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Short communications

Phenological studies of flowering and fruiting of peanut butter fruit (*Bunchosia armeniaca* (Cav.) DC.)

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Abstract
The study was carried out at Regional Agriculture Research Station, Pilicode and College of Agriculture Padannakkad from January 2022 to December 2022. The objectives were to study phenological stages regarding flowering, fruit setting and fruit development in peanut butter fruit. The flower bud initiation was started by the end of March. From flower bud initiation to anthesis it took about 28 days. The period of flowering and fruiting was observed from April to September, flowering peaks in three months *viz*., April, May and June. Whereas fruiting peaks in the months of May, June and July. Yellow-coloured flowers are borne on racemose inflorescence. From fruit set to fruit ripening, it took about 50 days. Fruits are found in clusters. Green-coloured fruits produced during the fruit set gradually change their colour to greenish yellow then orange and red at maturity.

Keywords: Exotic fruit, Malphigiacea, Peanut Butter fruit, Phenology.

Peanut butter fruit botanically *Bunchosia armeniaca* (Cav.) DC., is a tropical evergreen perennial tree or shrub, indigenous to the Andean nations of Colombia, Ecuador, Peru, and Bolivia. This plant is non-native to Brazil but it is frequent in Brazil and various other South American countries. This hardy and highly ornamental plant belongs to the family "Malpighiaceae". It grows to a height of up to 5 meters, featuring multiple trunks. The peanut butter fruit, within its natural habitat, can be found at elevations ranging from sea level up to 2,400 meters. It prospers when exposed to ample sunlight in well-drained, nutrient-rich loamy soil that contains a significant amount of organic material, and its optimum soil pH range falls between 6 and 7.6 (Lim, 2012).

The yellow-coloured flowers of *B.armeniaca* are generally hermaphrodite and actinomorphic, born on axillary, compact, racemose inflorescence. It produces small fleshy fruits. The ripened fruits are primarily consumed fresh, or in processed form, the pulp can be frozen and fruits can be stored in the refrigerator (Lim, 2012). The red-coloured edible fruit contains bioactive compounds (Karunasena et al., 2018; Premathilaka and Silva, 2016). In the GC-MS analysis of fruits extracts several compounds that possesses various biological activity *viz*., 2-Furanmethanol (antiviral), 4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6- methyl, 1H-Pyrrole-2,5-dione (antimicrobial and anti-inflammatory), n-Hexadecanoic acid and methyl-ester (flavour and antioxidant), 1-Nonadecene (antifungal and anticancer). The seeds of ripe fruits of *B. armeniaca* possess the potential to serve as innovative and powerful antibacterial treatments against multidrug-resistant strains of *Escherichia coli* (Dassanayake, 2019). This plant is traditionally used for treating a wide range of conditions, including endocrine, inflammatory, infectious, nutritional, and metabolic disorders, as well as offering potential benefits in the treatment of certain types of cancer (Karunasena,

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2018). The fruit is utilized in making jellies, jams, muffins, and preserves, and as a flavouring agent for beverages and milkshakes (Lim, 2012).

The tree is primarily grown for its fruits and use as a garden adornment. The exotic plant is now being cultivated in the homesteads of Kerala and seems to thrive well under the climatic conditions of Kerala. It is a pleasant addition to the home garden landscape. A study on phenology may be useful in further investigation of the crop concerning cultivation and climate resilience. Therefore, the present study was undertaken to study of phenological stages concerning flowering, fruit setting and fruit development in peanut butter fruit.

Flowering and fruiting of peanut butter fruit were observed from plants maintained at the fruit orchard of RARS, Pilicode located at 13°N and 75°E longitude at an elevation of 15m above mean sea level in the year 2022. Monthly average weather parameters of RARS, Pilicode from January 2022 to December 2022 is provided as Appendix 1. The phenological changes were observed from flower bud initiation to fruit ripening. The flowering twigs under observation were marked by tagging with ribbon and observed for phenological changes.

Observations like month of flowering, month of fruit setting, stages of fruit development and visual observable changes during fruit development were recorded every two days from flower bud initiation to fruit ripening.

Flowering of peanut butter fruit was observed in the month of April and continued up to September. Peak of flowering was observed in the month of April, May and June. In some accessions of *Syzygium cumini* Skeels, a similar flowering time was observed, *i.e.,* the peak of flowering was during early and mid-April (Alam et al., 2020). Also, in a study conducted by Banu (2009), passion fruit grown from seed under natural conditions produced flowers in the month of April and plants grown from vines produced flowers in the month of June. The major flowering phase of *Artocarpus heterophyllus* lam was observed from March to June with a peak in May (Pushpakumara, 2006). In *Malphigia*

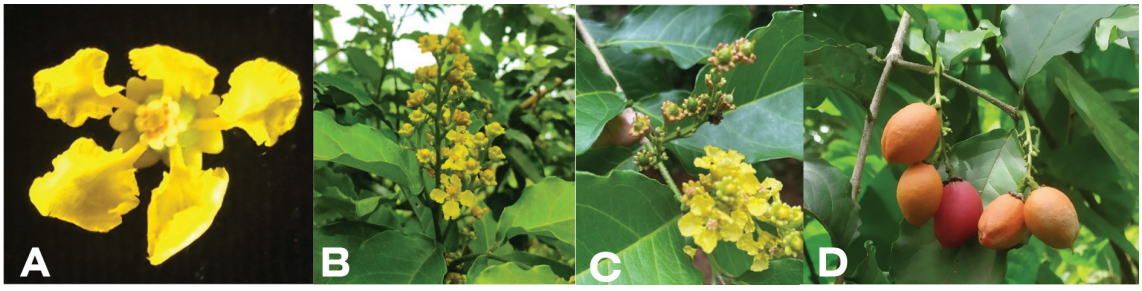

Plate 1. Phenology of peanut butter fruit: (A) Flower of *Bunchosia armeniaca*(B)Inflorescence of *Bunchosia armeniaca* (C Fruit set and inflorescence in *Bunchosia armeniaca*(D) Fruit bunch of *Bunchosia armeniaca*

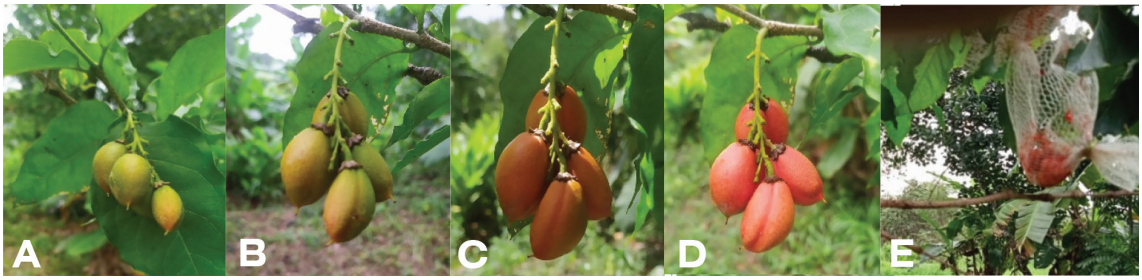

Plate 2. Ripening in fruit bunch of *Bunchosia armeniaca*: (A) August 1 (B) August 4 (C) August 13 (D) August 22 (E) August 28

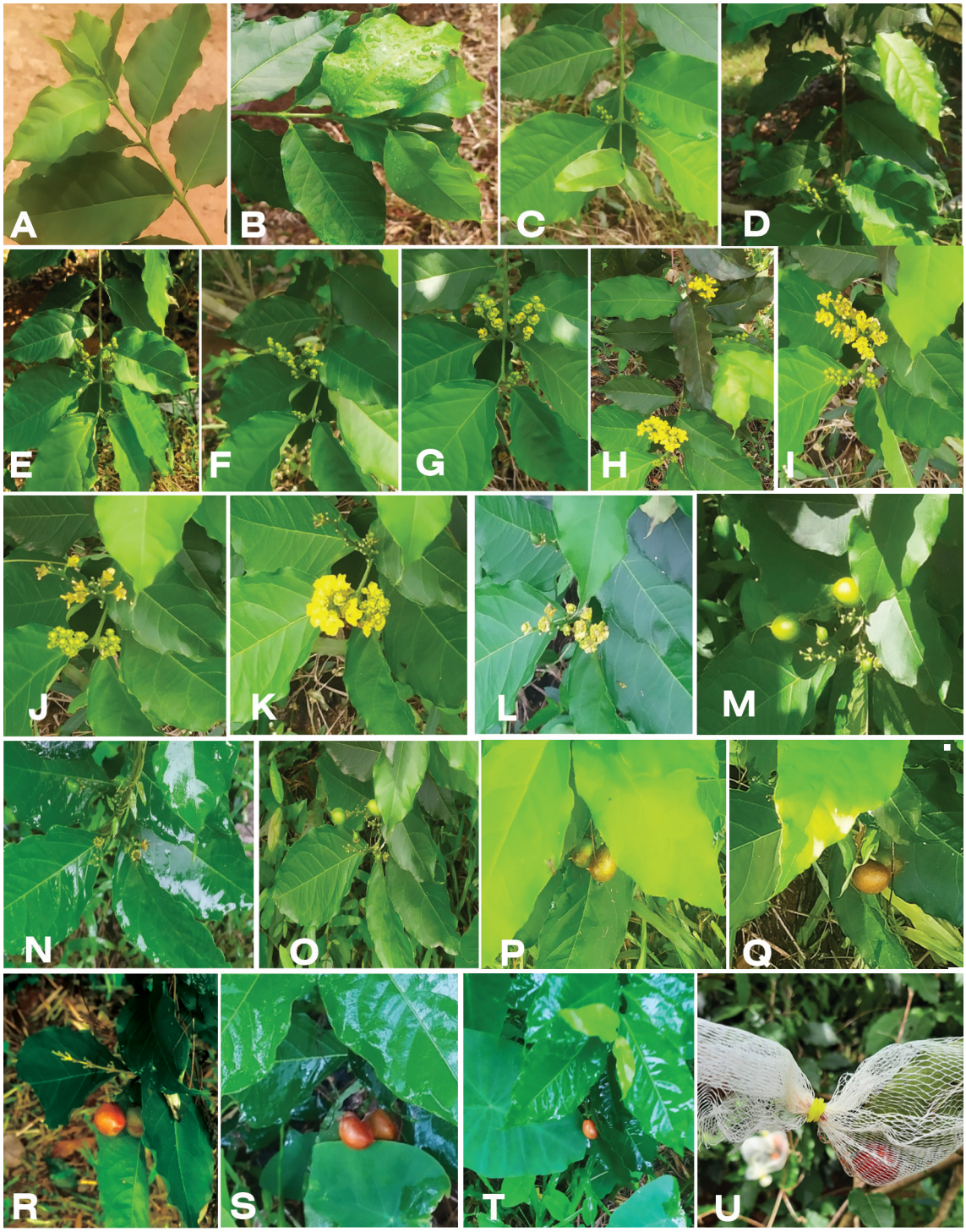

Plate 3. Stages of fruit development: (A)April 1 (B) April 5 (C) April 13 (D) April 18 (E) April 20 (F) April 22 (G) April 25 (H) April 28 (I) April 30 (J) May 4 (K) May 8 (L) May 12 (M) May 18 (N) May 27 (O) May 30 (P) June 10 (Q) June 13 (R) June 16 (S) June 27 (T) July 1 (U) July 4

emarginata, a fruit which belongs to the family of peanut butter fruit (Malphigiacea), flowering was observed between October and April in semiarid regions (municipality of Feira de Santana, Bahia state) (de Almeida, 2014). The relief from water stress or a sudden drop in temperature that takes place in the second half of the dry season acts as a trigger which results in a series of synchronised anthesis, and rainfall acts as a trigger for the final phase of bud formation (Opler et al., 1976). The anthesis of peanut butter fruit was observed in the month of April. The pre-monsoon showers might have acted as a trigger for flower bud initiation and flowering in *Bunchosia armeniaca*.

Fruit set in Peanut Butter Fruit was observed from April to September and peaks in May, June and July.According to Joseph et al. (2022), peak fruiting of passion fruitwas observed from June to September. David et al. (2012) studied the seasonality in fruiting of non-fig and fig species in Sriharikota Island and most fleshy fruit species ripened their fruit during the rainy season with 71 per cent of plant species producing ripe fruit at this time. A common strategy among plants in the seasonally dry forest is to synchronize their leafing and flowering around the onset of the rainy season, fruits are also produced at the same time to reduce the risk of seedling mortality during the following dry season (Van Schaik, 1993). In the case of peanut butter fruit also, fruiting wasobservedduring the rainy season which may be a mechanism for its natural propagation. According to Lieberman (1982), species with dry fruits mainly produce fruit during dry seasons, and species with fleshy fruits produce fruit during both wet and dry seasons, although fleshy fruits are most plentiful during wet seasons.

Flower bud initiation started in the month of March. From flower bud initiation to anthesis it took around 28 days (Plate 3 A-H). Yellow-coloured flowers (Plate 1A) are borne in a racemose inflorescence (Plate 1B) that is borne axillary. Flower opening starts from the basal portion of inflorescence and is completed in 2-3 days. From fruit set to fruit ripening, it took around 50 days (Plate U). Green-coloured fruits are produced during the fruit set (Plate 1C) gradually changing their colour to greenish yellow then orange and red at maturity (Plate 2). According to Karunasena et al. (2018), climacteric fruits in general, undergo many changes during ripening and peanut butter fruit being a climacteric fruit undergoes softening, colour change, sweetening etc. peanut butter fruit produces fruits in bunches depicted in Plate1D. Phenological changes of a flowering twig in which floral bud initiation began in the first week of April is given in Plate 3.

Conclusion

In the first report of phenological studies of peanut butter, flowering was observed from April to

Appendix I

Monthly average weather parameters of RARS, Pilicode from January 2022 to December 2022

Month	Max Temp.	Min Temp.	RH 1	RH 2	BSS	Rainfall (mm)	Evaporation (mm)
January	32.9	20.3	92.5	61.6	8.5	0.0	2.1
February	32.9	21.8	92.9	61.8	8.3	0.0	4.5
March	34.2	22.2	89.5	56.5	8.6	0.0	5.4
April	33.8	24.9	86.0	73.2	8.5	0.0	6.2
May	34.2	25.6	81.1	67.8	8.1	26.8	5.9
June	32.4	24.5	90.7	78.7	4.6	454.2	5.5
July	30.4	23.2	92.2	86.5	1.7	1084.9	5.9
August	31.5	23.9	88.0	80.0	7.3	148.8	5.6
September	30.4	23.7	91.3	85.9	4.5	672.4	6.0
October	32.0	24.5	91.0	82.6	6.8	109.3	4.7
November	33.1	24.2	90.1	82.5	7.7	133.9	3.1
December	34.1	24.4	88.1	82.3	8.5	17.8	3.4

September and peak of flowering was observed in April, May and June. The fruit set was observed from April to September with its peak in the month of May, June and July. Flower bud initiation started in the month of March. From flower bud initiation to anthesis it took around 28 days. From fruit set to fruit ripening, it took around 50 days. We can conclude that fruiting of peanut butter fruit coincides with monsoon.

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