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Assessment of genetic variability for crop improvement and its components in chickpea (*Cicer arietinum* L.): A review

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Abstract
The present review emphases on genetic variability component study in chickpea. Despite enormous potentials for its quantitative and qualitative improvement. Chickpea is bestowed with unique combination of reasonable yielding ability even under adverse conditions, optimal nutritional profile, high tolerance to abiotic stresses and above all high biomass production; part of which get added to soil when leaves are shed consummating in value addition to soil. The incredible legume has diversified uses with unequivocal exquisite consumer's preference across the country. The finding will help to a great extent in maintenance breeding, quality seed production, seed certification and seed testing program. It also used for screening of genotypes for quality and high yield. Despite the productivity of the crop has not evinced ameliorations in consonance to its significance. Generating information about the genetic variability, relationships, and mechanisms of inheritance of the genetic characters involved is the key task in genetic improvement of any crop plant. The knowledge of heritability helps the plant breeder in predicting the behavior of the succeeding generation and making desirable selection.

Keywords: Chickpea, abiotic, biomass, genetic variability, yield and heritability

Introduction
Domestic annual production of pulses had been more or less rallying around 13-14 million metric tons, though lately in pursuant to food security mission it has catapulted to over 18 million metric tons. The shortage of pulses has been critical since long. The major reason for this sorry state of affairs of production of pulses is the second rung treatment meted out to pulses vies a visa green revolution. As a spinoff, the production of pulses could not take precedence to burgeoning population. This has pathetically tipped the situation towards malnutrition as the national per capita availability of pulses is abysmally low (28 g/capita/day) as compared to optimum and minimum requirements of 104 and 80g/capita/day as per WHO standard, respectively [1]. The dilemma becomes still more precarious considering that the predominant Indians are vegetarians.

Chickpea (*Cicer arietinum* L.) is a major food crop, especially in tropical and subtropical climates [2], and is classified as one of the world's ancient and most often cultivated legumes in the Fabaceae (Leguminosae) family [3]. It is a cool-season pulse crop [4], and also known as Gram, Bengal gram or Chana in Hindi (as well as other names). Despite the fact that it is a diploid (2n=2x =16) and primarily self-pollinated crop, cross-pollination by insects does occur on occasion. It has spread across more than 50 countries, with Asia accounting for 89.7 percent of the total, Africa accounting for 4.3 percent, America accounting for 2.9 percent, Oceania accounting for 2.6 percent, and Europe accounting for 0.4 percent [5]. In India, It is grown mainly as a rainfed crop.

Chickpea is hardy, widely adaptable and more tolerant to drought and high temperatures than most other pulse crops. It grows well in tropical and sub-tropical environments extending between 300N and 300S latitudes with a temperature range of 20° to 40°C [6]. It is normally grown as an annual shrub, though seminally it is perennial. The early maturity with low spread of the plant, determinate growth habit, resistance to biotic and abiotic stresses are some the characters that have been improved over time in cultivated plant type. Consequent upon these ameliorations, the country has been harvesting almost the same production of chickpea in lesser number of days than what it used to harvest earlier making lot of spare land available for other crops [7].

Overview of Genetic Improvement Programs

India distinguishes itself by ranking first in acreage, production and growing over a dozen numbers of pulses over different seasons. This reflects that though the green revolution has reduced the hunger index, yet malnutrition is still rampant and pervasive over punctuated expanses. The weather conditions have been predicted to be more truant or otherwise capricious both in quantum and kind as a consequence of global warming. The impact of such forebodes is already evident on agricultural production scenarios in many parts of the world [8].

The social need for food and nutritional security to ever burgeoning population pressure sync with dissipating natural resources and imminent impulsive unpredictability of weather conditions for sure foreshadows the challenges ahead to rein insurmountably ensnared mal-nutrition, if comprehensive corrective steps are not taken. This simply accentuates for all out concerted efforts for enhancing of production of pulses that are rich sources of protein and minerals. Chickpea is a good source of carbohydrates (64%), proteins (23%), fats (5%), starch (47%), crude fiber (6%), solid sugar (6%), ash (3%) and essential minerals (Ca, Fe) (Kumari & Singh, 2017). As 60% of Indians are vegetarians and Chickpea is a good substitute to meat, Importance of Chickpea is more in our country when compared to other Asian countries. Chickpea is consumed in whole fried form, split grains, green immature grains is used as vegetable, Chickpea flour is a common ingredient in sweets and snacks in the sub-continent [9].

Breeding Behavior

The ultimate aim of any plant breeding program is to develop cultivars with high potential and consistent performance over diverse environments. The study of genetic variability is the pre-requisite for any crop improvement program. Success in recombination breeding depend on suitable exploitation of genotypes as parent of obtaining high heterosis crosses and transgressive segregants or the presence of genetic variability in base population is essential [10]. Hence, the first step in the development of varieties is assessing the genetic variability of available genotypes for the characters of interest [11]. The presence of genetic variability in available gene pool provides an opportunity for selecting superior genotypes, which can be obtained through high screening and evaluation. Generating information about the genetic variability, relationships, and mechanisms of inheritance of the genetic characters involved is the key task in genetic improvement of any crop plant. The knowledge of heritability helps the plant breeder in predicting the behavior of the succeeding generation and making desirable selection.

Genetic Resources and their Utilization

The role of exotic germplasm in supplementing genetic variability in native cultivated chickpea both for broadening the genetic base and providing good combination for exploitation of heterosis in pigeonpea has been documented [12]. The yielding ability is the manifestation of implicitly complex gene action with intricately juxtaposed byzantine interactions of enumerable quantitative components. Therefore, precise knowledge of gene action, environment and their convoluted interactions besides pervasive genetic phenomena like character threshold for expression, penetrance and expressivity etc. assume decisive significance both for breeding and realizing higher yield under the situation [13].

Genetic Variability Behavior

Heritability is the proportion of phenotypic variance attributable to genetic variance. In other words, it may be defined as the extent to which genetic individual differences contribute to individual differences in observed behavior. Its numerical value will range from 0.0 (genes do not contribute at all to phenotypic individual differences) to 1.0 (genes are the only reason for individual differences). For human behavior, almost all estimates of heritability are in the moderate range of .30 to .60.

Improvement in the mean genotypic value of selected plants over the parental population is known as genetic gain under selection. The success of genetic advance under selection depends on three main factors [14].

Correlation is used to find out degree and direction between two or more variables. It is represented by r. correlation may be positive or negative. If the association between two traits is positive, it shows increase of one trait as increase of another trait. And the negative association shows that increase of one trait as decrease of other traits.

Correlation ranges lies between -1 to 1. It is independent of unit of measurement. Simple correlation is three types: Genotypic correlation, phenotypic correlation, and environment correlation.

Genotypic correlation may be either due to pleiotropic action of genes or due to linkage or more likely both. The main genetic cause of such correlation is pleiotropy, which refer to manifold effects of a gene [15]. Phenotypic correlation includes both genotypic and environmental effects and therefore differs under different environmental conditions. Environmental correlation is due to the environmental effects or due to error variance. This is not of much importance to a breeder as it is not heritable and stable.

The concept of path coefficient analysis was originally developed by [16] but the technique was first used in plant breeding by [17]. This method was illustrated as a means of analyzing correlation coefficient. A path coefficient is simply standardized partial – regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of the correlation coefficients into components of direct and indirect effects. The path analysis unravels whether the association of independent characters with dependent variable is due to their direct effect on it or is a consequence of their indirect effect via some other traits.

Conclusion

The success of any hybridization program is truly based on the level of genetic diversity and variability available among the genotypes under study. Path coefficient analysis can be expressed as the ratio of the standard deviation of the effect due to a given cause to the total standard deviation of the effect, also called standard partial regression coefficients which splits the correlation coefficient into the measures of direct and indirect effects, i.e., it measures the direct and indirect contribution of various independent characters on a dependent character. They are free from units, directional and may be more or less than unity and therefore, enable easy interpretation. Study of genetic diversity helps to identify the most diverse genotypes which is required for selection in

breeding program. Knowledge regarding the parameters of variability such as GCV and PCV helps to study the extend of variability present among the genotypes. Heritability is another important parameter which helps us to estimate the transmission of characters from parents to the off springs. Character association analysis such as path and correlation studies help to select the best high yielding genotypes and the associated traits related to it.

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