

# Flowering Behaviour Studies in Some Selected Cultivars of Amla (*emblica officinalis* Gaertn.) Under Vindhyan Region

## Research Article

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### Abstract

Amla or Indian gooseberry (*Emblica officinalis* Gaertn. Syn. *Phyllanthus emblica* L.), belongs to the ancestors Euphorbiaceae and is an important aboriginal fruit crops of Indian subcontinent. Fourteen years old trees of seven cultivars viz., NA-10 (Balwant), NA-5 (Krishna), NA-4 (Kanchan), Local Variety (NeAPSU1), Chakaiya, Local Variety (NeAPSU2) and Local Variety (NeAPSU3) were included for the study. Reproductive behaviour studies include all vegetative parameters, floral biology and fruiting pattern. This experiment work includes flowering Inflorescence type & its colour, budding & blooming, anthesis & its dehiscence. The duration of blooming also varied with the cultivar. Blooming aeon lasted for 36 (cv. Chakaiya) to 48 days (cv. Krishna). The beggarly best amounts of Male flowers were empiric in the cultivar Balwant and the least amount was empiric in the NeAPSU3. The best amounts of female flowers were empiric in cultivar Kanchan and atomic was empiric in cultivar Balwant. Sex ratio (male: female) was begin to alter from 77:1 (cv. NeAPSU1) to 101:1 (cv. Balwant).

**Keywords:** Indian gooseberry; Cultivars; blooming; dehiscence; Inflorescence

### Introduction

*Emblica officinalis* Gaertn. Syn. *Phyllanthus emblica* L. (popular known as Amla or Aonla or Indian gooseberry) is an ephemeral tree belonging to the Euphorbiaceae family. Aonla fruits are edible and are mainly found in regions of India, Southeast Asia, China, Iran, and Pakistan. According to ancient Indian historical mythology, this is the first tree to be “produced in the universe” [1-12]. Aonla has an important role in the traditional medicine of India to reduce anxiety and burning sensation in skin and eyes, improve liver health, improve anemic condition, favor the health of the male reproductive system and reproduction, facilitate digestion and also exert a tonic effect in the cardiovascular system. The wild amla is small while cultivated amla is big, smooth and juicy. Chemical composition of the amla fruit contains more than 80% of water. It also has protein, carbohydrate,

fiber and mineral and also contains Gallic acid which is a potent polyphenol. Vitamin C is important for human beings [13-15]. It is all-important for the amalgam of the inter-cellular cementing actuality which is amenable for befitting the beef of the physique together. The amla fruit appear to accommodate about 20 times as abundant vitamin C as orange juice. The comestible amla fruit tissue has 3 times the protein concentration and 160 times the ascorbic acerbic. The fruits of *Emblica officinalis* are widely used in the Aryurveda and are believed to increase defense against diseases. It has its beneficial role in cancer, diabetes, liver treatment, heart trouble, ulcer, anemia and various other diseases. Similarly, it has application as antioxidant, immunomodulatory, antipyretic, analgesic, cytoprotective, antitussive and gastroprotective. Additionally, it is useful in memory enhancing, ophthalmic disorders and lowering cholesterol level. It is also helpful

in neutralizing snake venom and as an antimicrobial. It is often used in the form of Triphala which is an herbal formulation containing fruits of *Emblica officinalis*, *Terminalia chebula* and *Terminalia belerica* in equal proportions. Beside this *Emblica officinalis* is a rich source of vitamin C. Some of the plant has only male, female or Hermaphrodite flower and some plant has all three types of flower on the same plant. These reproductive characters greatly influence the productivity of *Emblica officinalis* [16-21].

In India, abundant assortment of Amla is accessible in the backwoods breadth of Vindhyan hills, lower hills of Uttarakhand and Himachal Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan and Bihar. Krishna, Banarasi, Chakaiya, Francis (Hathijhool), Kanchan (NA-4), NA-6, NA-7, Anand-1, 2 and 3 are some of the commercially able varieties of Amla [22-25]. So this investigation was done to find out the flowering & fruiting behaviour of some selected local cultivars of Amla found under Vindhyan region.

## Materials & Methods

The present study was carried out at Centre for Biotechnology studies, A.P.S. University Rewa and Department of Horticulture, College of Agriculture Rewa (M.P.) during the year 2014-2019. Amla trees of different varieties of the same age were selected and all the horticultural techniques and practices were carried out uniformly throughout the period of experimentation. Fourteen years old trees of seven cultivars viz., NA-10 (Balwant), NA-5 (Krishna), NA-4 (Kanchan), Local Variety (NeAPSU1), Chakaiya, Local Variety (NeAPSU2) and Local Variety (NeAPSU3) were included for the study. The materials include varietal description, vegetative body parameters, floral biology including blooming, anthesis and their dehiscence.

## Results and Discussion

Amla (*Emblica officinalis* Gaertn.) tree bears two types of shoot viz., indeterminate (long) and determinate (short) shoots. The determinate shoots (branchlets) were either barren or floriferous with embricate leaves. Floral buds appeared as tiny pin heads on slender branchlets which were produced on woody branches, irrespective of their age in the middle of January when the tree is leafless. The nature of inflorescence was racemes type in all the cultivars. Male flowers appeared in clusters in the leaf axils all over the branchlets while female flowers were born on the upper end of the branchlet. A typical flower consists of perianth and androecium or gynoecium. Male flowers were baby and hardly blush in the bud date but at anthesis, they angry buttery white.

**Table 1:** Floral morphological features of Amla cultivars.

Characters	Balwant	Krishna	Kanchan	NeAPSU1	Chakaiya	NeAPSU2	NeAPSU3
<b>Male Flowers</b>							
Number of flower per branchlet	399-756	475-729	392-675	450-702	384-674	429-724	356-695
Number of flower per cluster	7-15	10-18	5-11	5-12	6-11	7-14	6-13
<b>Female Flowers</b>							
Average number of flower per branchlet	5.2	6.89	6.54	5.91	4.35	5.64	4.72
Average number of flower per cluster	1-2	1-2	1-2	1-2	1-2	1-2	1-2
Colour of inflorescence	Deep pink	Deep pink	Pinkish green	Pinkish green	Deep pink	Pinkish green	Pinkish green

## Flowering Characters

### Full Bloom

Variety NeAPSU1 exhibited full bloom as early as 16 days from the flower initiation followed by Kanchan (17 days), Krishna and NeAPSU2 (18 days). While the cultivar Balwant, Chakaiya, NeAPSU3 attained full bloom at 20, 22 and 24 days respectively (Table 1, Figure 1).

### Duration of flowering

Maximum duration of flowering was recorded in Krishna (48 days) followed by NeAPSU3 & Kanchan (45 days), Balwant (42 days), NeAPSU2 (41 days) and minimum duration of flowering was recorded for Chakaiya (36 days) followed by NeAPSU1 (38 days) (Table 1, Figure 1).

### Floral morphology

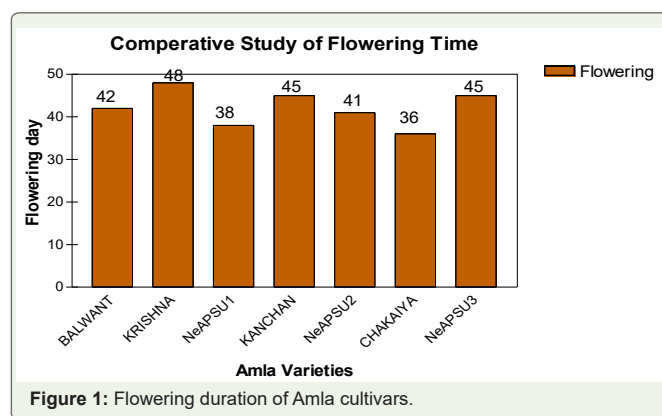
Data on floral morphology features like colour of inflorescence, number of flowers per branchlet and number of flowers per cluster in male and female flowers for all the cultivars were recorded and the results are presented in Table 1.

### Colour of inflorescence

Deep pink colour of inflorescence was observed in Balwant, Krishna and Chakaiya cultivars. Pinkish green coloured inflorescence was observed in Kanchan, NeAPSU1, NeAPSU2 and local NeAPSU3 (Table 1).

### Number of male flowers per branchlet

Male flowers per branchlet were maximum in Balwant (399-756) followed by Krishna (475-729), NeAPSU2 (429-724), NeAPSU1 (450-702), NeAPSU3 (356-695) and Kanchan (392-675), while the least



number of flowers per branchlet was observed in Chakaiya in the range of 384-674 (Table 2).

### Number of male flower per cluster

Maximum range of male flower per cluster was recorded in Krishna (10-18), followed by Balwant (7-15), NeAPSU2 (7-14), NeAPSU3 (6-13) and NeAPSU1 (5-12), while the least range of male flowers per cluster was observed in Kanchan (5-11) followed by

Chakaiya (6-11) (Table 2).

### Average number of female flowers per branchlet

The average number of female flower per branchlet was highest in the Krishna (6.89) followed by Kanchan (6.54), NeAPSU1 (5.91), NeAPSU2 (5.64), Balwant (5.2) and NeAPSU3 (4.72), while least number of female flowers per branchlet was observed in Chakaiya (4.35) (Table 2).

### Average number of female flower per cluster

The average range of female flower per cluster ranged in between one to two in all the six cultivars of amla including the local variety (Table 2).

### Sex expression and sex ratio

The amla tree is monoecious and produces several hundred male flowers (516.42) and a few female flowers (6.02) on the slender branchlet (i.e. determinate shoot). In amla, male flowers appeared on every branchlet but female flowers were born on only a few branchlets of a branch (Table 2).

### Sex ratio

The data regarding sex ratio male: female was the highest in Balwant (101:1) followed by NeAPSU2 (93:1), Krishna (83:1), Chakaiya (83:1), NeAPSU3 (82:1) and Kanchan (78:1) while it was the least in NeAPSU1 (77:1) (Table 2).

### Anthesis

Time of anthesis and per cent of flowers opened at hourly intervals were recorded and are presented in Table. F-test was found to be significant at different time intervals at 5% probability level. Statistical analysis showing all flower opening time significantly different ( $P < 0.0001$ \*\*\*) to each other (Table 3,4, Figure 2,3).

### Time of anther dehiscence

The data regarding 'time of anther dehiscence' is presented in Table 4. Dehiscence of anthers and flower opening were observed simultaneously. It was observed that as the perianth segments began to separate, the dehiscence of anthers took place. The mode of dehiscence was the same in all the seven cultivars under study. The maximum percentage of dehiscence (83.11 per cent) was noticed

**Table 2:** Sex ratio in different cultivars of Amla.

Varieties		Number of flowers per branchlet		Sex ratio
		Female	Male	
Early	BALWANT	5.50	558.90	1:101
	KRISHNA	6.30	526.07	1:83
	NeAPSU1	6.47	501.03	1:77
Mid	KANCHAN	6.67	525.13	1:78
	NeAPSU2	5.60	520.80	1:93
Late	CHAKAIYA	6.17	512.83	1:83
	NeAPSU3	5.73	470.17	1:82
Mean		6.06	516.42	-
F-test		.	.	-
S.Em $\pm$		0.03	1.56	-
C.D@ 5%		0.08	4.81	-

\*Significant

**Table 3:** Time of anthesis and per cent flowers opening in different Amla cultivars.

Varieties		Percent Flowers opened						P Value
		6pm-8am	8am-10am	10am-12pm	12pm-2pm	2pm-4pm	4pm-6pm	
Early	BALWANT	08.04	3.20	1:101	1.16	0.38	80.69	$P < 0.0001$ ***
	KRISHNA	09.11	2.61	1:83	0.58	0.44	81.63	
	NeAPSU1	04.83	0.91	1:77	0.79	7.68	83.42	
Mid	KANCHAN	10.31	2.55	1:78	1.25	1.07	83.18	
	NeAPSU2	06.06	1.86	1:93	1.28	1.42	87.69	
Late	CHAKAIYA	05.00	1.58	1:83	0.97	4.46	87.15	
	NeAPSU3	07.58	1.83	1:82	0.30	1.65	82.70	
Mean		07.28	4.65	2.08	0.92	2.44	83.78	
F-test		.	.	.	.	.	.	
S.Em $\pm$		0.12	0.10	0.04	0.02	0.15	0.15	
C.D@ 5%		0.37	0.32	0.13	0.06	0.47	0.47	

\*Significant

**Table 4:** Profile of anther dehiscence of different Amla cultivars across two hourly intervals.

Varieties		Percent Flowers opened						P Value
		6pm-8am	8am-10am	10am-12pm	12pm-2pm	2pm-4pm	4pm-6pm	
Early	BALWANT	6.11	5.89	5.22	4.66	7.67	82.89	$P < 0.0001$ ***
	KRISHNA	6.67	5.48	4.22	3.67	4.67	80.56	
	NeAPSU1	10.22	5.22	4.22	4.22	4.89	80.22	
Mid	KANCHAN	5.78	4.00	3.33	1.33	4.56	83.11	
	NeAPSU2	4.89	5.33	4.11	2.11	11.56	76.78	
Late	CHAKAIYA	5.22	4.78	3.89	1.78	7.44	80.78	
	NeAPSU3	5.71	5.78	5.22	1.55	8.44	79.22	
Mean		6.37	5.21	4.32	2.76	7.03	80.51	
F-test		.	.	.	.	.	.	
S.Em $\pm$		0.10	0.04	0.04	0.08	0.15	0.13	
C.D@ 5%		0.31	1.11	0.12	0.25	0.46	0.34	

\*Significant

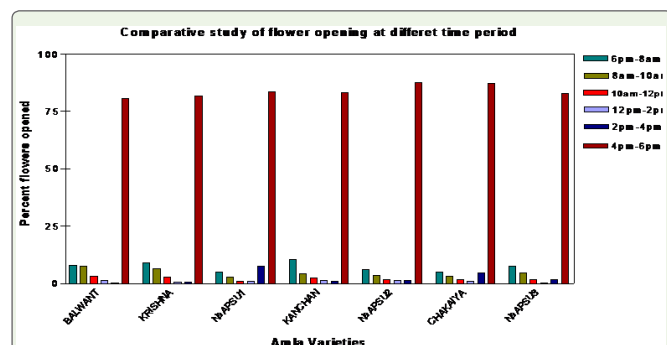


Figure 2: Time of anthesis and per cent flowers opening in different Amla cultivars.

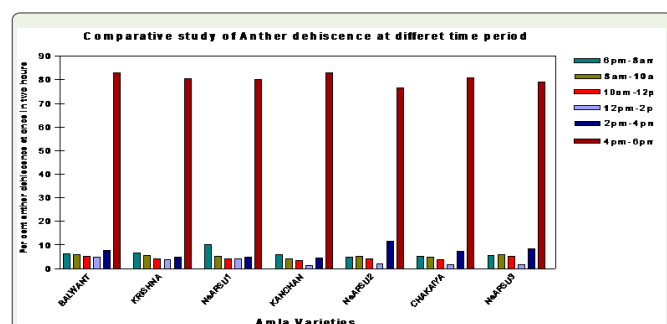


Figure 3: Time of anthesis in different Amla cultivar.

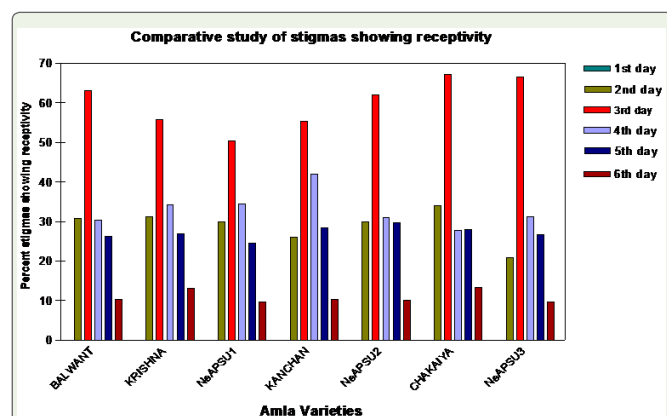


Figure 4: Receptivity of stigma at different periods after anthesis in Amla cultivars.

between 4 pm and 6 pm. The dehiscence was low in the morning and afternoon hours. The average rate is given in (Table 3,4, Figure 2,3).

### Stigmatic receptivity

Stigmatic receptivity of Amla cultivars at different day intervals are illustrated in Table 5. Significant variation was observed for stigma receptivity at different day's intervals.

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