Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2826

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (2):** 836-841 (2017)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Path Analysis of Morphological and Drought Related Traits under Water Stress Condition in Mungbean

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Received: 10.04.2017 | Revised: 22.04.2017 | Accepted: 23.04.2017

ABSTRACT

In this present study, path analysis was carried out to decide direct and indirect effects of morphological and drought related traits to seed yield in mungbean. Thirty one mungbean accessions were evaluated for fifteen characters under water stress condition in RBD design with three replications. Path analysis towards seed yield plant^{-1} revealed the importance of harvest index % (0.5807) followed by plant height, number of clusters plant^{-1} and number of pods plant^{-1}. So, in water stress harvest index plays a major role in effecting the seed yield plant^{-1}. These characters (Harvest index %, plant height, number of clusters plant^{-1} and number of pods plant^{-1}) showed high possibility of gain from indirect selection, with greater possibility of success when joining multiple traits and a genotype of better performance.

Key words: *Mungbean, Path analysis, Morphological traits, Drought related traits, Water stress condition*

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 protein (24%) and carbohydrate (38-50%) for human consumption. Among other pulses it is chosen first because it is easily digestible. It is sown in variety of environments because of its drought tolerance ability, so it can be sown in arid as well as in irrigated areas. 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.

One breeding target of mungbean is to obtain genotypes that produce higher amounts of yield with abiotic stress tolerance. However, yield is a complex trait resulting from the expression and association of different components[2]. Thus, knowledge of the degree of this association through correlation studies can identify traits that could be used as indirect selection criteria for yield or as secondary traits, improving the efficiency of the selection process.

Cite this article: Rekha, K.S. and Reddy, D.M., Path Analysis of Morphological and Drought Related Traits under Water Stress Condition in Mungbean, *Int. J. Pure App. Biosci.* **5(2):** 836-841 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2826

For a better understanding of the factors involved in the associations of traits, Wright[17] proposed a method of partitioning correlations, estimating the direct and indirect effects of variables on a main variable, which is called path analysis. The direct influence of one variable on another is measured independently of the others[1,5,6,]. Path analysis can therefore be made from genetic or environmental correlations[3]. This study evaluated the relationship between morphological characteristics and drought and yield related traits identified their direct and indirect effects by path analysis, with a view to contribute to the selection process.

MATERIALS AND METHODS

The experimental material for the present investigation consisted of thirty one mungbean genotypes obtained from Regional Agricultural Research Station, Lam, Guntur and Agricultural Research Station, Madira. The experiment was conducted in randomized block design (RBD) with three replications during summer, 2013-14 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. In the present study, moisture stress was induced during pod filling stage by withholding irrigation for fifteen days. Observations were recorded on five randomly selected plants per replication 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 percentage (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. The hypothesis considered for path analysis was: seed yield plant^{-1} as dependent variable and the others are explanatory variables. Path coefficient analysis was done suggested by Dewey and Lu[4] to partition the genotypic correlation into direct and indirect effects.

RESULTS AND DISCUSSION

Analysis of variance showed the existence of genetic variability among the genotypes evaluated since the effect of genotypes was significant for all the character evaluated. In a breeding program, quantification of genetic variability of a population is a determining factor since it reveals the genetic structure of the populations[14].

Path analysis partitions the total correlation coefficient into direct and indirect effects and measures the relative importance of the casual factor individually. In the present study, seed yield plant^{-1} was considered as dependent character and other fourteen characters plant height, days to 50% flowering, days to maturity, 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) were taken as independent characters.

Correlation coefficients, though gives information regarding the association of different component traits, it does not project the complete picture especially when the casual factors were inter-related. Therefore, the correlation coefficients which are found significant between yield and its each component characters were partitioned into corresponding direct and indirect effects through path coefficient analysis and were presented in the Table 1.

Direct effects of Yield Components on Seed Yield

Path coefficient among seed yield and its components revealed that harvest index (P=0.5801) exhibited the highest positive effect on seed yield plant^{-1} followed by number of clusters plant^{-1} (P=0.4341), plant height (P=0.4065), number of pods plant^{-1} (P=0.4011) and number of seeds pod^{-1} (P=0.3017). While, Relative Injury% (P=0.2682) showed moderate direct effect on seed yield. Although, chlorophyll content (P=0.1813) had showed positive effect on seed yield but it was low. Negligible direct effect on seed yield was shown by SCMR (P=0.045), Specific Leaf Area (P=0.036) and 100 seed weight (P=0.005).

Indirect Effects of Yield Components on Grain Yield

The indirect effect of yield components on grain was separated into high, moderate, low and negligible based on values given by Lenka and Mishra[9].

Days to 50% flowering: This trait showed positive low indirect effect on seed yield plant^{-1}through number of clusters plant^{-1} and Relative Water Content and negligible indirect effect through number of pods cluster^{-1}, Relative Injury %, Chlorophyll Content and Specific Leaf Area.

Days to maturity: This trait showed positive low indirect effect seed yield plant^{-1} through plant height, Harvest index and Relative Injury% and negligible indirect effect through number of clusters plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1} and Relative Water Content.

Plant height: This trait showed positive low indirect effect on seed yield plant^{-1} through number of clusters plant^{-1} and Relative Injury% and negligible positive indirect effect through number of pods cluster^{-1}, Harvest Index% and Chlorophyll Content.

Number of clusters plant^{-1}: Clusters plant^{-1} contributed low positive indirect effect on seed yield **-** plant through plant height and number of pods plant^{-1} and negligible positive indirect effect through 100 seed weight, Relative Injury% and Chlorophyll Content.

Number of pods cluster^{-1}: Number of pods cluster^{-1} exerted low positive indirect effect on seed yield plant^{-1} through number of clusters plant^{-1} and Harvest index and negligible positive indirect effect through days to 50% flowering, number of pods plant^{-1}, SCMR and Specific Leaf Area.

Number of pods plant^{-1}: Number of pods plant^{-1} contributed low positive indirect effect on seed yield through number of clusters plant^{-1} and Harvest index and negligible positive indirect effect through days to 50% flowering and 100 seed weight

Number of seeds pod^{-1}: Number of seeds pod^{-1} exerted positive negligible indirect effect on seed yield through days to 50% flowering, number of pods cluster^{-1}, 100 seed weight, harvest index, SCMR, Relative Water Content, Relative Injury%, Chlorophyll Content and Specific Leaf Area

100 seed weight: 100 seed weight contributed negligible positive indirect effect on seed yield plant^{-1} through days to 50% flowering, number of clusters plant^{-1}, number of pods cluster^{-1}, number of seeds pod^{-1}, SCMR and Specific Leaf Area.

Harvest index: Harvest index recorded positive low indirect effect on seed yield through number of pods plant^{-1} and positive negligible indirect effect days to 50%

flowering, plant height, number of seeds pod^{-1}, SCMR, Relative Injury%, Chlorophyll content and Specific Leaf Area.

SPAD Chlorophyll Meter Reading (SCMR): SPAD Chlorophyll Meter Reading contributed negligible positive indirect effect on seed yield through days to 50% flowering, days to maturity, number of seeds pod^{-1}, 100 seed weight, Harvest index and Specific Leaf Area.

Relative water content (%): Relative water content (%) contributed moderate positive indirect effect on seed yield through Harvest index and low positive indirect effect on seed yield through number of clusters plant^{-1} and number of pods plant^{-1} and negligible positive indirect effect through days to 50% flowering, plant height, days to maturity, 100 seed weight, SCMR and Chlorophyll Content.

Chlorophyll Content: Chlorophyll content contributed low positive indirect effect on seed yield through plant height and negligible positive indirect effect through days to maturity, number of clusters plant^{-1}, number of pods cluster^{-1}, number of seeds pod^{-1}, Harvest index, Relative injury% and Specific Leaf Area.

Relative Injury%: Relative injury% contributed low positive indirect effect on seed yield through plant height and negligible positive indirect effect through number of clusters plant^{-1}, number of pods cluster^{-1}, number of seeds pod^{-1}, Harvest index, Relative Water Content, Chlorophyll Content.

Specific Leaf Area: Specific leaf area exerted negligible positive indirect effect through days to maturity, number of seeds pod^{-1}, 100 seed weight, Harvest index, SCMR, Relative Water Content and Chlorophyll content.

The component of residual effect of path analysis under water stress condition was 0.5315. The higher the residual effect indicated the inadequacy of the trait chosen for the path analysis.

By and large, the path analysis studies based on path coefficient revealed that, the characters harvest index showed positive direct effect on seed yield plant^{-1} due to its direct contribution which was highest in magnitude, there by indicating a true correlation and could be taken as components for the improvement of yield. Traits *viz.*, number of clusters plant^{-1} (P=0.4341), plant height (P=0.4065), number of pods plant^{-1} (P=0.4011) and number of seeds pod^{-1} (P=0.3017) also contributed high to seed yield. Hence selection based on these traits also helps in increasing the seed yield. Negligible direct effect on seed yield was shown by SCMR (P=0.045), Specific Leaf Area (P=0.036) and 100 seed weight (P=0.005). Hence direct selection of these traits does not have any improvement in yield. Similar findings were also reported by Pandey *et al.*[12] and Haritha and Reddy Sekhar[7] for harvest index; Khan[8] for number of clusters plant^{-1}; Mallikarjuna Rao *et al.*[11] for number of pod plant^{-1} and harvest index; Vinay *et al.*[15] for number of seeds pod^{-1} and harvest index; Lukman Hakim[10] for number of pods cluster^{-1}; Wani *et al.*[16] for number of pod plant[1] and Saifullah *et al.*[13] for harvest index.

Path analysis studies of the present investigation revealed that harvest index, number of clusters plant^{-1}, number of pods plant^{-1} and number seeds pod^{-1} were important yield components having direct bearing on the improvement of seed yield. Hence, selection of genotypes based on these characters as selection criterion would be helpful in improving seed yield and drought potential of genotypes. Indirect selection also could be considered for characters which are showing high to moderate positive indirect effect on seed yield plant^{-1}.

Table 1: Path coefficients among grain yield plant^{-1} and other yield components in mungbean

	Days to 50% flowering	Plant height (cm)	Days to maturity	No. of clusters plant^{-1}	No. of pods cluster^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Harvest index (%)	SCMR	Relative water content (%)	Relative injury (%)	Chlorophyll content	Specific leaf area (cm^2 g^{-1})
Days to 50% flowering	**-0.23546**	0.33483	-0.07269	0.12546	0.02812	-0.04087	-0.06463	-0.0015	-0.03565	-0.01281	0.10501	0.08436	0.03804	0.00161
Plant height (cm)	-0.19393	**0.40653**	-0.06049	0.15542	0.00191	-0.08196	-0.07369	-0.00095	0.03799	-0.01414	-0.05052	0.10443	0.06231	-0.00826
Days to maturity	-0.10083	0.14487	**-0.16975**	0.05724	-0.01609	0.05893	0.00884	-0.00131	0.13277	-0.01139	0.0415	0.1009	-0.02736	-0.00406
No. of clusters plant^{-1}	-0.06804	0.14554	-0.02238	**0.43415**	-0.05151	0.12703	-0.10141	0.00103	-0.02728	-0.00968	-0.11895	0.02544	0.03259	-0.00797
No. of pods cluster^{-1}	0.04103	-0.00482	-0.01692	0.13857	**-0.16139**	0.08028	-0.04989	-0.00047	0.15734	0.02215	-0.17228	-0.02826	-0.01906	0.00068
No. of pods plant^{-1}	0.02399	-0.08307	-0.02494	0.1375	-0.0323	**0.4011**	-0.04792	0.00017	0.15612	-0.00307	-0.10995	-0.07342	-0.05871	-0.00089
No. of seeds pod^{-1}	0.05042	-0.09927	-0.00497	-0.1459	0.02668	-0.06369	**0.30178**	0.00194	0.08219	0.00616	0.05398	0.07749	0.03438	0.00936
100 seed weight (g)	0.05928	-0.06515	0.03726	0.07487	0.01285	0.01157	0.09854	**0.00595**	-0.00575	0.00381	-0.0148	-0.01882	-0.00334	0.00406
Harvest index (%)	0.01446	0.02659	-0.03881	-0.0204	-0.04372	0.10783	0.04271	-0.00006	**0.58074**	0.00518	-0.16282	0.01186	0.00291	0.00166
SCMR	0.06198	-0.01181	0.03974	-0.08632	-0.07346	-0.02529	0.03822	0.00047	0.06187	**0.04867**	-0.04647	-0.04378	-0.02525	0.01785
Relative water content (%)	0.06118	0.05082	0.01743	0.12779	-0.0688	0.10912	-0.04031	0.00022	0.23398	0.0056	**-0.40412**	-0.00325	0.06458	-0.00511
Relative injury (%)	-0.07404	0.15825	-0.06384	0.04118	0.017	-0.10977	0.00842	-0.00042	0.02566	-0.00794	0.0049	**0.26828**	0.00975	-0.01131
Chlorophyll content	-0.04941	0.13971	0.02561	0.07805	0.01697	-0.12988	0.05723	-0.00011	0.00932	-0.00678	-0.14395	0.01442	**0.1813**	0.00719
Specific leaf area (cm^2 g^{-1})	-0.01036	-0.09172	0.01884	-0.09448	-0.00298	-0.00978	0.07717	0.00066	0.02638	0.02373	0.05642	-0.08288	0.03561	**0.03661**

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