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CLONAL EVALUATION OF YAM TUBERS RAISED FROM YAM TRUE SEED

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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_1 generation, increasing doses of gamma rays decreased plant heights, number of leaves, and tuber yield. At the MV_2 generation however, these disappeared. Correlation analysis revealed significant relationship ($p = 0.01$) between first generation tuber sett 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 *Diocorea 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 (Waitt 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 (Onwueme, 1978, Ammirato, 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 yam true seeds are presented.

MATERIAL AND METHOD

A total of 3000 first generation tubers (lines) isolated from first generation *Dioscorea rotundata* seedlings of true yam 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 doses, 0. 75, 100,50, 200 and 250(Gy) constituted the treatments. The yam minisett technique was employed in the field operations (Okoli,*et al* 1982). The stand population was 1500 yam stands per block and these were planted in four rows measuring 75m per block. The inter-row and intra-row spacing were 1m and 20cm, respectively. The stands were staked singly to facilitate observations on individual plants and the experimental field was weeded as necessary.

Each line was given an identification number for easy identification and separation from the seedling stage in case it deserves being selected for further trial as a potential new variety. Data collected from each tuber before planting were the tuber weight, and the number of setts isolated from it. Others were the diameter and length of the tuber, which were used to calculate the tuber shape index (TSI). The tuber shape index was calculated as

$TSI = \frac{D}{L}$ where D is the diameter of the tuber and L is its length (Nwachukwu and Obi, 1999).

Twelve weeks after planting, when vegetative growth had peaked (Onwueme, 1978),the following data were collected from each line: plant height, number of leaves, number of vine per stand and leaf spot disease. The leaf spot disease was scored using 1-5 scoring scale as outlined below: 1= no infection, 2= 25% infection, 3 = 50%infection, 4 = 74% infection and 5 = over 75% infection.

Tubers were harvested when senescence set in. Yield data collected were number of tubers per stand, weight of tuber per stand and the diameter and length of the tuber. The data collected were statistically analysed based on randomised complete block design, and significant effects were separated according to Obi, (1986).

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 MV_1 and MV_2 generations. At the MV_1 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 gama 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 MV_1 stage. These results agree with the reports of Nair and Susan Abraham (1988) on yam bean *pachyrrhizus erosus* Linn. and Vasudevan and Jos (1992) on *Dioscorea alata* and *D.esculenta*. In all the cases, the mean values of some quantitative characters in MV_1 populations derived from irradiated plant part were lower than those from untreated ones (Scossiroli, 1977). At the MV_2 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 MV_1 generation to the subsequent generations but physiological effects (physiological damage) may not be hereditary. For practical purposes selection for mutants starts from MV_2 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 rotund shapes, and for lines with dwarf vines that may be grown without or with minimal staking. In the present trial, MV_2 yam lines selected because of their modified vegetative

Table 1: The Vegetative characteristics of irradiated yam seedlings at the MV_1 and MV_2 generations

Gamma ray dose (Gy)	Plant height (cm)		Number of leaves per stand		Number of vines per stand	
	MV_1	MV_2	MV_1	MV_2	MV_1	MV_2
0	40.2	78.1	39.7	69.4	1.5	1.2
75	30.2	85.8	30.3	85.9	1.6	1.2
100	27.5	81.2	28.1	75.4	1.4	1.2
150	22.5	77.7	23.0	71.1	1.4	1.2
200	18.3	77.7	19.4	66.1	1.4	1.2
250	14.8	716	16.8	66.1	1.3	1.3
F.LSD (P = 0.05)	12.8	Ns	1.7	Ns	Ns	Ns

Ns = not significantly different

Table 2: The mean number of tubers, tuber shape index, mean tuber yield per stand of yam plants raised form irradiated true yam seeds at MV_1 and MV_2 generations.

Gamma ray dose (Gy)	Number of tubers per stand		Tubers shape index		Tuber yield (g)	
	MV_1	MV_2	MV_1	MV_2	MV_1	MV_2
0	1.2	1.2	0.3	0.2	17.9	99.4
75	1.2	1.3	0.4	0.2	13.1	143.5
100	1.3	1.3	0.3	0.2	11.2	124.3
150	1.0	1.3	0.4	0.1	10.0	116.0
200	1.2	1.2	0.4	0.2	5.9	95.1
250	1.2	1.3	0.5	0.2	4.4	80.2
F.LSD (P = 0.05)	ns	ns	ns	ns	5.4	ns

ns = not significantly different

Table 3: The number of MV_2 yam lines selected for their vegetative characteristics

Gamma ray Dose (Gy)	Vegetative Characteristics		
	Bunchy, Bushy and climbing	Bushy, spreading and climbing	Bunchy with canopy
0	1.0	1.0	0
75	1.5	1.0	1.0
100	3.0	1.5	1.0
150	1.3	1.0	1.0
200	3.5	1.0	2.3
F.LSD (P = 0.01)	1.1	0.4	0.8

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

	Agronomic Characters	Correlation Coefficient (r)
1	First generation set weight and second generation tuber yield per stand	0.46**
2	First generation tuber shape index and second generation tuber shape	0.27**
3	Tuber yield per stand and leaf spot disease score	0.14*

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 bunchy and bushy vegetation, bunchy 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 sett 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 sett 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 sett 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 sett weight and yield. Thus, in the present trail, sett 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 sett sizes under replicated trails.

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