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ASSOSCIATION BETWEEN YIELD AND ITS COMPONENT TRAITS UNDER IRRIGATED AND DROUGHT CONDITIONS IN CHICKPEA

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ABSTRACT

Five hundred and seventy five selected chickpea genotypes of F_2 population and F_2derived F_3 progeniesof cross between ICC 13124 and WR 315 was carried out under drought and irrigated conditions to determine the nature of association between grain yield and yield components by partitioning the correlation coefficients into direct and indirect effects.Considering the correlation and path analysis, under drought and irrigated situation,seed yield per plant had highly significant phenotypic relationship withtraits like number of pods per plant (0.91 and 0.79) and number of seeds per plant(0.31 and 0.88). When correlation coefficient was portioned into direct and indirect effect, the number of seeds per plant (0.97 and 0.95) and number of pods per plant(0.08 and 0.04)have shown high direct effect on seed yield per plant under drought and irrigated situation, respectively. These results suggested that improvement of grain yield in chickpea is linked with these traits.

Key words: Chickpea, correlation, path coefficient analysis, drought, segregating generations.

INTRODUCTION

Chickpea (*Cicerarietinum*L.) is the third leading grain legume in the world and first in the South Asia. Ninety two % of the area and eighty nine % of the production of grain are concentrated in semi-arid tropical countries. Research into the plant response to water stress is becoming increasingly important, as most climate change scenarios suggest an increase in aridity in many areas of the globe. Breeding efforts for improvement of drought tolerance in crop plants is primarily based on selection for grain yield under drought stress. Because of the variability in drought pattern from year to year, further progress may not be achieved by selecting solely for grain yield. However, the progress in breeding for drought resistance is generally considered to be slow due to the quantitative and temporal variability of available moisture across years, the low genotypic variance in yield under these conditions and inherent methodological difficulties in evaluating component traits (Ludlow and Muchow, 1990) together with the highly complex genetic basis of this character (Turner *et al*., 2001).The correlation studies are helpful in formulating efficient breeding programme for multiple trait selection. Correlation coefficient measures the mutual relationship between various plant characters and gives reasonable indication for plant breeders to face selection on characters to improve economic yield and also for planning more efficient breeding programmes. In crop like chickpea, where production of hybrid is out of question and hybridization followed by selection is the main procedure for improvement, the knowledge on correlation is an obligate necessity for achieving genetic improvement. The importance of correlation study in selection programme is appreciable when highly heritable characters are associated with important characters like yield which have low heritability. Selection for yield to improve productivity most often will not be fruitful, since it is a highly complex trait. However, improvement in productivity can be brought about by affecting selection for its closely associated component traits. In order to plan such selection strategy, information on the nature and magnitude of association of the component traits with productivity is a basic pre-requisite. In the present study correlations, were worked out using F_2 population and F_{2-3} progenies under irrigated and drought condition separately.

MATERIALS AND METHODS

The experimental material consisted of two parents, one check, F_2 population and F_2 derived F_3 progenies of the cross between ICC13124 and WR 315. Till now breeding for drought resistance in chickpea is done using either ICC 4958 or Annigeri 1. Where as in our study we have used a new source ICC 13124 which was identified as one of the best drought tolerant line by Parameshwarappa and Salimath (2010) in Dharwad after screening mini core collections obtained from ICRISAT, Hyderabad. F_2 populations were evaluated during rabi 2009-10. F_2 derived F_3 progenies were evaluated during *rabi* 2010-2011 in both irrigated and drought condition. Each F_2 derived F_3 progenies along with parents and

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check at regular interval were grown in augmented design with 8 blocks and 3 checks. Individual progeny row was sown in single row of 2. meter length, spaced 30 cm apart and 20 cm between plants. The moisture stress was created by taking up sowing 30 days later than normal sowing and withholding irrigation after germination and seedling establishment. The last irrigation given to stress plot was on 14th day after sowing while for non-stress condition, irrigation was given at regular intervals up to physiological maturity. All other recommended package of practices were adopted for raising the good crop.From 575 $F_{2\text{-}3}$ plants, observation was made on nine quantitative characters., *viz.* days to 50% flowering (DFF), plant height (PH), primary branches per plant (PB), secondary branches per plant (SB), number of pods per plant (N0P), seeds per pod (SPP), number of seeds per plant (NOS), test weight (TW) and seed yield per plant (SY) were recorded.In both the segregating populations, the simple correlation coefficients were calculated to determine the direction and magnitude of associations among different characters and tested against table 'r' values (Fisher and Yates, 1963) at (n-2) degree of freedom both at 0.05 and 0.01 probability levels for their significance. Simple correlations were calculated by using the formula as given Weber and Moorthy (1952). Path coefficient analysis suggested by Wright (1921), Dewey and Lu (1959) was carried out to know the direct and indirect effect of the morphological traits on plant yield.

RESULTS AND DISCUSSION

The phenotypic correlations of seed yield per plant with other quantitative characters in both F_2 population, $F_{2\text{-}3}$ progenies under irrigated and drought conditions are presented in Table 1. It is observed that in F_2 and F_3 generations, seed yield was significantly and positively correlated with all the character like primary branches, secondary branches, number of pods per plant,, seeds per pod, number of seeds per plant and test weight (Meena., 2010). Whereas in $F_{2,}$ plant height is negatively correlated with seed yield (Salimath and Patil 1990 and Ali *et al*. 2011).

Table 1: Phenotypic correlation coefficient among yield components in F_2 population, $F_{2\text{-}3}$ progenies under irrigated and drought condition

		PH	PB	SB	NOP	SPP	NOS	TW
	F_2	1						
PH	F_3I	1						
	F_3D	1						
	F_2	0.049	1					
PB	F_3I	0.27**	1					
	F_3D	0.38**	1					
	F_2	0.071	0.488**	1				
SB	F_3I	0.400**	0.460**	1				
	F_3D	0.310**	0.360**	1				
	F_2	-0.046	0.360**	0.340**	1			
NOP	F_3I	0.380**	0.170**	0.390**	1			
	F_3D	0.340**	0.480**	0.390**	1			
	F_2	-0.081	0.360**	0.340**	0.910**	1		
SPP	F_3I	0.430**	0.190**	0.430**	0.860**	1		
	F_3D	0.350**	0.480**	0.390**	0.970**	1		
	F_2	-0..037	0.04	0.027	0.068	0.258**	1	
NOS	F_3I	0.120**	0.08	0.060	-0.080	0.240**	1	
	F_3D	0.120**	0.170**	0.100*	0.250**	0.410**	1	
	F_2	0.134**	0.003	-0.034	-0.191**	-0.250**	-0.160**	1
TW	F_3I	0.140**	-0.090	-0.07	-0.170**	-0.260**	-0.200**	1
	F_3D	0.160**	-0.080	-0.030	-0.390**	-0.420**	-0.270**	1
	F_2	-0.024	0.385**	0.349**	0.865**	0.914**	0.180**	0.068
SY	F_3I	0.480**	0.150**	0.400**	0.790**	0.880**	0.880**	0.20**
	F_3D	0.436**	0.500**	0.420**	0.910**	0.920**	0.310**	0.08

**- Significance at 5%, **- Significance at 1%*

Plant height in F_2, was negatively correlated with traits like number of pods per plant, seeds per pod, seeds per plant and test weight (Ali *et al.*, 2011 and Padmavathi *et al.*, 2013). In F_3, plant height was positively correlated with these traits. Linkage between genes contributing to most of the character would have broken due to segregation.The primary and secondary branches per plant were positively and significantly correlated with grain yield per plant in both F_2 and F_3 (Vijayalakshmi*et al.*,2000, Jeena and Arora., 2001). Hundred seed weight is negatively correlated with number of seeds per plant, pods per plant which were in contrast (Abhishek*et al.*, 2012). Number of pods per plant and seeds per plant showed significant and positive correlation with each other (Malik *et al.*, 2010, Yucel and Anlarsal 2010 and Sarker *et al.*, 2014). Hence, number of seeds per plant should be used as selection for yield improvement in chickpea (Ali *et al*. 2011). As expected seeds per pod were positively and significantly correlated with seeds per plant but negatively with number of pods per plant.Seed yield per plant had highly significant phenotypic relationship with pods per plant, seeds per plant (Sharma and Saini 2010). Under drought condition, the seed yield exhibited a highly positive correlation with seed number. The plant height had significant correlation with all characteristics except the unfilled pod per plant in both cultivars and high positive correlation was observed between height and seed per plant.These results suggested that improvement of grain yield in chickpea is linked with these traits and selection of these characters might have good impact on seed yield per plant.

Table 2: Direct (diagonal) and indirect effects of different characters on seed yield per plant in F_2 population

	PH	PB	SB	NOP	SSP	NOS	TW
PH	**0.008**	0.001	0.001	-0.001	-0.0003	-0.001	0.001
PB	0.001	**0.019**	0.009	0.007	0.001	0.007	0.0001
SB	0.001	0.004	**0.080**	0.003	0.0002	0.003	-0.0003
NOP	-0.009	0.073	0.069	**0.200**	-0.014	0.181	-0.038
SPP	-0.002	0.002	0.001	-0.003	**0.044**	0.012	-0.007
NOS	-0.064	0.286	0.272	0.718	0.204	**0.790**	-0.198
TW	0.042	0.001	-0.011	-0.059	-0.051	-0.078	**0.310**
SY	-0.024	0.385	0.349	0.865	0.185	0.914	0.067
R^2	-0.001	0.007	0.003	0.172	0.008	0.722	0.0209

Residual effect: 0.26

The estimation of correlation coefficient revealed only the relationship between yield and yield components but did not show any direct and indirect effects on different yield components on yield *per se*. There was correspondence between direct effect and phenotypic correlation for most of the component characters with seed yield per plant in the F_2 population and $F_{2\text{-}3}$ progenies. Further, it revealed high direct effect of seeds per plant and pods per plant on seed yield per plant. Hence, desirable improvement may be brought about by selecting genotypes with more number of pods and seeds per plant.Plant height had a positive direct effect on seed yield per plant (except F_2). It is mainly due to its indirect effect via major characters which affect the seed yield per plant, like number of seeds per plant and number of pods per plant which were positive and of higher magnitude (Yucel *et al*., 2006). Primary and secondary branches exerted positive direct effect on seed yield per plant in both F_2 and F_3 population and high indirect effect through number of seeds per plant.This indicates that selection of plants with more branches will help in increasing seed per plant and simultaneously increased yield (Kumar *et al*., 2003, Abhishek *et al.*, 2012).

Table 3: Direct (diagonal) and indirect effects of different characters on seed yield per plant in $F_{2\text{-}3}$ progenies under irrigated condition

	DFF	PH	PB	SB	NOP	NOS	SPP	TW
DFF	**0.0013**	-0.0003	-0.0001	-0.0001	-0.0002	-0.0002	0	0
PH	0.0017	**-0.0072**	-0.0019	-0.0029	-0.0027	-0.0031	-0.0009	-0.001
PB	0.0001	-0.0005	**-0.0019**	-0.0009	-0.0003	-0.0004	-0.0001	0.0002
SB	-0.001	0.0059	0.0068	**0.0147**	0.0057	0.0063	0.0008	-0.001
NOP	-0.006	0.0167	0.0074	0.0173	**0.0443**	0.038	-0.0032	-0.0074
NOS	-0.1117	0.4074	0.1857	0.4064	0.8178	**0.9549**	0.2283	-0.2447
SPP	0	0.0001	0	0	0	0.0001	**0.0004**	-0.0001
TW	-0.0143	0.0636	-0.0403	-0.0308	-0.0754	-0.1156	-0.0918	**0.4512**
SY	-0.13	0.4856	0.1557	0.4038	0.7892	0.88	0.1335	0.1971
R^2	-0.0002	-0.0035	-0.0003	0.006	0.035	0.8403	0.0001	0.0889

Residual effect = 0.2018

It was observed that a higher indirect contribution was exhibited on number of pods per plant and seeds per plant by most of the yield components; thus, these traits related to seed yield per plant should be given emphasis in selection (Padmathi *et al.*, 2013 and Sarke *et al.*, 2014). Low residual effect indicated that the selection of traits for path coefficient analysis is appropriate and no characters were neglected. The pods per plant, seeds per plant, plant height and branches per plant were important components characters which must be given due weightage when a plant breeder practices selection.

Table 4: Direct (diagonal) and indirect effects of different characters on seed yield per plant in $F_{2\text{-}3}$ progenies under drought condition

Characters	DFF	PH	PB	SB	NOP	NOS	SPP	TW
DFF	**0.0013**	0	0	0	0	0	-0.0001	0
PH	0	**-0.0101**	-0.0039	-0.0032	-0.0035	-0.0036	-0.0012	-0.0016
PB	-0.0008	0.0084	**0.0222**	0.0079	0.0106	0.0106	0.0037	-0.0018
SB	-0.0001	0.0047	0.0053	**0.015**	0.0058	0.0058	0.0015	-0.0005
NOP	-0.0018	0.0303	0.0423	0.0344	**0.0888**	0.0863	0.0225	-0.0346
NOS	-0.0359	0.347	0.4662	0.3773	0.9509	**0.979**	0.398	-0.4108
SPP	0.0011	-0.0018	-0.0026	-0.0015	-0.0039	-0.0062	**-0.0152**	0.0041
TW	-0.0028	0.0577	-0.0296	-0.0132	-0.1406	-0.1515	-0.0976	**0.3612**
SY	-0.0389	0.4361	0.5	0.4167	0.9081	0.9202	0.3118	0.0841
R^2	-0.0001	-0.0044	0.0111	0.0062	0.0807	0.9009	-0.0047	-0.0304

Residual effect = 0.1837

Days to 50% flowering had a negative and low direct effect on seed yield per plant, but a high indirect effect via number of pods and seeds per plant, hundred seed weight, and plant height. These results suggested that the selection of shorter flowering lines contribute to increasing seed yield per plant with an indirect effect via these traits. Number of seeds and pods are the two important traits which have positive association with seed yield under drought situation (Yadav *et al.*, 2005). Further, it revealed high direct effect of seeds per plant and pods per plant on seed yield per plant even under drought condition also. Hence, desirable improvement may be brought about by selecting genotypes with more number of pods and seeds per plant for breeding genotypes with drought tolerance.

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