MORPHOGENESIS AND GROWTH ANALYSIS OF PANICUM MAXIMUM CULTIVARS

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ABSTRACT

Four cultivars of *Panicum maximum*, grown in pots, were evaluated regarding their leaf appearance and elongation rates, tillering appearance rate, as well as growth indices. Differences among cultivars were found as to leaf appearance and elongation rates and tillering rates. Main tiller leaf appearance was higher relative to primary tiller in the seedling growth, only. Primary tiller showed higher leaf elongation rate in the aftermath growth. No difference among cultivars was found for drymatter yield after 52 d growth period, leaf mortality, net assimilation rate, leaf area ratio and relative growth rate.

KEYWORDS

Centenário, Mombaça, Tanzânia, Vencedor, leaf area, leaf senescence

INTRODUCTION

Drymatter production closely correlates with plant leaf area which varies according to plant tiller number and leaves number per tiller. Development stage (Robson, 1973) and genotype (Pinto *et al.*, 1994) are among the many factors associated with the number of live leaves on a tiller. Leaf appearance and elongation are the main physiological processes determining tiller weight; and leaf appearance rate shows high correlation with tiller numbers per plant (Skinner and Nelson, 1992; Van Loo, 1992). Tiller number and size are two components of plant weight, their relative importance changes with plant developmental stage (Silsbury, 1966) and sward plant population. Drymatter yield correlates better with tiller weight than number (Nelson and Zarrough, 1981). Growth indices such as leaf appearance, elongation and senescence rates, tillering, relative growth and net assimilation rates and leaf area ratio are important information in the interpretation of forage drymatter production as affected by environment, genotypes, and management. Drymatter production of *Festuca arundinacea* correlated highly with leaf extension rate (Horst *et al.*, 1980) and net assimilation rate (Wilhelm and Nelson, 1978).

MATERIALS AND METHODS

Four cultivars of *Panicum maximum*: Centenário, Mombaça, Tanzânia and Vencedor were grown in plastic pots kept under a transparent plastic cover and watered twice daily. The pots were filled with clay type soil, pH 4.5; 4.7 and 58 $mg.dm^{-3}$ of P and K, 0.6 and 1.9 cmolc dm^{-3} of Ca + Mg and Al. This soil was limed and enriched with 150 $mg.Kg^{-1}$ with N and P. At sowing, the pots were wetted before receiving 18 seeds of the appropriate cultivar. Seven days after seedling emergence the pots were thinned to 5 plants each. The plants grew over a 52 days period, receiving N and K solution at the rate of 50 mg Kg^{-1} soil, every other week. Two trials were run. In the first one, records of the ligule appearance and length of leaf lamina, leaf senescence and death and tillers appearance, were made on the main and one primary tillers, tagged with colored plastic wire, three times a week. There were four pots per cultivar in a randomized design consisting of two growths: seedling and aftermath from cutting taken when plants were 21 days old, and four cultivars. Regression analysis on accumulated leaf length per tiller and leaf number per tiller vs time (d) was used to determine the lamina extension rate per tiller (LER) and the leaf appearance rate (LApR).

The second trial dealt with the growth analysis of the last three cultivars. There were three pots per cultivar, which were clipped at soil level at the ages of 17, 24, 31, 38, 45 and 52 days after seedling emergence. At each clipping, records were made on total drymatter weight, leaf drymatter weight and leaf area measured in area meter (LI-COR LI - 3100B). Quadratic equations were fitted to average values of leaf area, leaf dry weight and total drymatter vs time (d), from which net assimilation rate (NAR), relative growth rate (RGR) and leaf area ratio (LAR) were estimated according to Radford (1967).

RESULTS AND DISCUSSION

During the seedling growth, the number of live expanded leaves on the main tiller raised quadraticly with plant age reaching a maximum of 7 leaves on the 22^{nd} day (Fig. 1a); but, latter expanded leaves reached greater length (Fig. 1b) and area, hence tiller leaf area kept growing longer, despite senescence and death of first expanded leaves. The elongation rate of individual leaves increased assymptoticaly with insertion level up to leaf 7, while leaves of higher insertion level exhibited longer elongation period (Fig. 1b). The average length of the first 13 leaf laminas increased linearly (r = 56.8 $mm.Li^{-1}$) with leaf insertion level (Li) (Fig. 1b). Mean life span of leaves number 6 to 9 ranged from 19 to 21 days. Main tiller leaf senescence was first seen on day 20^{th} and developed at a rate of 0.28 $leaf.d^{-1}$. The number of tillers appearing on Mombaça main tiller increased, during the first three weeks (Fig. 1a). Average number of tillers per plant varied ($P<0,05$) from 8 up to 13, in Mombaça and Tanzânia, respectively, on the 52nd day.

Seedling growth compared favorably with aftermath growth as to leaf appearance rate (0.17 vs 0.12 $leaf.d^{-1}$) and elongation rate (85.6 vs 69.1 $mm.tiller^{-1}.d^{-1}$). LApR and LER exhibited interaction ($P<0.05$) between tiller types and growths. Main tiller had higher LApR (0.18 vs 0.16 $leaf.d^{-1}$) in the seedling growth while primary tiller had higher LER (73.6 vs 64.6 $mm.d^{-1}.tiller^{-1}$) in the aftermath growth. The cultivars differed among themselves regarding both growth rates. Leaf appearance rates ranged from 0.12 up to 0.18 $leaf.d^{-1}$ in Mombaça and Vencedor, respectively; while leaf extension rates ranged from 69.4 to 90.2 $mm.tiller^{-1}.d^{-1}$ in Tanzânia and Centenário, respectively.

No difference was found among Mombaça, Tanzânia and Vencedor as to leaf drymatter, leaf area and total plant drymatter, per pot, at the age of 52 days. Estimates of NAR, LAR and RGR reached high values and varied among cultivars at the age 17 days (Table 1). From the age of 24 days on the estimates were uniform among cultivars and dropped as plants developed, linearly for LAR and quadraticly for NAR and RGR. Aging and self-shading of leaf area, together with total plant respiration, account for the decrease in NAR values; while lower LAR values come from greater allocation of assimilates to plant tissues other than the assimilatory machinery.

The difference in leaf appearance and tillering rates among the cultivars ($P<0,05$) were either too small or offset by differences in NAR to bring about differences among cultivars as to plant leaf area and total drymatter yield.

REFERENCES

Horst, G.L.; C.J. Nelson and K.H. Asay. 1980. Relationship of elongation to forage yield of tall fescue genotypes. Crop Sci. **18**: 715-719.

Nelson, C.J. and K.M. Zarrough. 1981. Tiller density and tiller weight as yield determinants of vegetative swards. In: Wrigth, C. E. Pant physiology and herbage production. Occasional symposium n.13, pp 25-29.

Pinto, J.C.; J.A . Gomide; M. Maestri and N.F. Lopes. 1994. Crescimento de folhas de gramÌneas tropicais, cultivadas em vasos, sob duas doses de nitrogÍnio. Rev. Soc.Bras. Zoot. **23:** 327-322.

Radford, P.J. 1967 Growth analysis formulae: Their use and abuse. Crop Sci. **7:** 171-175.

Robson, M.J. 1973. The growth and development of simulated sward of perennial ryegrass. Ann. Bot. **37:** 487-500.

Silsbury, J.H. 1966. Interrelation in the growth and development of Lolium. II Tiller number and dry weight at low density. Aust. J. Agric. Res. **17:** 841-847.

Skinner, R.H. and C.J. Nelson. 1992. Estimation of potential tiller production and site usage during tall fescue canopy development. Annals of Botany. 70: 493-499.

Van Loo, E.N. 1992. Tillering, leaf expansion and growth of plants of two cultivars of perennial ryegrass grown using hidroponics at two water potentials. Annals of Botany. **70:** 511-518.

Wilhelm, W.W. and J.R. Nelson. 1978. Growth analysis of tall fescue genotypes differing in yield and leaf photosynthesis. Crop Sci. **18:** 951-954.

Table 1

Net assimilation rate (NAR), leaf area ratio (LAR) and relative growth rate (RGR) of three *Panicum maximum* cultivars at six ages.

CULTIVARS*

Age (days)	1	2	3	1	2	3	1	2	3
	NAR ($g.m^{-2}.dia^{-1}$)			LAR ($m^2.g^{-1}$)			RGR ($g.g^{-1}.dia^{-1}$)		
17	20.0	36.1	30.2	0.029	0.096	0.171	0.585	3.462	5.164
24	8.4	8.4	9.3	0.015	0.017	0.016	0.124	0.142	0.182
31	6.1	5.4	5.8	0.012	0.014	0.012	0.073	0.074	0.072
38	5.3	4.4	4.6	0.010	0.012	0.010	0.053	0.051	0.048
45	4.9	4.0	4.0	0.009	0.010	0.009	0.042	0.039	0.036
52	4.7	3.9	3.8	0.007	0.008	0.007	0.035	0.032	0.029

* 1- Mombaça; 2- Tanzânia; 3- Vencedor

Figure 1

a- Number of expanded leaves (total u and alive n) and tiller per main tiller (l) of Mombaça plotted against time; **b-** Lamina elongation rate (mm.d $^{-1}$ u), elongation period (days n and lamina length (cm l) of successive leaves.