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Genetic Variability and Heritability Study for Quantitative Traits in Advance Generation (F5) of Cross between Green Seeded Desi (GKB-10) and White Kabuli (MNK-1) Chickpea Genotypes (*Cicer arietinum* L.)

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A B S T R A C T

Ninty green chickpea (*Cicer arietinum* L.) genotypes were evaluated for genetic potential, heritability, genetic advance, and traits association of yield contributing characters during 2016-2017 at ARS Kalaburgi, University of agricultural science Raichur, Karnataka, India. The experiment was carried out in augmented design; data were recorded on days to 50% flowering, pods per plant, seeds per pod, number of primary branches /plant, number of secondary branches/ plant, 100-seed weight and seed yield /plant. Analysis of variance (ANOVA) showed that mean sum of squares due to genotypes were highly significant for most of the characters in advance generation of green chickpea. High amount of variability was observed for both phenotypic and genotypic coefficient of variability. Broad sense heritability estimates were highest for biological yield per plant (85.76), number of seeds per pod (72.94), seed yield per plant (67.44), test weight (66.55), leaf let size (60.01) and plant height (52.76). Genetic advance was higher for biological yield per plant (11.45), test weight (9.93), days to 50 per cent flowering (9.84) and plant height (6.01). High heritability with high genetic advance per cent mean was observed for number of seeds per pod, biological yield per plant, test weight and seed yield per plant, whereas low heritability with low genetic advance per cent mean was observed for the traits like, number of pods per plant and number of primary branches per plant. The remaining traits like, leaf let size, plant height, basal height and number of secondary branches per plant recorded moderate heritability coupled with moderate genetic advance per cent mean.

Introduction

Chickpea (*Cicer arietinum* L.) is an important food legume providing protein in human diet. Chickpea ranks third among pulses, and it accounts for 12% of the world pulses production. The Asian region contributes 70% to the total world's chickpea production (Malik *et al.*, 2010). Genetic variability is a prerequisite for any breeding program, which provides opportunity to a plant breeder for selection of high yielding genotypes.

Information on the relative magnitude of the different sources of variation particularity among different genotypes for several traits helps in measurement of their range of genetic variability and may provide evidence for identification of their relationship. The variability of a biological population is an outcome of genetic constitution of the individuals and its interaction with the prevailing environment. A survey of genetic variability with the help of suitable parameters such as genetic coefficient of variation, heritability estimates and genetic advance are absolutely necessary to start an efficient breeding program. Progress in any breeding program depends upon the nature and magnitude of variability present in the base population. Assessment of the extent of genetic variability within chickpea is fundamental for chickpea breeding (Qureshi *et al.,* 2004). Chickpea breeders should consider heritability estimates along with genetic advance because heritability alone is not a good indicator of the amount of usable genetic variability (Noor *et al.,* 2003). The concept of heritability explains whether the differences observed among individuals arose as a result of differences in genetic makeup or due to environmental forces. Genetic advance gives an idea of possible improvement of new population through selection, when compared to the original population. The genetic gain depends upon the amount of genetic variability and magnitude of the masking effect of the environment. Information of the genetic variability, heritability and genetic advance per cent mean of various characters provides a basis to the plant breeders to breed the chickpea genotypes possessing higher yield potential. Selection on the basis of grain yield, a polygenic character, is usually not very efficient, but selection based on its component characters could be more efficient. Keeping in view the chief importance of genetic variability, heritability and genetic advance, the present investigation was undertaken for 90 green seeded chick pea genotypes.

Materials and Methods

The experimental material comprised 90 green seeded chickpea genotypes developed by F_5 (advance generation) of cross Between Green Seeded Desi (GKB-10) and White Kabuli (MNK-1) Chickpea genotypes along with 4 standard checks viz., MNK-1, GKB-10, KAK-2 and JG-11 obtained from ARS Kalaburagi, were planted in augumented block design, during 2016-17.

The genotypes were planted in six blocks which was consisted of two rows of each genotype with a plant-to-plant and row-to-row distance of 10 and 30 cm, respectively. Recommended cultural practices were carried out to maintain healthy crop growth. Number of days to flowering was recorded at the time when at least 50% plants showed the appearance of first flower. At maturity, data were recorded for yield and its various components including, number of primary branches per plant, number of secondary branches per plant, 100-seed weight and seed yield per plant. The data was subjected to statistical analysis by statistical software WINDOSTAT package, 8.1version.

Results and Discussion

Analysis of variance

Analysis of variance (ANOVA) showed that mean sum of squares due to genotypes were highly significant for most of the traits in advance generation of green chickpea genotypes *viz.*, days to 50 per cent flowering, length of leaf let size, width of leaf let size, plant height, basal height, number of secondary branches, number of pods per plant, number of seeds per pod, biological yield, harvest index, seed yield per plant and test weight, while it was non- significant for

number of primary branches and days to maturity. The details of results are presented in Table 1.

The phenotypic and genotypic coefficients of variation were estimated using genotypic and phenotypic variances respectively. The coefficient of variation indicates only the extent of variability existing for various traits, but does not give any information about the heritable portion of it. Therefore, heritability accompanied by estimates of genetic advance as per cent of mean was estimated. In the present study, the advance generation of green seeded chickpea genotypes was evaluated for the extent of variability, heritability and genetic advance. The results are presented in Table 2 and are depicted in Figure 1 and 2.

Days to 50 per cent flowering was ranged from 40 to 56 days with a mean value of 49 days. In the present study the genotypes have shown low genotypic (8.46%) and phenotypic (9.58 %) co-efficient of variation for days to 50 per cent flowering and these findings were in accordance with the earlier findings of (Meena *et al.*, 2014**;** Bala *et al.,* 2015**;** Jeena *et al.,* 2005 and Akanksha *et al.,* 2016). For this trait, narrow difference between phenotypic and genotypic variance was observed, it indicated that there was less influence of environmental factors. High heritability (77.93 %) coupled with low genetic advance as a percent mean (9.84 %) indicated that the trait was under the influence of non additive gene action and thus selection for this trait will result in less genetic gain. These results are in agreement with (Meena *et al.*, 2014**;** Jeena *et al.,* 2005 and Arshad *et al.,* 2004). The high heritability may be due to favorable influence of environment rather than genotype and selection for such traits may be non rewarding.

Length of leaf let size was ranged from 8.80 to 22.20 mm with a mean value of 14.42 mm the genotypes have shown moderate GCV (13.67%) and PCV (17.64%). High heritability (60.01%) with low genetic advance (4.02) was recorded; it is an indicative of non additive gene action. In the same way width of leaf let size was ranged from (10.70%) and PCV (19.24%). Low heritability (30.91%) with low genetic advance (1.56) was recorded (Farshadfar et al.2008).Iit indicates length and wide of leaf let size showed wide range of difference for GCV and PCV, so environment factors play important role for this traits.

We observed lot of variation with respect to the size of leaf lets in chickpea, in general small and medium leaf lets is more is more common in desi group of chickpea genotypes whereas larger leaf let size in kabuli groups. In this study the leaf let size was recorded after 35 days of sowing and characterized as small, medium and large, most of the genotypes recorded medium leaf let size. In chickpea the leaf let size is directly related to the seed size.

Plant height was ranged from 36.20 cm to 60.40 cm with a mean value of 49.06 cm, the genotypes have shown low GCV (6.36%) and PCV (8.75%) for plant height and these findings were in accordance with the earlier findings of (Bala *et al.*, 2015and Meena *et al.*, 2014), For this trait, narrow difference between phenotypic and genotypic variance was observed, it indicated that there is less influence of environmental factors. Moderate heritability (52.76%) (Mohammad *et al.,* 1992 and Arshad *et al.,* 2004) coupled with low genetic advance as a percent mean (6.01%). In the same way basal height was ranged from 19.00 cm to 36.00 cm with a mean value of 25.95 cm, the genotypes have shown low GCV (9.83%) and PCV (13.47%) for plant height and Moderate heritability (53.26%) coupled with low genetic advance as a percent mean (5.02%) indicated that the trait was influenced by the environment thus selection based on this trait may be result in insufficient genetic gain.

Table.1 Analysis of variance for yield and yield attributing traits in advance generation of green seeded chickpea genotypes

Source of Variation	Df	DF 50%	LSL	LSW	PH	BH	NPB	NSB	P/P	S/P	DM	BY	HI (%)	TW	SYP
Block	5	2.14	5.44	3.42	23.62	12.65	0.59	1.29	24.27	0.001	22.44	14.05*	8.54	6.65	1.91
Entries	93	36.7**	9.56**	6.53*	22.99*	16.63*	0.38	2.64*	84.12	0.02**	27.91	30.69**	37.38*	94.84**	5.49**
Checks	3	82.48**	80.09**	86.89**	90.75**	42.88**	0.61	5.55*	794.16**	0.16**	44.59	14.15*	17.02	1590.04**	1.14
Genotypes	89	26.70**	7.29*	3.90	20.73*	14.24*	0.34	2.46	60.61	0.02**	27.12	30.28**	32.06	36.52**	5.68**
Checks Vs Genotypes	1	791.65**	0.05	0	21.46	150.38**	2.77*	10.03*	46.50	0.06**	47.33	117.09**	572.05**	799.70**	1.69
Error	15	5.05	2.58	2.53	8.8	5.98	0.35	1.23	55.5	0.001	17.52	3.64	15.35	10.70	1.61

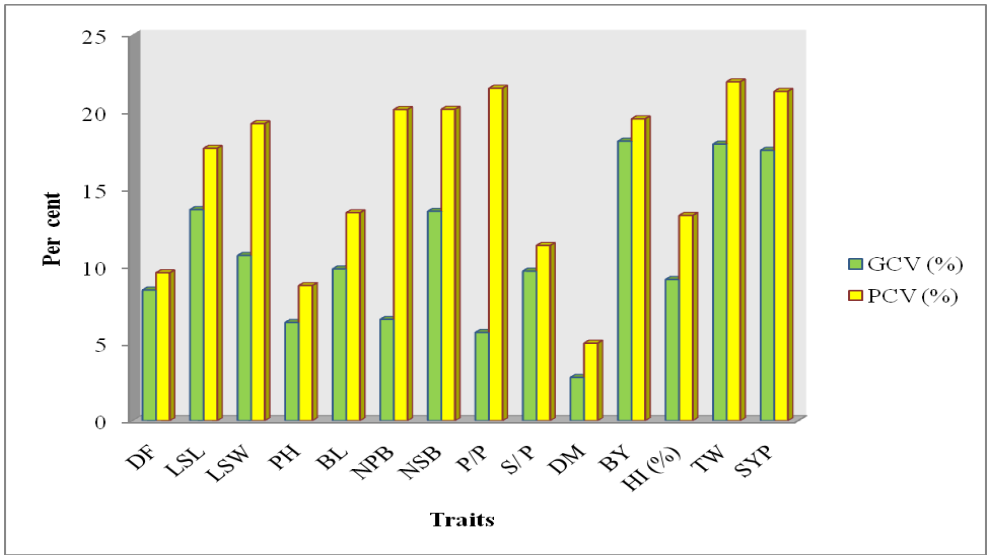
* = Significant at 5 per cent ** = Significant at 1 per cent

df= degrees of freedom; DF = Days to 50% flowering; LSL = Length of leaf let size (mm); LSW = Width of leaf let size (mm); PH = Plant height (cm); BH = Basal height (cm); NPB = Number of primary branches per plant; NSB = Number of secondary branches per plant; P/P = Number of pods per plant; S/P =Number of seeds per pod; DM = Days to maturity; BY = Biological yield per plant (g); HI = Harvest index (%); TW = Test weight (g); SYP = Seed yield per plant (g).

Table.2 Genetic variability parameters for yield and yield attributing traits of green chickpea genotypes

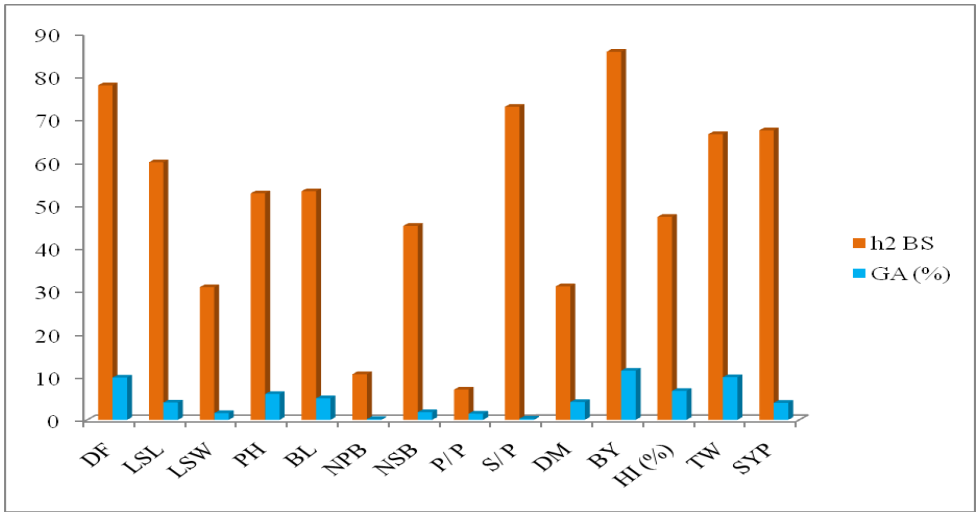
Traits	Range		Mean	GCV (%)	PCV (%)	h^2 (*bs*) (%)	GA (5%)
	Min.	Max.					
Days to 50% flowering	40.00	56.00	49.00	8.46	9.58	77.93	9.84
Length of leaf let size (mm)	8.80	22.20	14.42	13.67	17.64	60.01	4.02
Width of leaf let size (mm)	4.40	17.80	9.94	10.70	19.24	30.91	1.56
Plant height (cm)	36.20	60.40	49.06	6.36	8.75	52.76	6.01
Basal Height (cm)	19.00	36.00	25.95	9.83	13.47	53.26	5.02
Primary branches per plant	1.80	4.80	3.06	6.56	20.15	10.62	0.17
Secondary branches per plant	3.40	11.80	7.27	13.56	20.17	45.18	1.78
Pods per plant	17.40	59.00	35.56	5.71	21.53	7.04	1.43
Seeds per pod	1.00	1.60	1.21	9.69	11.35	72.94	0.26
Days to maturity	92.00	112.00	100.00	2.80	5.02	31.10	4.14
Biological yield per plant (g)	13.30	39.20	25.35	18.10	19.55	85.76	11.45
Harvest index (%)	26.21	55.48	41.77	9.14	13.29	47.29	6.73
Test weight (g)	15.00	64.80	27.12	17.91	21.95	66.55	9.93
seed yield per plant (g)	4.50	16.20	10.51	17.51	21.33	67.44	3.96

Fig.1 Phenotypic and genotypic coefficient of variation for 14 traits in green chickpea genotypes



GCV= Genotypic coefficient of variation; PCV= phenotypic coefficient of variation; DF = Days to 50% flowering; LSL = Length of leaf let size (mm); LSW = Width of leaf let size (mm); PH = Plant height (cm); BH = Basal height (cm); NPB = Number of primary branches per plant; NSB = Number of secondary branches per plant; P/P = Number of pods per plant; S/P =Number of seeds per pod; DM = Days to maturity; BY = Biological yield per plant (g); HI = Harvest index (%); TW = Test weight (g); SYP = Seed yield per plant (g).

Fig.2 Heritability and genetic advance as per cent mean estimate for 14 traits in green chickpea genotypes



h^2 BS = Heritability (Broad Sense); GA= Genetic advance; DF = Days to 50% flowering; LSL= Length of leaf let size (mm); LSW = Width of leaf let size (mm); PH = Plant height (cm); BH = Basal height (cm); NPB = Number of primary branches per plant; NSB = Number of secondary branches per plant; P/P = Number of pods per plant; S/P =Number of seeds per pod; DM = Days to maturity; BY = Biological yield per plant (g); HI = Harvest index (%); TW = Test weight (g); SYP = Seed yield per plant (g).

The basal height in chickpea is important for mechanical harvesting, as basal height is more, it facilitate for easy mechanical harvesting.

Number of primary branches per plant showed low GCV (6.56%) and moderate PCV (20.15%). which was in agreement with Malik *et al.,* (2010), Bala *et al.,* (2015), Singh *et al.,* (2009) in the present study wide gap between GCV and PCV was reported it may be due to this trait is highly influenced by the polygenes. Low heritability (10.62%) coupled with low genetic advance observed for this trait these results were in accordance with (Malik *et al.,* 2010; Singh *et al.,* 2009; and Gul *et al.,* 2013). This character is highly influenced by environmental effect and selection would be ineffective. Similarly the number of secondary branches per plant showed moderate genotypic (13.56%) and phenotypic (20.17%) co-efficient of variability which was in agreement with (Singh *et al.,* 2009; Akanksha *et al.,* 2016 and Jeena *et al.,* 2005), the presence of wide gaps between GCV and PCV for number of secondary branches per plant indicated that this trait is influenced by the environmental factors. Moderate heritability (45.18) coupled with neglisible genetic advance (1.78) was observed for this trait which was in accordance with (Arshad *et al.,* 2002; Jeena *et al.,* 2005), the value of genetic advance was low; it indicates that the character was governed by non-additive gene.

Low genotypic (5.71%) and high phenotypic (21.53%) co-efficient of variation was observed for number of pods per plant, this findings are in agreement with Arshad *et al.,* (2002). Low heritability (7.04%) coupled with low genetic advance (1.43%) was recorded this findings are in agreement with (Akanksha *et al.,* 2016 and Arshad *et al.,* 2002). Low genetic advance with low heritability indicates that the character is highly

influenced by environmental effect and selection would be ineffective, this due to fact that number of pods per plant perhaps governed by polygenic traits.

Moderate genotypic (9.69%) and phenotypic (11.35%) co-efficient of variation was recorded for number of seeds per pod this findings was in accordance with Singh *et al.,* (2009). High heritability coupled with low genetic advance was recorded this was in accordance with Meena *et al.,* (2014).High heritability accompanied with low genetic advance, it is indicative of non-additive gene action. The high heritability is being exhibited due to favorable influence of environment rather than genotype and selection for such traits may not be rewarding.

Low genotypic (2.8%) and phenotypic (5.02%) coefficient of variation was recorded for days to maturity this finding was in accordance with the earlier findings of (Meena *et al.,* 2014). Moderate heritability coupled with low genetic advance was recorded in accordance with earlier findings of Babbar *et al.,* (2015).

Moderate GCV (17.51%) and PCV (21.33%) were recorded for seed yield per plant, high heritability accompanied with low genetic advance, it is indicative of non-additive gene action. The high heritability is being exhibited due to favorable influence of environment rather than genotype and selection for such traits may not be rewarding. Moderate GCV (26.43%) and PCV (32.97%) were recorded for test weight. This finding was in accordance with the earlier findings of (Babbar *et al.,* 2015; Singh *et al.,* 2009 and Gul *et al.,* 2013). Further high heritability coupled with moderate genetic advance was recorded for this trait findings were in accordance with Meena *et al.,* (2014).

On the basis of these results it was suggested that Pods per plant, primary branched per plant, secondary branches per plant and 100 seed weight may be given more importance while making selection for higher yield potential in chickpea.

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