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CYTOGENETIC STUDIES OF VARIABILITY INDUCED THROUGH HYBRIDIZATION AND GAMMA IRRADIATION IN *PENNISETUM AMERICANUM*. I. SEEDLING EMERGENCE AND PLANT SURVIVAL IN M_1 GENERATION*.

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Abstract

Four varieties (Awn Selected, Ex-Borneo, Japan bajra and B-18) were treated with different doses (0, 5, 10, 15, 20, 25 and 30kR) of gamma rays. M_1 generation was grown in a split polt design and observations on seedling emergence and plant wurvival were taken. The radiation doses showed significant negative correlation with seedling emergence in all the four varieties. Analysis of variance revealed significant differences for plant survival among varieties as well as among different gamma rays treatments. Varieties Japan bajra and Ex-Borneo were significantly ($P \geqslant .05$) different from B-18 and Awn selected in plant survival. Regression analysis was used to determine the rate of decrease in seedling emergence as well as in plant survival. The results are discussed with refrence to exploitation of mutations for genetic improvement of pearl millet.

Introduction.

Pearl millet (*Pennisetum americanum* (L.) Leeke), is one of the several different grasses which collectively constitute the class of cereal grains known as millets. In tropical and subtropical regions of Asia and Africa, pearl millet is grown extensively. Yields of millet grains are usually low in comparison with those of other cereal grains. However, pearl millet often produces a greater quantity of grain than do other cereals under conditions of infertile soil, intense heat and limited rainfall. Pearl millet can also be grown in areas where the growing season is very short. Because of these characteristics pearl millet is frequently grown in marginal areas under adverse conditions (Freeman & Bacon, 1973). In Pakistan, pearl millet is cultivated mainly in Sind and Punjab.

Pearl millet is also an excellent crop for cytogenetic research and offers almost unlimited possibilities of genetic improvement through selection, hybridization and induced mutations. We have made efforts to induce additional genetic variability in *P. americanum* by using ionizing radiation on important varieties grown in Pakistan. The present paper reports and discusses the effect of gamma rays on seedling emergence and plant survival.

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Materials and Methods

Seeds of *P. americanum* var Awn Selected was obtained from the Department of Botany, University of Sind, Jamshoro, and varieties Ex-Borneo, Japan bajra and B-18 from the Agricultural Research Centre Yousufwala, Sahiwal. Pure seeds of all the four varieties of pearl millet were treated with different doses of gamma rays (viz. 0, 5, 10, 15, 20, 25 and 30 – kR using Cobalt-60 source at the Atomic Energy Agricultural Research Centre, Tandojam.

Seeds were sown in the month of June 1972 in the fields of Agronomy Section, Agricultural Research Institute Tandojam in well prepared plots by dibling method. The sowing was done in split plot design. Spacing was 15 cm from plant to plant and 30 cm from row to row. Just after sowing the plots were irrigated by fine showers. Observation on seedling emergence was completed within seven days and data on plant survival were recorded at maturity.

Results and Discussion

i) *Effect of gamma rays on seedling emergence*

Data on the effects of different doses of gamma rays on seedling emergence are graphically presented in Fig. 1 The radiation doses showed negative correlation with seedling emergence in all the four varieties. The negative corelation was also highly significant in all the varieties. Regression analysis revealed that the decrease for unit increase in dose was 1.1214 in Awn selected, 0.9645 in Ex-Borneo, 1.1429 in Japan bajra and 0.4571 in B-18 respectively (Fig. 1)

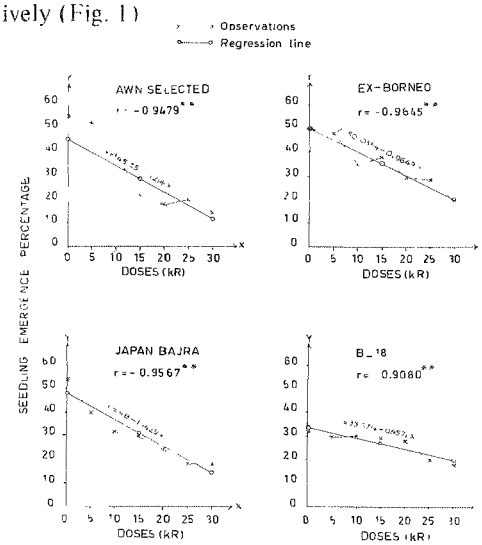

Fig. 1 Effect of different doses of gamma rays on seedling emergence in four varieties of *Pennisetum americanum*

Table 1. Annalysis of variance for plant survival in four varieties of *Pennisetum americanum.*

Source of variation.	D.F.	MS	F-ratio
Replicates	3	14.9167	-
Varieties (V)	3	25.6548	8.52**
Error (a)	9	3.0119	-
Treatments (D)	6	87.5179	33.49**
(VxD) interaction	27	2.7242	1.04 ns.
Error (b)	72	2.6131	-
Total	111	-	-

S.E. of a variety mean = 0.3278 Coefficient of variability = 5.62%
LSD (.05) = 1.05, LSD (.01) = 1.51

S.E. of a treatment mean = 0.4041 Coefficient of variability = 6.92%
LSD (.05) = 1.14 LSD (.01) = 1.51

S. E. of a (VxD) Interaction mean. = 0.8083 Coefficient of variability = 13.84%

ii) *Effect of gamma rays on plant survival*

Analysis of variance (Table 1) showed highly significance differences for plant survival among varieties as well as among different gamma rays treatments. The interaction between varieties and treatments was not significant which indicates that the radiation doses had similar effects in all the varieties.

Table 2. Effect of Gamma Rays on plant survival of 4 varieties of *Pennisetum americanum*

Varieties	Average over doses	Significance	S.E.	LSD_1	LSD_2
Japan Bajra	6.68	a A	0.33	1.05	1.51
Ex-Borneo	6.61	a A			
B-18	5.32	b AB			
Awn selected	4.75	b B			

Means not followed by the same letter are statistically significant. Capital and small letters indicate significance at 1% and 5% levels of probability respectively.

Table 3. Effect of different doses of Gamma Rays on plant survival of *Pennisetum americanum.*

Dose kR	Average varietal response	Significance		S.E.	LSD_1	LSD_2
0	9.44	a	A	0.4041	1.14	1.51
5	7.75	b	B		-	
10	6.81	b	BC			
15	5.63	d	CD			
20	4.75	cd	DE			
25	3.81	de	EF			
30	2.69	e	F			

Means not followed by the same letter are statistically signifiant. Capital and small letters indicate significance at 1% and 5% levels of probability respectively.

Varieties responded differently to radiation treatments. Varieties Japan bajra and Ex-Borneo were significantly (⩾ .05) different from B-18 and Awn Selected in plant survival (Table 2). Details of differential effects of gamma rays treatments are given in (Table 3). The results reveal significant difference among different doses of radiation with respect to plant survival. Doses of gamma rays showed highly significant negative correlation with plant survival in all the varieties (Fig. 2). Regression analysis indicated that the rate of decrease in plant survival for increase in dose was highest (0.2732) in

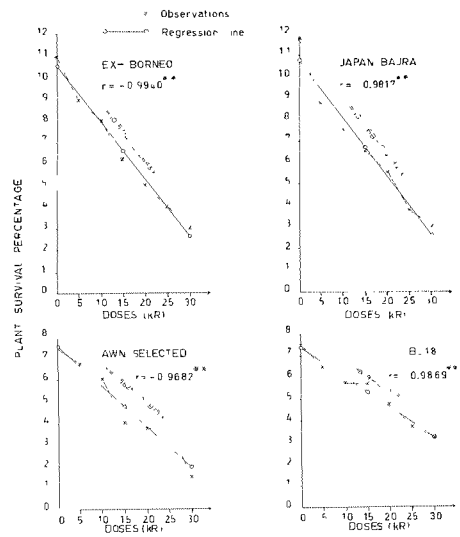

Fig. 2. Effect of different doses of gamma rays on plant survival in four varieties of *Pennisetum americanum.*

Japan bajra followed by Ex-Borneo (0.2643) Awn Selected (0.1875) and B-18 (0.1375). respectively.

M_1 generation offers the possibilities of studying the immediate effects of mutagenic treatments. It is important to differentate between the physiological and genetical effects. An estimation of the consequence of the treatments therefore, becomes quite necessary in M_1 generation.

The present work was mainly concerned with the initiation of genetic variability through the use of ionizing radiation. The mutagenic treatments essentially provide a threshhold of heterzygosity (Siddiqui, 1973; Ghafoor Arain & Siddiqui, 1976) and subsequently a basis of segreation in M_2 or even in M_3 generation. Elegant methods of cytogenetic manipulation (Siddiqui, 1972) as well as of exploitation of mutations (Siddiqui *et al.* 1978, 1979) are now available which can be utilized for improvement of a crop of economic importance like pearl millet.

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