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Studies on floral biology and nut set in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

AS Waghmare, RG Khandekar, BR Salvi, UB Pethe and KV Malshe

Abstract

Areca nut (*Areca catechu* L.) is native to Malaysia or the Philippines (chromosome no. $2n = 32$). The Areca nut palm belongs to the family palmae. The study was undertaken entitled "Studies on floral biology and nut set in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala" during the year 2021-2022. It was observed that initiation of flowering season started in Areca nut cvs. Shrivardhan from 24th November 2021 and it last upto 26th May 2022. While, in Mangala variety initiation of flowering started from 24th November 2021 and it last upto 30th May 2022. The peak flowering period for male and female flowers from 4th December 2021 up to 27th March 2022 whereas the variety Shrivardhan recorded length of spadix was 50.14 cm whereas mangala recorded as 49.01 and the Shrivardhan variety recorded breadth of spadix as 76.08 cm and Mangala variety recorded it 71.59 cm. The Shrivardhan variety recorded mean secondary rachis per inflorescence 13.72 and Mangala variety recorded it as 13.81. The Shrivardhan variety recorded mean number of male flower per inflorescence as 31182.32 whereas Mangala variety recorded as 33622.05. The Shrivardhan variety recorded days required for spathe fall 3.58 whereas, Mangala variety recorded 3.34 and the Shrivardhan variety recorded total rachis per inflorescence 448.3 and Mangala variety recorded it as 474.12. The Shrivardhan variety recorded mean breadth of spathe 13.99 cm whereas Mangala variety recorded as 14.58 cm and while, the Shrivardhan variety recorded mean Period required for spathe splitting from last leaf fall as 2.91 (days) and Mangala variety recorded as 2.49. The Shrivardhan variety time taken for fertilization (days) 61.54 while, Mangala variety recorded 59.15 days.

Keywords: Spadix, fertilization, anthesis, cultivars

Introduction

Areca nut (*Areca catechu* L.), also referred to as "Betle nut" or "Supari," is a significant crop in India. (Chromosome no. $2n = 32$). The Areca nut palm belongs to the family palmae. It is a product with traditional, commercial and economic value. Areca is a word from the Malayan language that means "cluster of nuts." It is typically assumed that it is native to Malaysia or the Philippines, where it is cultivated in a wide range of variations. It is a tropical crop that is planted throughout Asia, Bangladesh, India, China, Sri Lanka, and Malaysia, from the West Indies to the East Coast of Africa. The inflorescence in a spadix is entirely encased in a sealed boat and is generated in the leaf axil spathe in form. The tertiary and distal ends of the secondary rachis are where the female flowers are located. The male flowers grow on filiform branches that emerge beneath and beyond the female flowers.

It is a cross-pollinated crop the period necessary to transition from full bloom to up to 40%. If the plant is allowed to grow, it may live up to 60–65 years, but it is advisable not to let the palm become older than 42–45 years because there is a severe decrease in yield which makes the plant less productive. South Western and North are the primary regions for Areca nut farming particularly in the states of Kerala, Assam, Maharashtra, Goa, and Meghalaya, Andhra Pradesh, West Bengal, and Tamil Nadu. Although Areca nut production is regional, in a few states, the commercial product is consumed and disseminated widely across the nation by all socioeconomic groups.

Areca nuts differ from one location to another in terms of quality, diversity, and type. Areca nuts come in two varieties White Chali type Areca nut & Red-boiled Areca nut. Areca nuts have 245 calories, 46.2 g carbohydrates, 4.2 g protein and 4.2 g fat per 100 g. Iron (1.4 mg), phosphorus (0.4 mg). Additionally, it has trace amounts of vitamins B₆ and A and alkaloids like arecaidine and arecoline, which are intoxicating and mildly addictive when chewed, are found in the seed. Areca tannins, which are condensed tannins (Procyanidins), are also present in the seed. (Anon. 2016).

In South and Southeast Asian nations, Areca nut is often used as a masticator, either with or without betel leaves. It does, however, have a unique ethno-religious significance in India. Indian ceremonies and marriages frequently feature Areca nuts. Areca nut is a fundamental component of Indian religion; as part of religious rites, it is offered to god representations.

Materials and Methods

The field experiment took place at the experimental Plot, which is located at the near Kisan Bhavan, College of Horticulture, Dapoli (M.S.) Dist. Ratnagiri, Maharashtra, India. For this experiment, 20 years old Areca nut palm of cvs. Shrivardhan and Mangala were selected. 30 palms were selected for experimental purpose. Observation tables were drawn according to the stages of flowering, such as initiation of flowering, spathe formation period, number of nut set per inflorescence. Along with the images, daily observations were also kept track of between November 2021 to May 2022. The observations on different floral characters were recorded from initiation of flowering to nut set character as suggested by Ananda (2007) [10] in Areca nut descriptors. The data from many observations during the study were statistically analyzed with the help of the method suggested by Panse and Sukhatme (1995), and basic statistics and means were taken for the comparison and interpretation of results. The analysis

was carried out at Computer Cell, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli from 2021 to 2022.

Result and Discussion

1. Initiation of flowering of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

The flowering season of Areca nut was considered as the emergence of first spadix. The flowering season was observed and recorded by visiting the orchard daily during the season. Initiation of flowering in Areca nut cultivar Shrivardhan started from 24th November 2021 and it lasts upto 26th May 2022. While, in Mangala variety initiation of flowering started from 24th November 2021 and it lasts upto 30th May 2022. The data presented in table 1 indicates that the initiation of flowering of Areca nut (*Areca catechu* L.) variety Shrivardhan begins on 24th November 2021 and ends on 26th May 2022 and in case of Mangala variety it was starts from 24th November 2021 and ends on 30th May 2022. There is slight variation in period of flowering among two varieties i.e. Shrivardhan and Mangala. This might be due to difference in genetic makeup of varieties. Also it is affected by climatic conditions of the region period from November to may might be favourable season for flowering in Areca nut under Dapoli (M.S.) conditions. Rajesh and Ananda (2019) [7] reported observation analogous to above findings.

Table 1: Initiation of flowering of Areca nut (*Areca catechu* L.) variety Shrivardhan begins on 24th November 2021 and ends on 26th May 2022 and in case of Mangala variety it was starts from 24th November 2021 and ends on 30th May 2022

Variety	Initiation of the flowering season	End of the flowering season
Shrivardhan (T ₁)	24 th November 2021	26 th May 2022
Mangala (T ₂)	24 th November 2021	30 th May 2022

2. Length and breadth of spadix of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

2.1 Length of spadix (cm)

The data on length of spadix of Areca nut are presented in table 2. It was observed from the table 2 that there was significant variation for length of spadix in both the varieties. The Shrivardhan variety recorded mean length of spadix as 50.14 cm whereas Mangala variety recorded it as 49.01 cm. The data presented in Table 2 length of spadix of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In the variety Shrivardhan recorded length of spadix was 50.14 cm whereas mangala recorded as 49.01. Whereas, for the length of spadix in the present study ranged from 49.50 to 50.67 cm with a mean of 49.57 cm. In the present study, the length of spadix were lower than those found by other authors for the variation that occurs. Ananda and Rajesh (2002) [1] noticed that variations of the mean spadix length of Areca nut varieties varied between 62.83 cm in Mangala and 70.59 cm in Mohitnagar cultivar with a mean of 66.37cm. The

temperature and environmental conditions might be the reason for the differences in the findings.

Breadth of spadix (cm): The data on breadth of spadix of Areca nut are presented in table 2. It was observed from the table 2 that there was significant variation for breadth of spadix in both the varieties. The Shrivardhan variety recorded mean breadth of spadix as 76.08 cm and Mangala variety recorded it as 71.59 cm. The data presented in Table 2 indicates that the breadth of spadix of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. The breadth of spadix of Areca nut varied among the selected Areca nut palm of cvs. Shrivardhan, ranging from 75.33 to 76.67 cm and mangala ranging from 70.67 to 72.67 with a mean of 73.84. Ananda and Rajesh (2002) [1] noticed that the maximum spadix breadth of 16.97cm was observed in Sumangala and minimum of 14.23cm in Saigon. The breadth of spadix might be varied due to differences in the flowering behaviors of the Areca nut varieties and environmental conditions.

Table 2: Length of spadix of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Treatments	Length of spadix (cm)	Breadth of spadix (cm)
T ₁ (Shrivardhan)	50.14	76.08
T ₂ (Mangala)	49.01	71.59
Mean	49.57	73.84
Range	T ₁ =49.50 - 50.67 T ₂ =46.50 - 51.67	T ₁ =75.33 - 76.67 T ₂ =70.67 - 72.67
S.Em ±	0.33	0.15
CD @ 5%	1.00	0.46
F-test	SIG	SIG

Number of male and female flower per rachis of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Number of male flower per rachis

The data on number of male flowers per rachis of Areca nut are presented in table 3. It was observed from the table 3 that there was significant variation for number of male flowers per rachis in both the varieties. The Shrivardhan variety recorded mean number of male flower per rachis as 75.99 whereas Mangala variety recorded as 70.93. The data presented in table 3 indicates the number of male flower per rachis in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In Shrivardhan variety it ranged from 68.50 to 80.33 whereas in mangala variety it ranged from 61.67 to 83.25. number of male flower per rachis was higher 75.99 observed in case of Shrivardhan variety of Areca nut than mangala 70.93. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions. Similar results were recorded by Archana (2017) in Areca nut.

Table 3: Indicates the number of female flower per rachis in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Treatments	Number of male flower per rachis	Number of female flowers per rachis
T ₁ (Shrivardhan)	75.99	19.64
T ₂ (Mangala)	70.93	23.66
Mean	73.46	21.66
Range	T ₁ = 68.50-80.33	T ₁ =12-30.33
	T ₂ =61.67-83.25	T ₂ =15.66-32.33
S.Em ±	1.13	0.93
CD @ 5%	3.42	2.82
F-test	SIG	SIG

Number of male and female flower per inflorescence of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Number of male flower per inflorescence

The data on number of male flower per inflorescence of Areca nut are presented in table 4. It was observed from the table 4 that there was significant variation for number of male flower per inflorescence in both the varieties. The Shrivardhan variety recorded mean number of male flower per inflorescence as 31182.32 whereas Mangala variety recorded as 33622.05. The data presented in table 4 indicates the number of male flower per inflorescence in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In mangala variety it ranged from 30289.50 to 35428 whereas in Shrivardhan variety it ranged from 30048 to 31875. number of male flower per inflorescence was higher 33622.05 observed in case of mangala variety of Areca nut than Shrivardhan 31182.32. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties. Similar results were recorded by Archana (2017) [2]; Rajesh and Ananda

Number of female flower per rachis

The data on number of female flower per rachis of Areca nut are presented in table 3. It was observed from the table 3 that there was significant variation for number of female flower per rachis in both the varieties. The Shrivardhan variety recorded mean number of female flower per rachis as 19.64 whereas Mangala variety recorded as 23.66. The data presented in table 3 indicates the number of female flower per rachis in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In mangala variety it ranged from 15.66 to 32.33 whereas in Shrivardhan variety it ranged from 12 to 30.33. Number of female flower per rachis was higher 23.66 observed in case case of mangala variety of Areca nut than Shrivardhan 19.64. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties. Similar results were recorded by Nath (2017) [5]; Rajesh and Ananda (2019) [7] in Areca nut.

(2019) [7] in Areca nut.

Number of female flower per inflorescence

The data on number of female flower per inflorescence of Areca nut are presented in table 4. It was observed from the table 4 that there was significant variation for number of female flower per inflorescence in both the varieties. The Shrivardhan variety recorded mean number of female flower per inflorescence as 269.57 whereas Mangala recorded as 326.87. The data presented in table 4 indicates the number of female flower per inflorescence in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In mangala variety it ranged from 208 to 439.33 whereas in Shrivardhan variety it ranged from 166.50 to 435.33. number of female flower per inflorescence was higher 326.87 observed in case of mangala variety of Areca nut than Shrivardhan 269.57. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions. Similar results were recorded by Archana (2017) [2]; Rajesh and Ananda (2019) [7] in Areca nut.

Table 4: Indicates the number of female flower per inflorescence in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Treatments	Number of male flower per inflorescence	Number of female flower per inflorescence
T ₁ (Shrivardhan)	31182.32	269.57
T ₂ (Mangala)	33622.05	326.87
Mean	32402.19	298.22
Range	T ₁ = 30048.00-31875.00	T ₁ =166.50-435.33
	T ₂ =30289.50-35428.00	T ₂ =208.00-439.33
S.Em ±	210.58	12.21
CD @ 5%	638.74	37.04
F-test	SIG	SIG

Period lapsed between male and female phase and time taken for fertilization of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Period lapsed between male and female phase (days)

The data on Period lapsed between male and female phase (days) of Areca nut are presented in table 5. It was observed from the table 5 that there was significant variation for Period lapsed between male and female phase (days) in both the varieties. The Shrivardhan variety recorded mean Period lapsed between male and female phase (days) as 5.65 days where as Mangala variety recorded it as 6.78 days. The data presented in table 5 indicates the period lapsed between male and female phase (days) in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In Mangala variety it ranged from 5.33 to 8 whereas in Shrivardhan variety it ranged from 4.50 to 7. Period lapsed between male and female phase (days) was more 6.78 observed in case of Mangala variety of Areca nut than Shrivardhan 5.65. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions. Similar results were recorded by Thomas and Josephraj Kumar (2013) [9]; Rajesh

and Ananda (2019) [7] in Areca nut.

Time taken for fertilization (days)

The data on time taken for fertilization (days) of Areca nut are presented in table 5. It was observed from the table 5 that there was significant variation for time taken for fertilization (days) in both the varieties. The Shrivardhan variety recorded mean time taken for fertilization (days) as 61.54 days where as Mangala variety recorded it as 59.15 days. The data presented in table 5 indicates the time taken for fertilization (days) in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In Shrivardhan variety it ranged from 59.33 to 64.50 whereas in mangala variety it ranged from 56 to 62.50. Time taken for fertilization (days) was more 61.54 observed in case of Shrivardhan variety of Areca nut than mangala 59.15. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental factors that directly affect on the growth of flower organs like temperature, humidity and availability of food material especially carbohydrates. Similar results were recorded by Harun and Noor (2002) [3] in Areca nut.

Table 5: Time taken for fertilization (days) of Areca nut

Treatments	Period lapsed between male and female phase (days)	Time taken for fertilization (days)
T ₁ Shrivardhan)	5.65	61.54
T ₂ (Mangala)	6.78	59.15
Mean	6.22	60.35
Range	T ₁ =4.50-7.00	T ₁ =59.33-64.50
	T ₂ =5.33-8.00	T ₂ =56.00-62.50
S.Em ±	0.18	0.46
CD @ 5%	0.54	1.39
F-test	SIG	SIG

Number of nut set per rachis, number of nut set per inflorescence and percentage of nut set of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Number of nut set per rachis

The data on number of nut set per rachis of Areca nut are presented in table 6. It was observed from the table 6 that there was significant variation for number of nut set per rachis in both the varieties. The Shrivardhan variety recorded mean number of nut set per rachis as 7.47 whereas Mangala variety recorded it as 8.71. The data presented in table 6 indicates the Number of nut set per rachis in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In mangala variety it ranged from 12.23 to 20.25 whereas in Shrivardhan variety it ranged from 8.27 to 14.99. Number of nut set per rachis was more 15.85 observed in case of mangala variety of Areca nut than Shrivardhan 12.18. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions and availability of carbohydrate and water to plant for development of fruits (nuts). Similar results were recorded by Rajesh and Ananda (2019) [7], Nath (2017) [5], Swaray *et al.*, (2021) [8] in Areca nut.

Number of nut set per inflorescence

The data on number of nut set per inflorescence of Areca nut are presented in table 6. It was observed from the table 6 that there was significant variation for number of nut set per inflorescence in both the varieties. The Shrivardhan variety recorded mean number of nut set per inflorescence as 105.10 whereas Mangala variety recorded it as 121.57. The data presented in table 6 indicates the Number of nut set per

inflorescence in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In mangala variety it ranged from 215.12 to 223.66 whereas in Shrivardhan variety it ranged from 157.00 to 174.00. Number of nut set per inflorescence was more 219.00 observed in case of mangala variety of Areca nut than Shrivardhan 167.13. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions and available food material especially carbohydrate and available water in plant system. Similar results were recorded by Murthy and Bavappa (1960) [4]; Raghavan and Baruah (1956) [6]; Harun and Noor (2002) [3]; Rajesh and Ananda (2019) [7] in Areca nut.

Percentage of nut set

The data on nut set percentage of Areca nut are presented in table 6. It was observed from the table 6 that there was significant variation for nut set percentage in both the varieties. The Shrivardhan variety recorded percentage of nut set as 61.99 whereas Mangala variety recorded it as 67.00. The data presented in table 6 indicates the percentage of nut set in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. In Mangala variety it ranged from 63.68 to 72.16 whereas in Shrivardhan variety it ranged from 58.33 to 64.50. Percentage of nut set was more 67.00 observed in case of mangala variety of Areca nut than Shrivardhan 61.99. The variation that occurs might be due to the variation in the flowering behaviour of Areca nut varieties and environmental conditions. Similar results were recorded by Rajesh and Ananda (2019) [7]; Archana (2017) [2] in Areca nut.

Table 6: Nut set percentage of Areca nut

Treatments	Number of nut set per rachis	Number of nut set per inflorescence	Percentage of nut set
T ₁ (Shrivardhan)	12.18	167.13	61.99 (51.93741)
T ₂ (Mangala)	15.85	219.00	67.00 (54.93848)
Mean	14.01	193.06	64.50
Range	T ₁ =8.27-14.99	T ₁ =157.00-174.00	T ₁ = 58.33-64.50
	T ₂ =12.23-20.25	T ₂ =215.12-223.66	T ₂ =63.68-72.16
S.Em ±	0.57	0.67	0.49
CD @ 5%	1.73	2.04	1.47
F-test	SIG	SIG	SIG

Orientation of nuts on spadix of Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala

Orientation of nuts on spadix

From the table 7 observed that orientation of nut on spadix in mangala (T₂) variety was only of drooping type. While, in

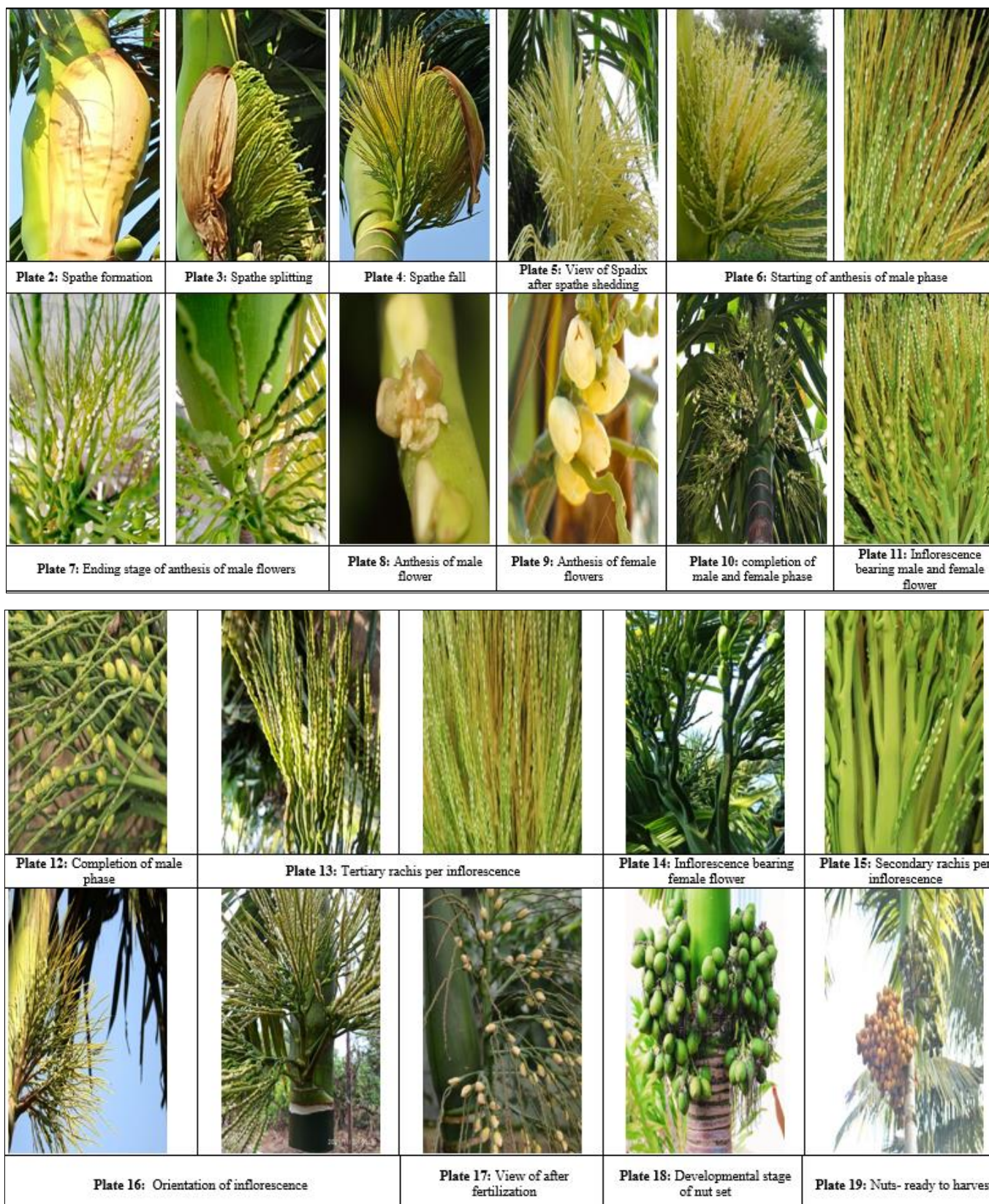
case of Shrivardhan (T₁) it was observed drooping as well as horizontal type. The variation that occurs might be due to the varietal character of Areca nut varieties. This might be due to genetic make-up of varieties.

Table 7: Orientation of nut on spadix in mangala (T₂) variety was only of drooping type

Replication	Variety	
	Shrivardhan	Mangala
R ₁	Drooping	Drooping
R ₂	Drooping	Drooping
R ₃	Horizontal	Drooping
R ₄	Drooping	Drooping
R ₅	Horizontal	Drooping
R ₆	Horizontal	Drooping
R ₇	Drooping	Drooping
R ₈	Drooping	Drooping
R ₉	Drooping	Drooping
R ₁₀	Drooping	Drooping
R ₁₁	Drooping	Drooping
R ₁₂	Drooping	Drooping
R ₁₃	Drooping	Drooping
R ₁₄	Horizontal	Drooping
R ₁₅	Drooping	Drooping



Plate 1: General View of the experimental plot



Conclusion

The results of the present study have provided some basic information on the floral biology and nut set in Areca nut (*Areca catechu* L.) cvs. Shrivardhan and Mangala. Under Dapoli conditions. Initiation of flowering of Areca nut cv. Shrivardhan started from 24th November 2021 and it lasts up to 26th May 2022. While, in Mangala variety initiation of flowering started from 24th November 2021 and it lasts up to

30th May 2022. The peak flowering period for male and female flowers in Areca nut starts from 4th December 2021 to 27th March 2022. The Shrivardhan variety recorded mean time taken for fertilization (days) as 61.54 days where as Mangala variety recorded it as 59.15 days. The Shrivardhan variety recorded mean number of nut set per inflorescence as 167.13 whereas Mangala variety recorded it as 219. There was variation in different aspects of the variety which might

be due to the tree age, positions of flowers and fruits on the plant and agroclimatic conditions of the region.

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