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Original Research Article

Performance of Colocasia (Taro) Genotypes under *Tarai* Condition of Uttarakhand

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Genotypes, Quantitative characters, Base population, Variability

A B S T R A C T

Variability is one of the of the imperative factor for any breeding improvement programme but it is very limited in Colocasia. Therefore, The Present investigation on study of twenty genotypes of taro was done during spring summer season of the year 2018 at Vegetable Research Centre of G.B.P.U.A. & T. Pantnagar (Uttarakhand) to assess most promising and high yielding genotypes suitable to this area for cultivation. Under *Tarai* region of Uttarakhand respect performance of taro of fifteen different quantitative characters regarding growth, yield and quality were studied. Wide range of variations was recorded for all the characters which is indicative of diverse genetic nature of the base population. The genotype PA 13 was most promising as produced significantly more yield than check variety Rajendra Arvi. This genotype is suitable for improvement of taro under *Tarai* condition of Uttarakhand.

Introduction

Taro (*Colocasia esculenta* (L) Schott var. *antiquorum*) is one of the oldest most important tuber crops. It is known as eddoe type or *arvi*. Worldwide it is the 5th most consumed root vegetable and about 25 per cent of total world production contributed by South East Asia. India is considered as "Home of Colocasia" because it has maximum diversity in India and some parts of South East Asia. There are many recognized cultivars which are different in colour, shape, size of corms etc. Information about sexual reproduction of this crop is very fragmentary because plants do not flower in normal condition (Plucknett, 1970) and do not produce the seeds. Variability is one of the of the important factor for any breeding improvement programme but it is very limited in colocasia. Therefore, it is necessary to survey the available useful variability. Like yield is a complex character and it is useful in identifying the yield components. Yield is polygenically controlled character and the characters controlled environmentally determined by nature and magnitude of their genetic variability. So, it is essential to categorized all the variability into heritable and non-heritable components with the help of genetic parameters like heritability, genetic coefficient of variation and genetic advance. The genetic variability in a population along with heritability gives an idea of the genetic advance to be ejected from selection for a given character (Johnson *et al.*, 1955). Germplasm evaluation is a measure of the

tendency of individual genotypes in a population to vary from each other. The variability of a trait describes how that trait is different in response to environmental and genetic influences. It always plays a vital role in the development of promising line since time immemorial. It is studied in most of the crop plants that selection for yield would not be as effective as selection for yield components. Therefore, for any crop improvement programme which is aimed to get maximum productivity, a proper knowledge of above factors like genetic variability, diversity, heritability, genetic advance, path coefficient of various quantitative and qualitative traits and their contribution towards yield is very important. But researches are very less in this direction and these cannot be generalized for every climatic condition.

Materials and Methods

The present study was undertaken during spring summer season of 2018-19 at Vegetable Research Centre of the G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand (India). Vegetable Research Centre of G. B. Pant University is situated in the *Tarai* area of Uttarakhand near the foothills of Shivalik range of the Himalayas. Geographically, it is located at an altitude between 79.3° E longitudes and 29° N latitude having an altitude of 243.84 meters above the mean sea level. The climatic condition of Pantnagar region is humid sub-tropical with lowest and highest temperature fluctuating between 4°C to 25.8°C and 17.7°C to 43°C, respectively. The summers are humid, hot and dry however the winters are cool. Generally, the monsoon reaches nearly on 3rd week of June and lasts up to September. Occasionally, light rains and frost occurs during winter season.

The experimental materials used in this investigation contain 20 genotypes of taro (*Colocasia esculenta* (L.) Schott *var. antiquoram*). The genotypes were varied with respect to morphological and important economical traits. Among 20 genotypes, Rajendra Arvi was taken as standard check. List of genotypes is given in the Table 1.

The observations on several morphological and quantitative characters which constitute plant growth, corm and cormels yield were recorded. There were fifteen quantitative namely predominant position of leaf lamina surface, leaf blade margin, leaf blade margin colour, leaf blade colour, leaf main vein colour, petiole colour, petiole basal ring colour, corm shape and cormel shape and nine qualitative characters namely days to sprouting, plant height, diameter or thickness of stem, number of leaves per plant, leaf length (cm), leaf breadth (cm), weight of corms per plant (g), number of cormels per plant, length of corms (cm), length of cormels (cm), diameter of corms (cm), diameter of cormels (cm), Tuber yield/plant (g), Tuber yield/ha (q) and disease infestation like leaf blight. For recording the data five random plants were tagged in each row.

Twenty genotypes were planted in a Randomized block design in March 2018 with Rajendra Arvi as a check variety. Experimental materials were assigned in three replications in randomized block design with check circulated randomly in each replication block. For statistical analysis of data Randomized Block Design (RBD) was used. The significance of variance among genotype means will checked by F-test. F-test found to be significant when critical difference (CD) at 5 per cent level of significance was calculated. The coefficient of variability were calculated using a formula which is given by Burton and De Vane (1952). Heritability is estimated as the ratio of genotypic variance to the phenotypic variance and expressed in percentage (Hanson *et al.*, 1956). The extent of genetic

advance to be expected by selecting 5% of the superior progeny and was calculated by using the formula which is given by Robinson *et al*. (1949).

Results and Discussions

The analysis of variance presented which showed significant difference among genotypes for days to sprouting. In Table 5, the mean values of different genotypes for days to sprouting are presented. The mean value for days to sprouting showed significant variations among the genotype.

The general mean of days to sprouting was 22.95 and ranged from 18.33 to 28.00. The maximum days to sprouting was observed in PA 76 and minimum in PA 23. Genotypes PA 24, PA 10 and PA 75 showed significantly more days to sprouting than the check variety while genotypes PA 20 and PA 63 showed significantly less days to sprouting than the check variety and all other genotypes were significantly similar to the check. Three genotypes were found statistically at par with PA 76 namely, PA 24, PA 10 and PA 75. Plant height of all twenty genotypes ranged from 37.43 cm to 91.43 cm with general mean of 59.28 cm. (Table No. 5) The highest plant height was found in PA 75 and lowest in PA 10 among all the genotypes. Out of all twenty genotypes PA 43, PA 68, PA 13, PA 69, PA 18 and PA 28 showed significantly lower plant height than the check variety and PA 84, PA 81, PA 58, PA 23, PA 12 and PA 6 were significantly similar to check variety for plant height and remaining genotypes showed significantly higher plant height than the check variety. Three genotypes PA 63, PA 20 and PA 57 were found statistically at par with PA 75. The diameter of stem ranged from 2.03 cm to 4.07 cm with general mean of 2.94 cm. It was recorded maximum in PA 75 and PA 6 while minimum in PA 28. Genotypes PA 10, PA 12, PA 13, PA 18, PA 23, PA 68, PA 69, PA 81 and PA 84 found significantly similar to the check variety and remaining genotypes exhibited significantly higher diameter of stem than the check variety. Six genotypes PA 20, PA 24, PA 57, PA 58, PA 63 and PA 76 were found statistically at par with PA 75. The range of number of leaves per plant for all twenty genotypes were varies from 4.60 to 6.60 with a general mean of 5.70 leaves per plant. Among all the genotypes number of leaves per plant was recorded maximum in PA 20 and minimum in PA 12. Genotypes PA 23, PA 24 and PA 28 showed significantly higher number of leaves per plant than the check variety while other all genotypes were significantly similar to check variety. (Table No. 4) Three genotypes PA 23, PA 24 and PA 28 showed statistically at par with PA 20. The range of leaf length varied from 23.22 cm to 42.33 cm among all the genotypes with a general mean of 30.22 cm. The maximum leaf length was found in PA 75 and minimum in PA 10. The leaf length was observed significantly higher in genotype PA 6, PA 57, PA 76 and PA 63 as compared to check variety; PA 13, PA 43, PA 68 and PA 12 exhibited significantly lower leaf length as compared to check variety and remaining genotypes were observed significantly similar to the check variety for this character. Four genotypes PA 6, PA 76 and PA 63 were observed statistically at par with PA 75.

Leaf breadth of all twenty genotypes ranged from 20.70 cm to 38.53 cm with a general mean of 26.88 cm. Among all genotypes the leaf breadth was recorded maximum in PA 75 and minimum in PA 10. The leaf breadth was observed significantly higher in genotype PA 6, PA 76, PA 63 and PA 57 as compared to check variety; PA 13, PA 43, PA 68, PA 69 and PA 81 showed significantly lower leaf breadth than the check variety and rest of genotypes showed significantly similar

difference for leaf breadth than the check variety. Four genotypes were observed statistically at par with PA 75 namely, PA 6, PA 76, PA 63 and PA 57.

Length of corms for all twenty genotypes ranged from 6.77 cm to 10.97 cm with a general mean of 8.07cm. The corm length was recorded maximum in genotype PA 63 and minimum in PA 6. Two genotypes PA 6 and PA 10 showed significantly lower length of corms as compared to check while other all other genotypes were significantly higher to the check variety. Two genotypes were recorded statistically at par with PA 63 namely, PA 57 and PA 75. (Table No. 2)

The range of diameter of corms for all twenty genotypes were varies from 3.20 cm to 6.20 cm with a general mean of 4.16 cm. Among all genotypes highest corm diameter was observed in PA 63 and lowest in PA 6. Three genotypes PA 10, PA 58 and PA 76 have showed lower corm diameter than the check variety while all other genotypes showed higher corm diameter than the check variety. Four genotypes were recorded statistically at par with PA 63 namely, PA 12, PA 13, PA 28 and PA 57.

The range of number of cormels per plant for all twenty genotypes varies from 3.93 to 12.67 with a general mean of 7.23. The genotype PA 28 has maximum number of cormels per plant whereas genotype PA 12 have minimum number of cormels per plant. Genotypes PA 18, PA 20, PA 23, PA 28, PA 43, PA 63 and PA 68 exhibited significantly higher number of cormels per plant than the check whereas remaining genotypes showed significantly lower number of cormels per plant than the variety. Three genotypes were found statistically at par with PA 28 namely, PA 68, PA 84, PA 63 and PA 20.

The range of length of cormels for all twenty genotypes varied from 5.10 cm to 9.03 cm with a general mean of 6.93 cm. The maximum length of cormels was recorded in PA 76 whereas minimum in genotype PA 6. Genotypes PA 76, PA 12, PA 69, PA 20, PA 63 and PA 24 showed significantly higher length of corms than the check variety; PA 6, PA 18, PA 57, PA 68 and PA 76 showed significantly lower length of corms than the check variety and all remaining genotypes were recorded significantly similar to check variety. Four genotypes were recorded statistically at par with PA 76 namely, PA 12, PA 20, PA 57 and PA 69. (Table No. 3)

The range of diameter of cormels for all twenty genotypes varied from 2.50 cm to 4.53 cm with a general mean of 3.25 cm. The highest diameter of cormels was observed in the genotype PA 76 and lowest in genotype PA 13. Genotypes PA 76, PA 69 and PA 24 showed significantly higher diameter of cormels than check variety; genotypes PA 13, PA 43, PA 57 and PA 84 showed significantly lower than check variety and rest of the genotypes showed significantly lower diameter of cormels than the check variety Three genotypes were found statistically at par with PA76 namely, PA 69, PA 24 and PA 81 (Table 2).

Weight of corms per plant for all twenty genotypes ranged from 111.67 g to 283.33 g with a general mean of 145.17 g. The highest weight of corms per plant recoded in PA 13 and lowest in PA 43. Out of twenty genotypes, PA 13, PA 81, PA 75 and PA 23 showed significantly higher weight of corms per plant than check variety and PA 43, PA 58 and PA 76 showed significantly lower weight of corms per plant than check variety and remaining genotypes were recorded significantly similar to the check variety for this character. One genotype PA 75 was recorded statistically at par with PA 13.

Weight of cormels per plant for all twenty genotypes ranged from 121.67 g to 321.67 g

with a general mean of 234.38 g. Among all genotypes weight of cormels per plant was recorded maximum in PA 81 and minimum in PA 69. Genotypes PA 81, PA 20, PA 28 and PA 24 showed significantly higher weight of cormels per plant; genotypes PA 69, PA 75, PA 57 and PA 12 showed significantly lower weight of cormels per plant than the check variety and remaining genotypes showed significantly similar difference to check variety. Two genotypes were found statistically at par with 81 namely, PA 28 and PA 20.(Table No.3)

Tuber yield per plant for all twenty genotypes ranged from 258.33 g to 535.00 g with a general mean of 379.55 g. The highest tuber yield per plant recorded PA 13 and lowest in PA 69. Out of twenty genotypes, PA 13, PA 18, PA 20, PA 23, PA 24, PA 28, PA 68 and PA 81 showed significantly higher; PA 69 and PA 57 showed significantly lower tuber yield per plant than the check variety and remaining genotypes showed significantly similar tuber yield per plant difference as compared to check.

Tuber yield per hectare for all twenty genotypes ranged from 143.52 q/ha to 297.22 q/ha with a general mean of 210.86 q/ha. Among all genotypes the maximum tuber yield per hectare recorded in PA 13 and minimum in PA 69. PA 13 and PA 81 showed significantly higher tuber yield than the check variety; PA 69 and PA 57 showed significantly lower tuber yield per hectare and remaining genotypes showed significantly similar tuber yield per hectare than check variety (Table 4).

Table.1 List of genotypes under study

S. No.	Genotypes	Symbol	Source
1.	PA 6	(G_1)	GBPUA&T, Pantnagar.
2.	PA10	(G_2)	GBPUA&T, Pantnagar.
3.	PA12	(G_3)	GBPUA&T, Pantnagar.
4.	PA 13	(G_4)	GBPUA&T, Pantnagar.
5.	PA 18	(G_5)	GBPUA&T, Pantnagar.
6.	PA 20	(G_6)	GBPUA&T, Pantnagar.
7.	PA 23	(G_7)	GBPUA&T, Pantnagar.
8.	PA 24	(G_8)	GBPUA&T, Pantnagar.
9.	PA 28	(G_9)	GBPUA&T, Pantnagar.
10.	PA 43	(G_{10})	GBPUA&T, Pantnagar.
11.	PA 57	(G_{11})	GBPUA&T, Pantnagar.
12.	PA 58	(G_{12})	GBPUA&T, Pantnagar.
13.	PA 63	(G_{13})	GBPUA&T, Pantnagar.
14.	PA 68	(G_{14})	GBPUA&T, Pantnagar.
15.	PA 69	(G_{15})	GBPUA&T, Pantnagar.
16.	PA 75	(G_{16})	GBPUA&T, Pantnagar.
17.	PA 76	(G_{17})	GBPUA&T, Pantnagar.
18.	PA 81	(G_{18})	GBPUA&T, Pantnagar.
19.	PA 84	(G_{19})	GBPUA&T, Pantnagar.
20.	Rajendra Arvi (Check)	(G_{20})	RAU, Bihar.

Table.2 Leaf length, leaf breadth, length of corms and diameter of corms

S.No.	Genotype	Leaf length(cm)	Leaf breadth (cm)	Length of corms	Diameter of corms(cm)
1.	PA 6	40.43	35.83	**6.77**	**3.20**
2.	PA 10	**23.27**	**20.70**	6.83	3.63
3.	PA 12	27.10	24.27	8.80	4.43
4.	PA 13	24.53	22.30	8.63	4.50
5.	PA 18	27.13	24.20	7.57	3.97
6.	PA 20	30.17	27.73	7.77	3.77
7.	PA 23	28.83	26.07	7.70	3.80
8.	PA 24	27.50	24.73	8.33	4.27
9.	PA 28	27.83	24.23	8.80	4.60
10.	PA 43	25.47	22.67	7.17	3.67
11.	PA 57	33.83	30.27	10.47	6.13
12.	PA 58	32.03	28.23	7.73	3.63
13.	PA 63	36.47	32.77	**10.97**	**6.20**
14.	PA 68	26.93	23.57	7.17	3.90
15.	PA 69	27.87	23.97	7.10	3.80
16.	PA 75	**42.33**	**38.53**	9.10	4.23
17.	PA 76	36.83	33.20	7.07	3.60
18.	PA 81	27.50	23.23	8.87	4.30
19.	PA 84	29.13	25.20	7.80	3.83
20.	Rajendra Arvi (check)	29.27	25.80	6.83	3.67
	General mean	**30.22**	**26.88**	**8.07**	**4.16**
	C.V.	**14.29**	**15.57**	**4.66**	**8.31**
	S.Em.	**2.49**	**2.42**	**0.22**	**0.20**
	C.D. at 5%	**7.14**	**6.92**	**0.62**	**0.57**
	Minimum	**23.27**	**20.70**	**6.77**	**3.20**
	Maximum	**42.33**	**38.53**	**10.97**	**6.20**

Table.3 Number of cormels/plants, length of cormels, Diameter of cormels and weight of corms/plant

S.No.	Genotype	Number of cormels/plants	Length of cormels (cm)	Diameter of cormels (cm)	Weight of corms/plant (g)
1.	PA 6	5.67	**5.10**	2.83	128.33
2.	PA 10	4.60	6.40	3.23	148.33
3.	PA 12	**3.93**	8.10	3.37	143.33
4.	PA 13	5.53	6.70	**2.50**	**283.33**
5.	PA 18	8.27	5.63	2.80	133.33
6.	PA 20	9.40	7.97	3.40	126.67
7.	PA 23	8.67	7.00	3.03	163.33
8.	PA 24	6.33	7.83	3.83	128.33
9.	PA 28	**12.67**	7.60	3.37	131.67
10.	PA 43	7.33	6.23	2.93	**111.67**
11.	PA 57	5.47	5.87	2.87	123.33
12.	PA 58	6.07	6.80	3.17	111.67
13.	PA 63	9.67	7.87	3.33	143.33
14.	PA 68	12.47	5.90	3.23	151.67
15.	PA 69	4.87	7.97	3.90	136.67
16.	PA 75	5.47	6.50	3.10	203.33
17.	PA 76	5.87	**9.03**	**4.53**	116.67
18.	PA 81	6.40	7.47	3.73	163.33
19.	PA 84	9.20	6.03	2.53	123.33
20.	Rajendra Arvi (check)	6.67	6.67	3.23	131.67
General mean		**7.23**	**6.93**	**3.25**	**145.17**
C.V.		**6.47**	**4.98**	**6.75**	**16.56**
S.Em.		**0.27**	**0.20**	**0.13**	**13.88**
C.D. at 5%		**0.77**	**0.57**	**0.36**	**39.74**
Minimum		**3.93**	**5.10**	**2.50**	**111.67**
Maximum		**12.67**	**9.03**	**4.53**	**283.33**

Table.4 Weight of cormels/plant, number of cormels/plant, tuber yield per plant and tuber yield per hectare

S.No.	Genotype	Weight of cormels/plant (g)	Tuber yield per plant(g)	Tuber yield per hectare(q/ha)
1.	PA 6	221.67	350.00	194.44
2.	PA 10	188.33	336.67	187.04
3.	PA 12	166.67	310.00	172.22
4.	PA 13	251.67	**535.00**	**297.22**
5.	PA 18	291.67	425.00	236.11
6.	PA 20	313.33	440.00	244.44
7.	PA 23	276.67	440.00	244.44
8.	PA 24	306.67	435.00	241.66
9.	PA 28	316.67	448.33	249.07
10.	PA 43	262.67	374.33	207.96
11.	PA 57	143.33	266.67	148.15
12.	PA 58	256.67	368.33	204.63
13.	PA 63	186.67	330.00	183.33
14.	PA 68	250.00	401.67	223.14
15.	PA 69	**121.67**	**258.33**	**143.52**
16.	PA 75	133.33	336.67	187.04
17.	PA 76	248.33	365.00	202.77
18.	PA 81	**321.67**	485.00	269.44
19.	PA 84	216.67	340.00	188.89
20.	Rajendra Arvi (check)	213.33	345.00	191.66
General mean		**234.38**	**379.55**	**210.86**
C.V.		**11.46**	**10.50**	**10.50**
S.Em.		**15.51**	**23.02**	**12.79**
C.D. at 5%		**44.39**	**65.89**	**36.61**
Minimum		**121.67**	**258.33**	**143.52**
Maximum		**321.67**	**535.00**	**297.22**

Table.5 Days to sprouting, plant height, diameter of stem and number of leaves per plant

S.No.	Genotype	Days to sprouting	Plant height (cm)	Diameter of stem (cm)	Number of leaves per plant
1.	PA 6	21.00	59.87	4.07	5.60
2.	PA 10	26.00	**37.43**	2.33	5.40
3.	PA 12	21.33	59.27	2.63	**4.60**
4.	PA 13	23.00	44.30	2.87	5.27
5.	PA 18	24.33	46.53	2.10	5.40
6.	PA 20	19.67	80.83	3.27	**6.60**
7.	PA 23	**18.33**	57.70	2.70	6.13
8.	PA 24	26.33	64.27	3.43	6.33
9.	PA 28	21.33	47.47	**2.03**	6.27
10.	PA 43	21.33	39.97	2.13	5.67
11.	PA 57	25.33	72.32	3.40	5.73
12.	PA 58	22.00	56.27	3.80	5.80
13.	PA 63	20.67	86.40	3.27	5.47
14.	PA 68	21.67	43.17	2.27	5.33
15.	PA 69	23.33	45.47	2.83	5.73
16.	PA 75	26.00	**91.43**	**4.07**	5.67
17.	PA 76	**28.00**	66.77	4.03	5.53
18.	PA 81	21.67	54.63	2.77	5.93
19.	PA 84	25.00	52.67	2.57	5.60
20.	Rajendra Arvi (check)	22.67	78.90	2.30	5.87
General mean		**22.95**	**59.28**	**2.94**	**5.70**
C.V.		**9.47**	**11.06**	**17.52**	**8.52**
S.Em.		**1.25**	**3.79**	**0.30**	**0.28**
C.D. at 5%		**3.59**	**10.84**	**0.85**	**0.80**
Minimum		**18.33**	**37.43**	**2.03**	**4.60**
Maximum		**28.00**	**91.43**	**4.07**	**6.60**

The mean range of genotypes for several characters revealed the highest range in tuber yield per plant i.e. (258.33-535.00 g), the difference being 276.67 g; weight of cormels per plant i.e. (121.67-321.67 g) with difference of 200.00 g. comparatively high range of variability also found in weight of corms per plant (111.67-283.33 g), tuber yield per hectare (143.52-297.22 q/ha), plant height (37.43-91.43 cm), leaf length (23.27-

42.33 cm), leaf diameter(20.70-38.53 cm),), days to sprouting (18.33-28.00), number of cormels per plant (3.92-12.67) exhibiting a difference of 171.66, 153.70, 54.00, 19.06, 17.66, 9.67, 8.75 respectively. The character showing relatively low variability range were length of corms (4.20 cm) length of cormels (3.93 cm), diameter of corms (3.00 cm), number of leaves per plant (2.00), diameter of stem (2.04 cm) and diameter of cormels (2.03 cm). (Table No. 3)

In this study, plant height exhibited significantly positive correlation with diameter of plants shows that the gene controlling both parameters is closely associated. The same result found by Orji and Ogbonna (2015). Number of cormels per plant showed positive correlation with yield. This indicates that an increase in weight of cormels per plant, increases the yield. Same study supported by Singh *et al*., (1992); Dwivedi and Sen (1999); Cheema *et al.*, (2007) and Pandey *et al*., (2009). Yield was significantly correlated with weight of corms and cormels per plant. Similar result was reported by Sarma *et al*., (2010

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