Biological Forum – An International Journal **14(2): 1041-1044(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Recent Trends on Genetic Variability and Diversity in Chickpea (*Cicer aritenum* L.)

Sheeshpal, Suhel Mehandi*, Harmeet S. Janeja, Mamta Choudhary and Nidhi Sharma
[1]Department of Genetics and Plant breeding, School of Agriculture,
Lovely Professional University, Jalandhar (Punjab), India.

(Corresponding author: Suhel Mehandi)*
(Received 15 March 2022, Accepted 20 May, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Intake of low nutritional food which does not contain enough number of proteins, fats, vitamins etc. It is very common in Asian countries. Condition of malnutrition can easily be seen in child under age of 5 and mostly in vegetarian population of India. In such case, genetical improvement of crop by increasing their nutrient content through genetic engineering has potential to overcome with this issue. Pulses are the best alternative of protein rich diet for people, nutritional content of pulses is much higher than that of cereals. There are many pulses crop like Moong bean, Urd bean, Lentil, Arhar and Chickpea. India is the largest grower or supplier of pulses in world it accounts overall 20% of food grain area under pulses. In this review we will discuss about the chickpea its characterization on the basis of origin, cultivation, morphology, genetic makeup, nutrition content etc.

Keywords: Chickpea, variability, diversity, protein.

INTRODUCTION

Cicer arientinum L. commonly known as Chana and is known by different other names in different areas and localities. Chickpea is a self-pollinated crop having chromosome number 16 and belongs to family Fabaceae. In India, state to state local names of Chickpea varies. Chickpeas are most commonly grown *kharif* season crop in Northern India. Which is also known as Bengal gram, Chana, Chole, Kabuli Chana, Egyptian Pea etc. (Hajibarat *et al.*, 2015). It is reported as originated in South Eastern part of Turkey and spread all over the world (Ahmad *et al.*, 2010). It scientifically named "*Cicer arientinum*" belongs to family Leguminosae and comprises of almost 43species among all only 9 are cultivated and seasonal others are perennial in nature. Chickpea is considered as third staple pulse crop after French bean and Field pea. The Chickpea is preferred to be grown in Rabi season in areas of good rainfall for higher yield and well adopted to be grown in semi-arid region. Sandy loam soil with good drainage is required for good cultivation of chickpea (Talebi *et al.*, 2008). There are two types of Chickpeas grown in all over world one is Desi and other is Kabuli both are grown in Rabi season (Thudi *et al.*, 2016). Chickpea is cultivated in an area of 13.2 m ha from this amount of area it accounts about 11.62 m tonnes per annum and is grown in more than 50 countries. The area and production wide India ranks first in position by producing 70% of world production. Chickpea is one of the most suitable crop for sustainable agriculture. Chickpea crop fixes atmospheric nitrogen having tap root system and also completes crop rotation with cereals. It seems like too good a fixer of nitrogen through its symbiotic association with Rhizobium. It fixes about 140 Kg N/ha and meets 80% nitrogen requirement. The root of Chickpea goes too deep in the soil and makes lower layer of porous which promotes good aeration and water holding capacity of the soil. After harvesting a good amount of atmospheric fixed nitrogen as well other biomass of crop has remained in the field which promotes the soil quality. In India and other regions like the Middle east and South Asian countries. Chickpea provides a great source of proteins for vegetation peoples and provides protein content about 22%. Minerals like Magnesium, Calcium, Phosphorus and Lipids etc. in unsaturated fatty acids and fiber also present in good amount in Chickpea. The amount of Caretonoids present in Chickpea is high as compared to golden rice. Chickpea has no anti-nutritional factor like it does not suppress the level of other nutrients. Various kinds of acid exudates were released from the leaves of chickpea has a very beneficial role medicinally like in Snakebite, diarrhea, cholera, constipation, warts and sunstroke (Nisar *et al.*, 2007). It is also used to reduce

blood cholesterol levels and acts as a hypo-cholesteric agent. Both economic and biological parts of chickpea are important from a consumption point of view for humans and animals (Ahmad *et al.,* 2012). Humans used it as flour after grinding, processed fruits and after harvesting the remaining part of the plant is used as a feed for livestock. Purple is the flower color of the desi type of chickpea because of the presence of pigment anthocyanin but in Kabuli type there is an absence of pigments, therefore the flowers are whitish in color (Sethy *et al*., 2006). The seed color of the desi type of chickpea is dark multi-colored and the seed coat is rough while Kabuli chickpea is white in color and the size is large as compared to the desi type of chickpea. Chick pea accounts 50% of area under total pulse production. It supported as best food for human and animal as well. Husk left after processing could be easily utilize as cattle food (Naghavi *et al*., 2012).

Chickpea is commonly classified into two groups which are as follows:

Desi chana scientifically named as "*Cicer arientinum* L."Gram grown under this group are most widely grown group and have color variation from yellow to brown (Sethy *et al*., 2006). Seed of this particular group is small in size. Height of plant are less and heavily branched with thick erect stem. Crop of this group required almost 145-150 days to attain maximum maturity (Sani *et al.,* 2018). Total yield potential of per hectare is accounts 22-25 quintals. Kabuli chana scientifically named as "*Cicer kabulium*" Gram grown under this group are white in color and seed of this group are broad and well shaped. Plants of Kabuli (*Cicer kabulium*) are small but taller than that of Desi *(Cicer arietinum*) and heavily branched, flower color of this group plants is white (Bayraktar & Dolar 2009). The crop of this group matures in 130-140days under well irrigated condition. Total yield potential of this group is reported about 25 quintals per hectare (*Hajibarat et al*., 2015). Chickpea is one of highest protein rich pulse ranges 10-12%, Fiber 9.6g, Carbohydrates 35g, Fat 3.5g, Calories about 200g and another micro nutrient also. Chickpea can be considered as plant-based protein food which is very good supplement for hairs, skin and building block of body *(*Ahmad *et al*., 2012).

Genetic diversity of Chickpea. Characterization of genetic diversity of Chickpea (*Cicer aritenum* L.) and (*Cicer kabulium*) for carrying successful breeding program collection of germplasm is required. Genetical characterization of crop species are carried out by different biochemical, molecular method and genetical marker. The characterization done for identification of best variety, stability (Jingade *et al.,* 2014). The molecular markers used for genetic characterization are generally neutral in nature, not restricted with age of tissue, adopted in all kind of environmental conditions use of this markers are more efficient (Ahmad *et al*., 2012).

Germplasm collection of Chickpea. As global population rising and diamond for food and space will be expected to be increase in this race it causes major disturbance in ecosystem, extinction of various species of plants and animal as well (Bhagyawant and Srivastava 2008). In this case conservation of germplasm is required to maintain sustainability and to protect integrity of species so, in future it could be use for development of new species, their improvement through in situ & ex-situ conservation, genetical modification, gene library etc. Germplasm stored in the bank sever as foremost source of raw material for crop improvement program *(*Hameed *et al*., 2009). In India very large gene bank is located in NBPGR New Delhi where about orthodox seed is 396189 representing 1584 species and it was started in year 1970. Both Indian and USDA collabrotedly started work of conserving germ plasma of chickpea in year 1970, where they had stored 7000 germplasm under Pulse improvement program. NBPGR adjoining with ICRISAT has collected wide number of species of *Cicer. microphyllum* from many countries like Turkey, Afganistan, Pakistan and Syria (Rairia *et al.,* 2019; Mehandi *et al*., 2013).

The wild species collected from different continents of world are *C. nuristanicum, C. microphyllum, C. macrocanthum, C. judaicum, C. reticulatum, C. pinnatifidum, C. yamashitae.*

Collection of these germplasm found very valuable for conservation of species for our coming future generation *(*Upadhyaya *et al*., 2011).

LIST OF ANNUAL SPECIES	LIST OF PERENIAL SPECIES
• *C. bijugum* 49species from Iraq, Syria, and Turkey. • *C.chorassanicum* 4 species from Afghanistan . • *C. cuneatum* 5 species from Ethiopia. • *C. echinospermum* 18 species from Turkey. • *C. judaicum* 70species from Afghanistan Ethiopia, India, Israel, Jordan, Lebanon, Morocco, Syria, and Turkey. • C. ppinnatifidum 42 species from Ethiopia, Israel, Lebanon, Syria, and Turkey. • *C. reticulatum* 36 species from Turkey. • *C. yamashitae* 7 species from Afghanistan.	• *C. anatolicum* 3 species Turkey. • *C. canariense* 1 species from Spain. • *C. floribundum* 1 species fromTurkey. • *C. macracanthum* 5 species from Pakistan. • *C. microphyllum* 52 species fromIndia and Pakistan • *C. montbretii* 2 species from Turkey • *C. multijugum* 1 species Russian Federation • *C. nuristanicum* 2 species from Pakistan • *C. pungens* 9 species from Afghanistan • *C. rechingeri* 1 species from Afghanistan

Genetical markers and Gene Sequencing. Genetic modification or development of resistance against diseases through genetic process is done in wild species of Chickpea such as *C. nuristanicum, C. microphyllum, C. macrocanthum, C. judaicum, C. reticulatum etc.* Crop of chickpea is attacked by various pathogens such as fungi, bacteria, virus and nematodes like wilt, smut, blight and many more .One of most common diseases seen in Chickpea is fusarium wilt causal organism is *Fusarium oxysporum* cause most drastic damage to crop (Agarwal *et al*., 2012). The appearance of new strains of pathogens against pesticides, fungicides cause major problem for assessing the problem alteration of new variety with genetical modification against pathogen is required under which diseases resistance gene will be incorporated under DNA of plant further after field trails it will get available to farmers (Jain & Chattopadhyay 2010).

Characterization of gene. Annual Chickpea species *C. reticulatum* have been identified as most valuable species because it has ability to represent improved gene base for development of diseases resistance cultivated crop species Apart from diseases resistance genetic modification is also required for developing tolerance against biotic and a-biotic stress such as drought, water logging, salinity, heavy metal etc (Naghavi *et al.,* 2012). For developing resistance or tolerance against biotic and abiotic stress selection of gene and its importation in wild and cultivated species is done through inter-specific hybridization. Under the situation of stress Plant adopt itself on morpho-physiological bases in such case identification of correct gene for particular stress become most important part of gene characterization. Under Crop improvement program have many integrated parts like selection and identification of gene, proper utilization, alteration through genetic process and breeding. Without molecular techniques it is most difficult part to identify correct trait, marker assisted selection and incorporation in wild species. Many group of researcher has identified to species of Cicer for genetical breeding from cultivar *Cicer arientinum* and from wild *Cicer reticulatum* because of their durability. Whole resequencing of genome was done through process of single nucleotide polymorphism (Bayraktar & Dolar, 2009). Improved genetic map with more advancement of 95% spacing achieve 3d in Desi type of chana. In case of kabuli, sequencing of gene map was done in through shotgun method of sequencing. Both parental lines of *C. arietinum* and *C. arietinum* wild and cultivar species gene sequencing was also achieved by shotgun method of gene sequencing (Millan *et al.,* 2015). CDC frontier variety of Chickpea is the example of shot gun sequencing. Whole plastid genome of wild species is very important for understanding the phylogenic studies, crop improvement program and their function in increasing photosynthetic efficiencies. Selection of molecular marker for characterization of genetic diversity for economic purpose is very efficient and also improve the assessment of gene traits selection (Gusae & Petros 2018). In developing country like India carrying gene based technology work for developing new resistance cultivar is not much done because of some social, economical reason (Mehandi *et al.,* 2015). International agency like ICRISAT has started work on semi arid areas of world launched crop improvement programs and generated more then 1800SSR markers of Chick pea (Jingade *et al.,* 2014)

RESISTANCE	SPECIES
Stress	
• Drought	*C. microphyllum, C. montbretii, C. oxyodon*
• Salinity resilience	*C. pinnatifidum, C. reticulatum, C. microphyllum*
Diseases	*C. echinospermum, C. judaicum, C. pinnatifidum, C.*
• Root knot nematode resistance	*microphyllum, C. pinnatifidum, C. reticulatum, C. judaicum,*
• pod borer resistance	*C. pinnatifidum, C. reticulatum*
• Fusarium wilt resistance	

CONCLUSION

For developing countries like India, Pakistan, Afghanistan *etc.* pulses are serving as major source of protein. Chickpea is cultivated in all over world and considered as second most important pulse crop. Because of less engagement of researchers and breeders Chickpea does not get enough advancement in genetical models. Major focus of researchers are in developing high yielding varieties according different agroclimatic zones and less in devastating pathogen or stress resistance species. Recently, most focused area researchers to develop new resistance cultivar against drought, salinity, heat and pathogens etc. Genetic characterization of Chickpea provides wider scope for advancement of Chickpea.

REFERENCES

Agarwal, G., Jhanwar, S., Priya, P., Singh, V. K., Saxena, M. S., Parida, S. K., and Jain, M. (2012). Comparative analysis of kabuli chickpea transcriptome with desi and wild chickpea provides a rich resource for development of functional markers. *PloS one*, *7*(12), e52443.

Ahmad, Z., Mumtaz, A. S., Nisar, M., and Khan, N. (2012). Diversity analysis of chickpea (*Cicer arietinum* L.) germplasm and its implications for conservation and crop breeding. *Agricultural Sciences*, *3*(05), 723.

Ahmad, F., Khan, A. I., Awan, F. S., Sadia, B., Sadaqat, H. A., and Bahadur, S. (2010). Genetic diversity of chickpea (*Cicer arietinum* L.) germplasm in Pakistan as revealed by RAPD analysis. *Genetics and Molecular Research*, *9*(3), 1414-1420.

Bhagyawant, S. S., and Srivastava, N. (2008). Genetic finger printing of chickpea (*Cicer arietinum* L.) germplasm using ISSR markers and their relationships. *African Journal of Biotechnology*, *7*(24).

Bayraktar, H., and Dolar, F. S. (2009). Genetic diversity of wilt and root rot pathogens of chickpea, as assessed by RAPD and ISSR. *Turkish Journal of Agriculture and Forestry*, *33*(1).

Gubae, T. T., & Petros, Y. (2018). Genetic diversity of chickpea (*Cicer arietinum* L.) cultivars from Ethiopia by using ISSR markers. *Journal of Agricultural Biotechnology and Sustainable Development*, *10*(9), 178-184.

Gupta, P., Mehandi, S. and Lal, G.M. (2016). Genetic Diversity Study in Blackgram (*Vigna mungo* (L) Hepper) Genotypes *International Journal of Agriculture of Sciences*, *49*(8): 2056-2058.

Hajibarat, Z., Saidi, A., Hajibarat, Z., and Talebi, R. (2015). Characterization of genetic diversity in chickpea using SSR markers, start codon targeted polymorphism (SCoT) and conserved DNA-derived polymorphism (CDDP). *Physiology and molecular biology of plants*, *21*(3), 365-373.

Hameed, A., Shah, T. M., Atta, B. M., Iqbal, N., Haq, M. A., and Ali, H. (2009). Comparative seed storage protein profiling of Kabuli chickpea genotypes. *Pak. J. Bot.*, *41*(2), 703-710.

Jain, D., and Chattopadhyay, D. (2010). Analysis of gene expression in response to water deficit of chickpea (*Cicer arietinum* L.) varieties differing in drought tolerance. *BMC plant biology*, *10*(1), 1-14.

Jingade, P., Bhosale, L. V., Sanjayrao, J. A., Rajanna, R., Jain, M., and Ravikumar, R. L. (2014). Characterization of microsatellite markers, their transferability to orphan legumes and use in determination of genetic diversity among chickpea (*Cicer arietinum* L.) cultivars. *Journal of Crop Science and Biotechnology*, *17*(3), 191-199.

Millán, T., Madrid, E., Cubero, J. I., Amri, M., Castro, P., and Rubio, J. (2015). Chickpea. In *Grain legumes* (pp. 85-109). Springer, New York, NY.

Mehandi, S., Singh, C.M. and Kushwaha, V.K. (2013) Estimates of genetic variability and heritability for yield and yield component traits in mungbean [*Vigna radiata* (L.) Wilczek] *The Bioscan*, *8*(4): 1481-1484.

Mehandi, S., Singh, I.P., Bohra, A., and Singh, C.M. (2015) Multivariate analysis in green gram [*Vigna radiata* (L.) Wilczek]. *Legume Research*, *38*(6): 758-762.

Nisar, M., Ghafoor, A., Khan, M. R., Ahmad, H., Qureshi, A. S., and Ali, H. (2007). Genetic diversity and geographic relationship among local and exotic chickpea germplasm. *Pak. J. Bot.*, *39*(5), 1575-1581.

Naghavi, M. R., Monfared, S. R., and Humberto, G. (2012). Genetic diversity in Iranian chickpea *(Cicer arietinum* L.) landraces as revealed by microsatellite markers. *Czech Journal of Genetics and Plant Breeding*, *48*(3), 131-138.

Raina, A., Khan, S., Wani, M. R., Laskar, R. A., and Mushtaq, W. (2019). Chickpea (*Cicer arietinum* L.) cytogenetics, genetic diversity and breeding. In *Advances in Plant Breeding Strategies: Legumes* (pp. 53-112). Springer, Cham.

Sethy, N. K., Shokeen, B., Edwards, K. J., and Bhatia, S. (2006). Development of microsatellite markers and analysis of intraspecific genetic variability in chickpea (*Cicer arietinum* L.). *Theoretical and Applied Genetics*, *112*(8), 1416-1428.

Sani, S. G. A. S., Chang, P. L., Zubair, A., Carrasquilla-Garcia, N., Cordeiro, M., Penmetsa, R. V., and von Wettberg, E. J. (2018). Genetic diversity, population structure, and genetic correlation with climatic variation in chickpea *(Cicer arietinum*) landraces from Pakistan.

Talebi, R. E. Z. A., Fayaz, F. A. R. Z. A. D., Mardi, M. O. H. S. E. N., Pirsyedi, S. M., and Naji, A. M. (2008). Genetic relationships among chickpea (*Cicer arietinum*) elite lines based on RAPD and agronomic markers. *Int. J. Agric. Biol.*, *8*, 301-305.

Talebi, R., Naji, A. M., and Fayaz, F. (2008). Geographical patterns of genetic diversity in cultivated chickpea (*Cicer arietinum* L.) characterized by amplified fragment length polymorphism. *Plant Soil Environ*, *54*(10), 447-452.

Thudi, M., Chitikineni, A., Liu, X., He, W., Roorkiwal, M., Yang, W., and Varshney, R. K. (2016). Recent breeding programs enhanced genetic diversity in both desi and kabuli varieties of chickpea (*Cicer arietinum* L.). *Scientific Reports*, *6*(1), 1-10.

Upadhyaya, H. D., Thudi, M., Dronavalli, N., Gujaria, N., Singh, S., Sharma, S., and Varshney, R. K. (2011). Genomic tools and germplasm diversity for chickpea improvement. *Plant Genetic Resources*, *9*(1), 45-58.

How to cite this article: Sheeshpal, Suhel Mehandi, Harmeet S. Janeja, Mamta Choudhary and Nidhi Sharma (2022). Recent Trends on Genetic Variability and Diversity in Chickpea (*Cicer aritenum* L.). *Biological Forum – An International Journal*, *14*(2): 1041-1044.