ISSN impreso: 0258-5936
ISSN digital: 1819-4087

Ministerio de Educación Superior. Cuba
Instituto Nacional de Ciencias Agrícolas
http://ediciones.inca.edu.cu

RESPONSE TO CAYMAN GRASS (*Brachiaria hybrid* cv. CIAT BRO2/1752) TO WATER DEFICIT

Respuesta del pasto Cayman (*Brachiaria híbrido* cv. CIAT BRO2/1752) al déficit hídrico

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ABSTRACT. The objective of this work was to study, the effect of two irrigation treatments on soil moisture content, growth and yield variables in the Cayman grass (*Brachiaria hybrid*). The cultivar employed was CIAT BRO2 / 1752 grown in double row in concrete containers of 1,56 m^2. Irrigation treatments consisted of applying 50 and 100 % of ETc, (T 50 and T 100, respectively). Bottom fertilization was performed before planting with complete NPK (9-13-17) and urea (46-0-0), applying to each channel 0,1and 0,04 kg, respectively. The irrigation was applied through an automated system of micro spray and the delivery of the water was controlled by valves placed conveniently in each treatment. The results showed a significant effect of the treatments on the soil water content where the T 50 plants showed a water deficit at 50 and 74 days after sowing (DAS), also the effect of the irrigation treatments on the growth variables was observed where significant differences were only found in the accumulation of dry mass of the aerial part, root and total of T 100 plants. The relative content of water decreased in plants T 100 although this did not influence to obtain higher results in dry mass production (t ha^{-1}).

Key words: growth, irrigation, water use

RESUMEN. El objetivo de este trabajo fue estudiar el efecto de dos tratamientos de riego en el contenido de humedad del suelo, variables del crecimiento y el rendimiento en el pasto Cayman (*Brachiaria híbrido)* cv CIAT BRO2/1752 cultivado en doble hilera en contenedores de hormigón de 1,56 m^2. Los tratamientos de riego, consistieron en aplicar el 50 y el 100 % de la Evapotranspiración estándar del cultivo (ETc), T 50 y T 100, respectivamente. Se realizó una fertilización de fondo antes de la siembra con fórmula completa NPK (9-13-17) y urea (46-0-0) aplicando a cada canaleta 0,1 y 0,04 kg, respectivamente. El riego se aplicó mediante un sistema automatizado de micro aspersión y la entrega del agua se controló mediante válvulas colocadas convenientemente en cada tratamiento. Los resultados mostraron un efecto importante de los tratamientos en el contenido hídrico del suelo donde las plantas T 50 mostraron un déficit hídrico a los 50 y 74 días después de la siembra (DDS), también hubo efecto de los tratamientos en las variables del crecimiento donde sólo se encontraron diferencias significativas ($P<0,05$) en la acumulación de masa seca de la parte aérea, raíz y total a favor de las plantas T 100. El contenido relativo de agua disminuyó para las plantas T 100 aunque esto no influyó para que se obtuvieran resultados superiores en la producción de masa seca (t ha^{-1}).

Palabras clave: crecimiento, riego, uso del agua

INTRODUCTION

The availability of good quality forages has been one of the main limitations for the tropics; given their characteristics of location and climatic conditions, they become specialized areas for the production of meat and milk, thus improving the living conditions of the livestock producers. A decision of the breeder is to choose the grass that best adapts to the conditions of his land, to the management and zootechnical purpose of his productive unit (1).

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The pastures of the *Brachiaria* genus are an option to study in plots in a controlled manner and, in this way, to test if they are a potential alternative to recommend for the tropical livestock of the region.

On the other hand, water is one of the most important factors in the development of grasses, since this constitutes approximately 80 % of the tissues of plants. When low rainfall occurs or the distribution of these is irregular, water deficit conditions in the soil are generated, which negatively affect the internal water relations, which limits the survival of the species (2).

Forage grasses, like many species, vary considerably in their tolerance to stress due to water deficit. In some cases they undergo changes that may allow them to adapt or escape the negative effects caused by water stress (3). The hybrid Brachiaria Cayman grass with a growth habit tiller produces abundant stolons. In addition, in conditions of high humidity, this grass modifies its habit of growth and develops, early in its growth cycle, a large number of decumbent stems, which produce tillers and roots in the nodules, a characteristic similar to that of *Brachiaria humidicola*. These superficial roots support the plant, absorb nutrients and supply oxygen to the plant in adverse conditions of poor drainage (4).

Taking into account the aforementioned, the research that aimed to evaluate the response of Brachiaria hybrid cv. CIAT bro2 / 1752 (Cayman grass) to water deficit under semi-controlled conditions.

MATERIALS AND METHODS

The work was carried out in the central area of the National Institute of Agricultural Sciences (INCA) during the months of September to December 2016, for which 12 concrete containers were sown 2,60 m long by 0,60 m wide (1,56 m^2) containing Ferralitic Red Leached soil (5). In each container, seeds of Cayman grass (*Brachiaria* hybrid cv CIAT BR 02/1752) were sown in drilling and arranged in two rows, with a separation between them of 0,25 m.

Background fertilization was performed with complete formula NPK (9-13-17) and urea (46-0-0) applying to each container 0.1 and 0.04 kg, respectively. Irrigation was applied by means of an automated micro spray system and water delivery was controlled by valves placed on the sides of each treatment. Two irrigation variants (six containers per treatment) distributed according to an experimental design of random blocks with three repetitions were tested. The irrigation treatments tested were:

T100, irrigated at 100 percent of the crop standard Evapotranspiration (ETc.).

T50, irrigated at 50 percent of the ETc.

The evapotranspiration of the reference culture (ETo) was calculated using a series of data 27 years of a nearby meteorological station (approximately 200 m from the experiment) and the FAO Penman-Monteith method (6) was used. The standard crop evapotranspiration (ETc.) was calculated by the following equation:

$$ETc. = ETo * Kc. \quad [1]$$

Where:

Etc. Culture evapotranspiration [mm d^{-1}],

Kc. Crop coefficient [dimensionless],

Eto. Evapotranspiration of the reference culture [mm d^{-1}].

The Kc cultivation coefficients used were the following:

Kc. initial= 0,30, Kc. mean= 0,75 y Kc. final= 0,75

During the period of germination and emergence (first 10 days), irrigation was 3 mm per day in both treatments to guarantee homogeneous initial growth. From this moment, irrigation was applied according to each treatment. Effective rainfall was considered when it was greater than 3 mm. Other cultural services (mainly manual weeding) were carried out equally in both treatments.

During the conduction of the experiment the maximum, minimum and average temperatures were recorded, processing the data of the three variables in a decennial manner.

Soil moisture (%) was evaluated weekly, using a TDR (Time Domain Reflectrometry) Field Scout TDR 100 System, Spectrum Technologies, Inc., in each treatment 30 measurements were made (10 in each container) at 20 cm of depth. In addition, the relative water content (CRA) was determined in well-developed young leaves (7) taking 9 leaves in each treatment (3 plants in each container), according to the gravimetric measurement procedure, using the following equation:

$$CRA\ (\%) = [(MF - MS)/\ (MT - MS)] \times 100$$

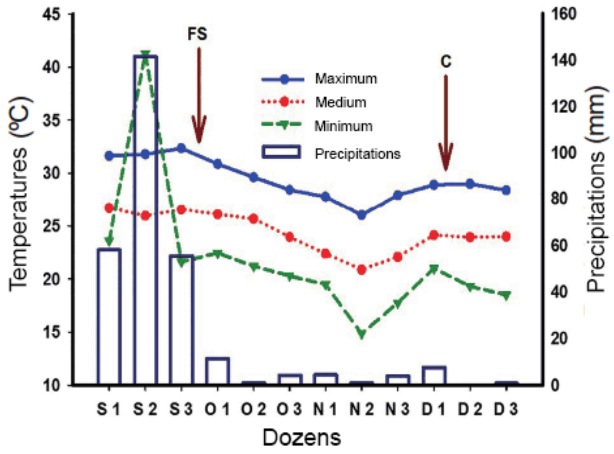
Where: MF- fresh dough, MS- dry mass, MT- turgid dough.

The yield of dry matter was determined at 30, 60 and 80 days after sowing (DAS), harvesting a sample of six plants per treatment, dried in forced air oven at 75 °C during 72 h, its dry mass was recorded and with these data the dry matter yield of the aerial, root and total part was determined, as well as the ratio of aerial dry mass / dry root mass.

For the processing of the data, the comparison of means and the calculation of the confidence interval, the Statistical Program SPSS 19.0 for Windows and the SIGMA PLOT 11.0 were used to graph the results.

RESULTS AND DISCUSSION

Figure 1 shows the environmental conditions (minimum, average and maximum temperatures), as well as the precipitations that occurred during the development of the experiment.



Air temperature values and decadal precipitation. The arrows indicate date of sowing (FS) and harvest (C). 1, 2 and 3, are the tens

Figure 1. Environmental conditions in the experimental period at INCA, San José de las Lajas, Mayabeque

Pasture growth and productivity is influenced by existing climatic conditions, mainly due to the annual distribution of rainfall, which, together with other environmental and management factors, have an impact on the fact that these do not fully reflect their productive and nutritional potential (8). The basic biochemical or physiological processes related to the synthesis, transport and degradation of substances in plants are also affected, by the degree of relationship they have with the kinetics of biochemical reactions and the maintenance of the integrity of the membranes (9). Not all grass species have the same optimal temperature value. Thus they reported that in tropical grasses (9), the photosynthetic optimum is between 35-39 ˚C with a high sensitivity to low temperatures, whose negative effects on growth occur between 0 and 15 ˚C and in some species at 20 ºC, which is given by the low conversion of sugars in the tissues of plants, product of a decrease in biosynthesis processes and an energy deficit produced by a reduction in the respiratory rate.

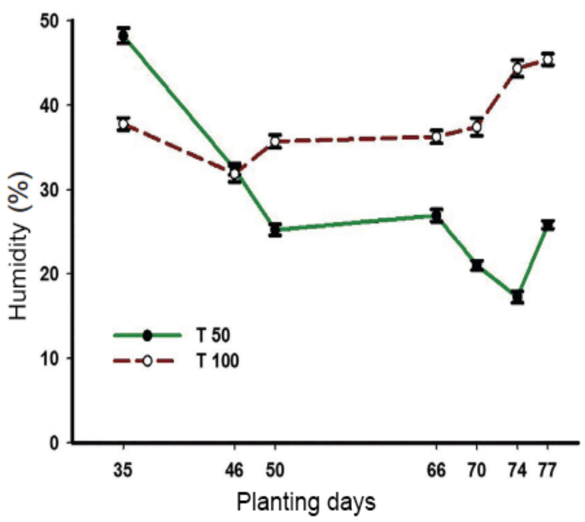
As it is observed, temperatures are below what was previously stated with an average of around 25 ºC, which seems to indicate that it is not a limiting element in this case. Similar results have been obtained in the growth of *Pennisetum purpureum* sp (10) and in *Cynodonn lemfuensis* Vanderyst (11) which showed their maximum growth in the period from May to October. Also in works carried out (12) it is stated that the forage species known in Cuba grow at an annual average temperature between 20 and 30 ºC, which allows them to have a wide range of adaptation throughout the territory.

In addition, it arises in the growing use of the *Brachiaria* genus, as is the case of the Cayman grass is because it has better agronomic characteristics, greater adaptation and resistance to various abiotic factors (waterlogging and drought), fungal attacks, pests and simultaneously selected for greater biomass production and better nutritional quality (13,14).

In the case of rainfall despite being scarce (below 5 mm), they did not limit the development of the crop since two treatments were established in which 50 and 100 % of the ETc were irrigated.

The effect of rainfall related to the growth and quality of pastures depends on multiple factors that are associated with the environment, the soil and the plant species (15). In this sense, it has been pointed out in the literature that (8), the growth of pastures is a function of the humidity available in the soil and that this in turn varies depending on the amount and distribution of rainfall, the structure and slope of the soils, the radiation and temperature values, as well as the area covered by the vegetation (9).

Figure 2 shows the behavior of soil moisture in both treatments. In T100 soil moisture remained in most of the experimental period between 30 and 40 % and at the end (74 and 77 DAS) increased above 40 %, while in T50 between 35 and 50 DAS the humidity decreased from around 50% to approximately 25%, however, between 50 and 66 DAS remained between 20 and 30 %, so it is evident that plants from T 50 to 70 and 74 DAS were subject to stress severe water.



The bars on the average values represent the confidence interval of the means, α=0.5

Figure 2. Seasonal variation of soil water content in both treatments T 50 and T 100 at 20 cm depth

Similar results in terms of variations in soil moisture were found in the cultivation of wheat (*Triticum aestivum* L.) cultivar INCA TH 4 when studying the physiological response to water deficiency of the soil (16).

The growth indicators evaluated in the different moments of the crop cycle are presented in the Table, where it is shown that at both the 60 and the 80 DAS no significant differences were found (P< 0,05) in any of these variables between the plants of the two treatments, although in general the values were slightly higher in well watered plants (T 100). At 30 DAS, only statistically significant differences were found in the dry mass accumulation of the aerial, root and total parts in favor of the T 100 plants.

Table 1. Effect of irrigation treatments on growth variables at 30, 60 and 80 DAS

Treatment	Dry mass Aerial part (g)	Dry mass Root (g)	Dry mass Total (g)	Relation MS PA/ MS Raíz
30 DDS				
T 50	0,500	0,121	0,621	4
T 100	1,277	0,309	1,586	4
ESx	0,127*	0,038*	0,156*	0,494 ns
60 DDS				
T 50	3,182	0,928	4,110	4
T 100	2,344	0,678	3,022	3
ESx	0,437ns	0,196 ns	0,618 ns	0,496 ns
80 DDS				
T 50	3,165	0,913	4,078	4
T 100	4,480	1,322	5,802	3
ESx	0,504 ns	0,167 ns	0,615 ns	0,871 ns

Average of six plants. ESx, is the standard error of the means, n. s. indicates that there are no significant differences and an asterisk indicates that the significance was at p = 0.05%

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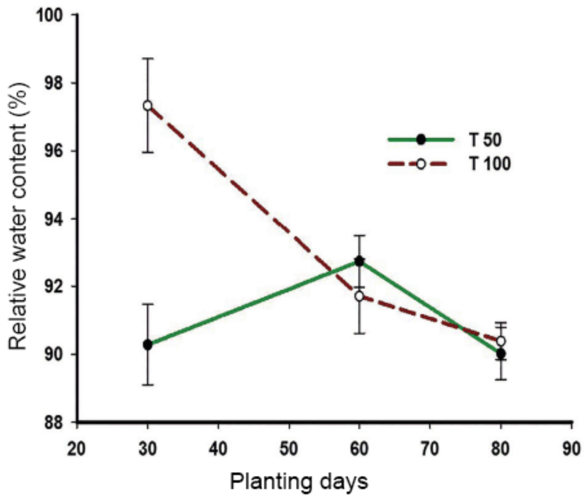
In general, it can be summarized that the irrigation treatments had practically no effect on the growth variables of the plants evaluated, since only significant differences were found in the accumulation of dry biomass of the aerial part, root and total at 30 DAS, respectively, and always in favor of the T 100 plants. However, at the 60 and 80 DAS evaluated no statistically significant differences were found, behavior that may be associated to that in both treatments practically had until the first 66 DAS a sufficient water supply to allow the plants to maintain adequate levels of accumulation of dry biomass, in addition to the precipitations that occurred just before sowing (Figure 1).

The relative water content (CRA) is the most used expression to measure the water level of a fabric. It is the measure of the water content with respect to the total that it can store; it is expressed as a percentage and allows knowing the water status of the plant.

There is abundant information on the water content of native and exotic grasses, an attribute commonly calculated as a byproduct of dry matter estimation for biomass yield studies (17).

Figure 3 shows the relative water content (CRA) in the evaluated treatments where it can be seen that the T 50 plants experienced an increase of about 50 days decreasing at the end of the cycle, however, the plants did well irrigations of T 100 decreased the CRA from the beginning.

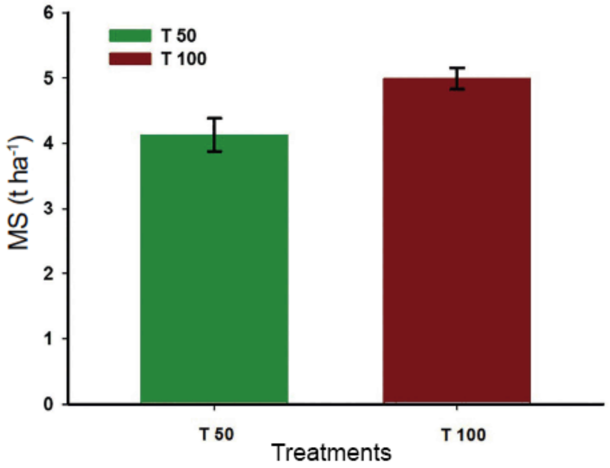


The bars above the mean values represent the confidence interval of the means, α=0.5

Figure 3. Relative water content (%) in both treatments T 50 and T 100

The condition of the soil moisture deficit present in the T 50 plants (Figure 1), limited the dry matter production potential (Figure 4). This low humidity availability means that the plants do not express their productive potential, in this case, in the production of DM. This was demonstrated in a similar work but in alfalfa (*Medicago sativa*) carried out in 46 different environmental conditions (18), where it was observed that when the varieties grew under limiting conditions of soil moisture, they showed very little variation in DM production among themselves. , that when they developed under favorable conditions of humidity.

Similar results were obtained in a trial where this same cultivar was used to estimate the accumulated forage production every ten weeks in the rainy season in Oaxaca - Mexico (19).



The bars above the mean values represent the confidence interval of the means, α=0.5

Figure 4. Effect of irrigation treatments T 50 and T 100 on the production of dry matter (DM) (t ha⁻¹)

CONCLUSIONS

By way of conclusion, it can be stated that the plants of the CIAT BR02/1752 cultivar of the Cayman grass to reach a development, yield and make an efficient use of water, do not necessarily require excessive water supplies, but a good management.

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Received: June 16th, 2017
Accepted: December 26th, 2017

Revista Cultivos Tropicales
Instituto Nacional de Ciencias Agrícolas