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Effect of different doses of gamma radiation on the seedlings of *Digitaria exilis* (Kipp) Stapf.

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ABSTRACT: Seeds of *Digitaria exilis* were exposed to four doses (0, 100, 500 and 1000 gy) of gamma irradiation from ^{60}Co source and the effects of the doses were tested on the vegetative characters of the seedlings. Percentage germination was highest in 100 gy followed by 0 gy (control) and lowest in 1000 gy. This trend was also true for other vegetative characters except for the root length which was highest in 500 gy. Mean squares from analysis of variance revealed that all vegetative characters showed significance at 0.01 probability level with respect to level of irradiation dosage.

Key Words: Gamma irradiation; Seed germination; *Digitaria exilis*; Mutation.

Introduction

Digitaria exilis in a cereal grown in the savannah zone of West Africa. It is being cultivated in Bauchi and Pleatue States in Nigeria as a staple food. (Stanfield, 1971). *Digitaria exilis* has been described to have great genetic and developmental potentials. It also has the ability to withstand continous and intermittent drought conditions that result from uncertain rainfall and im most cases resistant to many of the diseases associated with other cereals.

Despite these attributes, *Digitaria* is not being widely cultivated due to the very small grain size which adversely effects the yield. Variability within the available germplasm is low this has made crop improvement through selection almost impossible.

To generate variability, induction of mutation has been widely used. These mutations can be generated by using chemical mutagens such as EMS, mustard gas etc. and radiation which can be ionizing. Ionizing radiation which include gamma rays are most commonly used because they penetrating ability due to the short wave length and high energy photon. (Gonzalez, 1994).

This radiation has been recognised to cause structural changes in chromosome effect of which may be lethal, inhibitory or stimulatory (Goltschalk and Wolff 1983). Vigorous vegetative growth has been linked with low doses of radiation in crops like onion (Kahan, 1969) also low doses of gamma irradation had been found too positively affect the yield of tomatoes (Sidrack and Suess 1973) Soyabean (Stan and Crottoru 1970).

This study is aimed at:

1. Determining the effect of different does of gamma radiation on the seedling of *Digitaria exilis*
2. Determining the dose that will generate useful mutation in *D. exilis*

Materials and Methods

Seeds of *D. exilis* were collected from the National Cereals Research Institute of Nigeria baddeggi. Irradiation of seeds was done at Centre for Energy and Reseaech Development Obafemi Awolowo University Ile-Ife with gamma rays from ^{60}Co source. Dry seeds were irradiated using four doses (0, 100, 500 and 1000 gy).

Treated seeds were sown in four properly labelled plastic buckets which had been previously filled with rich loamy soil. The plastic buckets were then kept in a space that served as nusery in the department of biological sciences, University of Ilorin. Transplanting was done after four weeks of sowing. Thirty seedlings for each treatment were transplanted into ten pots already filled with topsoil at the three seedlings per pot. Percentage survival of seedlings after transplanting for each treatment was recorded. Morphological characters which include shoot length, number of primary root branches, number of leaves, average leaf width were measured at the time of transplanting to compare effects of doses on the seedlings. Data were subjected to single classification Anova.

Results and Disscussion

Germination started in all the treatment after the third day of sowing, Germination was fastest in the 100gy followed by the control and lowest in 1000gy. This fast rate of germination in 100gy must have due to increased enzyme and mitotic activities while the slow rate of germination observed in 500 and 1000gy must have resulted from decreased enzymatic activity. Since it takes a high dose to inactive an enzyme, it explains while in 100gy germination was stimulated rather than being impeded. (Kaplan 1963).

At emergence 1000gy seedlings showed purple coloration at the tip which later turned green, by the 12th day of sowing most of the seedling, had started dying back. This has been found to occur in rice as a result of pleiotropic effect of purple pigment in rice.this pigmentation which in being cided by a gene can only express itself in the absence of an inhibitor gene. Hence it is possible that the purple coloration in *D exilis* could be due to pleiotropic effect when the inhibitor gene had been knocked off as a result of high dose of irradiation. The green coloration later expressed could then be the over shadowing effect of the chlorophyll since the plants were not raised in a green house. On the alternative, the purple could be a form of chlorophyll mutation as was observed by Venkateswarly *et al* (1988) in *Catharanthus* roseus where withering occurred at 10 – 15 days of gemination. This was similar to what was observed in *D exilis* however the few that survived, change to green which could have resulted from reversion of mutation.

Table 1: Percentage survival after transplanting.

Treatment	Number of Seedling Planteds	Number that survived	Percentage survival
Control	30	24	80.00
100gy	30	26	86.67
500gy	30	22	73.33
1000gy	30	7	23.30

Table 2: Means of quantitative characters and coefficient of variation

Character	Control		100 Gy		500 Gy		1000 Gy	
	Mean ± SD	CV %	Mean ± SD	CV %	Mean ± SD	CV %	Mean ± SD	CV %
Shoot length	5.53 ± 1.23 (2.60 – 7.70)	22.24	8.35 ± 2.82 (3.20 – 12.10)	33.29	6.46 ± 1.89 (2.50 – 10.20)	29.26	2.96 ± 0.92 (1.90 – 5.50)	31.08
Root length	4.18 ± 1.02 (2.50 – 6.00)	24.40	3.95 ± 2.10 (2.20 – 7.50)	53.16	4.9 ± 1.01 (3.50 – 6.80)	20.61	3.38 ± 0.80 (1.90 – 1.80)	23.67
No. of primary root branches	1.95 ± 0.22 (1.00 – 4.00)	11.28	2.35 ± 1.23 (1.00 – 5.00)	52.39	2.6 ± 0.88 (1.00 – 4.00)	33.85	1.10 ± 0.31 (1.00 – 2.00)	28.18
No. of leaves	2.85 ± 0.49 (2.00 – 4.00)	17.19	3.30 ± 0.47 (3.00 – 4.00)	14.24	2.35 ± 0.67 (2.00 – 4.00)	28.15	2.60 ± 0.82 (2.00 – 5.00)	31.53
Average leaf length (cm)	2.72 ± 0.67 (0.97 – 3.67)	24.63	3.64 ± 0.92 (1.47 – 4.87)	25.27	3.99 ± 1.25 (1.73 – 6.45)	31.33	1.63 ± 0.48 (1.10 – 3.05)	29.45
Average leaf width (cm)	0.12 ± 0.01 (0.08 – 0.19)	8.33	0.16 ± 0.03 (0.11 – 0.23)	18.75	0.16 ± 0.03 (0.10 – 0.23)	18.75	0.11 ± 0.03 (0.07 – 0.17)	27.27

A high degree of mortally recorded at an early seedling stage for 100gy could have resulted from the decrease in synthetic process of DNA and RNA (Kaplan, 1963). It is also possible that upon germination the embryo had the material needed for growth but radiation induced damage became apparent later when *de novo* synthesis has been impaired. Another factor that could also be responsible for this poor development that wa evident by the number of primary root branches and the root length. After transplanting, percentage survival was highest in 100gy (86.67%) and lowest in 1000gy with (23.33%). (Table 1).

Table 2 gives the means of characters studied and the co-efficient of variation. A dose of 100gy led to increase in all characters studied when compared with the control, while a dose of 1000gy to decrease in all charcters. The reduction in the vegetativecharacter could be as result of increase in abscicic acid concentration. This radiation induced increase in abscicic acid concentration is likely to upset the hormal balance and utimately the growth. (Degani and ltai 1978). For 100gy which showed increase in all vegetative characters, irradiation at this dose might not have been high enough to cause such hormonal inbalance. The increase observed must have been due to mitotic activities that has been sustained from the germination.

From Table 2, variability was lowest of all characters in the control, while for charcters like shoot length, root length and primary root branches, 100gy showed highest variability. Number of leaves was highest in 100gy while average leaf width and leaf length was highest in 500gy. It can be said that irradiation has generated variability in the species and this cn be employed in the crop improvement. For effective breeding programme, a dose of between 100 and 500gy will be most appropriate since variability is mostly enhanced in this two treatments.

Analysis of variance also showed significant differences in all the characters observed with respect to dosage at 0.01 probability level. (Table 3).

Table 3: Mean squares from analysis of variance

Characters	df	MS
Shoot length	3	100.52**
Rot length	3	8.05**
Primary root branches	3	8.63**
Average leaf length	3	21.21**
Number of leaves	3	3.28**
Average leaf width	3	0.2**

**Significant at 0.01 probability level.

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