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Research Article

ESTIMATION OF FLORESCENCE (%) AND QUANTUM YIELD IN GAMMA RADIATED COWPEA VARIETIES (*Vigna unguiculata* L.)

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Abstract: The present study was an attempt to study the florescence (%) and quantum yield in gamma radiated cowpea varieties. Plant responses in terms of growth parameters were analyzed. The result indicated an improvement in growth performances of cowpea varieties under gamma radiation. There was a significant difference in QY and FT in all the varieties of cowpea under different treatments.

Keywords: *Cowpea, Growth, Gamma Radiation, Climate change*

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Introduction

In several countries around the world, a large number of cowpea varieties had been published and the joint collaborations between the breeding program and national program scientists were very successful. A total of 68 countries identified and released improved varieties of cowpea for general cultivation [1]. In the production of agricultural and economically important varieties, gamma rays are often used on plants with high productivity potential. The gamma ray adversely affected plant characteristics, depending on the species or varieties of plants and the dosage of irradiation [2]. The stimulating effect of high-dose is due to mutagens stimulating the role of growth-and yield-responsible enzyme and growth hormone. Slow germination of seeds, limited and delayed rooting of the vegetative cuttings has hindered the mass propagation of this plant Increased number of fruits per plant due to gamma irradiation [3-5]. The most sensitive growth stages of cowpea to drought were flowering and pod filling, with yield reduction from 35 to 69 % depending on the timing and length of the drought treatment. A soil water deficit during the vegetative stage had the least effect on crop yield [6]. Many cowpea varieties submitted to water stress have been separately investigated for physiological, biochemical and agro morphological mechanisms [7-13]. Maximizing the efficiency of biomass production per unit of yielded water (WUE) was a major research focus of plant scientists, especially in tropical conditions [14]. Gamma radiation at the lower concentration of gamma rays 5, 10, 15Kr was the lowest mutation frequency, was slightly earlier, *i.e.* before regulation, but the highest mutation frequency and chromosomal variance was observed when the exposure increased with dose / concentration 20, 25 and 30 Kr. It has been documented that radiation causing chromosome variance is the result of partial nucleus disassociation [15]. There are two naturally stable Carbon Isotopes, ^{12}C and ^{13}C. The majority of the carbon is ^{12}C (98.9 percent) with ^{13}C being 1.1 percent. The isotopes are unevenly distributed among and within different compound and this isotopic distribution can reveal information about the physical, chemical and, metabolic processes involved in carbon transformation [16].

Materials and Methods

The present study entitled was conducted in the research field on cowpea varieties at the Department of Plant Physiology, SHIATS, Allahabad. The experiment laid out in randomized block design (RBD) within five treatments, four verities, each replicated tree times. Experimental Materials 4 varieties of Cowpea namely, Gomati, Khashi HR-1, BG-12 were purchased from local market Allahabad. Seeds treated by Gamma radiation in National Botanical Research Institute (NBRI) research institute of CSIR at Lucknow.

Number of flowers/plant

From the selected plants number of flowers was calculated on 30 and 45 DAS. Each observation was recorded.

Estimation of chlorophyll by DMSO method

The estimation of chlorophyll was done by using Dimethyl sulfoxide (DMSO) extraction procedure. Plant samples were collected at random and leaves were shopped into pieces. 50 mg samples from these chopped leaves were in added Dimethyl sulfoxide (DMSO) [Fig-1].

Statistical analysis

The experiment used RBD with three treatments and each treatment was analysed with three replications. Statistical analysis was performed using ANOVA.P values d ≤ 0.05 were considered as significant.

Results and Discussion

Alteration in growth performance of cowpea under the treatment of gamma ration by analyzing the growth parameters. The Data presented in [Table-1] show the effect of gamma radiation on number of flowers of different cowpea varieties. The results showed that there was a significant difference in number of flowers among all the treatments. The results observed for number of flowers is summarized.

Table-1 *Effect of Gamma Radiation on number of flowers of Cowpea varieties at flowering period*

Varieties	30 DAS						45 DAS					
	No of flowers						No of flowers					
	T_0	T_1	T_2	T_3	T_4	Var. Mean	T_0	T_1	T_2	T_3	T_4	Var. Mean
V_1	4	2	0	2	0	1.6	8	4	4	4	3	4.6
V_2	3	2	0	2	0	1.4	6	4	2	2	2	3.2
V_3	6	2	2	2	2	2.8	7	5	4	4	4	4.8
V_4	5	3	2	3	2	3	9	4	4	4	2	4.6
Treatment Mean	4.5	2.2	1	2.2	1	2.2	7.5	4.2	3.5	3.5	2.7	4.3
	No of flowers		Varieties		Interaction		No of flowers		Varieties		Interaction	
S. Ed. (±)	0.04		0.04		0.09		0.07		0.08		0.16	
C. D. (P = 0.01)	0.15		0.17		0.35		0.27		0.30		0.61	

Table-2 *Effect of gamma radiation on chlorophyll a (mg/g) and chlorophyll b (mg/g) content in different varieties of cowpea by DMSO method*

Varieties	Chlorophyll ‘a’ (mg/g) FW						Chlorophyll ‘b’ (mg/g) FW					
	T0	T1	T2	T3	T4	Var. mean	T0	T1	T2	T3	T4	Var. mean
V1	1.96	1.94	1.84	1.83	1.08	1.73	0.64	0.56	0.51	0.48	0.35	0.5
V2	1.71	1.63	1.45	1.29	1.03	1.42	0.76	0.71	0.55	0.51	0.41	0.58
V3	1.98	1.43	1.34	1.24	1.07	1.41	0.45	0.42	0.36	0.34	0.33	0.38
V4	1.46	1.42	1.31	1.26	1.09	1.30	0.48	0.41	0.39	0.38	0.31	0.39
Treatment mean	1.7775	1.605	1.485	1.405	1.0675	1.46	0.5825	0.525	0.4525	0.4275	0.35	0.46
	Chlorophyll ‘a’		Varieties		Interaction		Chlorophyll ‘b’		Varieties		Interaction	
S. Ed. (±)	0.02		0.02		0.05		0.07		0.08		0.01	
C. D. (P = 0.01)	0.08		0.09		0.19		0.02		0.03		0.06	

Table-3 *Estimation of Florescence (%) and Quantum yield in different varieties of cowpea*

Varieties	Florescence (%)						Quantum yield (%)					
	T0	T1	T2	T3	T4	Var. mean	T0	T1	T2	T3	T4	Var. mean
V1	39.3	34.5	35.4	32.4	31.7	34.6	36.5	34	31.1	26.8	24.6	30.6
V2	31.5	28.4	27.1	24.1	26.7	27.5	32.4	28.6	24.2	24.1	22.4	26.3
V3	32.3	29.4	28	27.4	21.8	27.7	34.5	29.5	24.4	28.7	22.3	27.8
V4	34.1	27.4	24.8	22.8	21.2	26.0	32.2	27.4	25.6	23.4	22.4	26.2
Treatment mean	34.3	29.9	28.8	26.6	25.3	29.0	33.9	29.8	26.3	25.7	22.9	27.7
	FT (%)		Varieties		Interaction		QY (%)		Varieties		Interaction	
S. Ed. (±)	0.45		0.5		1.00		0.43		0.48		0.96	
C. D. (P = 0.01)	1.72		1.92		3.85		1.64		1.84		3.53	

Fig-1 Chlorophyll by DMSO method

At 30 DAS, the data in [Table-1] showed that there was a significant difference on number of flowers in all the varieties under different treatments. The maximum number of flowers was observed in variety Khashi kanchan in control T0 (5.00), whereas the minimum was observed in variety HR-1 in T4 (1.00) at 40 Gy of gamma radiation, under all the treatments. There was a significant difference in number of flowers in all the varieties under different treatments at 45 DAS. The maximum number of flowers was observed in variety Khashi kanchan in control T0 (9.00), whereas the minimum was observed in variety BG-12 in T4 (2.00) at 40 Gy of gamma radiation, under all the treatments. Differences among genotypes in phenology may affect yield and also $\Delta^{13}C$, especially in drought-prone environments. For example, under Mediterranean conditions genotypes with fewer days from sowing to flowering show higher $\Delta^{13}C$ values [17]. The data presented in [Table-2] show the effect of gamma radiation on Chlorophyll a (mg/g) and chlorophyll b (mg/g) content of different cowpea varieties. The results showed that there was a significant difference in Chlorophyll a (mg/g) and chlorophyll ‘b’ (mg/g) content among all the treatments. The results observed for chlorophyll content is summarized.

The data presented in [Table-2] showed that there was a significant difference in Chlorophyll a content (mg/g) in all the varieties under different treatments [Fig-2]. The maximum Chlorophyll a content was observed in variety Ankur Gomati in control T0 (1.98 mg/g), whereas the minimum was observed in variety BG-12 in T3 (1.03 mg/g) at 30 Gy of gamma radiation, under all the treatments. There was a significant difference in Chlorophyll b (mg/g) content in all the varieties under different treatments at 45 DAS. The maximum Chlorophyll b (mg/g) content was observed in variety BG-12 in control T0 (0.76 mg/g), whereas the minimum was observed in variety Khashi kanchan in T4 (0.31 mg/g) at 40 Gy of gamma radiation, under all the treatments. A molecular basis for variation of groundnut genotypes in foliar $\Delta^{13}C$ values was identified due to variation in Rubisco rates. As an important molecular basis for variability in leaf carbon isotope discrimination in plants, the Leaf chlorophyll content has received very little study. In Juniper, the total content of leaf chlorophyll was also stated to be positively associated with foliar $\Delta^{13}C$. These investigations aim at understanding which of the traits contribute importantly to yield under drought [18 and 19]. The Data presented in [Table-3] show the effect of gamma radiation on FT and QY of different cowpea varieties. The results showed that there was a significant difference in FT and QY among all the treatments [Fig-3]. The results observed for FT and QY is summarized. There was a significant difference in FT (%) in all the varieties under different treatments. The maximum was observed in variety HR-1 in control T0 (39.3%), whereas the minimum was observed in variety Ankur Gomati in T4 (21.2%) at 30 Gy of gamma radiation, under all the treatments. The data in [Table-3] showed that there was a significant difference in QY in all the varieties under different treatments. The maximum QY was observed in variety HR-1 in control T0 (36.1 %), whereas the minimum was observed in variety Ankur Gomati in T4 (22.3 %) at 40 Gy of gamma radiation, under all the treatments.

Further investigations on these cowpea genotypes are needed to demonstrate whether there are significant positive effects on grain yield related to the partial opening of stomata under drought conditions [20]. The reason for the positive relationship between $\Delta^{13}C$ and yield is that a genotype exhibiting higher $\Delta^{13}C$ is probably able to maintain a better water status. Therefore, additional causes for such positive relationship may be envisaged. Positive relationships between $\Delta^{13}C$ and grain yield are mostly found under moderately to well-watered conditions, whereas for severely stressed environments [21 and 22].

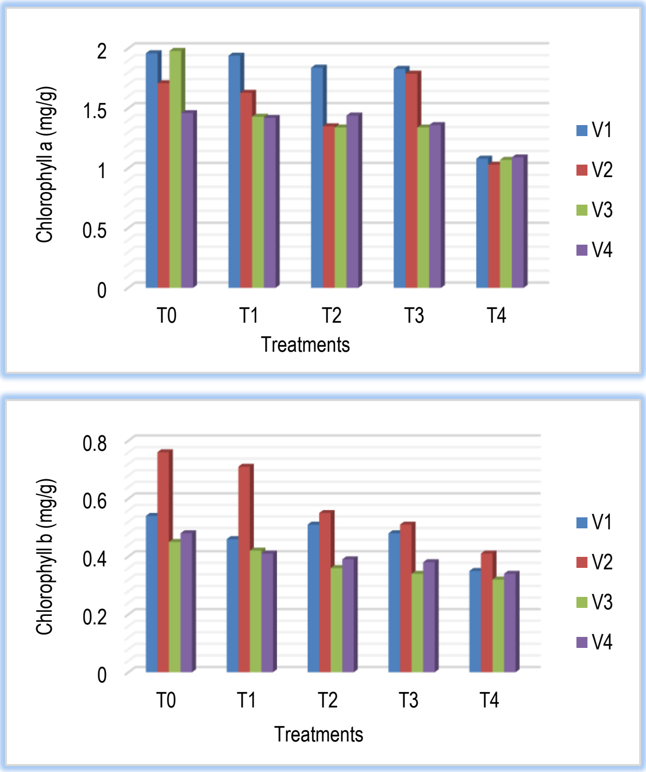

Fig-1 Effect of gamma radiation on Chlorophyll a (mg/g) and chlorophyll b (mg/g) content in different varieties of cowpea by DMSO method

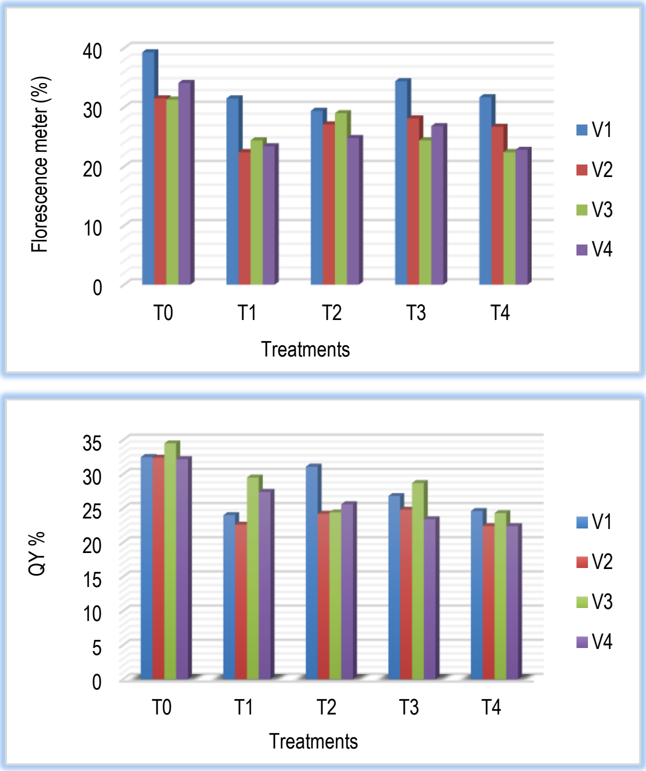

Fig-2 Estimation of FT (%) and QY in different varieties of cowpea

Conclusion

The present study on the basis of observation it was concluded that effect of gamma radiation on FT and QY of different cowpea varieties. HR-1 maximum growth, among all the varieties and whereas BG-12 were gamma radiation sensitive variety. There was a significant difference in QY in all the varieties under different treatments. The maximum QY was observed in variety HR-1 in control. Whereas the minimum was observed in variety Ankur Gomati 40 Gy of gamma radiation, under all the treatments. The morpho- physiological biochemical parameters in 4 cowpea varieties such as no of flowers and chlorophyll content showed significant decrease with the increase in gamma radiation treatment. From the agricultural point of view, the use of novel approaches combining physiological, and molecular techniques should provide exciting results in the development of cowpea varieties in the near future.

Application of research: Understanding response of cowpea varieties in terms of growth and development under for High water use Efficiency in Gamma Radiated Cowpea varieties (*Vigna unguiculata* L.)

Research Category: Plant Physiology

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Study area / Sample Collection: National Botanical Research Institute, Lucknow

Cultivar / Variety / Breed name: HR-1, BG-12, A Gomati, Khashi K

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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