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Full Length Research Paper

Evaluating agronomic characteristics of cassava genotypes in Bahia, Brazil

***Anderson C. Adriana, Alessandra Coelho and Luiz Luiz**

Department of Plant and Animal Science, State University of Southwest Bahia, Vitória da Conquista, Bahia, Brazil.

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This experiment was conducted with the objective of evaluating physiological and agronomic characteristics of cassava genotypes in the municipality of Cândido Sales, State of Bahia, Brazil, between October 2010 and August 2012. Complete randomized block design was used, with three replications and 28 treatments formed by genotypes Amansa Burro, Aramaris, Bom Jardim, Bromadeira, Caipira, Caitité, Caravela, Kiriris, Lagoão, Lavra Velha, Malacacheta, Mulatinha, Parazinha, Peru, Poti Branca, Salangor, Sergipe, Sergipe, Simbé, Tapioqueira, Tussuma, Verdinha, 2006-4, 2006-5, 2006-8, 2006-10 and 2006-12, coming from UESB, EMBRAPA and farmers in the region. Sergipe genotype is present in two treatments, one planted with cuttings collected from local farmers only called Sergipe, and another called Sergipe MR planted with cuttings originated from the rapid multiplication method. The crop spacing used was 1.0 x 0.6 m and each plot composed by 60 plants, being 26 plants considered useful. The evaluations were performed at the end of the first crop cycle, in July 2011, and the harvest in August 2012, twenty-two months after planting. The higher total leaf area and the high photosynthetically active radiation absorbed by the plants canopy at the end of the first crop cycle were correlated to an increase of productivity of shoot and dry weight of root. There was no change in leaf water potential among the genotypes. The genotypes Caipira, Poti Branca, Verdinha and Sergipe from cuttings obtained by the rapid multiplication method showed high productivity for tuberous roots associated to a higher dry matter values. A greater starch yield was observed in genotypes 2006-5, Verdinha, Malacacheta, Poti Branca, Caipira, 2006-10, Sergipe MR, Parazinha and Mulatinha, thus, they might be future alternatives for regional cultivation for industrial production.

Key words: *Manihot esculenta* Crantz, water potential, leaf area, varieties, tuberous root, starch.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a shrubby plant in Euphorbiaceae family that grows continuously having two alternating periods, one for growing and another for storing carbohydrates in its tuberous roots, and these periods are followed by an interval of dormancy (Alves, 2002). Brazil is considered the possible center of origin for this species (Allem, 1994), which is one of the most important crop in the tropics and the basic food for over

*Corresponding Author. Email: dr.adriana32@yahoo.com

800 million people (Nassar et al., 2009), being cultivated on 16 million hectares worldwide (El-Sharkawy et al., 2008).

Cassava is mostly cultivated on tropical countries situated in equatorial region, between 30º North and 30º South to equator with an altitude variation from sea level to 2.000 m, and annual rainfall between 500 mm up to 2,000 mm, which shows cassava capacity to adapt to a great number of environments and ecosystems (El-Sharkawy, 2012).

In 2015, Brazil produced 23.06 million tons of roots (IBGE, 2016). According to FAO (2016), Brazil is the fourth biggest producer of cassava; behind of Nigeria, Thailand, and Indonesia. The Bahia State has the third biggest yield of cassava in Brazil, in 2015 the state had produced 2.09 million tons of roots; however, the yield has been dropped by low average of productivity, only 11.05 t ha^{-1}. In the same year, the municipality of Cândido Sales was the biggest producer of cassava in the state of Bahia (IBGE, 2016).

The city of Cândido Sales is situated in the Southwest Bahia, and presents a semi-arid climate with hydric restriction in most part of the year, and cassava is one of the few alternatives for farmers. Being tolerant to low rainfall, cassava is a crop recognized by its social importance in areas characterized by erratic rainfall and an limited water resources systematization (El-Sharkawy and Tafur, 2010).

According to Lopes et al. (2010), among the causes that contribute to the low yield of cassava in Brazil, there is a lack of varieties adapted to different conditions, inadequate cultural practices or lack of it, and the use of low quality planting material, as well as growing in regions with annual precipitation lower than 1000-1500 mm, values considered adequate to the crop (Oliveira et al., 2006).

Selection of cassava varieties is important in many parts of the world. Acquah et al. (2011) identified that there is an immediate need for new cassava varieties in Africa to replace varieties that are losing desirable traits. In this context, Tumuhimbise et al. (2014), studying the effect of genotype and environment interaction on fresh root yield and cassava related traits in Uganda, observed a high degree of genetic variation among genotypes in three different environments. Demonstrating that cassava genotypes may have different behaviors in different environments, and may have a superior variety at each site.

The cassava is cultivated in all Brazilian regions with a diversity of varieties adapted to each of these different biomes giving to the species a large genetic diversity (Galera and Valle, 2007). This diversity represents a large base for breeding programs in tropics, concentrating genes for resistance to the major pests and diseases, also adaptation for different edaphoclimatic conditions (Fukuda et al. 1999).

According to Fukuda and Silva (2003), a way to improve the yield and the production system is the use of better varieties adapted to edaphoclimatic conditions for each region, due to the high genotype x environment interaction, a genotype rarely behave in a similar manner in different ecological regions.

In addition, according to Casaroli et al. (2007), the energy emitted by the sun, which affects the surface of the leaves, together with adequate supplies of water and nutrients, can be indicators of plant productivity. These factors are part of the physiological processes responsible for capturing solar energy and its subsequent biochemical transformation into organic compounds that result in food, fiber, cellulose and energy. Even for plants of one species, the rate of photosynthesis varies with genotypes (Pereira, 1987). Therefore, physiological studies among genotypes may indicate the most efficient in the conversion of photoassimilates to the production of tuberous roots and shoots of cassava plants.

However, many of created and selected varieties had not been used by farmers, and the most common cassava varieties used are still the same that have been planted in most regions during consecutive years (Fukuda et al., 1997), as it happens in the Southwest region of Bahia.

In this region, the variety Sergipe is the most cultivated among the cassava farmers for flour production and starch extraction, and the rusticity and the high productivity attributes justified the preference of producers in the region (Carvalho et al., 2009). However, in the last ten years, this variety has been suffering gradual drop in yield, and the introduction of new varieties may result in an improvement of living conditions for local farmers.

Given the above, this work was developed to evaluate physiological and agronomic characteristics of cassava genotypes, identifying the most promising genotypes for cultivation.

MATERIALS AND METHODS

The experiment was conducted at the locality Bomba, coordinates 15º18'13'' S and 41º17'32'' W, municicoality of Cândido Sales in southwest of Bahia state, Brazil. The city altitude in average is 627 m, and the semi-arid climate according to Köppen is classified as Aw type, tropical climate and dry season. The annual average temperature is 20.4ºC, and annual rainfall of 767.4 mm, being the rainy season between October and March (SEI, 2013). Figure 1

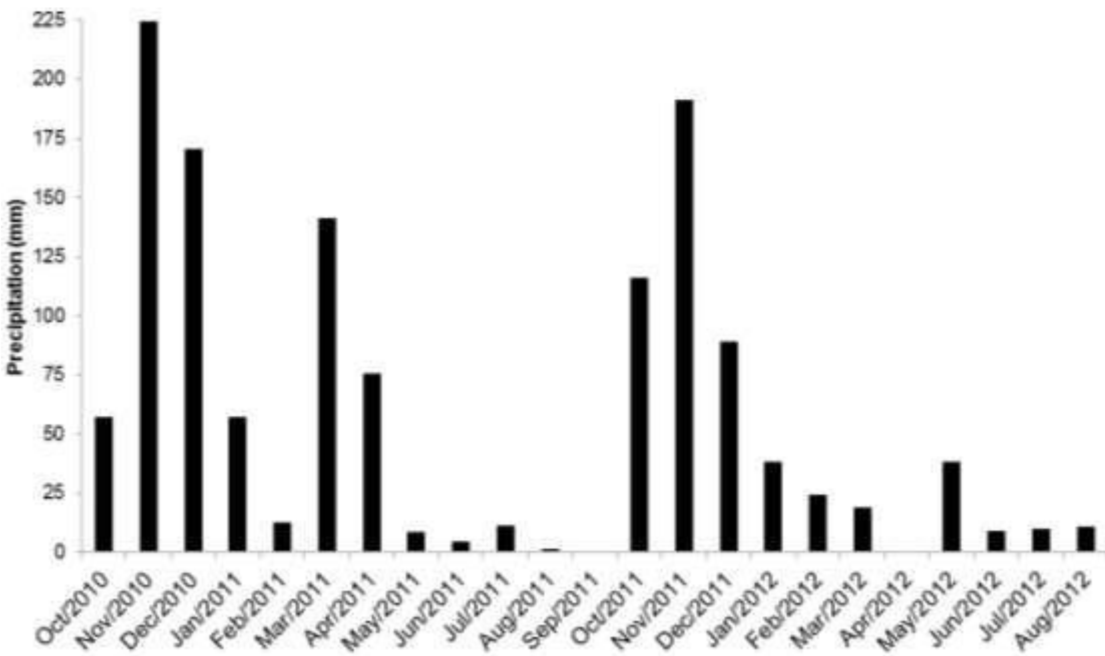

Figure 1. Monthly averages rainfall in the municipality of Cândido Sales - BA, from October 2010 to August 2012. Source: National Water Agency – ANA.

shows the rainfall data obtained during the trial period.

The soil in the experimental area was classified as Yellow Oxisol dystrophic clayey, which presented the following results for chemistry analysis in 0-20 cm depth: pH in water (1: 2.5): 4.5; P: 2.0 mg dm^{-3} (Mehlich^{-1}); K^{+}: 0.11 cmolc dm^{-3} (Mehlich^{-1}); Ca^{2+}: 0.4 cmolc dm^{-3} (KCl extractor 1 mol L^{-1}); Mg^{2+}: 0.4 $cmolcdm^{-3}$ (KCl extractor 1 mol L^{-1}); Al^{3+}: 1.0 cmolc dm^{-3} (KCl extractor 1 mol L^{-1}); H^{+}: 5.4 $cmolcdm^{-3}$ (SMP extractor solution, pH 7.5 at 7.6); Sum of Bases: 0.9 cmolc dm^{-3}; CEC effective: 1.9 cmolc dm^{-3}; CEC at pH 7.0: 7.3 cmolc dm^{-3}; Base saturation: 12%; Aluminum saturation: 52%. The area was tilled and plowed mechanically. The planting has occurred in October 2010 and it was done with cuttings 20 cm long and 2 to 3 cm in diameter, making an average of eight gems. The spacing between rows was 1.0 m and 0.60 m between plants, totaling 26 plants per plot, in 15.6 m².

Randomized block design with 28 treatments and three replications was utilized. The harvest was performed in August 2012, 22 months after planting.

Were evaluated 28 treatments, using 27 genotypes. The genotype Sergipe, the most cultivated in the region, was planted with cuttings collected with local farmers, called by Sergipe, and also planted with originated from the rapid multiplication method, called Sergipe MR, developed by the International Center of Tropical Agriculture (CIAT) in Colombia, and later adapted to Brazilian conditions (Santos et al., 2009).

Genotypes Amansa Burro, Aramaris, Caipira, Caravela, Kiriris, Lagoão, Mulatinha, Poti Branca, Tapioqueira and Verdinha were obtained from the Cassava Active Germplasm Bank in the National Research Center of Cassava and Fruticulture of EMBRAPA (Brazilian Agricultural Research Corporation), located in Cruz das Almas, Bahia, Brazil. In this sense, for developing this bank, these genotypes were collected from different regions of the country.

Genotypes Bom Jardim, Bromadeira, Caitite, Lavra Velha, Malacacheta, Parazinha, Peru, Salangor, Sergipana, Simbé and Tussuma were obtained from the Germplasm Collection of Cassava of UESB (Southwest Bahia State University), *campus* of Vitória da Conquista, Bahia, Brazil. It was also utilized botanical seeds genotypes deriving from open pollination: 2006-4, 2006-5, 2006-8, 2006-10 and 2006-12.

At the end of the first growing season, in July 2011, nine months after planting, period characterized by mild temperatures and lower rainfall index, the foliar area was evaluated measuring all leaves of one plant in each spot, using Area Meter model LI-3100; the photosynthetically active radiation (PAR) absorbed by the canopy, between plants (RBP), and between rows (RBR), in the period from 11:00 to 12:30 h, between rows and between plants at 0.20 m by the soil level and full sun, was evaluated using ceptometer Decagon, model AccuPAR LP-80. The values were obtained from the equations: % of RBP = 100 – [(PAR between plants / PAR under full sun) x 100] and %RBR = 100 – [(PAR between rows / PAR under full sun) x 100]; The leaf water potential was determined by measuring the middle third leaves of two plants per plot, collected at 5:00 AM (predawn) and 12:00 PM (noon) using a pressure chamber (Model 1000, PMS) according to methodology proposed by Scholander et al. (1964).

At harvest, in August 2012, 22 months after planting, it was evaluated the shoot yield, the tuberous roots yield, the dry matter percentage in tuberous roots, by the hydrostatic balance method based on the equation: DM = 15.75 + 0.0564 R, being R the weight of 3 kg of roots in water (Grossmann and Freitas, 1950), and the percentage of starch in tuberous roots, calculated by subtracting from the dry matter content the constant 4.65 (Conceição, 1983).

The statistical analyzes were performed using SAEG program (System for Statistical Analysis and Genetic) version 9.1 (Ribeiro Júnior, 2001). Data were submitted to analysis of variance and average treatments grouped by the procedure proposed by Scott-Knott at 5% probability.

Data was analyzed for normality using the Lilliefors test and the variances homogeneity by Cochran's test. When necessary, data transformation was performed. The Pearson correlation was analyzed using the t-test, at 5% probability to assess the relation between dependent characteristics.

Table 1. Shoot yield (SY), tuberous root yield (TRY), dry mass percentage for tuberous roots (DM) and starch productivity (SP) of cassava genotypes. Cândido Sales, Bahia, Brazil, in 2016.

Genotypes	SY (t ha^{-1})	TRY (t ha^{-1})	DM (%)	SP (t ha^{-1})
Amansa Burro	10.76^{b}	12.74^{b}	31.32^{a}	3.40^{b}
Aramaris	6.04^{c}	12.84^{b}	30.60^{a}	3.33^{b}
Bom Jardim	7.78^{c}	8.87^{b}	30.75^{a}	2.32^{b}
Bromadeira	4.66^{c}	9.81^{b}	31.49^{a}	2.70^{b}
Caipira	8.66^{c}	19.72^{a}	31.28^{a}	5.26^{a}
Caitite	14.15^{b}	16.64^{b}	27.56^{b}	3.82^{b}
Caravela	6.71^{c}	12.90^{b}	32.10^{a}	3.55^{b}
Kiriris	6.40^{c}	16.18^{b}	29.44^{a}	4.08^{b}
Lagoão	5.92^{c}	14.23^{b}	34.13^{a}	4.21^{b}
Lavra Velha	7.49^{c}	8.12^{b}	28.50^{b}	1.94^{b}
Malacacheta	10.58^{b}	22.50^{a}	28.18^{b}	5.34^{a}
Mulatinha	20.29^{a}	15.77^{b}	32.80^{a}	4.44^{a}
Parazinha	9.85^{c}	17.01^{b}	31.39^{a}	4.54^{a}
Peru	12.25^{b}	13.82^{b}	30.26^{a}	3.55^{b}
Poti Branca	16.52^{a}	19.44^{a}	32.28^{a}	5.32^{a}
Salangor	12.02^{b}	11.13^{b}	28.91^{b}	2.70^{b}
Sergipana	9.08^{c}	10.06^{b}	28.20^{b}	2.44^{b}
Sergipe	12.44^{b}	15.02^{b}	31.00^{a}	3.91^{b}
Sergipe MR	10.06^{c}	17.50^{a}	30.26^{a}	4.61^{a}
Simbé	11.42^{b}	14.74^{b}	30.10^{a}	3.71^{b}
Tapioqueira	6.72^{c}	13.74^{b}	30.28^{a}	3.54^{b}
Tussuma	12.58^{b}	12.99^{b}	30.53^{a}	3.44^{b}
Verdinha	9.12^{c}	22.86^{a}	31.26^{a}	6.14^{a}
2006-4	6.63^{c}	18.08^{a}	23.16^{c}	3.41^{b}
2006-5	10.08^{c}	29.27^{a}	28.85^{b}	7.11^{a}
2006-8	10.91^{b}	18.05^{a}	26.69^{b}	3.98^{b}
2006-10	7.63^{c}	22.93^{a}	26.82^{b}	5.07^{a}
2006-12	7.64^{c}	15.75^{b}	25.22^{c}	3.17^{b}
Overall Average	**9.80**	**15.81**	**29.76**	**3.97**

* Averages followed by the same letter in the column do not differ, according grouping criteria of Scott-Knott at 5% probability.

RESULTS AND DISCUSSION

The agronomic characteristics evaluation of 22 months after planting (Table 1) showed that the genotypes Mulatinha and Poti Branca produced more shoot than the others, with yield of 20.29 t ha^{-1} and 16.52 t ha^{-1}, respectively, being an alternative to animal feed or to increase production for planting cuttings in the region studied.

The shoot average yield obtained in this study was 9.80 t ha^{-1}, relatively low compared to those found in the literature, as cited by Alves et al. (2011), whom reported for genotype Poti Branca and shoot yield of 43.00 t h^{-1}. Such differences can be attributed to environmental conditions, particularly rainfall and temperature. According to Sagrilo et al., (2002), the production of aerial part depends mainly on climate factors, since high temperatures with heavy rainfall not only favor the growth of stems, but as also the leaves production.

There was a positive correlation between shoot yield and the tuberous roots yield (r = 0.39 *), and between shoot yield and starch yield (r = 0.44 *), indicating that plants with more developed aerial part produce more tuberous roots and more starch, due to the higher photoassimilates production. According to Mulualem and Ayenew (2012), increments of vegetative parts have significant effect on the dry matter production of cassava.

Observing the tuberous roots yield (Table 1), a variation from 8.12 t ha^{-1} (Lavra Velha) to 29.27 t ha^{-1} (2006-5) is noticed, indicating variability for this trait. Among the 28 genotypes studied, nine were considered to be more productive with values ranging from 17.50 t ha^{-1} to 29.27 t ha^{-1}, being higher than the national average, which according to IBGE (2016), it was 15.24 t ha^{-1} in 2015.

The genotypes obtained from botanical seeds selected in UESB showed higher values for tuberous roots yield, except genotype 2006-12.

The genotype Sergipe, when propagated through the traditional method, produced less tuberous roots than when planted with cuttings obtained by the rapid multiplication method (Santos et al., 2009). In this method, the selection and the care with the cuttings lead to obtain more vigorous plants, contrasting the plants development from cuttings collected from the producers. Due the continuous cultivation for about 25 years in low natural soil fertility, without the use of fertilizer and the accumulation of pests and diseases have caused a "degeneracy" for the propagation material of Sergipe genotype, which has led to reduced productivity and the consequent reduction of area cultivated with this material. The drought experienced in the region in recent years has helped to accentuate this problem.

The harvest of cassava roots must be performed in the physiological resting period of the plant, when the roots has higher content of dry matter, differently from the growth season, when the dry matter content in the roots is reduced (Sagrilo et al., 2006; Keating et al., 1982; Guimarães et al., 2009). These conditions are found in the study area during August, a period characterized by milder temperatures and low rainfall, when the majority of local farmers harvest the roots. This leads, however, the need for storage of planting material for three to four months until the beginning of the rainy season, usually in October or November, reducing their quality.

For the characteristic of dry mass for tuberous roots, it was possible to separate the genotypes into three groups, highlighting the genotype Lagoão into the group that showed higher values (Table 1). In this group the dry matter content ranged from 29.44 to 34.13%, values that can be considered high, according to Teye et al. (2011).

The satisfactory results presented by genotypes obtained from free pollination for tuberous roots yield did not occur to dry mass of roots. Despite these genotypes forming considerable number of roots, they had higher moisture, which is not suitable for the industrialization of cassava.

It is desirable that the varieties responsible for higher productions of tuberous roots be also those which have higher dry matter content, maximizing the yield of the final product by cultivated area unit (Vidigal Filho et al., 2000). In this study, the genotypes Caipira, Poti Branca, and Sergipe from cuttings obtained by the rapid multiplication method and Verdinha stood out in both characteristics.

The cassava starch and its derivatives have been used in products for human consumption or as input from various industries such as: canned food, packaging, glues, paper, mining, textile and pharmaceutical (Cardoso and Gameiro, 2006). Genotypes that have high yield of starch may be recommended for industrial use in the region.

Nine genotypes stood out for starch yield (Table 1), showing values between 4.44 to 7.11 t ha^{-1}. The overall average of the experiment was 3.98 t ha^{-1} of starch, considering the 28 treatments. Introducing genotypes can lead to increase yield of roots by improving the income of farmers in the region. However, this work is still recent in the studied region, and further studies in different locations and years are necessary to evaluate the yield stability and subsequent recommendation for cultivation.

Separation of two genotypes groups in relation to total leaf area is observed in Table 2. The group with the lowest total leaf area was formed basically by genotypes 2006-4, 2006-5, 2006-8, 2006-10 and 2006-12, obtained from botanical seeds, deriving from open pollination selected in UESB, except the genotypes Bromadeira and Malacacheta traditionally farmed in the region.

Low temperatures and poor soil moisture change the pattern of leaf longevity, increasing the senescence process, abscission and restricting the expansion of the leaf blade (Calatayud et al., 2000). For El-Sharkawy (2006), larger leaf longevity may be important to achieve higher yields in crops such as cassava. In this crop, the development of the shoot and roots occur simultaneously, enabling the selection of cassava varieties for both traits simultaneously (Lenis et al., 2006). In this study, a correlation was found between total leaf area (TLA) and root dry weight (r = 0.43*), indicating that genotypes which maintained high leaf retention had higher starch accumulation in tuberous roots.

Table 2 indicates that the RBP and RBR were similar between genotypes. The study of correlations showed that higher value of these characteristics are associated to higher starch accumulation in the tuberous root (r = 0.34* and r = 0.50*, respectively).

The efficiency of genotypes for leaf area maintenance makes the plants to absorb more light energy producing more photoassimilates, accumulating it in the shoot and in the roots, as dry matter. The results corroborate with Lenis et al., (2006), which state that the increased longevity of the leaves or better leaf retention is a way to increase the cassava yield. These authors also highlight the importance for incorporating the leaf retention as an important feature to be target in breeding and selection programs to increase roots yield.

The genotypes showed similar leaf water potential (Ψw) in both the predawn period and the noon period (Table 3). This feature reflects the dynamic conditions of the water transport process in the soil-plant-atmosphere system, constituting the main component responsible for the water flow in the plant (Pereira, 2006).

Water stress usually occurs gradually in nature, and the tolerant plants have developed mechanisms to adapt to conditions of low water availability in the soil (Chaves Filho and Stacciarini-Seraphin, 2001). This study had showed no significant difference in leaf water potential between genotypes at extreme periods of day, therefore, it is concluded that the plant defense mechanisms were

Table 2. Total leaf area (TLA), photosynthetically active radiation absorbed by the canopy of plants (RBP) and between rows (RBR) at the end of the first crop cycle of cassava genotypes, in July 2011. Cândido Sales, Bahia, Brazil, in 2016.

Genotypes	TLA (cm^2)	RBP (%)	RBR (%)
Amansa Burro	2,359.67[a]	39.31[b]	38.33[b]
Aramaris	2,239.00[a]	39.38[b]	40.24[b]
Bom Jardim	2,520.67[a]	44.60[b]	44.54[b]
Bromadeira	1,231.33[b]	26.96[c]	24.56[c]
Caipira	2,998.67[a]	61.84[a]	57.77[a]
Caitite	2,124.67[a]	41.31[b]	40.25[b]
Caravela	4,001.00[a]	42.21[b]	44.87[b]
Kiriris	2,757.67[a]	32.23[c]	38.69[b]
Lagoão	3,179.67[a]	46.15[b]	48.93[a]
Lavra Velha	2,452.67[a]	44.81[b]	41.77[b]
Malacacheta	1,369.67[b]	33.44[c]	35.73[b]
Mulatinha	3,309.00[a]	57.11[a]	61.30[a]
Parazinha	4,070.33[a]	42.41[b]	36.19[b]
Peru	2,302.67[a]	60.01[a]	57.64[a]
Poti Branca	4,110.33[a]	50.96[a]	56.67[a]
Salangor	4,321.67[a]	64.01[a]	65.17[a]
Sergipana	2,768.67[a]	41.26[b]	32.19[c]
Sergipe	3,015.33[a]	52.98[a]	40.11[b]
Sergipe MR	3,698.67[a]	59.15[a]	53.48[a]
Simbé	3,170.67[a]	64.56[a]	56.11[a]
Tapioqueira	2,426.67[a]	40.00[b]	39.11[b]
Tussuma	3,294.67[a]	62.80[a]	59.48[a]
Verdinha	2,554.67[a]	58.37[a]	53.66[a]
2006-4	615.67[b]	26.31[c]	23.97[c]
2006-5	664.00[b]	20.51[c]	22.11[c]
2006-8	349.67[b]	21.78[c]	20.98[c]
2006-10	907.00[b]	30.33[c]	26.81[c]
2006-12	1,014.33[b]	33.35[c]	31.42[c]
Overall Average	**2,493.88**	**44.22**	**42.59**

* Averages followed by the same letter in the column do not differ according grouping criteria of Scott-Knott at 5% probability.

similar between the different genotypes, such as osmotic adjustment to better coexist with drought, and they did not show considerable variation among them.

Conclusions

Therefore, regarding edaphoclimatic conditions of the experiment, it is concluded that:

i) Higher total leaf area and high photosynthetically active radiation absorbed by the canopy of plants, observed at the end of the first cycle, were correlated to the increase of shoot yield and root dry weight.
ii) There was no change in leaf water potential among the genotypes.
iii) The genotypes Caipira, Poti Branca, Verdinha and Sergipe from cuttings obtained by the method of rapid multiplication showed high productivity of tuberous roots associated with higher dry matter values.
iv) Greater starch yield was observed in genotypes 2006-5, Verdinha, Malacacheta, Poti Branca, Caipira, 2006-10, Sergipe MR, Parazinha and Mulatinha and they might be future alternatives for regional cultivation for industrial production.

Conflict of Interests

The authors have not declared any conflict of interests.

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Table 3. Module of leaf water potential (Ψw) conducted in the predawn and noon periods, at the end of the first crop cycle of cassava genotypes, in July 2011. Cândido Sales, Bahia, Brazil, in 2016.

Genotypes	Ψw Predawn (MPa)	Ψw Noon [1] (MPa)
Amansa Burro	0.483[a]	1.095[a](1.199)
Aramaris	0.483[a]	0.847[a](0.717)
Bom Jardim	0.433[a]	1.152[a](1.327)
Bromadeira	0.583[a]	1.117[a](1.248)
Caipira	0.367[a]	0.888[a](0.789)
Caitite	0.783[a]	1.148[a](1.318)
Caravela	0.433[a]	1.020[a](1.040)
Kiriris	0.300[a]	1.083[a](1.173)
Lagoão	0.417[a]	1.021[a](1.042)
Lavra Velha	0.433[a]	1.030[a](1.061)
Malacacheta	0.383[a]	1.164[a](1.355)
Mulatinha	0.517[a]	1.134[a](1.286)
Parazinha	0.567[a]	1.088[a](1.184)
Peru	0.343[a]	1.088[a](1.184)
Poti Branca	0.470[a]	1.137[a](1.293)
Salangor	0.560[a]	1.051[a](1.105)
Sergipana	0.450[a]	1.251[a](1.565)
Sergipe	0.463[a]	1.125[a](1.266)
Sergipe MR	0.243[a]	1.114[a](1.241)
Simbé	0.477[a]	0.961[a](0.924)
Tapioqueira	0.510[a]	0.772[a](0.596)
Tussuma	0.533[a]	1.012[a](1.024)
Verdinha	0.583[a]	1.008[a](1.016)
2006-4	0.417[a]	1.212[a](1.469)
2006-5	0.500[a]	1.172[a](1.374)
2006-8	0.500[a]	1.323[a](1.750)
2006-10	0.400[a]	1.221[a](1.491)
2006-12	0.517[a]	1.036[a](1.073)
Overall Average	**0.470**	**1.081 (1.182)**

[1] Data transformed to $\sqrt{X}$, and not transformed averages in parentheses. * Averages followed by the same letter in the column do not differ, according grouping criteria of Scott-Knott at 5% probability.

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