*Original research paper

Heritability Estimates and correlations Among Flowering and Yield Related Traits in Mungbean Genotypes

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ABSTRACT

The research work was conducted at the Farm of Plant Breeding and Genetics Department of Khyber Pakhtunkhwa, Agricultural University, Peshawar during the year of 2009. The objectives of this research were to estimate heritabilities and genotypic correlations among traits of 10 mungbean genotypes. A randomized complete block (RCB) design with four replications was used. The parameters included were days to flowers initiation, days to pods initiation, plant height, days to maturity, grain yield plant^{-1}and 100-grain weight. Highly significant ($P \leq 0.01$) differences were observed for days to flower initiation, plant height, days to maturity and 100-grain weight, while significant ($P \leq 0.05$) differences were observed for days to pods initiationand grain yield plant^{-1}. Genotype NM-93 took minimum number of days to 50% flowering (42.0 days), days to pods initiation (66.50 days) and days to maturity (78.25). Maximum grain yield was recorded for genotype Ramzan (45.35) while maximum 100-grain weight was recorded for NM-93 (5.85). High heritability was recorded for days to 50% flowering (88.75%), days to maturity (86.29%), 100-grain weight (77.17%) and plant height (67.32%). Low heritability was recorded for days to 50% pods formation (31.72%)and grain yield plant^{-1} (33.50%). The results revealed that grain yield plant^{-1} had highly significant phenotypic correlation with days to 50% pod formation (0.60) and with 100-grain weight. Grain yield plant^{-1} had significant genotypic correlation with days to pods formation (0.70). Based on present studies days to flowering, days to maturity and100-grain weight can be recommended as selection criteria and genotypes Ramzan, NM-93 and NM19-19 to be used in further mungbean breeding programmes.

INTRODUCTION

Mungbean (*Vignaradiata L.)* belongs to family leguminoseae. Mungbean is tropical or sub tropical warm season legume crop adapted to a variety of soil. Mungbean is successfully grown on sandy and loamy soils. Mungbean varieties based on their seed size can be classified into two groups. One is the bold- seeded varieties (50-70 g/1000 seed), usually called Philippino types, and is predominantly grown in Southeast Asian countries. They posses relatively higher yield potential (1-2 t/ha), large foliage and usually need 2-3 hand pickings to harvest the ripe pods due to pod shattering and lack of uniformity in maturity. These varieties usually fail in south Asian countries mainly due to their susceptibility to Mungbean Yellow Mosaic Virus (MYMV). The other is the small-seeded varieties (20-35 g/1,000 seed) mainly cultivated in south Asian countries. They have relatively low yield potential (0.5-1.0 t/ha) but are fairly adapted to the local environmental conditions. In Pakistan, it was planted on an area of 2.5 million hectares with a total annual production of 1.8 million tonnes with an average yield of 723 kg ha^{-1} (MINFAL, 2008-09). Out of the total area of Pakistan, Khyber Pakhtunkhwa covered an area of 10.1 thousand hectares with the production of 6.4 thousand tonnes producing an average yield of 634 kg ha^{-1}.

Mungbean has the potential to make up the gap of protein shortage, but its yield per acre in the country is still marginal. For any yield improvement programme selection of superior parents is an essential prerequisite i.e. possessing better heritability and genetic advance for various traits (Khan *et al*., 2005). Correlation analysis provides the information of interrelationship of important plant characters and hence, leads to a directional model for direct and/or indirect improvement in grain yield (Khan *et al*., 2004). Acharya*et al.* (1993) reported that phenotypic and genotypic coefficients of variation were high for pods per plant and yield per plant. Khan *et al.* (2004) indicated highly significant genetic differences among genotypes for days to 50% flowering, yield and yield related traits. Similarly, Celal (2004) pointed out positive and statistically significant relationships between seed yield per plant and days to flowering, pods per plant, seeds per plant, harvest index and 1000-seed weight. Imrie and Butler (2005) stated that the estimated variance due to environment exceeded than that due to genotypes for all characters.

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The Asian Vegetable Research and Development Center (AVRDC) have made tremendous contribution in improving the world mungbean production through its research and development efforts and a network of active research collaborators in the national programs. The genetic variability, correlation and heritability estimates for quantitative characters are important in selecting suitable genotypes and reliable yield components for efficient yield improvement. Thus, this study was conducted to evaluate mungbean genotypes under Peshawar conditions and estimate heritability for different important parameters and estimate genotypic correlations among various parameters of the mungbean.

MATERIALS AND METHODS

This research was conducted at the experimental Farm of Plant Breeding and Genetics Department of KPK Agricultural University, Peshawar, during the year of 2009. The objectives of this research were to estimate heritibilities and genotypic correlations among traits of 10 mungbean genotypes, viz., Chakwal, NM19-19, NM-28, NM-51, NM-98, 6601, Ramzan, Pak-22, AEM-96 and NM-93. These genotypes were procured from Nuclear Institute for Food and Agriculture (NIFA). The randomized complete block design (RCBD) was used with four replications. Each entry consisted of four row plot with a row length of 5m and a plant to plant distance of 0.3m. The recommended cultural practices were carried out throughout the experiment. Data were recorded on days to 50% flowering, number of branches, days to 50% pods formation, plant height (cm), days to maturity, numbers of pods plant^{-1}, pod length (cm), numbers of grains pod^{-1}, number of grains plant^{-1}, 100-grain weight (g), grain yield plant^{-1} (g)

Grain yield plant^{-1} was recorded by threshing all pods from the selected plants and weighing them on single plant basis by electronic balance.

Heritability in broad sense was estimated for the parameters according to Singh and Chaudhry (1979).

$$h^2 = \frac{S^2 v}{S^2 e + S^2 v}$$

Where h^2 = Broad sense heritability

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$$S^2v = \frac{\text{Varietal variance - error variance}}{\text{Number of replications}}$$

$$\text{Broad sense heritability} = \frac{\text{Genotypic variance}}{\text{Phenotypic variance}}$$

Phenotypic and Genotypic correlation coefficients were computed by the following formula suggested by Burton and Vane (1953).

1. Phenotypic correlation

$$\frac{(\delta gxy + \delta exy)}{[(\delta^2 gx + \delta^2 ex)(\delta^2 gy + \delta^2 ey)]^{1/2}}$$

2. Genotypic correlation

$$\frac{(\delta gxy)}{[(\delta^2 gx)(\delta^2 gy)]^{1/2}}$$

Where σ^2 gx = Variety component of variance for trait x.

σ^2gy = Variety component of variance for trait y.

σ^2ex = Error component of variance associated with trait x.

σ^2ey = Error component of variance associated with trait y.

σxy = Variety component of variance for trait x and y.

σexy = Error component of covariance associated with trait x and y.

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RESULTS AND DISCUSSION

This research was conducted on ten mungbean genotypes to find out genotypic correlations and heritability estimates for various characters. Mean squares are presented in Table 1, while mean values for different characters are presented in Table 2. Heritability values are presented in Table 3, whereas, genotypic and phenotypic correlations are presented in Table 4 and 5, respectively. The results are discussed as under:

Days to 50% flowering

Analysis of variance indicated highly significant differences ($P < 0.01$) among the genotypes for days to flowering (Table 1). The differences among the genotypes for days to 50% flowering were highly significant. These results are confirmed by the study of Siddique (2006) who reported significant differences among genotypes for this character. Days to flowering ranged from 42.0 to 67.25 days (Table 2). Genotype NM-93 took minimum number of days (42.0 days) to flowering followed by NM19-19 (43.0). The maximum number of days (67.25) to flowering were taken by genotype 6601. Broad sense heritability recorded for days to flowering was 88.75% (Table 3), which shows greater proportion of genetic variance to phenotypic variance and is expected to remain stable under varied environmental conditions, as environment is less influential on highly heritable traits and could easily be improved by applying selection pressure. High heritability value (88.75%) was recorded for days to 50% flowering. Similarly, high heritability for days to flowering has also been reported by Anwari and Soehendi (1999) and Vyas and Chauhan (1994).

The coefficient of genotypic correlation (Table 4) revealed that days to flowering was highly significant and positively correlated with plant height (0.80) and days to maturity (0.97). The association with grains per pod and grains per plant was positive and non-significant. While with the rest of the traits days to flowering had negative and non-significant correlations. At phenotypic level (Table 5) the correlation of days to flowering was highly significant with plant height and days to maturity. It had highly significant and negative correlation with 100-grain weight (-0.46). Highly significant genotypic correlation of days to flowering with plant height and days to maturity was found. Our results are also in agreement with the findings of Arshad*et al.* (2009), Anwari and Sochendi (1999) who reported highly significant genotypic correlation of days to flowering with plant height and days to maturity. However, association of days to 50%

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flowering with pod plant^{-1} and grain yield plan^{-1} was negative and non-significant which is supported by Yaqoob*et al.* (1997) who found that days to flowering have negative and non-significant correlation with pod plant^{-1} and grain yield plant^{-1}.

Days to 50% pods formation

Genotypes showed significant differences (P<0.05) for days to pods formation (Table 1). Days to pods formation ranged from 66.50 to 112.50 days (Table 2a). NM-93 took minimum number of days (66.50) to pods formation followed by genotype 6601 (76.75 days) and Pak-22 (77.5 days). The maximum number of days to pods formation were recorded for genotype Ramzan (112.5 days) (Table 2). Low broad sense heritability (31.72%) was found for days to pods formation (Table 3). Similar results were reported by Empig*et al.* (1970) who recorded significant differences and low heritability for days to flowering.

The coefficient of genotypic correlations (Table 4) for days to pods formation was highly significant and positive correlation with pods plant $^{-1}$(0.9) and grains plant^{-1} (0.81). The correlation with grain yield plant^{-1} (0.7) was positive and significant. While it had non-significant and negative correlation with days to flowering, plant height, days to maturity and 100-grain weight. Phenotypic correlations (Table 5) of days to pods formation were positive and highly significant with pods plant^{-1}, grain yield plant^{-1}. While with the rest of the traits it was non-significant. Significant genotypic correlation of days to 50% pods formation with grain yield plant^{-1} was observed. Our study is in line with the findings of Malik*et al*. (1987) who stated that number of days to pods formation have positive significant correlation with grain yield.

Plant height

Analysis of variance showed highly significant differences (P<0.01) among the mungbean genotype for plant height (Table I). Plant height ranged from 55.50 to 73.50 (Table 2a). Minimum plant height was observed for genotypes Pak-22 and Ramzan (55.5 cm). The results of Rahman and Hussain (2003) and Siddique (2006) are also in favor of our results who reported highly significant differences among genotypes for plant height. Moderate heritability (67.32%) was recorded for plant height (Table 3). High heritability value (67.32%) was observed for plant height. Our findings are in agreement with Vyas and Chauhan (1994), Yimram*et*

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al.(2009), Ali and Sheikh (1983) and Dikshit*et al.* (2002) who also recorded high heritability for plant height.

Plant height showed significantly high genotypic correlation with days to flowering (0.80) and days to maturity (0.76), while with the rest of the traits its correlation was non-significant (Table 4).Phenotypic correlations of plant height were positive and significant with branches plant^{-1}, days to flowering and days to maturity and non-significant with rest of the traits (Table 5). These results are confirmed by the study of Arshad*et al*. (2009), Kumar *et al.* (2004) and Anwari and Soehendi (1999) who observed positive significant correlation of plant height with days to flowering and days to maturity.. Non-significant and negative association of plant height with grain yield plant^{-1}, 100-grain weight and grains plant^{-1} was observed. Which is supported by the study of Yaqoob*et al.* (1997) and Pun and Villareal (1989) who reported non-significant and negative correlation of plant height with grain yield plant^{-1} 100-grain weight and grains plant^{-1}.

Days to maturity

The differences among the genotypes were highly significant for days to maturity. Which is similar with the findings of Mensah and Oludoya (2007) and Siddique (2006) they also found significant differences among the genotypes for this character. Days to maturity ranged from 78.25 to 105 days (Table 2a). Minimum days to maturity were recorded for genotype NM19-19 (78.50) followed by NM-93 (78.25), while genotype 6601 took maximum days to maturity (105.5 days) (Table 2). High broad sense heritability (86.29%) was observed for days to maturity (Table 3). Similarly, Yimram (2009), Varma and Garg (2001) and Empig*et al*. (1970) have also reported high heritability for days to maturity.

The genotypic correlation coefficient (Table 4) revealed that days to maturity had highly significant and positive correlation with days to flowering (0.97) and with plant height (0.76) and non significant correlations with rest of the traits. Phenotypic correlation of days to maturity was positive and highly significant with days to flowering (0.92) and plant height (0.57), while, highly significant but negative correlation with 100-grain weight (Table 5). Correlation of days to maturity with days to flowering and plant height was found significant and positive. These results are in agreement with the study of Yaqoob*et al*. (1997) and Arshad*et al.*(2009) who recorded positive and significant correlation of days to maturity with days to flowering and plant

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height. Significant negative association of days to maturity with 100-grain weight and pod length, which is supported by the study of Rahman and Hussain (2003) who reported significant negative correlation of days to maturity with 100-grain weight and pod length.

Grain yield plant $^{-1}$

Significant differences (P<0.05) were observed in genotypes for grain yield plant^{-1} (Table 1). Similarly, Siddique (2005), Aslam and Ajmal (2002) and Rahman and Hussain (2003) have also reported significant differences for grain yield plant^{-1}. Grain yield plant^{-1} ranged from 21.87 to 45.35 (Table 2b). Genotype Ramzan showed maximum grain yield plant^{-1} (45.35) followed by genotype NM-51 (35.40), while genotype NM19-19 had minimum grain yield plant^{-1} (Table 2b). Low heritability (33.52%) was recorded for grain yield plant^{-1} (Table 3). Low heritability (33.52) was recorded for grain yield palnt^{-1}. These results are in line with the study of Empig*et al.* (1970) and Anwari and Soehendi (1999) who also reported low heritability for grain yield palnt^{-1}. Grain yield plant^{-1} had positive and significant genotypic correlation with pods plant^{-1} and days to pod formation while non-significant correlations with all other traits (Table 4).Grain yield plant^{-1} showed highly significant phenotypic correlation with pods plant^{-1}, grains plant^{-1} and days to pods formation and significant correlation with 100- grain weight (Table 5). Our results are supported by Dikshit*et al*. (200), Kumar *et al*. (2004) and Malik *et al*. (1987) who also reported positive and significant correlation of grains yield plant^{-1} with pods plant^{-1} and days to pods formation. Grain yield had significantly positive correlation with 100-grain weight. Our results are in agreement with Rahman and Hussain (2003) and Khattak*et al.* (1999) who also reported significant positive correlation of grain yield with 100-grain weight.

100-grain weight (g)

Highly significant differences were observed for 100-grain weight among the genotypes. These results are supported by the findings of Mensah and Oludoya (2007), Dhuppe*et al*. (2005) and Khattak*et al*. (1999) who observed highly significant differences for 100-grain weight. The range of 100-grain weight was 3.22 g to 5.85 g (Table 2b). The maximum 100-grain weight (5.85g) was observed for NM-93 followed by Ramzan (5.07), while minimum 100-grain weight was observed for NM-28 (3.22g) (Table 2b). High heritability (77.17%.) was recorded for 100-grain weight. Heritability estimates for 100-grain weight is high. Higher heritability was also reported

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by Empig*et al*. (1970), Varma and Garg (2001) and Yimram*et al.* (2009) for 100-grain weight. 100-grain weight showed significant and positive genotypic correlation with pod length (0.66) and significant and negative correlation with branches plant^{-1} (-0.62) (Table 4). Phenotypic correlation of 100-grain weight was positive and highly significant with grain yield plant^{-1} (0.45) and positive and significant with pods length (0.39). While highly significant but negative correlation was observed with days to flowering, plant height, branches plant^{-1} and days to maturity (Table 5). Significant positive correlation of 100-grain weight with pod length were found. Our findings are supported by the study of Arshad*et al.* (2009) who stated significant positive correlation of 100-grain weight with pod length. Significant positive association of 100-grain weight with grain yield plant^{-1}.Our results are in line with the findings of Khattak and Haq (1999) and Pun and Villareal (1989) who reported significant positive correlation of 100-grain weight with grain yield plant^{-1}. Highly significant and negative correlation of 100-grain weight with days to flowering and days to maturity were observed. Rahman and Hussain (2003), Siddique*et al*. (2002) and Chaudhary and Rahman (1988) also reported significant negative correlation of 100-grain weight with days to flowering and days to maturity.

Table 1. Replication mean squares (RMS), Genotypic mean squares (GMS), coefficient of variation and heritability values for days to flowering, days to pod formation, plant height, days to maturity, grain yield plant^{-1} and 100-grain weight of 10 mungbeangenotypes.

Trait	RMS	GMS	CV	% h^2
Days to flowering	25.36	304.28**	5.49	88.75
Days to pod formation	64.63	1201.26*	22.03	31.72
Plant height	162.50**	208.93**	7.31	67.32
Days to maturity	14.46	357.50**	4.04	86.29
Grain yield plant^{-1}	172.18	188.71*	26.89	33.52
100 grain weight	0.35	3.05**	11.22	77.17

*, ** Significantly different from zero at 5% and 1% levels of probability, respectively.

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Table 2. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficientsamong days to flowering (DF), plant height (PH), days to maturity (DM), grain yield plant^{-1} (GYP), 100- grains weight (HGW), days to pods formation (DPF) of 10 mungbean genotypes.

	DF	PH	DM	GYP	HGW	DPF
DF	-	0.80**	0.97**	-0.15	-0.58	-0.02
PH	0.57**	-	0.76*	-0.31	-0.47	-0.07
DM	0.92**	0.57**	-	-0.19	-0.61	-0.04
GYP	-0.02	-0.25	-0.02	-	0.55	0.70*
HGW	-0.46**	-0.40**	-0.46**	0.45**	-	-0.05
DPF	-0.02	0.67	0.03	0.60**	-0.04	-

* ** Significantly different from zero at 5% and 1% levels of probability, respectively

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