Biological Forum – An International Journal **15(1): 36-41(2023)**

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

Evaluation of Taro (*Colocasia esculenta* L.) Genotypes for Growth, Yield and Quality Attributes under the Hill Zone of Karnataka

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(Received: 15 November 2022; Revised: 15 December2022; Accepted: 25 December, 2022; Published: 05 January, 2023)
(Published by Research Trend)

ABSTRACT: Colocasia is not being commercially grown under hill zone of Karnataka due to lack of suitable varieties and standard production technologies. Under given agro-climatic conditions, it is important to study the performance of varieties and to identify the best genotypes of colocasia with desirable characteristics for this zone. Twenty genotypes of colocasia were evaluated during *Rabi* 2020-21 at the College of Horticulture, Mudigere for their growth, yield and quality attributes. The experiment was laid out in a randomized complete block design with three replication. The analysis of variance exhibited highly significant differences among the genotypes for all the characters under study. Among the twenty genotypes evaluated, Piriyapattana Local performed better for most of the characteristics like plant height, number of leaves per plant, leaf length, leaf breadth, petiole length, petiole girth, leaf area, leaf area index, number of corms per plant, corm weight, corm yield per plant, tuber yield per plant, total sugars, protein and dry matter. Based on the mean performance, the genotypes Piriyapattana Local, Kushalnagar Local and Hyderabad Local are superior and high-yielding genotypes under the hill zone of Karnataka.

Keywords: Colocasia, Corm, Cormel, Growth, Yield, Quality.

INTRODUCTION

Taro (*Colocasia esculenta* L.) is a herbaceous perennial tuber-bearing plant known as eddoe type, or arvi belongs to the monocotyledonous family Araceae (Vanwyk, 2005). It is an ancient crop that originated in the Indo-Malayan region, probably in Eastern India and Bangladesh (Yen and Wheeler 1968). It is believed that the origin of domesticated taro is from wild type *C. esculenta* var. *aquatilis*, either in North EastIndia or South East Asia (Matthews, 1991). It is also known as the "potato of the tropics" and is grown throughout the tropics and sub-tropics. Taro is one of the few edible species in the genus colocasia. Cultivated types are mostly diploid (2n=2x=28), although some triploids are found (2n=3x=42) (Singh *et al.*, 2007). It is a staple source of people's diet and the fourteenth most consumed vegetable worldwide (Rao *et al.*, 2010). Globally taro is cultivated in an area of around 1.9 million hectares, with an annual production of 10 million tones and an average yield of 53 tonnes per hectare. Most of the world's production of taro is in Africa, followed by Asia and Oceania. Nigeria is the largest producer of taro in the world, with an annual production of 2.8 million metric tonnes, which accounts 27 per cent of the world's total production (FAOSTAT, 2019). The corms and cormels of colocasia are used as a vegetable after cooking because corms are acrid due to the presence of calcium oxalates. In India, colocasia occupies an area of 0.052 million hectares with a production of 0.0654 million tonnes and productivity of 12.57 tonnes per hectare (Reddy, 2012). The corms of colocasia are rich in starch (70-80 %) but contain comparatively low amounts of fat and protein. Colocasia contains water (63-85 %), proteins (8-13 %), fiber (0.6-1.2%), fats (2.0-4.0%), β-carotene 24 µg, thiamine 0.09 mg, riboflavin 0.03 mg, calcium 40 mg and iron 1.7 mg etc (Coursey, 1968). The corms are used to prepare fermented acidic products, *i.e.*, poi, consumed as cooked vegetables or made into puddings or breads.

In any crop improvement program, the evaluation of germplasm to assess the existing variability is a preliminary step. Since the environment greatly influences many quantitative characters, it is necessary to separate the variability into heritable and non-heritable components. Genotypes exhibiting high variability for desirable characters that contribute to the yield are to be selected in such a program of evaluation.

Taro is cross-pollinated due to a protogyny nature resulting in large variability. The presence of variability is a prerequisite for planning an effective breeding program for the plant breeder. This is useful for selecting and identifying promising variants for developing hybrids or varieties directly or through recombinant breeding.

The area and production of taro in Karnataka state are much less compared to other states in India, mainly due to the non-availability of suitable crop varieties to the farmers. Although it is an important tuber crop in India and Karnataka, more attention should be given to improving it. Germplasm can be utilized to develop new varieties suitable for different regions. The development of high-yielding cultivars is a continuous process and there is an urgent need to select the best genotype/variety. Therefore, the present study was conducted to evaluate 20 genotypes of taro for growth, yield and quality parameters under the hill zone of Karnataka.

MATERIALS AND METHODS

The present investigation was carried out at the Vegetable Science Block in the College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, during the *rabi* season 2020-21. The experimental material used for the investigation comprised twenty genotypes of taro (*Colocasia esculenta* L.), which were collected from different places (Table 1). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The tubers were sown with a spacing of 60 × 45 cm and all the cultural practices followed per the package of practices.

Observations were recorded on five randomly selected plants in each replication for quantitative and qualitative traits *viz.*, plant height (cm) at 120 DAP, number of leaves per plant at 120 DAP, leaf length (cm) at 120 DAP, leaf breadth (cm) at 120 DAP, petiole length (cm) at 120 DAP, petiole girth (cm) at 120 DAP, leaf area (cm^2) at 120 DAP, leaf area index at 120 DAP, corm length(cm), corm width(cm), cormel length(cm), cormel width(cm), number of corms per plant, number of cormels per plant, corm weight (kg), cormel weight (kg), cormel yield per plant (g), corm yield per plant (g), tuber yield per plant (g), starch content (%), protein content (%), dry matter (%), fiber content (%), TSS (°Brix), total sugars (%), reducing sugars (%)and non-reducing sugars (%). The data were subjected to statistical analysis.

Table 1: List of genotypes used in the experiment and their place of collection.

Sr. No.	Name of the genotype	Place of collection
1.	Piriyapattana Local	Piriyapattana
2.	Balehonnur Local	Balehonnur
3.	Sirsi Local	Sirsi
4.	Mandya Local	Mandya
5.	Kumuta-1	Kumuta
6.	Kumuta-2	Kumuta
7.	Sakleshpur Local	Sakleshpur
8.	Andhra Pradesh Local	Andhra Pradesh
9.	Gulbarga Local	Gulbarga
10.	Hyderabad Local	Hyderabad
11.	Shiralakoppa Local	Shiralakoppa
12.	Kushalnagar Local	Kushalnagar
13.	Koppa-1	Koppa
14.	Koppa-2	Koppa
15.	DavaMudli	Joida
16.	KasuMudli	Joida
17.	Mudli	Joida
18.	Madikeri Local	Madikeri
19.	Nymati Local	Nymati
20.	Mudigere Local (Check)	Mudigere

RESULT AND DISCUSSION

The data on the mean performance of twenty colocasia genotypes for growth, yield and quality parameters are presented in Tables 2-4, respectively.

Growth parameters. Significantly wide variation was shown among the twenty taro genotypes for growth parameters. Regarding plant height, the highest plant height significantly at 120 DAP of 174.97 cm was noticed in the genotype Piriyapattana Local followed by Mudigere Local (171.80 cm). In contrast, Nymati Local (132.77 cm) was the lowest. A significant maximum number of leaves per plant at 120 DAP were produced by genotype Piriyapattana Local (9.37) followed by Kumuta -1 (8.07) and a minimum was recorded by genotype Madikeri Local (5.30). Significantly the genotype Piriyapattana Local (48.16 cm) recorded the highest leaf length at 120 DAP, followed by Mudigere Local (46.85 cm) and the lowest was recorded in the genotype Nymati Local (27.43 cm). Significantly the genotype Piriyapattana Local (42.80 cm) recorded the highest leaf breadth at 120 DAP, followed by Koppa-1 (41.53 cm) and the lowest was recorded in the genotype

Kumuta-1 (26.40 cm). The genotype Piriyapattana Local (37.93 cm) showed the highest petiole length significantly at 120 DAP, followed by Mudigere Local (35.10 cm) and the lowest was recorded in the genotype Nymati Local (26.37 cm). Significantly the genotype Piriyapattana Local (6.73 cm) recorded the highest petiole girth at 120, DAP followed by Mudigere Local (6.70 cm) and the lowest was recorded in the genotype Kumuta-2 (3.57 cm). The genotype Piriyapattana Local (1545.93 cm^2) recorded a significant maximum leaf area at 120, DAP followed by Kasumudli (1390.46 cm^2) and a minimum was recorded in the genotype Nymati Local (619.23 cm^2). A significant maximum leaf area index at 120 DAP was recorded in the genotype Piriyapattana Local (5.36), followed by KasuMudli (3.94) and a minimum was recorded in the genotype Nymati Local (1.49). This variation in growth parameters among the genotypes might be due to genetic variation, varietal characteristics and environmental effects. Similar results were also reported by Surjit and Tarafdar (2015); Angami *et al.* (2015); Bassey *et al.* (2016); Rao *et al.* (2019); Shellikeri *et al.* (2020).

Yield parameters. All the twenty genotypes of taro varied significantly for yield attributes. Significant maximum corm length was recorded in the genotype DavaMudli (28.34 cm) followed by Kumuta-2 (15.03 cm), whereas minimum in the genotype Kumuta-1 (7.68 cm). Significant maximum corm width was recorded in the genotype DavaMudli (8.79 cm) followed by Kasu Mudli (7.89 cm), whereas minimum in the genotype Gulbarga Local (4.91 cm). The genotype DavaMudli (14.85 cm) recorded a significant maximum cormel length followed by Sirsi Local (6.93 cm), whereas the minimum in the genotype Gulbarga Local (4.39 cm). The genotype DavaMudli (2.13 cm) and Sirsi Local (2.36 cm) recorded significant minimum cormel width, whereas the maximum was recorded in the KasuMudli (3.29 cm). Significantly the genotype Piriyapattana Local (4.31 kg) recorded the highest corm weight, followed by Mudigere Local (3.21 kg), whereas lowest in the genotype Madikeri Local (0.55 kg). The genotype Hyderabad Local (3.59 kg) recorded significantly the highest cormel weight, followed by DavaMudli (3.11 kg), whereas the lowest in the genotype Madikeri Local (0.79 kg). A significant maximum number of corms per plant were produced by the genotype Piriyapattana Local (3.60) followed by Hyderabad local (3.20) and a minimum was recorded in genotype Mudigere Local (1.20). A significant maximum number of cormels per plant were produced by the genotype Andhra Pradesh Local (53.97) followed by Hyderabad local (48.50), whereas the minimum was recorded in genotype Madikeri Local (6.97). Significantly highest corm yield per plant was recorded in the genotype Piriyapattana Local (891.33 g) followed by Mudigere Local (661.00 g) and Mandya Local (592.00 g) and lowest in the genotype Madikeri Local (107.00 g). The genotype Hyderabad Local (731.67 g) recorded significantly highest cormels yield per plant, followed by DavaMudli (596.67 g), whereas the lowest was recorded in the genotype Madikeri Local (177.33 g). Significantly highest tuber yield per plant was recorded in the genotype Piriyapattana Local (1149.00 g) followed by Mudigere Local (1064.00 g) and minimum in the genotype Madikeri Local (284.33 g). This variation in yield parameters might be due to a greater quantity of dry matter having been translocated to the corm, combined with a higher rate of yield-attributing characters, *viz*., plant height, leaf area etc., throughout growth and also due to the genetic potential of that particular genotype and environmental effect. These results conformed with the findings of Rao and Lakshmi (2012); Sibyala (2013); Sharavati *et al.* (2018); Bekele and Boru (2020).

Quality parameters. Significantly wide variation was shown among the twenty taro genotypes for quality parameters. Effective maximum starch content was recorded in the genotype Andhra Pradesh Local (77.90 %), followed by Kushalnagar Local (76.50 %), while the minimum was recorded in the genotype Nymati Local (46.80 %). Protein content was significantly highest in the genotype Piriyapattana Local (11.68 %), closely followed by Madikeri Local (11.06 %), while it was least in the genotype Koppa-2 (7.32 %). Significantly dry matter content was lowest in the genotype DavaMudli (23.00 %), while it was highest in the genotype Piriyapattana Local (46.00 %), followed by Kushalnagar Local (37.40 %). Fiber content was significantly highest in the genotype Andhra Pradesh Local and Mudli (5.00 % each), followed by Gulbarga Local, Koppa-1 (4.25 % each) and it was minimum in the genotype Kushalnagar Local (1.34 %). Significant maximum TSS was recorded in the genotype Mandya Local (5.90 Brix) followed by Koppa-2 (4.90 Brix), while it was least recorded in the genotype Nymati Local (1.30 Brix). Total sugars were significantly highest in the genotype Piriyapattana Local (5.75 %) closely followed by Mandya Local (5.69 %) and it was lowest in the genotype Nymati Local (2.08 %). Significantly highest reducing sugars was recorded in the genotype KasuMudli (3.90 %), closely followed by Koppa-2 and Mudli (3.80 % each), while the lowest was recorded in the genotype Nymati Local (1.45 %). Non-reducing sugars were significantly highest in the genotype Balehonnur Local (2.50 %), closely followed by Mandya Local (2.49 %) and it was lowest in the genotype Mudli (0.21 %). This variation in total sugars might be due to an increase or decrease under the increase or decrease in TSS. The variation in sugar content may be attributed to the accumulation and translocation of photosynthates from leaves to fruits, as carbohydrates are manufactured in the leaves. The increased level of total sugar might be due to the degradation of insoluble polysaccharides and genetic makeup, which lead to the differential synthesis of total sugars and also due to variation in soil, environmental conditions and genetic makeup of the crop. Similar observations were also reported by Surjit and Tarafdar (2015); Amon *et al.* (2011); Singh *et al.* (2013); Hung *et al.* (2017).

Table 2: Mean performance of twenty colocasia genotypes for growth parameters.

Genotypes	1	2	3	4	5	6	7	8

Piriyapattana Local	174.97	9.37	48.16	42.80	37.93	6.73	1545.93	5.36
Balehonnur Local	166.90	7.33	45.85	33.49	33.07	5.87	1151.63	3.12
Sirsi Local	133.20	6.57	35.75	32.10	29.10	3.70	860.68	2.09
Mandya Local	135.80	7.47	37.08	35.37	28.93	3.70	983.63	2.72
Kumuta-1	143.83	8.07	40.69	26.40	29.00	4.73	805.66	2.40
Kumuta-2	151.60	7.23	31.34	31.10	28.40	3.57	731.00	1.95
Sakleshpur Local	159.97	7.13	33.66	35.03	27.87	5.70	884.33	2.33
Andhra Pradesh Local	145.07	6.80	37.82	32.10	29.00	3.70	910.51	2.29
Gulbarga Local	137.40	7.07	29.50	35.63	27.40	4.77	788.31	2.06
Hyderabad Local	142.07	6.63	31.11	33.87	27.33	3.80	790.27	1.94
Shiralakoppa Local	154.77	6.43	28.35	36.53	29.97	4.30	776.71	1.84
Kushalnagar Local	158.87	7.03	37.65	40.43	29.17	5.63	1141.64	2.97
Koppa-1	161.47	7.50	43.78	41.53	30.83	4.88	1363.63	3.78
Koppa-2	144.67	6.73	35.07	35.13	29.37	4.76	924.00	2.30
DavaMudli	133.37	5.73	32.48	29.07	27.17	3.92	708.14	1.50
KasuMudli	169.10	7.67	46.50	39.87	31.47	5.86	1390.46	3.94
Mudli	136.20	6.70	39.07	37.17	27.73	4.71	1089.17	2.70
Madikeri Local	144.70	5.30	32.52	33.30	26.57	3.77	812.18	1.59
Nymati Local	132.77	6.53	27.43	30.10	26.37	3.82	619.23	1.49
Mudigere Local (Check)	171.80	7.50	46.85	36.43	35.10	6.70	1280.05	3.55
Mean	149.93	7.04	37.03	34.87	29.59	4.73	977.86	2.596
S.Em.±	6.59	0.25	1.95	1.85	1.23	0.24	3.93	0.015
CD at 5%	18.86	0.71	5.57	5.31	3.52	0.70	11.29	0.044

1. Plant height (cm) at 120 DAP 2. Number of leaves per plant at 120 DAP
3. Leaf length (cm) at 120 DAP 4. Leaf breadth (cm) at 120 DAP
5. Petiole length (cm) at 120 DAP 6. Petiole girth (cm) at 120 DAP
7. Leaf area (cm^2) at 120 DAP 8. Leaf area index at 120 DAP

Table 3: Mean performance of twenty colocasia genotypes for yield parameters.

Genotypes	1	2	3	4	5	6	7	8	9	10	11
Piriyapattana Local	14.95	7.45	5.56	2.59	3.60	24.47	4.31	1.28	891.33	257.00	1149.00
Balehonnur Local	11.80	7.39	5.06	2.88	2.37	23.87	1.70	1.62	392.00	260.67	652.67
Sirsi Local	10.89	7.83	6.93	2.36	2.80	26.67	1.48	1.33	269.67	286.67	557.00
Mandya Local	12.47	6.89	6.00	2.41	2.47	17.90	2.81	1.43	592.00	289.00	881.00
Kumuta-1	7.68	5.18	4.63	2.70	2.07	44.50	1.21	2.78	254.67	528.33	783.00
Kumuta-2	15.03	6.77	5.08	2.70	1.73	11.13	1.31	1.22	256.67	240.33	497.00
Sakleshpur Local	12.26	6.23	5.57	2.65	1.80	16.30	0.96	1.19	177.67	266.33	444.00
Andhra Pradesh Local	13.87	6.24	4.69	2.56	1.73	53.97	0.85	2.26	165.00	490.00	655.00
Gulbarga Local	7.88	4.91	4.39	2.41	2.00	48.30	1.16	2.69	240.67	521.00	761.67
Hyderabad Local	8.08	5.51	4.93	2.82	3.20	48.50	1.57	3.59	321.33	731.67	1054.33
Shiralakoppa Local	8.33	5.96	5.51	2.91	1.73	19.30	0.71	1.41	164.00	224.00	388.00
Kushalnagar Local	13.10	6.20	4.97	2.87	2.20	27.77	2.85	2.30	576.67	458.00	1035.33
Koppa-1	14.03	7.83	4.79	2.38	2.47	33.90	0.65	2.07	138.33	415.33	553.00
Koppa-2	12.60	6.63	5.05	2.60	1.27	16.83	0.57	1.11	114.00	241.67	354.33
DavaMudli	28.34	8.79	14.85	2.13	3.03	21.30	1.31	3.11	296.00	596.67	892.67
KasuMudli	12.98	7.89	5.67	3.29	1.67	11.83	1.69	1.79	327.67	416.33	744.00
Mudli	12.73	6.64	5.11	2.43	1.93	12.30	1.46	1.89	305.67	379.33	685.00
Madikeri Local	12.83	6.45	4.91	2.66	1.30	6.97	0.55	0.79	107.00	177.33	284.33
Nymati Local	12.89	6.72	4.83	2.67	2.53	35.87	1.08	1.97	227.00	388.67	615.67
Mudigere Local (Check)	10.57	7.17	4.73	2.47	1.20	23.30	3.21	2.01	661.00	403.33	1064.00
Mean	12.67	6.73	5.66	2.62	2.16	26.25	1.57	1.89	323.92	378.58	702.55
S.Em.±	0.64	0.36	0.30	0.14	0.11	1.03	0.09	0.08	11.05	12.04	40.60
CD at 5%	1.84	1.02	0.86	0.39	0.32	2.95	0.24	0.22	31.64	34.48	116.24

1. Corm length (cm)
2. Corm width (cm)
3. Cormel length (cm)
4. Cormel width (cm)
5. Number of corms per plant
6. Number of cormels per plant
7. Corm weight (kg)
8. Cormel weight (kg)
9. Corn yield per plant (g)
10. Cormel yield per plant (g)
11. Tuber yield per plant (g)

Table 4: Mean performance of twenty colocasia genotypes for quality parameters.

Genotypes	1	2	3	4	5	6	7	8

Piriyapattana Local	66.50	11.68	46.00	2.30	4.30	5.75	3.70	2.05
Balehonnur Local	75.50	9.56	31.00	3.50	4.50	5.10	2.60	2.50
Sirsi Local	48.60	8.47	34.60	2.05	4.70	5.31	3.10	2.21
Mandya Local	52.10	10.39	37.00	3.30	5.90	5.69	3.20	2.49
Kumuta-1	53.37	8.48	34.20	2.45	4.50	4.50	3.10	1.41
Kumuta-2	62.40	9.43	31.40	3.15	3.80	4.30	3.10	1.20
Sakleshpur Local	54.80	10.03	29.59	2.05	3.59	4.20	2.50	1.70
Andhra Pradesh Local	77.90	7.68	32.00	5.00	2.30	4.10	2.20	1.90
Gulbarga Local	62.50	10.64	25.40	4.25	2.50	4.29	2.80	1.49
Hyderabad Local	71.00	8.64	32.40	2.00	2.90	4.12	2.10	2.02
Shiralakoppa Local	54.90	7.49	33.80	1.74	2.90	4.21	2.50	1.71
Kushalnagar Local	76.50	9.18	37.40	1.34	2.70	4.13	2.20	1.93
Koppa-1	64.50	9.37	28.60	4.25	2.80	4.25	2.70	1.55
Koppa-2	49.30	7.32	30.40	2.00	4.90	5.12	3.80	1.32
DavaMudli	70.50	10.29	23.00	2.50	2.90	4.32	3.59	0.72
KasuMudli	48.50	7.81	34.00	2.80	3.20	4.28	3.90	0.38
Mudli	68.30	8.51	25.40	5.00	2.80	4.01	3.80	0.21
Madikeri Local	74.50	11.06	30.59	2.35	2.90	4.21	2.50	1.71
Nymati Local	46.80	7.60	33.40	3.70	1.30	2.08	1.45	0.63
Mudigere Local (Check)	72.00	10.60	26.60	3.00	3.30	4.56	3.30	1.26
Mean	62.52	9.21	31.84	2.94	3.43	4.42	2.91	1.52
S.Em.±	3.97	0.67	1.34	0.13	0.16	0.22	0.14	0.06
CD at 5%	11.38	1.92	3.85	0.38	0.46	0.64	0.40	0.19

1. Starch content (%) 5. TSS (°Brix)
2. Protein content (%) 6. Total sugars (%)
3. Dry matter content (%) 7. Reducing sugars (%)
4. Fiber content (%) 8. Non-reducing sugars (%)

CONCLUSION

The present investigation revealed that a considerable degree of variability exists among the different genotypes of taro for growth, yield and quality traits. The best-performing genotypes identified from the present study based on the mean performance are Piriyapattana Local, Kushalnagar Local and Hyderabad Local with respect to yield characteristics. These genotypes may be recommended for commercial cultivation under the hill zone of Karnataka after yield stability analysis.

FUTURE SCOPE

Identified promising high-yielding genotypes *i.e.*, Piriyapattana Local, Kushalnagar Local, Hyderabad Local and Balehonnur Local, could be tested over different locations and seasons for their yield stability.

Acknowledgment. This study was carried out and supported by the Department of Vegetable Science, College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, to evaluate taro (*Colocasia esculenta* L.) genotypes for growth, yield and quality attributes under hill zone of Karnataka. The author is very thankful to Devaraju and G.K. Latha from the Department of Vegetable Science, C.S. Ravi, Y. Kantharaj and H.S. Yallesh Kumar from College of Horticulture, Mudigere and Dr. Arun Kumar, B from Department of Vegetable Science, AICRP, RHREC, Kumbapur, Dharwad for their support throughout the study.

Conflict of Interest. None.

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How to cite this article: Sangeeta, Devaraju, G.K. Latha, B. Arunkumar, C.S. Ravi, Y. Kantharaj and H.S. Yallesh Kumar (2023). Evaluation of Taro (*Colocasia esculenta* L.) Genotypes for Growth, Yield and Quality Attributes under the Hill Zone of Karnataka. *Biological Forum – An International Journal, 15*(1): 36-41.