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RESEARCH ARTICLE

INFLORESCENCE ARCHITECTURE IN TWENTY ACCESSIONS OF *JASMINUMSAMBAC*(L.)AIT.FROM KERALA.

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Abstract

The inflorescence architecture of twenty accessions of*Jasminumsambac*(Oleaceae) collected from various parts of Kerala was studied. The basic simple three-flowered dichasium diversified in both forward and backward directions through addition or suppression of lateral branches along with terminal or lateral monochasial branching. A maximum of two lateral branches led only up to nine flowers. The species appears to be in the intermediate stages of evolutionary advancement, along both reduction as well as progressive lines, with regard to inflorescence architecture. Progressive elaboration of inflorescence spread appears to be slowed down here, by the restriction of lateral branching.

Introduction:-

The attractive inflorescences consequentialto the clustering of blooms in various patterns of arrangement on a central axis and its branches, have received much attention largely due to their crucial role in effecting maximal propagation of plant species. The emergence of different forms of inflorescences in the course of evolution has been correlated with increasing reproductive efficiency, the highest degree of which has been witnessed in the highly condensed capitula of the largest family of angiosperms, the Asteraceae. Consequently, inflorescence architecture has been studied mostly in connection with developmental and reproductive biology (Bradley *et al.* 1996).Recently, additional disciplines such as computer simulation, developmental genetics, pollination ecology, evolutionary biology etc. have also been focused upon in the analysis of inflorescence structure and function (Kirchoff and ClaBen-Bockhoff, 2013). Parkin(1914) and later Wyatt (1982) have pointed out the lack of adequate attention paid to the floral branches and observed that inflorescence architecture has not yet advanced beyond the limits of pure description. Despite the wide range of variation presented in various features of inflorescence pattern, studies correlating variations in inflorescence architecture with systematics, have been made only in some genera like *Acacia* (Grimes, 1999), *Bragantia*(Nair and Narayanan, 1961), *Cordylanthus*(Chuang and Heckard, 1976), *Thottea*(ShaijuandOmanakumari, 2009) etc.

Jasminumsambac(L.)Ait., also known as Arabian jasmine, is a popular member of the olive family Oleaceae, and is native to southern Asia (Green and Miller, 2009). The plant is characterized by simple opposite leaves and white scented flowers. *J. sambac* is considered to be a ‘species-complex’ with a number of cultivars, including the 'Grand Duke of Tuscany' (or just 'Grand Duke') with its almost spherical, greatly doubled flowers, and 'Maid of Orleans' with semi-double flowers. Various accessions known by differing vernacular names such as *kuttimulla, kudamulla,*

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*arimulla, iruvachimulla, moonnadukkumulla, adukkumulla*etc., are grown locally all overKerala as horticultural favourites.The members of this species-complex display much variation in the pattern and extent of inflorescence architecture (branching, inflorescence type,position and flower number). Although there has been ample focus on the taxonomy of the species, no attempt has so far been made to study the inflorescence pattern and its variations at the intraspecific level. The present study is undertaken to fill this lacuna.

Materials and Methods:-

The study focuses on 20 accessions of *Jasminumsambac* collected from various parts of Kerala (Table 1).

Table 1:-List of *Jasminumsambac*(L.)Ait.accessionscollected with locality.

Sl.No	Accession Name	Locality	District	N	E
1	AC-1	Chirayinkeezhu	Thiruvananthapuram	8°39' 54"	76°47' 54"
2	AC-2	Anathalavattom	Thiruvananthapuram	8°39' 56"	76°46' 19"
3	AC-3	Koonthalloor	Thiruvananthapuram	8°39' 54"	76°47' 53"
4	AC-4	Neyyattinkara	Thiruvananthapuram	8°23' 20"	77°5' 60"
5	AC-5	Mamom, Attingal	Thiruvananthapuram	8°41' 11"	76°49' 21"
6	AC-6	Moonnumukku, Attingal	Thiruvananthapuram	8°41' 12"	76°49' 21"
7	AC-7	Palace Road, Attingal	Thiruvananthapuram	8°41' 38"	76°48' 44"
8	AC-8	Mamom, Attingal	Thiruvananthapuram	8°41' 12"	76°49' 21"
9	AC-9	Moonnumukku, Attingal	Thiruvananthapuram	8°41' 12"	76°49' 21"
10	AC-10	Kariavattom	Thiruvananthapuram	8° 33' 54"	76°53' 2"
11	AC-11	Kariavattom	Thiruvananthapuram	8°33' 54"	76°53' 3"
12	AC-12	Kacherinada, Attingal	Thiruvananthapuram	8°41' 56"	76°48' 59"
13	AC-13	Kulanada, Pandalam	Pathanamthitta	9°13' 22"	76°40' 38"
14	AC-14	Chalakkudy	Thrissur	10°18' 5"	76°9' 19"
15	AC-15	Pallikkara	Ernakulam	10°1' 8"	76°22' 59"
16	AC-16	Azheekkal	Alappuzha	9°29' 54"	76°20' 56"
17	AC-17	Pattambi	Palakkad	10°47' 2"	76°9' 40"
18	AC-18	ThazheChowva	Kannur	11°52' 33"	75°21' 46"
19	AC-19	Thalankara	Kasargod	12°29' 29"	74°59' 17"
20	AC-20	Kozhikode Beach	Kozhikode	11°14' 46"	75°46' 49"

Fresh inflorescences were collected, photographed using Canon 450 D camera and observed for branching pattern and other characteristics. Hand illustrations were made and the various inflorescence characters listed below were studied.

Qualitative characters	Quantitative characters
Inflorescence type	Number of flowers/ inflorescence
Inflorescence position	Pedicel length of terminal flower
Floral bract (present/absent)	Pedicel length of lateral flower
Monochasial branching (present/absent)	Length of peduncle
Nature of lateral branching	Length of bract

Results and Discussion:-

The inflorescences were terminal and/or axillary, with white scented andbracteate flowers. The number of flowers per inflorescence ranged from 1 to 9 (Table 2; Figs. 1-10). Maximum flowers were observed in 1-2 tier-flowered inflorescences.AC 12 with 2-5 tiered flowers also showed high number of flowers per inflorescence, and this may be attributed to its very narrow petals which keep the flower buds compact enough, providing space for additional flowers. Minimum number of flowers per inflorescence was observed in AC 6 and AC 7, both with large flowers resembling tiny roses. Here the multiple petals were broad and so compactly arranged that separate tiers of petals could not be discerned out.

Majority of the accessions studied showed solitary, simple or lax dichasial cymes, while the flowers were strictly solitary in AC-7 (Table 3). Inflorescences were terminal in most accessions, except in five (AC 1, AC 2, AC 3, AC 9

& AC 13) which produced flowers on both terminal and axillary shoots. Monochasial branching was observed in majority of the taxa studied, except in AC 7 with solitary blooms. The degree of lateral branchingwas low. All accessions showed consistently two floral bracts, while AC 6 and AC 7 stood apart due to the presence of additional bracteole-like structures. These bracteoles were profuse in AC 6, compared to AC 7 with only a few bracteoles(Figs. 11 & 12).

Table 2:-Quantitative inflorescence characters of *Jasminumsambac*(L.)Ait.accessions.

***Jasminumsambac* Accession**	**No.of petal tiers**	**No. of flowers / inflorescence**	**Pedicel length of terminal flower (cm)**	**Pedicel length of lateral flower (cm)**	**Length of peduncle (cm)**	**Length of bract (cm)**
AC 1	1	1-9	0.63±0.14	0.69±0.24	3.45±1.06	0.48±0.13
AC 2	2-3	1-5	0.64±0.12	0.79±0.14	3.05±1.68	0.63±0.08
AC 3	1	1-9	0.44±0.11	0.51±0.07	2.40±1.00	0.31±0.07
AC 4	2	1-3	0.63±0.14	0.59±0.24	1.51±0.75	0.48±0.13
AC 5	2-3	3-7	0.77±0.19	0.72±0.20	2.02±0.83	0.59±0.21
AC 6	several	1-3	0.95±0.20	0.65±0.17	1.81±1.31	0.54±0.17
AC 7	several	1	0.84±0.22	0	1.79±1.28	0.55±0.18
AC 8	2-5	1-5	0.76±0.11	0.74±0.05	1.61±0.42	0.80±0.37
AC 9	1	3-7	0.63±0.14	0.69±0.24	3.52±0.51	0.58±0.17
AC 10	2-5	1-6	0.55±0.24	0.57±0.12	3.32±1.35	0.41±0.17
AC 11	2-3	1-5	0.52±0.15	0.46±0.16	2.02±0.83	0.58±0.10
AC 12	2-5	1-9	0.78±0.28	0.75±0.24	1.81±0.62	0.81±0.34
AC 13	1	3-9	0.85±0.16	1.14±0.18	1.34±0.53	1.10±0.27
AC 14	2-3	3-7	0.66±0.07	0.81±0.09	2.37±0.91	0.60±0.23
AC 15	2-3	3-6	0.83±0.10	0.83±0.11	2.72±1.50	0.64±0.12
AC 16	2	2-8	0.82±0.17	0.79±0.12	1.50±0.60	0.70±0.16
AC 17	2-3	2-6	0.48±0.18	0.41±0.16	2.53±0.82	0.43±0.05
AC 18	1	3-7	0.74±0.11	0.69±0.15	6.21±1.92	1.03±0.17
AC 19	2-3	3-9	1.03±0.12	1.04±0.17	3.07±0.82	0.56±0.12
AC 20	1	3-4	0.76±0.11	0.86±0.10	1.48±0.15	0.89±0.14

Table 3:-Qualitative inflorescence characters of *Jasminumsambac*L. accessions.

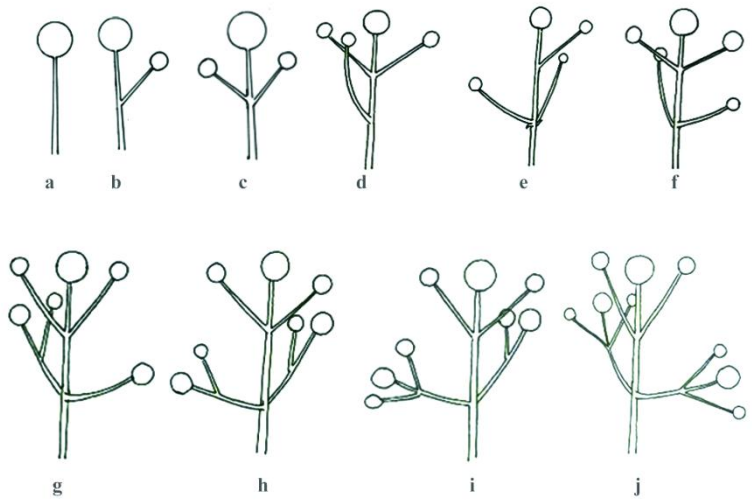
Accession	**Inflorescence type**	**Inflorescence position**	**Floral bract**	**Bracteole**	**Monochasial branching**	**Degree of lateral branching**
AC 1	Solitary, simple &lax dichasial cyme	Terminal & axillary	Present	Absent	Present	Low
AC 2	Solitary, simple&lax dichasial cyme	Terminal & axillary	Present	Absent	Present	Low
AC 3	Solitary, simple&lax dichasial cyme	Terminal & axillary	Present	Absent	Present	Low
AC 4	Solitary, simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 5	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 6	Solitary, simple &lax dichasial cyme	Terminal	Present	Present	Present	Low
AC 7	Solitary	Terminal	Present	Present	Absent	Absent
AC 8	Solitary, simple&lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 9	Simple &lax dichasial cyme	Terminal & axillary	Present	Absent	Present	Low
AC 10	Solitary, simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low

AC 11	Solitary, simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 12	Solitary, simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 13	Simple &lax dichasial cyme	Terminal & axillary	Present	Absent	Present	Low
AC 14	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 15	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 16	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 17	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 18	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 19	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low
AC 20	Simple &lax dichasial cyme	Terminal	Present	Absent	Present	Low

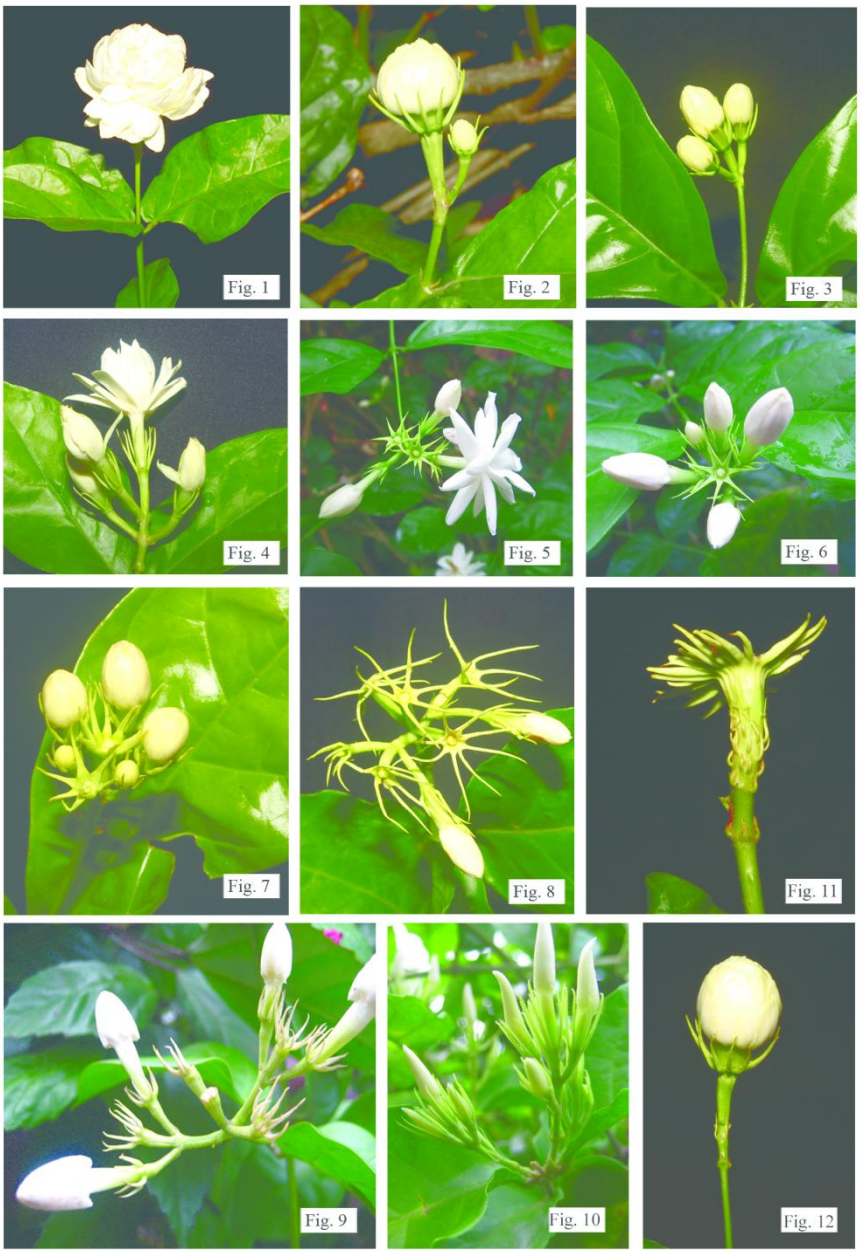
Inflorescence architecture:-

Jasminum at the generic level has been reported by several workers to display a wide range of inflorescence patterns ranging from solitary to 3-flowered simple cymes, few to many flowered dichasial cymes, panicles, umbellate cymes etc. (Green and Miller, 2009). But *Jasminumsambac*, the morphologically most diverse species-complex of the genus with several accessions highly sought after for their horticultural value, shows a limited range of inflorescence spread,centered around the basic simple 3-flowered dichasial cyme. The present study covered 20 accessions of the species collected from different parts of Kerala. This sizable representation of the diversity within the species-complex presented flowers ranging in number from 1 (solitary) to a maximum of 9, a number feasible by a maximum of two lateral branches alone (Text Fig. 1).

Text Fig. 1 : Inflorescence patterns in accessions of *Jasminum sambac* from Kerala



a-j : Various inflorescence patterns from solitary to 9-flowered lax dichasial cymes



Figs. 1-10 : Solitary cymes to 9-flowered lax dichasial cymes in accessions of Jasminum sambac from Kerala ; Fig. 11 – Profuse bracteole formation from the lower half of the calyx in AC 6; Fig.12 – Additional bracteoles in AC 7.

Various views have been put forward as regards the evolution of inflorescence architecture. Nageli (1883), Celakovsky (1892) and Pilger (1922) have considered the panicle as the most primitive. Parkin (1914) opined that the primitive flower was solitary, while Rickett (1944) considered the dichasium as the most primordial. However, Takhtajan (1991) observed that the primitive inflorescence might be either a simple leafy cymose “panicle” or simple leafy dichasium, from which evolution proceeded along both progressive as well as reduction lines.

The inflorescences observed in the present study were also based on the simple three-flowered dichasium - the primitive prototype. The two-flowered and solitary inflorescences observed in thesemembers represent evolution along the reduction series, and the few-flowered lax dichasial cymes sported by them reveal the ongoing processes of evolution along the progressive line. Divergences from the classical number of three in both forward and

backward directions are effected largely through addition or suppression of lateral branches of the inflorescence axis along with monochasial branching in the terminal or lateral branches of the peduncle, as the case may be. The maximum number of lateral branches observed is two, permitting a maximum number of nine flowers only. Monochasial branching and suppression of lateral branches have led to reduction in flower number from nine.

According to Chuang andHeckard (1976), the evolutionary trends in inflorescences point to a lineage from an elongate multi-flowered type via reduction in number of flowers to few and ultimately to one flower. From the evolutionary point of view, solitary flowers are believed to represent the surviving members of reduced inflorescences, and thereby the end of a reduction series (Stebbins, 1974). The one-few-flowered dichasial cymes observed in the accessionsof *J sambac* may be considered to reflect the ongoing trends of evolution within this highly variable species characterized by several accessions. The species may hence be considered to be in the intermediate stages of evolutionary advancement, along both reduction as well as progressive lines. However the latter seems to be limited within a small range through a 'hesitation ?' to put forth additional lateral branches.

Conclusions:-

The inflorescences of *Jasminumsambac*are based on the simple three-flowered dichasium - the primitive prototype. Divergences from thisbasic number in both forward and backward directions are effectedmostly through addition or suppression of lateral branches of inflorescence axis along with monochasial branching in the terminal or lateral branches of the peduncle.A maximum of two lateral branches led only up to nine flowers in the sample of twenty accessions of the species studied from Kerala.The species may be considered to be in the intermediate stages of evolutionary advancement, along both reduction as well as progressive lines. However further progression leading to elaboration of inflorescence spreadappears to be slowed down here, by the restriction of lateral branching.

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