Improved pastures:

Evaluation of white clover cultivars for dryland pastures in northern NSW

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The white clover zone in Australia covers an area of almost 6 million hectares (Clements 1987) and comprises a number of agro-geographic regions reflecting the wide adaptation of white clover. The requirements for successful adaptation vary between each region according to the limitations imposed by environmental conditions and pastoral use. This paper describes the northern tablelands region - the most extensive perennial pasture region in the temperate pasture zone and highlights the requirements for successful adaptation. A summary of results from two trials evaluating white clover cultivars is reported.

Northern tablelands pasture environment

The northern tablelands is a cool temperate highlands environment between latitudes 28°15'S and 31°30'S. The total area is 3.2 m. ha of which 2.2 m. ha is agricultural land (Hartridge 1979, Australian Bureau of Statistics 1993/94). The climate is characterised by high rainfall (750 - 1000 mm average annual rainfall) with marked summer incidence, a long frost interval and cold winter (Hobbs and Jackson 1977). A climate summary for Glen Innes, centrally located in the northern tablelands is provided in Table 1.

Approved cultivars

The northern tablelands is predominantly a grazing industries region favourably suited to pasture development with introduced temperate perennial species; 23 per cent of the total farm area is sown pasture (Australian Bureau of Statistics 1993/94). Tall fescue, phalaris and white clover are recommended for high fertility soils of the region; cocksfoot phalaris and white clover are recommended for low fertility granite soils (Lowien *et al.* 1991). Until cv. Haifa became commercially available in 1980 (Peterson 1987), New Zealand strains of white clover were mainly used (Archer and Gressor 1979); these included cv. Grasslands Huia and uncertified strains of locally produced seed from paddocks originally planted to "N.Z.P.P." or "N.Z. Mother". Cv. Haifa proved to be useful in the more marginal areas due to better heat tolerance, winter activity and seedling regeneration in comparison with cv. Grasslands Huia (Oram 1990). Cv. Grasslands Huia is presently recommended for high altitude (>900 m) and high rainfall (>850 mm aar) districts and cv. Haifa for drier districts to 600 m elevation and 775 mm AAR (Lowien *et al.* 1991). Cvv. Grasslands Tahora and Grasslands Kopu have recently been promoted to "generally" approved status and cv. El Lucero and Grasslands Prestige to "provisionally" approved status although these four cultivars remain largely untested.

Table 1. Climate summary for Glen Innes, northern tablelands of New South Wales.

Month	Temperature (°C) Max.	Temperature (°C) Min.	Pan Evap. (mm)	Rainfall (mm)	Frosts (days)
Jan	25.0	13.5	5.5	108	nil
Feb	24.4	13.4	4.9	92	nil
Mar	22.8	11.5	4.3	70	0.3
Apr	19.8	8.0	3.2	41	3.5
May	16.2	4.9	2.1	50	11.9
Jun	12.9	1.7	1.6	54	19.3
Jul	12.2	0.6	1.7	58	22.3
Aug	13.7	1.2	2.4	49	21.9
Sep	16.4	4.0	3.5	55	14.5
Oct	19.6	7.1	4.3	78	5.1
Nov	22.0	9.7	5.2	85	1.3
Dec	24.4	12.1	5.6	109	0.6

Limitations of current cultivars

The northern tablelands is regarded as a safe white clover area; white clover is the legume base of all perennial pastures and has also naturalised extensively. Although pasture improvement during the 1950s and 1960s was very successful, by the early 1980s poor persistence of white clover and large yield fluctuations had emerged as major problems (McDonald 1988). Large scale decline in white clover presence was accompanied by pasture decline and a decrease in animal productivity; the relatively poor performance of Merino weaners and crossbred prime lambs since the early 1980s is attributed to white clover decline (Duncan 1991).

A recent survey found that white clover based pastures in this region are resown every 5-6 years (Petersen *et al.* 1994). Low tolerance of soil moist-

Table 2. Yield performance of 10 cultivars relative to cv. Haifa, Site A.

Cultivar	Plant type	Winter activity		Maximum spring yield		Summer regrowth	
		Yr.2	Yr.3	Yr.2	Yr.3	Yr.2	Yr.3
Haifa	large leaf/early flowering	100c	100a	100c	100a	100b	100bc
G.Kopu	large leaf/mid-flowering	97cd	54de	79d	49d	94b	43d
El Lucero	large leaf/early flowering	108ab	99a	114b	111a	126a	93bc
Irrigation	medium leaf/early flowering	115a	77b	116ab	91ab	97b	150a
G.Huia	medium leaf/mid-flowering	102bc	49e	93c	70c	77c	71cd
Siral	medium leaf/early flowering	91d	61d	100c	67c	48d	114abc
G.Demand	medium leaf/mid-flowering	102bc	14f	120ab	44d	65c	64cd
G.Prestige	small leaf/mid-flowering	104bc	49e	129a	92ab	70c	79cd
G.Tahora	small leaf/mid-flowering	113a	62cd	124ab	51d	94b	64cd
Prop	small leaf/early flowering	114a	73bc	100c	82b	50d	121ab

Values within columns with different superscript letters are significantly different (P0<.05).

Table 3. Yield performance of 6 cultivars relative to Haifa, site B.

Cultivar	Plant type	Winter activity		Maximum spring yield		Summer regrowth	
		Yr.2	Yr.3	Yr.2	Yr.3	Yr.2	Yr.3
Haifa	large leaf/early flowering	100a	100b	100c	100b	100c	100ab
Ladino	large leaf	50d	82cd	71d	70d	69e	57d
G.Huia	medium leaf/mid flowering	68c	76d	98c	79c	82d	58cd
Irrigation	medium leaf/early flowering	92b	104b	134a	117a	133a	117ab
G.Tahora	small leaf/mid flowering	89b	139a	120b	106b	120b	83bc
Clarence	small leaf/early flowering	100a	97bc	123b	84c	114b	45d

Values within columns with different superscript letters are significantly different (P<0.05).

ure deficit by current cultivars results in poor persistence (Archer and Robinson 1989). Other limitations include low winter activity, poor growth in competition with grass, susceptibility to pests and diseases and low tolerance of close grazing (Ayres *et al.* 1992). The main requirements from new white clover cultivars for the northern tablelands is improved persistence through tolerance of summer moisture stress (Lowien 1991). Duncan (1991) also proposed seedling vigour, stolon density and tolerance of summer moisture stress/close grazing/ grass competition as primary breeding objectives; bloat safety and improved winter activity were proposed as secondary requirements.

Results from cultivar evaluation trials

Two trials were undertaken at Glen Innes to evaluate a world sourced collection of lines (site A) and a collection of northern NSW ecotypes (site B); cultivar standards were included in each evaluation using five replications per cultivar. The lines were evaluated under grazing for three years, 1994 - 1997. Plots (1 m^2) were established by propagating seedlings in the glasshouse and transplanting into a tall fescue sward in spring 1994 at site A and autumn 1994 at site B. Both sites were located on a basalt soil and were topdressed with superphosphate to maintain medium soil phosphate status. The plots were grazed with sheep following eight-weekly yield assessments; each yield assessment included a visual score of clover biomass per plot area on a 0-9 linear scale. Visual scores were calibrated to DM yield by scoring and harvesting 15 quadrats (75 x 100 cm). To compare cultivars, the statistical model accounted for spatial variability induced by within-site factors such as fertility and moisture gradients (Cullis and Gleeson 1991). Within-site variability was removed and the predicted yields were corrected for localised field conditions. This paper reports only on results for the cultivar standards.

Results (Tables 2 and 3) show that at site A, cvv. Grasslands Huia, Grasslands Kopu, Grasslands Demand, Grasslands Prestige and Grasslands Tahora were outperformed by cv. Haifa. At site B, Grasslands Huia, Ladino and Clarence were outperformed by cv. Haifa. Cvv. Irrigation and El Lucero showed outstanding yield stability across seasons and cv. Siral remained persistent. Although data for the performance of elite lines selected from site A for future breeding are not presented here, it is useful to record that they outperformed cv. Haifa in summer regrowth and persistence; the summer regrowth yield performance of Haifa relative to the mean performance of the elite lines was ~78% indicating the commencement of "Haifa decline" during year three.

Conclusions

1. Despite the importance of white clover for the grazing industries, there is a lack of adapted cultivars for dryland environments. Of nine cultivars presently registered for use in Australia, all except two, cv. Haifa and cv. Irrigation are imported. Cv. Irrigation was first certified by the Victorian Department of Agriculture in 1936 and cv. Haifa

was registered by the New South Wales Department of Agriculture in 1971 (Oram 1990). Imported cultivars have limited application in dryland environments presumably because of poor homoclime match between the country of origin and much of the Australian dryland zone.

2. These results and considerations emphasise the importance of developing locally bred cultivars with improved tolerance of summer moisture stress and heat and better persistence under sheep and cattle grazing. A program of white clover improvement is underway at Glen Innes addressing these breeding objectives. If successful, new cultivars will provide stable legume based pastures and improve productivity of pastures on the northern tablelands and in comparable pasture environments elsewhere.

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