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Induced Chemical Mutagenesis for the Improvement of Yield Attributing Traits and their Correlation Analysis for M1 Generation of Chickpea (*Cicer arietinum* L.)

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Abstract: ***Four widely adopted Chickpea genotypes SABOUR CHANA - 1, BRC - 5, BRC - 100 - 84, IPC 2012 - 49 were induced by chemical mutagen with different concentration (0.01%, 0.02%, 0.04%, 0.06%, 0.08% with SA) of sodium azide (NaN_3) and soaked with the above mentioned treatments for about 6hrs at the post graduate laboratory and were sown at field experimentation center, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj, U. P (Rabi - 2019). For study of micro - mutation, randomly selected fifteen plants were selected from each concentration/treatment lines were selected and threshed separately. A trail laid in randomized block design with three replications. In the present study, the treatments showed that maximum GCV and PCV for seed yield per plant (54.94 & 52.964), biological yield (39.10 & 40.2), number of effective pods per plant (30.793 & 31.70) in M_1 generation. Heritability and genetic advance were recorded maximum for number of pods per plant (94.40% and 16.01%) and number of effective pods per plant (91.6% and 14.77%). High heritability coupled with genetic advance was recorded for seed yield per plant (98.2% and 96.18%) followed by biological yield (95.40% and 78.68%) in M_1 generation. Seed yield was positively correlated with days to 50% flowering, seed index, biological yield and harvest index at the both genotypic and phenotypic levels in M_1 generation.***

Keywords: Mutagen, Sodium azide, GCV, PCV, Heritability, Genetic advance, Correlation coefficient

1. Introduction

Pulses can improve the overall nutritional value of cereals - based diet in developing countries like India. Chickpea (Cicerarietinum L.) is also known as Bengalgram, Gram, Chana or Garbanzo bean. It is a self - pollinated diploid (2n=16) annual grain legume that belongs to the family Fabaceae, subfamily Faboideae. It originated in south - eastern Turkey. The kabuli type chickpea is believed to have developed from desi type chickpea through natural mutation and selection (Moreno and Cubero, 1978; Giland Cubero, 1993). Mutation breeding has become a proven way of creating variation within a crop variety and offers the possibility of inducing desired attributes that either cannot be found in nature or have been lost during evolution (Novak and Brunner, 1992). To enhance the mutagenic effectiveness and efficiency of sodium azide and especially the metabolite, more knowledge about the effect of time, pH value, temperature, seed soaking and various concentrations are required (Khanetal., 2009). Mutation breeding in India has yielded considerable dividends both in enhancing our knowledge on various mutagenes is processes relevant to crop improvement and for developing improved varieties. The present study was aimed to assess variability, heritability, genetic advance and correlation coefficients for finding the optimal selection criteria to improve the seed yield of the chickpea

2. Materials and methods

The present investigation was carried out at the yield experimentation centre, Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad, U. P. (India) during *rabi*, 2019. The experimental materials consist of 24 genotypes (04 chickpea genotypes, 5 concentrations and 1control). The experiment was laid out in randomized block design with three replications. The genotypes were sown by hand dibbling in each plot by imposing randomization in each replication. The spacing of 30cm between rows and 10cm between plants. Observations were recorded in each plot and replication by taking five plants randomly for 11 qualitative characters *viz,* number of days to maturity, number of days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of effective pods per plant, biological yield, seed index, harvest index and seed yield per plant. Laboratory observations were germination percentage, root length, shoot length, seed dry weight, seed moisture weight, seedling length, seed vigor index I, seed vigor index II and LD 50. The statistical analysis was carried out for different experiment separately per standard statistical procedure. The concept of correlation was first put forward by Galton (1889) and later elaborated by Fisher (1918) and Wright (1921). The data obtained for each character in F1's and parents were analyzed for each statistical procedure given by Panse and Sukhtame (1967).

3. Results and Discussion

Table 1 showed Analysis of variance for various quantitative characters revealed that the mean sum of squares due to genotypes showed high significant differences for all characters underdaysto50%flowering, days to maturity, number of pods per plant, number of effective pods per plant, seed index, biological yield, harvest index and seed

yield per plant study at 1% level and 5% level except for plant height, number of primary branches per plant, number of secondary branches per plant where it is significant at 5% level.

Genetic parameters of yield and their components are given in table 2 in the present study seed yield per plant showed highest GCV (52.495) and PCV (52.964) were as days to maturity showed lowest GCV (1.527) and PCV (3.343). Heritability ranged highest for seed yield per plant (98.2) while lowest is ranged for days to maturity (20.900). genetic advance ranged highest for number of effective pods per plant (16.012), number of pods per plant (14.779) and harvest index (10.918). genetic advance as mean present ranged highest for seed yield per plant (98.182) while lowest is ranged for days to maturity (1.436).

The genotypic and phenotypic correlation coefficient were composed among 11 characters in table 3 days to 50% flowering, primary branches per plant, number of pods per plant, number of effective pods per plant, seed index, biological yield and harvest index. It has also been reported that the mutagenesis can weaken or strengthen the association between different agronomic traits (S. Khan *et al.*, 2005, J. M. Shin *et al.*, 2011). The increase in phenotypic and genotypic diversity in current crop using mutations can provide additional genetic markers for genetic enhancement and linkage studies. Correlation studies have become an important and useful tool in breeding to determine the selection criteria. Correlations studies in mutation breeding have already been reported by many workers (C. Toker et al., 2004, S. Khan et al., 2005).

LD_{50} by Probit Analysis for four genotypes

Table 1: Analysis of Variance (ANOVA) among 04 chickpea genotypes (5 concentrations and 1control) for 11 quantitative traits

Characters	Mean Sum of Squares		
	Replications	Treatments	Error
	(df=2)	(df=23)	(df=46)
Days to 50% of Flowering	61.47	60.50**	33.04
Days to Maturity	14.16	23.43**	13.08
Plant Height (cm)	19.07	31.58*	12.68
Number of Primary Branches per Plant	0.01	1.09*	0.04
Number of Secondary Branches per Plant	0.04`	1.56*	0.07
Number of Pods Per Plant	0.56	173.67**	5.14
Number of Effective Pods Per Plant	1.28	195.91**	3.82
Seed Index (gm)	2.23	57.33**	3.33
Biological Yield (gm)	0.91	71.93**	1.13
Harvest Index (%)	13.71	119.19**	10.49
Seed Yield Per Plant (gm)	0.003	32.82**	0.19

**1% level of significance
*5% level of significance

Table 2: Mean range, GCV, PCV, Heritability, Genetic advance and Genetic advance as a % Mean

Traits	GCV	PCV	h^2%	GA	GAM
Days to 50% flowering	4.207	9.033	21.700	2.903	4.036
Days to maturity	1.527	3.343	20.900	1.747	1.436
Plant height	5.839	10.137	33.200	2.978	6.929
Number of primary branches	18.429	19.642	88.000	1.143	35.621
Number of secondary branches	15.597	16.762	86.600	1.350	29.896
Number of pods per plant	23.586	24.642	91.600	14.779	46.506
Number of effective Pods plant	30.793	31.700	94.400	16.012	61.619
Seed index	16.275	17.718	84.400	8.028	30.795
Biological yield	39.102	40.027	95.400	9.777	78.687
Harvest index	12.488	14.183	77.500	10.918	22.652
Seed yield per plant	52.495	52.964	98.2	6.734	98.182

Table 3: Estimation of phenotypic and genotypic correlation coefficient

		Days to 50% flowering	Days to maturity	Plant height	Primary branches	Secondary branches	Pods/ plant	Effective pods/plant	Seed index	Biological yield	Harvest index	Seed yield
Days to 50% flowering	P	1	0.285*	- 0.106	0.121	- 0.102	0.523**	0.536**	0.18	0.399**	0.388**	0.379**
	G	1	0.295*	- 0.191	0.178	- 0.208	0.671**	0.693**	0.203	0.503**	0.244*	0.455**
Days to maturity	P		1	0.016	0.278*	0.01	0.359**	0.414**	0.132	- 0.022	0.004	- 0.037
	G		1	0.084	0.438**	0.083	0.455**	0.523**	0.137	- 0.015	- 0.003	- 0.044
Plant height	P			1	- 0.054	0.045	0.089	0.052	0.055	0.186	0.343**	0.196
	G			1	- 0.097	- 0.213	0.108	0.144	- 0.016	0.005	0.316**	0.087

Primary branches	P1				1	- 0.085	0.298*	0.380**	0.188	0.207	0.2	0.193
	G				1	- 0.065	0.557**	0.651**	0.396**	0.432**	0.226	0.386**
Secondary branches	P					1	- 0.036	- 0.073	- 0.231	- 0.237*	- 0.573**	- 0.261*
	G					1	0.147	0.128	- 0.622**	- 0.994**	- 0.548**	- 0.283*
Pods/plant	P						1	0.947**	- 0.039	0.207	0.023	0.272*
	G						1	0.991**	- 0.034	0.184	0.038	0.321*
Effective pods/plant	P							1	0.018	0.229	0.033	0.387**
	G							1	0.052	0.224	0.053	0.462**
Seed index	P								1	0.478**	0.588**	0.531**
	G								1	0.629**	0.649**	0.624**
Biological yield	P									1	0.801**	0.964**
	G									1	0.905**	0.935**
Harvest index	P										1	0.462**
	G										1	0.535**
Seed yield	P											1
	G											1

4. Conclusion

It is concluded that LD_{50} determined for mutagen is important as doses to prove in effective and higher doses may cause lethality**.** Analysis of variance showed high significant differences for all characters.5% level of significance is shown for number of primary branches per plant and number of secondary branches per plant. All other characters shown 1% level of significance. Seed yield per plant showed highest GCV, PCV, heritability and genetic advance as mean present were as effective pods per plant shown highest genetic advance. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with days to 50% flowering, primary branches, pods per plant, effective pods per plant, seed index, biological yield, biological yield and harvest index. Hence utmost importance should be given to these characters during selection for yield improvement in chickpea.

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