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RESEARCH ARTICLE

EFFECTS OF GAMMA RAY IRRADIATION ON THE METRIC TRAITS OF VEGETABLE COWPEA (*Vigna unguiculata* (L.) WALP) IN UMUDIKE SOUTHERN NIGERIA

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The effects of different levels of gamma ray irradiation on the vegetable cowpea varieties (IT8ID – 1228 –14, IT835- 899, IT93k – 915) were evaluated in 2002 and 2003 cropping seasons at Umudike Southeastern Nigeria. Six levels of irradiation ranging from 0 (control) to 25kr were applied to the cowpea seeds. Irradiation induced marked variability among the varieties. More number of pods per plant, fresh pod yield, plant height, fewer days to flowering and days to maturity were obtained by IT8ID – 1228-14. At 5 – 10kr, the varieties plant height; fresh pod length and width, number of pods per plant, number of seeds per pod, 100 seed weight and fresh pod yield increased to a maximum, while the same traits dropped with increasing irradiation.

Key words: Cowpea, mutation, genetic, mutagenesis, improved cultivars.

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INTRODUCTION

Cowpea (V*igna unguiculata* (L.) Walp) is an important source of dietary protein and nutritious fodder in most developing countries and for vast majority of Nigerians who either cannot afford (or for religious purpose abstain from) animal protein (Ogunbodede and Brunner, 1992; Okeleye *and* Ariyo, 2000; Ojimelukwe, 2002). The production of cowpea particularly in the southern part of Nigeria has not matched the demand. This short fall is traceable to problems of poor yield resulting from multifarious causes such as diseases and pests and cross ability affecting the crop at different stages of its development as well as continuous use of low yielding varieties (Okeleye and Ariyo, 2000). Mutation induction supplies breeders with genetic variants from which useful types have been selected (Micke, 1984, Para - Negrette *et aI*.; 1984, Choulwar and Borikar, 1986; Pathak, 1991; Ogunbodede and Brunner, 1992; Mensah and Eruotor, 1993; Aba *et aI*., 2001).

This offers the breeder a chance to enhance conventional breeding objectives and confer specific improvement without significantly altering its otherwise acceptable phenotype (Ojomo *et aI*., 1979; Micke, 1984, Ogunbodede and Brunner, 1992). Legume mutation breeding has led to improved cultivars with higher yield, better grain quality, or stronger resistance to pathogens. Genetic variation from mutagenesis complements those from germplasm collection as well as from crossing. In Nigeria, crop breeding through induced mutation is limited (Odeigah, 1991). The present study was undertaken to investigate the effects of different levels of gamma ray irradiation on the metric traits of three Nigerian vegetable cowpea.

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MATERIALS AND METHODS

The cowpea varieties 1T81D - 1228 - 14, IT835 - 899, and IT931 - 915 used in this study were obtained from the legume improvement programme of International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. The dried seeds were treated with $^{60}C_o$ gamma rays at the center for Energy Research and Development of Obafemi Awolowo University, Ife in September 2002; with six doses - 0 (control), 5,10,15,20 and 25KR. The experiment was conducted at the Teaching and Research farm of Michael Okpara University of Agriculture Umudike in the rain forest Zone of Nigeria (5°, 29'N, 7°33'E) in 2002 and 2003 cropping seasons. The experimental design was a

split plot arrangement laid out in a randomized complete block with 3 replicates.

The cowpea varieties constituted the main plots while the subplots were the different levels of gamma irradiation. The irradiated seeds together with the unirrradiated were planted at a spacing of 0.25m by 0.5m giving plant density of 80,000 per hectare. Two hand weeding was carried out at four and eight weeks after planting while insects' pests were controlled by using cypermethrine at 100ml per 15 litres of water. Measurements and observations were taken on the following traits: plant height, days to flowering, and days to maturity, fresh pod yield, and number of pods per plant, number of seeds per pod, fresh pod length, fresh pod width, 100 seed weight and number of leaves per plant. Analysis of variance of data was done according to Steel and Torrie (1980) and significant differences were evaluated using Duncan's multiple range test (DMRT).

RESULTS

All the cowpea varieties showed an increase in plant height after irradiation Figs. 1 and 2. Irradiating beyond 10KR led to decrease in plant height in all the varieties. Whereas a mild level of 5kR increased plant height by 4.8% and 21.0 % in IT81D-1228-14, the same level led to increase of 14.7% and 20.5% in IT835-899 and 11.0 % and 8.1% in variety IT93k-915 in 2002 and 2003 seasons respectively. The cowpea varieties differed significantly ($P < 0.05$) in Fresh pod Length Table 1. IT835-899 produced the longest fresh pod length. Averaged over seasons, 5KR significantly increased the pod length.

Although irradiation Levels did not have any significant effect on the fresh pod width, 5-10KR early increased the fresh pod width beyond which it progressively decreased Table 2. The effect of irradiation on fresh pod width was more pronounced in IT93K-915 than in other varieties. Varieties differed significantly

Table 1: Effects of different levels of gamma ray irradiation on fresh pod length (cm) of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	5	10	15	20	25	Mean
2002							
IT8ID-1228-14	20.07	31.20	20.77	20.57	19.97	19.90	20.41[b]
IT835-899		23.53	23.73	23.63	23.27	23.03	23.97 23.36[a]
IT93K-915		20.57	21.37	21.07	20.47	20.43	20.20 20.68[b]
Mean		**21.39**	**22.10**	**21.82**	**21.43**	**21.14**	**21.02**
2003							
IT8ID-1228-14	20.70	21.63	21.17	21.03	20.63	20.37	20.92[b]
IT835-899		23.87	24.20	23.97	23.63	23.20	23.20 23.69[a]
1T93K-915		21.63	22.27	21.90	21.53	21.63	21.30 21.71[b]
Mean		**22.06**	**22.70**	**22.34**	**22.07**	**21.82**	**21.66**

Means with the same superscript along the column and row are not significantly different (P>0.05)

Table 2: Effects of different levels of gamma rays irradiation on fresh pod width (cm) of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	5	10	15	20	25	Mean
2002							
IT81D-1228-14	0.87	0.89	0.86	0.82	0.78	0.81	0.84
IT835-899	0.94	0.96	0.97	0.94	0.91	0.68	0.90
IT93K-915	0.92	0.94	1.01	0.94	0.81	0.89	0.92
Mean	**0.91**	**0.93**	**0.95**	**0.90**	**0.83**	**0.79**	
2003							
IT81D-1228-14	0.89	0.90	0.94	0.91	0.87	0.87	0.90
IT835-899	0.89	0.93	0.93	0.96	0.93	0.95	0.93
IT93K-915	1.00	1.00	1.01	0.93	0.93	0.91	0.96
Mean	**0.93**	**0.94**	**0.96**	**0.93**	**0.91**	**0.91**	

Means with the same superscript along the column and row are not significantly different (P>0.05)

Table 3: Effects of different levels of gamma ray irradiation on number of pods per plant of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	5	10	15	20	25	Mean
2002							
IT81D-1228-14	25.9	33.3	27.73	22.57	25.67	19.53	25.79[a]
IT835-899	22.30	25.23	24.20	17.20	21.20	16.73	21.14[b]
IT93K-915	22.67	23.83	18.40	15.70	16.43	13.17	18.37[abc]
Mean	**23.63[b]**	**27.46[3]**	**23.44[b]**	**18.49[cd]**	**21.10[bc]**	**16.48[d]**	
2003							
IT81D-1228-14	27.77	26.77	26.27	22.23	19.83	16.47	23.22[a]
IT835-899	22.17	19.33	21.20	19.23	18.07	18.10	[ab]
IT93K-915	22.47	21.03	17.77	16.10	14.00	11.97	17.22[b]
Mean	**24.13[a]**	**22.38[ab]**	**21.74[b]**	**19.19[c]**	**17.30[cd]**	**15.51[d]**	

Means with the same superscript along the column and row are not significantly different (P > 0.05)

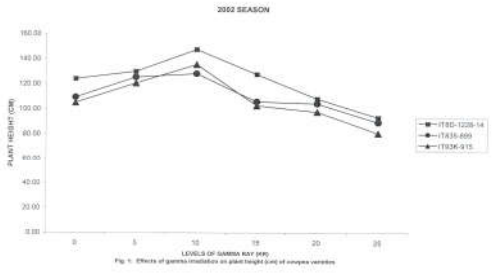

Fig. 1. Effect of gamma ray irradiation on plant height (cm) of cowpea varieties 2003 season

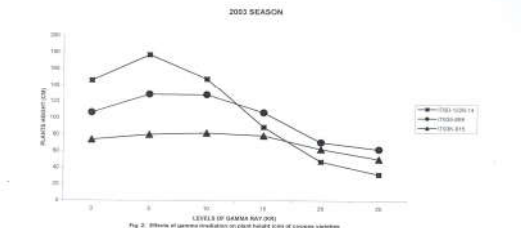

Fig. 2. Effect of gamma ray irradiation on plant height (cm) of cowpea varieties in 2003 season

In 2002, there was no significant increase in 100 seed weight of the varieties by irradiation Table 5. Also, the levels of irradiation had no significant effect on the 100 seed weight. In 2003, irradiation levels significantly reduced the 100 seed weight compared with the control while IT93K-915 gave the most 100 seed weight, IT81D-1228-14 had the least.

Varieties were not significant in the quantity of fresh pod yield after irradiation and ranged between 8049.92-9192.79 kg/ha Table 6. Across the seasons, irradiation levels had no significant effect on fresh pod yield but it increased at 5-10KR. In 2002 season, irradiation had no significant effect on the variety days to physiological maturity Table 7. IT81D-1228-14 had the least days to physiological maturity.5KR significantly reduced the days to physiological maturity by one.

The days to pod filling of the varieties were not significant Table 8. However,5-10KR significantly ($P < 0.05$) decreased the days to pod filling than at higher levels. For instance, at 5KR, it was 2 and1day (s) when compared with the control at 2002 and 2003 seasons respectively. The variety IT81D-1228-14 had the least

Table 4: Effects of different levels of gamma ray irradiation on number of seeds/pod of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	**5**	**10**	**15**	**20**	**25**	**Mean**
2002							
IT81D-1228-14	12.13	13.23	12.30	11.13	11.17	10.47	11.74^{a}
IT835-899	11.13	12.97	11.30	10.60	10.40	10.23	11.14^{b}
IT93K-915	12.77	13.87	12.60	11.23	12.27	9.97	12.12^{a}
Mean	**12.01^{b}**	**13.38^{a}**	**12.14^{b}**	**10.99^{cd}**	**11.27^{bc}**	**10.22^{d}**	
2003							
IT81D-1228-14	12.63	13.83	12.20	12.90	11.40	10.60	12.26^{b}
IT835-899	11.60	12.13	11.30	11.53	10.63	10.33	11.26^{c}
IT93K-915	13.40	14.67	12.83	12.56	12.73	11.80	12.97^{a}
Mean	**12.54^{ab}**	**13.48^{a}**	**12.11^{b}**	**12.33^{b}**	**11.59^{bC}**	**10.91^{c}**	

Means with the same superscript along the column and row are not significantly different (P > 0.05)

Table 5: Effects of different levels of gamma ray irradiation on 100 seed weight (g) of some varieties of cowpea.

Varieties	Levels of gamma rays						
	0	**5**	**10**	**15**	**20**	**25**	**Mean**
2002							
IT81D-128-14	12.80	13.26	12.63	16.03	12.27	11.60	13.10
IT835-899	13.27	13.64	14.90	12.90	12.30	12.17	12.88
IT93K-915	14.04	14.65	14.90	13.90	13.31	12.75	13.76
Mean	**13.37**	**13.85**	**13.18**	**14.28**	**12.62**	**12.17**	
2003							
IT81D-1228-14	12.93	12.79	13.01	12.91	11.80	10.93	12.40^{c}
IT835-899	14.31	13.74	13.90	13.38	13.21	12.55	13.52^{b}
IT93K-915	14.73	14.39	14.30	13.85	13.64	13.42	14.05^{a}
Mean	**13.99^{a}**	**13.64^{ab}**	**13.73^{ab}**	**13.80^{ab}**	**12.88^{bc}**	**12.30^{c}**	

Means with the same superscript along the column and row are not significantly different (P>0.05)

($P < 0.05$) in the number of pods per plant across the irradiation treatment Table3. IT810-1228-14 produced the highest number of pods per plant. In 2002, number of pods per plant increased significantly ($P < 0.05$) by 16% at 5KR when compared with the control. Conversely in 2003, the number of pods per plant linearly decreased with five levels of irradiation .Varietals variation was observed in the number of seeds per pod with IT93K-915 significantly ($P < 0.05$) having more number of seeds per pod by 11.4% and 7.5% in 2004 and 2005 seasons respectively Table 4.

days to flowering Table 9. The irradiation levels significantly ($P<0.05$) increased the number of days to flowering but not in a consistent trend. The result of this study also revealed that the interactions between cowpea varieties and the level of irradiation in all the parameters were not significant

DISCUSSION

The results in this study showed that vegetable cowpea responds a great deal to gamma irradiation. The increase in plant height at lower irradiation was favourable to more branch formation and pod

Table 6: Effects of different levels of gamma ray irradiation on fresh pod yield (kg/ha)

Varieties	Levels of gamma rays						
	0	**5**	**10**	**15**	**20**	**25**	**Mean**
'2002							
IT81D-1228-14	9297.38	9767.57	9645.47	8045.07	8682.10	7488.67	8821.03
IT835-899	9180.87	9861.43	8327.50	7736.13	7920.93	6423.97	8241.81
IT93K-915	8427.50	9485.43	8014.63	\7557.63	7485.20	7329.10	8049.92
Mean	**8968.57**	**9704.81**	**8662.53**	**7779.61**	**8029.41**	**7080.58**	
2003							
IT81D-1228-14	8501.87	11321.07	10786.33	8324.80	7935.73	8286.93	9192.79
IT835-899	9296.80	9733.23	8036.27	8035.17	7705.60	7650.13	8409.53
IT93K-915	8040.53	9132.53	8582.93	8006.93	7195.47	7681.07	8106.58
Mean	**8613.07**	**10,062.28**	**9135.18**	**8122.30**	**7612.30**	**7872.71**	

Means with the same superscript along the column and row are not significantly different (P>0.05)

Table 7; Effects of different levels of gamma ray irradiation on number of days to physiological maturity of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	**5**	**10**	**15**	**20**	**25**	**Mean**
2002							
IT81D-128-14	60.43	57.97	63.27	65.30	65.87	67.23	63.30
IT835-899	59.27	60.13	63.63	65.30	65.97	67.23	63.64
IT93K-915	61.97	60.53	61.63	65.27	66.90	67.37	63.94
Mean	**60.56^{bc}**	**59.54^{c}**	**62.84^{b}**	**65.29^{a}**	**66.24^{a}**	**67.39^{a}**	
2003							
IT81D-1228-14	56.30	54.13	57.83	56.93	58.77	59.20	12.40^{c}
IT835-899	55.30	56.53	59.60	57.97	59.63	60.00	13.52^{b}
IT93K-915	56.70	56.03	59.70	57.57	61.83	61.50	14.05^{a}
Mean	**56.10^{cd}**	**55.57^{d}**	**59.04^{ab}**	**57.49^{bc}**	**60.08^{a}**	**60.23^{a}**	

Means with the same superscript along the column and row are not significantly different (P > 0.05)

Table 8. Effects of different levels of gamma ray irradiation on days to pod filling

Varieties	Levels of gamma rays						
	0	**5**	**10**	**15**	**20**	**25**	**Mean**
'2002							
IT81D-1228-14	17.43	16.63	19.27	20.30	21.20	19.40	21.57
IT835-899	18.27	16.47	18.30	19.63	20.30	21.23	19.03
IT93K-915	19.30	17.87	17.30	19.93	21.57	21.70	19.61
Mean	**18.3^{bc}**	**16.99^{c}**	**18.29^{b}**	**19.96^{ab}**	**27.02^{a}**	**27.02^{a}**	
2003							
IT81D-1228-14	14.63	13.47	15.17	14.93	15.43	15.20	14.81
IT835-899	14.30	13.53	14.93	14.63	15.63	15.00	14.67
IT93K-915	14.70	13.70	15.37	13.90	16.53	15.83	15.06
Mean	**14.54^{ab}**	**13.57^{b}**	**15.16^{ab}**	**14.49^{ab}**	**15.79^{a}**	**15.34^{a}**	

Means with the same superscript along the column and row are not significantly different (P> 0.05)

Table 9: Effects of different levels of gamma ray irradiation on number of days to flowering of some varieties of cowpea

Varieties	Levels of gamma rays						
	0	5	10	15	20	25	**Mean**
2002							
IT81D-1228-14	43.00	44.00	41.33	45.00	44.67	45.67	**43.94**
IT835-899	41.00	45.33	43.67	45.87	45.67	46.33	**44.61**
IT93K-915	42.67	44.33	43.67	45.33	45.33	45.67	**44.33**
Mean	**42.22^{b}**	**42.57^{b}**	**42.57^{a}**	**45.33^{a}**	**45.22^{a}**	**45.89^{a}**	
2003							
IT81D-1228-14	41.67	40.67	42.67	42.00	43.33	44.00	**42.39**
IT835-899	41.00	43.00	44.67	43.33	44.00	45.00	**43.50**
IT93K-915	42.00	42.33	44.33	43.67	45.00	45.67	**43.83**
Mean	**41.56^{d}**	**42.00^{cd}**	**43.89^{a}**	**43.00^{bC}**	**44.11^{ab}**	**44.89^{a}**	

Means with the same superscript along the column and row are not significantly different (P> 0.05)

yield. Ogunbodede and Brunner (1992); Lingakumar and Kulandaivelu (1993), Mensah and Eruotor (1993) and Odeigah *et al* (1998) works were in conformity with this result that maximum plant height of some sowpea varieties were achieved at 5-10KR. A similar report by Tevini and Teramure (1989) on ultra violent beam (UV-B) radiation on legumes showed that reduced plant height were due to product of growth hormone indole-3 acetic acid (IAA). A stimulatory effect on the fresh pod length and width, number of pods per plant, number of seeds per pod, 100 seed weight, fresh pod yield at lower levels of irradiation (5-10KR) and a general progressive decrease in the same parameters at higher levels observed in this study was similar to the earlier reports of Ojomo and Chheda, (1972); Rubaihayo, (1975), and Mensah and Eruoto (1993). This also confirmed the suggestions of Ogunbodede and Brunner (1992) that irradiation might be a potential source of increase in leaf vegetables and seeds yield of cowpea only if such increase persist in increased photosynthesis.

With respect to days to pod filling and physiological maturity, low irradiation treatment reduced these parameters. Vasudevain and Jos (1992); and Mensah and Eruotor (1993) found a similar response with barley and lima beans. This earliness to pod filling and days to physiological maturity could serve as a basis for breeding short season cowpea. Irradiation showed no marked improvement in the number of days to flowering. All the irradiation plants required more days to flower than the control. This is in agreement with the work of Rajput (1974) in green gram; that the delay in flowering days might be due to mitotic arrest in the flower primordial. However in contrast, the results obtained by Odeigah *et al;* (1998) showed that gamma irradiation had been used to reduce days to 50% flowering of some cowpea varieties. This difference could be attributed to some environmental changes like sunlight, temperature, rainfall. The result of this study showed that gamma irradiation could induce variability and serve as a means of cowpea improvement hence, should be incorporated in its breeding.

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