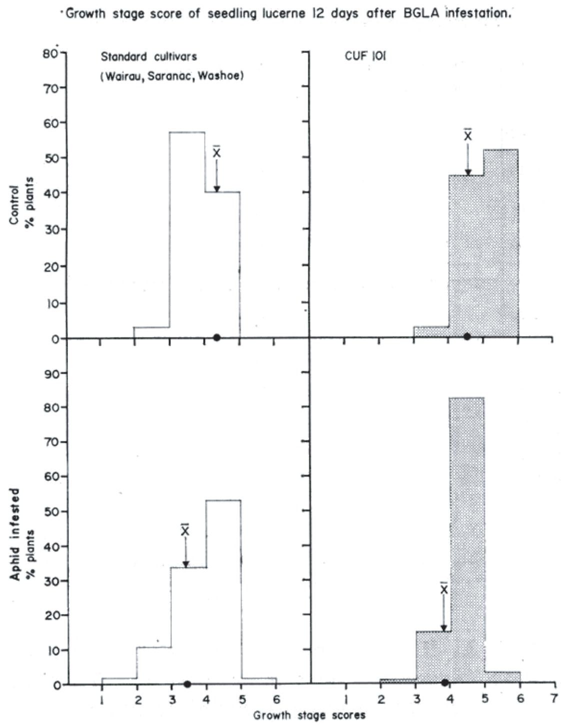


FIGURE 3. *Distributions of growth stage scores of seedling lucerne 12 days after BGLA infestation.* $\overline{X}$ *denotes the mean of the distribution.*

## CONCLUSION

Half the seedlings of cultivar CUF101, which was selected for resistance to BGLA in California, were resistant to extremely heavy BGLA infestations in the glasshouse. Susceptible plants were stunted and altered in growth habit, suggesting that resistance is due to a tolerance to BGLA infestation and its associated toxic effect, as well as to the apparent colonisation difference and antibiosis effect shown by Dunbier *et al.* (1977).

## ACKNOWLEDGEMENT

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