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Stability in Phenological, yield and yield attributes of chickpea over environments

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SUMMARY

Fifty-two chickpea genotypes of advance breeding lines of AICRP centres were sown at three different soil temperatures *i.e.* 24.5^{0}C, 21.5^{0}C and 18.5^{0}C in randomized block design with two replications to know the stability in Phenological, yield and yield attributes over different environments in chickpea. In pooled analysis the mean square due to genotypes, environments and G x E interaction were highly significant for all the traits except G x E interaction of biological yield/plant. Six genotypes *viz.*, GNG-1407, IPC-99-47, GL-99016, BG-2002, BG-2003 and H-98-58 were above average yielder and showed their suitability for favorable environmental condition.

Key words : Phenological, Yield attributes, Yield, Chickpea

Pulse crops are major source of protein, minerals and vitamins and form important part of predominantly vegetarian diet of Indian people. Among all the grain legumes, chickpea (*Cicer arietinum* L.) is the most important *rabi* pulse crop covering 48.9 lakh ha/area and 35.22 lakes tones of production per annum in India. Its productivity is 720 kg/ha in India. It occupies 5th position in area and 4th position in production among all food crops *i.e.* cereals and pulses.

The characteristics of growth and development in chickpea are such that a critical examination of these functions is needed to evaluate the extent of variability in the germplasm. The duration of vegetative growth, formation of floral primodia, differential periods of various reproductive phases are under genetic control. Success of yield improvement largely depends upon the magnitude and nature of genetic variability present in the existing material as it is the prerequisite for any crop improvement.

Screening of genotypes for stability under varying environmental conditions is an essential component of breeding programme. Studies on genotypic, environmental and genetypic x environment interaction (G x E) facilitate identification of genotypes with stability of characters. The present investigation was therefore, planned with objectives to know the stability in Phenological, yield and yield attributes over different environments in chickpea.

MATERIALS AND METHODS

The present investigation was carried out during *rabi* season of 2002-2003 at All India Co-ordinated Research Project on chickpea, Rafi Ahmed Kidwai College of Agriculture, Sehore (M.P.).

The soil of experimented area was clay loam vertisol with 52% clay, 41.3% silt and 6.6% sand and having the pH ranging from 7.2 to 7.8. It was low in nitrogen, medium in phosphorus and high in potash content. Fifty-two genotypes of advance breeding lines of AICRP centres were sown at three different soil temperatures *i.e*. 24.5^{0}C, 21.5^{0}C and 18.5^{0}C in randomized block design with two replications. Each replication consisted of 52 row of 2 meter length, sown 30 cm apart with plant to plant spacing of 10 cm. Fertilizer dose of 20 : 50 : 0 : 20 NPKS kg/ha was applied as basal. Plant protection measures were taken as and when required. Five randomly selected competitive plants from each replication were tagged for recording the observations. The mean of these five plants was taken as replication mean. Observations recorded for the present study were growing degree-days of flowering duration (GDD of FD), heliothermal unit of flowering duration (HTU of FD), photothermal index of flowering duration (PTI of FD), growing degree days of podding duration (GDD of PD), heliothermal unit of podding duration (HTU of PD), photothermal index of podding duration (PTI of PD), growing degree days of seed filling duration (GDDof SFD), heliothermal unit of seed filling duration (HTUof SFD), photothermal index of seed filling duration (PTI of SFD), number of pods/ plant, biological yield/plant (g), seed yield/plant (g) and 100 seed weight (g).

RESULTS AND DISCUSSION

Studies on genotypes x environment interaction facilitate identification of genotypes for phenotypic stability. Screening number of genotypes over a range of environment thus becomes an essential part in breeding

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Table 1 : Stability analysis of variance for seed yield and its contributing characters in chickpea

Source of variation	Degree of freedom	GDD of flowering duration	HTU of flowering duration	PTI of flowering duration	GDD of podding duration	HTU of podding duration	PTI of podding duration
Genotypes	51	10959.080**	1383231.000**	214.265**	11150.414**	1580860.000**	254.271**
Environment	2	61317.647**	11754239.000**	43417.553**	27154.357**	7777503.700**	69821.568**
GXE interaction	102	2979.94**	451691.38**	87.41	3766.24**	546839.79**	131.03**
Environ.(linear)	1	122638.150**	23501988.000**	86840.546**	54308.719**	15559131.000**	139635.360**
GXE (linear)	51	4411.681**	416664.320	117.123**	5105.706**	362141.160	209.390**
Pooled deviation	52	1518.385**	477483.270**	56.491	2380.107**	717391.060**	51.810**

Table 2 : Stability analysis of variance for seed yield and its contributing characters in chickpea

Genotypes	51	38679.946**	5418262.600**	318.765**	714.811**	95.657**	75.760**	21.937**
Environment	2	1453642.700**	97906611.000**	75288.596**	4462.849**	355.562**	67.335**	313.055**
GxE interaction	102	13680.88	1975467.200**	80.05**	148.17	41.83	4.47**	7.68*
Environ.(linear)	1	2907299.300**	195828490.000**	150571.980**	8925.666**	711.156**	134.669**	626.118**
GxE (linear)	51	13079.435	1726806.100	98.171*	186.260**	61.963**	5.622**	7.776*
Pooled deviation	52	14007.412**	2181063.000**	62.811**	107.979	21.286	3.272**	4.765

* and ** indicates significant of values at P=0.05 and 0.01, respectively

programme.

The whole cycle of plant life is characterized by distinct phases like vegetative pod bearing and seed filling. The component, seed number is from between the time of flowering to pod filling stage. In grain legume like chickpea the flowering, pod bearing and seed filling vary from genotype to genotype (Subodh *et al.* 2000 and Subhash *et al*., 2001). The interaction of genotypes to microenvironments and superiority of certain genotypes have also reported (Subodh *et al*., 2000).

In pooled analysis the mean square due to genotypes, environments and G x E interaction were highly significant for all the traits except G x E interaction of biological yield/plant. It revealed that, sowing at different soil temperatures affected the expressions of Phenological and yield traits among the genotypes and genotypes also had varied response in sowing at different soil temperatures. This is in confirmation with the findings of Hussain *et al.* (1998), Bhattacharya and Pande (1999) and Patil *et al.* (1998).

The genotype of an individual is a characteristic assembly of genes possessed by the individual and the expression of a phenotype is an out come of several integrated reaction. The problem of maintaining a steady state of equilibrium centres around the overall working of the genetic system in relation to its internal and external environment. The underlying mechanism of genetic homeostasis depends upon the integration of the physiological process during the course of development. Stability of development of phases in various environment implies physiological adjustments, is a property of the homeostatic genotype.

Under *rainfed* conditions moderate to heavy drought stresses occur during growth cycle and this causes inadequate germination, resulting in low planting density and less productivity. It also affects the physiological adjustment affecting the yield also (Popalghat *et al*., 1999; Bhattacharya *et al*., 1999). The range of moisture stress can be given by various techniques. One of the useful field methods is to screen genetically diverse lines in a wide temperature range created by manipulating seeding dates at different soil moisture regimes. Due to shorter day length in late planting days, vegetative sink reduces. While due to higher temperature coupled with longer days during seed filling stage, reproductive sink is affected (Poniedzialek *et al*., 1999).

Success in breeding crops for rainfed condition lies in selecting plants that are of economic user of plant water, adjusting their phenological durations and converting it to economic yield by effective seed filling.

Stability analysis helps to isolate stable, high yielding genotypes having better equilibrium and also having stable and balanced growth system. Keeping in view, in the present investigation fifty two diverse genotypes were sown at three different soil temperature regimes, in order to evaluate the stability of phenological and yield attributes of these genotypes maximum number of time character including pods/plant and grain yield/plant have highest values of environment - II (Table 1). It also had higher environmental index for growing degree-days of flowering

Table 3 : Number of varieties showing linearity of regression and deviation from regression

Characters	b>1	b=1	b<1	S2 di>0
GDD of flowering duration	21	20	11	12
HTU of flowering duration	09	37	06	26
PTI of flowering duration	11	38	03	04
GDD of podding duration	18	11	23	27
HTU of podding duration	04	28	20	41
PTI of podding duration	17	28	07	12
GDD of seed filling duration	10	37	05	43
HTU of seed filling duration	08	41	03	44
PTI of seed filling duration	06	38	08	08
No. of pods/plant	19	32	09	02
Biological yield/plant	09	15	18	02
100 seed weight	10	32	11	07
Seed yield/plant	08	34	08	04

duration, heliothermal unit of flow was duration, growing degee days of podding duration, pods/plant and seed yield/plant (Table 2). Environment-III (sowing at 18.5^{0}C st) had significantly lower values for GDD of seed filling duration, HTU of seed filling duration, pods/plant, 100 seed weight and seed yield/plant. However GDD and HTU of seed filling duration, biological yield/plant and 100 seed weight have higher values in environment - I (sowing at 24.5^{0}C st). It might be due to the longer growth period attributed to the early sowing of the crop. However, increment in yield could not be achieved by early sowing.

Thirty three genotypes had regression coefficient near one and deviation from regression around zero, out of which 15 genotypes *viz.*, SG-25070, SG-25089, SG-96026, SG-96032, SG-96033, SG-96043, SG-96046, SG-96077, SG-96052, SG-96059, SG-96074, Vijay, SAKI-9516, Phule-G-97110 (K) and PBG-151 exhibited average seed yield. Nine genotypes had regression near zero. Amongst these six genotypes *viz.*, GNG-1407, IPC-99-47, GL-99016, BG-2002, BG-2003 and H-98-58 were above average yielder. These genotypes showed their suitability for favorable environmental condition. HTU and GDD of seed filling duration and HTU of podding duration were most affective traits while, biological yield and pods/plant were least affective characters by environmental fluctuations.

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