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UNB 033: AN INTERESTING INTERSPECIFIC CASSAVA HYBRID[1]

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ABSTRACT

Evaluating progeny of an interspecific hybrid of cassava with *M. dichotoma* showed that it has an erect stature combined with rapid stem growth, which makes it a candidate for intercropping with other crops. Analysis of its leaf content showed twice the amount of carotin , five times that of minerals, and higher protein content of 26.4%.

Key words: *Manihot esculenta, M. dichotoma*, carotin, minerals, protein content.

RESUMO

UnB 033: UM INTERESSANTE HÍBRIDO INTERESPECÍFICO DE MANDIOCA

A avaliação de um híbrido interespecífico da mandioca com *Manihot dichotoma* mostrou que ele tem crescimento ereto e muito rápido, tornando-o candidato ao consorciamento com outras culturas. A analise de suas folhas revelou que possui o dobro de caroteno e cinco vezes mais de minerais, além de 26,4% de proteína em relação à mandioca.

Palavras-chave: *Manihot esculenta, M. dichotoma,* caroteno, minerais, proteína.

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INTRODUCTION

Cassava ranks fifth among the most important staple crops in the tropics and subtropics. It is consumed by more than 800 million people (*3*) and it is one of the most efficient calorie producers reaching 250 kilocalories per hectare/day (2). In various countries of Africa and Latin America, cassava is grown in a mixture culture, which is known as intercropping. Since protein content of cassava is as low as 1% in its roots,one of approaches to optimize its use is to intercrop it with legumes. Another approach is to improve its leaf protein content during intercropping and add the leaves to poor people diet. Carotins and minerals also needs to be improved in cassava, considering its daily use by the poor people. In addition to this, breeding programs must aim at a modified plant stature to enable the plant to adapt to a consorsium model. The best stature is to grow erect as opposed to canopy shading form, and to change the spatial arrangement from rectangular to single stem growth, preventing it from covering the adjacent plants.

Wild *Manihot* species are a source of many useful genes that may contribute to change the cultivar's stature, and provide many useful genes (*5, 6, 9,10*). One of these species, *M. dichotoma*, is known for its compact form, which raise the possibility to select among its hybrids with cassava vertical form cultivars. If the leaves of these cultivars are rich in protein and other nutrients, it will be ideal for intercropping system, offering a low-cost source of balanced food for poor people.

MATERIAL AND METHODS

As part of the breeding program set up by the first author, hybrids of cassava wild *Maniho*t species and cassava were obtained (*7*). The cassava - *M. dichotoma* hybrid was left for open pollination. From its progeny a clone displaying a unique vertical stem was selected (Fig.1), herein called UnB 033, and described as follows: roots conic with rough surface, external color brown, root fresh color cream; stem grows vertical and reaches 4 m within 6 months, color grey, large scars; leaf lobe shape ovate; sinuosity of lobes linear; length of median lobe less than 12 cm; width of median lobe ca. 2 cm; petiole green; young foliage reddish blue; mature fruit green. It was planted for growth habit and productivity evaluation at the experimental station of the Universidade de Brasília, where soil analysis (mg/100 ml) is as follows: Ca+Mg 4.5, Ca 3.4, Mg 1,1, Al 0.0, H+Al 1.8, N 0.05, K 19.0, P 0.0. The analysis of the leaves of this clone for protein content, carotinoid, HCN and minerals were carried out according to the A. O. A. C. procedures (*1*), using 5 replications for every treatment. Anova analysis applied Bonferroni correction and Stats 95 program. Our results are presented as medium and standard deviation.

FIGURE 1 - Left: clone UnB 033, right: common cassava clone

RESULTS AND DISCUSSION:

Despite the poor soil where phosphorous content is almost zero, the selected clone showed rapid growth. The unique erect stem reached about 4 m height within 8 months (Fig. 1). Root productivity per plant planted in 1x1 m apart ranged from 2.8 ± 0.2 kg after 8 months from planting. Vertical growth habit is very rare in cassava. Some literature is available on using it as a cultivated variety. Single stem growth habit is ideal for intercropping systems since it replaces the normal canopy growth habit of cassava (Fig. 1), allowing maximun light exposure for the combined crops. The analysis for HCN, protein content, and B-carotin is seen in Table 1. Results for Mg, Al, P, Mn, Fe, Cu, Zn and Ca analyses are presented in Table 2 .

TABLE 1 - HCN, protein and carotinoid content in the selected clone UnB 033 and common cassava clone EB01

Clone	HCN mg/kg	Protein %	B-carotin mg/kg
UnB	128.55±11.67	26.41±1.66	22.30±3.3
EB01	152.30±18.26	24.25±0.43	13.10±1.5

TABLE 2 - Mineral content (mg/kg) in the selected clone (UnB) 033 and common cassava clone EB01

Clone	Mg	Al	P	Ca	Mn	Fe	Cu	Zn
UnB 033	36.58±4.77 17.18±2.91	17.18±2.91	1196.67±97.81	1435.00±142.19	3.87±0.51	16.49±2.69	1.20±0.11	16.36±1.48
EB01	37.71±1.3519.77±3.34	19.77±3.34	1090.83±39.38	1139.17±167.49	0.72±0.05	13.58±1.24	1.00±0.10	3.18±0.28

HCN content was found to be 128.5 ± 11.67 mg per kg in the selected clone compared to 152.3 ± 18.26 in the common cassava clone EB01. Cyanide levels in the cassava leaf ranging from approximately 100 to 1,100 mg HCN per kg of fresh leaf are occasionally reported, e.g., 1,860 mg HCN per kg fresh leaf weight (*4*). These levels are compared with a normal range of 15 to 400 mg per kg in fresh cassava roots (*2*). Leaf cyanide levels have little correlation with root content of this material. Direct comparison of leaf and root cyanide levels often yielded conflicting results. Yeoh and Oh (*13*) found that leaf cyanide levels were similar to those in root peel but 6 times higher than those in root pulp. In the case of the improved bred clone 033, this is a medium HCN level, which allows using this clone in animal nutrition after sun drying for one day maximum or using the plant for silage purposes. Both the treatments shall lead to detoxification of HCN. Protein content in leaves was found to be 26.41±1.66 g per kg compared to 24.25±0.43 in the cassava clone. A wide range of protein content has been reported, varying considerably among cultivars. Rogers (*12*), who tested over 100 samples, found a minimum of 20% crude protein (total N x 6.25) on a dry weight basis.

Attempts have been made in the past to increase the protein content of the leaves of some cassava cultivars by crossing with other *Manihot* species (*11*) but no concrete result has been reached. In the literature, probably the only successful case was reported by Nassar and Dorea (*8*) analyzing hybrid of cassava and *M. oligantha*. These researchers reported double of protein content in the hybrid root accompanied by increased root production and hybrid vigour. This result was confirmed by us recently through chemical analysis of the hybrid produced by Nassar in the 1980's (*7*).

The most striking feature of analysis of this developed clone (033) is the doubled carotin content compared to the other cassava clone used in this experiment, and the very high mineral content, specially of Mn and Zn, up to five times for both minerals. The results show clearly that wild species confer cassava not only resistance to diseases and pests but can also contribute significantly to increasing their nutritive value, and above all, reshaping the plant for different culture purposes.

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REFERENCES

1. A. O. A. C. Official methods of analysis of the Association of Agricultural Chemists.11th ed. Washington,1970. 1075 p.
2. COURSEY, D. G. & HYNES, P. H. Cassava as a food: toxicity and technology. In Nestel, B. & MacIntyre, R. (eds.). Chronic cassava toxicity. London, Proc. Interdisciplinar Workshop, 1973. p.27-36.
3. FAO. Yearboock production. 1998.
4. GONDWE, A T.D. Studies on the hydrocyanic acid content of some local varieties of cassava (*Manihot esculenta* Crantz) and some traditional cassava food products. E. African Agric. Forest J., 40:161-7, 1974.
5. NASSAR, N. M. A wild Manihot species of Central Brazil for cassava breeding. Can. J. Plant Sci., 58:257-61, 1978.
6. NASSAR, N. M. A. Some further species of Manihot with potential value to cassava breeding. Can. J. Plant Sci., 58:915-7, 1978.
7. NASSAR, N. M. A. Attempts to hybridize wild Manihot species with cassava. Economic Botany, 34:13-5. 1980.
8. NASSAR, N. M. A. & DOREA, G. Protein contents of cassava cultivars and its hybrid with Manihot species. Turrialba, 32:429-32, 1982
9. NASSAR, N. M. A. Genetic variation of wild Manihot species native to Brazil and its potential for cassava improvement. Fields Crops Res., 13:177-84. 1986.
10. NASSAR, N. M. A. Cassava, *Manihot esculenta* Crantz genetic resources: their collection, evaluation and manipulation. Advances in Agronomy ,69:179-230, 1990.
11. NOBRE, A. E. C. & NUNES, W. O. Seleção de variedades e clones da mandioca visando um melhoramento protéico. Bol. Tecn. Centro Tecnol. Agric. Aliment., 5:15-21, 1973.
12. ROGERS, D. J. Cassava leaf protein. Econ. Bot., 13:261-3. 1959.
13. YEOH, H. H. & OH, H. Y. Cyanide content of cassava. Malayan Agric. J., 52:24-8, 1979.