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SEASONAL VARIATION OF WHITE CLOVER MORPHOLOGY AT THE NORTH OF BUENOS AIRES PROVINCE, ARGENTINE

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Abstract

In order to study the seasonal variation in morphological characters that contribute to forage production in white clover (*Trifolium repens* L.) cultivars, a trial was conducted at Pergamino Agricultural Experimental Station INTA located north of Buenos Aires province, Argentina. The experimental plots were set out in a completely randomized design with four replicates. Measurements were performed over eight seasons throughout two years. The used cultivars had been previously reported as having differences in seasonal productivity. Significant differences were detected among seasons for all measured characters i. e. stolon length, number of buds, branches and leaves, and leaf area. Differences among cultivars in almost all the season were only found for leaf area and stolon length. The growth in length of stolons kept a consistent pattern in both years. No cultivar produced vegetative buds during summers. The characters most affected by environmental stress were bud and branch development.

Keywords: *Trifolium repens* L., morphological characters, seasonal variation, cultivars.

Introduction

White clover is a common component of legume-grass pastures in the north of the Buenos Aires province, Argentina. In this area, the maximum growth of white clover occurs from middle spring to middle summer and the minimum in winter. If water becomes a limiting factor during the summer the growth is poor. In autumn, with favorable conditions, a growth peak can be observed. In this region, the persistence of this species in pastures is mainly due to vegetative propagation (Pagano and Scheneiter, 1998).

Horizontal spread of white clover depends on the stolon growth, and mainly leaflets and petioles compose the harvestable yield. The contribution made by leaves on each order of branch has been observed to vary with seasons (Beinhart, 1963). Selection for seasonal growth was effective to obtain cultivars with distinctive growth patterns (Williams 1987). The objective of this work was to study the seasonal variation for morphological characters that contribute to forage production in four white clover cultivars in the north of Buenos Aires province, Argentina, throughout two years.

Material and Methods

The trial was carried out at Pergamino Agricultural Experimental Station INTA (33º 56’ S; 60º 33’ W*)* Treatment were:

Grasslands Pitau (GP): Medium large-leaved cool-season active cultivar. Selected from hybrids between Grasslands Huia and a Spanish strain. Selection was done for winter growth. (Caradus, 1986).

Grasslands Kopu (GK): Large-leaved cultivar. Good summer and cool season growth. Based on crosses between G. Pitau and plants from ladino cultivars. (Caradus, 1986)

Cultivar experimental (L49): Large-leaved selected from El Lucero MAG. Selection was done for adaptation, annual herbage yield, persistence and seed production in the north of Buenos Aires province.

Ladino Gigante Lodigiano (GL): Large leaf size from northern Italy. Good spring and autumn production.

The experiment plots were set out in a completely randomized design with four replicates. The size of plots was 5,65 m^2 , separated with rows of tall fescue. The plants were not irrigated during the trial. Measurement was carried out over eight seasons for two consecutive years. In each season, 30 stolons of similar size per plot were chosen and the youngest internode was tagged with colored wire hoop. Tagged stolons were harvested after a period of 20 (spring), 30 (summer and autumn) and 40 (winter) days. In the lab, the following measurements were carried out in harvested stolons:

-total length stolon (mm)

-the number of bud (stolon growing from the axils with one unfolded leaf).

-the number of branches (stolon growing from the leaf axils and having at least three unfolded leaves).

-the number of leaves/stolon.

-Second opening leaf area (Carlson, 1966).

Data were statistically analyzed using GLM of SAS and least significant difference (LSD) test was used.

Results and Discussion

A summary of the results is shown in Tables 1 and 2. There were significant differences among seasons in bud production, although, among cultivars, differences occurred only during the first winter, being L49 and GL different to GP and GK ($p< 0.05$). The production of branches showed a similar pattern and differences for cultivars occurred only in the first autumn and winter. Both characters were the most affected by environmental stresses.

This fact suggests that the season was the principal factor affecting the bud and branch production in this region, with a drastic reduction during the summer, in agreement with the observations of Lawson et al (1997).

Stolon length was significantly different among seasons. The higher values were recorded in spring, and then stolon length decreased reaching the lowest peak in winter.

L.49 had a greater stolon length as compared to the other cultivars ($p < 0.05$) whenever differences were detected, and G. Pitau always showed the lowest stolon growth. A differential response of the cultivars was expected, particularly during the winter because some of them were improved for winter growing. The adapted material was superior, anyway. These results indicate the importance of using germplasm adapted to local environment conditions.

The number of leaves was high in spring, declined in summer and increased again in autumn. However, this behavior changed during the second year, probably due to spring drought**.** Differences among cultivars were significant in several seasons, L49 and GL showed a tendency to have a higher leaf number than GP and GK.

The leaf area followed a pattern of seasonal change similar to that of leaf number. There were also differences among cultivars in all the seasons, but the second summer.

The seasonal variations detected in the studied morphological characteristics, would probably explain cultivar differences in herbage yield observed in previous evaluations.

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Table 1 - Seasonal variation for morphological characteristics during two consecutive years

Character	Year	Spring	Summer	Autumn	winter	significance
buds	Year 1	1.23	0.02	0.75	0.28	***
nº/stolon	Year 2	0.15	0.006	0.25	0.15	**
branches	Year 1	3.38	0.00	1.12	0.63	***
nº /stolon	Year 2	0.05	0.14	0.43	0.34	***
stolon	Year 1	250	56.7	51.3	26.80	***
(mm)	Year 2	61.3	41.8	33.03	17.17	***
leaves	Year 1	13.7	2.8	7.14	5.32	***
(nº/stolon	Year 2	3.8	4.0	3.95	4.3	ns
Leaf area	Year 1	4.64	1.62	2.04	2.13	***
(cm^2)	Year 2	2.83	2.26	2.72	1.68	***

Table 2 - Seasonal variation for morphological characteristics of four cultivars throughout two consecutive years.

character	cultivars	----------YEAR 1----------				----------YEAR 2 ----------			
		spring	summer	autumn	winter	spring	summer	autumn	winter
nº buds/stolon	GP	1,10a	0,011a	0,72a	0,12b	0,18a	0,0a	0,084a	0,067a
	GK	1,09a	0,00a	0,34a	0,0c	0,13a	0,0a	0,145a	0,12a
	L49	1,017a	0,098a	0,81a	0,43a	0,06a	0,035a	0,197a	0,667a
	GL	1,54a	0,001a	1,04a	0,572a	0,2a	0,0a	0,455a	0,325a
nº branches/ stolon	GP	3,65a	0,003a	1,13b	0,0b	0,02a	0,239a	0,223a	0,453a
	GK	3,58a	0,010a	0,31b	0,97ab	0,09a	0,275a	0,297a	0,37a
	L49	3,94a	0,002a	2,19a	0,51ab	0.06a	0,063a	0,620a	0,36a
	GL	3,36a	0,002a	0,60b	1,045a	0,03a	0,095a	0,517a	0,315a
stolons (mm)	GP	193c	27,5b	32,07b	22,8bc	56,7a	24,14a	14,08b	9,11a
	GK	266b	43,50b	30,88b	26,5b	62,6a	46,4a	29,4b	20,95a
	L49	346a	105,2a	77,71a	41,1a	58,4a	48,28a	52,80a	24,92a
	GL	194c	44,30b	57,1ab	16,94c	69,5a	47,78a	29,45b	14,84a
nº leaves/ stolon	GP	13,32a	1,93a	6,17b	5,02a	3,48b	3,41a	3,83a	3,02b
	GK	14,85a	2,94a	4,55b	6,46a	3,16c	4,70a	3,99a	4,53ab
	L49	13,09a	3,64a	10,67a	4,97a	3,85b	3,70a	4,08a	4,32ab
	GL	13,54a	2,07a	6,31b	4,82a	4,52a	4,13a	3,95a	5,09a
leaf area (cm^2)	GP	3,48b	1,18b	1,28b	1,60b	2,16b	1,57a	1,84b	1,15a
	GK	4,36b	1,12b	1,61ab	1,68b	2,29b	2,30a	2,65b	1,87a
	L49	6,33a	2,32a	2,55a	3,38a	2,80b	2,81a	3,75a	2,25a
	GL	4,39b	1,77a	2,66a	1,85b	4,04a	2,34a	2,52b	1,53a

Numbers with different letters differ significantly ($P < 0.05$)