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Studies on floral morphology and biology in *Jasminum* spp.

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ABSTRACT

The present investigation was carried out to study the floral morphology and biology of 5 genotypes during 2016-17. Many flowered cymes both terminal and axillary were observed in *J. auriculatum* and *J. grandiflorum*; whereas, cluster bearing flowers in terminal position were observed in *J. multiflorum* (IIHR JM–1 and IIHR JM–2), *J. calophyllum, J. flexile* and *J. malabaricum.* Flower bud was pointed and long in all genotypes; its colour was either green white (157 B) or white (155 C) or white (155 D).Tinge on flower bud was observed in *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. rigidum*, *J. nitidum* and *J. malabaricum.* Flower petal tip was either sharp or blunt and flower colour on opening was either white (155 C) or white (155 D) or white with pinkish underneath (155 D) in all the genotypes. Among the 15 genotypes, *J. grandiflorum* var. CO.1 Pitchi recorded longest flower bud length (4.81 cm) and corolla tube length (2.92 cm); however, maximum corolla length was recorded in *J. nitidum* (2.15 cm). Maximum number of forks per cymes was recorded in *J. auriculatum* var. CO.1 Mullai (40.13). Maximum number (6.51) and length of calyx lobe (1.28 cm) was recorded in *J. multiflorum* –IIHRJM-2 and *J. nitidum*, respectively. Flower diameter ranged from 1.74 (*J. auriculatum*-IIHRJA-2) to 4.93 cm (*J. nitidum*), whereas number of petals varied from 4.97 (*J. grandiflorum* var. CO.1 Pitchi) to 10.67 (*J. nitidum*). All genotypes recorded one style per pistil and its length varied from 0.42 cm (*J. auriculatum* var. CO.2 Mullai) to 2.32 cm (*J. grandiflorum* var. CO.1 Pitchi). Anthesis and anther dehiscence was recorded earlier in summer months, while, it was delayed during cooler months. However, the peak anthesis was observed from 6:00 to 7:00 P.M. and anther dehiscence from 4:00 to 7:00 P.M. The earliest anthesis was observed in *J. auriculatum* genotypes and anther dehiscence was observed in *J. auriculatum* and *J. multiflorum* genotypes. The stigma was receptive 12 h before an thesis and up to 24 h of anthesis. The maximum receptivity was observed from the time of anthesis to 12 h after anthesis.

Key words: Anther dehiscence, Anthesis, Floral morphology, Jasmine, Stigma receptivity

Jasmines are one of the most important ornamental flowering plants widely cultivated in the Southern and Eastern parts of India for their attractive and fragrant flowers. They are grown for garden decoration, landscaping, for making garland, hair decoration and for extraction of essential oil. The genus *Jasminum* belongs to the family Oleaceae and basic chromosome number is x=13 (Taylor 1945, Krishnaswamy and Raman 1948).

Jasmine produces flowers profusely, but set seed very rarely and is propagated chiefly by vegetative means. Occurrence of various problems relating to unfavourable climatic conditions for normal sexual reproduction, excessive production of staminate flowers, lack of sufficient and fertile pollen among the cultivated varieties, variation in flowering season among the species, cross incompatibility, presence of variable ploidy types have resulted in a poor fruit set in jasmine. To overcome these problems, the study of exact floral morphology and biology of different species of jasmine will give an insight. Information on these aspects have been documented only in some of the commercially cultivated species.The wild species also have a better flower quality, different notes of fragrance and tolerance to biotic stresses.

The knowledge of floral morphology and biology are essential pre-requisites for initiating any breeding programme. Information regarding season of flowering, anthesis, anther dehiscence, stigma receptivity and pollen morphology are essential for successful hybridization programme. Therefore, a study was carried out on floral morphology and biology of 15 genotypes/species.

MATERIALS AND METHODS

The present investigation was carried out in the Division of Floriculture and Medicinal Crops, of the institute during 2016-17. The experimental material used for the study were

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15 genotypes/species, i.e. *J. auriculatum* var. CO.1 Mullai, CO.2 Mullai, Parimullai, IIHR JA - 1, IIHR JA - 2, IIHR JA - 3, *J. grandiflorum* var. CO.1 Pitchi, Arka Surabhi, *J. multiflorum*- IIHR JM - 1, IIHR JM - 2, *J. rigidum, J. nitidum, J. calophyllum, J. flexile, J. malabaricum.* All the species of jasmine were planted during June 2012. All the plants were grown in open field with the recommended cultural practices.

Observations were recorded on quantitative characters of floral morphology like flower bud length, corolla length, corolla tube length, number of forks per cymes, number of calyx lobe, length of calyx lobe, flower diameter, number of petals and qualitative characters like flower bearing habit and bearing position, flower bud shape, flower bud colour and colour on opening, shape of open corolla, flower petal tip, reflexing of flower. Floral biology traits like number of stamen and style, length of style and stamen, season of flowering, time of anthesis, anther dehiscence, duration of stigma receptivity and natural seed set were also studied. The duration of stigma receptivity was recorded by calculating the hours taken from initiation to completion of receptivity.

The stigma receptivity was recorded by treating the hydrogen peroxide (H_2O_2) on the stigma. To determine the stigma receptivity, 10 flowers in each replication for individual species were examined. A drop of hydrogen peroxide was added on the stigmatic surface of flower. Receptive stigmas were characterized by high enzymatic activity. The occurrence of bubbling action on the stigmatic surface as an indicator of peroxidase activity was determined by H_2O_2. Observations were recorded when stigma showed pure foam producing bubbles as a receptive stigma. The time period of effervescence was calculated at different time intervals to study the duration of stigma receptivity. The stigma receptivity was evaluated based on the density of bubbles produced and recorded as -, none; +, less; ++, moderate; and +++, high.

The data were analyzed statistically by using randomized complete block design for field observation and complete randomized block design for lab observation with three replications (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Floral morphology traits: Variation was observed among the genotypes/species with respect to flower bearing habit and bearing position (Table 1). All the genotypes of *J. auriculatum* and *J. grandiflorum* produced multi-flowered cymes both in terminal and axillary positions, whereas, multi-forked cymes in terminal or axillary position was observed in *J. multiflorum* (IIHR-JM-1 and IIHR-JM-2, *J. calophyllum, J. flexile* and *J. malabaricum*). Arumugam *et al*. (2002) also reported many flowered cluster flowers in terminal position in *J. multiflorum*, terminal or axillary cyme in *J. grandiflorum* and pubescent compound many flowered flax cymes in *J. auriculatum*. All 15 genotypes/species recorded pointed and long shaped flower buds. Raman (1955) classified and grouped conical buds under '*sujimallige*' (*Jasminum grandiflorum*). However, Champa (2012) reported that conical buds are preferred for making flower strings for hair decoration.

Among 15 genotypes/species, flower bud colour was either green white (157B) or white (155D) or pink (186B). The Green White (157B) flower buds were recorded in all genotypes of *J. auriculatum*, *J. calophyllum* and *J. flexile,* White (155D) was recorded in *J. multiflorum* (IIHR JM-1 and IIHR JM-2) and Pink (186B) recorded in *J. grandiflorum* (CO.1 Pitchi, Arka Surabhi) and *J. malabaricum.* Tinge on flower bud was observed in *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. rigidum*, *J. nitidum* and *J. malabaricum.* Singh (2016) found that *J. multiflorum* produce pure white scentless flower. Arumugam *et al*. (2002) reported that large flowers, white, reddish beneath in *J. grandiflorum*, buds are tinted pink on the outside but flowers are white when open in *J. nitidum*, while, white colour flowers in *J. auriculatum*. All 15 genotypes/species recorded star shaped open corolla. Veluswamy *et al*. (1973) also reported star shaped flowers in *J. muliflorum*.

Flower petal tip was observed sharp in *J. auriculatum* var. Parimullai, *J. multiflorum* - IIHR JM-1, IIHR JM-2, *J. rigidum*, *J. nitidum* and *J. malabaricum* while, blunt flower petal tip was recorded in *J. auriculatum* (CO.1 Mullai, CO.2 Mullai, IIHR-JA-1, IIHR-JA-2, IIHR-JA-3), *J. grandiflorum* var. CO.1 Pitchi, Arka Surabhi, *J. calopyllum* and *J. flexile* (Table 1). Flower reflexing was observed in *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. rigidum, J. calopyllum* and *J. flexile.* Flower colour on opening was either white (155 C) or white with pinkish tinge (155 D) underneath the petals; White (155 C) in all genotypes of *J. auriculatum*, *J. flexile* and *J. calophyllum*, White (155 D) in *J. multiflorum* (IIHR JM-1 and IIHR JM-2) and pure white with pinkish tinge underneath (155 D) in *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. rigidum, J. nitidum* and *J. malabaricum.* All 15 genotypes/species bears single type of flowers.

Significant variation was recorded in flower bud length (Table 2). Maximum flower bud length was recorded in *J. grandiflorum* var. CO.1 Pitchi (4.81 cm) and minimum in *J. auriculatum*-IIHR JA-2 (2.28 cm). However, corolla length among genotypes recorded maximum in *J. nitidum* (2.15 cm), whereas, minimum recorded in *J. auriculatum* - IIHR JA-2 (0.66 cm). The longest corolla tube length was recorded in *J. grandiflorum* var. CO.1 Pitchi (2.92 cm) which was at par with *J. grandiflorum* var. Arka Surabhi (2.78 cm), while, *J. auriculatum* var. Parimullai recorded shortest corolla tube length (1.41 cm). Champa (2012) reported long conical flower buds with high fragrance with long flower stalk in different genotypes of *Jasminum grandiflorum*. Moreover, higher stalk length is a desirable trait for easy picking and generally used for essential oil extraction. Significant variation was recorded among the genotypes for number of forks per cymes. The maximum forks per cyme was recorded in *J. auriculatum* var. CO.1 Mullai (40.13), whereas, minimum in *J. rigidum* (3.62). The genotypes of *J. auriculatum* recorded higher number of forks per cyme compared to other genotypes.

Table 1 Floral morphology traits in different *Jasminum* genotypes/species

Genotype/Species	Flower bearing habit	Flower bud shape	Flower bud colour (RHS Colour Chart)	Tinge on flower bud	Shape of open corolla	Flower petal tip	Flower bearing position	Reflexing of flower	Flower colour on opening (RHS colour chart)	Flower type
J. auriculatum var. CO.1 Mullai	Many flowered cymes	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal and Axillary	Absent	White (155 C)	Single
J. auriculatum var. CO.2 Mullai	Many flowered cymes	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal and Axillary	Absent	White (155 C)	Single
J. auriculatum var. Parimullai	Many flowered cymes	Pointed and long	Green white (157 B)	Absent	Star shaped	Sharp	Terminal and Axillary	Absent	White (155 C)	Single
J. auriculatum - IIHR JA-1	Many flowered cymes	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal and Axillary	Absent	White (155 C)	Single
J. auriculatum - IIHR JA-2	Many flowered cymes	Pointed and short	Green white (157 B)	Absent	Star shaped	Blunt	Terminal and Axillary	Absent	White (155 C)	Single
J. auriculatum - IIHR JA-3	Many flowered cymes	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal and Axillary	Absent	White (155 C)	Single
J. multiflorum - IIHR JM-1	Cluster	Pointed and long	White (155 D)	Absent	Star shaped	Sharp	Terminal	Absent	White (155 D)	Single
J. multiflorum - IIHR JM-2	Cluster	Pointed and long	White (155 D)	Absent	Star shaped	Sharp	Terminal	Absent	White (155 D)	Single
J. grandiflorum var. CO.1 Pitchi	Many flowered cymes	Pointed and long	Pink (186 B)	Present	Star shaped	Blunt	Terminal and Axillary	Present	White with pinkish underneath (155 D)	Single
J. grandiflorum var. Arka Surabhi	Many flowered cymes	Pointed and long	Pink (186 B)	Present	Star shaped	Blunt	Terminal and Axillary	Present	White with pinkish underneath (155 D)	Single
J. rigidum	Many flowered cymes	Pointed and long	Pink (186 B)	Present	Star shaped	Sharp	Terminal	Present	White with pinkish underneath (155 D)	Single
J. nitidum	Many flowered cymes	Pointed and long	Pink (186 B)	Present	Star shaped	Sharp	Terminal	Absent	White with pinkish underneath (155 D)	Single
J. calophyllum	Cluster	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal	Present	White (155 C)	Single
J. flexile	Cluster	Pointed and long	Green white (157 B)	Absent	Star shaped	Blunt	Terminal	Present	White (155 C)	Single
J. malabaricum	Cluster	Pointed and long	Pink (186 B)	Present	Star shaped	Sharp	Terminal	Absent	White with pinkish underneath (155 D)	Single

Table 2 Floral morphology traits in different *Jasminum* genotypes/species

Genotype/Species	Flower bud length (cm)	Corolla length (cm)	Corolla tube length (cm)	No. of forks per cymes	No. of calyx lobe	Length of calyx lobe (cm)	Flower diameter (cm)	Number of petals
J. auriculatum var. CO.1 Mullai	2.60	0.93	1.65	40.13	0.00 (0.71)	0.00 (0.71)	2.61	7.62
J. auriculatum var. CO.2 Mullai	2.88	1.12	1.75	33.73	0.00 (0.71)	0.00 (0.71)	2.62	8.52
J. auriculatum var. Parimullai	2.37	0.91	1.41	20.80	0.00 (0.71)	0.00 (0.71)	2.54	8.12
J. auriculatum - IIHR JA-1	3.07	1.01	1.76	22.10	0.00 (0.71)	0.00 (0.71)	2.64	8.25
J. auriculatum - IIHR JA-2	2.28	0.66	1.60	27.52	0.00 (0.71)	0.00 (0.71)	1.74	7.13
J. auriculatum - IIHR JA-3	2.66	0.95	1.76	27.50	0.00 (0.71)	0.00 (0.71)	2.31	7.80
J. multiflorum - IIHR JM-1	3.64	1.63	1.88	23.10	6.35 (2.62)	1.04 (1.24)	4.36	7.50
J. multiflorum - IIHR JM-2	3.64	1.72	1.90	23.77	6.51 (2.65)	1.03 (1.24)	4.44	7.40
J. grandiflorum var. CO.1 Pitchi	4.81	1.89	2.92	11.03	4.92 (2.33)	0.73 (1.11)	4.89	4.97
J. grandiflorum var. Arka Surabhi	4.59	1.86	2.78	10.67	4.93 (2.33)	0.65 (1.07)	4.56	4.98
J. rigidum	3.55	2.07	1.47	3.62	5.72 (2.49)	0.35 (0.92)	4.10	8.03
J. nitidum	4.10	2.15	1.91	12.80	6.07 (2.56)	1.28 (1.34)	4.93	10.67
J. calophyllum	3.50	1.26	2.22	19.43	0.00 (0.71)	0.00 (0.71)	2.96	7.90
J. flexile	3.43	1.23	2.46	20.03	0.00 (0.71)	0.00 (0.71)	2.85	7.40
J. malabaricum	3.36	1.35	1.97	23.40	5.13 (2.37)	0.59 (1.04)	3.44	8.15
Range (cm)	2.37-4.81	0.66-2.15	1.41-2.92	3.62-40.13	4.92-6.51	0.35-1.28 cm	1.74-4.93 cm	4.97-10.67
SEm±	0.03	0.02	0.07	0.57	0.00	0.00	0.03	0.09
CD (P=0.05)	0.07	0.04	0.21	1.66	0.03	0.01	0.08	0.28

Calyx lobe was absent or rudimentary in all genotypes of *J. auriculatum*, *J. calophyllum* and *J. flexile*, however, it was ranged 4.92 (*J. grandiflorum* var. CO.1 Pitchi) to 6.51 (*J. multiflorum*-IIHR-JM-2) in remaining genotypes/species. The maximum length of calyx lobe was recorded *J. nitidum* (1.28 cm) and minimum in *J. rigidum* (0.35 cm). The bigger flower was recorded in *J. nitidum* (4.93 cm), while, smallest in *J. auriculatum*-IIHR-JA-2 (1.74 cm). Similar findings were also reported by Khan and Muthuswamy (1969). The size of open flowers in *J. nitidum* was larger than *J. auriculatum* genotypes. Among 15 genotypes/species, number of petals recorded maximum in *J. nitidum* (10.67), whereas, minimum in *J. grandiflorum* var. CO.1 Pitchi (4.97). Nirmala *et al*. (2017) also assessed 48 genotypes for thirty-nine qualitative and twenty quantitative morphological traits including vegetative and floral characters.

Floral biology traits: In jasmine, the improvement and evolution of new genotypes is usually done through hybridization and for that, the knowledge of floral biology is mandatory in order to find out parents with desirable characters, viz. stamen and style length, position of stigma in relation to stamen, anthesis, anther dehiscence and stigma receptivity.

All 15 genotypes had one style per pistil (Table 3). The number of stamens which varied from 2.00 to 2.28 among the different genotypes, however, maximum number of stamen was recorded in *J. auriculatum* var. Parimullai (2.28), whereas, minimum number of stamen (2.00) was recorded in *J. auriculatum* var. CO.1 Mullai, CO.2 Mullai, *J. grandiflorum* var. CO.1 Pitchi, Arka Surabhi, *J. rigidum, J. nitidum* and *J. malabaricum.* Significant differences were recorded with respect to stamen and style length. The highest stamen and style length was recorded in *J. grandiflorum* var. CO.1 Pitchi (2.13 cm and 2.32 cm, respectively), while, shortest in *J. multiflorum*-IIHR-JM-2 (1.06 cm) and *J.auriculatum* var. CO.2 Mullai (0.42 cm), respectively. Laksmi and Ganga (2017) also reported two stamens and single pistil in *J. auriculatum*, *J. grandiflorum* and *J. sambac*.The stamens *J. auriculatum* (three cultivars) and *J. grandiflorum* (two cultivars) contained higher pollen content, while, pollen load was less in *J. sambac*.

Anthesis and anther dehiscence are important aspects for hybridization. These two traits are observed in different months in genotypes/species based on the flowering season. Anthesis and anther dehiscence was earlier in summer months, while, it was delayed during cooler months (Table 3). Among 15 genotypes/species, *J. auriculatum* (CO.1

Table 3 Number of style per pistil, number of stamen, length of stamen, length of style and time of anthesis in different *Jasminum* genotypes/species

Genotype/Species	Number of style per pistil	Number of stamen	Length of stamen (cm)	Length of style (cm)	Time of anthesis				
					February (P.M.)	March (P.M.)	April (P.M.)	May (P.M.)	June (P.M.)
J. auriculatum var. CO.1 Mullai	1.00	2.00	1.25	1.37	6:30	6:15	6:10	6:00	6:10
J. auriculatum var. CO.2 Mullai	1.00	2.00	1.58	0.42	NF	6:30	6:15	6:00	6:10
J. auriculatum var. Parimullai	1.00	2.28	1.19	1.03	6:00	5:40	5:30	5:30	5:35
J. auriculatum - IIHR JA-1	1.00	2.23	1.51	1.62	NF	NF	NF	6:15	6:30
J. auriculatum - IIHR JA-2	1.00	2.05	1.24	1.61	NF	NF	NF	5:45	6:05
J. auriculatum - IIHR JA-3	1.00	2.12	1.49	0.55	6:30	6:25	6:15	6:05	6:20
J. multiflorum - IIHR JM-1	1.00	2.05	1.20	2.00	10:10	9:55	9:40	9:30	9:35
J. multiflorum - IIHR JM-2	1.00	2.15	1.06	1.95	10:00	9:50	9:35	9:25	9:30
J. grandiflorum var. CO.1 Pitchi	1.00	2.00	2.13	2.32	7:05	6:50	6:40	6:30	6:45
J. grandiflorum var. ArkaSurabhi	1.00	2.00	2.06	2.30	7:00	6:45	6:40	6:35	6:45
J. rigidum	1.00	2.00	1.18	1.65	NF	7:00	6:45	6:30	NF
J. nitidum	1.00	2.00	1.52	2.26	8:15	7:50	7:45	7:35	7:40
J. calophyllum	1.00	2.10	1.83	2.10	7:05	6:50	6:35	6:30	6:45
J. flexile	1.00	2.10	1.78	2.06	7:00	6:55	6:40	6:30	6:45
J. malabaricum	1.00	2.00	1.44	1.29	7:00	6:45	6:35	6:30	6:40
Range	1.00 - 1.00	2.00 - 2.28	1.06 - 2.13	0.42 - 2.32					
SEm±	0.00	0.04	0.02	0.02					
CD (P=0.05)	0.00	0.13	0.04	0.05					

NF, Not flowered.

Mullai, Parimullai and IIHR-JA-3), *J. multiflorum* (IIHR-JM-1 and IIHR-JM-2), *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. nitidum, J. calophyllum, J. flexile* and *J. malabaricum* flowered during February, March, April, May and June; whereas, flowering in *J. auriculatum* var. CO.2 Mullaiwas not observed during February. In *J. auriculatum* (IIHR JA-1 and IIHR-JA-2) flowering was observed only in May and June. The species *J. rigidum* flowered during March, April and May. Anthesis started from 5:30 P.M. and continued till 10:10 P.M. However, the peak anthesis was observed from 6:00 to 7:00 P.M. The earliest anthesis was observed in *J. auriculatum* genotypes (5:30 P.M. to 7:00 P.M.) and it was delayed in *J. multiflorum* genotypes (9:15 P.M. to 10:00 P.M.). Among the 15 genotypes, earliest anthesis was recorded in Parimullai (5:30 P.M. to 6:00 P.M.). However, in other genotypes it was ranged 6:30 P.M. to 8:00 P.M.

The variation was recorded in time of anther dehiscence and duration of stigma receptivity in different genotypes/species (Table 4). The anther dehiscence started from 4:05 P.M. and continued till 6:40 P.M. and peak anther dehiscence was observed from 4:00 to 7:00 P.M. The earliest anther dehiscence was observed in *J. auriculatum* and *J. multiflorum* genotypes (4:00 P.M. to 5:00 P.M.) and delayed in *J. nitidum* (6:00 P.M. to 7:00 P.M.). However, in other genotypes anther dehiscence varied from 4:30 P.M. to 6:00 P.M. Among the 15 genotypes, earliest anther dehiscence was recorded in Parimullai (4:00 P.M. to 4:30 P.M.).

Almost in all the genotypes/species, stigma receptivity started 12 h before anthesis and completed after 24 h of anthesis. The maximum stigma receptivity was observed 12 h after anthesis. Among the 15 genotypes, maximum duration of stigma receptivity was recorded in *J. auriculatum* (CO.1 Mullai and IIHR-JA-3) followed by *J. grandiflorum* (CO.1 Pitchi and Arka Surabhi), *J. rigidum* and *J. nitidum*. Ling *et al*. (2011) also reported highest stigma receptivity during flowering and decreased gradually in *J. mesnyi*. In present study also, all the *Jasminum* spp. recorded highest stigma receptivity at the time of flowering then decreased gradually.

The basic information generated on floral morphological and floral biology traits in 15 genotypes/species will facilitate the planned crop improvement programmes in Jasmine.

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Table 4. Time of anther dehiscence and duration of stigma receptivity in different *Jasminum* genotypes/species

Genotype/Species	Time of anther dehiscence					Duration of stigma receptivity						
	February (P.M.)	March (P.M.)	April (P.M.)	May (P.M.)	June (P.M.)	30 h before anthesis	24 h before anthesis	12 h before anthesis	At anthesis	12 h after anthesis	24 h after anthesis	30 h after anthesis
J. auriculatum var. CO.1 Mullai	5:00	4:50	4:35	4:20	4:30	+	++	+++	+++	++	+	+
J. auriculatum var. CO.2 Mullai	NF	5:00	4:50	4:40	4:45	-	-	+	+++	+	+	-
J. auriculatum var. Parimullai	4:25	4:15	4:05	4:00	4:10	+	++	++	+++	++	++	-
J. auriculatum - IIHR JA-1	NF	NF	NF	4:40	5:05	+	++	++	+++	++	++	-
J. auriculatum - IIHR JA-2	NF	NF	NF	4:20	4:35	+	++	++	+++	++	++	-
J. auriculatum - IIHR JA-3	5:05	4:45	4:40	4:30	4:35	+	++	++	+++	++	++	+
J. multiflorum - IIHR JM-1	4:45	4:30	4:25	4:10	4:15	-	-	+	+++	++	+	-
J. multiflorum - IIHR JM-2	4:40	4:30	4:15	4:10	4:05	-	-	++	+++	++	+	+
J. grandiflorum var. CO.1 Pitchi	5:10	4:50	4:40	4:30	4:45	+	++	++	+++	+	++	+
J. grandiflorum var. ArkaSurabhi	5:05	4:50	4:45	4:35	4:50	+	+	++	+++	++	++	+
J. rigidum	NF	6:00	5:40	5:35	NF	+	++	++	+++	++	++	+
J. nitidum	6:40	6:30	6:25	6:10	6:20	+	++	+++	+++	+++	++	+
J. calophyllum	5:30	5:20	5:05	5:00	5:15	-	+	++	+++	++	+	-
J. flexile	5:35	5:25	5:15	5:05	5:10	-	+	++	+++	+++	++	-
J. malabaricum	5:30	5:15	5:05	5:00	5:10	-	+	++	+++	++	+	-

NF, Not flowered; stigma receptivity: **-,** none; +, less; ++, moderate; +++, high.

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