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Research article

STUDIES ON FLORAL BIOLOGY OF AONLA (*Emblica officinalis*) CULTIVAR CHAKAIYA AND NA-7 UNDER VALLEY CONDITIONS OF GARHWAL HIMALAYAS

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ABSTRACT: Vegetative and floral shoot emergence of aonla Cultivar Chakaiya and NA-7 was observed in the month of April. The flowers were mostly borne in cluster in the leaf axils on determinate shoots. Chakaiya produced more number of male flowers as compared to female flowers with the sex ratio 162.20:1 on the recemose inflorescence NA-7 also beared racemose inflorescence with the sex ratio of 70.50:1. The chronology of flower bud development includes five distinct stages and time required for flower bud development to reach anthesis was recorded 15-16 days in Chakaiya and 14-15 days in NA-7. Main period of anthesis in Chakaiya and NA-7 under Srinagar (Garhwal) conditions was recorded between 6 AM to 4 PM with a peak period (82.21% in Chakaiya, and 77.23% NA-7) between 6 AM to 8 AM and minimum between 4-6 PM in both the cultivars. Just after the anthesis, either dehiscence started immediately or after 10-15 minutes of anthesis
Key Words: Anthesis, Chakaiya, dehiscence, determinate, indeterminate.

INTRODUCTION

Aonla (*Emblica officinalis* Gaerth), also known as Indian gooseberry, is said to be indigenous to tropical South-East Asia, particularly in the Central and Southern India. Aonla tree has two types of shoots, the indeterminate and determinate. Indeterminate shoots are longer and attain fresh growth in the season and do not bear flowers while determinate shoots come at the nodes of indeterminate shoots and number vary from 3-5 depending upon the genotype. Determinate shoots bear very small reduced, closely arranged leaves giving the impression of pinnately compound leaves. Small, inconspicuous, greenish-yellow flowers are borne in compact clusters in the axils of the lower leaves. There are a few important diseases like rust, wilt, fruit rot, and pests like shoot gall maker, mealy bug, stone borer, aonla aphid, bark eating caterpillar and physiological disorders like internal necrosis which are very dangerous for the aonla cultivation. Due to these problems, the production and quality of fruits in aonla is reduced and therefore, there is need to develop resistant cultivars of quality fruits. To initiate any breeding programme, a precise knowledge of floral biology is a pre-requisite and the present investigation was therefore, carried out to have detailed information on floral biology of aonla cultivars NA-7 and Chakaiya under Srinagar (Garhwal) region.

MATERIAL AND METHODS

The trees of Chakaiya and NA-7 selected for present investigation at Horticultural Research Center, Chauras, H.N.B Garhwal, university, Srinagar (Garhwal) were of Twelve- year- old and four- year- old, respectively. All the experimental trees were kept under similar cultural schedule during the course of investigation.

EXPERIMENTAL RESULTS

Vegetative Shoot Emergence

Both Chakaiya and NA-7 are deciduous under subtropical conditions and they shed leaves completely during the month of Feb to March. Under the valley condition of Srinagar, new growth emerges from the first week of April, 2012 in Chakaiya and in NA-7; it starts from the second week of April, 2012. Along with the new growth flowering also commences.

Bearing Behavior

As shown in Table 1, Chakaiya started bud initiation in the first week of April. The newly emerged shoots attained a length of 4-7cm with an average length of 4.3cm. It produced flower in cluster of an average of 165.6 flowers per determinate shoot with the sex ratio of 162.20:1.

NA-7 produces flowers in second week of April and the length of the shoots varied from 6-20cm with an average length of 18.20cm. Determinate shoots bear cymules of male flowers at the lower side of stem and a cymule of one female flower on the upper portion of the stem. The bearing shoots produce an average of 128.00 flowers per bearing shoot. It produced male and female flowers in the ratio of 70.50:1. Both Chakaiya and NA-7 produced male and female flowers on the branchlets, male flower in the leaf axil and female flower on the apex of branchlets. Ram [2] reported that in aonla, male flowers are many more than female ones. Dhar [1] also reported that the ratio of female to male flowers may vary from 1:109 to 1:501 in aonla depending upon the cultivars. However, the sex ratio in different cultivars of aonla varies from 1:12 to 1:89 under hot arid ecosystem of Rajasthan [3]. Raju and Ezradanam [4] reported that in Jatropa numerically, 1–5 female flowers and 25–93 male flowers were produced per inflorescence. The average male to female flower ratio was 29: 1.

Flower Bud Development

The observations with regard the bud development stages in Chakaiya are shown in Table 2. In both cultivars under study, the total span of flower bud development from emergence to anthesis was divided in to five stages. The morphological characters of buds in different stages of development for Chakaiya and NA-7 are discussed below:

Stage 1: At this stage, the buds were very small, round in shape and completely covered with the calyx tube. The size and length of bud cannot be recorded due to very small in size.

Stage 2: As the bud entered this stage, these slightly enlarged although still looked round in shape.

Stage 3: The flower bud further enlarged and became pinkish-cream in colour. The calyx tube of buds showed cracking.

Stage 4: All the calyx started to open.

Stage 5: The petal pushed apart, exposing the stamens and stigma and finally the buds reached the full bloom stage.

The total time required for flower bud to reach the anthesis was 13.7 days in Chakaiya and 14.6 days in NA-7. The growth of flower bud in each cultivar under present investigation showed slow growth for initial days but prior to anthesis the growth was noticed faster (Table 2). Randhawa *et al.* [5] described seven stages of floral bud development in different plum cultivars varied from 16-23 days. The floral bud development required 20-23 days to passes through the seven developmental stages in different cultivars of lemon and citron under study [5].

Table-1: Sex Ratio of Aonla Cvs. Chakaiya and NA-7

Cultivar	Av. no. of flower recorded	Av. no. of male flowers	Av. no of female flowers	% of male flowers	% of female flowers	Sex ratio (male:female)
Chakaiya	17726	17518	108	98.82	0.60	162.20:1
NA-7	18684	18419	265	98.58	1.41	70.50:1

Table-2: Chronology of bud development stages in Chakaiya and NA-7

No. of buds observed	Stage I-II		Stage II-III		Stage III-IV		Stage IV-V		Total no of days	
	Chakaiya	NA-7	Chakaiya	NA-7	Chakaiya	NA-7	Chakaiya	NA-7	Chakaiya	NA-7
1	3	3	5	5	6	4	1	3	16	15
2	3	3	8	6	3	4	2	2	16	12
3	3	4	5	5	6	4	2	3	16	15
4	3	3	8	5	3	4	1	2	15	14
5	3	4	5	5	4	4	2	2	14	14
6	3	3	5	7	4	3	1	2	15	15
7	3	3	5	7	4	3	2	1	14	14
8	3	4	5	5	3	6	1	2	15	17
9	3	3	8	7	3	3	1	1	15	14
Average.	3	3.3	6.2	5.7	3.6	3.7	1.4	2	13.7	14.6

Table-3: Time and duration of flowering of Aonla Cvs. Chakaiya and NA-7

Variety	Commencement of flowering	Full bloom(about 75%) flowers open	No. of days to attain full bloom	End of flowering	Duration of flowering
Chakaiya	2/4/2012	19/4/2012	18	31/4/2012	31
NA-7	8/42012	24/4/2012	16	10/5/2012	32

Time and Duration of Flowering

The data recorded in Table 3 shows that in Chakaiya, the flowering started from first week of April and total flowering period was recorded to be 31 days. Full bloom (75% flowering) reached at 18 days after the first flower initiation. In case of NA-7 flowering started during the second week of April and continued for 32 days, full bloom took place at 16 days after initiation of first flower. Bajpai, [6]; Ram [2] and Anon [3] found the similar results in relation to flowering. Chadha [7] studied the time and duration of flowering of 7 cultivars of pomegranate and reported that it commenced in last week of March in all Iranian cultivars *i.e*. Anar Alak, Anar Post-e-Shifid Shirin and Anar Shirin-e-Mohamad Ali.

Anthesis

Main period of anthesis in Chakaiya and NA-7 under Srinagar (Garhwal) conditions have been recorded between 6 AM to 4 PM with a peak period (82.21% in Chakaiya and 77.23% in NA-7) between 6 AM to 8 AM and minimum between 4-6 PM in both cultivars. Just after the anthesis, either dehiscence starts immediately or after 10-15 minutes of anthesis (Table 4 & 5 and Fig1 & 2). Chattopadhyay [8] and Shukla *et al.* [9] also observed same time of anthesis and dehiscence in aonla. Allemullah and Ram [10] reported that anthesis of male flowers occured between 4 PM and 5 PM in Banarasi, and both in morning (8.30-11.00 AM) and afternoon (3.30-6.30 PM) in Chakaiya. Raju and Ezradanam [4] reported that in Jatropa the flowers opened daily during 5:30–6:30 AM. The dehiscence of anthers started soon or 10 - 15 minutes after anthesis.

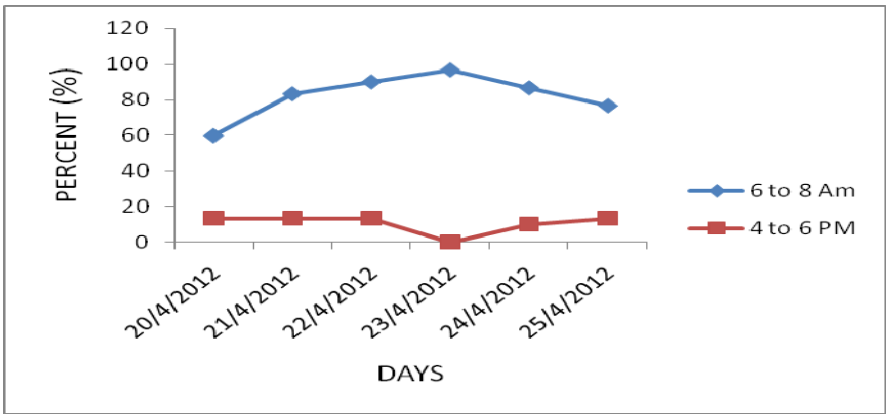

Fig. 1: Time of anthesis in Chakaiya.

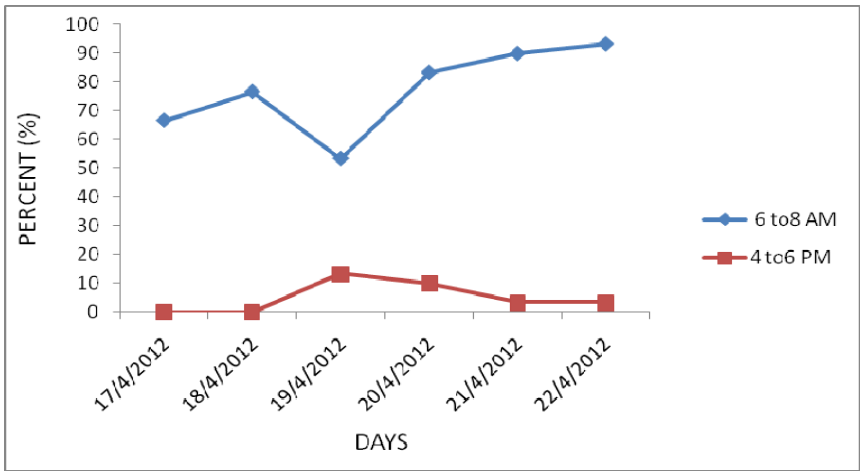

Fig. 2: Time of anthesis in NA-7.

Mode of Dehiscence

In both the cultivars under investigation, the dehiscence of anthers started just after opening of flower. The anther lobes started bursting longitudinally. All the anthers of flower did not dehisce synchronously, some of these start to dehisced just after opening of flower whereas others did so later in the day, it tookeabout 10 to 15 minut for complete dehiscence. Singh and Dhuria [11] studied the floral biology of sweet lime and reported that the maximum anthesis took place between 10 AM to 12 noon and the dehiscence of maximum anther occurred between 10 AM and 2 PM.

Table-4: Time of anthesis in Chakaiya

Date of observation	Total no. of flower observed	Percentage of flowers opened at different interval						Temperature (°C)		RH (%)
		6-8 AM	8-10 AM	10-12 Noon	12-2 PM	2-4 PM	4-6 PM	Mini.	Max.	
20/4/2012	30	60.00	-	-	-	-	13.33	14	37	20
21/4/2012	30	83.34	-	-	-	-	13.33	17	38	20
22/4/2012	30	90.00	-	-	-	-	13.33	14	36	20
23/4/2012	30	96.67	-	-	-	-	-	14	37	20
24/4/2012	30	86.67	-	-	-	-	10.00	15	40	20
25/4/2012	30	76.67	-	-	-	-	13.33	15	41	20
Average	30	82.21					10.55	14.83	38.16	20

Table-5: Time of anthesis in NA-7

Date of observation	Total no. of flowers observed	Percentage of flowers opened at different interval						Temperature (C°)		RH (%)
		6-8 AM	8-10 AM	10-12 Noon	12-2 PM	2-4 PM	4-6 PM	Mini.	Max.	
17/4/2012	30	66.67	-	-	-	-	-	12	36	20
18/4/2012	30	76.67	-	-	-	-	-	12	31	20
19/4/2012	30	53.34	-	-	-	-	13.34	14	37	20
20/4/2012	30	83.34	-	-	-	-	10.00	14	37	20
21/4/2012	30	90.00	-	-	-	-	3.34	17	38	20
22/4/2012	30	93.34	-	-	-	-	3.34	14	36	20
Average	30	77.23	-	-	-	-	5.003	13.83	35.83	20

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