PATH COEFFICIENT ANALYSIS IN MUNGBEAN UNDER IRRIGATED AND MOISTURE STRESS CONDITIONS

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Abstract: An investigation was carried out with fifty eight mungbean genotypes to understand direct and indirect effects of yield attributes and drought related traits on seed yield per plant under both irrigated (E_1) and moisture stress (E_2) conditions for yield components. Path analysis revealed that, harvest index had positive direct effect on seed yield per plant per plant under both irrigated (E_1) and moisture stress conditions (E_2). However, days to maturity, number of pods per plant and number of pods per cluster in E_1 and number of clusters of plant, number of pods per plant, plant height, 100 seed weight and relative water content in E_2 contributed moderate and direct effect on seed yield per plant.

Keywords: Mungbean, Path analysis, Yield, Drought, Parameters

INTRODUCTION

Vigna radiata (L.) Wilczek, commonly called as mungbean or greengram, and it is known for easily digestable protein component. The seed yield of mungbean is low, the productivity of this crop is stepped up by evolving high yielding varieties. Therefore, there is need to explore the possibility of increasing the productivity through better understanding of constraints of its production. The low production may be due to various abiotic and biotic factors. Among abiotic factors, drought is a major determinant causing tremendous yield losses and low crop productivity globally. Drought problems for mungbeans are worsening with the rapid expansion of water stressed areas of the world including 3 billion people by 2030 (Postel, 2000). Drought stress inhibits the photosynthesis of plants by causing changes in chlorophyll content and reducing relative water content. Genetic improvement in mungbean for drought resistance requires investigation of possible physiological traits related to drought along with yield and exploitation of their genetic variation. To evolve suitable genotypes for drought, information on cause-effect relationship between yield, yield attributes and drought related parameters is very essential. Hence, the present study was under taken to estimate path coefficients for yield, yield attributes and drought related parameters in munbean under both irrigated (E_1) and moisture stress (E_2) conditions.

MATERIAL AND METHOD

Fifty eight mungbean genotypes were evaluated for yield and other nine yield component characters during *kharif,* 2012 at dry land farm, Sri Venkateswara Agricultural College, Tirupati, Andhrapradesh. The experimental material was sown in two sets simultaneously in field (E_1) as well as in rainout shelter (E_2) by adopting augmented block design -II (Federer, 1956) having 6 blocks and 4 checks. Each entry was sown in single row of plot of 3 m length, with a spacing of 30 cm between the rows and 10 cm between the plants. Rainout shelter was utilized to impose moisture stress as well as to avoid natural precipitation. The crop under rainout shelter was imposed to moisture stress by withholding irrigation from 42 days after sowing to crop maturity. This moisture stress treatment was synchronized with pod development stage of the crop. Common agronomic practices and plant protection measures were taken up for both the conditions during the crop growth period, as per the standard recommended package of practices. Observations were recorded on randomly selected five plants from each genotype on plant height (cm), number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, 100 seed weight (g), harvest index (%), SCMR (SPAD Chlorophyll Meter Reading), specific leaf area (cm^2 g^{-1}), relative water content (%), relative injury (%), chlorophyll stability index (%) and seed yield per plant (g) except days to 50% flowering and days to maturity which could be taken on plot basis. Path coefficient analysis was carried out by the procedure originally proposed by Wright (1921) which was subsequently elaborated by Dewey and Lu (1959) to estimate the direct and indirect effects of the individual characters on yield.

RESULT AND DISCUSSION

Path coefficient analysis accommodates anassistance for categorizing the total correlation into direct and indirect effects. The results of path analysis showed (Table 1) harvest index (E_1=0.4951; E_2=0.3070) had high and positive direct effect on seed yield per plant under both E_1 and E_2.

Under E_1, days to 50 per cent flowering (0.2703) had high and positive direct effect on seed yield per plant; number of pods per plant (0.2347) and number of pods per cluster (0.2024) showed moderate direct effect on seed yield per plant. Though number of branches per plant (0.1967), SCMR (0.1240) and relative water content (0.1074) had positive direct

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Table 1. Direct and indirect effects of yield components and drought related traits as partitioned by path analysis in mungbean under irrigated (E_1) and moisture stress (E_2) conditions

Character		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches / plant	No. of clusters/ plant	No. of pods/ cluster	No. of pods/ plant	100 seed weight (g)	Harvest index (%)	SCMR	Specific leaf area ($cm^2 g^{-1}$)	Relative water content (%)	Relative injury (%)	Chlorophyll stability index	Seed yield/ plant (g)
Days to 50% flowering	E_1	**0.2703**	-0.0973	-0.0215	0.043	-0.0146	0.0494	0.0658	0.0312	-0.0044	-0.0001	-0.0016	0.0328	0.0146	-0.0056	0.362*
	E_2	**0.0329**	0.0273	0.0759	0.0257	-0.0044	-0.0039	-0.0072	-0.0728	0.0405	-0.0037	0.0004	0.0286	0.0116	0.0115	0.162
Days to maturity	E_1	0.142	**-0.1852**	-0.0239	0.0359	-0.019	0.0691	0.0936	0.0596	0.025	0.0089	-0.0023	0.0062	-0.0073	-0.0101	0.193
	E_2	0.0158	**0.0567**	0.0652	-0.0346	0.0132	-0.0112	0.0531	-0.0391	0.0409	0.0058	0.0006	0.047	0.0156	0.0409	0.270
Plant height (cm)	E_1	0.0614	-0.0467	**-0.0947**	0.061	-0.0087	0.0713	0.0912	0.0168	0.0381	-0.0026	-0.0021	0.0016	0.0182	0.0052	0.210
	E_2	0.0117	0.0174	**0.2127**	-0.0551	0.0359	0.0025	0.0499	-0.0219	0.0859	0.0039	0.0002	-0.0191	-0.0193	-0.0058	0.299**
No. of branches/ plant	E_1	0.0591	-0.0337	-0.0294	**0.1967**	-0.0069	0.0433	0.1236	0.0358	-0.2008	-0.026	-0.0019	0.0011	0.0165	-0.0018	0.176
	E_2	-0.0026	0.006	0.0358	**-0.3278**	0.1252	0.0012	0.0886	-0.0268	-0.098	-0.0028	0.0002	0.0144	0.0123	0.0187	-0.156
No. of clusters/ plant	E_1	0.0700	-0.0625	-0.0147	0.0243	**-0.0563**	0.0098	0.1307	0.058	-0.0149	-0.0349	-0.0132	-0.0007	0.0179	-0.0068	0.107
	E_2	-0.0006	0.003	0.0301	-0.1618	**0.2537**	-0.0279	0.1313	-0.0757	-0.0688	-0.0084	-0.0006	-0.0143	0.0017	0.0056	0.067
No. of pods/ cluster	E_1	0.0660	-0.0632	-0.0333	0.0421	-0.0027	**0.2024**	0.0727	0.0190	-0.0468	-0.0023	0.0053	0.018	0.0219	-0.0069	0.292**
	E_2	-0.0009	-0.0044	0.0037	-0.0028	-0.0495	**0.1429**	0.1106	-0.0566	0.0465	0.0032	-0.0002	-0.0028	-0.028	-0.0081	0.154
No. of pods/ plant	E_1	0.0758	-0.0739	-0.0368	0.1036	-0.0313	0.0627	**0.2347**	0.0621	-0.086	-0.0139	-0.002	-0.0008	0.0264	-0.0054	0.315*
	E_2	-0.0011	0.0136	0.0479	-0.1309	0.1503	0.0713	**0.2218**	-0.1021	0.0118	-0.0021	-0.0004	0.0032	-0.0011	0.0089	0.291**
100 seed weight (g)	E_1	-0.0516	0.0676	0.0097	-0.0431	0.0200	-0.0236	-0.0893	**-0.1633**	0.0711	0.0396	0.0091	0.0231	0.0003	0.0079	-0.122
	E_2	-0.0117	-0.0109	-0.0228	0.0431	-0.0941	-0.0396	-0.1108	**0.2043**	0.0544	0.0126	0.0006	0.0368	-0.0041	-0.0157	0.042
Harvest index (%)	E_1	-0.0024	-0.0093	-0.0073	-0.0798	0.0017	-0.0191	-0.0408	-0.0235	**0.4951**	0.0436	0.0042	0.0146	-0.0152	-0.0056	0.356**
	E_2	0.0043	0.0076	0.0596	0.1046	-0.0569	0.0216	0.0085	0.0362	**0.3070**	0.0063	0.0005	-0.0133	-0.0163	0.0051	0.475*
SCMR	E_1	-0.0002	-0.0134	0.002	-0.0413	0.0158	-0.0038	-0.0262	-0.0522	0.174	**0.1240**	0.0106	0.002	-0.0231	-0.0013	0.167
	E_2	-0.0041	0.0110	0.0279	0.0313	-0.0717	0.0152	-0.0157	0.0865	0.0646	**0.0298**	0.0008	0.0127	-0.0188	0.0041	0.173
Specific leaf area ($cm^2 g^{-1}$)	E_1	0.0147	-0.0141	-0.0065	0.0125	-0.0248	-0.036	0.0157	0.0496	-0.0695	-0.0437	**-0.0300**	-0.0181	0.0405	0.0017	-0.108
	E_2	-0.0046	-0.0121	-0.0173	0.0222	0.0519	0.0086	0.0302	-0.0412	-0.0561	-0.0079	**-0.003**	-0.0395	-0.0187	-0.0223	-0.11
Relative water content (%)	E_1	0.0826	-0.0106	-0.0014	0.0021	0.0004	0.0339	-0.0017	-0.0351	0.0674	0.0023	0.0051	**0.1074**	0.0064	-0.0106	0.248*
	E_2	0.0047	0.0133	-0.0203	-0.0234	-0.018	-0.002	0.0035	0.0374	-0.0203	0.0019	0.0006	**0.2010**	0.0207	0.0448	0.244**
Relative injury (%)	E_1	-0.0303	-0.0104	0.0132	-0.0248	0.0077	-0.034	-0.0475	0.0004	0.0576	0.022	0.0093	-0.0052	**-0.1304**	0.0042	-0.168
	E_2	-0.0028	-0.0065	0.0302	0.0295	-0.0031	0.0293	0.0019	0.0062	0.0367	0.0041	-0.0004	-0.0306	**-0.1362**	-0.031	-0.073
Chlorophyll stability index	E_1	0.0383	-0.0469	0.0124	0.009	-0.0096	0.0353	0.0319	0.0323	0.069	0.0039	0.0013	0.0285	0.0138	**-0.0398**	0.179
	E_2	0.0028	0.0171	-0.009	-0.0451	0.0106	-0.0085	0.0145	-0.0237	0.0115	0.0009	0.0005	0.0664	0.0311	**0.1357**	0.205

Residual effect (E_1): 0.5342; Residual effect (E_2): 0.5145; Bold: Direct effects; Normal: Indirect effects; * Significant at 5% level; ** Significant at 1% level effect on seed yield per plant but it was low. On contrary, relative injury (-0.1304) had negative direct effect on seed yield per plant but it was low. Hence selection based on these traits would be effective in increasing the seed yield per plant. On contrary, the traits specific leaf area (-0.0300), chlorophyll stability index (-0.0398), 100 seed weight (-1633), days to maturity (-0.1852), number of clusters per plant (0.0276) and plant height (-0.0947) contributed negative direct effect on seed yield per plant per plant.

Under E_2, path coefficient analysis among seed yield per plant and it's components, revealed that number of clusters per plant (0.2537) exhibited the highest positive direct effect along with significant positive association with seed yield per plant. While, number of pod per plant (0.2218), plant height (0.2127), 100 seed weight (0.2043) and relative water content (0.2010) showed moderate direct effect and on seed yield per plant. Hence selection based on these traits would be effective in increasing the seed yield per plant. In contrast, chlorophyll stability index (0.1357) and relative injury (-0.1362) exhibited low positive and negative direct effect on seed yield per plant. Negligible direct effect on seed yield per plant was exhibited by days to maturity (0.0567), days to 50 per cent flowering (0.0329) and SCMR (0.0298). On contrary, specific leaf area (-0.0030) and number of branches per plant (-0.3278) contributed negative direct effect on seed yield per plant.

Similar findings were also reported by Rao *et al*. (2006), Pandey *et al*. (2007), Ajmal *et al*. (2001) for harvest index; Reddy *et al*. (2005) for days to 50 per cent flowering; Zubair and Srinives (1986), Lakshman and Ruben (1989), Lavanya and Toms (2009), Kumar *et al*. (2013), Srikanth *et al*. (2013) for number of clusters per plant; Naidu *et al*. (1994), Venkateswarulu (2001), Wani *et al*. (2007), Lavanya and Toms (2009), Reddy *et al*. (2011), Ahmad *et al*. (2013) for number of pod per plant; Swathi (2013) for SCMR and Meenakshi (2004) for relative water content.

Path analysis revealed that, harvest index had positive direct effect on seed yield per plant per plant under both irrigated and moisture stress conditions. 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 under both irrigated and moisture stress conditions. However, days to maturity, number of pods per plant and number of pods per cluster in E_1 and number of clusters of plant, number of pods per plant, plant height, 100 seed weight and relative water content in E_2 contributed moderately to seed yield per plant. Although, number of branches per plant, SCMR, relative injury and relative water content in E_1 and number of pods per cluster, relative injury and chlorophyll stability index in E_2 had positive direct effect on seed yield per plant but it was low. Hence selection based on these traits also helps in increasing the seed yield per plant under both irrigated and moisture stress conditions. Negligible direct effect on seed yield per plant was shown by days to 50 per cent flowering and days to maturity in moisture stress condition. Hence direct selection of this trait could not help in improvement in yield under moisture stress conditions.

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