Management and productivity of white clover in a kikuyu grass sward in subtropical Australia

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Abstract

This plot-cut study, on heavy clay soil, evaluated the establishment, productivity and persistence of Haifa white clover (*Trifolium repens*) in a vigorous sward of kikuyu grass (*Pennisetum clandestinum*). Defoliation treatments were 5 or 12 cm stubble height in spring and 14 days or "when ready" (lower leaves beginning to senesce) in spring and autumn. Over the 2½ years of the study and under optimal defoliation treatment (5 cm stubble height in spring and at the "when ready" defoliation interval in spring and autumn), total yield of forage was 19 952 kg DM/ha/yr, of which 57% was white clover. The reason for the loss of vigour of white clover in year 3 is not clear. It may have been due to the heavy infestation of the root knot nematode *Meloidogyne* or to defoliation management over the second summer, or both. Management at the transition phases between the two pastures (early autumn and late spring) is critical to success and is explained in the light of farmer experience.

Keywords: defoliation management, *Pennisetum clandestinum*, subtropics, *Trifolium repens*

Introduction

On the subtropical coast of NSW over 30% of dairy pastures are kikuyu-based. It has been common to grow kikuyu as a monoculture in summer, fertilised with about 250-350 kg N/ha/year. To fill the winter feed gap, the kikuyu grass pastures are oversown with ryegrass (or under dry land, oats) also with application of N fertiliser. This system is costly in terms of N fertiliser usage and its effect on soil pH (Tietzell 1991), and nitrates reaching ground water may be of concern. Inclusion of white clover in a kikuyu grass pasture is a cost effective method of addressing this problem.

Previous attempts to establish and maintain white clover in coexistence with kikuyu have been largely unsuccessful due to the vigour of kikuyu over summer. Recently we have taken a different approach by growing a two pasture system with kikuyu in summer and white clover in autumn to spring. The two pastures are switched on and off by judicious management in late spring and early autumn.

This three-year study evaluated defoliation practices that would allow kikuyu and white clover to complement, rather than compete, with each other over time.

Method

In a plot cut study on heavy clay soils, Haifa white clover was established in a vigorous kikuyu sward by spraying the area with 0.5 l glyphosate/ha in mid March and then, after kikuyu was mown to 5 mm stubble height, sowing with 4 kg Haifa white clover on 1 April. At sowing, 250 kg superphosphate molybdenum plus 100 kg muriate of potash/ha was applied, Kikuyu was mown when shoot length exceeded 50 mm to suppress its growth while white clover seedlings were establishing.

The plots were irrigated at 5- to S-day intervals as required in order to replace evapotranspiration losses. After the clover became dominant, 4 m^2 plots were randomly allocated to defoliation at 5 or 12 cm stubble height in spring and at an interval of 14 days or "when ready" (lower leaves began to senesce) in spring and autumn. All treatments were replicated 3 times and plots not sown were used as controls.

During summer the kikuyu was managed in such a way as to provide maximum amount of leaf by defoliating to 5 cm stubble height when the plant was at the "when ready" stage (approximately 4 leaves fully extended on each stolon) (18–30 days) (Reeves, unpub. Data) and applying 100 kg urea/ha/month (Reeves et al. 1995).

Results

Plots cut to 5 cm stubble height at the "when ready" stage of growth in spring and autumn produced 16% more white clover DM than the next most productive treatment and 69% more white clover DM than the least productive treatment (see Table 1).

Over the 2½ years of the study, plots subjected to this optimal defoliation treatment produced on average 19 952 kg DM/ha/yr, of which 57% was white clover (Figure 1).

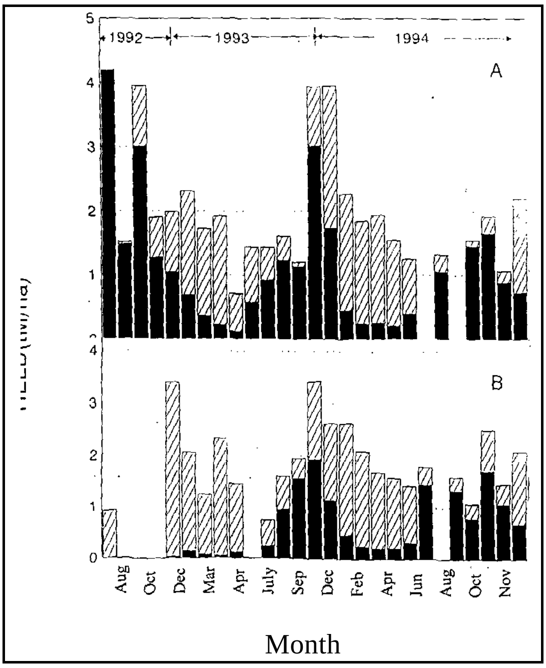
The yield of the sown variety of white clover declined in year 2 and 3 and the DM yeilds shown in Figure 1A for 1994 (year 3) were almost entirely naturalised white clover. The "invasion" of naturalised white clover is paralleled in the control plots (Figure 1B).

Table 1 Yield (kg DM/ha) of white clover the 2.5 years of the study, for plots defoliated at 5 *or* 12 cm stubble height in spring and at 14 d or "when ready" in spring and autumn. Means with different subscripts are significantly different at $P < 0.05$ level.

Stubble height (cm)	Spring Defoliation* interval	Autumn Defoliation* interval	kg DM/ha
5	14 d	14 d	18 964[bc]
	14 d	WR	24 408[ab]
	WR	14d	21 324[bc]
	WR	WR	28 226[a]
12	14 d	14 d	17 852[c]
	14 d	WR	20 327[bc]
	WR	14 d	18 341[c]
	WR	WR	16 704[c]

*WR (lower leaves beginning to senesce)

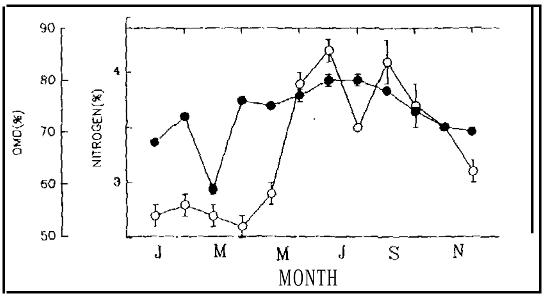
Figure 1 Yield (kg DM/ha) of kikuyu (▨) and whiteclover (■) for plots sown to Haifa white clover (A) or for control plots (B) in which volunteer white clover had gradually invaded plots subject to the same fertiliser and irrigation management. Means are only for plots defoliated to 5 cm stubble height in spring and at the "when ready" stage in spring and autumn.



Although naturalised clover is difficult to distinguish from Haifa, it is believed that naturalised clover did not make a significant contribution in year 2, i.e., did not parallel the control plots due to suppression by sown clover.

The mean forage quality (of kikuyu plus white clover *over* all treatments) is shown in Figure 2.

Figure 2 OMD (●) and nitrogen (O) % of forage from a kikuyu/white clover sward. Samples (n = 4 to 6) were taken to defoliation height. Standard errors are shown as vertical bars.



The abnormally low organic matter digestibility (OMD) value in March was associated with a "severe" defoliation in March imposed to set back the kikuyu and encourage white clover growth.

Over the summer, when kikuyu completely dominated the sward, OMD varied from 60 to 70% and this rose to 70–80% when white clover dominated. Protein levels (N% x 6.25) were near 20% at all times of the year.

Discussion

The reason for the decline in vigour of the white clover after the second summer is not clear at present, but could be related to infestations of the root knot nematode *Meloidogyne*, which reached very high levels in year 3. Extensive monitor&g suggests the problem is not caused by a decline in soil fertility (which increased), pH, moisture stress or stock damage (evident in cut plots as well) (W. Fulkerson, unpub. Data). *Alternatively, it* could be due to the effect of management practices on stolon survival over the critical late summer/early autumn period. Recent studies by D. Donaghy (unpub. Data) indicates break-up of white clover stolons in a ryegrass sward in the first summer after sowing, and this was associated with a high death rate of stolon *segments. Stolon dynamics over this* second *summer* period are now being monitored, particularly in view of the observation (Fulkerson & Slack 1995) that regeneration of white clover in this environment relies almost entirely on stolon survival, rather than seedling recruitment.

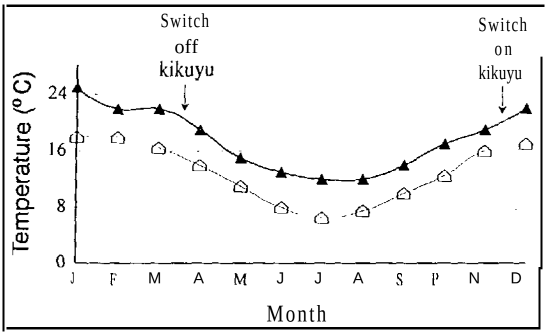
Subsequent studies are looking at the potential of other *Trifolium* species under a system of management which seems to be most effective at establishing and maintaining the legume component.

The technique for establishment of white clover has been further refined under commercial conditions, recognising the critical importance of timing in relation to soil temperature and light penetration to the clover.

Success relies on the following procedures:

I. Removal of the kikuyu sward by heavy grazing, forage harvesting or, as a last resort, mulching after the previous grazing and allowing the mat to decompose. Herbicides provide a variable suppression and merely stop growth but do not remove the "shade". The timing of sowing in the establishment year, or initiating management to favour white clover over kikuyu, is important. If this is begun too early, kikuyu is difficult to suppress, but if too late low temperatures suppress establishment of clover - a soil temperature (at 10 cm) of about 19°C seems optimal (Figure 3).

Figure 3 Long-term average minimum (132 years) (◊) and soil (3 years) (▲) temperature. Approximate times when kikuyu is "switched" on and off are indicated.



2. Repeated grazing after sowing whenever new shoots of kikuyu exceed 5 cm (this may vary from 6 to 14 days).

3. Cessation of N fertiliser application 3 weeks before sowing but apply P, K and molybdenum.

4. Once dominant, white clover is grazed infrequently but severely (results of this study).

5. In late spring, at the time when kikuyu starts growth, management is altered to favour kikuyu growth:

(a) apply N fertiliser

(b) increase frequency and decrease severity of grazing

(c) increase watering interval (if applicable).

Failure to do this will cause death of kikuyu through shading and result in invasion of weeds or less desirable grasses.

Total DM yields, under commercial dairy farm conditions, in excess of 12 000 kg DM/ha from sowing to early November in the year of establishment (Battese 1995) have been obtained.

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