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Morphological Characterization Of Some Nalkachu Genotypes

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ABSTRACT
Comparative morphological study of thirteen varieties of Colocasiaesculenta (L.) Schott present in Assam, Manipur and west bengal State, India was carried out, in order to furnish plant taxonomists with information which could be of great help in delimitation of the varieties. The result showed that adaxial surface of Manipur green, Manipur black, BCKVST-1, BCKVST-3, BCKVST-5, BCKVST-13, BCKVST-14, Tezpur and Karimganj pink had a purplish dot on the centre, abaxial leaf surface of BCKVST-1, BCKVST-3, BCKVST-5, BCKVST-13, Tezpur and Bilachipara black had a conspicuous purplish colour at the point of attachment to the leaf, and the caudex had numerous striking vertical purple stripes on the surface. The leaf lamina ranged from 1.70±1.78cm (Bholakachu) to 1.51±1.83cm (BCKVST-3). Petiole length of Bholakachu was the highest (92.15±29.50cm), whereas the least was Manipur green (61.87±19.70cm). The caudex length ranged from 77.21cm (Bholakachu) to 21.82cm (BCKVST-14), while the stolon length ranged from 127.13cm (BCKVST-14) to 62.17 cm (Karimganj). This work has revealed diagnostic and differential morphological characters, which could be useful for identification and description of varieties of C. esculenta. In addition, it provided additional information which might be helpful in resolving the on going controversy in the taxonomy of Colocasia, which would, in turn, probably lead to possible delimitation of C. esculenta.
Keywords:*Colocasia, Caudex, Diagnostic characters, Morphological characters, Plant taxonomy*

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INTRODUCTION

Nalkachu (*Colocasiaesculenta* var. *stolonifera*) is one of the important tuber crops of Assam. Unlike other upland colocasia cultivars, nalkachu is grown for stolon as well as caudex. It is also cultivated in West Bengal and Bangladesh. It is a highly nutritious tuber crop, which contains good amount of starch, calcium, iron, β-carotene, vitamin B1 and vitamin-C. It can be cultivated with minimum effort and it can sustain growth in water logged environment, tolerate brief submergence (Roy Chowdhury*et al*., 2010). So this crop is easily cultivated in low lying areas where other vegetable crops cannot be grown. The crop is also highly remunerative and a commercial crop can give an income of about Rs. 52,000 per ha (Saud and Barua, 2000). The crop produces runner (stolon) which is preferred as a vegetable and is very popular in Assam, Bihar, West Bengal and adjoining Bangladesh. In some cultivars, after harvesting of stolons, the caudex fully develop and are the main marketable part of the crop. Depending upon cultivars, stolons, leaves, petioles and caudex are used as vegetable (Roy Chowdhury*et al*., 2004). In comparison to other crops, it has better light utilization strategies even under low light conditions prevalent during cloudy monsoon (Roy Chowdhury*et al*., 2008; 2009). The observed varieties of *C. esculenta* showed a lot of variability in morphological characters. This variability is common among crops that have been cultivated for a long time. The knowledge of variability of *C. esculenta*is deficient and limited. In addition, there is paucity of literature on its taxonomy, which implies that thorough taxonomic research has not been done on *C. esculenta* (Ezeabara*et al.,* 2015). As a result, a morphological study on varieties of *C. esculenta* becomes a necessity; because morphological characters are the strongest tools used in taxonomic classification of plants, and this makes its application very crucial (Ezeabara*et al.,* 2015). Plants are generally grouped by their relationship to one another based on their similarities and differences, which is based on the characters they possess. This study, therefore, supplied additional morphological

information which might be helpful in resolving the on going controversy in the taxonomy of *Colocasia,* which would in turn, probably lead to possible delimitation of *C. esculenta* (Ezeabara*et al.,* 2015).

MATERIALS AND METHODS :

Sources of materials

The materials for the present investigation comprised of 13 cultivars of *Colocasiaesculenta*var.*stolonifera* collected from different parts of North eastern regions of the country. The list of the materials and the sources from where they were collected are given in Table 2.1

Table 2.1. List of genotypes with its place of collection

Genotypes	Source
Manipur black, Manipur green	Manipur
BCKVST-1, BCKVST-3, BCKVST-5, BCKVST-13, BCKVST-14	West Bengal
Tezpur, Bholakachu, Hybrid, Karimganj, Karimganj pink, Bilachipara black	Assam

Morphological study

The petiole and leaf measurements were done in February 2014; hence the plants were four months old when the measurements were done. The caudex and stolons were measured in August 2015. The meristem of the caudex were removed untill they cannot be removed without force;Stolons from the base of the main stem were randomly choosen and third fully opened active leaves and petioles from the base were measured. The petiole measurement started from the ligule to the base of the leaf. The raw caudex and stolons from the base of the main stem were peeled with knife. Observations and measurements of the plants parts were done usingeye lens thread and ruler. Photographs of the habit and plant parts were taken with digital camera (Sony Dsc-W230, China).

Statistical analysis:

The data were subjected to the analysis of variance for Randomized Block Design as suggested by Panse and Sukhatme (1985). Partitioning the total variance into replications and treatments represented the expectations of the variance and the appropriate degrees of freedom in each case. The computation of analysis of variance is as follows:

The model of ANOVA used is presented below:

$$Y_{ij} = \mu + g_i + v_j + e_{ij}$$

RESULTS:

The leaf of all the varieties was thick,succulent and downward-pointing, with reticulate venation. Three strong midribs arose from the point of attachment to the petiole, the main midrib pointed towards the basal lobe, while other two smaller midribs extended to the two postrior lobes, with one midrib on each lobe. The primary lateral veins originated from the three midribs, while the veinlets emanated from these primary lateral veins. The leaf margin was entire and undulate; the leaf blade was sagittate and peltate but not shiny, the abaxial and adaxial surfaces of the leaf blade were glabrous; the anterior lobes were twice as large as the postrior lobes, which were round in shape; and the petiole attachment was peltate. Petiole had a wide range of colors, including pale green, dark green, yellowish green and purple **(figure1(a))** The base of petiole of BCKVST-5 was deep purple (**Figure 1(b)**) When compared with other varieties (**Figure 1(c)**) The leaf of Karimganj has a prominent distinctive feature, which was presence of a purplish dot on the centre of the adaxial surface (**Figure 1(d)**). The petiole of Manipurgreen was yellowish green (**Figure 1(e)**) and **Table 1**) While that of Bholakachu was purple in colour. While other varieties like Karimganj absent in petiole junction colour(**Figure 1(f)**) Abaxial leaf surface of Bilachipara black had a conspicuous purplish colour at the point of attachment to the leaf (**Figure 1(g)**).

*Colocasiaesculenta*var*stolonifera*and Bholakachu had large caudex which were more or less cylindrical in shape. (**Figurre 1(h)**)Where as caudex of BCKVST-14 and BCKVST-1 were more or less oval. (**Figure 1(i)**) stolons of BCKVST-14 and BCKVST-13 were long (**Figure 1(j)**). They were relatively longest, where as those of Bholakachu were the smallest. (**Figure 1(k)**).

There was significant difference among the petiole lenth of all the varieties at $p<0.05$. Petiole length of Bholakachu was the highest (92.15±29.50cm), whereas the least was Manipur green (61.87±19.70cm),where as others differed. There was significant difference among the leaf lamina of all the varities at $p<0.05$. The leaf lamina ranged from 1.70±1.78cm (Bholakachu) to 1.51±1.83cm (BCKVST-3). The leaves of Bholokachu were deep green colour, while those of Hybrid were light green.There was significant difference among the caudex length of all the varieties The caudex length ranged from 77.21cm (Bholakachu) to 21.82cm (BCKVST-14). There was significant difference among the stolon length of all the varieties. While the stolon length ranged from 127.13cm (BCKVST-14) to 62.17 cm (Karimganj).

fig 1(a,)

fig1(e)

fig (b)

fig (c)

fig (d,g)

fig (f)

fig (h)

fig (i)

fig (j) fig (k)

Figure 1Photos Showing habit,abaxial leaf surface , length of caudex and length of stolonofnalkachu varieties

Table 1: Morphological characters of Colocasiaesculentavaresculenta varieties

Varieties	Petiole Length	PetiolColour	Leaf Lamina	Leaf Colour	Caudex Length	Length of Stolon (cm)	Girth of Stolon (cm)
AAUST-3	25.44±72.31	Purple	1.9 ±1.64	Dark green	44.36	74.9	0.63
BCKVST-5	22.7±65.88	Green	2±1.54	Light green	31.38	101.57	0.63
AAUST-5	21.39±66.31	Green	1.7±1.63	Dark green	35.22	76.13	0.65
AAUST-4	18.8±65.08	Green	1.53±1.68	Dark green	33.23	62.17	0.49
CAUST-2	19.7±61.87	Green	1.45±1.71	Dark green	32.21	63.9	0.54
BCKVST-3	23.23±69.02	Purple	1.83±1.65	Dark green	31.7	105.93	0.79
AAUST-1	28.13±86.83	Green	1.19±1.66	Light green	64.45	100.47	0.73
BCKVST-14	28.4±81.98	Green	1.99±1.66	Dark green	21.82	127.13	0.87
AAUST-2	29.5±92.15	Green	1.78±1.7	Light green	77.21	116.67	0.83
AAUST-6	27.23±78	Green	1.62±1.72	Light green	49.54	88.53	0.63
BCKVST-13	26.2±77.21	Green	1.97±1.69	Dark green	33.82	121.03	0.75
CAUST-1	21.13±71.78	Green	1.87±1.71	Dark green	31.03	67.33	0.63
BCKVST-1	21.36±62.4	Green	1.97±1.62	Dark green	32.44	91.93	0.63

AAUST-1= Tezpur, AAUST-2= Bholakachu, AAUST-3= Hybrid, AAUST-4= Karimganj, AAUST-5= Karimganj pink, AAUST-6= Bilachipara black, CAUST-1= Manipur black, CAUST-2= Manipur green.

DISCUSSION

The common leaf features of all the varieties of colocasiasame.The appearance of *C.esculenta*and *X. sagittifolium*are some times confusing, as a result of their similarity. The leaves of *Xanthosoma* (Tannia) are large, approximately 20cm in length, 15cm in width, hastate (sagittatate-ovate) in shape, with the anterior lobe twice as large as the posterior lobe, with distinct marginal vein, and round basal lobes. In addition, the petiole attachment of *Xanthosoma* is at the margin of the leaf. Leaves of *X.saggittifolium*are nearly in rosette in acaulescentplants,or in a distal crown in mature plants. blades horizontal to slight ascending, with the posterior lobes ascending, simple , upper surface dark green with light green primary secondary veins on basal lobes, lower surface light green with dark green veination; petioles light green;

basal lobes of the leaf sub rhomboid obtuse; colocasia can therefore, easily distinguished from *Xanthosoma* by the point where the petiole is attached to the leaf. In colocasia , the petiole attachment was peltate, where as for *Xanthosoma*, the petiole attachment is at the margin of the leaf. Moreover, *C.esculenta* can be differentiated from *X. saggittifolium*by shape of the basal lobes, position of the leaf blades, and colour of petiole and leaf. In *Colocasiaesculenta* the basal lobe of leaf was round, leaf blade pointed downward, and leaf colour was dark green with petiole colour ranging from pale green, dark green, yellowish green and purple; while for *X.sagittifolium*, basal lobes is sub-rhomboid obtuse, blades horizontal to slight ascending, with leaf and petiole light green It has been stated that morphological characteristics are the strongest determinants of the agronomic value and taxonomic classification of plants.

Generally, all the varieties of *C.esculenta*looked alike in the feilduntill a closer look was made. Interestingly, however, there were remarkable differences in some parts of the varieties. The variety of Bholakachu was the highest leaf lamina; and deep purple colour of the petiole was the most conspicuous morphological feature differentiating it from others.Diagnostic character for Bholakachu was location of purplish spot in the centre of the adaxial surface of the leaves. The use of leaf characters in classification and identification of plants has been extensively reported. it has been documented that the leaf characters such as arrangement, type, form, duration and veination are widely used in both classification and identification in palms, *Salix* and *Populus.* Leaf character has been reported to be critical tool in the hand of taxonomists in the classification and separation of taxa.

Moreover,there were some similarities between *C.esculenta* var.*stolonifera* and *C. esculenta* var*. esculenta*. There was a significant difference in the leaf lamina of all the genotypes. The leaf lamina ranged from 1.70±1.78cm (Bholakachu) to 1.51±1.83cm (BCKVST-3). However some morphological characters can be used in differentiating them.There was significant difference among the caudex length of all the varieties The caudex length ranged from 77.21cm (Bholakachu) to 21.82cm (BCKVST-14). There was significant difference among the stolon length of all the varieties. While the stolon length ranged from 127.13cm (BCKVST-14) to 62.17 cm (Karimganj).Bholakachuhad large caudex length and BCKVST-14 had small caudex length. Incase of stolon length BCKVST-14 had large stolon length and Bholokachu had small stolon length, therefore , were the most prominent morphological characters which distinguished them from each other. Some of these characters have extensively been used to differentiate between *C.esculenta*var*stolonifera* and *C. esculenta*var*esculenta* by various workers.

There was also significant difference in the caudex length, caudex width and stolon length of all the varieties of *C.esculenta*. This indicated that these characters could be usefull in distinguishing the varieties. Long caudex length of"Bholokachu " could be used as a ready distinctive character, as well as the largest stolon length and stolon width of BCKVST-14. It has been specified that under ground parts, such as roots and tubers, are of some taxonomic value in plants. The tubers are helpfull in the taxonomy of *Dioscorea*and*cyperaceae.* Such a vegetative characters that play a major role in plant taxonomy and deducing phylogeny include growth habit, phonological characters, underground organs, stems, leaves, petiole and stipules. Three sesame species, namely *Sesamumalatum*, *S.radiatum* and *S.indicum*were differentiated on the basis of their vegetative and the pod characteristics. In addition, such characteristics, because of their high taxonomic importance, could be used in constructing a taxonomic key for the purpose of easy and quick identification of the three sesame species irrespective of their growth environment.

CONCLUSION:

This work provided information on the morphology of these thirteen varieties of *Colocasiaesculenta*var*stolonifera*present in Assam, Manipur and West Bengal state India; Which was previously lacking, secondly , the overwhelming evidence from this study suggested close relatedness between *C.esculenta*var*stolonifera*and *C. esculenta*var*esculenta*and provided diagnostic characters for "Bholakachu ", " BCKVST-14 " and "Manipurgreen "

Conspicuous diagnostic characters observed in" Bholokachu" were presence purplish colour at point of attachment to the leaf of the abxial surface, as well as presence of purplish dot on the center of the adaxial surface of the leaf, and numerous purplish stripes on the surface of the caudex. Purplish colour of petiole and yellowish green colour of "Bholokachu" and " Hybrid " was only the diagnostic character. The differential character include, large caudex length with cylindrical shapein "Bholokachu " and small caudex length with oval shape in "BCKVST-14".

Plants are generally grouped by their relationship to one another based on their similarities and differences, which is based on the characters they possess. This study, therefore, supplied additional morphological information which might be helpful in resolving the on-going controversy in the taxonomy of colocasia, which would, in turn, probably lead to possible delimitation of *C.esculenta*.

REFERENCES

1. Ahmed, G. and Rashid, M.M. (1975).A comparative study of the gross morphological characters and the yield poten- tialities of the major types of edible aroids of Bangladesh.*Bangladesh Hort*. **3**(1): 15-21.
2. Al-Jibouri, H.A.; Miller, R.A. and Robinson, H.F. (1958). Genotypic and environmental variances and co-variances in an upland cotton across of inter specific origin. *Agron. J.***50**: 633-637.
3. Annual Report of Bangladesh Agricultural Research Institute (1987-1988), Joydevpur, Gazipur.
4. Anonymous (1967).Quality in potatoes.*Potato Bull.***94**:65-68.
5. Anonymous (1985).Uniform regional trial on colocasia.*Ann. Rept.* CTCRI,Trivandrum.
6. Anonymous (1988).Uniform regional trial on colocasia.*Ann. Rept.* CTCRI, Trivandrum.
7. Anonymous (2000).Uniform regional trial on colocasia*Ann. Rept*. CTCRI Trivandrum.
8. Ashokan, P.K.; Hassan, M.A. and Neelakanthan, P.N. (1980). Quality attributes of Colocasia (*Colocasiaesculenta*). *Agric. Res. J.Kerala***18**(1): 102-103.
9. Akwee, P. E., Netondo, G., &Palapala, V. A. (2015). Comparative analysis of phenotypic characterization of Kenya and Pacific Islands tarogengermplasm collections Colocasiaesculenta L.(Schott). *Sci. Agric*, *9*(2), 113-119.
10. Baksh, M.E.;Rehman, M.M.andMondal, N.A. (1992). Aqua aroids in high land, farmers experience in Jamalpur. *Ann. Bangladesh Agric*. **2**(1): 41-46.
11. Barooah, H. (1982). Collection, screening and evaluation of some local Colocasia (*Colocasiaesculenta* L.Schott) and Xanthosoma (*Xanthosomasagittifolium* L. Schott) cultivars of Assam. M.Sc. (Agri.) Thesis, AAU, Jorhat.
12. Baruah, N.N. (1999). Sources of organic nitrogen and levels of inorganic nitrogen on performance of swamp taro (*Colocasiaesculenta* L.) cultivar Nalkachu. M.Sc. (Agri) Thesis, AAU, Jorhat.
13. Bhuiyan, M.A.J. and Quadir, M.A.(1989). Crop duration effect on growth and yield contributing components of taro (*Colocasiaesculenta* L.). *South Ind. Hort*. **37**(4): 235-236.
14. Biradar, R.S.;Venkateswarlu, T. and Hrishi, N. (1978).Leaf area estimation in colocasia.*J.Root Crops***4**(2):51-53.
15. Choudhury, B. (1967). *Vegetables,* National Book trust, New Delhi, India, p. 198.
16. Cochran, W.G. and Cox, G.M. (1960).Experimental design.2nd edition. John Willey and Sons, Inc. NewYork.
17. Devsharmah, R.K. (1998). Effect of nitrogen and potasium on the yield and quality of Xanthosoma (*Xanthosomasagittifolium* L.Schott) cv. "Bogadohi". M.Sc. (Agri.) Thesis, AAU, Jorhat.
18. Dechassa, N., &Kifle, A. (2006).*Characterization and Divergence Analysis of Some Ethiopian Taro (Colocasia esculent (L.)Schoot) Accessions* (Doctoral dissertation, Haramaya University).
19. Ezeabara, C.A.;Okeke, C.U.;Amadi, J.E.;Izundu, A.I.;Aziagba, B.O.;Egboka, P.T. and Udechukwu, C.D. (2015).Morphological comparison of five varieties of *Colocasiaesculenta* (L.)Schott in Anambra State, Southeastern Nigeria.*American J. Pl. Sci.* **6**: 2819-2825.
20. FAO (1988).The FAO World Food Model, Model Specification, Suppliment to FAO agri. comodity Projection to 1990. Rome. FAO.
21. Goenaga, R. (1994). Growth, nutrient uptake and yield of tanier (Xanthosoma spp.) grown under semiarid conditions. *The Journal of agriculture of the University of Puerto Rico (USA)*.
22. Gopalan, C.;Ramasastri, B.V. and Balasubranium, S.C. (1980).Nutritive value of Indian Foods.National Institute of nutrition, ICMR, Hyderabad.
23. Han, G.P. and Lee, D.G. (1976).Studies on the effect of number of petiole bundles on yield of taro *Colocasiaantiquorum*.*Res. Report Rural Develop. Hort*. **18**:33-36.
24. Hashad, M.M. (1956). Transformation and translocation of carbohydrates in taro plant during growth. *Ann. Agric. Sci. Fac. Agric.Ain Shams Univ.Cario***1**(1):261-267.
25. IBPGRI (1999).Descriptors for taro (*Colocasiaesculenta*).IPGRI, Rome, Italy.
26. Igobokwe, M.C. (1984). Growth and development of *Colocasia* and *Xanthosoma* species under upland condition. Trop, Root crop Production and uses in Africa, Edited by Terry, E. R., Ooku, E.V., Arene, D. B. and Mahangaottawa, N. M., Canada, pp. 172-174.
27. Kurian, J.; Mani, S.B. and Indian, P. (1981). Studies on Maturity index in Colocasia. *Agril.Sci. Digest*. **1**(4):227-228.
28. Lowry, O.H.;Rosebrough, N.J.; Farr, A.L. and Randall, R.J. (1951).*J. Biol. Chem*., pp.193-265.
29. Mohankumar, C.R. and Sadanandan, N. (1990).Growth and rooting pattern of taro (C*olocasiaesculenta*L. Schott) as influenced by NPK nutrition.*J. Root Crops***16**(1): 61-63.
30. Mandal, R., Mandal, N., Mitra, S., Mukharjee, A., &Tarafdar, J. (2015). Development of DUS standard for taro [Colocasiaesculenta var. antiquirom (L.)Schott.]using digital morphometrics. *Applied Biological Research*, *17*(1), 70-76.
31. Naskar, S.K.; Mukherjee, Archanaand Nedunzhiyan (1999). Selection of taro for upland and swampy condition.*Ann. Rept.* CTCRI, Trivandrum,pp. 96-97.
32. Onwueme, I.C. (1978). The tropical tuber crops, John Willey and Sons, New York, p. 199.
33. Oyenuga, A.(1968). Nigerian Foods and Feeding stuff. Univ. of Ibadan Press. Nigeria, p,99.
34. Panse, V.G. and Sukhatme, P.V. (1978).Statistical methods for agricultural workers.Indian Council of Agricultural workers. Indian council of Agricultural Research, New Delhi, India..
35. Paul, K.K. and Bari, M.A. (2011).Studies on direct and indirect effects of different plant characters on yield of taro (*Colocasiaesculenta* L. Schott.) var. antiquorum.*Agricst*. **9**: 89-98.
36. Plucknet, D.L.; Pena, R.S.Dela and Obrero, R.T. (1970).Taro (*C. esculenta*).*Field Crop Abst*.**23**: 413-326.
37. Plucknett, D.C. (1970). Status and future of the major edible aroids: Colocasia, Xanthosoma, Alocasia, Cyrtosperma and amorphophollus second international. Symposium. Trop. Root crops (Honolulu).
38. Plucknett, D.L. and de lapena, R.S. (1971). Taro production in Hawaii.*World Crops***23**(5): 244-287.

39. Prabhakar, M. and Nair, G.M.(1984). Influence of time of planting on the growth and yield of taro.*J. Root Crops***10**(1&2):23-27.
40. Purseglove, J.W. (1972).Araceae.TropicalCrops: Monocotyledons 1, London. Longman Group Ltd., pp. 58-74.
41. Reddy, V.B.; Meredith, W.F. and Brown, B.T. (1968).A note on the relationship between corm yield and certain leaf measurements in taro (*Colocasiaesculenta*L.).*Trop. Agric*. *Trinidad*, pp. 45-243.
42. Roy Chowdhury, S. (1995). Leaf area development in Colocasia and its relationship with yield.*Indian J. Pl. Physiol*. **38**:305-308.
43. Roy Chowdhury, S.;Anand, P.S.B.;Kundu, D.K. and Kumar, A. (2010).Performance of swamp taro cultivars as affected by brief submergence.*J. Root Crops***36**: 204-209.
44. Roy Chowdhury, S.;Anand, P.S.B.;Sahoo, N. and Verma, H.N. (2004). Canopy characteristics, dry matter partitioning efficiency and runner yield in swamp taro (*Colocasiaesculenta* (L) Schott.) grown under water-logged condition. *Trop. Agric.***81**: 45-48.
45. Roy Chowdhury, S.; Kumar, A. and Sahoo, N. (2009). Diurnal changes in chlorophyll fluorescence and light utilization in *Colocasiaesculenta* leaves grown in marshy water-logged area. *Biol. Plant.***53**: 167-170.
46. Roy Chowdhury, S.; Thakur, A.K. and Kumar, A. (2008). Comparative study of utilization of incident radiation and chlorophyll fluorescence in swamp taro (*Colocasiaesculenta*), Alocasia and tannia (*Xanthosoma* spp.) leaves. *J. Root Crops***34**: 5-9.
47. Salvia, S. and Irizarry, A. (1981).Effect of depth of water table on yields of tanniers.*J. Agric.Univ.Puerto Rico*. **64**(2):241-242.
48. Sadasivam, S. And Manickam, A. (1992) In: Biochemical methods for agricultural sciences, wiley eastern limited, New delhi, PP. 11-12
49. Sarmah, G.K.(1994). Evaluation and screening of some colocasia (*Colocasiaesculenta*L.) cultivars, M.Sc. (Agri.) Thesis, AAU, Jorhat.
50. Sarmah, I. (1997). Performance of some colocasia under different spacings. M.Sc. (Agri.) Thesis, AAU, Jorhat.
51. Saud, B.K. and Baruah, R.K.S.M. (2000). 'Pani-Kachu'- A special taro cultivation in southern Assam. Intensive Agric., 38:26-27. Sinclair, T.R.1998. Historical changes in harvest index and crop nitrogen accumulation. *Crop Sci*. **38**: 638–643.
52. Sen, H. (2000). Collection, evaluation, documentation and crop management of swamp taro.*Ann.Rept*. CTCRI, Trivandrum.
53. Shanmugam, A. and Ramaswamy, C. (1972).Relationship between certain yield components of Colocasia (*Colocasiaesculenta*L.). *Andhra Agri. J*. **79**(5 and 6):162.
54. Shanmugam, S. (1973). Care for Colocasia (*Colocasiaesculenta* L.).*Intensive Agric.***11**(10):73-74.
55. Simmonds, N. W. (1966). Bananas, Longmans, London, 2nd Edn.
56. Sivam, P. (1978). Growth and development of taro (*Colocasiaesculenta*) under dry land condition in Fiji. Proc. 5thsymp.Inter. Soc. Trop. Root crops, Philippine,pp.637-646.
57. Rangana, S. (1986) Hand book of analysis and quality control for fruits and vegetable products, Tata Mcgrew Hill pub, co, Ltd. New delhi.
58. Sivam, P. (1983). Proc. 6thSymp. Inter. Soc. Trop. Root crops.CIP, Lima, Peru, pp. 103-107..
59. Tang, C.S. and Sakai, W.S. (1983).Acridity of taro and related plants.In :Taro Wang, J. K (ed.), Univ, of Hawaii Press, Honolulu, pp. 148-163.
60. Unnikrishnan, M.;Nayar, G.G.;Thankamma, P.K. and Vasudev, K.;Venkateswarlu, M.T. and Lakshmi, K.R. (1987).*Ann.Rept. J. Root Crops***13**(2):11-16.

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