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Association Studies of Yield Contributing and Physiological Traits on Yield in Mungbean (*Vigna radiata* (L.) Wilczeck) under Summer Condition

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Abstract

Correlation analysis was carried out with thirty one genotypes of mungbean for different yield and physiological contributing traits. Correlation was worked out among traits days to 50% flowering , days to maturity, plant height, number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, 100 seed weight, harvest index, SPAD chlorophyll meter reading (SCMR), Relative Water Injury (RWC), Relative Injury % (RI), Chlorophyll content, Specific Leaf Area (SLA) and seed yield plant^{-1}. Correlation provides information on magnitude of the association of different components characters with seed yield which is regarded as highly complex trait in which the breeder is ultimately interested in. In this study, phenotypic coefficient of variation was slightly higher in magnitude than the genotypic coefficient of variation. Highly significant positive correlation of seed yield was observed with harvest index followed by SCMR, 100 seed weight, RWC, number of clusters plant^{-1} and number of pods plant^{-1} at both phenotypic and genotypic levels showing that increase in these traits would result in increase in the seed yield directly and in contrast plant height, number of pods cluster^{-1}, chlorophyll content and specific leaf area displayed significant negative association with grain yield and these characters indirectly helps in improving seed yield . Hence selection based on these positively significant characters would be highly useful for the selection of high yield mungbean genotypes under summer conditions.

Keywords: Correlation, mungbean, physiological traits

1. Introduction

Mungbean is one of the most important legumes in many Asian countries such as India and China. It occupies the second position after chickpea among legume crops. Mungbean is the cheap source of proteins (24%) and carbohydrates (38–50%) for human consumption. Production of mungbean is influenced by genetic and environmental factors. The yield can be increased by improving the genetic makeup and incorporating the resistance against the environmental stresses.

The entire success of plant breeding programme of any crop largely depends on the wide range of variability present in that crop. It is the range of genetic variability in respect of important economic characters present in the population upon which it is based on the effectiveness of selection. Environment has a profound influence upon the economically important characters, which are quantitatively inherited. Hence, it is difficult to decide upon whether the observed variability is heritable or due to environment and it is, therefore, necessary to partition the same into its heritable and non-heritable components (Patel et al., 2014). Selection procedure is more difficult in a trait, where heritability is low or is not precisely measurable. Indirect selection in such a situation is more effective and study of correlation among different economic traits are, therefore, essential for an effective selection programme because selection for one or more trait results in correlated response for several other traits (Searle, 1965) and sequence of variation will also be influenced (Waddington and Robertson, 1966). Hence, the knowledge of genotypic and phenotypic correlation between yield and its contributing characters is very essential. Canci and Toker (2014) reported that biological and straw yield showed positive significant correlation with seed yield plant^{-1}. Kumar et al. (2013) mentioned that secondary branches plant^{-1}, bunches plant^{-1}, pods plant^{-1}, grains pod^{-1}, pod length and 100 seed weight showed positive significant correlation with seed yield plant^{-1}. Srivastava and Singh (2012) reported that pods plant^{-1}, 100 seed weight, days to first picking maturity, primary branches plant^{-1} and pods cluster^{-1} showed positive significant correlation with seed yield plant^{-1}. Zaid et al. (2012) in their studies mentioned that plant height and seeds pod^{-1} showed positive significant correlation with seed yield plant^{-1}. Kumar et al. (2010) reported that harvest index and pods plant^{-1} showed

positive significant correlation with seed yield plant^{-1}. Gul et al. (2008) suggested in their results that harvest index, yield ha^{-1} and pods plant^{-1} showed positive significant correlation with seed yield plant^{-1}. Makeen et al. (2007) observed in their findings that plant height and pods plant^{-1} showed positive significant correlation with seed yield plant^{-1}. Sirohi and Kumar (2006) mentioned that clusters plant^{-1} and productive pods plant^{-1} showed positive significant correlation with seed yield plant^{-1}. Rohman et al. (2003) reported that seeds pod^{-1}, 100 grain weight and pods plant^{-1} showed positive significant correlation with seed yield plant^{-1}. Keeping these in view, the study was conducted to assess the inter relationship among various yield and physiological traits. So, that appropriate weightage could be given to each character at the time of selection for improving yield and drought tolerance.

2. Materials and Methods

The present field investigation was conducted during summer 2013–14 using 31 mungbean genotypes obtained from RARS, Lam, Guntur and ARS, Madhira, Telangana State, India. The experiment was aimed at association studies of yield contributing and physiological traits on yield in RBD with three replications at wet land farm, Sri Venkateswara Agricultural College, Tirupati, Andhra Pradesh, India. Each genotype was sown in three rows of 4 m length with a spacing of 30 cm between rows and 10 cm between plants within rows. Observations were recorded on five randomly selected plants replication^{-1} for traits namely plant height, number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, 100 seed weight, harvest index, SPAD chlorophyll meter reading (SCMR), Relative Water Injury (RWC), Relative Injury % (RI), Chlorophyll content and Specific Leaf Area (SLA), whereas, traits days to 50% flowering and days to maturity observations were recorded on plot basis. The mean values for each trait over the replications were subjected to the analysis of variance. Genotypic and phenotypic correlation coefficients were calculated by using the method given by Johnson et al. (1955). The significance of correlation coefficients was tested by comparing the genotypic and phenotypic correlation coefficients with table value [Fishers and Yates (1967)] at (n-2) degrees of freedom at 5% and 1% levels, where, 'n' denotes the number of treatments used in the calculation.

3. Results and Discussion

The analysis of variance indicated significant differences among the genotypes for all the characters. The phenotypic and genotypic correlations amongst the characters showed almost similar trend of association between the character pairs, the later values being little higher in most cases, indicating the prepondance of genetic variance in the expression of different characters (Table 1). It might be due to masking or modifying effect of environment on character association at the genetic level. This is in confirmation with the findings Pandey et al. (2007) and Khajudparn and Tantasawat (2011).

3.1. Correlation with seed yield

In the present study, seed yield plant^{-1} showed highly significant and positive correlation with harvest index followed by SCMR, 100 seed weight, RWC, number of clusters plant^{-1} and number of pods plant^{-1} at both phenotypic and genotypic levels showing that increase in these traits would result in increase in the seed yield. Similar results were also obtained by Begum et al. (2013); Srivastava and Singh (2012) for 100-seed weight and number of pods plant^{-1}.

In contrast, seed yield plant^{-1} showed negative significant correlation with number of pods cluster^{-1}, chlorophyll content, plant height and specific leaf area. These results were also in agreement with the findings of Haritha and Reddi Sekhar (2002) for plant height. The genetic reason for this type of negative association may be due to linkage or pleitropy. According to Eberhart and Newall (1959), when two characters show negative phenotypic and genotypic correlation, it would be difficult to exercise simultaneous selection for these characters in the development of a variety. Hence, under such situations, judicious selection programme might be formulated for simultaneous improvement of such important developmental and component characters.

The trait seed yield plant^{-1} showed non-significant positive association with days to maturity. On contrary, seed yield plant^{-1} exhibited non-significant negative correlation with days to 50% flowering, number of seeds pod^{-1} and relative injury. Similar results were also obtained by Begum et al. (2013); Khajudparn and Tantasawat (2011) for days to 50% flowering.

3.2. Inter-correlation among traits

When the characters having direct bearing on yield are related, their associations with other characters are also taken into account simultaneously as they will have considerable affect on seed yield. Hence, the inter-association among all component traits was studied.

The trait days to 50% flowering registered highly significant positive association with days to maturity, plant height, number of seeds pod^{-1}, specific leaf area and chlorophyll content. Days to maturity had significant and positive association with plant height, specific leaf area, number of seeds pod^{-1} and relative injury. The trait plant height recorded significant and positive association with specific leaf area and relative injury. Number of clusters plant^{-1} recorded positive and significant association with relative injury and number of pods plant^{-1}. Number of pods cluster^{-1} registered positive significant association with number of seeds pod^{-1}. Number of pods plant^{-1} recorded significant positive association with harvest index. Number of seeds pod^{-1} registered significant positive correlation with RWC and chlorophyll content. 100 seed weight was positively and significantly associated with SCMR and harvest index. The trait harvest index had positive and significant association with SCMR. Relative injury recorded positive and significant association with specific leaf area. Chlorophyll content was found to be associated positively and significantly with specific leaf area. For efficient breeding program, identification of superior genotypes with high yield

Table 1: Phenotypic (rp) and genotypic (rg) correlation coefficients among fifteen characters in thirty one genotypes of mungbean under summer condition

Character		DM	PH (cm)	NCP	NPC	NPP	NSP	SW (g)	HI (%)	SCMR	RWC (%)	RI (%)	CC	SLA	SYP (g)
DF	rp	0.8565**	0.5722**	-0.2373*	-0.0272	-0.0719	0.3076**	-0.0752	-0.0082	-0.4667**	-0.0553	0.1434	0.1957*	0.2509*	-0.0494
	rg	0.9072	0.6145	-0.2610	-0.0326	-0.0765	0.3320	-0.0811	0.0201	-0.5066	-0.1128	0.1578	0.2131	0.2822	-0.0610
DM	rp		0.5452**	-0.2515*	-0.0442	-0.0056	0.2203*	-0.0211	0.1140	-0.3685**	-0.1101	0.1937*	0.1284	0.3492**	0.0743
	rg		0.5572	-0.2639	-0.0451	-0.0038	0.2187	-0.0207	0.1183	-0.3786	-0.1387	0.2007	0.1306	0.3669	0.0727
PH	rp			-0.1313	0.1117	0.1425	0.1084	-0.2161*	0.1035	-0.3320**	-0.1923*	0.2192*	0.1244	0.4323**	-0.2771**
	rg			-0.1403	0.1116	0.1440	0.1082	-0.2178	0.1059	-0.3357	-0.2145	0.2209	-0.1260	0.4362	-0.2829
NCP	rp				-0.3908**	0.2512*	-0.4509**	0.0397	0.1057	-0.0288	-0.3178**	0.3202**	-0.1611	0.0267	0.2651**
	rg				-0.4073	0.2614	-0.4731	0.0378	0.1071	-0.0251	-0.3412	0.3318	-0.1731	0.0262	0.2672
NPC	rp					-0.2933**	0.4197**	0.0466	-0.0573	-0.0170	0.1567	-0.0909	0.1106	-0.1317	-0.4070**
	rg					-0.2946	0.4217	0.0463	-0.0568	-0.0170	0.1832	-0.0916	0.1111	-0.1330	-0.4113
NPP	rp						-0.3157**	0.0143	0.3038**	0.0048	-0.2418*	0.0714	-0.1712	0.0835	0.2145*
	rg						-0.3179	0.0150	0.3079	0.0048	-0.2869	0.0721	-0.1740	0.0822	0.2154
NSP	rp							0.0978	0.0305	0.0204	0.3888**	-0.2451*	0.2754**	-0.0285	-0.0308
	rg							0.0984	0.0319	0.0206	0.4577	-0.2454	0.2787	-0.0266	-0.0319
SW	rp								0.3228**	0.5297**	-0.2258*	-0.0597	-0.0053	-0.2394*	0.2751**
	rg								0.3234	0.5346	-0.2546	-0.0591	-0.0055	-0.2430	0.2767
HI	rp									0.3001**	0.0212	-0.0702	-0.1257	0.0095	0.6057**
	rg									0.3057	0.0399	-0.0710	-0.1256	0.0077	0.6143
SCMR	rp										0.0474	0.0664	0.0353	-0.1976*	0.3469**
	rg										0.0534	0.0670	0.0346	-0.1980	0.3534
RWC	rp											-0.2627**	-0.0731	-0.0463	0.2700**
	rg											-0.2988	-0.0861	-0.0395	0.3119
RI	rp												0.1482	0.2744**	-0.0138
	rg												0.1494	0.2777	-0.0123
CC	rp													0.3034**	-0.3068**
	rg													0.3084	-0.3153
SLA	rp														-0.2667**
	rg														-0.2714

DF: Days to 50% Flowering; DM: Days to maturity; PH: Plant height (cm); NCP: No. of clusters plant^{-1}; NPC: No. of pods cluster^{-1}; NPP: No. of Pods Plant^{-1}; NSP: No. of seeds pod^{-1}; SW: 100 seed weight (g); HI: Harvest index (%); RWC: Relative water content (%); RI: Relative injury (%); CC: Chlorophyll content; SLA: Specific leaf area (cm^2 g^{-1}); SYP: Seed yield plant^{-1} (g); *: p<0.05; **: p<0.01

and information about the components traits association with yield and also with each other is essential. Therefore, inter relationship of these characters could also be considered during selection process to bring about improvement for highest yield under summer condition.

The above results obtained from character association analysis implied that the characters number of clusters plant^{-1}, number of pods plant^{-1}, 100 seed weight, harvest index, SCMR and RWC exhibited significant positive association with seed yield plant^{-1}, indicating that increase in these traits would result in direct increase in the seed yield. Hence, these traits are directly used in selection programme for crop improvement. In contrast, plant height, number of pods cluster^{-1}, chlorophyll content and specific leaf area displayed significant negative association with grain yield. Hence, judicious selection programme might be formulated by repeated inter-mating to break the negative correlation between number of pods cluster^{-1} and seed yield plant^{-1} for simultaneous improvement of these characters.

For the development of efficient breeding strategy for evolving superior genotypes, identification of important yield components and information about the association with yield and also with each other is essential. Inter- relationship between yield characters revealed that days to 50% flowering was positively and significantly correlated with days to maturity, plant height, number of seeds pod^{-1}, chlorophyll content and SLA; days to maturity with plant height, number of seeds pod^{-1}, relative injury and specific leaf area; plant height with relative injury and SLA, suggesting the inter-dependency of these characters. In addition, clusters plant^{-1} showed positive significant association with number of pods plant^{-1} and relative injury; number of pods cluster^{-1} with number of seeds pod^{-1}; number of pods plant^{-1} with harvest index; number of seeds pod^{-1} with RWC and chlorophyll content; 100 seed weight with harvest index and SCMR; harvest index with SCMR; relative injury with SLA and chlorophyll content with SLA. Therefore, these characters can also be considered during selection process to bring about improvement for highest yield with drought tolerance.

4. Conclusion

The traits harvest index, SCMR, 100 seed weight, RWC, number of clusters plant^{-1} and number of pods plant^{-1} were reported positive significant correlation with yield and these are major components which influences yield, hence should be given top priority while formulating a selection criteria for improvement of yield in mungbean under summer condition.

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