

Cuttings were obtained from 12 months old individual varieties and were replanted on ridges of 10 plants each. The evaluation of the twelve cassava varieties for some of their agronomic characters related to yield was undertaken in 1985. Harvesting was carried out after 8 months from planting.

Plant height, branching levels, number of initial branches, number of leaves/plant, petiole length, petiole colour, leaves yield, leaf area, tuber yield, tuber length, tuber diameter, tuber colour and root to top ratio at 8-month plant age were recorded. Moreover, HCN in fresh leaves and tubers was determined for each variety at the Organization Protein Laboratory, Ministry of Agriculture, Egypt according to A.O.A.C. (1980). The obtained data were statistically analyzed according to procedures outlined by Steele and Torrie (1960).

#### RESULTS AND DISCUSSION

##### 1- Plant height and branching behaviour:

Data presented in table (1) indicate that the height of the studied varieties ranged from 138.8 to 243.8 cm., with variety 3 as the shortest and variety 7 as the tallest. Four varieties, i.e. 4, 7, 8 and 9 are considered as tall varieties with plant height exceeding 200 cm., six varieties namely, 1, 2, 5, 6, 10 and 12 have a medium height ranging from 171.3 and 195.0 cm. and two varieties, i.e. 3 and 11 are considered short with plant height less than 150 cm.

Data on branching levels showed that varieties can be divided into distinct groups with branching levels ranging from zero to 3. Three of the tall varieties, i.e., 4, 8, 9 were no branching levels. An exception to this occurred with variety 12 which possessed two levels. The short varieties possessed 2 or 3 branching levels. It can be generally concluded that there was negative relationship between plant height and number of branching levels. This may be due to the genetical constitution of the varieties.

With regard to the number of initial branches/plant, it was observed that seven of the tested varieties were characterized by bearing only one initial branch. These varieties were 2, 4, 6, 7, 8, 11 and 12. Four varieties, i.e. 1, 3, 5 and 9 had about two initial branches and only variety 10, a high yielding variety, possessed 3 initial branches. Two out of the three high yielding varieties bore only one initial branch, and had two branching levels.

Table (1): Some growth characters of 12 tissue cultured cassava varieties after 8 months from planting in 1985.

Variety No.	Plant height cm.	Bran- ching levels	No. of initial branches/ plant	No. of leaves/ plant	Leaf area cm <sup>2</sup>	Petiole length cm	Petiole colour
1	182.00	3	2.000	504.00	151.80	22.900	light green green
2	183.00	2	1.000	168.00	150.50	27.000	light green
3	138.00	2	2.250	311.00	147.40	20.600	light green
4	221.80	0	1.000	105.00	466.80	31.400	rose
5	171.00	3	1.750	355.00	254.90	28.300	green reddish
6	182.00	2	1.250	188.00	192.20	28.200	green reddish
7	243.00	2	1.000	360.00	326.80	32.300	green reddish
8	223.80	0	1.000	112.00	402.30	41.000	green reddish
9	228.00	0	2.000	243.00	341.80	45.500	green reddish
10	171.30	2	3.000	565.00	368.70	38.000	green reddish
11	145.00	3	1.000	279.00	326.00	33.000	rose
12	195.00	2	1.000	222.00	293.10	22.500	green reddish
L.S.D. 5%	19.65	-	0.503	87.58	68.74	2.164	--
L.S.D. 1%	26.47	-	0.678	117.95	92.65	2.914	--

Results obtained by Hunt *et al.* (1977), indicated that genotype and environment play a main role on branching characters. Moreover, Keating *et al.* (1982), demonstrated that main stem and lateral branch number showed little variation either between dates or with time in any one planting.

#### 2- Leaf characteristics:

Number of leaves/plant showed marked differences among the tested varieties where this number varied from a minimum of 105 in variety 4 to a maximum of 565 in variety 10 (Table 1). The tested varieties can be arranged into four groups, the first group developed from 100 to 200 leaves/plant including varieties 2, 4, 6 and 8, the second group developed from 200 to 300 leaves/plant including three varieties, i.e. 9, 11 and 12 followed by the third group bearing from 300 to 400 leaves/plant and including the three varieties namely, 3, 5 and 7 the fourth group bearing over 500 leaves/plant including varieties 1 and 10. These differences may be due to the differences in the genetical constitution of the tested varieties.

As for leaf area, a wide variation was manifested from 147.4 cm<sup>2</sup> for variety 3 to 466.8 cm<sup>2</sup> for variety 4 with significant differences among most of the tested varieties. Varieties No. 4, 7, 8, 9, 10 and 11 have great leaf area ranging between 300 cm<sup>2</sup> and 500 cm<sup>2</sup>, followed by varieties 5 and 12 having a leaf area between 200 and 300 cm<sup>2</sup>, the lowest leaf area of 100 to 200 cm<sup>2</sup> was for varieties 1, 2, 3 and 6.

Results reported by Cook *et al.* (1979), indicated that crop growth rate increased with the increase in leaf area. Moreover, Keating *et al.* (1982), demonstrated that some vigorous cultivars showed improved yield performance during the second year, while the less vigorous types failed to increase yield substantially after the first year.

Petiole length showed significant differences among the tested varieties. The lowest petiole length was 20.6 cm for variety 3 and the maximum petiole length was 45.5 cm for variety 9. Most varieties have petiole length around 30 cm. The three high yielding varieties i.e. 7, 10 and 12 have petiole length of 32.3, 38.0 and 22.5 cm, respectively (Table 1).

Petiole colour showed also considerable variation from light green, green, green reddish to rose. The majority of the tested varieties have green reddish petioles. The three high yielding varieties, i.e. 7, 10 and 12 have also green reddish petiole.

### 3- Tuber characteristics:

The results in Table (2) show that the 12 varieties varied markedly in tuber length. The minimum length was 12 cm for variety 1 and maximum length was 45 cm for variety 12. It is clear that the three outstanding varieties with regard to tuber yield/fad. are 7, 10 and 12 possessed high tuber lengths of an average of 29.8, 35.3 and 45.0 cm, respectively. The data showed that the four varieties namely 1, 3, 4 and 5 fall in a category length of less than 20 cm and the five varieties, i.e. 2, 6, 7, 8 and 9 are with a tuber length from 20 to 30 cm, while the three varieties namely, 10, 11 and 12 are superior in this important yield component and have a tuber length over 30 cm.

With regard to tuber diameter (Table 2), the statistical analysis showed no significant difference among varieties in this character in spite of marked variations among the tested varieties. The data showed that the maximum diameter was 6 cm for variety 12 which ranked the first with regard to tuber yield/fad.; and the minimum diameter was 2.5 cm for variety 3 which was an inferior variety in tuber yield/fad. The greatest diameters of the three high yielding varieties, i.e. 7, 10 and 12 was 5.0, 4.8 and 6.0 cm, respectively. It was quite clear that this character was greatly related with tuber yield/fad.

The data on number of marketable tubers/plant showed also great variations. This value was zero with variety 1, producing no any marketable tubers and a maximum of 11 tubers/plant for variety 7 (Table 2). Also, the three high yielding varieties namely, 7, 10 and 12 produced the highest values of this trait, i.e. 11.00, 9.00 and 7.25, respectively. It is clear from the data that a close relationship is found between tuber yield/fad and tuber number/plant.

Onwueme (1978), stated that the number of tubers/plant varies from 4 to 10. This number is dependent on cultivar as well as the orientation of cuttings. He also concluded that the components that contribute to yield are the main weight per tuber, the number of tubers/plant and the number of plants/ha.

Tuber colour ranged from white cream to dark brown. It is quite interesting that the three high yielding varieties, 7, 10 and 12 are of light brown colour. Seven varieties namely, 1, 4, 5, 6, 8, 9 and 11 are of brown coloured tubers and only the two varieties, i.e. 2 and 3 are of white cream tubers.

Table (2): Yields of tubers and leaves, HCN content (ppm/100 g fresh weight) of 12 tissue cultured cassava varieties after 8 months from planting in 1985.

Variety No.	Tuber length length cm	Tuber dia-meter cm	No. of marke-table tubers	Tuber colour	Leaves yield t/fed.	Tubers yield		Root to top ratio	HCN content	
						kg/ plant	t/fad.		ppm/100 g fresh weight	in in tubers tubers
1	12.00	3.7	--	brown	7.993	0.101	0.4557	0.044	190	150
2	28.00	4.7	7.25	white cream	3.711	2.150	9.6750	0.538	197	295
3	19.30	2.5	1.00	white cream	4.880	0.308	1.3840	0.205	157	514
4	16.30	3.4	5.00	brown	3.535	0.500	2.5000	0.250	190	143
5	17.50	3.3	8.25	brown	9.592	0.500	2.2500	0.125	115	222
6	20.60	3.5	8.25	brown	5.063	1.075	4.8375	0.015	151	295
7	29.80	5.0	11.00	light brown	15.390	4.200	18.9000	0.067	218	255
8	28.50	3.5	7.25	brown	8.141	1.575	7.0875	0.063	106	325
9	24.80	2.8	5.00	brown	16.143	1.150	5.1750	0.143	114	160
10	35.30	4.8	9.00	light brown	21.612	2.775	18.7000	1.110	150	323
11	34.50	3.4	5.25	brown	8.776	0.275	0.3375	0.462	146	284
12	45.00	6.0	7.25	light brown	7.073	4.375	19.6875	0.717	213	247
L.S.D. 5%	5.04	n.s.	1.27	--	2.380	0.260	1.1510	0.057	--	--
L.S.D. 1%	6.78	n.s.	1.17	--	3.204	0.340	1.5500	0.077	--	--

#### 4- Yield of leaves and tubers and root to top ratio:

The results in Table (2) show that yield of leaves/fad. varied significantly among the varieties. Minimum yield was 3.5 t/fad. for variety 4 and maximum leaves yield was 21.6 t/fad. for variety 10. Three varieties were considered as leading varieties in leaf yields with a yield above 15 t/fad., they are varieties 7, 9 and 10. This group was followed by a second one yielding from 5 to 10 t/fad. and it includes the 6 varieties namely, 1, 5, 6, 8, 11 and 12. Inferior leaf yields of less than 5 t/fad. were produced by varieties 2, 3 and 4. It could be concluded that a wide range of variability was found in this quite important character, since leaves are used for human food and as fodder animals as well.

The results of tuber yield/plant showed also significant variation among the tested varieties. The highest tuber yield/plant was of two leading varieties, i.e. 7 and 12 where the tuber yield/plant was 4.200 and 4.375 kg, respectively. These two varieties were followed by three varieties namely, 2, 10 and 11 with a yield of tubers/plant of more than 2 kg but less than 3 kg, then a third group of three varieties including 6, 8 and 9 producing an average tuber yield/plant of over one kg but less than two. The last four varieties namely, 1, 3, 4 and 5 are of inferior tuber yield/plant of less than one kg. It was quite clear that tuber yield/plant was the most important character contributing to the tuber yield/fad. The three promising varieties produced a satisfactory tuber yield/plant and are leading in this respect.

With regard to tuber yield/fad., highly significant differences were found among the tested varieties. Three leading varieties namely, 7, 10 and 12 produced an average tuber yield of 18.9, 18.7 and 19.7 t/fad., respectively. These three varieties were also superior with regard to the yield component characters such as branching levels, number of marketable tubers/plant, tuber length, tuber diameter and tuber yield/plant. These varieties are promising and can be included in further investigations for more comprehensive studies. Another group including three varieties, i.e. 2, 8 and 11 produced an average tuber yield of 9.7, 7.1 and 9.3 t/fad., respectively. This group ranks second in importance and may prove to have better merits in further investigations. The other six varieties are inferior with regard to tuber yield ranging from 0.46 t/fad in variety 1 to 5.17 t/fad. in variety 9.

The great variation in tuber yield/fad. indicates clearly the effect of the genetical make up of the investigated varieties. It could be concluded that three varieties namely, 7, 10 and 12 are recommended for further investigations and evaluation of their merits.

Results reported by Mattos *et al.* (1982), indicated that varieties vary widely in tuber yield. It was also estimated that on the world basis, the average yield was 10 t/ha. (F.A.O., 1974). i.e. about 4.2 t/fad.

Results in Table (2) showed that root to top ratio indicated highly significant differences among the tested varieties. This ratio ranged from a minimum of 0.015 in variety 6 to a maximum of 1.110 in variety 10. The best varieties in this trait were 2, 10, 11 and 12 with a ratio ranging from 0.462 and 1.110 followed by varieties 3, 4, 5 and 9 with a ratio less than 0.125 for varieties 1, 6, 7 and 8. The wide variation in this ratio is mainly due to the differences in growth characters as well as the yielding capacity of the tested varieties.

#### 5- Hydrocyanic acid in tubers and leaves:

The chemical analysis showed that HCN content in tubers varies greatly among varieties (Table 2). Content of HCN varied from 106 ppm in variety 88 to 218 ppm in variety 7. All tested varieties could be included in the poisonous category with HCN content of over 100 ppm according to Purselove (1977). However, the tested varieties can be grouped into three groups within this poisonous category. The first group is slightly poisonous containing from 100 to 150 ppm HCN including varieties 5, 8, 9, 10 and 11. The second is moderately poisonous including varieties 1, 2, 3, 4 and 6 with HCN content of 150 to 200 ppm. The third group is highly poisonous with HCN content of over 200 ppm and included varieties 7 and 12 and they are therefore considered as bitter cassava. It is disappointing to note that two out of the three outstanding varieties (7 and 12) are grouped as highly poisonous tubers. Such results were confirmed by those of Greentree and Lambourne (1933).

Results showed also that considerable variation in HCN content in cassava leaves was found. There was no clear relevance between HCN content in tubers and leaves. The minimum content was 143 ppm in variety 4 and the maximum reached 514 ppm in variety 3. Between these two extremes 2 varieties i.e. 1 and 9 contained 150 and 160 ppm, respectively, which are moderately poisonous. Six varieties

contained from 200 to 300 ppm including 2, 5, 6, 7, 11 and 12 and two varieties namely, 9 and 10 contained over 300 ppm HCN content. It is also worth to note that the three promising varieties, i.e. 7, 10 and 12 contained high HCN content in their leaves.

The detoxification of leaves is very simple procedure and can be achieved by chopping or crushing the leaves, boiling for few minutes and discarding the water or more simply by means of sundrying. Therefore, precaution should be paid for detoxification before utilization of cassava leaves in human or animal nutrition. Onwueme (1978), stated that levels of cassava containe cyanogenic glucocides at a concentration of about 200 ppm of fresh leaves.

#### REFERENCES

- A.O.A.C. (1980): "Association of Official Agriculture Chemists" Official methods of analysis 10<sup>th</sup> Ed., Washington D.C.
- C.I.A.T. (1979): Centro Internacional do Agric. Tropica. Annual report, Cali, Colombia.
- Cook, J.H.; Franklin, D.; Sandeval, G. and Juri, D. (1979): The ideal cassava plant for maximum yield. *Crop Sci.* 19: 271-279.
- El-Fishawy, M.A. (1986): Evaluation of some agronomic characters related to growth and yield of cassava (Manihot esculenta Grantz.). Ph.D. Thesis, Fac. of Agric., Moshtohor, Zagazig Univ., Egypt.
- Ezumah, H.C. (1980): Cassava improvement in the programme National Manioc in Zaire, objectives and acheivements up to 1978.
- F.A.O. (1974): Production year book, Vol. 28.
- Greenstreet, V.R. and Lambourne, J. (1933): Tapioca in Malaya Strait Settlements, Federate Malaya States Dep. Agric. Gen. Ser. 13 Kuala Lumpur.
- Hunt, L.A.; Wholey, D.W. and Cock, J.H. (1977): Growth physiology of cassava. (c.f. *Field Crop Abst.*, 30(2): 77-91).
- I.I.T.A. (1974): Internation Institute of Tropical Agriculture. Ibadan, Nigeria. Annual report.



- Jones, W.O. (1959): Manioc in Africa. Standford Univ. Press, Standford, 315 pp.
- Keating, B.A.; Evenson, J.P. and Fukai, S. (1982): Assimilate distribution and storage organ yield. Field Crop Res., 5: 293-303.
- Mattos, P.L.P.; Caldas, R.C. and Gome, J.D. (1982): Comparison of cassava cultivars and clones for fresh matter production. (c.f. Field Crop Abst. "1982" 35(7): 551).
- Onwueme, I.C. (1978): The tropical tuber crop. Text book English Language book. Society, John Wiley & Sons. Chickester.
- Purseglove, J.W. (1977): Tropical crops, dicotyledon. Longmans, London.
- Santiago, A.D. and Maglhars, P.C. (1982): Introduction of cassava cultivars into the State of Alaga. (c.f. Field Crop Abst., 35(3): 2525).
- Steel, R.G.D. and Torie, J.H. (1960): Principles and procedures of statistic. McGraw-Hill Book Company, Inc., New York.

EVALUATION OF SOME CASSAVA (MANIHOT ESCULENTA GRANTZ.)  
VARIETIES INTRODUCED BY TISSUE CULTURE

BY

Shafshak\*, S.E.; Oraby\*\*, F.T.; El-Deepah\*, H.R.A.  
and El-Fishawy\*\*, M.A.

- \* Fac. of Agric. Moshtohor, Zagazig Univ. Egypt.  
\*\* Inst. of Efficient Productivity, Zagazig Univ., Egypt.

ABSTRACT

Fifty in vitro cassava (Manihot esculenta Grantz.) varieties produced by tissue culture were obtained from IRRT, San Carlos, California, USA. From those, only 12 varieties were well adapted to Egyptian climate. The acclimatization process and the experiment were carried out in the Vegetable Research Division, Agric. Res. Center, Giza, Egypt during 1984 and 1985. After 2 months the plants were transplanted into a well watered field in March 1984 for propagation to get enough cuttings for next season. Cuttings were obtained from 12 months old plants and were planted on ridges. The evaluation of the 12 varieties for some of the agronomic characters related to yield was undertaken in 1985. Data on growth and yield characters (8 months age) were recorded at harvest.

The tested varieties differed gratly in plant height, branching levels, number of leaves/plant, leaf area, petiole length and petiole colour. Tuber length ranged between 12 to 45 cm, tuber diameter between 2.5 and 6 cm, number of marketable tuber varied from zero to 11, tuber colour varied from white cream to dark brown, yield of leaves varied from 5 to 21.6 t/fad., tuber yield/plant reched a maximum of 4.4 kg for var. 12 and varieties number 7, 10 and 12 were the three leading with an average yield of about 19 t/fad. Root to top ratio ranged from 0.015 to 1.11. Content of HCN in tubers varied from 10 ppm to 218 ppm and HCN in leaves ranged from 143 to 514 ppm.

INTRODUCTION

Cassava is very recently introduced to the Egyptian agriculture on experimental level. As a new crop there will be the need to introduce early maturing, disease resistant and high yielding varieties. Studies are also needed

to reduce cyanide content of cassava, breeding for early harvest and fairly storable varieties.

Jones (1959), stated that pattern of branching of cassava plant varies with different cultivars. Reports of IITA (1974), showed that the number of stems/plant dose not affected cassava yield. Hunt *et al.* (1977), concluded that genotype and enviroment play a main role on branching character. Onwueme (1978), stated that components contributing to yield are the mean weight/tuber, the number of tubers/plant and number of plants/ha. Reports of CIAT (1979), indicated linear correlation among several traits in cassava germplasm evaluation. Ezumah (1980), showed that the main oriteria selection have been high root yield, resistance to major diseases and pests, high starch concentration, platability in addition to colour, odour, texture and taste. Mattos *et al.* (1982), found that the highest fresh yields produced were 46.5, 40.9 and 39.0 t/ha in three cultivars. Santiago and Magalharse (1982), evaluated 70 cultivars and found that the highest aboveground yields were 25.5, 22.9, 21.5 and 20.5 t/ha. Starch content ranged between 24.6 and 38.0%.

The aim of the present study was to evaluate 12 cassava varieties for some agronomic characters related to yield.

#### MATERIALS AND METHODS

Fifty *in vitro* cassava varieties produced by tissue culture were obtained from the International Plant Research Institute, San Carlos, California, USA. The acclimatization of the *in vitro* materials were carried out under sanitary media, and growth area essential to plant integrity along with cultural requirements such as high humidity, light intensity of 7000 to 10000 lux, minimum night temperature of 20°C and adequate plant nutrition to maximize growth were considered. This acclimatization process was carried out in the phytotron of the Vegetable Research Division, Agric. Res. Center, Giza. The procedure Followed is given in details by El-Fishawy (1986).

Plants were placed in 10 cm plastic pots and left in covered chamber. When plants reached 30 cm length (2 months age), they were treansfered to the field by setting the plants under 50% shade for 2 weeks. The plants were transplanted thereafter into a well watered field on March 1984 for propagation to get enough cuttings for next season.