

RELATIONSHIP OF PLANT HEIGHT, DAYS TO FLOWERING AND MATURITY TO GRAIN YIELD IN SHORT-DURATION DETERMINATE PIGEONPEA

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ABSTRACT

Generally, pigeonpeas of determinate growth habit and short duration are of short stature compared to the traditional indeterminate types. The association of plant height, days to flowering and maturity, and grain yield were assessed among 100 determinate short-duration pigeonpea lines derived from different genetic backgrounds. Plant height and days to maturity showed strong positive genotypic and phenotypic correlation with grain yield. Days to flowering was positively correlated with days to maturity and plant height. Tall determinate plants appeared to be promising for grain yield. However, the existence of a positive association between plant height and growth duration may cause difficulties in the selection of early flowering tall plants. Nonetheless, high selection pressure for medium to tall determinate plants among early-flowering segregates may yield more productive genotypes.

Key words: *Cajanus cajan*, pigeonpea, correlations, crop duration.

Landraces of pigeonpea (*Cajanus cajan* (L.) Millsp.) are known for their slow juvenile growth but later on they develop rapidly into tall woody perennial shrubs. In view of their slow initial growth, they are often cultivated as mixed or intercrops with fast-growing cereal and pulse crops. Although tall bushy growth is advantageous in these cropping systems management of such plant types pose difficulties, especially for pest management and mechanized cultivation. Because of these and other considerations plant types of relatively shorter stature and growth duration have been developed in recent years for cultivation under monocropping systems. Short stature associated with determinate growth lends itself to effective crop management [1-5]. Gupta and Kapoor [5] further emphasized that determinate type pigeonpea with similar maturity were as productive as the indeterminate types. Short duration determinate plant types with maturity duration of 110 days have been

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developed in addition to those maturing in 130–135 days. In this study the association of plant height, days to flowering and maturity duration to grain yield is reported.

MATERIALS AND METHODS

Six determinate and short-duration pigeonpea lines i.e. ICPL 151, 83015, 85012, 85024, 85031 and 85059 with large differences in plant height, maturity, and seed size were used to generate material for this study. Four crosses involving these parents were (ICPL 85012 x ICPL 151; ICPL 83015 x ICPL 85031; ICPL 85024 x ICPL 151 and ICPL 85024 x ICPL 85059) made and F₂ populations were sown in 40-row plots. Observations on days to flowering and maturity, plant height at flowering and maturity, 100 grain weight were recorded on 500 random plants of each cross. These plants were harvested separately for progeny evaluation. Progenies representing extra-early and early maturity and tall and short-plant heights were identified in F₃. From each cross, 20 high yielding progeny bulks representing tall and short-plant stature were selected for evaluation. These eighty progenies out of four crosses were tested in F₄ and F₅ generations along with 20 other short-duration lines including 6 parental lines in a 10 x 10 simple-lattice design at ICRISAT Center, Patancheru and Modipuram. The experiment was conducted during the rainy seasons of 1990 and 1991 at Patancheru and during the 1991 rainy season at Modipuram.

The experiment was laid out in single-row plots of 4 m length in two replications in 1990 and in three replications in 1991. Rows were spaced 30 cm with a plant-to-plant spacing of 10 cm. Recommended cultural practices were followed in both years. The crop was protected against insect pests by three spray applications. Data were collected on days to flowering and maturity, plant height, and grain yield. On the basis of days to maturity at Modipuram, the lines were divided into two groups: those maturing in up to 125 days, and those maturing in more than 125 days. The analysis of variance was done following the standard statistical procedures. The genotypic and phenotypic correlations were worked out following the procedure of Falconer [6].

RESULTS AND DISCUSSION

On an average, the plants flowered in about 58 days at Patancheru and in 74 days at Modipuram (Table 1). The differences in maturity between the two locations were about 20 days. The plants were about 40 cm taller and recorded higher yields at Modipuram than at Patancheru.

Correlations between characters across genotypes were estimated for each location (Tables 2 and 3). Days to flowering, days to maturity and plant height were correlated with grain yield at both locations, however, the magnitude of correlations of days to flowering

and maturity with grain yield varied over locations. Plant height also showed strong positive correlations with days to flowering and days to maturity at both locations.

Days to flowering showed a strong positive correlation with days to maturity at both the locations, suggesting that days to flowering may be considered an index for

maturity classification in pigeonpea. This may particularly apply to situations where insect pests may cause complete loss of the first flush of flowers, leading to generation of a second flush of flowers that often masks days to maturity. Days to flowering showed a positive association with plant height and grain yield in both years at Patancheru (Table 2). At Modipuram, however, days to flowering was found to be associated with grain yield only at the genotypic level (Table 3). The nonsignificant correlation at the phenotypic level probably resulted from environmental factors that suppressed this association. When lines

Table 2. Genotypic and phenotypic (lower values) correlation coefficients among characters of determinate short-duration pigeonpea lines at Patancheru (ICRISAT) in 1990 and 1991

Trait	Days to flower	Days to maturity	Plant height	Grain yield
Days to flower	—	0.98**	0.89**	0.83**
	—	0.96**	0.79**	0.75**
Days to maturity	0.98**	—	0.91**	0.86**
	0.93**	—	0.82**	0.75**
Plant height	0.69**	0.73**	—	0.89**
	0.64**	0.66**	—	0.78**
Grain yield	0.83**	0.81**	0.61**	—
	0.67**	0.63**	0.50**	—

**Significant at 0.01 level.

Note. Right (above diagonal) — values for 1990.
Left (below diagonal) — values for 1991.

Table 1. Mean, standard errors and range for four characters recorded on short-duration determinate pigeonpea lines grown at Patancheru (A.P.) and Modipuram (U.P.)

Location and year		Flowering days	Maturity days	Plant height (cm)	Grain yield (kg/ha) ⁻¹
		mean $\pm$ SE	mean $\pm$ SE	mean $\pm$ SE	mean $\pm$ SE
Patancheru ICRISAT 1990	mean	57 $\pm$ 1.0	103 $\pm$ 1.6	89 $\pm$ 5.2	1284 $\pm$ 169
	range	50–70	95–121	53–133	447–2637
Patancheru ICRISAT 1991	mean	58 $\pm$ 1.3	102 $\pm$ 2.9	95 $\pm$ 1.9	815 $\pm$ 182
	range	50–71	88–118	60–145	153–2838
Modipuram 1991	mean	74 $\pm$ 1.8	124 $\pm$ 2.0	134 $\pm$ 6.4	1518 $\pm$ 265
	range	61–112	105–175	105–172	477–3252

were divided into two groups based on maturity i.e. lines maturing in about (i) 125 days and (ii) lines maturing in more than 125 days, it was observed that there was no association of maturity with grain yield in the lines maturing in more than 125 days, but a weak positive correlation was observed among the lines maturing in 125 days or less. Previous reports [7–9] refer to a strong positive association of days to maturity with grain yield in early and medium indeterminate genotypes of pigeonpea. The weak correlation between days to maturity and grain yield observed in this study, especially at Modipuram, where the growing degree days (GDD) is higher resulting in relatively longer crop duration, indicates the

possibility of combining early maturity with high grain yield in determinate pigeonpea.

Plant height showed high genotypic and phenotypic correlation with grain yield at both locations in all the years. Also, plant height showed positive correlation with maturity. However plant height did not show any association with maturity in the lines maturing in more than 125 days at Modipuram (Table 4) but was highly correlated with maturity in those lines which matured within 125 days. Therefore, it appeared that plant height is more important yield component in determinate genotypes of pigeonpea maturing within 125 days. In indeterminate genotypes also plant height is reported to be associated with grain yield [7, 10, 11].

This investigation has revealed not only a high correlation of plant height, days to flowering, and days to maturity with grain yield, but also a strong association between the

Table 4. Genotypic and phenotypic (lower values) correlation coefficients among genotypes maturing within and more than 125 days at Modipuram during 1991

Trait	Days to flower	Days to maturity	Plant height	Grain yield
Days to flower		0.86**	-0.28	-0.18
		0.85**	-0.23	-0.15
Days to maturity	0.80**		0.04	0.16
	0.76**		0.06	0.13
Plant height	0.79**	0.77**		0.79**
	0.50**	0.56**		0.71**
Grain yield	0.27*	0.26*	0.51*	
	0.16	0.23	0.43**	

**Significant at 0.05 and 0.01 levels of probability, respectively.

Note. Right (above diagonal) — genotypes maturing in more than 125 days.
Left (below diagonal) — genotypes maturing within 125 days.

Table 3. Genotypic and phenotypic correlation coefficients among characters to determine short duration pigeonpea lines grown at Modipuram in 1991

Traits	Days to flower	Days to maturity	Plant height
Days to maturity	0.88**	—	—
	0.86**	—	—
Plant height	0.39**	0.59**	—
	0.35**	0.56**	—
Grain yield	0.23*	0.43**	0.77**
	0.18*	0.38**	0.68**

**Significant at 0.05 and 0.01 levels respectively.

Note. Upper values are genotypic and lower values are phenotypic correlation coefficients.

three former traits; plant height with days to maturity. Although the potential for increasing productivity through genetic manipulation of these three components is implied, the need to conform to cultural practices and cropping systems may prevent unrestricted exploitation of all of them for improved productivity. In the case of plant height, for example, because of its relationship to maturity, efforts to obtain taller plants would result in delayed maturity and therefore hinder the use of such tall plants in cropping systems requiring shorter duration. Often the preferred maturity duration for early pigeonpea is 125 days or less. Hence the plant height

achievable in that growth period would, affect productivity. On this basis, days to flowering, days to maturity and plant height probably determine the productivity in short-duration determinate pigeonpea to a large extent.

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