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REGULAR ARTICLE

GAMMA RADIATION INFLUENCES ON GROWTH, BIOCHEMICAL AND YIELD CHARACTERS OF *CAJANUS CAJAN* (L.) MILLSP

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ABSTRACT

The present investigation deals with the effect of gamma radiation on growth, Biochemical and yield traits of Pigeon pea. The seeds of Pigeon pea Var. CO-7 were treated with different doses of gamma rays like 15, 20 and 25KR. The treated seeds were sown in field along with control to raise M_1 generation and the radiation effects was noted from seed germination percentage, seedling survival (%), seedling height on 30th days, Days to first flower, plant height, (at maturity), number of branches, number of leaves, number of cluster, pollen viability (%), number of pods, seed yield, hundred seed weight (g), fresh and dry weight (g), Seed viability (%) and seed protein content (%). The results indicate that the growth, biochemical and yield parameters were gradually decreased when compare to control and the highest reduction was noted at higher doses of gamma radiation treatments. The pollen and seed viability (%) analysis were also revealed that gradually reduction in lower to higher doses of gamma rays treatments.

Keywords: Gamma rays, Pigeon pea, Seed germination, Pollen and seed viability, Seed protein

INTRODUCTION

Pigeon pea (*Cajanus cajan* L.) Millsp. 2n=22) is one of the most economically important pulse crop in the world and it having a major source of 20% of protein, minerals, vitamins, carbohydrates and amino acids [1]. The various parts of pigeon pea plant are put to several uses such as medicine, hedges, fodder, feed, fuel wood, windbreaks, root thatches and green manure [2]. It is mostly grown in the tropical and sup tropical region of the world and more than 20 countries like India, Myanmar, Nepal, Uganda, Tanzania, and Dominican Republic in Americas are the major Pigeon pea producers in world and an annual production is 3.48 million tons for 4.5 million hectares land [3]. In India the pigeon pea contributes, about 90% of the world's production [4].

Mutation can be induced by the application of some physical and chemical agents are known as mutagens [5]. Some mutation occurs in gene sequences referred as point mutations while some mutations occurs in chromosomal structure or even in number of chromosomes are known as chromosomal mutations. The application of mutation used for improve morphological and physiological characters, disease resistance and qualitative characters in yield ability are known as mutation breeding [6]. Induced mutagenesis is the best method for inducing genetic variability with in short time and also improved to yield ability of self-pollinated seed and vegetative propagated crops [7].

Gamma rays is an electromagnetic ionizing radiations produced by decaying of some radioisotopes and is known to be more popular mutagen for their simple application, good penetration, less disposal problems, higher mutation frequency and reproducibility [8]. Majority of mutant varieties (64%) were developed using gamma rays [9]. In the present study aimed to analyze the effect of gamma rays on growth and yield parameters of pigeon pea var. Co7.

MATERIALS AND METHODS

Healthy and dry seeds of pigeon pea var. CO-7 were irradiated with different doses of gamma rays such as 15, 20 and 25KR and it was done at Indira Gandhi Centre for Atomic research (IGCAR), Kalpakkam, Tamil Nadu. After completion of irradiation, all the treated and control seeds were sown in the field separately according to their doses in a randomized block design with three replications. A total of 300 seeds were sown for each treatment with three replications and each replication consisted of hundred seeds. All the treated and control plants were raised adopting a space of 30 cm in between rows and 30 cm between plants. Cultural practices like irrigation and weeding were carried out through the crop growth period. The following measurements were made quantitatively and

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analysis the mutagenic effects on seed germination, (15th days seedling stage), seedling height and seedling survival after 30 d in 15 randomly selected seedlings from each treatment along with control and it was expressed in percentage and cm. days to first flowering of each treated individual plants were observed and recorded as number of days. Pollen viability (fertility) was determined from 10 randomly selected plants from each treatment and the pollen grains are collected from freshly dehisced anthers were stained with 2% freshly prepared acetocarmine solution for few munities and observed under compound microscope. Darkly stained and normal size pollen grains were considering as fertile (viable) and those of whole empty, partially stained, irregular shaped and shrinked pollen grains were counted as sterile and it was expressed in percentage.

At the end of crop growth (fully maturity), the following observations were made and arithmetic mean was calculated. They were, plant height, (cm) number of branches, number of clusters, numbers of pods, seed yield (g), hundred seed weight (g), fresh weight and dry weight (g) and seed protein content (%). The protein content was estimated based on the method of Lowry *et al.* [10] using bovine serum albumin as standard.

RESULTS AND DISCUSSION

Seed germination (%)

Results showed seed germination was decreased with higher doses of gamma rays when compared with control. Highest per cent of reduction was noted on 25KR of gamma rays treatment (table 1). Many workers observed these similar observations in different crops [11-14]. The reduction of seed germination might have been due to the effects of mutagenic damage on the initially dividing cells of seeds. In addition, delay in mitotic cell division make changes in the seed germination [15-18].

Seedling survival (%) and seedling height (cm)

A reduction of seedling survival and height was observed from the study. The highest reduction of survival and height was noted at 25KR of gamma rays treatment when compare to control (Table-1). Several researchers observed similar result in plant survival and seedling height in Cowpea [19,20] and in Sesame [13]. The seedling survival (%) and seedling height reduction might to be effect of mutagen on seed meristematic tissues and damage the nature of chromosomes [21].

Pollen fertility (%)

The pollen and seed viability were decreased gradually with increased in gamma rays doses when compared to control (table 1 and 2). The higher dose of gamma rays (25KR) treatment showed least percentage of viability. The reduction of pollen viability occurs due to the cumulative effects of various meiotic aberration stages as well as physiological and genetic damages that induced by the chromosome breakage through formation of an anti-metabolic agent in the cell or may be due to irregular disjunction of chromosome at anaphase [22]. These similar meiotic abnormalities of pollen sterility were also reported in cotton [23] and in chickpea [15]. The increasing seed sterility has been harmful effects of mutation in clued death in the embryonic state and inability to observe water and disease resistance [24].

Table 1: Effect of gamma rays on growth, yield characters of Pigeon pea in R_1 generation

Doses	30th. P. H	D. F. F	P. H	L. P	B. P	C. P	P. P
control	36.83±1.25	57.68±0.51	131.03±0.65	332.60±1.71	8.80±0.44	58.70±1.60	138.10±0.41
15KR	34.14±1.23	59.97±0.83	128.76±0.65	327.30±1.20	8.00±0.27	55.00±1.27	134.90±0.08
20KR	31.30±1.19	61.00±0.33	126.73±0.97	320.70±1.45	7.30±0.27	50.60±1.08	131.60±1.29
25KR	26.84±1.03	63.49±0.38	122.24±0.94	315.00±1.29	6.00±0.27	50.10±1.14	127.40±1.15
SE	1.1722	0.5109	0.8489	1.4112	0.3123	1.2665	0.7301
SED	1.6621	0.7534	1.1909	2.0002	0.4453	1.7689	1.3951
CD(P=0.05)	0.0335	0.0147	0.0239	0.0402	0.0089	0.0360	0.028
CD(P=0.01)	0.0446	0.0196	0.032	0.0537	0.0119	0.0480	0.0373
CV	5.1900	1.2123	1.0137	0.6181	6.0520	3.3209	1.0522

(Mean value±stranded error thee replication, SE-stranded error, SED-stranded error deviation, CD-critical difference, CV-critical variation), (30th PH-30th day plant height, DFF-Days to first flowering, PH-Plant Height, LP-Leaves per plant, BP-Branches per plant, CP-Cluster per plant, PP-Pods per plant).

Table 2: Effect of gamma rays on growth, Biochemical, yield and seedling characters of Pigeon pea in R_1 generation

Doses	F. W	D. W	S. Y	H. S. W	S. P. C	Seed Germination (%)	Survival (%)	Pollen fertility (%)
control	174.04±2.84	113.03±1.15	21.81±0.98	10.31±0.57	23.34±0.47	89.40±0.41	88.80±0.67	96.44
15KR	169.47±1.44	108.00±2.37	18.94±0.95	9.59±0.47	23.02±0.34	57.80±0.82	55.30±1.17	82.68
20KR	164.48±2.26	106.03±1.80	18.34±0.42	8.99±0.31	22.16±0.30	53.10±1.08	50.30±0.75	76.44
25KR	162.16±1.43	98.49±2.06	15.69±0.90	7.80±0.76	21.12±0.56	45.50±0.75	40.40±0.97	69.30
SE	1.9909	1.8408	0.8144	0.5323	0.1400	1.0120	1.8654	0.4512
SED	2.1812	2.6119	1.1552	0.7598	0.5600	1.6312	2.0089	1.4521
CD(P=0.05)	0.056	0.0525	0.0232	0.0151	0.0118	0.02321	0.0745	0.8800
CD(P=0.01)	0.0756	0.0700	0.0309	0.0202	0.0158	1.0223	0.0915	1.6245
CV	1.6710	2.4728	6.3011	5.7609	2.6021	1.0110	2.0308	3.3048

(FW-Fresh weight per plant, DW-Dry weight per plant, SY-Seed yield per plant, HSW-Hundred seed weight, SPC-Seed protein content).

Quantitative characters of M_1 generation

In M_1 generation, the growth and yield traits were significantly decreased with increasing the gamma rays doses except days to first flowering and it was took 2 to 3 d later flowering than control (table 1 and 2). The similar results types of delay in days to first flowering were observed several workers in various crops [11, 12, 19, 20, 24]. A deduction of growth and yield characters due to higher doses has been explained differentially by previous researchers [20, 25]. It may be inhibitory effects of gamma rays on physiological traits [26]. And it may be due to the sudden destruction of growth inhibitors and metabolic status of seedlings [27-29].

A significant reduction of all the characters were observed with increasing doses of gamma rays particularly 25KR of gamma rays treatment showed maximum reduction.

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