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Research Article

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Character Association and Path Coefficient Analysis in Extra Large and Large Seeded *Kabuli* Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Thirty kabuli chickpea genotypes were evaluated in a randomized block design with three replications. Character association analysis revealed that number of secondary branches per plant, number of pods per plant shoot biomass per plant and harvest index showed highly significant and positive correlation with seed yield per plant. Path analysis also revealed that among correlated traits, harvest index and shoot biomass exerted high direct effect on seed yield per plant. Hence, selection would be more effective through harvest index and shoot biomass to improve seed yield.

Keywords: *Path coefficient, Yield components and Kabuli.*

INTRODUCTION

Chickpea is one of the earliest food legumes cultivated. During the last five decades, its production has increased significantly which is primarily due to introduction of high yielding and disease resistant varieties and adoption of improved production technologies. India is the largest chickpea producer and consumer in the world. Among desi and kabuli, large seeded kabuli types have more consumer preference and hence fetch premium price to the farmers. Fortunately, the trading of extra-large seeded kabuli types is dominating the international market. Approximately one million tons of chickpea were imported by Government, private organizations and other agencies. In chickpea, the large seeded kabuli types produce a lower yield than the small seeded kabuli types. The large seeded cultivars produced <90% yield per unit area of the small seeded cultivars, mainly due to lower number of pods per unit area, greater number of empty pods, and a fewer number of seeds per pod than the small seeded cultivars (2003). A negative correlation was observed between seed yield and seed size under water limiting environment (2005). In the improvement of any crop, the knowledge of association of one or more characters associated with yield is useful in selecting the individual with high yield. Correlation helps in selecting suitable plant types and plant breeding procedure. Path coefficient analysis is involved in partitioning the correlation coefficient into the measures of direct and indirect effects of the independent character on the dependent character.

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Hence, the present study was undertaken to find out the contribution of eighteen characters to seed yield in kabuli chickpea.

MATERIALS AND METHODS

The present investigation was taken up during rabi 2018-19 at Regional Agricultural Research Station (RARS), Nandyal, Andhra Pradesh, India. Thirty genotypes of chickpea were sown in a Randomized Block Design with three replications. Each genotype was sown in a double row plot of 3m length with inter row spacing of 30 cm and intra row spacing of 10 cm. Two supplemental irrigations were provided through sprinklers at 35 and 55 days after sowing for irrigated condition. Observations were recorded for 19 parameters viz., days to 50% flowering, days to physiological maturity, SCMR, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, seed diameter, protein content, 100 seed weight, 100 grain volume, water absorption after soaking, volume expansion after soaking, cooking time for raw seeds, cooking time for soaked seeds, shoot biomass per plant, harvest index and seed yield per plant.

RESULTS AND DISCUSSION

CORRELATION ANALYSIS

Phenotypic and genotypic correlation coefficients among yield and yield components in 30 genotypes were presented in Table 1. Seed yield per plant exhibited highly significant positive correlation with number of secondary branches per plant (r_p = 0.524**), number of pods per plant (r_p = 0.592**), shoot biomass per plant (r_p = 0.535**), harvest index (r_p = 0.621**). Number of primary branches per plant (r_p = 0.216*) and protein content (r_p = 0.216*) showed significant positive correlation. Days to physiological maturity (r_p = -0.236*) expressed significant negative correlation at phenotypic level. These results were in line with the reports of Quresi et al. (2004), Jeena et al. (2005), Malik et al. (2010), Gul et al. (2013), Padmavathi et al. (2013), Jida and Alemu (2010) who reported significant and positive correlation of seed yield with number of secondary branches per plant, number of primary branches per plant, number of pods per plant, shoot biomass per plant, harvest index. And at genotypic level, seed yield per plant exhibited highly significant positive correlation with number of primary branches per plant (r_g = 0.363**), number of secondary branches per plant (r_g = 0.508**), number of pods per plant (r_g = 0.766**), shoot biomass per plant (r_g = 0.478**), harvest index (r_g = 0.650**). Protein content (r_g = 0.243*) showed significant positive correlation. Days to 50% flowering (r_g = -0.258**), days to physiological maturity (r_g = -0.283**), water absorption after soaking (r_g = -0.300**) expressed significant negative correlation. Quresi et al. (2004), Jeena et al. (2005), Renukadevi and Subbalakshmi (2006), Malik et al. (2010), Gul et al. (2013), Padmavathi et al. (2013), Jida and Alemu (2010) also reported significant positive association between seed yield with number of primary branches per plant, number of secondary branches per plant, number of pods per plant, shoot biomass per plant, harvest index. Renukadevi and Subbalakshmi (2006), Ali et al. (2008), Singh et al. (2017) also reported significant negative association between seed yield with days to 50% flowering.

At genotypic level, SCMR showed significant negative correlation with protein content under rainfed condition. Whereas, under irrigated condition it exhibited significant positive correlation with protein content. The difference of association was due to the linkage of genes which can be broken in the segregating populations.

100 seed weight showed positive association with seed yield and negative correlation with number of seeds per plant. This may be due to the large size of the seeds. Moreover, 100 seed weight exhibited positive correlation with shoot biomass per plant which in turn was positively correlated with seed yield per plant. Hence, selection for high shoot biomass per plant may result in high 100 seed weight and seed yield.

PATH COEFFICIENT ANALYSIS

Path coefficient analysis was conducted using seed yield per plant as dependent variable and seven characters which showed significant correlation with seed yield. The phenotypic path analysis results of seed yield and yield attributing characters were presented in Table 2. The results of path coefficient analysis revealed that harvest index (0.7527) had positive and high direct effect, followed by shoot biomass per plant (0.6784), negligible positive direct effect of number of primary branches per plant (0.0794), number of pods per plant (0.0270) and days to 50% flowering (0.0035). Negative and negligible direct effect was shown by number of secondary branches per plant (-0.0961), followed by protein content (-0.0046). Similar result of high positive direct effect of harvest index on seed yield per plant was reported by Talebi et al. (2007), Gohil and Patel (2010), Akanksha et al. (2016), Dehal et al. (2016), Singh et al. (2018) and of shoot biomass by Talebi et al. (2007), Gohil and Patel (2010), Hasan and Deb (2014), Dehal et al. (2016), Singh et al. (2018) and of number of primary branches per plant by Talebi et al. (2007), Dehal et al. (2016). Further result of negative direct effect of number of secondary branches per plant was earlier noticed by Talebi et al. (2007), Hasan and Deb (2014).

Table 1: Genotypic (above diagonal) and Phenotypic (below diagonal) correlation coefficients among among yield and yield components in 30 chickpea genotypes

	DF	DPM	SCMR	PH	NPB	NSB	NPP	NSP	SD	PC
DF	1	0.959**	0.131	0.720**	0.1	-0.245*	-0.261*	-0.568**	0.430**	-0.068
DPM	0.905**	1	0.164	0.734**	-0.155	-0.171	-0.280**	-0.637**	0.422**	-0.117
SCMR	0.097	0.089	1	0.035	0.127	0.249*	0.147	0.267*	0.014	0.478**
PH	0.654**	0.696**	-0.027	1	-0.251*	-0.261*	-0.382**	-0.472**	0.584**	-0.268*
NPB	0.048	-0.082	0.2	-0.114	1	0.387**	0.605**	0.363**	-0.641**	0.239*
NSB	-0.137	-0.14	0.147	-0.186	0.076	1	0.477**	0.246*	-0.232*	0.348**
NPP	-0.212*	-0.232*	0.073	-0.306**	0.278**	0.431**	1	0.479**	-0.712**	0.301**
NSP	-0.513**	-0.569**	0.113	-0.419**	0.209*	0.108	0.352**	1	-0.656**	0.006
SD	0.358**	0.327**	0.107	0.406**	-0.148	-0.119	-0.548**	-0.493**	1	-0.055
PC	-0.046	-0.08	0.265*	-0.188	0.166	0.212*	0.168	0.023	-0.054	1
100 GV	0.219*	0.219*	0.144	0.361**	-0.187	-0.024	-0.573**	-0.466**	0.647**	0.077
WAS	0.426**	0.416**	0.147	0.250*	-0.017	0.056	0.1	-0.084	-0.013	-0.02
VES	0.158	0.109	-0.141	0.267*	0.07	-0.09	0.105	0.156	-0.001	-0.214*
CTR	0.366**	0.341**	-0.093	0.320**	0.102	-0.097	-0.133	-0.356**	0.147	-0.182
CTS	0.248*	0.2	-0.045	0.039	0.023	-0.253*	-0.01	-0.065	-0.027	0.121
100 SW	0.086	0.079	-0.02	0.388**	-0.184	-0.073	-0.545**	-0.367**	0.656**	-0.043
SBP	0.298**	0.209*	0.118	0.300**	0.041	0.365**	0.343**	-0.173	0.119	0.269*
HI	-0.524**	-0.508**	0.064	-0.436**	0.146	0.474**	0.469**	0.302**	-0.289**	0.054
SYP	-0.2	-0.236*	0.154	-0.073	0.216*	0.524**	0.592**	0.136	-0.104	0.216*

Table1: contd…

	100 GV	WAS	VES	CTR	CTS	100 SW	SBP	HI	SYP
DF	0.232*	0.610**	0.169	0.392**	0.284**	0.084	0.345**	-0.602**	-0.258*
DPM	0.233*	0.593**	0.1	0.367**	0.230*	0.081	0.279**	-0.547**	-0.283**
SCMR	0.249*	0.197	-0.270**	-0.182	0.044	0.002	0.213*	0.059	0.104
PH	0.382**	0.331**	0.317**	0.349**	0.052	0.406**	0.415**	-0.475**	-0.099
NPB	-0.347**	0.045	0.105	0.178	0.07	-0.412**	0.207	0.343**	0.363**
NSB	-0.043NS	0.119	-0.19	-0.123	-0.342**	-0.131	-0.033	0.386**	0.508**
NPP	-0.699**	0.205	0.143	-0.16	0.023	-0.666**	0.331**	0.516**	0.766**
NSP	-0.498**	-0.193	0.159	-0.411**	-0.270*	-0.406**	-0.187	0.384**	0.173
SD	0.799**	0.127	-0.015	0.191	-0.04	0.778**	0.161	-0.389**	-0.182
PC	0.106	0.006	-0.286**	-0.241*	0.12	-0.055	0.400**	0.039	0.243*
100 GV	1	-0.376**	-0.482**	0.233*	-0.058	0.898**	0.134	-0.127	0.012
WAS	-0.279**	1	0.484**	-0.084	0.195	-0.555**	0.195	-0.460**	-0.300**
VES	-0.496**	0.365**	1	-0.081	0.097	-0.230*	-0.101	-0.108	-0.114
CTR	0.216*	-0.08	-0.078	1	0.144	0.265*	0.096	0.007	-0.11
CTS	-0.07	0.178	0.095	0.133	1	-0.132	-0.061	-0.035	-0.09
100 SW	0.866**	-0.478**	-0.210*	0.255*	-0.124	1	0.096	-0.014	0.117
SBP	0.1	0.111	-0.029	0.069	-0.068	0.081	1	-0.433**	0.478**
HI	-0.112	-0.335**	-0.077	0.01	-0.045	-0.005	-0.16	1	0.650**
SYP	-0.004	-0.151	-0.028	-0.063	-0.066	0.098	0.535**	0.621**	1

* Significant at 5% level; ** Significant at 1% level

DF: Days to 50% flowering; DPM: Days to physiological maturity; PH: Plant height (cm); NPB: Number of primary branches per plant; NSB: Number of secondary branches per plant; NPP: Number of pods per plant; NSP: Number of seeds per plant; SD: Seed diameter (mm); PC: Protein content (%); 100GV: 100 grain volume (ml); WAS: Water absorption after soaking (%); VES: Volume expansion after soaking (%); CTR: Cooking time for raw seeds (min); CTS: Cooking time for soaked seeds (min); 100SW: 100 seed weight (g); SBP: Shoot biomass per plant (g); HI: Harvest index (%); SYP: Seed yield per plant (g).

Table 2: Phenotypic path coefficients among seven characters in 30 chickpea genotypes under irrigated condition

	DPM	NPB	NSB	NPP	PC	SBP	HI	SYP
DPM	**0.0035**	-0.0065	0.0135	-0.0063	0.0004	0.1420	-0.3824	-0.2359*
NPB	-0.0003	**0.0794**	-0.0073	0.0075	-0.0008	0.0277	0.1103	0.2164*
NSB	-0.0005	0.0061	**-0.0961**	0.0116	-0.0010	0.2477	0.3565	0.5242**
NPP	-0.0008	0.0221	-0.0414	**0.0270**	-0.0008	0.2330	0.3528	0.5917**
PC	-0.0003	0.0132	-0.0204	0.0045	**-0.0046**	0.1827	0.0406	0.2157*
SBP	0.0007	0.0032	-0.0351	0.0093	-0.0012	**0.6784**	-0.1202	0.5351**
HI	-0.0018	0.0116	-0.0455	0.0126	-0.0003	-0.1083	**0.7527**	0.6211**

Residual Effect: 0.4532

Bold: Direct effects; Normal: Indirect effects

* Significant at 5% level; ** Significant at 1% level

DPM: Days to physiological maturity; NPB: Number of primary branches per plant; NPP: Number of pods per plant; NSP: Number of seeds per plant; PC: Protein content (%); SBP: Shoot biomass per plant (g); HI: Harvest index (%); SYP: Seed yield per plant (g).

CONCLUSION

Present studies revealed that number of primary branches per plant, number of secondary branches per plant, number of pods per plant, shoot biomass per plant, harvest index, protein content exhibited significant positive correlation. Whereas, days to 50% flowering, days to physiological maturity, water absorption after soaking recorded significant negative correlation with seed yield. Thus, indicating that selection could be done for number of primary branches per plant, number of secondary branches per plant, number of pods per plant, shoot biomass per plant, harvest index, protein content for effective improvement of seed yield.

High positive direct effect and significant positive association was shown by harvest index and shoot biomass per plant with seed yield per plant. Moreover, significant positive association of other traits *viz.*, number of primary branches per plant, number of secondary branches per plant, number of pods per plant and protein content with seed yield per plant was due to their positive indirect effects through harvest index and shoot biomass per plant. Therefore, characters viz., harvest index and shoot biomass per plant should be given more importance during selection process under irrigated condition.

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