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RESEARCH ARTICLE

INTERRELATIONSHIP BETWEEN YIELD AND COMPONENTS OF GAMMA RAY IRRADIATED COWPEA UNDER HUMID TROPICAL RAINFOREST CONDITIONS OF UMUDIKE, NIGERIA

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ABSTRACT

Field experiment was conducted at the Michael Okpara University of Agriculture, Umudike Farm in 2002 and 2003 season with the aim of determining the association between characters of gamma ray irradiated cowpea varieties. Forage yield was found to be positively correlated with number of leaves per plant, number of pods per plant, leaf length, and fresh pod yield. Number of days to flowering, number of days to pod filling and number of days to physiological maturing and fresh pod yield were negatively correlated thus making simultaneous improvement of both traits difficult. Number of branches per plant, number of leaves per plant, plant height, number of pods per plant and number of seed per pod had a positive correlation with fresh pod yield and could be a possible basis for effective selection in cowpea production.

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INTRODUCTION

Crop improvement to a large extent depends on variability in a base population. Variability and character association is a prime requisite for an efficient yield selection; a complex quantitative trait desired by farmers. It determines the most quick, indirect, cost effective and appropriate selection method of superior genotype for crop improvement programme (Kadams *et al.*, 1990; Laurie *et al.*, 1999; Osekita *et al.*, 2000; Adebisi *et al.*, 2001). There is a great genetic variation in Cowpea with wide environmental adaptation. However, the productivity of cowpea in Nigeria are in the region of 300kg/ha, a very low value compared to the potential of over 400kg /ha. These low yield poses a major hindrance to increase production (Quin, 1987; Vanderborgh and Baudion, 2001).

In breeding programme, knowledge of the relationship among various quantitative and qualitative characters with yield, the end product of multiplication interactions of character is essential as an end aid to apportion a choice of appropriate parameters to be used as selection indices and the extent of environmental influence on them. Quite often, characters are correlated and selection of one character may lead to positive or negative response in the other character.

Ajibade and Morakinyo (2000) reported a positive correlation between seed yield and plant height, number of leaves per plant, leave surface area and base stem diameter in cowpea. Their work was in agreement with the observations of Oseni, (1994). Tenebe *et al.* (1995), Lawhale (1982) and Mensah and Eruotor, (1993) reported that gamma irradiated legumes have been improved through selection of plant height, number of pods per plant, number of seeds per pod, due to its genetic variance and wide environmental adaptation. Similar report was also made by Rubahaiyo and Okello-Anyanga (1997) and Pama-Negrette *et al.* (1984). Mutagens have been greatly utilized by breeders to provide a desired variability in a population from which selections are made. The work reported here was therefore to examine the relationship between yield components for yield in order to initiate an effective selection programme aimed at getting improved yield.

MATERIALS AND METHODS

The study was conducted at Michael Okpara University of Agriculture Farm, Umudike, Nigeria (5^o 29' N, 7^o 33' E), during 2002 and 2003 seasons. The mean annual rainfall and temperature of the area was 200mm and 29^oC respectively. Three contrasting vegetable cowpea varieties used for this study were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria and irradiated with a ⁶⁰Co gamma rays 220 unit cell at the Centre for Energy Research and Development, Obafemi

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Table 1. Estimates of phenotypic (b^2_{ph}), genotypic (b^2_g), error (b^2_e), variance and broad sense heritability ($h^2_{b.s\%}$) for different characters.

Characters	b^2_{ph}		b^2_g		b^2_e		$h^2_{b.s\%}$	
	2002	2003	2002	2003	2002	2003	2002	2003
Plant height (cm)	941.72	3543.59	8037.31	2977.57	104.41	565.92	88.91	85.03
No. of branches per plant	11.23	0.84	10.99	0.34	0.24	0.50	97.86	40.48
Days to flowering	9.35	5.61	6.01	4.24	3.34	1.37	64.28	75.58
Leaf area (cm ²)	276.96	728.96	130.90	363.07	146.06	365.89	47.26	47.81
No. of flowers per plant	56.69	49.23	43.44	41.73	13.25	7.50	76.63	84.77
No. of pods per plant	53.63	35.83	43.26	30.56	10.37	5.27	80.66	85.29
Pod filling period (days)	11.35	3.67	8.29	1.27	3.06	2.40	73.04	34.60
Days to maturity	34.35	4.15	28.26	11.05	6.09	3.10	82.27	78.09
Fresh pod length (cm)	5.67	4.57	1.04	0.58	4.64	3.99	18.34	12.69
Fresh pod width (cm)	0.04	0.02	0.01	0.01	0.03	0.01	25.00	50.00
100 seeds weight	3.96	1.82	0.71	0.85	3.25	0.97	17.93	46.70
No. of seeds per pot	10.61	3.01	9.79	1.92	0.82	1.09	92.27	63.79
Fresh pod yield (kg/ha)	7331169.18	254055492.50	252883.88	62063250.83	7079285.30	91992241.70	3.44	24.43
Forage yield (kg/ha)	4356853.66	20019818.16	1800480.16	3136521.74	2556373.50	16883296.28	41.33	15.67
No. of leaves per plant	18.97	34.95	6.94	8.10	12.03	16.85	36.58	51.71

Awolowo University (OAU) Ife, Nigeria. The levels applied ranged from 0-25Kr. The experiment was a split in a randomized complete block design with three replicates. The varieties were the main plots and the irradiation levels the subplots. Each plot measured 3m x 3m with six rows 0.5m apart and 0.25m between plants giving a plant population of 80,000 plants. Weeding was manually done twice. Cypermethrine at 100mls/15 litres of water was applied to control insect pests.

Observations were made to the following characters: plant height, number of leaves/plant, number of branches/plant, number of pods/plant, days to flowering, days to maturity, fresh pod length, fresh pod width, fresh pod yield, forage yield, leaf length and leaf width, days to pod filling, and number of flowers plant, leaf surface area. Analysis of variance (ANOVA) was carried out and simple linear correlation coefficients among the characters were determined.

RESULT AND DISCUSSIONS

Correlation coefficients of the studied characters are presented in Tables 2 and 3. Number of branches/plant was significantly correlated ($P < 0.05$) to number of leaves/plant, plant height and number of pods/plant in the two seasons. Also number of pods/plant showed positive association with plant height, number of leaves/plant, number of branches/plant, fresh pod length, fresh pod width, and number of seed/plant. Similarly, the plant height showed a positive association with the number of branches/plant, number of leaves/plant, leaf surface area, leaf length, number of flowers/plant, number of pods/plant, number of seed/pod, 100-seed weight, fresh

pod yield and forage yield. Tenebe *et al.*, (1995) and Ajibade and Morakinyo (2000), reported that significant positive correlation of plant height and seed yield, number of leaves/plant, 100-seed weight, leaf surface area were probably due to increase in plant height and greater leaf surface area exposed to more light, which directly determines the amount of photosynthesis available for plant growth.

Fresh pod yield and forage yield showed positive correlation with number of flowers/plant, number of pods/plant, number of seeds/pod and leaf area. This is in conformity with the earlier findings of Ariyo *et al.*, (1987) and Osekita *et al.*, (2000) Atuhene-Amankwa and Hossain (1991) suggested the use of number of pods/plant, as an indirect selection criterion for increasing yield. However, fresh pod yield had negative correlation with days to flowering, day to physiological maturity, and days to pod filling indicating that early maturing genotypes should not be selected in populations if high yield is desirable. Premium should be placed on genotypes with more number of branches/plant, number of pods/plant, number of seeds/pod, plant height and leaf surface.

If accelerated fresh pod and forage yield increase in cowpea are to be achieved, the negative relationship between these characters to others has to be eliminated, in addition to disease and pest resistance. Further work would need to be conducted over several seasons and locations and with more germplasm tested in order to capture more genetic variability to confirm the result of this work.

Table 2. Phenotypic correlation coefficient between agronomic characters in 2002

CHARACTERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
	No. of branches per plant	No. of leaves per plant	Plant height (cm)	Days to flowering	Leaf width (cm)	Leaf length (cm)	Leaf area (cm ²)	No. of flowers per plant	No. of pods per plant	No. of filling period (days)	Pod physio maturity	Fresh pod length (cm)	Fresh pod width (cm)	100 seeds weight (g)	No. of seeds per pot	Fresh pod yield (kg/ha)	Forage yield (kg/ha)	
1	No. of branches per plant	1.000	0.446**	0.356** *	-0.450	0.091	0.346*	0.215	0.448**	0.410**	-0.277*	-0.197	0.192	0.079	-0.006	0.167	0.028	0.181
2	No. of leaves per plant		1.000	0.354** *	-0.251	-0.148	0.170	-0.025	0.555**	0.518	0.145	-0.234	-0.051	-0.045	-0.018	0.071	0.108	0.445*
3	Plant height (cm)			1.000	0.301*	-0.047	0.110	0.003	0.517**	0.524**	-0.515	0.500**	-0.098	0.101	0.274*	0.470**	0.345*	0.236
4	Days to flowering				1.000	0.012	-0.148	-0.047	-0.381**	0.434**	0.332**	0.817**	0.132	-0.120	0.007	-0.289*	-0.126	0.259
5	Leaf width (cm)					1.000	0.697** *	0.940**	0.059	0.030	0.243	-0.141	0.511**	0.205	-0.031	0.005	-0.090	0.135
6	Leaf length (cm)						1.000	0.897**	0.292	0.327**	-0.281*	-0.263	0.516	0.055	-0.021	0.065	-0.013	0.328*
7	Leaf area (cm ²)							1.000	0.092	0.123	0.271*	-0.194	0.560**	0.146	-0.040	0.007	0.068	0.236
8	No. of flowers per plant								1.000	0.965**	-0.397**	0.477**	-0.019	0.121	0.036	0.307*	0.351**	0.353*
9	No. of pods per plant									1.000	-0.432**	-0.531**	0.010	0.086	0.091	0.365**	0.334*	0.316*
10	No. of filling period (days)										1.000	0.815**	-0.106	0.101	-0.205	-0.440**	-0.277*	-0.136*
11	Pod physio maturity											1.000	0.016	-0.136	0.121	-0.446**	-0.247	-0.130
12	Fresh pod length (cm)												1.000	0.241	-0.146	-0.078	0.026	-0.239
13	Fresh pod width (cm)													1.000	-0.053	0.126	0.055	0.093
14	100 seeds weight (g)														1.000	0.325*	0.253	0.246
15	No. of seeds per pot															1.000	0.115	0.162
16	Fresh pod yield (kg/ha)																1.000	0.212
17	Forage yield (kg/ha)																	1.000

*** - significantly different at 0.05 and 0.01 probability levels respectively.

Table 3. Phenotypic correlation coefficient between agronomic characters in 2003

CHARACTERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
	No. of branches per plant	No. of leaves per plant	Plant height (cm)	Days to flowering	Leaf width (cm)	Leaf length (cm)	Leaf area (cm ²)	No. of flowers per plant	No. of pods per plant	No. of filling period (days)	Pod physio maturity	Fresh pod length (cm)	Fresh pod width (cm)	100 seeds weight (g)	No. of seeds per pot	Fresh pod yield (kg/ha)	Forage yield (kg/ha)	
1	No. of branches per plant	1.000	0.339*	0.443**	-0.034	0.394**	0.133	0.319*	0.335	0.316*	-0.142	0.323*	-0.275	-0.052	0.014	-0.030	0.020	0.327*
2	No. of leaves per plant		1.000	0.418**	-0.449**	0.225	0.166	0.222	0.395**	0.352**	-0.006	-0.298*	-0.056	-0.097	0.136	0.314*	0.046	0.374*
3	Plant height (cm)			1.000	0.380**	0.407**	0.212	0.366**	0.638**	0.612**	-0.317*	-0.472**	0.195	-0.016	0.111	0.293*	0.111	0.512**
4	Days to flowering				1.000	-0.129	-0.159	-0.151	-0.574**	0.585**	0.079	0.709**	0.107	0.087	-0.114	-0.344	-0.195	-0.429*
5	Leaf width (cm)					1.000	0.546**	0.911**	0.428**	0.391**	0.297*	0.294*	0.247	0.261	0.040	0.061	0.178	0.239
6	Leaf length (cm)						1.000	0.841**	0.231	0.280*	0.201	0.246	-0.109	0.036	0.151	0.345*	0.319*	-0.066
7	Leaf area (cm ²)							1.000	0.381	0.383**	-0.286*	-0.301*	0.105	0.184	0.091	0.199	0.263	0.120
8	No. of flowers per plant								1.000	0.956	0.314*	-0.597**	0.020	-0.003	-0.069	0.253	0.220	0.524*
9	No. of pods per plant									1.000	-0.346*	-0.627**	-0.048	-0.047	-0.120	-0.273*	0.234	0.560**
10	No. of filling period (days)										1.000	0.759**	-0.245	-0.145	0.005	0.133	-0.218	-0.303*
11	Pod physio maturity											1.000	-0.104	-0.045	0.071	0.319*	-0.275*	-0.495**
12	Fresh pod length (cm)												1.000	-0.101	0.214	-0.273*	-0.161	0.101
13	Fresh pod width (cm)													1.000	0.402**	0.259*	0.043	-0.043
14	100 seeds weight (g)														1.000	0.405**	-0.047	-0.81
15	No. of seeds per pot															1.000	0.109	0.222
16	Fresh pod yield (kg/ha)																1.000	0.082
17	Forage yield (kg/ha)																	1.000

* ** - significantly different at 0.05 and 0.01 probability levels respectively

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