Original Article

SELECTION OF CASSAVA VARIETIES FOR BIOMASS AND PROTEIN PRODUCTION IN SEMIARID AREAS FROM BAHIA

SELEÇÃO DE VARIEDADE DE MANDIOCA PARA PRODUÇÃO DE BIOMASSA E PROTEÍNA NO SEMIÁRIDO BAIANO

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ABSTRACT: The selection of cassava varieties for cultivation in semiarid regions constitutes an alternative to generate income and for animal feed. The objective of this study was to evaluate the potential for biomass and protein production of seven cassava varieties in semiarid area from Bahia. Eleven agronomic shoot (SH) and root (ROT) traits, as well as crude protein (CP), were evaluated using a randomized block design with four replications in Senhor do Bonfim (BA). Principal component analysis (PCA) and correlations analysis were carried out among the traits. Significant differences were found among varieties for all traits except for dry matter content of the shoots. Important variations were identified for crude protein content (17.9 to 25.13%), root yield (8.17 to 19.79 t.ha^{-1}), yield of the upper third of the aerial part (from 9.36 to 15.89 t.ha^{-1}) and dry matter yield of the shoot (1.99 to 3.14 t.ha^{-1}), crude protein content in the shoot (0.37 to 0.64 t.ha^{-1}) and roots (from 0.12 to 0.37 t.ha^{-1}). According to the PCA the first two components accounted for over 77% of the variation, and traits related to yield were the main sources of diversity among the cassava varieties. Most of the correlations were positive and favorable for the selection of the most suitable varieties for production in semiarid regions. Although, grouping the cassava varieties based on PCA was not possible, varieties ‘BRS Verdinha’ showed good potential for protein production and variety ‘Izabel de Souza’ as a producer of biomass (shoot and roots).

KEYWORDS: Animal feed. Alternative. *Manihot esculenta* Crantz.

INTRODUCTION

In the tropics, the herd food base is the native pasture, whose production is highly dependent on seasonal rains (LIMA JÚNIOR et al., 2013). In semiarid region rainfall range is narrow (between 250 and 600 mm/year) concentrated especially in summer. The potential evapotranspiration generally exceeds the annual rainfall, making the plant biomass rather sparse (SANTOS et al., 2010). In general, soils are shallow, with low natural fertility due whether to fertility limitation, draining profile depth or even to the high level of exchangeable sodium (CUNHA et al., 2008).

Given these limitations, semiarid rainfed agriculture is largely vulnerable to losses. According to Araújo Filho and Carvalho (2001), in drought years the activities related to agriculture and livestock are may lose up to 72% and 20% of its average yield, respectively. Thus, despite the productivity of ruminants in the semiarid being influenced by the irregularity in the fodder supply, livestock acts as a stabilizer of climate changes year after year.

Crops traditionally used in livestock fed are even more vulnerable to cultivation in semiarid region due to their increased water requirement. Moreover, the use of crops better adapted to semiarid climate can reduce the influence on the production systems being an alternative to herd’s nutritional intake. Among these species, cassava (*Manihot esculenta* Crantz) is characterized for being an excellent option for animal feed because it is a source of carbohydrates, proteins, vitamins, minerals and carotenoids (Modesto et al., 2004; Montagnac et al., 2009). Although deficient in methionine, cassava leaves’ aminoacid profile is comparable to that of most leafy vegetables and in some cases superior to soybean flour (ADJEBENG-DANQUAH; SAFO-KANTANKA, 2013).

Farmers often cultivate cassava focusing on root production for their own consumption or as an income source, while the leaves are left on the plantation without any use. In contrast, several studies have shown that, within certain limits, the replacement of conventional foods derived by cassava, such as the silage shoot and hay, do not negatively affect animal performance in ruminants (MODESTO et al., 2008; LIMA JÚNIOR et al.,

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2013), and non-ruminants (GARCIA; DALE, 1999; PRESTON; RODRIGUEZ, 2004).

Despite the potential of cassava use as a low cost alternative for use in animal feed, cassava varieties are often developed exclusively focused on root production. However, an ideal cassava variety for animal feed must have a high leaf biomass production associated with tolerance to periodic pruning without apparent loss in root productivity. Moreover, it is possible to obtain genetic progress in cassava breeding for both roots and shoots attributes considering the genetic variation of species (AINA et al., 2007).

In many African countries cassava is considered a food security crop for its wide adaptability to marginal soils and irregular rainfall conditions, conditions which are limiting for most conventional crops (ADJEBENG-DANQUAH; SAFO-KANTANKA, 2013). Considering the similar conditions in Brazilian Northeast, this study aimed to evaluate the potential for biomass and protein production of different cassava varieties subject to the cultivation conditions in Bahia's semiarid.

MATERIAL AND METHODS

Varieties and experimental conditions

The experiment was conducted at the Instituto Federal de Educação, Ciência e Tecnologia Baiano - Senhor do Bonfim Campus (BA), located in the so-called "drought polygon". The dryland planting was carried out in May 2013 and the harvest in April 2014. During the experiment, rainfall occurrence was higher in December 2013 (25.80% of 801.40 annual mm); although lower rainfall intensity occurred at the beginning of plant development, in order to contribute to germination and adequate experiment development.

Seven cassava varieties cassava were used; three developed by Embrapa Mandioca e Fruticultura ('BRSVerdinha', 'BRS Amansa Burro' and 'BRS Mulatinha') and four local varieties ('Isabel de Souza', 'Mani Branca', 'Do Céu' and 'Cigana Preta'). The varieties' choice is due to the fact that although they are predominantly used for root production (production of flour and starch), field observations indicate a good production of shoot biomass.

The design was randomized blocks with four replications. Each plot contained 100 plants (5 lines with 20 plants each), and the spacing used was 0.90 m between rows and 0.80 m between plants. Cultural practices related to fertilization and weed control were performed according to the crop recommendations (Souza et al., 2006).

Assessed traits

At harvest the roots (11 months after planting), the following traits were evaluated: 1) yield of the upper third of the aerial part (YUp3AP - in $t.ha^{-1}$), comprising stem (not woody tissue) leaves and petioles; 2) stem yield (StY - in $t.ha^{-1}$), characterized by the portion above ground and below the upper third of the plant; 3) root yield (RoY - in $t.ha^{-1}$); 4) dry matter content of the shoot (Sh-DMC - in %); 5) dry matter yield of shoots (Sh-DMY - in t.ha-1); 6) crude protein content of the shoots (Sh-CPC - in%); 7) crude protein yield of the shoots (Sh-CPY - in t.ha-1); 8) dry matter content of the roots (Ro-DMC - in %); 9) dry matter yield of the roots (Ro-DMY - in t.ha-1); 10) crude protein content of the roots (Ro-CPC - in %); 11) crude protein yield of the roots (Ro-CPY - in t.ha-1).

Full nitrogen (%) of each sample was accessed according to Kjeldahl method described by Silva and Queiroz (2002) and then protein content was calculated using the formula: $Protein\ content\ (\%) = N\ x\ 6.25$, where N = % nitrogen in the sample.

Data analysis

Data were subjected to variance analysis (ANOVA) for a randomized block design and mean test (Scott Knott at 5% probability) using *agricolae* package (de Mendiburu, 2010), while the adjusted means of the variables were submitted to principal component analysis (PCA) using the *stats* package. All these packages were analyzed in R program version 3.0.1 (R Development Core Team, 2013).

RESULTS AND DISCUSSION

Fresh and dry biomass production

Genotypic variations were observed in different cassava varieties regarding dry and fresh biomass yield. There were significant differences among varieties ($p \leq 0.01$) for most of the evaluated traits, except for the shoot dry matter content (Sh-DMC) (Table 1). The variation coefficient (CV) was below 20% for most traits related to biomass production of shoots and roots, showing an adequate experimental precision.

Regarding the fresh shoot yield both on the upper third and stems (YUp3AP and StY), cassava varieties showed very similar behavior. However, important differences were observed on varieties 'BRS Amansa Burro', 'BRS Verdinha', 'Izabel de Souza' and 'Mani Branca' for having the highest yield for these traits. Yield of the upper third of the aerial part of 12.53 t.ha-1 was observed on these varieties (Table 2). Significant varietal differences were not observed (p> 0.01) for Sh-DMC, whose variation was 18.13 to 21.58%.

Table 1. Analysis of variance for biomass and protein production in cassava varieties grown in Bahia. Year 2013/2014.

Sources of variation	DF	Mean square for each trait[1]					
		YUp3AP	StY	RoY	Sh-DMC	Sh-DMY	Sh-CPC
Block	3	0.94^{ns}	14.75^{ns}	38.70^{ns}	1.65^{ns}	0.12^{ns}	1.30^{ns}
Varieties	6	22.58**	33.26**	72.34**	5.47^{ns}	0.90**	18.06**
Residue	18	6.12	6.49	13.94	2.13	0.21	1.32
CV		19.94	21.38	25.06	7.20	18.58	5.51
Sources of variation	DF	Mean square for each trait					
		Sh-CPY	Ro-DMC	Ro-DMY	Ro-CPC	Ro-CPY	
Block	3	0.004^{ns}	11.58^{ns}	5.74*	0.14^{ns}	0.017^{ns}	
Varieties	6	0.032**	19.52**	7.20**	1.11**	0.025**	
Residue	18	0.008	4.07	1.16	0.19	0.004	
CV		17.88	7.35	26.29	8.32	31.46	

[1]YUp3AP: yield of the upper third of the aerial part (t.ha-1); StY: stem yield (t.ha-1); RoY: root yield (t.ha-1); Sh-DMC: dry matter content of the shoot (%); Sh-DMY: dry matter yield of shoots (t.ha-1); Sh-CPC: crude protein content of the shoots (%); Sh-CPY: crude protein yield of the shoots (t.ha-1); Ro-DMC: dry matter content of the roots (%); Ro-DMY: dry matter yield of the roots (t.ha-1); Ro-CPC: crude protein content of the roots (%); Ro-CPY: crude protein yield of the roots (t.ha-1).

Table 2. Mean of biomass and protein production values in cassava varieties grown in Bahia. Year 2013/2014.

Varieties	Traits[1]					
	YUp3AP	StY	RoY	Sh-DMC	Sh-DMY	Sh-CPC
'BRS Amansa Burro'	12.53a[2]	12.24a	17.49a	21.58a	2.41b	21.79b
'BRS Mulatinha'	10.02b	7.79b	18.96a	21.28a	2.05b	17.99b
'BRS Verdinha'	15.89a	14.16a	14.31a	19.65a	3.14a	20.45b
'Cigana Preta'	9.36b	8.74b	8.17b	21.45a	1.99b	20.28b
'Do Céu'	11.11b	10.89b	10.94b	18.13a	2.00b	25.13a
'Izabel de Souza'	14.08a	14.92a	19.79a	20.43a	3.05a	19.27b
'Mani Branca'	13.89a	14.67a	14.62a	20.78a	2.93a	19.49b
Varieties	Traits					
	Sh-CPY	Ro-DMC	Ro-DMY	Ro-CPC	Ro-CPY	
'BRS Amansa Burro'	0.50a	29.98a	5.28a	4.35d	0.21b	
'BRS Mulatinha'	0.37b	27.95a	5.34a	5.15c	0.28a	
'BRS Verdinha'	0.64a	25.60b	3.71b	5.05c	0.19b	
'Cigana Preta'	0.40b	27.78a	2.29b	5.08c	0.12b	
'Do Céu'	0.57a	24.28b	2.67b	5.33c	0.14b	
'Izabel de Souza'	0.58a	30.72a	5.87a	6.23a	0.37a	
'Mani Branca'	0.53a	26.28b	3.76b	5.55b	0.23b	

[1] YUp3AP: yield of the upper third of the aerial part (t.ha-1); StY: stem yield (t.ha-1); RoY: root yield (t.ha-1); Sh-DMC: dry matter content of the shoot (%); Sh-DMY: dry matter yield of shoots (t.ha-1); Sh-CPC: crude protein content of the shoots (%); Sh-CPY: crude protein yield of the shoots (t.ha-1); Ro-DMC: dry matter content of the roots (%); Ro-DMY: dry matter yield of the roots (t.ha-1); Ro-CPC: crude protein content of the roots (%); Ro-CPY: crude protein yield of the roots (t.ha-1). 2Valores seguidos pela mesma letra não diferem entre si pelo teste Scott-Knott (p≤0,05).

Besides the 'BRS Mulatinha' variety, the four most productive varieties for shoot were also the most productive for fresh roots (RoY). RoY on these varieties ranged from 14.31 t.ha-1 ('BRS

Verdinha') to 19.79 t.ha-1 ('Isabel Souza') (Table 2). Unlike shoot, cassava varieties showed significant differences for the dry matter content of the roots (Ro-DMC). In this case the highest levels were observed in varieties 'Cigana Preta' (27.78%), 'BRS Mulatinha' (27.95%), 'BRS Amansa Burro' (29.98%) and 'Isabel de Souza' (30.72%).

In the assessed semiarid conditions, local varieties 'Do Céu' and 'Cigana Preta' had low potential for biomass production (both root as shoot). In contrast, 'BRS Mulatinha' variety stood out for its high root production at the expense of shoot production and presented a high harvest index.

Considering the dry matter yield of shoot biomass (Sh-DMY), 'Mani Branca', 'Isabel de Souza' and 'BRS Verdinha' varieties were higher than the others with Sh-DMY of 2,93 t.ha-1, 3,05 t.ha-1 and 3,14 t.ha-1, respectively. On the other hand, the dry matter yield of roots was higher in varieties 'BRS Amansa Burro' (5.28 t.ha-1), 'BRS Mulatinha' (5.34 t.ha-1) and 'Isabel de Souza' (5.87 t.ha-1) (Table 2). Only 'Isabel de Souza' variety had a good balance in the production of shoot and root biomass. The yield of biomass presented in this study were below the range from 15.23 to 41.07 t.ha-1 and 3.58 to 9.78 t.ha-1, reported by Adjebeng-Danquah and Safo-Kantanka (2013) for fresh and dry shoots, respectively; and 5.3 to 6.3 t.ha-1 reported by Hue et al. (2012) for dry shoot. However, the results are close to those observed by Costa et al. (2007) in which dry matter yield of shoot ranged from 1.06 to 7,36 t.ha-1, depending on the varieties.

Some environmental characteristics such as soil fertility, climatic conditions and cutting intensity, in addition to used variety are crucial to cassava shoot yield. Although the genotypic effect of cassava varieties have a high importance on cassava shoot yield, possibly the extremely adverse weather conditions of the Bahia semiarid region have contributed to the low yield on these traits compared to other literature reports. Another important difference compared with the two aforementioned reports is due to the fact that in these works pruning was carried out at different planting stages, which certainly contributed to increase the above ground biomass yield.

Content and protein production of cassava varieties

Similar to biomass, cassava varieties showed significant differences ($p \leq 0.01$) for protein production both for root and shoot (Table 1). The CV ranged from 5.51% (Sh-CPC) to 31.46% (Ro-CPY). Possibly the highest variation to Ro-CPY trait is related to their association with root yield, whereas the CV from Ro-CPC was low (8.32%). However, in the case of quantitative traits, these CVs are considered of median magnitude.

The wide variation in average levels of crude protein content in shoots (Sh-CPC ranged from 17.99% to 25.13%) shows the difference between the genotypes for this trait. The 'Do Céu' variety was the most promising (25.13%), and then varieties 'Cigana Preta' (20.28%), 'BRS Verdinha' (20.45%) and 'BRS Amansa Burro' (21.79%). Adjebeng-Danquah and Safo-Kantanka (2013) reported a narrow change in crude protein content at 12 months of harvest (13.8 to 18.9%) compared to the present study, when evaluating 25 cassava varieties in Ghana at different harvest time. Moreover, these authors observed maximum crude protein output six months after planting and large genotypic differences between varieties analyzed (13.3% and 19.8% 'DMA 004' and 'Nkabom' varieties, respectively).

Similarly, when evaluating three cassava varieties in Vietnam, Hue et al. (2012) did not observe significant differences between varieties for Sh-CPC. However, significant variation was observed in different leaf harvest time, and there was a positive correlation between increased harvest frequency and dry matter and crude protein production in the cassava shoot. Considering that the data from this study refer to harvesting 12 months after planting, it is necessary to investigate whether crops staggered the aerial part of cassava in semiarid conditions can become an alternative to further increase biomass production per area without compromising the root production, which are commonly used to generate income in farms.

When considering crude protein yield of the shoots (Sh-CPY), there were no significant difference ($p>0.01$) between varieties 'BRS Amansa Burro' (0.50 t.ha-1), 'Mani Branca' (0.53 t.ha-1), 'Do Céu' (0.57 t.ha-1), 'Isabel de Souza' (0.58 t.ha-1) and 'BRS Verdinha' (0.64 t.ha-1) (Table 2). Some authors have shown that the genetic variability existing between cassava varieties for leaf protein content is an indicative of their potential response to selection (Ravindran, 1991). Although comparisons with other studies may bring inaccurate inferences due to the multiplicity of factors that affect the field experiments, we observed lower Sh-CPY in cassava varieties grown in Bahia, considering the higher amplitude for this trait in other studies, such as 0.64 to 1.63 t.ha-1 variations observed by Adjebeng-Danquah and Safo-Kantanka (2013).

Regarding crude protein content in the roots (Ro-CPC), despite the narrow variation (4.35 to 6.23%), varieties ‘Mani Branca’ and ‘Izabel de Souza’ were the most promising, with Ro-CPC of 5.55% and 6.23%, respectively. In contrast, considering crude protein yield of the roots, the most productive varieties were ‘BRS Mulatinha’ and ‘Izabel de Souza’, with 0.28 t.ha-1 and 0.37 t.ha-1, respectively (Table 2). In this case, only the range of ‘Isabel de Souza’ was superior in both traits.

Even with all the difficulties imposed on food production in semiarid region, the possibility of obtaining more than 500 kg of crude protein (shoot) on the best cassava varieties; it opens perspectives for keeping animals in prolonged drought, with low cost and high nutritional value food. This is especially important considering the insufficient supply and high prices for cereals traditionally used in animal feed. Therefore, the availability and adaptability on some cassava varieties in the semiarid region make this crop a good alternative to replace corn and other cereals (CHAUYNARONG et al., 2009). Besides its consumption in fresh form, chopped and dried (important for leaf detoxification), some alternatives to use cassava shoots has been evaluated, same as hay and silage storage, making its use viable during critical periods for cattle feeding (COSTA et al., 2007; LIMA JÚNIOR et al., 2013).

Multivariate analysis of biomass and protein production

In order to determine variation and to detect any structural pattern between the traits related to the biomass and protein production, PCA was used considering all variables simultaneously (Figure 1).

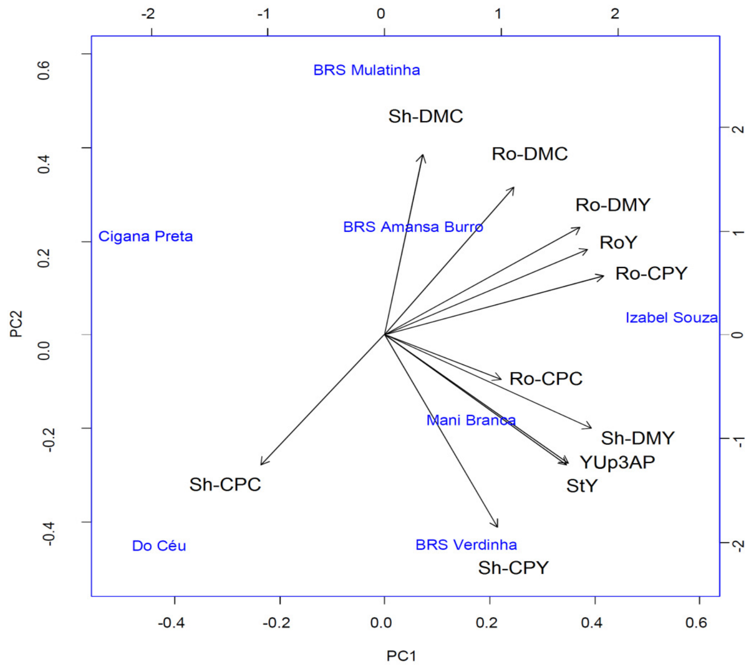

Figure 1. Graphical dispersion of characteristics related to biomass and protein production in seven cassava varieties evaluated in Bahia semiarid, considering the first two main components (CP1 and CP2).

The first and second PCA elements explained 44.2% and 32.9% of data variance, and thus more than 77% of data variance allows us to represent the cassava variety diversity based on these two major components (Table 3). Even with less explanation of the total variance in the first two axis, Agbagla-Doahnani et al. (2001) and Andrade et al. (2003) demonstrated the PCA potential in the assessment of chemical and morphological variability of rice straw from different European varieties (69%), and sugar cane varieties (66%) as an alternative source for animal feed.

The most important traits in the first PCA axis were StY, YUp3AP, Ro-DMY, RoY, Sh-DMY and Ro-CPY, while Sh-CPY, Sh-CPC, Ro-DMC and Sh-DMC were more important for the second PCA axis (Figure 1). Several traits were important sources of variation in at least one PCA axis; and there were no unique traits on different main components explaining most of the variation.

However, although most the evaluated traits contributed to the varieties representation in the dispersion graphic, it was observed that yield-related data (roots, shoots and proteins) were the main diversity source among the cassava varieties. Chioma and Trinitas (2009) used a similar strategy to group cassava varieties based on their nutritional quality, and also observed that the protein and carbohydrates content were important to define the variety diversity.

Table 3. Principal component analysis on evaluation of cassava varieties for biomass and protein production in semiarid of Bahia, with eigenvalue and variation proportion associated with each axis. Year 2013/2014.

Parameter	Main Components						
	CP1	CP2	CP3	CP4	CP5	CP6	CP7
Standard deviation	2.206	1.902	1.037	0.950	0.685	0.267	0.009
Variance proportion	0.442	0.329	0.098	0.082	0.042	0.006	0.001
Cumulative proportion	0.442	0.771	0.869	0.951	0.993	0.999	1.000

In general, it was not possible to set a specific grouping of cassava varieties, considering its wide dispersion in different quadrants of the PCA analysis. Similar situation occurred in the representation of evaluated traits (Figure 1). However, it was found that the Sh-DMC, Ro-DMC, Ro-DMY, YUp3AP, RoY and Ro-CPY traits were important in characterizing ‘BRS Amansa Burro’ and ‘Isabel de Souza’ varieties in the upper right quadrant (Figure 1). The varieties in the lower right quadrant (‘Mani Branca’ and ‘BRS Verdinha’) are characterized by presenting greater Ro-CPC, Sh-DMY, YUp3AP, StY and Sh-CPY. On the other hand, the ‘Do Céu’ and ‘Cigana Preta’ varieties were positioned quite differently from other varieties, in the lower quadrant and upper left, respectively. The ‘Do Céu’ variety was characterized by the highest Sh-CPY.

Phenotypic correlations between traits

The YUp3AP was positively correlated to StY (0.92), Sh-DMY (0.95) and Sh-CPY (0.88) traits (Figure 2). Possibly this high correlation between YUp3AP and StY is related to greater plant vigor which results in high amount of leaves in the shoot. A similar trend was also observed for StY *versus* Sh-DMY (0.92) and StY *versus* Sh-CPY (0.86). In addition, the positive correlation between the yield of the upper third of the aerial part and the yield of dry matter (shoot and root) and protein yield seems to be independent from the content of these elements in the shoot, considering the insignificance of the correlation Sh-DMC *versus* Sh-DMY and Sh-CPC *versus* Sh-CPY. Even though factors such as sampling, plant maturation stage, climatic conditions affect the protein content in cassava shoots, observations that crude protein yield is more dependent on shoot yield than on the protein content has been reported in other studies, such as Adjebeng-Danquah and Safo-Kantanka (2013) which also found high positive correlation (0.97) between Sh-DMY and Sh-CPY while low correlation between Sh-CPC and Sh-CPY (0.13) were observed.

Considering the root yield, significant and positive correlations with Ro-DMY (0.98) and Ro-CPY (0.93) were observed (Figure 2). Unlike the aerial part, the dry matter content of the roots and dry matter yield of the roots were positively correlated (0.75). In addition, in the roots the dry matter and protein yield were also highly correlated (0.90) (Figure 2). Therefore, even with significant differences among varieties for Ro-DMC and Ro-CPC, identifying varieties with higher root yields can contribute more directly for obtaining high yields for these traits per unit area. This can be explained by the fact that the protein content in the roots has a much lower variation range than root yield, which depends on a large number of genetic and environmental factors. Positive and significant correlations were also observed between Sh-DMC and Ro-DMC (0.70) and between Sh-DMY and Sh-CPY (0.76).

The only pair of trait significantly and negatively correlated was Sh-DMC and Sh-CPC (-0.70). Similar results were obtained by Imran et al. (2010) evaluated seven millet varieties in Turkey. In this case, in general, the highest level of dry matter in the shoot resulted in lower crude protein levels. However, the increase in the total protein yield can be better exploited by increasing biomass yield and protein content in leaves itself.

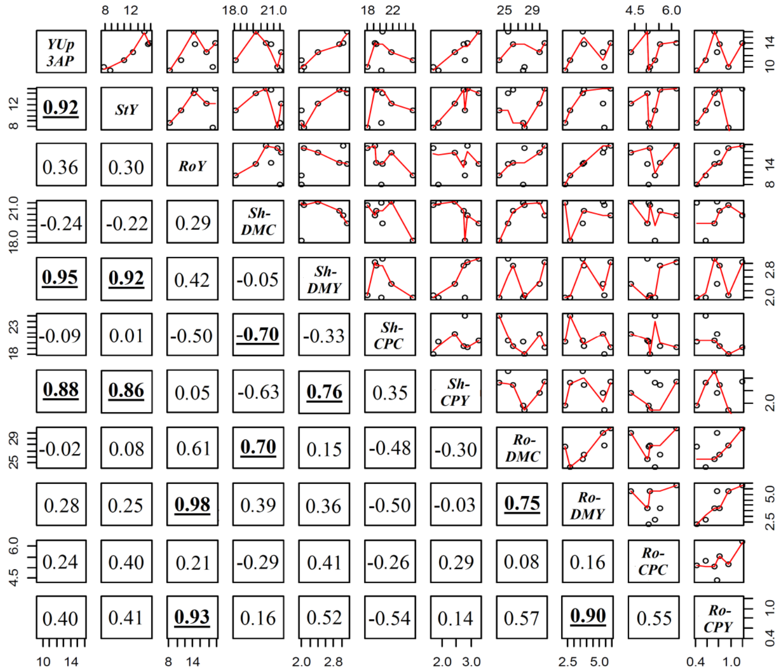

Figure 2. Graphic of phenotypic correlations between traits related to biomass and protein production in seven cassava varieties evaluated in Bahia semiarid. The significant correlations (p <0.05) are shown in bold and underlined.

CONCLUSIONS

Differences in biomass production capacity on shoots and roots in cassava from different genotypes grown in the semiarid region, allow the selection of the most appropriate varieties for animal food production in these weather conditions.

The protein yield in shoots and roots depends more on the dry matter yield compared to crude protein levels. Therefore, the selection of cassava varieties producing biomass seems more promising than the selection of varieties with high protein content itself.

Based on the analysis of principal components, productive traits (roots, shoots and proteins) were the main diversity sources among cassava varieties.

Considering the diversity of cassava uses by the farmer, 'BRS Verdinha' can be used as the best suited variety to maximize the protein yield per unit area, while 'Izabel de Souza' variety may be indicated for biomass production in shoot or roots.

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RESUMO: A seleção de variedades de mandioca para cultivo nas regiões semiáridas constitui-se uma alternativa para geração de renda e uso na alimentação animal. O trabalho teve por objetivo avaliar o potencial de produção de biomassa e proteína de sete variedades de mandioca no semiárido baiano. Foram avaliadas 11 características agronômicas da parte aérea e raiz, bem como teor de proteína bruta (PB), utilizando delineamento experimental de blocos casualizados com quatro repetições. Também foram realizadas a análise de componentes principais e de correlações entre características. Foram identificadas diferenças significativas entre as variedades para todas as características exceto para teor de matéria seca na parte aérea. Variações importantes foram identificadas para teor de proteína (17,90-25,13%), produtividade de raízes (8,17 a 19,79 t.ha^{-1}), matéria fresca (9,36-15,89 t.ha^{-1}) e seca da parte aérea (1,99-3,14 t.ha^{-1}), proteína na parte aérea (0,37-0,64 t.ha^{-1}) e na raiz (0,12-0,37 t.ha^{-1}). De acordo com a análise de componentes principais os dois primeiros responderam por mais de 77% da variação dos dados, e as características relacionadas à produtividade foram as principais fontes de diversidade entre as variedades de mandioca. A maioria das correlações foram positivas e favoráveis à seleção de variedades mais aptas para produção no semiárido. Embora, não tenha sido possível agrupar as variedades de mandioca com base na análise de componentes principais, foi possível verificar o potencial da variedade BRS Verdinha para produção de proteína e da variedade Izabel de Souza como produtora de biomassa tanto parte aérea quanto raiz.

PALAVRAS-CHAVE: Alimentação animal. Alternativa. *Manihot esculenta* Crantz.

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