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ASSOCIATION OF SEED YIELD WITH DIFFERENT PHASES OF THE REPRODUCTIVE PERIOD IN PIGEONPEA

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ABSTRACT

Twenty eight genotypes of pigeonpea were used to estimate various genetic parameters for physiological and yield components. The FF (days from date of sowing to 50% floral buds opening on the main stem), PF (days from sowing to 50% pods on the main stem with 50% seed fill) and days to maturity showed significant positive association among themselves and with seed yield. Path analysis showed that days from sowing to 50% seed filling in 50% pods, maturity and pod establishment period (FF to PF) had positive and high direct effects on seed yield. The utility of the results for pigeonpea improvement is discussed.

Key words: Pigeonpea, *Cajanus cajan*, reproductive phases, correlation.

A wide range of maturity groups exists in pigeonpea (*Cajanus cajan* (L.) Millsp.), an important factor in the adaptation of the crop to diverse agroclimatic areas and agronomic systems. The distribution and utilization of assimilates are primarily functions of sink which indicate that source–sink relationship is very important for breeding high yielding genotypes [1]. However, the sink capacity of pigeonpea plant is generally determined by the duration of the reproductive period. The present study aims to determine the association of different reproductive periods among themselves and with seed yield and its components.

MATERIALS AND METHODS

Twenty eight diverse genotypes of pigeonpea (determinate, semi determinate and indeterminate) were field tested in randomised block design with three replications and row-to-row and plant-to-plant spacings of 50 cm and 25 cm, respectively, for two seasons (1989, 1990). The crop was sown on 20 June, 1989 and 15 June, 1990. Each genotype was sown in a 4-row plot of 4 m length. The experiment was irrigated in both years. Data were recorded on 10 random plants taken from the two central rows to eliminate border effect.

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Different developmental stages were identified to measure reproductive periods, viz., FF-days from date of sowing to 50% floral buds opening on the main stem; PF-days from sowing to 50% pods on main stem having 50% seed fill; and M-days to maturity from sowing to 95% pods matured. These stages were determined visually on individual plants in a plot for FF and PF and on the plot basis for M. The FF, PF and M stages correspond to the R5, R6 and the R8 reproductive stages, respectively [2]). The total reproductive period, or TRP (FF to M) was partitioned into pod establishment period, or PEP (FF to PF) and pod filling period, or PFP (PF to M). PEP was chosen to cover the period from initiation to establishment, and PFP to cover the pod filling to maturation period. The PFP/PEP ratio which gives the proportion of the total reproductive period that is devoted to pod filling relative to pod establishment was also calculated. It is generally assumed that genotypes with higher pod filling period/pod establishment period ratio tends to have higher seed yield [1]. Data were also recorded for pods per plant, seeds per pod, 100-seed weight, seed yield per plant, and harvest index. The character means of ten plants over two years for different characters were used to estimate the coefficient of variation and correlation coefficients [3]. Path analysis was done to partition total correlation into the direct and indirect effects [4].

RESULTS AND DISCUSSION

The estimates of correlation coefficients are given in Table 1. The days from sowing to 50% floral buds opening, days from sowing to 50% seed filling in 50% pods and days to maturity were positively correlated among themselves indicating that late maturing genotypes are late in flowering and have longer pod filling period. The significant negative association of days to 50% seed filling in 50% pods with pod filling period/pod establishment period ratio indicates that genotypes taking more days to 50% seed filling in 50% pods had shorter pod filling period/pod establishment period ratio, and vice versa. The maturity period was positively associated with pod filling period, total reproductive period, and pod filling period/pod establishment period ratio suggesting that late maturing genotypes have longer pod filling period and total reproductive period and greater pod filling period/pod establishment period ratio. The correlation of total reproductive period with days to 50% flowering, days to 50% seed filling in 50% pods (negative but nonsignificant) and days to maturity (positive and significant) suggested that longer total reproductive period could be obtained through early flowering. The pod establishment period was negatively associated with pod filling period and pod filling period/pod establishment period ratio. It indicates that genotypes with higher pod filling period and pod filling period/pod establishment period would have short pod establishment period. The positive association of pod filling period with total reproductive period and pod filling period/pod establishment period and that of total reproductive period with pod filling period/pod establishment period suggested that selection should be done for longer pod filling period to obtain high yielding genotypes. Hanson [1] also reported that genotypes with higher pod filling period as compared to pod establishment period had higher seed yield in soybean.

Table 1. Correlation coefficients among different traits in pigeonpea

Traits	PF	M	PEP	PFP	TRP	PFP/PEP	Pods per plant	Seeds per pod	Seed mass	Seed yield	HI
FF	0.95**	0.57**	−0.06	−0.15	−0.16	−0.13	0.19	0.23	−0.10	0.38*	−0.12
PF		0.51**	0.25	−0.25	−0.19	−0.39*	0.22	0.24	−0.03	0.39*	−0.10
M			−0.13	0.70**	0.71**	0.48**	0.24	0.19	0.04	0.43*	−0.02
PEP				−0.40*	−0.11	−0.70**	0.08	0.07	0.19	0.11	0.06
PFP					0.95**	0.84**	0.09	0.00	0.07	0.07	0.05
TRP						0.68**	0.12	0.05	0.13	0.11	0.06
PFP/PEP							−0.01	−0.05	−0.06	−0.04	0.07
Pods/plant								0.03	−0.15	0.48**	0.07
Seeds/pod									0.40	0.10	−0.04
100-seed mass										0.06	0.02
Seed yield											0.39*

*$P < 0.05$, **$P < 0.01$.

FF—Days from sowing to 50% floral buds opening on main stem. PF—Days from sowing to 50% seed filling in 50% pods. M—Days to maturity. PEP—Pod establishment period. PFP—Pod filling period. TRP—Total reproductive period.

The days to 50% floral buds opening, days to 50% seed filling in 50% pods and days to maturity had positive association with seed yield suggesting that late maturing genotypes (180–200 days) will produce high seed yield. This is supported by the fact that most of the late maturing improved cultivars like H 82-1 and T 21, of pigeonpea are very high yielding as compared with the short duration cultivars like Prabhat and AL 15 (130–140 days) under North Indian conditions. It is generally assumed that the genotypes with a longer pod establishment period of pod development are more adapted to adverse weather conditions and have potentially more seed-sink. The genotypes with longer period filling period make photosynthates available to seed sink over a longer period. However, in the present study, nonsignificant association of seed yield with pod establishment period and pod filling period suggested that length of period for sink establishment and assimilate transport to the sink were not important. It also suggest that, in the present genetic material, the length of period for sink establishment and assimilates transport to the sink may be adequate to obtain the required sink load. Hanson [1] also reported nonsignificant association of seed yield with pod establishment period, but significant with pod filling period in soybean. Correlation between total reproductive period and seed yield was nonsignificant as also reported by Hanson [1] in soybean. However, Johnson and Robinson [5] obtained high

genotypic association between total reproductive period and seed yield in soybean. Seed yield was positively associated with pods per plant and harvest index.

Path analysis revealed that days from sowing to 50% seed filling in 50% pods, days to maturity and pod filling period had high and positive direct effects on seed yield (Table 2). On the other hand, the direct effects of days to 50% floral buds opening, pod establishment period, total reproductive period and pod filling period/pod establishment period were highly negative on seed yield. The negative direct effect but positive correlation of days to 50% floral buds opening with seed yield is due to its high and positive indirect effects via other characters (Table 2). The indirect effects of pod establishment period via days to 50% seed filling in 50% pods, pod establishment period via pod filling period/pod establishment period and pod filling period via days to maturity on yield were also highly positive. The negative indirect effects of pod filling period via other reproductive periods may be responsible for the nonsignificant association of pod filling period with seed yield.

Regarding yield components, pods per plant, 100-seed weight and harvest index had high direct effects on seed yield. In general it has been observed that the association of seed weight with seed yield becomes negative if the seed size increases a certain threshold limit.

Table 2. Direct (in bold) and indirect effects of different traits on seed yield in pigeonpea

Traits	FF	PF	M	PEP	PFP	TRP	PFP/PEP	Pods per plant	Seeds per pod	Seed mass	HI	Correlation with seed yield
FF	**-0.62**	0.27	0.27	0.01	-0.02	0.02	0.04	0.07	0.00	-0.01	-0.05	0.38*
PF	-0.21	**0.79**	0.15	-0.04	-0.04	-0.03	0.10	0.15	0.00	0.00	-0.04	0.39*
M	-0.13	0.15	**0.50**	0.20	0.20	-0.10	-0.14	0.12	0.00	0.00	-0.01	0.43*
PEP	0.01	0.07	-0.04	**-0.18**	-0.05	0.01	0.20	0.03	0.00	0.01	0.02	0.11
PFP	0.03	-0.07	0.21	0.06	**0.25**	-0.13	-0.24	0.04	0.00	0.01	0.02	0.07
TRP	0.04	-0.05	0.21	0.02	0.14	**-0.14**	-0.20	0.05	0.00	0.01	0.02	0.11
PFP/PEP	0.03	-0.10	0.14	0.12	0.13	-0.09	**-0.29**	0.00	0.00	-0.01	0.03	-0.04
Pods/plant	-0.04	0.06	0.07	-0.01	0.01	-0.02	0.00	**0.69**	0.00	-0.02	0.03	0.48**
Seeds/pod	-0.05	0.07	0.06	-0.01	0.00	-0.01	0.01	0.01	**-0.01**	0.04	-0.01	0.10
Seed mass	0.02	-0.01	0.01	-0.13	0.01	-0.02	0.02	-0.06	0.00	**0.14**	0.01	0.06
HI	0.00	-0.03	-0.01	-0.01	0.01	-0.10	-0.02	0.03	0.00	0.00	**0.40**	0.39*

FF—Days from sowing to 50% floral buds opening on main stem. PF—Days from sowing to 50% seed filling in 50% pods. M—Days to maturity. PEP—Pod establishment period. PFP—Pod filling period. TRP—Total reproductive period.

However, in genotypes with small to medium seed size (6–10 g/100 seeds) as in the present study, this association is generally positive. Moreover, the negative or nonsignificant association of 100-seed weight with seed yield may be due to its negative indirect effects via other yield components. The indirect contributions of various yield components through different reproductive phases towards seed yield was comparatively low.

It must be noted that correlation of days to 50% floral buds opening with seed yield is positive but its direct effect is negative. This is due to the fact that the indirect effects of days to 50% floral buds opening via days to 50% seed filling in 50% pods, days to maturity, pods per plant and seeds per pod were negative on seed yield. Days to 50% seed filling in 50% pods had positive correlation as well as positive direct effect on seed yield which suggest that longer the pod filling period, the larger the sink size, and ultimately higher the seed yield. The present study suggests that our selection criteria in pigeonpea should be based on days from sowing to 50% seed filling in 50% pods and pod filling period along with pods per plant to obtain high yielding genotypes.

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