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SEASONAL GROWTH CURVES OF PERENNIAL RYEGRASS IN MEXICO

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Abstract

An experiment was established at Colegio de Postgraduados Research Station, Texcoco, México to evaluate the seasonal pattern of growth curve of perennial ryegrass (*Lolium perenne*) swards. Growth rate increases rapidly from a low level immediately after defoliation, and eventually reaches an equilibrium level as the amount of green leaf in the sward stabilize. The time required to reach this state varied according to the season of year, with the four seasons ranked in the order: spring (4 weeks) < summer (5 weeks) < autumn and winter (6 weeks). Once swards reached equilibrium, growth rates started to decline as a consequence of an increase in dead material and pseudostem. These increases were highest in spring and lowest in winter. The results of this study suggest that sward management to maximise herbage production and utilisation in ryegrass swards must be done once the highest green leaf mass is reached. In this trial, it was reached at 5, 6, 6 and 4 weeks in summer, autumn, winter and spring, respectively.

Keywords: Seasonal growth curve, perennial ryegrass, green leaf, sward management

Introduction

Growth and development of plants are strongly controlled by the environment conditions. The knowledge of the seasonal growth curve allows to fit the frequency of defoliation to control losses by senescence and decomposition and to get high forage quality. An understanding of the dynamics of pasture growth during the intervals between defoliations is therefore essential to an understanding of effects of frequency and intensity of defoliation on pasture growth (Hodgson *et al*., 1981).

As a consequence of the sward responses to the environment, substantial variation in management may have a relatively high impact upon the amount of herbage harvested throughout the year, particularly during winter time. Therefore, the seasonal dry matter accumulation of a pasture could be maximised if pastures are allowed to regrowth just beyond the optimum LAI when rates of net herbage accumulation approach a maximum (Chapman and Lemaire, 1993). The timing of these events will change according with the season. The objective of this experiment was to define the seasonal patterns of growth curve, in order to determine the extent to which perennial ryegrass should be harvested.

Material and Methods

A field plot experiment was lied down at the research unit, Colegio de Postgraduados, Montecillo, Texcoco, México. Ryegrass was sown in the autumn of 1996 and at the commencement of the experiment in the summer of 1998 sward consisted of approximately 95 % of ryegrass. The experiment lay-out included 32 plots harvested successively at weekly intervals (four plots per week) during a regrowth period of eight weeks, in each season of the year. All plots were cut to ground level only once during the experiment. Each plot was 2 by 2 m and each

block of 8 plots was surrounded by a mown headland sufficiently wide to permit access for individual plot cutting. During the dry period, plots were watered every 2 weeks.

Herbage mass was determined from three 0.25 m^2 quadrat per plot harvested to ground level. Herbage was washed then dried at 80 °C for 24 h and weighted. From the three quadrat cut one pooled subsample of herbage per plot was used to determine plant components (leaf, pseudostem, seedhead and dead material). Differences in accumulative herbage mass and sward characteristics for the four seasons were analysed statistically in a completely randomised block design with four replicates, with separate analyses carried out for each harvest date.

Results and Discussion

Seasonal changes in ryegrass growth curve are given in Figure 1. The results shows that growth curve changed according with the season of the year. In all seasons, the growth curve was sigmoide. In general, growth rate increases rapidly from a low level immediately after defoliation and eventually reaches an equilibrium level as the amount of green leaf in the sward stabilises (Table 1). The time required to reach this state varied according with the season of year; in spring it was reached faster (4 weeks) than summer (5 weeks), autumn and winter (6 weeks). A probable explanation of this increasing growth rate lies in the fact that during regrowth, pasture growth rate increases until the point where 95-100% of incident light is intercepted (Chapman and Lemaire, 1993). At this point, LAI is considered as the optimum, because green leaf accumulation rate was at a maximum and varied with season; it was higher in spring and summer when light intensities were greater.

Total herbage accumulation was lowest in winter and highest in spring, with the four seasons ranked in the order spring > summer > autumn > winter (Figure 1). Seedheads were

observed in late spring and summer, although its contribution to total herbage accumulation was less than 10 % (Table 1). Pseudostem tended to increase progressively as the regrowth age increased. The losses to senescence and decomposition initially increase more slowly, depending upon the season of year (Figure 1), but increase progressively and eventually come to equal the rate of growth; in some cases yields declined (spring and winter) because the death and decay of already grown offset any new growth (Hernández-Garay *et al*., 1999). It means that, net accumulation rate of biomass was at a maximum when the highest green leaf mass was reached, and then began to decline as leaves in the lower layers of the canopy were shaded below their light compensation point. These shaded leaves eventually die while other leaves pass into the shaded layer and move below light compensation point (Chapman and Lemaire, 1993); ceiling point was reached in spring and winter at four and six weeks of regrowth, respectively. At this point rates of growth tissue production are equalled by rates of tissue death and no further net accumulation of biomass results (Parsons, 1988).

The results of this experiment showed that defoliation management to improve pasture production and utilisation varied according with the season of the year. Also shows that the optimum time of defoliation to maximise pasture performance must be of 5, 6, 6 and 4 weeks for summer, autumn, winter and spring, respectively, once green leaf mass had reached its highest level and rates of tissue death started to increase progressively.

References

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Table 1 - Weekly changes on leaf, pseudostem, dead material, seedhead and total herbage accumulation over a 8-weeks regrowth period during the differents seasons of the year.

Season		Weeks of growth									
	Yield	1	2	3	4	5	6	7	8	SEM	Sig
	measured[1]	----------DM (kg/ha)----------								*	
Summer	Leaf	264	524	731	1142	1673	1577	1732	1667	127	***
98	Pseudostem	147	202	175	283	484	334	525	689	46	**
	Dead material	-60	-36	8	42	30	36	146	215	36	NS
	Seedhead	0	0	0	0	74	91	233	218	22	***
	Total	350	691	914	1467	2262	2037	2635	2790	197	***
Autumn	Leaf	185	272	373	653	881	1167	1019	1222	89	***
98	Pseudostem	36	24	8	68	94	213	177	395	34	*
	Dead material	234	159	182	249	271	323	348	661	40	*
	Total	454	455	562	970	1245	1704	1543	2279	152	**
Winter	Leaf	17	47	105	293	389	738	573	421	55	***
98	Pseudostem	18	2	20	79	108	222	210	152	23	NS
	Dead material	39	56	28	1	71	269	315	177	37	NS
	Total	74	105	153	373	568	1229	1097	750	96	***
Spring	Leaf	405	849	1065	1983	1466	1781	1056	1026	108	***
99	Pseudostem	45	380	439	923	565	604	673	701	63	***
	Dead material	280	425	438	513	825	1036	1052	1074	93	NS
	Seedhead	0	0	0	112	130	96	324	277	27	***
	Total	730	1653	1942	3532	2986	3517	3106	3079	217	***

SEM = standard error of difference between means.

* P < 0.05; ** P< 0.01; *** P < 0001; NS no significant differences.

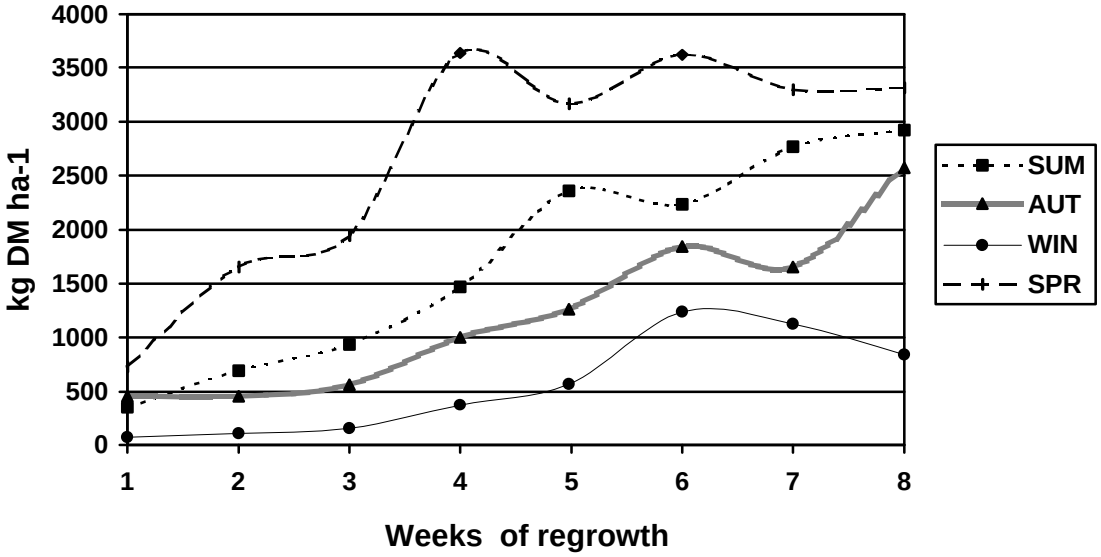

Figure 1 - Growth curves of ryegrass perenne over a 8-weeks regrowth period during the different seasons of the year.