CHAPTER - II

REVIEW OF LITERATURE
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A brief review of the literature on various aspects of chick pea (Cicer arietinum L) has formed the basis of the investigation which has been grouped under the following heads:

1. Variability (Phenotypic and Genotypic coefficients)
2. Heritability
3. Genetic Advance
4. Correlation coefficient (Phenotypic and Genotypic)
5. Path coefficient analysis (direct and in direct effects of the traits)

1. VARIABILITY:

Variability is the most distinctive feature of living beings and from the foundation of plant improvement. The importance of genetic variability for disease resistance and wide adaptability is well known. Moreover, the efficiency of selection in plant breeding largely depends on the extent of the genetic variability present
in the plant population. Numerous studies have been conducted to determine the genetic variability for the reduction in genetic variability. The uniform varieties have narrow genetic base, poor adaptability and are more prone to the new races of pathogen of compared to diverse genotypes. A brief review of work done on the above aspects in chickpea given below:

*Chand et al. (1975)* reported that the highest genotype coefficient of variability for the number of seeds per pod was observed in a study comprising thirty genotypes.

*Patil and Phadnis (1977)* reported that the genetic variation was highest for pods per plants pod weight per plant and 100-seed weight. All the characters varied widely except days to maturity.

*Kumar et al. (1981)* reported the highest coefficient of variation for biological yield followed by grain yield and pods per plant. Kurtosis was found to be positive for biological yield and pods per plant, which indicated a preponderance of measurement near the mean. The data further revealed that coefficients of variation were low in
case of days to flowering, plant height, length and breadth of pod and seeds per pod. the last threee characters were normally distributed. in case of days to flowering and kurtasis was positive. the study indicated the presence of appreeiable variability for biological yeild, grain yield and pods per plant.

*Adhikari and pandey (1982)* Studied the characters nomely, days to 50 percent flowering, plant height, number of reproductive nodes, primary and secondary branches per plant, pods per plants, 100 seed weight and seed yield per plant and reported that phenotyhpic coefficients of variation were always higher than genotypic coefficients of variation for seed yield, number of pods per plants, seed weight and secondary branches per plant.

*Islam et al. (1984)* Reported that the variability was wride for pods and yield per plant but narrow for days to flowering and days to maturity.

*Jivani and yadvendra (1988)* Reported the genotypic and phenotypic coefficient of variation for seed yield per plant and yield related traits in gine tically diverse genotypes of Bengal gram, coefficients of variation were found to be high for number of pods per plant and 100 seed weight.
Sharma et al. (1990) Observed genotypic and phenotypic coefficients of variation and reported that the highest value was shown by secondary branches per plant followed by 100 seed weight.

Aroro (1991) Presented the analysis of variance, which revealed that mean square of genohtpes were signficant for all the characters with little differences in phenotypic and genotypic coefficients of variation suggesting the presence of sufficient genetic variability to allow the selection for individual traits, higher PCV and GCV values for pods per plants, 100-seed weight and seed yield per plant and moderately high value for plant height, primary branches per plant, secondary branches per plant and harvest index in dicating relatively little environmental influence suggesting that selection for those characters could to effective.

Bhatia et al. (1993) reported that highest variability was observed for number of pods per plant.

Rao et al. (1994) Concluded that maximum variability was observed for secondary branches followed of pods per plant, 100-seed weight and seed yield per plant, Sinierlarly, Rao (1994) reported that the highest coefficient of variation was observed for
seed yield per plant followed by reproductive period and 100-seed weight.

_Chavan et al. (1995)_ revealed that genetic variability was greatest pods per plants pod weight per plant and branches per plant. low genetic variability was noted for remaining characters.

_Jahagirdor et al. (1995)_ reported that high genotypic and phenotypic coefficients of variations were recorded for number of pod per plant.

_Tripathi (1988)_ observed the high genotypic coefficient of variation for pods per plants, seeds per plant, biological yield and yield per plant indicating the pre-dominance of additive genetic variance in the expression of these traits. It is suggested that selection criteria based on plant height, biological yield and pods per plant will improve seed yield.

Wahid and Ahmad (1999) reported the genetic coefficients of variation to be greatest for plant height, pods, per plants and seed yield. the phenotypic coefficient of variation was greater than genotypic or environment coefficient of variation. It is therefore suggested that plant height and pods per plant could be used as selection criteria for further improvement.

_Yadav et al. (1999)_ reported that the analysis of variance
revealed considerable variability for different traits. Number of nodes, seeds per pod and seed weight were rated as stable traits and are suggested for use as selection criteria in breeding programmes.

*Kumar et al. (1999)* Reported on genotypic and phenotypic coefficients of variation is derived from data on 7 yield-related traits in 50 chick pea genotypes from the Indian Institute of pulses Research, grown at Meerut during Rabi 1994-95. Genotypic and phenotypic coefficient of 'Variation were high for number pods per plant, 100-seed weight, seed yield per plant and harvest index.

2. **HERITABILITY** :

   The concept of heritability is important to determine whether the phenotypic differences observed among various individuals are genotypical or due to the effect of environmental factors. The heritability expresses the proportion of genotypic variation to the total variance i.e. attributable to the average effect of genes, which determines the degree resemblance between relatives.

   Heritability always emphasises about the selection in relation to the genetic traits. Heritability in broad
sence, provides a measures of relation ship between real or genetic variance and the observed phenotypic variance. Heritability in broad sense reflects the functioning of genotypes as a whole. In narrow sense it is that parts of the observed variance, which is caused by additeve genetic variance.

**Gupta et al. (1972)** Noted high estimates of heritability in broad sense for the number of seeds per pod and 100-seed weight.

**Bharaduwaj and singh (1972)** Reported high heritability estimates for all the characters except the number of seeds per pod for which it was very low. It appeared that phenotypic selection for branches per plant, pods per plant, 100-seed weight and seed yield per plant was effective for all practical purposes.

**Singh et al. (1973)** Reported that pod bearing length of the (distance) between first and last pod, pods per plant, 100-seed weight and seed yield per plant showed high estimates of heritability in borad sense.

**Chand et al. (1975)** Observed that heritability estimates were moderately high for plant height and 100-seed weight.
Setty (1977) Reported that broad sense heritability estimates were high for 100-seed weight, protein content and harvest index.

Adhikari and pandey (1982) Reported that in case of seed weight, number of pods per plant and seed yield the major part was genotypic showing high heritabilities. Although others characters such as days to flowering and seeds per pod exhibited relatively high heritabilities but the expected genetic advance due to selection was low because of narrow total variation .

Kambale et al. (1984) Observed that the pod variation per plant, dry matter production per plant, 100-seed weight and seed yield per plant gave moderate to high values for heritability.

Jivani and yadvendra (1988) Revealed high heritability estimates for plant height, days to flowering, days to maturity, plds per plant, 100-seed weight and harvest index.

Mishra et al. (1988) Reported high heritability estimates for all the characters studied. High heritability coupled with high genetic advance was observed for number of secondary branches per plant, number of pods per plant, seed yield per plant, biological yield per plant and harvest index.
Sindhu et al. (1989) Noted that both grain yield and protein content showed high heritabilities (88.1% and 73.8% respectively).

Sharma (1990) Reported that heritability estimates were high for days to 50 percent flowering, days to maturity, plant height, pods per plant and 100-seed weight.

Singh and Rao (1991) Noted that heritability was high for all the characters except plant spread, pod bearing length and primary branches.

Rao et al. (1994) Noted that heritability estimates were found to be higher for 100-seed weight, plant height and days to flowering while rest of the characters showed low heritability estimates.

Jahagiradar et al. (1995) Observed high heritability estimates for 100-seed weight, days to 50 per cent flowering, number of secondary branches per plant and number of pods per plant.

Samal and Jagdev (1996) Studied the choice of character combination based on four criteria which were functions of heritability ($h^2$) with yield. Yield should be indicated first followed by character having higher $h^2$ rg values.
Kumar and Krishna (1998) Reported that the grain yield showed poor heritability while first podding node, inter node length, days to 50 percent flowering and 100-seed weight showed high heritability.

Tripathi (1998) Reported the high broad sense heritability estimates for pods per plant, seeds per plant, biological yield and yield per plant. It is suggested that selection criteria based on plant height, biological yield and pods per plant will in prove seed yield.

Wahid and Ahmed (1999) Reported that heritability (broad sense) was highest for plant height followed by seed yield and pods per plant.

Kumar and Sharma (1999) Reported that high heritability coupled with high genetic advance as a percentage of mean was observed for number of pods per plant, 100-seed weight. Seed yield per plant, number of pods per plant.

3. GENETIC ADVANCE:

Genetic advance is the most useful estimate as it is the improvement in the genotype in the new population over the base population. Genetic advance is directly related with
the heritability as it gives an idea about the expected genetic gain on account of selection applied for a particular trait. The difference between the mean genotypic value of the progenies of selected population and the mean genotypic value of the original base population dtermines the amount of an expected that would result from selection.

A brief review of work done on the above aspect in chickpea is given below:

**Patil and Phadnis (1977)** Reported that expected genetic advance was high for pods per plant, pod weight per plant, seed weight per plant and 100-seed weight.

**Ram et al. (1978)** Reported that seed number per plant and 100-seed weight showed genetic advance.

**Adhikari and Pandey (1982)** Studied the character like seed weight, number of pods and seed yield per plant and reported high genetic advance from selection. Although other characters such as days to flowering and seeds per pod exhibited the low expected genetic advance due to selection because of narno total variation.

**Khorgade et al. (1985)** Reported that 100-seed weight, seeds per pod, days to 50 percent flowering and branches
per plant gave high estimates of genetic advance.

Maloo and Sharma (1987) Noted high expected genetic advance coupled with high heritability for seed yield, pods per plant and primary branches per plant.

Jivani and Yadavendra (1988) Reported the highest genetic gain for 100-seed weight, pods per plant and to flowering.


Sharma et al. (1990) Reported the highest genetic advance for seed weight.

Sharma et al. (1990) Reported the highest genetic advance of secondary branches per plant followed by 100-seed weight.

Mishra (1991) Revealed that genetic advance was high for 100-seed weight and number of pods per plant.

Chavan et al. (1995) Reported that high genetic advance was recorded for ponds per plants and seed yield. High genetic advance coupled with high heritability for ponds per plant and seed yield indicated the importance of additive genetic variance.
Samal and Jagdev (1996)  Reported that selection indices for yield were constructed and their efficiency assessed in terms of predicted genetic advanced using 24 cultivars. Four groups of indices based on 1-7 characters including yield were evaluated. Efficiency of the indices over direct selection in terms of predicted genetic advance ranged from 5.4 to 101.7% the highest efficiency being for all the inclusive 7 character index. In all the four groups, the efficiency of indices increased with increasing number of characters.

Kumar and Krishna (1998)  Observed genetic advance and Suggested that first podding node, inter node length and number of pods per plant were important yield components to select for high yield. High genetic advance was also reported for 100-seed weight.

Tripathi (1998)  Reported that high genetic advance were observed for pods per plant, seeds per pod, biological yield and yield per plant. It is expected yield and pods per plant will improve seed yield.

4. CORRELATION STUDIES:

The study of correlation provides on estimates of association between the various characters.
The correlation Coefficients suggest the component characters on which selection can be based for substantial improvement in yield, the data available to the plant breeder on to or more plant characteristics of a sample or a group of particular crop help einmensely in estimating to degree of association among them. The degree of relationship is generally measured in the term of statistical correlation coefficient which varies from 1 to +1

A brief review of work done on above aspect in chickpea is given below:

Phadhis et al. (1970) Analyzed the correlation coefficients between yield and other aronomic characters and reported that yield was highly influenced by seed weight followed by number of seed and number of pods plant. A negative correlation was observed between yield and plant height. These indicated that selection of dwarf plants with higher number of pods and seeds per pod can give better yield.

Khosh-Khui and Nekhecyad (1972) Observed that minimum number of genes controlling height were significantly corre-
lated with total seed weight and significantly but negatively correlated with 100-seed weight.

Gupta et al. (1972) reported that seed yield had significant and positive phenotypic correlation with days to 50 days to 50 percent flowering primary branches, secondary branches, pods per plant and seeds per pod.

Singh et al. (1973) studied the seed yield which showed a significant and positive phenotypic correlation with 100-seed weight and pod bearing length. Pod number showed significant negative correlation with pod bearing length and 100-seed weight. Pod bearing length was positively correlated with 100-seed weight.

Khan et al. (1975) reported yield to be positively correlated with plant height, number of primary branches secondary and tertiary branches and number of pods per plant. Negative correlations were observed between yield, number of seeds per pod and seed size. There were strong positive genetic correlations between yield and all the other traits studied except seed size.

Bahl et al. (1976) observed that seed yield per plant had significant positive correlations with number of pods per
plant and 100-seed weight. Number of Branches were significantly and positively correlated with pods number per plant. Seeds per pod showed significant and negative correlation with seed weight.

*Singh et al. (1976)* reported that seed yield was positively correlated with the number of branches and pods per plant. Whereeas 100-seed weight was negatively correlated with the number of seeds per pod.

*Oraon et al. (1977)* reported that henolypic correlations were slightly higher than their correlations esponding phenotypic correlations. Grain yield per plant was positively correlated with number of pods per plant and number of seeds per pod.

*Tyagi et al. (1982)* coneladed that grain yield was found to be positively associated with pods per plant, seeds per pod and secondary branches.

*Islam et al. (1984)* reported taht yield per plant was significantly and positively correlated with pods per plant and number of secondary branches per plant.

*Khorgade et al. (1985)* observed that partial correlation and regression studies showed that 100-seed weight and
branches per plant were the most important yield components of 18 selection indices compared. The only single character index was more effective than yield was 100-seed weight.

Singh et al. (1986) observed that seed size. Pods per plant and primary branches per plant were the main yield component traits.

Paliwal et al. (1987) noted that seed yield per plant was positively correlated (at phenolypic level) with plant height days to 50 percent maturity and days to 50 percent flowering.

Sharma et al. (1988) found that seed yield was positively associated with plant spread of primary branches, secondary branches per plant, pod bearing length, number of pods per plant, biological yield and harvest index.

Jivani and Yadvendra (1998) reported that yield is positively and significantly correlated with branches per plant, pods 100-seed weight and it was suggested that number of branches and pods per plant, 100-seed weight and harvest index could be used to make indirect selection for seed yield.

Malik (1988) reported that pods plant, seeds per pod
and 100-seed weight were positively correlated with seed yield.

_Sindhu and Mandal (1989)_ reported that seed yield was positively correlated with primary and secondary branches, pod number & seed number and seed per pod.

_Chaudhary et al. (1991)_ Concluded through their study that biological yield was main determinant of seed yield.

_Lal et al. (1993)_ observed that seed yield was significantly and positively correlated with pod number and plant height and significantly but negatively correlated with 100-seed weight.

_Arora and Kumar (1994)_ concluded that seed yield per plant was positively associated with biological yield per plant, pods per plant, plant height and 100-seed weight.

_Rao et al. (1994)_ reported that seed yield per plant had significant and positive association with pods per plants, harvest index, secondary branches, primary branches, primary branches and 100-seed weight.

_Bhambolta et al. (1994)_ revealed positive association of pod bearing branches per plant, pods per plant and plant height with seed yield.
Sarvila and Hoyal (1995) revealed significant association between yield and 100-seed weight, plant height, number of primary branches, secondary branches, number of pods per plant, days to maturity and days to 50 percent flowering at both phenotypic and genotypic level.

Chand and Singh (1997) studied on eight yield components in 49 genotype grown during 1983-84 and concluded that number of pods and seeds per plant were the most important yield contributing characters.

Altinbase et al. (1998) reported significant differences among the genotypic performances for seed yield and 100-seed weight. All simple and rank correlation between the two trials were estimated to be non-significant. Some genotypes with higher yields and bolder seeds than control cultivars were suitable for branches per plant. 1000-seed weight and seed yield was recommended based on the results.

Yadav and Sharma (1998) reported the yield to be positively correlated with days to maturity and seeds per pod and megalively correlated with days to 50 percent
flowering number of branches per plant and 100-seed weight.

*Wahid and Ahmed (1999)* reported that plant height and pods per plant had a strong and positive association with seed yield.

*Kumar and Sharma (1999)* reported that number of pods per plant, 100-seed weight and harvest index showed highly significant and positive correlations with seed yield per plant.

5. **PATH COEFFICIENT ANALYSIS**:

Path coefficient analysis was originally proposed by Wright in (1921) and later described by Dewasy and Lu in (1959) in a more lucid manner, Path coefficient is simply standardized partial regression coefficient and as such measures the direct influence of one variable upon another which permits the separation of "r" (Correlation coefficient) in two component of direct and indirect effect. The use of path coefficient analysis requires an causal and effect situation among variables.

The literature available for the path coefficient analysis in chickpea (Cicer arietinum L.) are discussed below:
Grain yield per plant was found to be high but negative. Singh et al. (1978) reported that a selection index based on more number of pods and primary branches and these secondary branches should improve the yield. Tomar et al. (1982) observed that pods per plant and secondary branches were the most stable and important yield contributing traits. The other characters, which would be kept in mind for selection of plants were 100-grains weight, seeds per pod and pod bearing length coupled with longer duration of seed development would provide a better plant type. Tyai et al. (1982) reported that primary branches per plant, seeds per pods and 100-seeds weight had higher positive direct effects on grain yield. Singh et al. (1985) indicated that seeds per pod had the highest direct effect on yield while most of the other characters affected the yield indirectly via pods per plant. Singh (1986) noted that pods per plant, seed per plant and secondary branches per plant had the greatest effects on yield, seed weight was on pods per plant, seeds per pod and branches per plant.
Paliwal et al. (1987) reported that 100-seed weight had the highest positive direct effect on yield followed by pods per plant, seeds per pod and days to 95 percent at maturity.

Sharma and Maloo (1988) examined that number of pods per plant had the maximum direct effect in both the plantings followed by number of primary branches per plant and days to flowering.

Sharma (1989) concluded that the number of pods per plant exhibited the highest direct positive contribution towards the seed yield.

Sindhu et al. (1991) reported that pods per plant had the highest direct genotypic and phenotypic effects on seed yield. They again resolve that seed yield was positively associated with seeds per pod, primary and secondary branches and ponds per plant and the letter three traits had good association among themselves.

Lal et al. (1993) reported the number of pods per plant had direct effect on seed yield followed by plant height.

Arun (1994) suggested that while making selection the maximum emphasis should be given on biological yield.
Sarvalia and Goyal (1994) Reported that number of pods per plant and 100-seed weight had high direct effect on seed yield.

Arora et al. (1995) Observed that biological yield per plant, harvest index, pods per plant and 100-seed weight had the highest positive direct effect on seed yield per plant.

Das Gupta et al. (1995) Determined that the pods per plant, 100-seed weight per plant, seeds per plant and seeds per pod registered highly positive direct effects on yield.

Singh et al. (1996) Concluded that bio-mass per cent had the greatest direct effect on seed yield followed by 100-seed weight and seed per pod.

Yousefi et al. (1997) Observed the path coefficients and showed that 100-seed weight, number of pods per plant and number of seeds per pod had high direct effects on yield.

Cinowy and Yaman (1998) Reported that nearly about 125 Populations were examined for 17 yield components at several places in Turkey in 1993. They got Significant correlations between pods per plant and seed weight per plant, and seed weight per plant. Direct effect on leoflet
length, length of pods and seeds per pod on seed weight were Significant. They also revealed that negative correlation between seed weight, period of flowering and canopy height.

*Kumar and Kuamr (1999)*  Reported that path coefficient analysis indicated that harvest index and biomass yield per plant registered highly positive direct effects on seed yield.

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