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Genetic variability for different quantitative characters in colocasia (*Colocasia esculenta var. antiquorum.*)

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Abstract

An experiment was conducted withnine Colocasia (*Colocasia esculenta* var. antiquorum (L.) Schott.) genotypes to evaluate the genetic variability for different quantitative characters. The experiment was conducted using a Randomized Complete Block Design with three replications. The genetic parameters between yield and yield contributing characters of different Colocasia genotypes were studied. Analysis of variance showed significant variation among the genotypes for all tested characters. The highest total yield was recorded in Indira Arvi-1 (29.54 t ha^{-1}), which was followed by TTr 17-1 and TTr 17-12 (25.31 t ha^{-1} and 18.27 t ha^{-1}, respectively). Corm weight showed the highest genotypic and phenotypic variance (71.52 and 72.41), whereasthe number of leavesshowed the lowest one (14.95 and 18.72). High value of heritability was observed for all the characters except numberof leaves per plant. Genetic advance as percent of mean was reported highest for total yield, yield per plant, weight of cormelsand plant height. The genotypes exhibited a wide range of variability for all the traits studied.

Keywords: Colocasia, Genetic variability, Heritability, Genetic advance, Corm yield

Introduction

Colocasia (*Colocasia esculenta* var. *antiquorom*(L.) Schott) is one of the most popular and extensively consumed tubercrops grown world wide due to its acclimatization to a wide variety of environments. It is also known as taro andarvi. It belongs to the family Araceae and is a native of South-east Asia. It is grown throughout the tropics for its edible corms and leaves and is believed to be one of the earliest cultivated tuber crops inthe world (Kuruvilla and Singh, 1981). Food and Agriculture Organization (FAO) reported that taro production has doubled over the past decade (FAOSTAT, 2000) and is now the fifth most-consumed root vegetable world wide.

Success of plant breeding depends upon the nature and magnitude of variability present in the different genotype. Moreover, evaluating the heritable and non-heritable aspects of overall unviability will hold significant importance in selecting appropriate breeding methodologies. Corm yield is a quantitative character, which is influenced by a number of yield contributing characters such as plant density, soil quality, cultural and farming practices, climatic conditions and so on. Selection for corm and cormel yield, the complex interrelationship between the yield contributing characters usually shows a complex chain of interrelating relationship. In Chhattisgarh, colocasia is grown during the rainy and summer seasons. It is one of the most

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important tuber crops of Chhattisgarh. However, the yield of Colocasia in Chhattisgarh is not satisfactory enough in comparison with other Colocasia growing states. Despite tremendous potentialities, aroids are running in vulnerable condition without being properly and scientifically evaluated. Hence, the present study was planned to evaluate genetic parameters for corm yield and yield contributing characters to find out and establish suitable selection criteria for higher corm yield through the study of variability. The main objectives were to estimate the variation through in-depth study on gross morphological characters, the phenotypic and genotypic variability present in different characters, contributing to yield per plant and to estimate the heritability and genetic advance for yield per plant and its components.

Materials and Methods

The study was carried out during the *Kharif* season of 2020-21 under the All India Coordinated Research Project on Tuber Crops at S. G. College of Agriculture and Research Station, IGKV, Jagdalpur, Chhattisgarh. The experimental material comprised of nine genotypes of Colocasia (TTr 17-1, TTr 17-2, TTr 17-3, TTr 17-5, TTr 17-8, TTr 17-12, TTr 17-13, and the two check varieties, *viz*., Sree Rashmi and Indira Arvi-1). The experiment was laid out in a randomized block design with three replications at the spacing of 60 cm between rows and 45 cm between plants. A plot size of 3m × 3m was kept for each genotype. All the recommended cultural practices were followedto grow a healthy crop. Data was recorded on five randomly selected plants for seven characters *viz.,* plant height (cm), number of leaves per plant, number of cormel, weight of corm (g), weight of cormels (g), yield per plant (g) and total yield (corm + cormel) (t ha^{-1}). The data were subjected to statistical and biometrical analysis (Singh and Chaudhary, 1985). The coefficient of variation for different characters was estimated using the formula suggested by Burton (1952). The estimates of genotypic and phenotypic coefficient of variance were classified as low (less than 10%), moderate (10 to 20%) and high (more than 20%) as suggested by Sivasubramanian and Madhavamenon (1973). The expected genetic advance was calculated usingthe formula given by Johanson et al., (1955). Heritability in broad sense (h2 bs) was calculated as per the formula suggested by Burton and De Vane (1953).

Results and Discussion

The analysis of variance of all the characters under study is presented in Table 1. This revealed that the mean sum of squares due to genotypes was highly significant for all characters. This is an indication of the existence of sufficient variability among the genotypes for total yield and its components traits. Significant mean sum of squares due to total yield (corm + cormel) and attributing characters revealed existence of considerable variability in material studied for improvement for various traits. These findings are in general agreement with the findings of Paul et al., (2011) and Cheema et al., (2007).

The mean performance and genetic variability were estimated and presented in Tables 2 and 3. The significantly higher total yield (corm + cormel) was recorded in the genotype Indira Arvi-1 (29.54 t ha^{-1}), followed by TTr 17-1 (25.31 t ha^{-1}) and TTr 17-12 (18.27 t ha^{-1}). Maximum plant height was recorded in Indira Arvi -1 (105.66 cm) followed TTr 17-1 (52.10 cm) and TTr 17-12 (48.30 cm). Maximum number of leaves per plant was recorded in Indira Arvi-1 (9.84) followed by TTr 17-5 (9.12). Maximum number of cormels per plant, weight of cormels and weight of corms recorded in Indira Arvi-1 was 14.73, 539.96 g

Table 1. Analysis of variance for corm yield and its component characters in Colocasia

Sl. No.	Character	Mean sums of square		
		Replication	Treatment	Error
1	Plant height (cm)	6.93	1274.99**	215.42
2	Number of leaves per plant	0.16	4.86**	0.77
3	Number of cormels	0.05	41.50**	1.26
4	Weight of corm (g)	47.53	21936.62**	181.25
5	Weight of cormels (g)	374.84	56780.70**	1419.07
6	Yield per plant (g)	165.22	123579.05**	2045.02
7	Total yield (t ha^{-1})	0.225	169.48**	2.8

**: Significant at 1%

and 257.7 g, respectively followed by TTr 17-1 (14.33, 486.42 g and 196.89 g, respectively). A wide range of variation was recorded for plant height, corm weight, cormel weight and total yield, which indicated that there is better scope for selection for the improvement of these characters. Pandey et al., (1996) observed wide range of variability among 31 genotypes for yield plant^{-1}, weight of mother cormels and weight of cormels. These findings are in close proximity with the results of Cheema et al., (2007) who reported variability for number of leaves per plant, number of cormels per plant, corm weight and yield per plant. Similar findings were reported by Solanki et al., (2001), Mukherjee et al., (2003) and Singh et al., (2003).

Maximum values for genotypic (71.52%) and phenotypic (72.41%) coefficient of variation were observed for weight of corms followed by total yield (47.12 and 48.02%, respectively) and yield per plant (46.72 and 47.88%, respectively). The least genotypic and phenotypic coefficient of variation was observed for number of leaves per plant (14.95 and 18.72%). Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing their expression.

Wide difference between phenotypic and genotypic coefficient of variations indicated their sensitivity to environmental fluctuations whereas, narrow difference showed less environmental interference on the expression of these traits. The traits which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection. These characters implied their

Table 2. Mean performance for corm yield and its components in Colocasia

Genotype	Character						
	Plant height (cm)	No. of leaves per plant	No. of cormels	Weight of corm (g)	Weight of cormels (g)	Yield per plant (g)	Total yield (t ha^{-1})
TTr 17-1	52.10	6.50	14.33	486.42	196.89	683.31	25.31
TTr 17-2	41.11	6.61	11.89	363.55	45.77	409.33	15.16
TTr 17-3	43.87	5.78	13.78	279.77	87.11	366.88	13.59
TTr 17-5	45.37	9.12	12.89	321.33	85.55	406.88	15.07
TTr 17-8	38.67	8.17	5.44	109.34	52.97	162.31	6.01
TTr 17-12	48.30	8.55	5.33	259.11	234.2	493.30	18.27
TTr 17-13	43.00	7.66	9.33	271.55	50.66	322.21	11.93
Sree Rashmi	45.67	8.05	8.01	174.38	60.74	235.12	8.71
Indira Arvi-1	105.66	9.84	14.73	539.96	257.7	797.66	29.54
Mean (x)	51.53	7.81	10.64	311.71	119.07	430.78	15.95
SEm±	2.12	0.48	0.65	21.75	7.77	26.11	0.97
CD (p=0.05)	6.35	1.42	1.94	65.01	23.23	78.05	2.89

Table 3. Genetic parameters for yield and its attributing characters in Colocasia

Sl.No.	Character	Mean	Range		Coefficient of variation (%)		Heritability (h^2, %)	GA as percent of mean
			Min	Max	GCV	PCV		
1	Plant height (cm)	51.53	38.67	105.66	39.83	40.46	96.89	80.77
2	No. of leaves per plant	7.81	9.84	6.50	14.95	18.72	63.75	24.59
3	No. of cormels	10.64	5.33	14.33	34.43	36.01	91.39	67.8
4	Weight of corm	119.07	45.77	257.70	71.52	72.41	97.56	45.52
5	Weight of cormels	311.71	109.34	539.96	43.46	46.11	92.82	86.25
6	Yield per plant (g)	430.78	162.31	797.78	46.72	47.88	95.09	93.90
7	Total yield (t ha^{-1})	15.95	6.01	29.54	47.12	48.02	96.19	94.64

relative resistance to environmental variation. These findings are in consonance with Mukherjee et al., (2003), Cheema et al., (2007), Devi and Singh (2019).

Heritability and Genetic Advance

In the present investigation, heritability estimates in broad sense are depicted in Table 3. High estimates for heritability were exhibited byall the characters except numberof leaves per plant (63.75%), which showed moderate estimates of heritability. Weight of corm (97.56%), plant height (96.89%), total yield (96.19%), yield per plant (95.09%), weight of cormels (92.82%) and number of cormels (91.39%) showed high heritability. The characters which showed high value of heritability demonstrated that they were least influenced by environmental changes and selection based on phenotypic performance would be reliable. Similar results were also reported by Pandey et al., (1996), Singh et al., (2003) and Paul et al., (2011). On the other hand, high heritability coupled with high genetic advance was observed for all the characters except numberof leaves per plant. Weight of corm (97.56% and 45.52%), plant height (96.89% and 80.77%), total yield (96.19% and 94.64%), yield per plant (95.09% and 93.9%), weight of cormels (92.82% and 86.25), number of cormels (91.39% and 67.8%) exhibited high heritability with high genetic advance indicating that most likely the heritability is due to additive gene effects and selection may be effective. Therefore, selection based on phenotypic performance of these traits would be effective to select desirable plant types. Pandey et al., (1996) observed high heritability coupled with high genetic advance for weight of mother cormels, weight of cormels and yield per plant. Similar resultswere also reported by Paul et al., (2011) who observed high heritability with moderate to high genetic advance for plant height, petiole length, leaf length, stolon weight, total stolon weight, stolon length and corm length. Number of leaves per plant showed moderate heritability (63.75%) with low value of genetic advance (24.59%). Characters which showed moderate to low heritability coupled with moderate to low genetic advance as percentage mean indicated the role of non-additive genetic variance in their expression.

Conclusion

Nine Colocasia (*Colocasia esculenta* var. *antiquorum* (L.) Schott.) genotypes were evaluated for the genetic variability for different quantitative characters. The study revealed sufficient genetic variability for quantitative traits among the genotypes, which can be exploited for varietal improvement and can be further used as a source material to develop promising varieties in colocasia.

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