Agricultural Reviews, 39(3) 2018: 255-258
Print ISSN:0253-1496 / Online ISSN:0976-0539

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Genetic diversity among taro (*Colocasia esculenta* (L.) Schott var. *antiquorum*) germplasm- A review

Khushboo Kathayat*, M.L. Kushwaha[1] and Monisha Rawat

Department of Vegetable Science,
Lovely Professional University, Jalandhar G.t Road, Phagwara-144 411, Punjab, India.
Received: 05-10-2017 Accepted: 12-03-2018 DOI: 10.18805/ag.R-1762

ABSTRACT

Taro (*Colocasia esculenta* (L.) is one of the important underground vegetable crops grows vegetatively in various parts of India as well as in Africa. But there are few standard cultivars available for commercial cultivation and local germplasms across various parts of the world have a lot of genetic variation. For any crop improvement programme, aimed to achieve maximum productivity, a detailed knowledge of facts such as genetic variability, genetic diversity, heritability, genetic advance, correlation and path coefficient of various quantitative traits and their contribution towards yield is essential. Studies in this direction are very less and can not to be generalized for every climatic condition and with other genetic materials. Hence, the information in a collection of some indigenous genotypes of taro in order to formulate a sound breeding plan for its improvement has been reviewed here.

Key word: Correlation, Genetic diversity, Taro, Path coefficient, Variability.

Success of any breeding programme depends much on genetic diversity available to the breeders and the judicious selection of parents. The success of breeding programme is achieved by the efficient utilization of heritability and variability available in the population. The importance of genetic diverse genotypes as a source of obtaining transgressive seggregants with desirable combinations have been realized by several workers (Kurian and Peter, 1994). Mahalanobis (1936) has been used distance as an efficient tool in quantitative estimation of genetic diversity and a rational choice of potential parents for a breeding programme. Knowledge of interrelationship between yield and its components is obvious for efficient selection of desirable plant type. Unlike the correlation coefficient values, which measure the extent of relationship, path coefficient (Wright, 1921; Dewey and Lu, 1959) measure the magnitude of direct and indirect effects of characters on complex dependent characters like yield and thus enable the breeders to judge best about the important component characters during selection.

Genetic variability, heritability and genetic advance contributing traits: Genetic variability is an obvious feature of considerable importance in crop improvement. It is the basic necessity for any breeding programme to be successful. The knowledge of existing variability with respect to yield and yield attributing traits in the germplasm of a crop is the basic requirement in order to select the desirable types. Vavilov (1951) for the first time perceived the importance of genetic variability and advocated that the wide range of variability provides better scope of selecting desired genotypes. According to Allard (1960), heritability is the proportion of observed variability which is due to genetic causes, the remainder being due to the environmental cause. Heritability of a character indicates the extent to which the character can be transmitted from one generation to another (Balouch *et al*., 2003) and is a valuable tool to predict the magnitude of genetic gain that follows selection for a character (Adeniji and Kehinde, 2003). Mukherjee *et al.* (2003) observed that cormels per plant showed high genetic coefficient of variation, phenotypic coefficient of variation, heritabiliy and genetic advance as percent of mean.

Genotypic and phenotypic coefficients of variation were high for number of leaves per plant, oxalate content, number of corms and cormels per plant, total yield per plant and corm weight. High heritability coupled with higher genetic advance observed for all the above characters suggesting the importance in the selection programme of yield improvement (Cheema *et al*., 2007).

Yadav *et al*. (2007) observed high genotypic coefficient of variation and heritability among leaves per plant, corm weight, cormel weight, corm length, yield and leaf blight incidence. Three important characters, namely, corm weight per plant, cormel weight per plant and yield (q/ha) recorded high heritability coupled with high genetic and coefficient of variability and advance and indicating a possible role of additive gene effect for the genotypic

*Corresponding author's e-mail: khushboo.22214@lpu.co.in
Lovely Professional University, Jalandhar G.t Road, Phagwara-144 411, Punjab, India.

variance for these characters. Pandey *et al*. (2009) found that phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates that environment plays an important role in expression of these traits.

Sarma *et al*. (2010) revealed highly significant differences among the germplasm for different traits and exhibited higher range of variation. For all the characters phenotypic coefficient of variance was found higher than genotypic coefficient of variance. The studies revealed that almost all the characters showed high heritability coupled with high genetic advance which indicates that characters are least influenced by the environmental effects and governed by additive genes therefore, for improvement of these traits selection will be useful.

Choudhary *et al. (2011)* reported that there was more variability in the characters like plant girth, number of side suckers, number of cormels and cormel yield. The high values of genetic advance coupled with high estimates of heritability suggest that real progress in improvement through selection could be made for yield and associated traits like number of leaves, lamina length and breadth, cormel weight and cormel size.

Devi *et al*. (2013) reported highest phenotypic and genotypic coefficient of variation for the characters like weight of corm per plant, average weight of cormel, average weight of corm, tuber yield per plant, starch content, number of cormel per plant and weight of cormel per plant in taro. High heritability (broad sense)and genetic advance in percent of mean for the characters like weight of corm per plant, average weight of corm, tuber yield per plant, starch content, number of cormel per plant and weight of cormel per plant in taro.

Bhattacharjee *et al*. (2014) observed that length of main sucker and girth of main sucker had high heritability with moderately to high genetic advance percentage as a mean, which indicates additive nature of genetic variance and less influence of the environment and there is more possibility of character improvement through selection. Whereas number of side sucker per plant had moderately low heritability with moderate genetic advance over mean indicating less possibility of improvement of the character through selection. Poddar *et al*. (2015) at Bhubaneswar conducted experiment on variability and heritability of one forty five genotypes of taro. They observed that in general phenotypic coefficient of variation was higher than genotypic coefficient of variation and it indicated the environmental influence over the expression of these characters. They observed high PCV and GCV values among the evaluated genotypes which indicated the presence of considerable variability. Maximum heritability was noticed in yield, number of cormels, corm length and plant height.

Singh *et al*. (2015) at Faizabad observed high phenotypic and genotypic coefficient of variation for corm yield (g) and corm yield per plant. Mukherjee *et al*. (2016) observed highest genotypic and phenotypic coefficient of variation for dry matter percentage. Higher heritability and genetic advance were exhibited by number of cormels per plant and dry matter percentage, indicating the potentiality of selection for improvement of such characters.

Correlation and path coefficient studies: Correlation coefficient is a statistical measure to determine the extent of association, whether positive or negative, between various plant characters and thus, helps to identify the character on which selection can be imposed for improvement in associated characters. Path coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation into direct and indirect effects. In other words, it measures the direct and indirect contribution of various independent characters on a dependent character. The concept of path analysis was developed by Wright (1921) and the technique was first used by Dewey and Lu (1959) that helps in determining yield contributing characters thus, useful in indirect selection. Correlation coefficients along with path coefficients together provide more reliable information, which can be effectively predicted in crop improvement program. If the correlation between yield and a character is due to direct effect of a character, it reveals true relationship between them and direct selection for the trait will be rewarding for yield improvement. However, if the correlation coefficient is mainly due to indirect effect of the character through another component trait, indirect selection through such trait will be effective in yield improvement.

Mehta *et al*. (2003) reported a positive and significant association of tuber yield with corm yield, number of cormels per plant, plant height, number of suckers per plant, petiole length and girth of cormel at genotypic level in taro. Singh *et al*. (2006) studied 36 genotypes of *Colocasia* and reported that the number of corms per plant exhibited highly significant positive correlation with yield per plant where as corm weight per plant showed highly significant and positive association with yield per plant.

Cheema *et al*. (2007) observed fourteen characters in twenty four clones of taro collected from different parts of North India. Studies revealed that there is strong positive and significant correlation between total yield per plant and number of corms, number of cormels per plant, oxalate content, protein content and corm length. The analysis of path reported that number of cormels per plant, protein content, corm weight and length showed direct and positive effects while number of corms per plant and oxalate content had indirect and positive effects on total yield per plant. Similarly Pandey *et al*. (2009) observed that the total yield per plant was positively and significantly associated with number of cormel per plant.

Paul and Bari (2011) evaluated thirty accessions of taro (*Colocasia esculenta* L.) for different plant characters, namely, plant height, petiole length, petiole breadth, leaf number, leaf length, leaf breadth, LAI, inflorescence length, peduncle length, corm length, corm breadth, cormel number, cormel length, cormel breadth, corm weight, cormel weight on yield per plant with objective to study the direct and indirect effects. At the genotypic level plant height, petiole length, corm breadth, cormel number and cormel length showed direct effect on yield per plant whereas at the phenotypic level cormel weight and cormel breadth showed the highest direct effect on yield per plant. Devi *et al.* (2013**)** revealed that weight of corm per plant had maximum positive direct effect on tuber yield per plant followed by weight of cormel per plant at genotypic and phenotypic level in *Colocasia*.

Paul *et al*. (2014) reported that significant and positive correlation with yield per plant was shown by leaf length, leaf number, LAI, cormel length, corm weight and cormel weight.

Singh *et al*. (2015) observed that length of lamina showed positive and highly significant correlation with width of lamina, number of corm per plant, corm yield per plant, diameter of corm, diameter of cormel and cormel yield per plant.

Genetic divergence studies: Genetic diversity in the available gene pool is the source of variation, which is raw for the improvement work. For effective conservation and utilization of *Colocasia* genetic resources, a clear understanding of genetic diversity and relationships of varieties is essential. Precise information on the nature and degree of genetic divergence of the parents is the prerequisite for an effective breeding program. Genetic diversity is a useful tool in quantifying the degree of divergence in a biological population at genotypic level and to assess relative contribution of different components to the total divergence both at intra and inter-cluster levels (Jatasara and Paroda, 1978).

Okpul *et al*. (2004) observed wide variation by using multivariate analysis which was mainly influenced by botanical variety, plant height, lamina colour and variegation, petiole colour, corm shape, corm weight and palatability. The first six principal components gave Eigen-values more than 1.0 and cumulatively accounted for 72.66 % of the total variation. The variation in PC1 was mainly related with corm shape, lamina colour and corm weight whereas, in PC2 the main characters were plant height, petiole colour and palatability. In PC3 most important character is botanical variety. PC4 showed minimum influence from all traits although higher correlation coefficients for altitude, growth habit, leaf shape and petiole colour variations. PC5 and PC6 were mainly associated with lamina variegation and plant height, respectively.

Naskar and Sreekumar (2011) identified three vectors with minimal Eigen value criterion through Principal component analysis, which explained 78% of the variation in the traits. Non- Hierarchical cluster analysis classified all forty three accessions of taro into eight clusters. The maximum number of genotypes was noted in cluster III. The accessions TL-3 and Megh-1 (Meghalaya) were found to be far apart from other accessions and can be utilized for further breeding programmes.

Bhattacharjee *et al*. (2014) assessed the genetic diversity within the population of twenty genotypes of taro collected from different districts of West Bengal and other parts of India by using D^2 statistics and principal component analysis. Appreciable genetic diversity within and between six clusters consisted of 4, 9, 3, 1, 2 and 1 genotypes. Highest genetic dissimilarity was observed between the genotypes BCC-21 and BCC-30, BCC- 18 and BCC-30 and between BCC-30 and BCC- 46. On basis of magnitude of genetic distance, contribution of different characters towards the total divergence and magnitude of cluster means for different characters it was found that FC-4, FC-11, PKS-1, BCC-32, BCC-30 and Muktakeshi might be used as parental material for future breeding program. Similarly Mezhii *et al*. (2015) stated that fifty genotypes were grouped into ten clusters in first year and in second year, nine clusters were observed. The studies revealed that the characters, namely, corm girth, corm yield per plant and number of cormels contributed maximum towards genetic divergence. The clustering patterns indicatethat geographic diversity has impact on genetic diversity.

Poddar *et al*. (2015) observed narrow genetic base among the taro germplasm collection through PCA derived scatter plot. Three major groups were obtained and maximum number of genotypes found to be in major group-II. Intra-specific variability in group-I and group-III was found to be more as compared to group-II. This indicates that there is ample scope for selection of genotypes.

CONCLUSION

The literature reviewed in this paper highlighted the genetic divergence and variability available in taro genotypes. Knowledge of association between yield and its components is very useful for efficient selection of desirable plant type. Therefore, genetically divergent genotypes could be utilized for crop improvement in taro.

REFERENCES

Adeniji, O.T. and Kehinde, O.B. (2003). Inheritance of pods and seeds in West African okra (*Abelmoschus callei*): Generation Mean Analysis. *Nig. J. Genet*., **18**.1-4.

Allard, R.W. (1960). Principles of Plant Breeding. John Wiley and Sons, New York, pp. 92-98.

Balouch, M.Z., Ansari, B.A. and Memon, N. (2003). Performance and selection of intra-specific hybrids of spring wheat (*Triticum aestivum* L.). *Pakistan Journal of Agricultural Sciences*, **19**: 28-31.

Bhattacharjee, M., Tarafdar, J. and Sadhukhan, R. (2014).Assessment of genetic diversity of some indigenous collections of upland taro [*Colocassia esculenta* var. *antiquorum* (L.) Schott] for selection of genotypes aiming at improvement in breeding programme. *IOSR Journal of Agriculture and Veterinary Science*, **77**(1):31-43.

Cheema, D.S., Singh, H., Dhatt, A.S., Sidhu, A.S. and Garg, N. (2007). Studies on genetic variability and correlation for yield and quality traits in *Arvi* [*Colocasia esculenta* (L.) Schott]. *Acta Horticulturae*, **75**(2): 255-260.

Choudhary, V.K., Kumar, S.P., George, J., Kanwat, M. and Saravanan, R (2011). Genetic variability and character association in taro (*Colocasia esculenta* (L.) Schott.) under Mid-Hills of Arunachal Pradesh. *Journal of Root Crops*, **37**(2):155-161.

Devi, H. S., Singh, V., Duwey, R. K. and Chauhan, V.B.S (2013). Assessment of genetic diversity in taro (*Colocasia esculent L.*) National conference on: Tuber crops (other than potato) for sustainable agriculture and livelihood security in climate change scenario AAU. Jorhat on dated April 29:53-54.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path analysis of the components of crested wheat grass seed production. *Agronomy Journal*, **51**: 515-518.

Jatasara, D.S. and Paroda, R.S. (1978).Genetic divergence in wheat under different environmental conditions, *Cereal Res. Comm.*,**6**: 307-317.

Kurian, A. and Peter, K.V. (1994). *South Indian Hort.* **42** (2): 85-88.

Mahalanobis, P.C. (1936). *Proc. Nat. Inst. Sci. India*, **12**: 49- 55.

Mehta, J.L., Bendale, V.W., Bhawe, S.G., Saindane, A.K. and Pethe, U.B. (2003). Correlation and path coefficient analysis in taro*Journal of Root Crops*, **29**(2): 32-35.

Mukherjee, D., Chattopadhyay, A., Rao, L.T.P., Satapathy, M. R. and Sen, H (2003). Genetic variability and causal relationship in dasheen taro *(Colocasia esculenta* var**.** *esculenta* L. Schott.).*Annals of Agricultural Research*, **24(**3): 593-597.

Mukherjee, D., Roquib, M.A., Das, N.D. and Mukherjee, S. (2016). A study on genetic variability, Character association and path co-efficient analysis on morphological and yield attributing characters of Taro [*Colocasia esculenta* (L.) Schott]. *American J. of Plant Sciences*, **7**:479-488.

Naskar, S.K. and Sreekumar, J. 2011. Evaluation of taro (*Colocasia esculenta* (L.) Schott.) germplasm using multivariate analysis. *Journal of Root Crops*, **37**(2):150-154.

Okpul, T., Singh, D., Gunua, T. and Wagih, M.E. (2004).Assessment of diversity using agro-morphological traits for selecting a core sample of Papua New Guinea taro (*Colocasia esculenta* (L.) Schott) collection. *Genetic Resources and Crop Evolution*, 51: 671-678.

Pandey, V.S. Ojha, M.D. and Singh, P.K. (2009). Genetic variability and correlation studies in arvi (*colocasia esculenta*var. *antiquorum*). *Vegetable Science*, **36**(3): 431-434.

Paul, K.K. and Bari, M.A. (2011). Studies on direct and indirect effects of different plant characters on yield of taro (*Colocasia esculenta* L. Schott Var. *Antiquorum*). *The Agriculturists*, **9**(1-2): 89-98.

Paul, K.K., Bari, M.A., Islam, S.M.S. and Debnath, S.C. (2014). Genotypic and phenotypic correlation coefficient studies for taro (*Colocasia esculenta* (L.) Schott.). *Bangladesh Journal of Botany*, **43**(1): 113-117.

Poddar, A., Mukherjee, A., Sreekumar, J., Abraham K., Naskar, S.K., Unnikrishnan, M. and Mukherjee, A. (2015). Phenotypic variability among germplasm lines of Elephant Foot Yam (*Amorphophallus paeoniifolius*) and taro (*Colocasia esculenta*). *International Journal of Tropical Agriculture*, **33**(2):377-380.

Sarma, P., Singh, V.B. and Yadav, D.S. (2010). Variability and character association ship studyin colocasia. *Indian Journal of Horticulture*, **67**(3):409-413.

Singh, H.K., Gupta, S. and Singh, H.K. (2006). Correlation of quantitative characters contributing corm yield in colocasia. *Haryana Journal of Horticultural Sciences*, **35**(1-2):138-139.

Singh, M.K., Dev, C., Singh, Y.P. and Singh, P. (2015). Studies on genetic variability under mean, range and coefficients of variation for yield and its contributing traits in *Arvi* (*Colocasia esculenta* var. *antiquorum*) germplasm. *Research in Environ*ment *and Life Sciences*, **8**(2):309-312.

Vavilov,N.I. (1951). The Origin, Variation, immunity and breeding of cultivated plants. *Chronica Botanica*. **13**:364.

Wright, S. (1921). Correlation and causation. *Journal of Agricultural Research*, **20**:257-787.

Yadav, R.K., Rai, N., Yadav, D.S. and Sanwal, S.K. (2007). Correlation, path-coefficient and genetic diversity pattern in *Colocasia* genotypes. *Vegetable Science*, **34**(2):153-156.