

EFFECTS OF METHOD OF RENOVATION AND RATE OF NITROGEN ON NATURALIZED PASTURES IN ATLANTIC CANADA

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ABSTRACT

Pastures in Atlantic Canada require periodic rejuvenation to maintain productivity. The effects of method of pasture renovation, soil loosening by paraplowing and nitrogen rates on naturalized pastures were determined. Both direct drilling and cultivation and sowing *Lolium perenne* L. and *Trifolium repens* L. in naturalized pastures increased the yields slightly and proportion of white clover. Loosening the soil by paraplowing tended to reduce the yields of naturalized swards. Nitrogen concentration and digestibility of dry matter were greatest in sown pastures.

KEYWORDS

Direct drilling, *Lolium perenne* L., nitrogen fertilization, *Poa* spp., paraplowing, *Trifolium repens*

INTRODUCTION

In Atlantic Canada pastures require periodic rejuvenation to maintain their productivity. Rundown pastures can be rejuvenated by reestablishing adapted and persistent grass and legume species. Reducing competition from the resident species by clipping, grazing or spraying with herbicides is usually necessary to establish adapted grasses and legumes. Suitable pasture renovators modify the seedbed so that the seed can be placed in contact with soil. This action also reduces competition from vegetation in immediate surroundings of seedlings. Compacted soil layer in pastures grazed by cattle can reduce sward growth and mechanical loosening of such soils may be needed to enhance pasture growth (Davies *et al.* 1989). However, although soil loosening may provide improved soil conditions it may have variable effects on pasture productivity (Frost 1988; Harrison *et al.* 1994).

The aim of this study was to determine the effects of methods of renovation, soil loosening and nitrogen fertilization on yields, composition and sward characteristics of naturalized pastures.

MATERIALS AND METHODS

The experiment was conducted in Charlottetown, Prince Edward Island, Canada. The soil was fine sandy loam, an Orthic Humo-Ferric Podzol, with a pH of 6.4. Fertilizer was applied in early May of each year at 35 kg ha⁻¹ of P and 66 kg ha⁻¹ of K. At seeding, nitrogen and boron were also applied at 20 and 0.8 kg ha⁻¹, respectively. The naturalized sward consisted mainly of *Poa pratensis* L., *Elytrigia repens* Nees., *Trifolium repens* L., *Taraxacum officinale* Weber.

The methods of sward renovation included:

- 1 Naturalized sward, unimproved
- 2 Naturalized sward, soil loosened by paraplowing (Howard Rotavator Co.Ltd, UK) to a depth of 20 cm on May 1, 1989.
- 3 Naturalized sward, sprayed with paraquat at 0.8 kg a.i. ha⁻¹ our days before direct drilling *Lolium perenne* L. cv. Norlea at 14 kg ha⁻¹ and *T. repens* cv Sonja⁻¹ at 4.0 kg ha⁻¹ with a pasture renovator (Hunter's, Chester, UK) on May 15, 1989.
- 4 Naturalized sward paraplowed and direct drilled as in 3.
- 5 Naturalized sward sprayed with glyphosate at 1.8 kg ha⁻¹ September 26, 1988 and cultivated by rototilling two weeks later. The plots were cultivated again and *L. perenne* sown with *T. repens* on May 15, 1989

Loosening of the 0 to 25 cm soil depth was carried out using a paraplow, a slant legged soil loosener which does not invert the soil (Carter *et al.* 1988; Frost 1988). Soil resistance to penetration, as an indice of soil compaction, was measured to the 35 cm soil depth at intervals of 3.5 cm using a recording penetrometer fitted with a 13 mm cone (Carter *et al.* 1988). Measurements were taken twice a year throughout the duration of the study.

Nitrogen, as ammonium nitrate, was broadcast in four monthly applications starting in early May:

- No nitrogen applied
- N applied at 115 kg ha⁻¹ in total
- N applied at 230 kg ha⁻¹ in total

The swards were cut four times a season at monthly intervals starting June 11 of each year. Vegetation samples were separated into sown species, other species and dead matter and dried at 80°C. Mineral and fibre composition of plant tissue was determined in freeze-dried samples. Five soil cores of 60 cm² each were collected from the plots receiving 115 kg N ha⁻¹. Grass tiller numbers, and stolon length of *T. repens* were measured.

The experiment was arranged as a split plot with rates of nitrogen in main plots and methods of renovation in sub-plots. Analysis of variance was performed on data for seeding and combined production years.

RESULTS AND DISCUSSION

In the seeding year dry matter yields were 0.5 to 2.6 t ha⁻¹ greater for the naturalized control than renovated swards (Table 1). In the production years the direct-drilled swards were the highest yielding. Steer gains on naturalized swards with similar composition have been somewhat less than on sown pastures (Kunelius and Narasimhalu 1993). Although loosening the soil plow layer by paraplowing significantly improved the soil physical condition (data not shown), it tended to lower the dry matter yields of naturalized sward of this long term pasture. In Wales Davies *et al.* (1989) found that slitting compacted soil with an aerator almost doubled the herbage production, while Harrison *et al.* (1994) showed that loosening the surface soil in pastures significantly increased pasture production in the first year. However, Frost (1988) indicated that loosening can adversely influence pasture yield due to sward disruption and root damage. In some cases, lack of yield response to soil loosening may be related to the absence of excessive levels of soil compaction at the initiation of the study that can influence pasture species.

Nitrogen at 115 kg ha⁻¹ increased yields over no N treatment but further yield increases due to 230 kg N ha⁻¹ rate was minimal. There was a large increase in *T. repens* yield in direct-drilled and cultivated treatments compared with naturalized sward (4.0 vs 0.6 t ha⁻¹).

In the production years, the N concentration of herbage was greater in swards direct-drilled or cultivated than in the naturalized control sward. This difference was due to greater *T. repens* content in the renovated than in naturalized sward. Nitrogen fertilizer increased total N of herbage in the seeding year when the *T. repens* content of

swards was low. The *in vitro* digestibility of dry matter (IVDDM) was greater for cultivated than other treatments. The cultivated sward contained largely sown species whereas direct-drilled swards had a large proportion of *Poa pratensis* and other resident species with lower IVDDM at the time of harvest. Nitrogen rates did not affect IVDDM.

The tiller density was greater in the naturalized sward than in direct drilled and cultivated stands. Naturalized sward contained a high proportion of *P. pratensis* while *Lolium perenne* cv. Norlea was the sown grass species. Tiller density was considerably greater for 230 kg N ha⁻¹ than for 115 kg N ha⁻¹ rate and control. Density of stolons and growing points of *T. repens* were greater for cultivated and direct-drilled sward than for naturalized control in the production years.

In conclusion, these data demonstrate the potential yield of naturalized pastures in Atlantic Canada; herbage yields were almost equal to those of renovated swards in the production years. Loosening the soil by paraplowing did not result in any significant improvement in herbage production.

REFERENCES

- Carter, M.R., H.W. Johnston and J. Kimpinski.** 1988. Direct drilling and soil loosening for spring cereals on a fine sandy loam in Atlantic Canada. *Soil Tillage Res.* **12:** 365-384.
- Davies, A., W.A. Adams and D. Wilman.** 1989. Soil compaction in permanent pasture and its amelioration by slitting. *J. Agric. Sci., Camb.* **113:** 189-197.
- Frost, J.P.** 1988. Effects on crop yields of machinery traffic and soil loosening. Part 1. Effects on grass yield of traffic frequency and date of loosening. *J. Agric. Engng Res.* **39:** 301-312.
- Harrison, D.F., K.C. Cameron and R.G. McLaren.** 1994. Effects of subsoil loosening on soil physical properties, plant root growth, and pasture yield. *New Zealand J. Agric. Res.* **37:** 559-567.
- Kunelius, H.T. and P. Narasimhalu.** 1993. Effect of grass-white clover mixtures on steer performance and sward characteristics in Atlantic Canada. *Proc. XVII International Grassland Congress, New Zealand:* 851-852.

Table 1

Effect of method of renovation and rates of nitrogen on mean dry matter yields, composition of herbage and on density of tillers and stolons in the seeding year (Sy) and two production years (Py).

Method	Yield, t ha ⁻¹		Total N, g kg ⁻¹		IVDDM, g kg ⁻¹		Tillers m ⁻²		Stolon, m m ⁻²	
	Sy	Py	Sy	Py	Sy	Py	Sy	Py	Py	
Naturalized (Nat.)	8.3	7.8	39	30	640	720	5514	4225	2.86	
Nat. + paraplow	7.8	7.4	40	29	630	706	5424	4102	3.08	
Direct-drill (DD)	5.7	8.5	37	34	721	737	2873	2422	4.59	
DD + paraplow	5.7	8.4	39	33	711	737	2428	2233	5.02	
Cultivate + seed	6.5	7.6	41	34	763	769	3112	1851	5.52	
sem, n 12, df 36	0.20	0.16	1.6	0.45	14.5	8.4	289	240	0.552	
F probability	<.001	<.001	.60	<.001	<.001	<.001	<.001	<.001	.004	
<u>Rate of N, kg ha⁻¹</u>										
0	5.7	6.8	35	31	697	746	3631	2771	5.49	
115	7.2	8.4	38	31	684	727	4299	2693	3.64	
230	7.5	8.7	44	34	697	728	3680	3436	3.51	
sem, n 20, df 6	0.19	0.14	.69	0.34	12.2	6.0	462	146	0.257	
F probability	.001	<.001	<.001	<.001	.72	.11	.55	.02	.003	