GRAZING AND MOWING EFFECTS ON THE SEED PRODUCTION OF *STYLOSANTHES HAMATA* CV. VERANO

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ABSTRACT

Stylosanthes hamata *cv. Verano was grown with volunteer grasses under irrigation at Mt. Cotton, south-east Queensland. Effects of the timing of grazing with sheep and mowing at* 10 *cm height on seed yield and growth were measured. A single heavy grazing followed by mowing at early flowering stage increased seed yield from* 221 *kg* ha^{-1} *in the undefoliated control treatment to* 355 *kg* ha^{-1}*. Intermittent grazing and mowing at a later stage decreased seed yield.*

INTRODUCTION

Seed production is necessary for the regeneration of short-lived perennial legumes in grazed pastures. The grazing of seed crops is also attractive to many seed growers, since income is diversified and seed production may possibly be enhanced by grazing. However, the effects of grazing and mowing on the flowering and seed production of tropical pasture species are not well understood (Humphreys 1974) and no studies have been reported for the promising (Gillard 1975) legume *Stylosanthes hamata* cv. Verano (Caribbean stylo) (Mackay 1975). This paper describes a field experiment in south-east Queensland in which *S. hamata* cv. Verano was grown with volunteer grasses under irrigation and grazed or mown at different times.

METHODS

The experiment was conducted at the University of Queensland Mt. Cotton Farm, 40 km south-east of Brisbane, on a red-yellow podzolic soil (Beckmann 1967). The site had previously grown *Setaria anceps* and *Panicum maximum* var. *trichoglume* pastures, and was sown to a winter crop of oats in 1974. After seed bed preparation and application of a mixed fertilizer containing P, K, S, Ca, Cu, Zn and Mo, seed of *S. hamata* cv. Verano which had been scarified with concentrated sulphuric acid for 2 h and inoculated with CB 756 rhizobium was surface drilled at 17 kg ha^{-1} on October 9, 1974.

The experimental treatments were:

Control: not grazed or mown
68CR: grazed by 12 sheep on December 25 and 26 (at early flowering stage 68 days after *S. hamata* emergence), and mown on December 27, 1974.
83CR: grazed by 12 sheep on January 10 and 11, and mown on January 12, 1975.
98CR: grazed by 12 sheep on January 24 and 25, and mown on January 26, 1975.
68 INT: grazed intermittently by 4 sheep on 6 days between December 24 and February 22, and mown on February 25, 1975.
83 INT: grazed intermittently by 4 sheep on 6 days between January 9 and February 23, and mown on February 25, 1976.
98 INT: grazed intermittently by 4 sheep on 6 days between January 25 and February 24, and mown on February 25, 1976.

There were six replications of each treatment, arranged as randomized blocks. Plot size was 3.5 m × 9 m, and plots were separately fenced and arranged in two rows with a central 3 m wide laneway between them. The laneway was kept mown short,

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and on any grazing occasion all sheep had free access to all six plots of the particular treatment being grazed. In this design all defoliation treatments received the same number of sheep grazing days (1270 sheep days ha^{-1}, or 590 ha^{-1} if a laneway is included) and a single mowing at 10 cm height. The drawback of this design is that the time of commencement of intermittent grazing was confounded with frequency of grazing, which was 12, 9 and 6 days in the 68 INT, 83 INT, and 98 INT treatments respectively.

Plots were grazed by Border Leicester X Merino ewes weighing about 45 kg; small ruminants are more convenient than cattle for experiments of this character. Sheep ate both *S. hamata* and volunteer grasses on all grazing occasions, and tended to remove the apex and young leaves of terminal and primary lateral shoots first when grazing *S. hamata*. A sickle-blade mower was used, and cut material was hand-raked and removed from the plots. Supplementary spray irrigation was used to maintain good growth, and a total of 540 mm water was applied over fourteen occasions from October 24, 1974 to June 2, 1975.

S. hamata density was recorded on November 6, 1974 and February 26, 1975 using respectively four and seven 0.4 × 0.4 m quadrats per plot. Thirty plants per plot were ringed with coloured plastic pigeon leg-bands on the day before each grazing treatment commenced, or on January 28, 1975 for the control treatment. Survival of these plants was recorded on November 11, 1975. Yield samples were cut with handshears to 0.5 cm height from seven 0.4 × 0.4 m quadrats per plot before first grazing and after mowing, and on February 26 and June 30, 1975. Samples were separated into *S. hamata* and volunteer species, and oven-dried and weighed. Seed was hand threshed from these samples and was brushed up from the soil surface of the cut quadrats; it was separated from soil and litter by flotation in perchlorethylene. Light values at the upper surface of the *S. hamata* canopy were recorded on February 4 and April 17, 1975; 10 readings of short-wave radiation in and above the sward were made in each plot within 1 h of noon, using an EEL selenium cell.

RESULTS

Flowering and seed formation

S. hamata has a day-neutral flowering response (t' Mannetje 1966), and blooming was observed in 50 per cent of plants (Table 1) on December 23, 1974, only 67 days after seedling emergence. Grazing and mowing delayed flowering according to the time of mowing, the latest treatments flowering in early April. Flowering is determinate, and extended over a long period as successively produced axillary shoots flowered. Seed harvesting was delayed until shoots were senescent and most seed had fallen. "Crash" grazing and mowing at early flowering (68CR) significantly increased seed yield 61 per cent relative to the undefoliated control treatment. The intermittently grazed and late mown treatments gave significantly reduced seed yields, the

TABLE 1

Flowering time and seed yield of S. hamata.

Treatment*	Flowering Date	Seed Yield (kg ha^{-1}) On Plant	On Ground	Total
Control	23.xii.74	50	171	221
68CR	4.ii.75	65	290	355
83CR	25.ii.75	40	207	247
98CR	11.iii.75	39	238	276
68INT	9.iv.75	23	113	136
83INT	9.iv.75	21	171	192
98INT	9.iv.75	15	118	133
LSD (P = 0·05)		28	86	97

*For treatments, see text.

TABLE 2

Dry matter yield (kg ha^{-1}) of S. hamata *and volunteer grasses at various stages.*

Treatment	*S. hamata*				Grasses			
	Before Grazing	After Mowing	25.ii.75	30.vi.75	Before Grazing	After Mowing	25.ii.75	30.vi.75
Control	—	—	2840	5040	—	—	5570	4280
68CR	500	40	2390	5370	1340	620	3350	3140
83CR	470	150	1260	3780	3430	1700	2940	3210
98CR	1010	190	1220	3850	4380	1350	1980	2940
68INT	500	420	420	1900	1340	1650	1650	2790
83INT	470	490	490	2240	3430	1830	1830	2590
98INT	1010	660	660	2140	4380	1800	1800	3460
LSD (P = 0·05)			630	1410			980	1110

main effect yields being 154 and 293 kg ha^{-1} in the INT and CR treatments respectively.

Growth and plant survival

S. hamata density was 77 plants m^{-2} on November 6, 1974 and good growth of the sward occurred during the summer months. Volunteer grass seedlings grew more vigorously than *S. hamata*, and dominated the legume in all treatments on each sampling occasion except the last (Table 2). The effect of defoliation on competitive relationships between grass and legume is therefore of interest. The composition of the volunteer species was visually estimated on April 9, 1975 as: *Setaria anceps* 30 per cent, *P. maximum* var. *trichoglume* 20 per cent, *Eleusine indica* 15 per cent, *Eragrostis* spp. 15 per cent, *Cyperus* spp. 5 per cent, and other species 15 per cent. The yield of legume and grass immediately before the commencement of grazing and the residual yield after mowing are shown in Table 2. Light values at the upper surface of the legume canopy on February 4 were significantly modified by treatment. These were 0.48 full daylight in the control, and 0.73, 0.83 and 0.97 in the CR68, CR83 and CR98 treatments respectively, which had been mown. In the intermittently grazed treatments, which had not been mown at that time, light values were 0.49, 0.60 and 0.60 for the 68 INT and 83 INT and 98 INT treatments respectively. These treatment differences in light values had disappeared during the later phases of crop maturation on April 17, 1975. The situation on February 25, when all grazing and mowing treatments had been applied, was that *S. hamata* yields were of the same order in the control and 68CR treatments but the 68CR plants were better branched and less volunteer grass was present in this treatment. *S. hamata* yield was reduced in the 83 and 98CR treatments, and decreased still more in the INT treatments which had just been mown. In the subsequent autumn, growth of *S. hamata* was superior in the control and CR treatments to that of the INT treatments; volunteer grass growth showed the reverse effect (Table 2). This indicates that differences in the timing of defoliation altered the competitive balance of legume and grass, grass dominance being accentuated by late defoliation.

S. hamata density decreased independently of treatment to 58 plants m^{-2} on February 26, 1975. Per cent survival of plants to November 11, 1975 was 49 per cent in the ungrazed control; it averaged 57 and 42 per cent in the CR and INT treatments respectively, a difference approaching significance ($P < 0.1$). Good seedling emergence occurred in the 1975 November-December period, but despite further mowing, grass dominance became too great to make a repeated application of treatments of interest.

DISCUSSION

Defoliation may increase seed production by removing apical dominance, increasing branch density and providing more sites for inflorescence development. This occurs in the annual *Trifolium subterraneum* (Rossiter 1961), and Fisher (1973) reported a similar effect in pure swards of *S. humilis* at Katherine, where defoliation to 13 cm in February and March increased seed yield. This was probably a factor in the success of the crash-graze and mow at early flowering (CR68) treatment, although the evidence of increased branching is only from visual appraisal. In the taller perennial *S. guyanensis* judicious cutting will create a sward structure more suited to header-harvesting (Loch, Hopkinson and English, 1976). In mixed swards containing tall growing grasses defoliation can increase the light energy received by a shorter growing legume such as *S. hamata*. This was probably a second factor favouring *S. hamata* in the CR treatments, which grew less grass than the control treatment. However, the light environment of the later mown INT *S. hamata* plants was also improved, and other factors such as temperature must be involved in determining the direction of response, since grass dominance was greater in the INT plots. *Setaria anceps* grows better than *S. hamata* at cool temperatures, and the adverse effect of late defoliation on seed yield of *S. hamata* does not conform with another study (Wilaipon and Humphreys, unpublished data) conducted in a heated glasshouse.

Defoliation may decrease seed formation if it reduces the capacity of the leaf surface area to supply assimilate to the developing inflorescences, or if many inflorescences are actually removed by defoliation. Late stages of defoliation are clearly more vulnerable to these dangers. A further effect is the delayed flowering time caused by grazing and mowing. Moisture was not a limiting factor in this experiment, but mean daily minimum temperatures at Mt. Cotton fell to 15.8, 12.3 and 10.2°C respectively in April, May and June 1975. These are sub-optimal for flowering and seed formation in *S. humilis* (Skerman and Humphreys 1973) and *S. hamata* is similarly affected (P. Argel, personal communication).

S. hamata is not usually grazed by sheep or grown for seed in south-east Queensland, and extrapolation of the findings of this Mt. Cotton experiment is risky. However, the increase in seed yield of 61 per cent due to early grazing and mowing suggests the merit of further studies in other environments, and of trial by interested producers. The results agree with Norman and Phillips' (1973) recommendation of early wet season grazing and subsequent deferment of *S. humilis* pastures.

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