Original Research Article

Assessment of X-ray Irradiation on the Morphological Performance of Sweet Potato *(Ipomoea batatas* (L.))

ABSTRACT

Aim: Sweet potatoes (Ipomoea batatas (L.)) were studied to assess the influence of x-ray irradiation on the morphological performance.
Place and Duration of Study: Samples were collected from National Root Crop Research Institute (NRCRI), Umudike, irradiation was done in the x-ray unit of a medical laboratory, planting and data analysis were done at the experimental farm and laboratory of the department of Genetics and Biotechnology, University of Calabar..
Methodology: Stems of Sweet potatoes were grouped and non-control groups irradiated at different x-ray doses, planted and morphological parameters analyzed.
Results: The results showed no significant difference in the treatments for parameters such as number of leaves, leaf area, leaf length, plant height, leaf width and days to sprouting when kilo voltage (kV) was constant at 40kV and milli Amperes per second (mAs) varied from 1.6mAs to 3.2mAs. There was also no significant difference in the treatments for parameters such as leaf area, leaf length, leaf width and days to sprouting when mAs was constant at 1.6mAs and kilo voltage (kV) varied from 40kV to 100kV. The results also showed that the low doses of x-ray irradiation did not cause aberrations in the morphological performance of sweet potato.
Conclusion: These findings necessitate the need for adequate irradiation doses in the use of ionizing radiations on crops in order to maintain and improve their varieties.

Keywords: Sweet potato; x- ray; irradiation; treatments.

1. INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.)) Lam is a dicotyledonous plant belonging to the family *convolvulacea*, it is a field crop of major economic importance worldwide and the fourth most cultivated food crop after wheat, rice and maize [1]. It is a short duration crop that produces a large amount of calories and enriched with carbohydrates, protein, iron, magnesium, potassium and vitamin B & C [2]. It is widely used as source of food, feed and as a dietary supplement [3]. The current focus on energy production from biomass has led to the recognition of the potential of Sweet potato as a biomass species [4].

Irradiation-induced mutation breeding is effective in improving Sweet potato characters such as yield, starch and soluble sugar content, carotenoid content of storage roots and disease resistance [5, 6]. Irradiation has also been successfully used for mutation breeding in various crops and ornamental plants [7] and has proven an adept means of encouraging the expression of recessive genes and producing new genetic variations [7, 8, 9].

Ahloowalia and Maluszynski [10] established the use of ionizing radiation, such as x-rays, gamma rays, neutrons and chemical mutagens for inducing variation. Ahloowalia *et al.* [11] presented the global impact of mutation-derived varieties on food production and quality enhancement. Al-Safadi *et al.* [12] established that low doses of gamma irradiation on potato (*Solanum tuberosum* L.) cultivars enhanced tuberization in vitro without genetic changes. Das *et al*. [13] obtained heat tolerant mutants in commercial potato cultivars through *in vitro* mutagenesis of *in vitro* propagated plantlets.

Ikram *et al.* [14], investigated the exposure of x- rays on leguminous seeds in combination with Aerva javanica in the management of root rot fungal pathogens and on the growth of crop plants, seed of cowpea & mung bean and established that seeds treated with x- rays for 5 & 10 seconds showed significant enhancement in growth parameters and completely controlled the infection of root rot fungi (*Fusanum spp*, *Rhizoctonia solani* and *Macrophomina phaseolina*).

2. MATERIAL AND METHODS

2.1 Study Site

The research work was carried out at the experimental farm in the department of Genetics & Biotechnology, University of Calabar, Calabar.

2.2 Sample collection and processing

Stems of sweet potatoes were obtained from the National Root Crop Research Institute (NRCRI), Umudike and stem irradiation was done in the x-ray unit of a medical laboratory in Calabar metropolis.

2.3 X – ray irradiation (Treatment) of stems

Stems of sweet potatoes were cut into length of 6cm and divided into groups and labeled appropriately. The controls (group 1) were not exposed to irradiation (treatment), while the other groups (2-6) groups were irradiated at different doses as shown below.

Table 1: Irradiation schedule

Groups	First Trial	Second Trial
1	0kV/0mAs	0kV/1.6mAs
2	40kV/1.6mAs	40kV/1.6mAs
3	40kV/2.0mAs	55kV/1.6mAs
4	40kV/2.4mAs	70kV/1.6mAs
5	40kV/2.8mAs	85kV/1.6mAs
6	40kV/3.2mAs	100kV/1.6mAs

**kV was kept constant in the first trial while mAs varies*
mAs was kept constant in the second trial while kV varies
kV = kilo voltage
mAs = milli Amperes per second

2.4 Planting of Stems

A land measuring 10 x 10 meters was used for the planting of the stems. The land was manually cleared, soil tilted and beds made. The stems were sown at 30cm apart and about 3cm deep in a randomized complete block design (RCBD). Weeding was done when the need arose.

2.5 Data Analysis

Data such as days to sprouting, plant height, leaf length, leaf width, leaf area and number of leaves per plant was analyzed using Analysis of Variance (ANOVA) and means separated with the Least Significant Difference (LSD) at 0.05 probability level.

3. RESULTS AND DISCUSSION

The results showed the morphology of sweet potato when kilo voltage (kV) was constant and milli Amperes per second (mAs) varied (Table 2). The results for the number of leaves showed that there was no significant difference in the treatments and in the block (P>0.05). The mean number of leaves ranged between 5.8±0.5–7.7±1.1 with treatments from group 2 having the highest mean value. The leaf area showed no significant difference (P>0.05) in the treatments and the block. The mean leaf area varied from 192.9±32.0.2–334.9±43.86 with treatments from group 3 having the highest mean value. The leaf length were not significantly different in the block and also in the treatments (P>0.05). The leaf length also varied from 7.1±0.54 –8.2±0.8 with treatments from group 1 (control) having the highest mean value. The plant height showed significant difference in the block (P<0.05) but no significant difference in the treatments (P>0.05). The mean for the plant height ranged between 10.02±0.60 –10.9±0.98 with treatments from group 1 (control) having the highest mean value.

The leaf width showed no significant difference in the block and also in the treatments (P>0.05). The leaf width also ranged from 6.1±0.52 –7.2±0.22 with treatments from group 5 having the highest mean value. The days to sprouting showed no significant difference in the block and also in the treatments. Statistically no significant difference was observed in the days of germination. The parameters for the days of sprouting varied from 16.5±0.89 –20.5±2.33 with treatments from group 2 having the highest mean value.

Table 2. Means for the parameters studied when kV was constant and mAs variable

Parameters	1	2	3	4	5	6	LSD
No of leaves	7±0.6	7.7±1.1	6.3 ± 0.7	7.3±0.66	5.8±0.5	6.7±0.66	3.02
Leaf area	192.9± 32.06	266.6± 25.45	334.9± 43.86	227.3± 31.09	217.29 ±54.89	285.43± 121.86	243.2
Leaf Length	8.2±0.8	7.4± 0.47	7.3±0.69	7.7±0.36	7.1± 0.54	7.3±0.63	2.40
Plant height	10.9± 0.98	10.7±0 0.71	10.52± 0.82	10.8± 0.74	10.02 0.60	10.08± 1.01	2.86
Leaf width	6.1±0.52	6.6± 0.58	6.1±0.48	7.0±0.39	5.6±0.20	7.2±0.22	1.82
Days to Sprouting	17.2±1.85	20.5± 2.33	18.3± 2.47	16.5±0.89	17.8±0.60	19.8±0.79	8.80

**1= 0kV/ 0mAs*
2 = 40kV/ 1.6mAs
3 = 40kV/ 2.0mAs
4 = 40kV/ 2.4mAs
5 = 40kV/ 2.8mAs
6 = 40kV/ 3.2mAs

The results also showed the morphology of sweet potato when milli Amperes per second (mAs) was constant and kilo voltage (kV) varied (Table 3). The results for the number of leaves showed that the treatments had significant difference (P<0.05) and there was no significant difference in the block (P>0.05). The mean number of leaves ranged between 8.8±0.54–12.0±0.58 with treatments from group 2 and 5 having the highest mean value. The leaf area showed no significant difference (P>0.05) in the treatments and the block. The mean leaf area varied from 78.08±3.21 –92.63±4.78 with the mean leaf area of the control (Group 1) higher than that of the treatments. The leaf length were not significantly different in the block and also in the treatments (P>0.05).

The leaf length also varied from 8.1±0.82 –10.7±0.39 with leaf length of the control (Group 1) higher than that of the treatments. The plant height were significantly different in the treatments (P<0.05) and not significantly different in the block (P>0.05). The mean for the plant height ranged between 15.3±2.08-25.4±1.11 treatments from group 6 having the highest mean value. The leaf width showed no significant difference in the block and also in the treatments (P>0.05). The mean for the leaf width ranged from 8.6±0.32 –9.7±0.38 with treatments from group 6 having the highest mean value. The days to sprouting showed no significant difference in the block and also in the treatments (P>0.05). The mean days to sprouting ranged from 19.3±0.80 –24.5±2.35 with treatments from group 6 having the highest mean value.

Table 3. Means for the parameters studied when mAs was constant and kV variable

Parameters	1	2	3	4	5	6	LSD
No of Leaves	8.8± 0.54	12.0± 0.58	10.83± 0.94	9.5± 0.43	12.0± 0.58	11.0± 0.67	2.67
Leaf area	92.63± 4.78	84.53± 4.30	81.31± 5.89	85.53± 12.36	92.04± 10.87	78.08± 3.21	31.66
Leaf length	10.7± 0.39	9.6±0.59	9.5±0.60	9.1± 1.12	10.2± 0.83	8.1± 0.52	2.80
Plant height	21.2± 1.85	16.7± 0.49	15.3± 2.08	20.6± 1.23	22.7± 1.10	25.4± 1.11	5.66
Leaf width	8.7± 0.47	8.9± 0.46	8.6± 0.32	9.3± 0.32	8.9± 0.71	9.7± 0.38	1.74
Days to Sprouting	21.5± 2.30	19.3± 0.80	22.7± 2.47	20.2± 1.48	20.3± 1.49	24.5± 2.35	8.80± 0.82

**1= 0kV*/ 0mAs
2 = 40kV/ 1.6mAs
3 = 55kV/ 1.6mAs
4 = 70kV/1.6mAs
5 = 85kV/1.6mAs
6 = 100kV/1.6mAs

The influence of x-ray irradiation on the morphological performance of Sweet potato (*Ipomoea batatas* (L.)) when kilo voltage (kV) was constant at 40kV and milli Amperes per second (mAs) varied from 1.6mAs to 3.2mAs showed no significant difference in the treatments for parameters such as number of leaves, leaf area, leaf length, plant height, leaf width and days to sprouting. This means that the x-ray doses did not cause any aberrations in the morphological performance of sweet potato. This is in line with the study of Kehinde *et al.* [15] who reported that small doses of x-ray may stimulate cellular activities and growth while higher doses may cause higher aberrations. The study is also in conformity with Andrew *et al.* [16] who reported that low x-ray irradiation doses could induce variability and enhance vegetative growth and yield of plants using cowpea as a test plant.

The influence of x-ray irradiation on the morphological performance of Sweet potato (*Ipomoea batatas* (L.)) when milli Amperes per second (mAs) was constant at 1.6mAs and kilo voltage (kV) varied from 40kV to 100kV showed no significant difference in the treatments for parameters such as leaf area, leaf length, leaf width and days to sprouting. This also means that the low x-ray doses did not cause any aberrations in the morphological performance of sweet potato. This is also in line with Akpaniwo *et al.* [17] who evaluated the field performance and morphological variation of fluted pumpkin treated with various doses of x-ray radiation and observed that high doses of x-ray radiation reduce germination and survival percentage in the M1 generation.

4. CONCLUSION

The study evaluated the morphological performance of Sweet potato (*Ipomoea batatas* (L.)) irradiated with x-ray which is one of the ionizing radiations that have been used in improving the varieties and characters of important crops such as Sweet potato (*Ipomoea batatas* (L.)).

From the study, low doses of x-ray irradiation did not cause any aberration in the morphological performance of sweet potato. Therefore adequate irradiation doses are necessary in the use of ionizing radiations on Sweet potato and other crops in order to maintain or improve their varieties.

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