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RESEARCH ARTICLE

CORRELATION STUDIES IN CHICKPEA GROWN UNDER RAINFED AND IRRIGATED CONDITIONS IN NORTHERN PLAINS OF INDIA

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ABSTRACT

The experimental materials were sown in the research area of Department of Dry land Agriculture and Pulses Section of the Department of Genetics and Plant Breeding, CCS HAU, Hisar during *rabi* season of 2013-14. The experiment comprised 21 genotypes (including local & national checks) and was grown in 3 replications in a plot size of 8 rows of 4m length with plant-to-plant distance of 10 cm and row to row spacing of 45 cm in dry land area and 30 cm in irrigated area. Observations were recorded on Days to maturity, Plant height at 30, 45, 60 DAS and physiological maturity (cm), Primary branches per plant ,Seed yield per plant (g), Seed yield (g/plot), Rain water use efficiency (kg/ha-mm). The results indicated that days to maturity, plant height and Primary branches per plant recorded positive significant correlations with seed yield per plant under normal sown conditions which were changed in the rainfed areas. These are quite interesting results. The genetic diversity of the material under study is quite evident from the morphological data, The information so gathered will be used to decide the strategy of chickpea improvement for drought environment.

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INTRODUCTION

Among different legumes, chickpea is a highly acceptable crop during winter season in drought prone areas of India as well as in world on receding moisture. More than 85 per cent chickpea is grown as rainfed mostly on residual soil moisture after harvest of *kharif* crops (Reddy *et al.,* 2007). In India, the area under chickpea was 8.32 million hectare with productivity of 912 kg/ha and production of 7.70 million tonnes, whereas Haryana with an area of 80,000 ha; production of 70,000 tonnes; and productivity of 911 kg/ha during 2011-12. Despite significant gains in irrigation potential during last three decades, chickpea continued to be a rainfed crop in major parts of the country. Future estimates also indicate that not more than 25 per cent of total chickpea area is expected to be under irrigation. Thus drought is the single most important abiotic constraint limiting the chickpea production. Soil moisture stress reduces the productivity by delay or prevention of crop establishment, destruction of established crop, predisposition of crop to insects and diseases, alteration of physiological and biochemical metabolism in plant. Moisture deficit also affects seed germination and its establishment in the field, photosynthetic ability of the plants and osmotic behavior of cells. However, species and genotypes vary in their capacity to tolerate water stress. The improvement in the genotypes is the only alternative for yield stability under water stress environment. Therefore, the improved chickpea genotypes with better water use efficiency and high yield will be suitable for cultivation in drought prone areas and can prove a boon to improve the economic status of poor farmers. To achieve this, an understanding of physiological processes associated with drought tolerance is pre-requisite. Currently available drought tolerant chickpea genotypes are very few. Considering that a large number of traits are collectively needed to confer yield under drought, there is a need to identify more genotypes to introduce diversity in drought tolerance breeding programs. Root traits, such as depth and root biomass, have been identified as the most promising plant traits in chickpea for terminal drought tolerance (Neeraj *et al*., 2012). Therefore, the present study was undertaken with the objective to find out indirect selection criterion for drought tolerant genotypes in chickpea.

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MATERIALS AND METHODS

The experiment was carried out in the research farm area of Department of Dryland Agriculture, CCS HAU, Hisar during *rabi* season of 2013-14 and 2014-15 comprising 21 chickpea genotypes(including checks) in three replications, 4m row length and row to row spacing of 45 cm. The observations on various traits including morphological parameters viz., Days to 50 per cent flowering , Days to maturity, Plant height at 30, 60 ,90 DAS and physiological maturity (cm), Primary branches/plant, Pods/plant, 100- seed weight (g), Seed yield per plant (g), Seed yield (kg/ha), Biological yield (kg/ha), Rain water use efficiency (kg/ha-mm) and Physiological parameters viz., Relative leaf water content (%), Membrane injury index of leaf, Specific leaf weight (gm), Leaf water potential (-bars) and Osmotic potential (-bars). Moisture content at different depth (0-15, 15-30, 30-60, 60-90 and 90-120 cm) was also recorded from sowing till maturity of the crop at an intervals of 30 days. ANOVA was performed using standard procedure as explained by Panse and Sukhatme (1989). Correlation analysis was carried out following Pearson correlation coefficient.

Table 1. Pearson Correlation Matrix between different morphological and physiological parameters

	DF	DM	PH	B/P	P/P	100SW	HI	RWC	MII	SLW	LWP	SY/P
DF	1.000	0.530^{*}	0.057^{NS}	-0.209^{NS}	-0.203^{NS}	0.518^{*}	0.030^{NS}	-0.144^{NS}	0.110^{NS}	-0.274^{NS}	-0.268^{NS}	-0.221^{NS}
DM	0.530^{*}	1.000	0.268^{NS}	-0.323^{NS}	-0.449^{*}	0.241^{NS}	-0.026^{NS}	0.048^{NS}	0.069^{NS}	-0.261^{NS}	-0.204^{NS}	-0.093^{NS}
PH	0.057^{NS}	0.268^{NS}	1.000	0.308^{NS}	0.166^{NS}	0.248^{NS}	0.113^{NS}	0.438^{*}	-0.328^{NS}	-0.034^{NS}	0.111^{NS}	0.400^{NS}
B/P	-0.209^{NS}	-0.323^{NS}	0.308^{NS}	1.000	0.301^{NS}	0.034^{NS}	0.106^{NS}	0.387^{NS}	-0.600^{**}	0.141^{NS}	0.561^{**}	0.847^{**}
P/P	-0.203^{NS}	-0.449^{*}	0.166^{NS}	0.301^{NS}	1.000	0.130^{NS}	0.466^{*}	0.340^{NS}	-0.264^{NS}	-0.231^{NS}	0.184^{NS}	0.390^{NS}
100SW	0.518^{*}	0.241^{NS}	0.248^{NS}	0.034^{NS}	0.130^{NS}	1.000	0.240^{NS}	-0.102^{NS}	-0.332^{NS}	-0.059^{NS}	-0.198^{NS}	0.150^{NS}
HI	0.030^{NS}	-0.026^{NS}	0.113^{NS}	0.106^{NS}	0.466^{*}	0.240^{NS}	1.000	0.553^{**}	-0.335^{NS}	-0.321^{NS}	-0.043^{NS}	0.389^{NS}
RWC	-0.144^{NS}	0.048^{NS}	0.438^{*}	0.387^{NS}	0.340^{NS}	-0.102^{NS}	0.553^{**}	1.000	-0.408^{NS}	-0.140^{NS}	0.319^{NS}	0.541^{*}
MII	0.110^{NS}	0.069^{NS}	-0.328^{NS}	-0.600^{**}	-0.264^{NS}	-0.332^{NS}	-0.335^{NS}	-0.408^{NS}	1.000	-0.297^{NS}	-0.614^{**}	-0.694^{**}
SLW	-0.274^{NS}	-0.261^{NS}	-0.034^{NS}	0.141^{NS}	-0.231^{NS}	-0.059^{NS}	-0.321^{NS}	-0.140^{NS}	-0.297^{NS}	1.000	0.238^{NS}	0.091^{NS}
LWP	-0.268^{NS}	-0.204^{NS}	0.111^{NS}	0.561^{**}	0.184^{NS}	-0.198^{NS}	-0.043^{NS}	0.319^{NS}	-0.614^{**}	0.238^{NS}	1.000	0.466^{*}
SY/P	-0.221^{NS}	-0.093^{NS}	0.400^{NS}	0.847^{**}	0.390^{NS}	0.150^{NS}	0.389^{NS}	0.541^{*}	-0.694^{**}	0.091^{NS}	0.466^{*}	1.000

DF = days to flowering, DM = days to maturity, PH= plant height, B/P= branches per plant, P/P= pods per plant, 100SW= 10 seed weight, HI =harvest index, RWC=relative water content, MII = , SLW = , LWP=leaf water potential, and SY/P=seed yield per plant

RESULT AND DISCUSSION

Analysis of variance

Analysis of variance for all the morphological and physiological traits indicated existence of ample variability for all the traits under study. In general PCV and GCV values were high for all the trais. The heritability (BS) ranged from 68% (days to flowering) to 87% (membrane injury index). The genetic advance under selection also ranged from 22% (branches per plant) to 86% (membrane injury index). All these results indicate importance of membrane injury index as the most appropriate parameter to incorporate drought tolerance in chickpea genotypes. Parameshwarappa *et al.* (2010) showed wide range of genetic variability, moderate to high heritability and high genetic advance for yield and its component traits in drought tolerant accessions evaluated under moisture stress and irrigated situations.

Correlation studies

Correlations were calculated using Pearson correlation coefficient. The correlations were calculated in two seasons *i.e.* *rabi* 2013-14 and *rabi* 2014-15 under normal irrigated and rainfed conditions. It was very interesting to note that the correlations with seed yield per plant changed under rainfed conditions. The important correlations which were observed were between branches per plant and seed yield (0.847), between relative water content and seed yield (0.541), between leaf water potential and seed yield (0.466) and negative correlation between membrane injury index and seed yield per plant (0.694) (Table 1). These correlations clearly indicate that seed yield increases with the increase in number of branches per plant, relative water content and leaf water potential. However, negative correlation between seed yield per plant and membrane injury index clearly indicated that more the injury due to drought, more susceptible is the genotype. Therefore, these four parameters can very effectively be utilised for identification of chickpea genotypes suitable for drought conditions provided the genotypes are screened under drought. This is because these correlations hold true only under rainfed conditions. The survey of literature depicts the corollary between various studies and the study that we have conducted. Gupta *et al.* (2000) observed that genotypes, RSG-44, RSG-143-1 and ICC-4958, which were more tolerant to moisture stress, had lower membrane injury, retain imbibitions and higher seedling growth, osmotic regulation and water use efficiency. These metabolic adjustments resulted in lower drought susceptibility index in these genotypes. Deshmukh and Kushwaha (2002) also reported that RWC and MII of a genotype measured during early phase were found to provide an indication of its relative MII during reproductive stages. The genotypes were grouped into different categories on the basis of MII. They concluded that these traits were relatively simple and, therefore, can be used to screen large number of population for stress tolerance. Yadav *et al.* (2005) studied physiological parameters of chickpea under soil moisture stress condition. It was observed that at flowering stage, branches/plant, relative water content (RWC), leaf water potential, seeds/plant, seeds/pod and harvest index coupled with the higher leaf water potential were identified as important parameters for drought tolerance. However few contradictory reports are also available. For example Neeraj *et al.* (2012) evaluated chickpea genotypes for root characteristics, plant water status and membrane integrity. Root traits, such as depth and root biomass, have been identified as the most promising plant traits in chickpea for terminal drought tolerance. These traits are directly associated with maximum seed yield per plant.

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