CLONAL EVALUATION OF YAM TUBERS RAISED FROM YAM TRUE SEED

E. C. Nwachukwu¹ and I. U. Obi²

¹National Root Crops Research Institute, Umudike, P.M.B. 7006, 
Umuahia, Abia State, Nigeria.

²Department of Crop Science, 
University of Nigeria, Nsukka, Nigeria

ABSTRACT

Clonal evaluation of second generation yam (Dioscorea rotundata) plants raised from gamma ray treated and untreated yam true seeds, showed that, at the MV一代, increasing doses of gamma rays decreased plant heights, number of leaves, and tuber yield. At the MV一代, generation however, these disappeared. Correlation analysis revealed significant relationship (p = 0.01) between first generation tuber set weight and second generation tuber yield (r = 0.46), first generation tuber shape and second generation tuber shape (r = 0.27) and tuber yield and leaf spot disease infestation (r = 0.14), with n - 2 degrees of freedom of 718.

Agronomic traits that could be selected, at the first generation stage, are tuber shape and disease resistance but not tuber yield.

INTRODUCTION

Yams are important food crops in Nigeria, supplying the much needed starch food to millions of people in the country. The white yam Dioscorea rotundata, Poir, is the most widely cultivated. Coursey and Martin (1970) was of the belief that it is possible to increase the yield of yams through hybridization. The successful germination of yam true seeds (Waltt 1961, Doku, 1970; Sadik and Okereke, 1975 and Okoli, 1975) heightened this belief. However, more than 25 years after the successful germination of the yam true seeds, new yam genotypes are yet to be developed and released for commercial cultivation through hybridization.

Several reasons have been adduced as factors limiting the development of yams through hybridization. These include poor and inconsistent flowering pattern, poor fruits set and low seed yield. Because the yams have been propagated for a long time vegetatively through tuber segmentation, they have lost the ability for efficient sexual reproduction (Onwume, 1978, Anmirato, 1984). Most white yam cultivars have never been known to flower, and the few that flower produce only male or female flowers (Asiedu et al., 1992). These, as well as the limited genetic variability available in the yam germplasm, make it imperative to seek and utilize other easily available genetic improvement technologies such as mutation induction to supplement hybridization. Thus, in our yam genetic improvement programme, we are employing both mutation induction and hybridization techniques.

In this report, the results of the clonal evaluation of second generation yam plants raised from gamma ray treated and untreated true seeds are presented.

MATERIAL AND METHOD

A total of 3000 first generation tuber lines isolated from first generation Dioscorea rotundata seedlings of true yam true seeds treated to gamma ray, doses of 0.75, 100, 150, 200 and 250Gy were used in the trial. The weight range of the tubers was 0.2-142.0g. The tubers from each gamma ray treated dose group were planted in the field in a randomised complete block design (RCBD) of four replication. Gamma ray...
The results in tables 1 and 2 show the effects of gamma ray irradiation on some vegetative and tuber characteristics of irradiated yam seedlings measured at the MV1 and MV2 generations. At the MV1 generations, there were significant differences among the gamma ray doses when seedling heights and number of leaves per stand were compared. Generally, seedling heights and number of leaves per stand decreased with increasing doses of gamma ray irradiation. On the other hand, gamma ray irradiation did not seem to affect the number of vines per stand of the irradiated yam seedlings. Also, when the harvested tuber characteristics were compared, gamma ray irradiation did not affect the number of tubers per stand and the tuber shape index. (Table 2). Rather, significant differences were observed when tuber yields were considered. Increasing gamma ray doses decreased tuber yield at MV1 stage. These results agree with the reports of Nair and Susan Abraham (1988) on yam bean pachyrhizus erosus Linn, and Vasudevan and Jos (1992) on Dioscorea alata and Descunlenta. In all the cases, the mean values of some quantitative characters in MV1 populations derived from irradiated plant part were lower than those from untreated ones (Scessirol, 1977). At the MV2 generations, however, treatment means were not significantly different.

Mutagen treatment results in three types of effects physiological damages, (primary injury), factor mutations (gene mutations) and chromosome mutations (chromosomal aberrations) (Gaul, 1977). Factor and chromosome mutations can be transferred from MV1 generation to the subsequent generations but physiological effects (physiological damage) may not be hereditary. For practical purposes selection for mutants starts from MV2 generation (Vasudevan and Jos 1992), when physiological effects may have disappeared. Physiological injury sets a practical limit to increasing mutagenic dose and thus used extensively in establishing dose ranges (radio-sensitivity) for mutation induction (Nwachukwu et al., 1994).

In breeding, early detection and selection of promising lines save the breeders, time and energy used in carrying undesirable lines through several generations before being discarded. In yams, the major breeding objectives are, high tuber yields, high tuber dry matter content, tubers with round shapes, and for lines with dwarf vines that may be grown without or with minimal staking. In the present trial, MV2 yam lines selected because of their modified vegetative

RESULTS AND DISCUSSION

The results in tables 1 and 2 show the effects of gamma ray irradiation on some vegetative and tuber characteristics of irradiated yam seedlings measured at the MV1 and MV2 generations. At the MV1 generations, there were significant differences among the gamma ray doses when seedling heights and number of leaves per stand were compared. Generally, seedling heights and number of leaves per stand decreased with increasing doses of gamma ray irradiation. On the other hand, gamma ray irradiation did not seem to affect the number of vines per stand of the irradiated yam seedlings. Also, when the harvested tuber characteristics were compared, gamma ray irradiation did not affect the number of tubers per stand and the tuber shape index. (Table 2). Rather, significant differences were observed when tuber yields were considered. Increasing gamma ray doses decreased tuber yield at MV1 stage. These results agree with the reports of Nair and Susan Abraham (1988) on yam bean pachyrhizus erosus Linn, and Vasudevan and Jos (1992) on Dioscorea alata and Descunlenta. In all the cases, the mean values of some quantitative characters in MV1 populations derived from irradiated plant part were lower than those from untreated ones (Scessirol, 1977). At the MV2 generations, however, treatment means were not significantly different.

Mutagen treatment results in three types of effects physiological damages, (primary injury), factor mutations (gene mutations) and chromosome mutations (chromosomal aberrations) (Gaul, 1977). Factor and chromosome mutations can be transferred from MV1 generation to the subsequent generations but physiological effects (physiological damage) may not be hereditary. For practical purposes selection for mutants starts from MV2 generation (Vasudevan and Jos 1992), when physiological effects may have disappeared. Physiological injury sets a practical limit to increasing mutagenic dose and thus used extensively in establishing dose ranges (radio-sensitivity) for mutation induction (Nwachukwu et al., 1994).

In breeding, early detection and selection of promising lines save the breeders, time and energy used in carrying undesirable lines through several generations before being discarded. In yams, the major breeding objectives are, high tuber yields, high tuber dry matter content, tubers with round shapes, and for lines with dwarf vines that may be grown without or with minimal staking. In the present trial, MV2 yam lines selected because of their modified vegetative
Table 1: The vegetative characteristics of irradiated yam seedlings at the MV₁ and MV₂ generations

<table>
<thead>
<tr>
<th>Gamma ray dose (Gy)</th>
<th>Plant height (cm)</th>
<th>Number of leaves per stand</th>
<th>Number of vines per stand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MV₁</td>
<td>MV₂</td>
<td>MV₁</td>
</tr>
<tr>
<td>0</td>
<td>40.2</td>
<td>78.1</td>
<td>39.7</td>
</tr>
<tr>
<td>75</td>
<td>30.2</td>
<td>85.8</td>
<td>30.3</td>
</tr>
<tr>
<td>100</td>
<td>27.5</td>
<td>81.2</td>
<td>28.1</td>
</tr>
<tr>
<td>150</td>
<td>22.5</td>
<td>77.7</td>
<td>23.0</td>
</tr>
<tr>
<td>200</td>
<td>18.3</td>
<td>77.7</td>
<td>19.4</td>
</tr>
<tr>
<td>250</td>
<td>14.8</td>
<td>716</td>
<td>16.8</td>
</tr>
<tr>
<td>F.LSD (P = 0.05)</td>
<td>12.8</td>
<td>Ns</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Ns = not significantly different

Table 2: The mean number of tubers, tuber shape index, mean tuber yield per stand of yam plants raised from irradiated true yam seeds at MV₁ and MV₂ generations.

<table>
<thead>
<tr>
<th>Gamma ray dose (Gy)</th>
<th>Number of tubers per stand</th>
<th>Tubers shape index</th>
<th>Tuber yield (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MV₁</td>
<td>MV₂</td>
<td>MV₁</td>
</tr>
<tr>
<td>0</td>
<td>1.2</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>75</td>
<td>1.2</td>
<td>1.3</td>
<td>0.4</td>
</tr>
<tr>
<td>100</td>
<td>1.3</td>
<td>1.3</td>
<td>0.3</td>
</tr>
<tr>
<td>150</td>
<td>1.0</td>
<td>1.3</td>
<td>0.4</td>
</tr>
<tr>
<td>200</td>
<td>1.2</td>
<td>1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>250</td>
<td>1.2</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>F.LSD (P = 0.05)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

Ns = not significantly different
Table 3: The number of MV₂ yam lines selected for their vegetative characteristics

<table>
<thead>
<tr>
<th>Gamma ray Dose (Gy)</th>
<th>Bunchy, Bushy and climbing</th>
<th>Vegetative Characteristics</th>
<th>Bunchy with canopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>75</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>100</td>
<td>3.0</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>150</td>
<td>1.3</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>200</td>
<td>3.5</td>
<td>1.0</td>
<td>2.3</td>
</tr>
<tr>
<td>F.LSD (P = 0.01)</td>
<td>1.1</td>
<td>0.4</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Table 4: Correlation coefficients of some agronomic characters in Yam seedlings

<table>
<thead>
<tr>
<th>Agronomic Characters</th>
<th>Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 First generation set weight and second generation tuber yield per stand</td>
<td>0.46**</td>
</tr>
<tr>
<td>2 First generation tuber shape index and second generation tuber shape</td>
<td>0.27**</td>
</tr>
<tr>
<td>3 Tuber yield per stand and leaf spot disease score</td>
<td>0.14*</td>
</tr>
</tbody>
</table>

For the correlation coefficients, n = 720; ** Significant P ≤ 0.01; * significant P ≤ 0.05.
characteristics are shown in Table 3. No non-climbing lines were observed, however, distinct lines with bushy and bushy vegetation, bushy with conical canopies and bushy with spreading vine branches were isolated. In these lines, vines had reduced lengths, and possessed comparatively shorter canopies.

An attempt was also made to determine characters that could be selected for at first generation. Table 4 shows the correlation coefficients between first generation tuber set weight and second generation tuber yield, first generation tuber shape and second generation tuber shape and tuber yield and leaf spot disease infestation score. There were significant correlation (P = 0.01) between first generation tuber set weight and second generation tuber yield (r = 0.46) and first generation tuber shape and second generation tuber shape index (r = 0.27). There was also a significant correlation coefficient (P = 0.05) between tuber yield and disease infestation (r = 0.14). From this result, tuber shape and leaf spot disease can be selected for at the first seedling generation but tuber yield may not. Coursey, (1967) and Onwueme, (1980) noted that tuber shape in yams is variable but highly dependent on cultivars. Cobley (1956) implicated both genetic and environmental factors such as soil structure in determining the tuber shape.

With tuber yield, however, both variety (genetic) and tuber set weights play a large role in determining the final yield. Miege (1957), Onwueme (1972), Lyonga et al (1973) and Nwoke et al (1973) observed strong relationship between set weight and yield. Thus, in the present trial, seti sizes of the first generation tubers influenced the final yield in the second generation. Therefore, selection among the lines will be more effective in subsequent generations when it will be possible to plant equal seti sizes under replicated trials.

REFERENCES


Nwachukwu, E.C. and Obi, I.U. (1999). Some effects of gamma irradiation on MV, 
(Dioscorea rotundata, Poir) seedlings. Proc. 32nd Ann. Conf. Agric. Soc. Nige-

Nwoke, F.I.O.; Njoku, E. and Okonkwo, S.N.C. 
(1973). The effect of size of seed yams on yield of individual plants of Dioscorea 


Okoli, O.O. (1975). Yam production from seeds: 

Okoli, O.O., Igbokwe, M.C., Eni, i.S.O. and 
Bull. No2. NRCRI, Umudike Umuahia.

Onwueme, I.C. (1972). Influence of the weight 
of the planted tuber on the vegetative performance of white yam (Dioscorea 

Onwueme, I.C. (1978). Tropical tuber crops 
Yams, Cassava, Sweet potato, Cocos and. 

in yam research in Africa. 1st Triennial 

Sadik, S and Okeke, O.U. (1975). A new appr-
ach to improvement of yam, 
Dioscorea rotundata. Nature 254; 134 - 
135.

with continuous variation. In: Manual on mutation breeding 2nd. ed. IAEA, 
Vienna. Tech Rep. Series 119 Pp. 188 - 
123.

effects on yam Dioscorea alata L. and

D. esculenta (L.OUR) Burk. J Root Crops 
18; 94 - 98.

Waitt, A.W. (1961). Review of yam research in 