PRELIMINARY RESULTS ON AGRONOMIC PERFORMANCE OF CASSAVA-UROCHLOA BRIZANTHA INTERCROPPING

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ABSTRACT

This study aimed to evaluate agronomic traits of a cassava (*Manihot esculenta*) intercropping system with *Urochloa brizantha* (Syn. *Brachiaria brizantha*). The experiment was carried out at Paranavaí, Brazil, in the 2020-2021 agricultural season. Six treatments were studied with different establishment times of cassava-*Urochloa brizantha* intercropping and grass management: T1: cassava in double rows-DR (13,888 pl ha^{-1}) planted simultaneously with *U. brizantha* + mowing; T2: cassava DR and *U. brizantha* simultaneously + herbicide underdose; T3: cassava DR + *U. brizantha* sown 6 months after cassava + mowing; T4: cassava DR + *U. brizantha* sown 6 months after cassava + herbicide underdose; T5: single-row cassava monoculture with 13,520 pl ha^{-1}; T6: single row cassava monoculture with 18,168 pl ha^{-1}. *Urochloa brizantha* reduced the growth in height and stem diameter of cassava plants up to 180 days after planting (DAP) in T1 and T2, but not significantly ($p < 0.05$) in T2 when herbicide was used. The dry matter (DM) yield of pasture increased monthly from 90 (356 kg ha^{-1}) to 150 DAP (950 kg ha^{-1}), but it reduced 50% at 180 DAP (406 kg ha^{-1}).

Key words: BRS 429; double row arrangement; brachiaria

INTRODUCTION

Cassava (*Manihot esculenta* Crantz), originally from South America, is the main source of carbohydrate in the diet of poor populations in Africa, Asia and Tropical America. It is an easily cultivated food crop adapted to low fertility and acidity soil, to drought, little affected by pests, and requires minimal inputs (CEBALLOS et al., 2010). However, the successive cultivation of cassava can cause the depletion of soil nutrients and erosion, in addition to increasing losses due to competition with weeds, at levels above those observed in other crops under the same conditions. (SUYAMTO & HOWELER, 1997). Brazil is the fifth largest world cassava producer, with an annual production of 17.6 million tons of fresh roots from 1.2 million ha. Nigeria and Thailand are the two largest producers, with 59.5 and 31.7 million tons, respectively (FAO, 2019). Cassava cultivation in the center-south Brazil has expanded over sandy soils originating from sandstones, with emphasis on northwestern Paraná state, where the “Caiuá” formation predominates, occupying 3.2 million ha and covering 107 municipalities. The cassava root produced in these municipalities is used for industrial processing, mainly for starch production, which supplies the national market and represents more than 50% of Brazilian production (DERAL, 2020). The degree of technification is the highest in Brazil, with the use of mechanization, inputs, and genetics. However, these soils have a low organic matter content, low water retention capacity and high susceptibility to erosion, which, associated with the physiological characteristics and management practices, have caused a decline in the average root yield in the last decade at Paranavaí geographic microregion (IBGE, 2020). Another important agricultural activity in northwestern Paraná is beef cattle. Despite research and technology transfer efforts to expand the integrated crop-livestock-forest (ICLF) systems, high summer air temperatures and low soil water storage capacity raise climatic risks for crops of corn and soybeans, which has limited the full and widespread adoption of ICLF systems (FRANCHINI et al., 2016). The cassava’s crop is traditionally used in the renewal of pastures in areas under lease, which provides some economic advantage for cattle ranchers and farmers, but has contributed little to the improvement of soil attributes and the sustainability of activities. In the view of the challenges posed for cassava cultivation in the "Caiuá" sandstone and the need to develop a more sustainable livestock based on ICLF system, several technologies were sought to establish and evaluate a prototype of a cassava-brachiaria intercropping with purposes like those of the corn-brachiaria intercropping.

MATERIAL AND METHODS

The work was carried out in the Experimental Farm of the University Center Unifatecie, Paranavaí (PR), located at 23°00'52.0"S and 52°31'17.0"W; 467 meters of altitude. The soil is Typic Haplustox with sandy texture. The soil preparation was mechanized with plowing and two leveling harrows. The soil correction was carried out with the application of calcitic limestone at a dosage of 1,000 kg ha^{-1} and incorporation with disc plows when tilling the soil. The experiment was planted on August 7, 2020. The experimental design was completely randomized blocks, with six treatments and four replications. The treatments were combinations of cassava planting arrangements in consortium with *U. brizantha* cv. Marandu and ways of managing the grass during the cassava cycle. T1: cassava in double rows-DR (2.7 x 0.5 x 0.45 m, 13,888 pl ha^{-1}) planted simultaneously with *U. brizantha* + mowing; T2: cassava DR and *U. brizantha* simultaneously + herbicide underdose (Fluazifop-p-butyl, 55 g i.a. ha^{-1}); T3: DR cassava + *U. brizantha* sown 6 months after cassava + mowing; T4: Cassava DR + *U. brizantha* sown 6 months after cassava + herbicide underdose; T5: single-row cassava monoculture with 13,520 pl ha^{-1}(0.86 x 0.86 m); T6: single row cassava monoculture with 18,168 pl ha^{-1} (0.86 x 0.64 m). The plots of T1, T2, T3 and T4 consisted of three double rows of cassava, 4.05 m long and a total area of 36.85 m^2. The plots of T5 and T6 consisted of nine simple rows of 5.16 m and 3.84 m and total areas of 39.96 m^2 and 29.72 m^2, respectively. For the evaluation of the agronomic characteristics, a sample of 14 central plants of the plot was used, and for the double row's arrangement, the sampling was carried out in the double row located in the center of plot and, for the planting arrangement in single rows, the sampling was in the five central rows. The first and last plants of the central rows were not sampled. The industrial cassava cultivar was BRS 420. The propagation material was obtained from healthy plants at 12 months old and stem cuttings were cut with sharp machete and prepared with 5 to 7 buds and a diameter greater than 2 cm. The planting furrows were opened 10 cm deep with a tractor furrow. Planting fertilization was performed with the application of 40 kg P_2O_5 ha^{-1} at the bottom of the planting furrow. The fertilizer was covered with a thin layer of soil and the cuttings were manually placed in a horizontal position. The planting was finished with the closing of the furrows and leveling the land with a hoe. The cassava covering fertilization was 60 kg of K_2O and 40 kg of N ha^{-1}, the K being split in two periods, at 60 days after planting (DAP) together with all N, and at 90 DAP. The distribution was manual in lateral bands to the plant rows. The *U. brizantha* was sown manually, at a dose of 4 kg of pure viable seeds ha^{-1}, in furrows 3 cm deep and spaced 20 cm apart. In T1 and T2 treatments, 35 cm was initially left between the first row of grass and the first row of cassava, this distance being extended to 60 cm at 120 days after sowing. In T3 and T4, showing on February 26, 2021, the first row of grass maintained the distance of 60 cm to the row of cassava. The planting fertilization of *U. brizantha* was carried out in the sowing line with the same dosage and fertilizer applied for cassava. After planting cassava and grass, pre-emergent herbicides were applied, being Clomazone (1,000 g ai ha^{-1}) and *S*- metolachlor (1,920 g ai ha^{-1}), in mixture, in the area with cassava, and Flumioxazin (45 g ai ha^{-1}) in the area with *U. brizantha*. At 45 DAP, weed control of cassava was carried out with mechanical weeding. The chemical management of grass with underdoses of 55 g ai ha^{-1} of the herbicide Fluazifop-p-butyl was started at 35 days after sowing and was repeated whenever the pasture reached a height of 20 cm, with three applications in the T2 treatment. The applications were performed with a CO_2 pressurized backpack sprayer, an application bar with 2.5 meters, six flat fan nozzles (110 02 BD) spaced 0.5 m apart, with a spraying rate of 150 L ha^{-1}. The applications were performed on days when weather conditions were favorable to spraying. The mechanical management of the grass was initiated at 90 days after cassava planting and repeated at 90, 120, 150 and 180 DAP. The cuts were performed with a weed cutter with lowering up to 10 cm in height. The height and stem diameter evaluations were carried out in two seasons, at 100 and 180 DAP. The plant height was considered the vertical distance between the ground level and the highest point of the plant, measured with a ruler. The stem diameter was measured at 5 cm from the ground level, using a caliper. For plants that had more than one stem, the taller stem was considered for both measures. The dry matter yield of *U. brizantha* was done at the time of mowing. The pasture dry matter harvested on inter double rows in plots was considered for the extrapolation of the yield in kg ha^{-1}. For this determination, the fresh weight of the plot and the dry matter content of the grass were considered. The average dry matter content was calculated at each cutting season by taking a sample composed of four simple subsamples, one from each repetition. The average dry matter content was calculated at each cutting season by taking a sample composed of four subsamples, one from each repetition. The dry matter content was calculated by fresh and dry weight of *U. brizantha* samples, the first being measured immediately after cutting and the second after drying in an oven at 65 ºC for 72 hours. An analytical balance with a precision of 0.1 g was used. The height and diameter data were subjected to analysis of variance and the means were compared using the Tukey test at 5%. The dry grass yield data were treated statistically with the determination of the mean, the standard error, and the coefficient of variation of the mean.

RESULTS AND DISCUSSIONS

Figure 1 shows the results of plant height (1A) and stem diameter (1B) of cassava plants, cv BRS 420, with evaluations performed at 100 and 180 DAP. In the first evaluation, there was no significant difference ($p<0.05$) between the treatment means for both height and stem diameter, however there is a tendency for lower means for treatment T1. At 180 DAP, T1 stands out with the lowest average of characteristics and differs significantly from treatments T3 and T4 in plant height and from all treatments, except T2, in stem diameter (Figure 1, A and B). These preliminary results indicate that the consortium cassava with *U. brizantha*, in simultaneous sowing (T1), had a negative influence on the vegetative growth of cassava under double rows. However, management with underdoses of the herbicide Fluazifop-p-butyl (T2) induced mean height and diameter that did not differ from other treatments in double row arrangement (T3 e T4), that were sown with grass after the last agronomic evaluation. According to Albuquerque et al. (2008), the *U. brizantha* is considered a cassava weed of great occurrence in Brazil and surpasses the majority of weed plants in accumulation of fresh mass. Ferreira et al. (2015) supports the potential for interference of *U. brizantha* on cassava growth when they concluded that this species reduced the height and stem diameter of cassava plants in increasing levels with rise plant density at 50 days after emergence, under pot cultivation. These authors observed a reduction in height of up to 80% in relation to the control and found that the negative interference in the growth of cassava is greater than that caused by blackjack (*Bidens pilosa L.*), in the same study conditions. The treatments with arrangement in double rows T3 and T4 stimulated the growth in height of the cassava plants when compared to the treatments with plant arrangement in single rows T5 and T6, although the stem diameter is practically maintained unchanged among the treatments mentioned (Figure 1, A and B). The increase in plant density in single row arrangements from 13,500 (T5) to 18,000 pl ha^{-1} (T6) did not affect the growth of the above ground of the cv. BRS 420 to 180 DAP (Figure 1, A and B). Table 1 shows the average dry matter yield of *U. brizantha* in four mows. The low yields obtained in the first two mows (90 and 120 DAP) can be attributed in part to the drought occurred in the months of September, October, November of 2020 in the northwestern region of Paraná, which made it difficult to grass establishment. As of December, weather conditions were favorable to growth, producing a high dry matter yield in the 3rd mow (150 DAP), measured in January 2021. The 4th mow (180 DAP) registered a drop of more than 50% in the pasture dry matter yield in relation to the 3rd mow. A possible cause is the greater competitiveness of cassava at 180 DAP, when the crop has its maximum leaf area index (LAI) and, therefore, the lowest transmittance of sunlight to the layers closest to the soil (BACKER et al., 1989). Biffe et al. (2010) determined that the critical period of weed interference (CPWI) for cassava crop in northwest Paraná is from 18 to 100 DAP. These and other studies of weed interference periods in the cassava crop were carried out in a single row arrangement, so there may be variation in the period for the arrangement of double rows. The dry matter yields of *U. brizantha* cv. Marandu observed in this work are like those obtained by Kichel (2018) at the times when brachiaria was intercropped with corn, at 50 and 90 days after emergence (DAE), and under the effect of chemical suppression, but are lower in relation to the yields observed by the authors after the corn harvest (135 and 180 DAE).

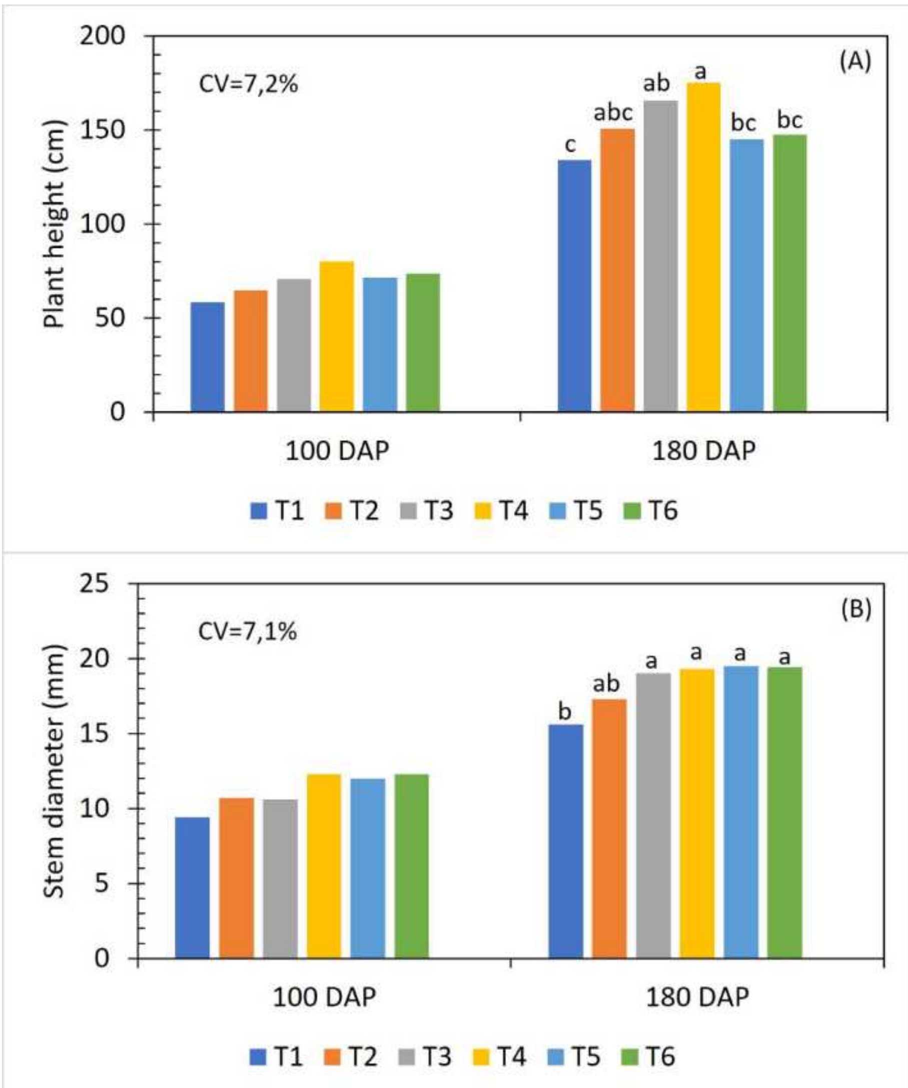

Figure 1. Height, in cm (A) and stem diameter, in mm (B) of cassava plants cv. BRS 420 at 100 and 180 days after planting (DAP), under different establishment times of cassava-*Urochloa brizantha* intercropping and 'Marandu' grass management. Paranavaí, Brazil. 2020/2021. Means followed by the same letter do not differ by Tukey's test, at 5% probability: T1: cassava in double rows-DR (13,888 pl ha^{-1}) planted simultaneously with *U. brizantha* + mowing; T2: cassava DR and *U. brizantha* simultaneously + herbicide underdose; T3: cassava DR + *U. brizantha* sown 6 months after cassava + mowing; T4: cassava DR + *U. brizantha* sown 6 months after cassava + herbicide underdose; T5: single-row cassava monoculture with 13,520 pl ha^{-1}; T6: single row cassava monoculture with 18,168 pl ha^{-1}.

Table 1. Above ground dry matter yield, kg ha^{-1}, standard error, and coefficient of variation of *Urochloa brizantha,* cv. Marandu, intercropped with cassava cv. BRS 420, with evaluations performed at 90, 120, 150 and 180 days after planting (DAP) cassava. Paranavaí, Brazil, 2020/2021.

Mow date (DAP)	Dry Matter (kg/ha)	CV (%)
90	364.9 (75.7)	41.5
120	459.3 (52.5)	22.9
150	944.5 (122.1)	25.8
180	406.4 (98.1)	48.3

CONCLUSIONS

Urochloa brizantha cv. Marandu, reduced the growth of cassava *Manihot esculenta* cv. BRS 420 when sowed simultaneously with the planting of cassava in the arrangement of double rows.

The growth management of Marandu grass with underdoses of the herbicide Fluazifop-p-butyl (55 g ia ha^{-1}) reduced their ability to compete with cassava until 180 days after planting.

ACKNOWLEDGMENTS

To CNPq for granting the 2nd author's scientific initiation scholarship. To UniFatecie for the availability of the structure and staff to accomplish this work.

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