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Monitoring the growth of fruit and seed of *Nyctanthes arbor-tristis* L. under subtropical conditions

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Abstract

Nyctanthes arbor-tristis Linn is an ornamental and medicinal plant utilised traditionally in India. The seeds of *N. arbor-tristis* were reported to contain immense pharmaceutical value due to the presence of essential oils and iridoid glycosides and hence it is essential to know its right stage of maturity. The morphological analysis of the fruit and seed was done to assess the different stages of maturity. At maturity, the average fruit length and breadth were 21.3 ± 0.45 mm and 16.7 ± 0.13 mm respectively. The average seed length and breadth were 12.8 ± 0.05 mm and 7.78 ± 0.08 mm respectively. The average fruit weight at 1 DAF and 90 DAF were 1.5 ± 0.49 mg and 424.4 ± 0.76 mg respectively. The average seed weight at 20 DAF and 90 DAF were 14.4 ± 0.25 mg and 105.7 ± 1.35 mg respectively. The seed set in the fruits were observed 20 days after flowering and the seed maturity was attained three to four months after flowering under Coimbatore climatic conditions. The data on morphological changes in the fruit and seed can aid in obtaining the fruit and seed at right stage of maturity for obtaining the desired bioactive compounds. Future work can be directed towards the assessment of chemical composition of the fruit and seed at different stages of maturity.

Keywords: *Nyctanthes arbor-tristis*, morphology, oleaceae, subtropical conditions

1. Introduction

Nyctanthes arbor-tristis Linn is a sacred, ornamental and medicinal plant, native to India. The plant belongs to the family Oleaceae. The presence of anomocytic stomata, crystals, trichome, brachysclereids, narrow campanulate calyx, binocular ovary supports to its position under Oleaceae [1]. The plant is native to South-east Asia and has been widely grown throughout India [2]. The plant is widely known for its attractive flowers which bloom at dusk and wither off at dawn, giving a flowery mat-like appearance on the ground around the tree. The flowers contain white, five to eight lobed corolla and orange coloured tubular calyx which is due to the presence of a carotenoid pigment called crocetin [3].

N. arbor-tristis has wide range of bioactivities and hence it has been widely used in the Indian Systems of medicine and Homeopathy (ISM&H) [4]. The seeds of *N. arbor-tristis* were reported to contain phenols, flavonoids, steroids, alkaloids, tannins, saponins and terpenes [5]. One of the important groups of bioactive compounds that has gained interest of researchers was the iridoid glycoside. Several iridoid glycosides has been reported from the matured seeds of *N. arbor-tristis* which includes arbortristoside A, arbortristoside B [6], arbortristoside C [7, 8], arbortristoside D and arbortristoside E [9]. The concentration of the phytochemicals may change according to the stage of maturity. The studies on fatty acid composition showed that there was difference in the total saturated and unsaturated fatty acid composition in aged green seeds and ripe seeds [10].

The present research work was carried out to analyse the morphological changes of the fruit and seeds from flowering to full maturity which can aid in obtaining the seeds at the right stage of maturity.

2. Materials and Methods

2.1 Collection of plant materials

The plant materials for morphological assessment were collected from the Medicinal plant garden located at the Department of Medicinal and Aromatic crops, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India (11.0148°N, 76.9315°E).

The study was carried out during February-May, 2022. The flowers were tagged with black, blue and red coloured markers on the next day after blooming. The procedure was carried out once in five days to obtain sufficient number of samples. The marked samples were collected in tens, once in ten days till maturity.

2.2 Assessment of morphological features of the collected samples

The flower bud diameter, flower bud length, corolla tube length, corolla length and diameter of open flower were measured after blooming. The size and weight of both fruit and seed were measured at ten days interval from day 1 to day 90 after flowering. The length and breadth of the fruit and seed were expressed in millimetre. The weight of the fruit and seed were expressed in milligrams. The ovary and stamen were examined using Binocular Stereo Microscope (Labomed CSM2).

2.3 Statistical analysis

Each sample analysis has been carried out in triplicates. All the data are expressed as mean±standard deviation. The data were statistically analyzed by analysis of variance (ANOVA)

using SPSS software (Version 16.0) and the p value ≤ 0.05 was considered statistically significant.

3. Results and Discussion

The flowering season of *N. arbor-tristis* in Coimbatore started in the month of February and lasted till the end of March, 2022. The flower opening occurred at dusk from 6:00 PM to 8:00 PM. The inflorescence is a terminal trichotomous cyme^[11]. The average length of the flower bud with corolla tube and the bud diameter was 1.75 ± 0.18 cm and 0.68 ± 0.07 cm respectively (Fig 1A). The average length of corolla and corolla tube was 1.54 ± 0.13 cm and 1.05 ± 0.16 cm. The average open flower diameter was 3.11 ± 0.19 cm (Fig 1B). The number lobes observed in the corolla was around 6 to 8 (Fig 1C). The stamen is two in number with spheroidal pollen grains and are transversely attached to the corolla tube (Fig 1D). The ovary was inferior with a septum in the middle (Fig 1E). The ovary contained two chambers with bicarpellate stigma. Rarely three chambers were present. Fruits of *N. arbor-tristis* were flattened and cordate in shape with two chambers (Fig. 1F). The fruit development had a linear growth from 1 DAF up to 70 DAF. After 70 DAF, the growth remained constant (Fig 2.).



Fig 1: Various parts of *N. arbor-tristis* flower, fruit and seed, (A) Flower buds, (B) Corolla with 7 lobes, (C) Stamens attached to the corolla tube, (D) Transversely attached stamen with spheroidal pollen grains, (E) Ovary with bicarpellate stigma, (F) Matured Fruit, (G) Matured seed.



Fig 2: Fruits collected once in ten days from first day after flowering (1 DAF) up to 90 DAF

The average fruit length and breadth at 1 DAF were 1.6 ± 0.23 mm and 1.03 ± 0.06 mm respectively (Table 1). On 90 DAF, the average fruit length and breadth were 21.3 ± 0.45 mm and 16.70 ± 0.13 mm respectively. Prominent seed structures were not visible in the fruit until 20 DAF. The average seed length

and breadth at 20 DAF were 2.51 ± 0.05 mm and 1.4 ± 0.08 mm respectively. On 90 DAF, the average seed length and breadth were 12.8 ± 0.05 mm and 7.78 ± 0.08 mm respectively. After 90 DAF the fruits, gradually dried and withered off from the plant.

Table 1: Fruit and seed growth parameters of *N. arbor-tristis* at different days after flowering (DAF)

Stage of maturity (DAF)	Avg. Fruit length (mm)	Avg. Fruit breadth (mm)	Avg. Seed length (mm)	Avg. Seed breadth (mm)	Avg. Fruit weight (mg)	Avg. Seed weight (mg)
1	1.6 ± 0.23	1.03 ± 0.06	0	0	1.5 ± 0.49	0
10	6.7 ± 0.26	3.65 ± 0.05	0	0	13.9 ± 1.17	0
20	11.3 ± 0.54	7.38 ± 0.10	2.51 ± 0.05	1.4 ± 0.08	66.4 ± 0.80	14.4 ± 0.25
30	14.3 ± 0.40	10.51 ± 0.07	5.08 ± 0.08	2.83 ± 0.07	172.2 ± 0.70	45.1 ± 0.65
40	16.8 ± 0.23	12.86 ± 0.10	8.05 ± 0.05	4.7 ± 0.05	272.6 ± 1.01	74.3 ± 0.86
50	18.2 ± 0.28	14.01 ± 0.17	8.98 ± 0.06	5.81 ± 0.07	328.1 ± 0.47	83.8 ± 1.05
60	19.2 ± 0.25	15.20 ± 0.10	9.63 ± 0.08	6.67 ± 0.05	364.8 ± 0.61	96.3 ± 4.82
70	20.5 ± 0.25	16.58 ± 0.07	10.35 ± 0.05	7.72 ± 0.02	422.7 ± 1.40	105.3 ± 1.62
80	20.7 ± 0.65	16.63 ± 0.07	11.93 ± 0.08	7.77 ± 0.06	423.7 ± 1.91	105.6 ± 0.90
90	21.3 ± 0.45	16.70 ± 0.13	12.8 ± 0.05	7.78 ± 0.08	424.4 ± 0.76	105.7 ± 1.35

The average fruit weight at 1 DAF and 90 DAF were 1.5 ± 0.49 mg and 424.4 ± 0.76 mg respectively (Fig 3). The average seed weight at 20 DAF and 90 DAF were 14.4 ± 0.25 mg and 105.7 ± 1.35 mg respectively (Fig 4). Thus, from the given data, it is evident that the seed maturity is attained 90 days after flowering. Modak and Chowdhury (2021) studied the morphological changes in the fruits and seeds under Darjeeling climatic conditions and reported that the fruit maturity is attained four months after flowering [12].

According to the present study, the fruit and seed maturity is attained three months after flowering. It is hypothesised that these differences in the growth parameters may be due to the changes in geographical conditions, physico-chemical growth conditions and the variation in climate. Similar variations in *N.arbor-tristis* flower morphology and wood elemental composition due to variation in climatic conditions were also reported [13, 14].

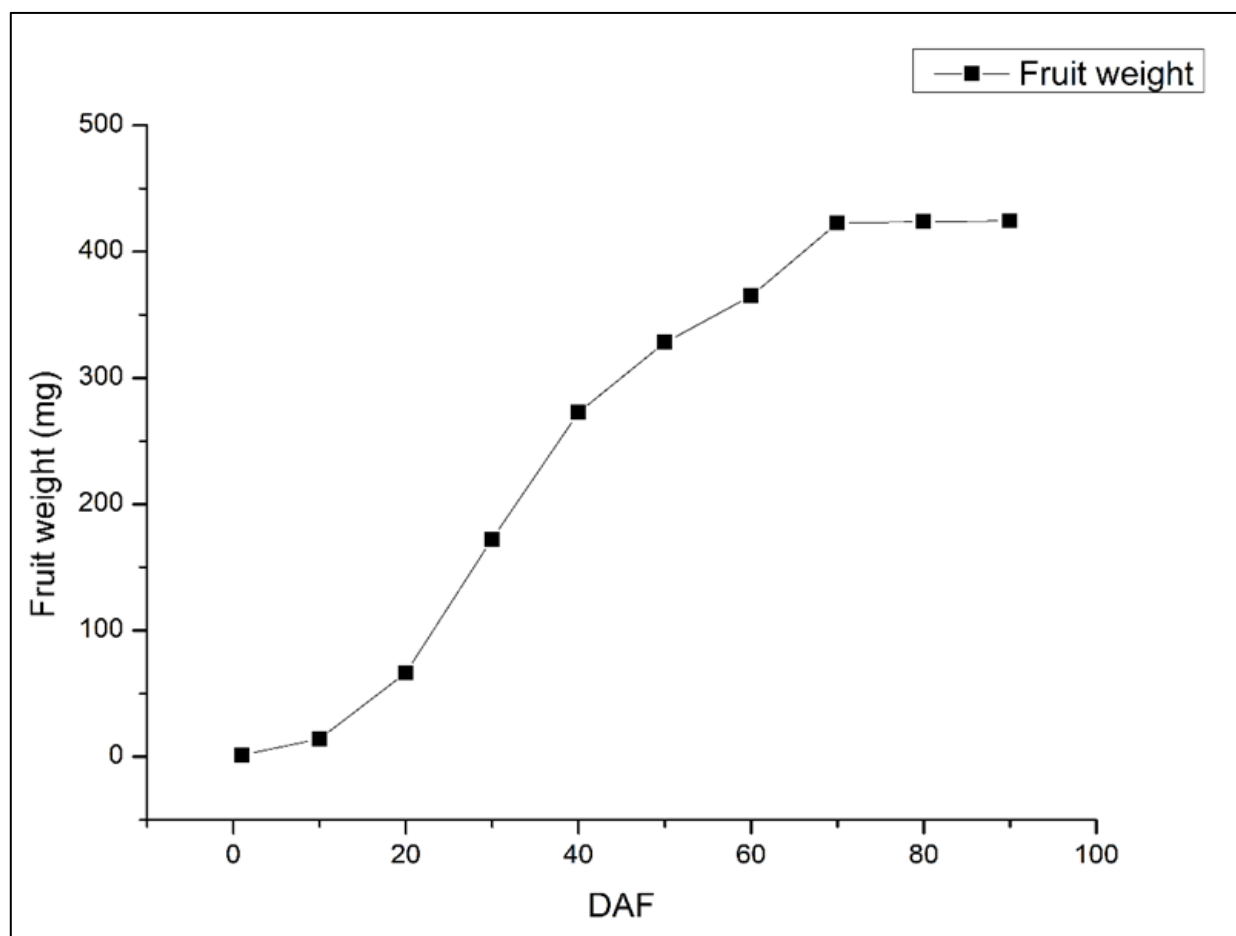


Fig 3: Change in fruit weight from first day after flowering to 90 days after flowering (DAF)

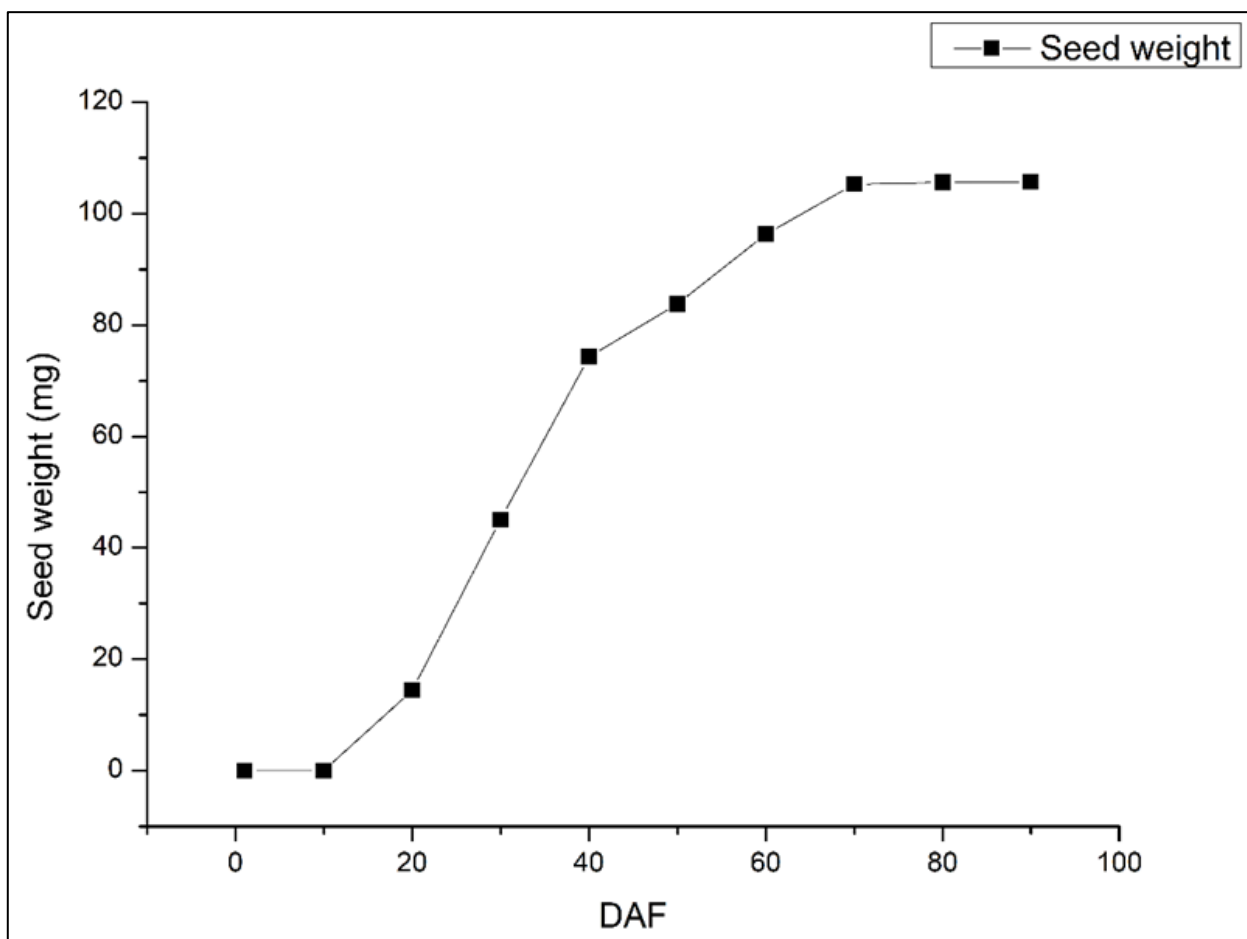


Fig 4: Change in seed weight from first day after flowering to 90 days after flowering (DAF)

4. Conclusion

The present study revealed the morphological changes in the fruit and seed development of *N. arbor-tristis* under sub-tropical conditions. The seed set was observed 20 days after flowering and full maturity was observed 90 days after flowering. From the results, it can be observed that the variation in climatic and geographical conditions can bring significant changes in the development of fruit and seed. Further investigation can be directed towards the assessment of chemical composition of the fruit and seed at different stages of maturity.

5. Funding sources

No external funding was obtained during the research work.

6. Conflict of interest

The authors declare no conflict of interest.

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