

Spadix Diversity of Aroids in Kamrup District, Assam (India)

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Abstract: "Spadix", the most consistent and characteristic feature of the family Araceae is a kind of inflorescence. It is composed of an unbranched spike bearing flowers, the spadix, with numerous tiny sessile flowers subtended by a single, mostly rather large bract the "spathe". The spadix may be completely covered with bisexual flowers or unisexual flowers and in the latter case the flowers are arranged on the spadix in regular spirals or in irregular spirals which may either monoecious or dioecious. "Appendix", an upper portion of the axis generally presents in unisexual spadix bears no flowers. Kamrup, one of the important districts in the Indian Mega Diversity Centre, where different types of tribes and communities reside along with their unique cultural heritage. Various kinds of food and recipes are part of cultural identity. The present work deals with observations of spadices of 26 species of Aroids occurring in Kamrup District, Assam (India). Results of qualitative and quantitative characters were presented in tabular form. A total of 26 species of Aroids belonging to 17 genera, of which six bear bisexual flowers and 20 bear unisexual flowers recorded from the study area. *Xanthosoma sagittifolium* (Linnaeus) Schott has the largest and *Pothos scandens* Linnaeus has the smallest inflorescence (spadix) here.

Keywords: Aroids, Kamrup District, Spadix, Inflorescence.

INTRODUCTION

The Araceae is a robustly monophyletic family of order Alismatales, comprising about 4000 species in 113 genera (Bogner and Peterson, 2007; Cusimano *et al.*, 2010) of which most of the species are tropical herbs. Members of the family are easily recognised on account of their conspicuous distinguishing characters of the inflorescence which is a "spadix" subtended by a spathe (Sabu, 1982). Discovered in the last century, *Amorphophallus titanum* (Becc.) Becc. ex. Arcang by the Italian botanist Odoardo Beccari has the biggest unbranched inflorescence in the plant kingdom. Interestingly this inflorescence was bloomed recently in Japan in Zindai Botanical Garden, Tokyo in the end of July, 2015 (Anonymous, 2015) after a long period of time.

"Spadix" the most consistent and characteristic feature of the family Araceae is comprised of an unbranched fleshy axis with numerous tiny sessile

flowers subtended by a single, mostly rather large bract the "spathe" which may vary from an inconspicuous green leaf-like organ (*Pistia*) to a coloured spreading showy structure (*Arum*) (Sabu, 1982). The spadix may be completely covered with bisexual flowers or unisexual flowers and in the latter case the flowers are arranged on the spadix in regular spirals or in irregular spirals which may either monoecious or dioecious. "Appendix", an upper portion of the axis generally presents in unisexual spadix bears no flowers.

Kamrup, one of an important district of North east region- a biodiversity rich area falling under transit region between Indo- Burma and Himalayan hotspot harbours a diverse plant communities is also rich in aroids. It is located between 25°46' and 26°49' North Latitude and between 90°4' and 91°5' East Longitude. It is bounded on the North by Nalbari and Baksa districts, on the South by Meghalaya, on the East by Darrang and Morigaon

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districts and on the West by Nalbari and Goalpara districts. The mighty Brahmaputra is flowing through the district and divides it into two major divisions - the South Bank and the North Bank (Anonymous 2011). Present investigation aims at the study of Spadix diversity of Aroids found in Kamrup District, Assam (India).

MATERIALS AND METHODS

Extensive field surveys were carried out during June 2011 to May 2013 covering all the seasons and all possible habitats to make a complete record of aroids from the Kamrup District of Assam. The prepared voucher specimens were identified with the pre-identified specimens in the GUBH, ASSAM, CAL, CALI, MH and with relevant literature. Up-to-date nomenclature was determined by consulting taxonomic literature and online data bases (www.plantlist.org, version 1.1). The inflorescences were worked out and observed under Stereo Zoom Microscope (LM-52-3611) and qualitative and quantitative characters were recorded.

RESULTS AND DISCUSSIONS

A total of 26 species out of 17 genera belonging to family Araceae were recorded from Kamrup District, Assam (India). Results were presented in tabular form [Table 1 and 2]. The inflorescence, of four species are terminal in position while, in twenty two species they are axillary in position. It was observed that all the recorded species are monoecious, six species bear bisexual flowers and twenty species are unisexual. Spathes are variously coloured from white, green, maroon, red, burgundy but most of them with green tube and golden yellow blade; shapes of the spathes found that fourteen spathes are constricted; in *Aglaonema marantifolium* Blume and *Philodendron lacerum* (Jacquin) Schott are boat-shaped; in *Amorphophallus bulbifer* (Roxburgh) Blume and *Amorphophallus napalensis* (Wallich Nathaniel) Bogner and Mayo basally convolute and upper lobe either erect or campanulate; *Anthurium andraeanum* Linden, Jean Jules heart-shaped, *Anthurium leuconeurum* Lemaire linear lanceolate, *Amorphophallus paeoniifolius* (Dennst.) Nicolson campanulate; *Homalomena aromatica* (Sprengal) Schott oblong-erect; *Lasia spinosa* (Linnaeus) Thwaites, linear, narrow and spirally twisted, *Pothos*

scandens Linnaeus cymbiform, ovate-concave; *Rhaphidophora decursiva* (Roxburgh) Schott initially involute later spreading; *Spathiphyllum cochlerispathum* (Liebmann) Engler ovate-acuminate. Spadix of seventeen species are stipitate and nine are sessile; perigone found in five species; appendix present in eleven species.

Among twenty unisexual species, thirteen of which, the female flowers are compact, basal in position and spirally arranged; in they are basal, close and spirally arranged; in *Alocasia cucullata* (Loureiro) G. Don species basal and close but not spirally arranged; in *Aglaonema marantifolium* Blume, *Dieffenbachia seguine* (Jacquin) Schott and *Pistia stratiotes* Linnaeus basal and loosely arranged; in *Amorphophallus paeoniifolius* (Dennst.) Nicolson basal, dense and sub-spirally arranged. Again in six species where appendix is present, male flowers are observed below the appendix, may be compact without any space between, while in *Amorphophallus bulbifer* (Roxburgh) Blume, *Amorphophallus napalensis* (Wallich Nathaniel) Bogner and Mayo and *Amorphophallus paeoniifolius* (Dennst.) Nicolson they are closely arranged having small spaces between; in *Philodendron latifolium* K. Koch and *Typhonium trilobatum* (Linnaeus) Schott densely arranged. When there is no appendix male flowers are always terminal in position, may be compactly or closely arranged.

A zone of neuter flowers present only in fifteen unisexual species, among them, in fourteen species they are found between male and female flowers-zones. In *Typhonium trilobatum* (Linnaeus) Schott, neuter zone occurs between naked and female flower- zone. In five unisexual species neuter flowers are absent. Eight species bear only solitary inflorescence in each floral sympodium; 1-2 found in four species; 2-5 in three species; 1 to many only in *Colocasia esculenta* (Linnaeus) Schott; 1-3 in *P. x domesticum* G.S. Bunting; 2-many in *Dieffenbachia seguine* (Jacquin) Schott and *Xanthosoma sagittifolium* (Linnaeus) Schott; 3-4 in *Philodendron lacerum* (Jacquin) Schott; 3-6 in *Pistia stratiotes* Linnaeus and *Homalomena aromatica* (Sprengal) Schott; 5-7 in *Syngonium podophyllum* Schott and *Colocasia gigantea* (Blume), species. Among the 26 species, *Xanthosoma sagittifolium* (Linnaeus) Schott

Table 1
Qualitative Characters of Spadices (Inflorescence) of Aroids of Kamrup District, Assam (India)

Name of the taxa	Inflorescence			Spathes		Spadix			Position & Arrangement of unisexual flowers		
	Position	Types of Flowers	Colour	Shape	Stipite/ sessile	Perigone	Appendix	Female flowers	Male flowers	Neuter Flower	
<i>Aglaonema marantifolium</i>	Axl	U	Cream	Bt S	Stpd	A	A	Bl, Ls	Trml, Cmp	A	
<i>Alocasia cucullata</i>	Axl	U	Green	Cnstd	Ssl	A	P	Bl, Cls	Blw Apx, Cmp	Bw MI & Flw	
<i>A. fornicata</i>	Axl	U	Tb green, Bdl Lgt yellow	Cnstd	Stpd	A	P	Bl, Spl & Cmp	Blw Apx, Cmp	Bw MI & Flw	
<i>A. macrorrhizos</i>	Axl	U	Tb green, Bdl Lgt yellow	Cnstd	Stpd	A	P	Bl, Spl & Cmp	Blw Apx & Cmp	Bw MI & Flw	
<i>A. odora</i>	Axl	U	Tb green, Bdl yellowish green	Cnstd	Stpd	A	P	Bl, Spl & Cmp	Blw Apx & Cmp	Bw MI & Flw	
<i>Amorphophallus bulbifer</i>	Trml	U	Pl green to greenish yellow with Blh	Tb Cvlt & Bl Elg Obvt	Stpd Cmp Cls	A	P	Bl, Spl & Blw Apx & A			
<i>A. nepalensis</i>	Trml	U	Pl green to greenish yellow	Lwr Lb Er, Bl Cvlt	Stpd	A	P	Bl, Spl & Cmp	Blw Apx & Cls	A	
<i>A. paeonifolium</i>	Trml	U	Pl green with cream Blh	Cmpt	Ssl	A	P	Bl, S Spr & Dns	Blw Apx & Cls	A	
<i>Anthurium andraeanum</i>	Axl	B	Red	Ht S	Stpd	P	A	-	-	-	
<i>Anthurium leuconeurum</i>	Axl	B	Copper	Lr- Llt	Stpd	P	A	-	-	-	
<i>Caladium bicolor</i>	Axl	U	Tb green, Bdl Lgt yellow	Cnstd	Stpd	A	A	Bl, Spl & Cmp	Trml & Cmp	Bw MI & Flw	
<i>Colocasia esculenta</i>	Axl	U	Tb green, Bdl golden yellow	Cnstd	Ssl	A	P	Bl, Spl & Cmp	Blw Apx & Cmp	Bw MI & Flw	
<i>C. gigantea</i>	Axl	U	Tb green, Bdl white	Cnstd	Ssl	A	P	Bl, Spl & Cmp	Blw Apx & Cls	Bw MI & Flw	
<i>Dieffenbachia seguine</i>	Axl	U	Both Tb and Bdl green	Sly Cnstd	Stpd	A	A	Bl, Ls	Trml & Cls	Bw MI & Flw	
<i>Homalomena aromatica</i>	Axl	U	Greenish yellow	Obt, Er	Stpd	A	A	Bl, Spl & Cls	Trml & Cmp	Bw MI & Flw	
<i>Lasia spinosa</i>	Axl	B	Maroon	Lwr , Nw & Spl Twd	Ssl	P	A	-	-	-	
<i>P. x domesticum</i>	Axl	U	Burgundy	Sly Cnstd	Stpd	A	A	Bl, Spl & Cmp	Trml & Cmp	Bw MI & Flw	

Cont. table 1

Name of the taxa	Inflorescence		Spathes		Spatix			Position & Arrangement of unisexual flowers		
	Position	Types of Flowers	Colour	Shape	Stipite/ sessile	Perigone	Appendix	Female flowers	Male flowers	Neuter Flower
<i>Philodendron lacernum</i>	Axl	U	Lwr half greenish maroon, Up lobe whitish green	Bt S	Ssl	A	A	Bl, Spl & Cmp	Trml & Cmp	Bw MI & Fl Flws
<i>P latifolium</i>	Axl	U	Lgt green to yellowish	Sly Cnstd Stpd	Stpd	A	P	Bl, Spl & Cmp	Blw Apx & Dns	Bw MI & Fl Flws
<i>Pistia stratiotes</i>	Trml	U	White	Cnstd	Stpd	A	A	Bl, Cls	Trml & cls.	-
<i>Pothos scandens</i>	Axl	B	Greenish to maroon	Cyf, Ovt Stpd Ccv	Stpd	P	A	-	-	-
<i>Rhaphidophora decursiva</i>	Axl	B	Yellow	Ivt, later Spd	Ssl	A	A	-	-	-
<i>Spathiphyllum cochlerispathum</i>	Axl		B	White	Ovt, Actm	Stpd	P	A	-	-
<i>Syngonium podophyllum</i>	Axl	U	Tb green & Bdl greenish white to creamy white	Cnstd	Ssl	A	A	Bl, Spl & Cmp	Trml, Spl & Cmp	Bw MI & Fl Flws
<i>Typhonium trilobatum</i>	Axl	U	Tb green & Bdl dark purple	Cnstd	Ssl	A	P	Bl, Spl & Cls	Blw Apx & Dns	Bw Nk Zn & Fl Flws
<i>Xanthosoma sagittifolium</i>	Axl	U	Tb green & Bdl golden yellow	Cnstd	Stpd	A	A	Bl, Spl & Cmp	Trml, Spl & Dns	Bw MI & Fl Flws

Abbreviation:- 'Axl'=Axillary; 'Trml'= Terminal; 'U'= Unisexual; 'B'=Bisexual; 'Tb'= Tube; 'Bdl'= Blade; 'Lgt'= Light; 'P1'=Pale; 'Blh'=Blotch; 'Lwr'= Lower; 'Up'=Upper; 'Bt S'= Boat-shaped; 'Cnstd'= Constricted; 'Sly Cnstd'= Slightly constricted; 'Cvlf'= Convolute; 'Elg'= Elongate; "Obvf'=Obovate; Cmpf'=Campanulate; Er'=Erect; 'Bl'= Basal; 'Hit S'= Heart-shaped; 'Lr'= Linear; 'Llf'=-lanceolate; 'Obl'=Oblong; 'Nw'=Narrow; 'Spl'= Spirally; 'Twd'=Twisted; 'Ovt'= Ovate; 'Ccv'= Concave; 'Actm'= Acuminate; 'Cyf'=Cymbiform; 'Ivt'= Involute; 'Spd'= Spreading; 'Stpd'=Sipitate; 'Ssl'= Sessile; 'P'= Present; 'A'= Absent; 'Ls'= Loose; 'Dns'= Dense; 'Cmp'=Compact; 'Bw'= Between; 'MI'=Male; 'Fl'= Female; 'Blw'= Below; 'Mdl'= Middle; 'Abv'= Above; 'Apx'= Appendix; 'Flws'= Flowers; 'Cls'- Close; 'S Spr'= Sub-spiral, 'Nk'= Naked, 'Zn'= Zone.

Table 2
Quantitative Characteristics of Spadices of Aroids of Kamrup District, Assam (India)

Name of the taxa	No of Inflorescence in each Sympodium	Inflorescence (Length cm)	Spathe (Length × Breadth cm)	Peduncle (Length cm)	Spadix (Length cm)	Stipe (Length cm)	Appendix (Length cm)	Female Flower/ Gynoecium (Length cm)	Male Flower/ Stamen (Length cm)	Tepal (Length cm)	Neuter Flower (Length cm)
<i>Aglanema marantifolium</i>	2-5	±10.0	±5.0 × 2.3	±5.0	±3.7	±1.3	-	±0.2	±0.16	-	-
<i>Alocasia cucullata</i>	1-2	±30.0	±9.1 × 3.9	±20.1	±9.5	-	±3.4	±0.19	±0.23	-	±0.25
<i>A. formicata</i>	1-2	±40.0	±17.7 × 7.9	±22.3	±14.5	±0.3	±7.6	±0.29	±0.25	-	±0.78
<i>A. macrorrhizos</i>	2-5	±54.5	±42.3 × 3.9	±12.2	±35.0	±0.5	±23.4	±0.4	±0.45	-	±0.39
<i>A. odora</i>	2-5	±74.0	±19.1 × 5.1	±53.9	±13.8	-	±4.4	±0.28	±0.27	-	±0.5
<i>Amorphophallus bulbifer</i>	1	±51.0	±27.5 × 14.0	±23.5	±20.3	±0.4	±11.0	±0.5	±0.4	-	-
<i>A. napalensis</i>	1	±110.0	±47.0 × 12.0	±63.0	±42.5	±0.3	±19.5	±0.37	±0.31	-	-
<i>A. paonifolium</i>	1	±40.0	±34.0 × 53.0	±6.0	±34.0	-	±11.0	±2.3	±0.45	-	-
<i>Anthurium andraeanum</i>	1	±57.0	±10.6 × 8.1	±46.4	±7.2	±0.4	-	±0.12	±0.1	±0.15	-
<i>Anthurium leuconeurum</i>	1	±73.0	±7.8 × 1.5	±65.2	±11.1	±0.75	-	±0.1	±0.08	±0.11	-
<i>Caladium bicolor</i>	1-2	±26.0	±7.50 × 4.5	±12.5	±5.7	±0.2	-	±1.1	±2.1	-	±0.3
<i>Colocasia esculenta</i>	1-many	±72.5	±20.0 × 2.6	±51.5	±12.5	-	±3.0	±0.2	±0.28	-	±0.27
<i>C. gigantea</i>	5-7	±63.0	±13.2 × 3.3	±49.8	±8.4	±0.7	±0.3	-	±0.19	-	±0.29
<i>Dieffenbachia seguine</i>	2-many	±33.0	±22.1 × 6.9	±10.9	±15.1	±0.5	-	±0.28	±0.26	-	±0.21
<i>Homalomena aromatica</i>	3-6	±21.4	±7 × 4.1	±13.6	±7.1	±0.5	-	±0.14	±1.0	-	±0.08
<i>Lasia spinosa</i>	1	±49.0	±21.4 × 3.2	±27.6	±4.5	±0.4	-	±0.2	±0.1	±0.20	-
<i>P × domesticum</i>	1-3	±28.0	±17.2 × 5.1	±11.8	±14.2	-	-	±0.15	±0.08	-	±0.1
<i>Philodendron lacerum</i>	3-4	±35.0	±11 × 4.9	±24.0	±9.50	-	-	±0.2	±0.11	-	±0.09
<i>P. latifolium</i>	1-2	±22.3	±12.7 × 10.0	±9.6	±11.0	±0.4	±0.5	±0.2	±0.17	-	±0.1
<i>Pistia stratiotes</i>	3-5	±2.4	±0.18 × 0.56	±1.22	±0.48	±0.6	-	±0.51	±0.02	-	-
<i>Pothos scandens</i>	1 rarely 2	±1.72	±0.71 × 0.17	±1.01	±0.81	±0.4	-	±0.09	±0.05	±0.10	-
<i>Rhaphidophora decursiva</i>	1	±39.0	±17.5 × 9.5	±21.5	±13.5	-	-	±0.6	±0.32	-	-
<i>Spathiphyllum cochlerispathum</i>	1	±24.5	±8.10 × 2.8	±12.4	±2.1	±2.0	-	±0.3	±0.12	±0.18	-
<i>Syngonium podophyllum</i>	5-7	±25.0	±10.50 × 3.5	±14.5	±10.5	±0.43	-	±0.55	±0.84	-	±0.76
<i>Typhonium trilobatum</i>	1(rarely 2)	±23.5	±19.3 × 8.6	±4.2	±13.2	-	±6.7	±0.2	±0.15	-	±1.01
<i>Xanthosoma sagittifolium</i>	2-many	±117.5	±24.1 × 12.3	±93.4	±20.5	±0.27	-	±0.36	±0.4	-	±0.6

bears longest inflorescence (± 117.5 cm) and shortest was observed in *Pothos scandens* Linnaeus (± 1.72 cm). Length of peduncle is maximum in *Xanthosoma sagittifolium* (Linnaeus) Schott (± 93.4), minimum in *Pothos scandens* Linnaeus (± 1.01 cm); *Amorphophallus paeoniifolius* (Dennst.) Nicolson bears largest spathe ($\pm 34 \times 53$ cm), smallest spathe present in *Pothos scandens* Linnaeus ($\pm 0.71 \times 0.17$ cm). Spadices are sessile in nine species. Length of stipe is maximum in *Spathiphyllum cochlerispathum* (Liebmann) Engler (± 2.00 cm). *Amorphophallus paeoniifolius* (Dennst.) Nicolson bears longest female flowers (± 2.30 cm). Length of male flower is maximum in *Caladium bicolor* (Aiton, William) Ventenat (± 2.10 cm), very small in *Pistia stratiotes* Linnaeus (± 0.02 cm).

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