IMPACT OF A PASTORAL FALLOW ON THE MORPHOLOGY AND GROWTH OF WHITE CLOVER (TRIFOLIUM REPENS L.) IN A NEW ZEALAND HILL PASTURE

Z.N. Nie[1], I. Valentine[1], D.J. Barker[2], A.D. Mackay[2], J. Hodgson[1]

[1] Department of Plant Science, Massey University, Palmerston North, New Zealand

[2] Sustainable Production Division, AgResearch, Private Bag 11008, Palmerston North, New Zealand

ABSTRACT

Lifting the content and improving the distribution of perennial legumes such as white clover (*Trifolium repens* L.) of hill pastures in New Zealand is a major objective of a pasture improvement programme. This paper reports on the ecology of white clover over a 2 year post-fallow period. The fallow was a 7 month period without defoliation over spring-summer-autumn. The stolon length and weight of white clover increased from year 1 (94/95) to year 2 (95/96) post-fallowing ($P<0.1$ and 0.05, respectively), while the average internode length declined ($P<0.05$). However, the white clover growth rate was not significantly increased in the two measurement years. Fallowing significantly increased grass growth rate ($P<0.05$) in the two years post-fallowing. The grasses seemed to have an immediate response post-fallowing, while the response of white clover was slower and cumulative.

KEY WORDS

Pastoral fallow, growth rate, stolon, white clover

INTRODUCTION

Lifting the content and improving the distribution of perennial legumes such as white clover (*Trifolium repens* L.) of hill pastures in New Zealand is a major objective of a pasture improvement programme. Nie et al. (1996) found that white clover stolons dispersed extensively during a pastoral fallow, which typically involves the absence of grazing of a pasture for a period usually from early spring (September or October) to autumn (May), and subsequently formed the nucleus of larger and/or new patches after the fallow was completed. This resulted in a substantial increase (76-200%) of sward white clover content 3 - 4 years post-fallowing. However, the short-term (1 and 2 years) effects post-fallowing on the ecology of white clover and the growth of pastures were not investigated. This paper examines the change of stolon characteristics of white clover and the growth of pasture components 1 and 2 years post-fallowing.

METHODS

The trial was conducted at the AgResearch Hill Country Research Station (40½19'S, 175½50'E) near Palmerston North, New Zealand. The trial site was a south (shady) aspect of moderate slope where the pasture consisted of predominantly low fertility-tolerant grasses such as browntop (*Agrostis capillaris* L.) and sweet vernal (*Anthoxanthum odoratum* L.). No fertiliser was applied in the 10 years before 1989.

In 1989, six areas of 500 - 800 m^2 each were fenced in three blocks. One plot was randomly chosen from each block to receive 35 kg phosphorus (P)/ha/year of North Carolina reactive phosphate rock and 14 kg sulphur (S)/ha/year of elemental sulphur added in August annually from 1989 to 1993. In October 1993 all plots (main plot) were split into sub-plots (split plot design) with one half fallowed from 19 October 1993 until 31 May 1994 and the other half rotationally grazed by sheep to maintain a herbage mass not exceeding 3,000 kg DM/ha. Measurements of pasture growth were made by cutting one 0.5 m^2 quadrat to 1 cm above ground-level in each sub-plot, three times during 15 December 1994 - 18 May 1995 for the first year (Year 1) post-fallowing, and 28 September 1995 - 5 February 1996 for the second year (Year 2) post-fallowing. Sub-samples of pasture were dissected into grass, white clover, other legume, weed and dead matter, to estimate the dry matter of each component. White clover stolon characteristics were measured on twenty 50 mm diameter tiller plugs from each sub-plot on 5 December 1994 and 30 November 1995, for Year 1 and 2, respectively. Tiller plugs were dissected to obtain all surface and buried clover stolons which were washed, dried and then trimmed to determine total stolon length, internode length and stolon dry matter.

RESULTS AND DISCUSSION

The morphological characteristics of white clover. There were clear interactions between the fallow treatment and post-fallowing time (Fig. 1) in white clover stolon length ($P<0.1$), weight ($P<0.05$) and internode length ($P<0.05$). The white clover stolon length and weight decreased, and internode length increased during fallowing. The widely spread clover stolons initiated branching at the end of fallowing which resulted in a cumulative increase of stolon length and weight and a decline of average internode length post-fallowing. The decline of both stolon length and weight in grazed pastures (Fig. 1a & b) was probably due to a drought during January - March, 1995. Brock et al. (1994) indicated that high pasture (grass) density that was capable of providing shelter from direct solar radiation to clover stolon gave superior survival of white clover during drought stress. The increase of stolon length and weight from Year 1 to Year 2 in the fallowed sward was the combination of both the formation of new clover patches (Nie et al., 1996) and a higher survival rate of clover during drought.

Pasture growth. Fallow did not significantly influence white clover and weed growth rate, but significantly ($P<0.05$) increased grass growth rate (Table 1). Although there was a clear increase in stolon length and weight of white clover with post-fallowing years, the response of white clover growth rate was not significant. A significant difference between fallow and grazing treatments in white clover yield was detected in the fourth year post-fallowing (Nie et al., 1996). The rapid improvement of grass growth was probably related to an increase of tiller density one year post-fallowing and the release of nitrogen stimulated by fallowing (Mackay et al., 1991). Significantly greater grass and weed growth rate ($P<0.01$) were found in Year 2 compared with Year 1 (Table 1). Clover growth rate were also higher in Year 2 than in Year 1, though not significant. The difference in growth rate between Year 1 and 2 was probably due to: a) a drought during January - March 1995 (mean monthly rainfall was 57 mm, 63% of the same period of 1996) of the first measurement year; b) the first measurement year was mostly during autumn, when the pasture growth rate is generally lower than in summer and spring. There was a significant increase (data not shown) between fertilised over non-fertilised treatments in white clover growth rate.

It was concluded that fallowing significantly improved pasture (grass) growth in the two subsequent years. Furthermore, white clover stolon characteristics were improved by fallowing, which, although not resulting in improved growth rate in the two subsequent years, might explain the response of Nie et al. (1996) 3 - 4 years post-fallowing.

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Table 1

Effects of fallowing and the time post-fallowing on the growth rate (kg DM/ha/month) of grass, white clover and weed in the periods of 15 December 1994 - 18 May 1995 (Year 1) and 28 September 1995 - 5 February 1996 (Year 2)

Treatment	Grass	Clover	Weed
Fallowed	925.8	36.3	89.1
Grazed	710.4	27.2	134.4
SEM	54.8	3.5	17.0
Significance	*	ns	ns
Year 1	641.1	23.5	50.3
Year 2	955.3	40.0	173.3
SEM	42.2	5.7	13.2
Significance	**	ns	**

Note: *, ** and ns denote significant at 5% and 1%, and not significant, respectively.

Figure 1

Response of (a) white clover stolon length, (b) stolon weight and (c) internode length to fallowed and non-fallowed (grazed) treatment in the first and second year post-fallowing of a North Island, New Zealand hill pasture (* and †, interaction significance P<0.05 and P<0.1, respectively)