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GENETIC IMPROVEMENT OF COWPEA, *V1GNA UNGUICULATA* (L) WALP SEED YIELD

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Cowpea is a vegetable used both as tender green pods and as shelled beans of mature pods. Rajendran *et al.* (1978) have reviewed the work done on the inheritance of various characters on cowpea and also studies relating to the inter-relationship amcng various characters. They have also reported detailed results pertaining to such a study when the tender green pods were harvested. The present study relates to the types suitable for vegetable used as shelled beans of mature pods.

Materials and Methods

Nineteen self fertilized cowpea varieties from the extensive germplasm available at Indian Institute of Horticultural Research were grown in an Randomised Block Design with four replications. Area of primary leaf in sq. cm (X_1), plant height in cms (X_2), plant spread in cm (X_3) days taken for first flowering (X_4), days taken to complete 50% flowering (X_5), number of flowers per bunch (X_6), number of pods set per bunch (X_7), 100 seed weight (X_8), length of peduncle in cm (X_9), number of peduncle per plant (X_{10}). number of primary branches (X_{11}), number of seeds per pod (X_{12}), per cent borer Infestation of pod (X_{13}) and seed yield per plant (Y) were recorded. Genetic components were estimated by adopting standard procedures as described by Barton (1952). Heritability on broad sense was estimated according to Hanson *et al.* (1956). The path coefficient analysis was done using method given by Dewey and Lu (1959). Selection indices were worked out using methods given by Rao (1952).

Results and Discussion

The heritability of different characters and their inter-correlations (Phenotypic, genotypic and environmental) are given in Table—Ia, b and c. As reported by Rajendran *et al.* (1978) and Tikka *et al.* (1977) the heritabilities of all characters are medium to high indicating existance of residual genetic variation which makes the crop amenable to improvement by selection programmes. Except for area of primary leaf, pod set per bunch and per cent borer infestation all other characters have significant genotypic positive correlation with yield. But in case of correlations with green pod yield a slightly different picture was reported by Rajendran *et al.*, (1978). The per cent borer infestation had

Table 1—A Phenotypic correlations among and heritability of different characters of cowpea

Character	Area of primary leaf X_1	Plant height X_2	Plant spread X_3	Days to first flowering X_4	Days to 50% flowering X_5	No. of flower/ bunch X_6	Pod set/ bunch X_7
Heritability (%)	93.81	94.31	94.12	92.63	91.39	59.90	77.81
X_1 rp	1.00	0.2499*	0.3362**	0.1998	0.1956	0.1789	—0.1908
X_2		1.0000	0.7246**	0.3824**	0.3511**	0.3208**	0.2342*
X_3			1.0000	0.6835**	0.6388**	0.3635**	—0.0110
X_4				1.0000	0.9005**	0.1448	0.1113
X_5					1.0000	0.2148	0.1267
X_6						1.0000	0.0978
X_7							1.0000

Table 1—A Continued

	100 seed weight X_8	Length of peduncle X_9	No. of peduncle X_{10}	No. of primary branches X_{11}	No. of seed/ pod X_{12}	Borer infestion of pod X_{13}	Seed yield per plant Y
Heritability (%)	93.58	67.02	75.80	72.35	90.87	86.84	84.42
X_1	0.7436**	0.3921**	0.0849	0.0489	0.3806**	0.1271	0.2343*
X_2	0.2375*	0.3465**	0.6111**	0.3442**	0.3354**	—0.1837	0.5722**
X_3	0.5075**	0.5418**	0.7468**	0.5978**	0.5161**	0.0358	0.7694**
X_4	0.3412**	0.1921	0.5070**	0.5213**	0.4569**	—0.1496	0.5480**
X_5	0.3050**	0.1641	0.4885**	0.5489**	0.5711**	—0.2643	0.5171**
X_6	0.2392*	0.2107	0.4850**	0.3996**	0.1553	-0.1700	0.3810**
X_7	—0.4242**	—0.3173**	0.0123	0.0241	—0.1727	—0.3773**	0.1331
X_8	1.0000	0.5022**	0.3028**	0.0712	0.5012**	0.3872**	0.4536**
X_9		1.0000	0.3956**	0.2451*	0.3676**	0.1787	0.5549**
X_{10}			1.0000	0.7066**	0.3214**	0.0905	0.7510**
X_{11}				1.0000	0.2248*	—0.2625*	0.5224**
X_{12}					1.0000	0.0176	0.5984**
X_{13}						1.0000	0.1288
Y							1.0000

* Significant at 5% level of significance ** Significant at 1% level of significance

Table 1—B Genotypic correlations among and heritability of different characters of cowpea

Character	Area of primary leaf X_1	Plant height X_2	Plant spread X_3	Days to first flowering X_4	Days to 50% flowering X_5	No. of flower bunch X_6	Pod set/ bunch X_7
Heritability (%)	93.81	94.31	94.12	92.63	91.39	59.90	77.81
X_1 rg	1.00	0.2729	0.3550	0.2007	0.2054	0.2698	—0.2266
X_2		1.0000	0.7713**	0.4054	0.3689	0.4199	0.2812
X_3			1.0000	0.7306**	0.6885**	0.4692	0.0110
X_4				1.0000	0.9603**	0.2032	0.1540
X_5					1.0000	0.3095	0.1517
X_6						1.0000	0.1609
X_7							1.0000

Table 1-B Continued

	100 seed weight X_8	Length of peduncle X_9	No. of peduncle X_{10}	No. of primary branches X_{11}	No. of seed/ pod X_{12}	Borer infestation of pod X_{13}	seed yield per plant Y
Heritability (%)	93.58	67.02	75.80	72.35	90.87	86.84	84.42
X_1 rg	0.7764**	0.5190*	0.1101	—0.0590	0.4081	0.1402	0.2572*
X_2	0.2568	0.4460*	0.7024**	0.4375	0.3564	—0.1904	0.6269**
X_3	0.5404*	0.6538**	0.8611**	0.6803**	0.5808**	0.4205	0.8626**
X_4	0.3537	0.2584	0.6263	0.6447**	0.4997*	—0.1605	0.6165**
X_5	0.3142	0.2350	0.6268**	0.7295**	0.6117**	—0.2794	0.6221*
X_6	0.3053	0.2933	0.6566**	0.5816**	0.2192	—0.2516	0.5396*
X_7	—0.5170	—0.4328	0.0174	—0.0120	—0.2491	—0.4533*	—0.1910
X_8	1.0000	0.6452**	0.3882	0.1041	0.5383*	0.4198	0.5309*
X_9		1.0000	0.4341	0.3078	0.4948*	0.2544	0.7070**
X_{10}			1.0000	0.8026**	0.4133	0.1040	0.8419**
X_{11}				1.0000	0.2827	—0.3326	0.5818**
X_{12}					1.0000	0.0196	0.6937**
X_{13}						1.0000	0.1741
Y							1.0000

* Significant at 5% level of significance ** Significant at 1% level of significance

a significant genetic correlation with green pod yield and characters like days to first flower, days to complete 50 per cent flowering and height did not exhibit any such significant relation. This may possibly ba due to the picking ef tender pods at regular intervals practiced in that case. Further it can be seen from the table that 100 seed weight and number of seeds per pod, the two major yield components show different type of relations with the other morphological characters. While area of primary leaf and pod set per bunch had significant negative correlation with 100 seed weight only. Days to first flowering, days to complete 50 per cent flowering, had significant relation with number of seeds per pod only. Plant spread and length of peduncle had significant relation with both the yield components and other characters considered did not show any relation with either of them.

Selection index method, where the selection is exercised based on the genetic effects of different characters on yield (here seed yield per plant), was tried to see whether any improvement is possible. It was seen that at best selection index using different combination of characters was on par with straight selection. Tikka *el al.,* (1977) have arrived at an index with 22.7% more efficient than straight selection for increase of seed yield. This apparent difference may be due to the higher heritability of yield shown in our conditions as also the broader genetic material included in the study.

A more clear understanding of the causation mechanism is desirable in arriving at desirable plant types or even to find out possible limitations of the selection procedure. The path ways (both direct and indirect) of the different characters on seed yield per plant are given in Table 2. The highest direct effects on yield are shown by pod set per bunch and number of seeds per pod but the former character has a high negative indirect effect also. The number of peduncle, days to first flowering, and length of peduncle are the characters which have above average positive direct and indirect effects. Days to 50 per cent flowering which has a very high positive indirect effect mainly through number of seeds per pod, length of peduncle and number of peduncle had an above average negative direct effect. An ideal plant which has characters influencing yield both directly and indirectly would have longer peduncles, more number of peduncle and more number of seeds per pod and should flower early. Among the morphological characters measured plant spread seems to be more important than height which has a slight negative indirect effect. These conclusions are entirely different from the results of analysis of Rajendran *et al.* (1978) for green pod yield wherein it was found that the different characters have antagonism among themselves and limit the possibility of increasing green pod yield indefinitely. Thus while methods other than selection have to be resorted to in increasing the green pod yield, selection exercised based on yield is likely to pave way for higher yielding plants in case of seed yield.

Table 1 —C Environmental correlations among and heritability of different characters of cowpea

Character	Area of primary leaf X_1	Plant height X_2	Plant spread X_3	Days to first flowering X_4	Days to 50% flowering X_5	No. of flower/ bunch X_6	Pod set/ bunch X_7
Heritability (%)	93.81	94.31	94.12	92.63	91.39	59.90	77.81
X_1 re	1.00	—0.1485	—0.1226	0.1876	0.0742	—0.1483	0.0242
X_2		1.0000	—0.0371	0.0538	0.1222	0.0345	0.0591
X_3			1.0000	0.0202	0.0033	0.0726	—0.1780
X_4				1.0000	0.2126	—0.0386	—0.1522
X_5					1.0000	—0.0764	—0.0094
X_6						10000	—0.0405
X_7							1.0000

Table 1—C Continued

	100 seed weight X_8	Length of peduncle X_9	No. of peduncle X_{10}	No. of primary branches X_{11}	No. of seeds/ pod X_{12}	Borer infestation of pod X_{13}	seed yield per plant Y
Heritability (%)	93.58	67.02	75.80	72.35	90.87	86.84	84.42
X_1 re	0.2555	—0.1361	—0.0649	—0.0020	0.0502	0.0058	0.0547
X_2	—0.0627	—0.0593	0.1467	—0.1375	0.0768	—0.1323	0.1361
X_3	0.0066	0.1620	0.1627	0.2851	—0.2874	—0.0249	0.0057
X_4	0.1736	—0.0735	—0.1333	—0.0460	—0.0190	—0.0582	0.0260
X_5	0.1944	—0.1176	-0.2299	—0.2878	0.1532	—0.1445	0.2536
X_6	0.0661	0.0683	0.1366	0.0500	—0.0334	0.0499	0.0106
X_7	0.1421	—0.0176	—0.0048	—0.1334	0.2578	—0.2729	0.1167
X_8	1.0900	—0.0603	—0.1935	—0.1084	0.0635	0.0952	0.1834
X_9		1.0000	0.3051	0.1019	—0.1067	—0.0737	0.1022
X_{10}			1.0000	0.4338	—0.1456	0.0345	0.3993
X_{11}				1.0000	—0.0280	0.0061	0.3260
X_{12}					1.0000	0.0017	—0.0766
X_{13}						1.0000	—0.1418
Y							1.0000

Table 2 Casual path ways in determination of total seed yield in cowpea (Indirect effects through)

Indirect effects of	Area of primary leaf X_1	Plant height X_2	Plant spread X_3	Days to first flowering X_4	Days to 50% flowering X_5	No. of flower bunch X_6	Pod set/ bunch X_7
X_1	—	—0.0174	0.0319	0.0446	—0.0632	0.0007	—0.0806
X_2	—0.0414	—	0.0709	0.0854	—0.1134	0.0012	0.0989
X_3	—0.0544	—0.0508	—	0.1526	—0.2063	0.0014	—0.0046
X_4	—0.0333	—0.0268	0.0699	—	—0.2908	0.0006	0.0470
X_5	—0.0326	—0.0246	0.0625	0.2011	—	0.0008	0.0535
X_6	—0.0298	—0.0225	0.0356	0.0323	—0.0694	—	0.0413
X_7	0.0318	—0.0164	—0.0011	0.0248	—0.0409	0.0004	—
X_8	—0.1240	—0.0167	0.0497	0.0762	—0.0985	0.0009	—0.1791
X_9	—0.0654	—0.0243	0.0530	0.0429	—0.0530	0.0008	—0.1340
X_{10}	—0.0142	—0.0429	0.0731	0.1132	—0.1578	0.0018	—0.0052
X_{11}	0.0082	—0.0242	0.0585	0.1164	—0.1773	0.0015	—0.0102
X_{12}	—0.0635	—0.0235	0.0505	0.1020	—0.1844	0.0006	—0.0729
X_{13}	—0.0212	0.0129	0.0035	—0.0334	0.0853	—0.0006	—0.1593
Direct effects	—0.1668	-0.0702	0.0978	0.2233	—0.3229	0.0038	0.4223
Total Indirect effects	0.4011	0.6424	0.6716	0.3247	0.8400	0.3722	—0.2892

Table 2 Continued

Indirect effect of	100 seed weight X_8	Length of peduncle X_9	No. of peduncle X_{10}	No. of primary branches X_{11}	No. of seed/ pod X_{12}	Borer infestation of pod X_{13}
X_1	0.1824	0.0146	0.0313	—0.0056	0.1611	0.0112
X_2	0.0583	0.0925	0.2250	0.0392	0.1419	—0.0162
X_3	0.1245	0.1446	0.2749	0.0682	0.2184	0.0032
X_4	0.0837	0.0513	0.1867	0.0594	0.1933	—0.0132
X_5	0.0748	0.0438	0.1799	0.0626	0.2417	—0.0233
X_6	0.0587	0.0562	0.1786	0.0456	0.0657	—0.0150
X_7	—0.1041	—0.0847	0.0045	0.0027	—0.0731	—0.0332
X_8	—	0.1340	0.1115	0.0081	0.2121	0.0341
X_9	0.1232	—	0.1457	0.0280	0.1556	0.0157
X_{10}	0.0743	0.1056	—	0.0806	0.1360	0.0080
X_{11}	0.0175	0.0654	0.2602	—	0.0951	—0.0231
X_{12}	0.1230	0.0981	0.1183	0.0256	—	0.0015
X_{13}	0.0950	0.0477	0-0333	—0.0299	0.0074	—
Direct effects	0.2453	0.2668	0.3681	0.1.140	0.4232	0.0881
Total Indirect effects	0.2083	0.2881	0.3829	0.4084	0.1752	0.0407

Residual effect = 0.3620

Summary

The heritability and inter-correlation study of Cowpea grown for seed purpose is reported. All characters examined were found to have high heritability. Selection index technique was found to be not efficient over straight selection. An ideal plant which gives higher seed yield should preferably flower early, have longer peduncles, have more peduncles and have more number of seeds per pod.

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സംഗ്രഹം

വിത്തിനുവേണ്ടി വളർത്തിയ മാമ്പയറിന്റെ വംശാഗതത്വവും അന്തരാ-സഹസംബന്ധവും ഇവിടെ വെളിപ്പെടുത്തിയിരിക്കുന്നു. പ്രാനവിധേയമാക്കിയ എല്ലാ സ്വഭാവങ്ങളും ഉയർന്ന വംശാഗതത്വം പ്രകടിപ്പിക്കുന്നതായി കണ്ടു. നേർനിർധാരണത്തിൽ നിർധാരണ സൂചികാ സങ്കേതം ഫലപ്രദമായിക്കണ്ടില്ല. ഉയർന്ന നിരക്കിൽ വിത്തുല്പാദനം നടത്തുന്ന ഒരു മാതൃകാസസ്യം നേരത്തേ പൂക്കുന്നതും നീണ്ട പൂങ്കുലത്തണ്ടുള്ളതും കൂടുതൽ പൂങ്കുലകളും കൂടുതൽ വിത്തടങ്ങിയ കായ്കളും ഉല്പാദിപ്പിക്കുന്നതും ആയ ഒന്നാകാനാണു കൂടുതൽ സാധ്യതയെന്നു കണ്ടു.

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