

**STUDIES ON FLORAL BIOLOGY IN POMEGRANATE CV. GANESH AND  
KANDHARI UNDER VALLEY CONDITIONS OF SRINAGAR (GARHWAL)  
(BEARING HABIT, TIME AND DURATION OF FLOWERING, BUD  
DEVELOPMENT, FLOWER CHARACTERS AND ANTHESIS)**

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**ABSTRACT**

The cultivars Ganesh and Kandhari were deciduous in nature under subtropical condition of Srinagar (Garhwal). The vegetative shoot emergence was occurred in the month of February. Both of the cultivars produce flowers once in a year during March under Srinagar (Garhwal) valley condition. As monthly observations the flowering under Srinagar conditions commences between last week of March to last week of May with peak period 30 days after opening of first flower. Total span of flowering takes 63 days in Ganesh and 64 days in Kandhari. The flowers were hermaphrodite male and intermediate with numerous stamens. The maximum rate of anthesis in both the two pomegranate cultivars was found between 10A.M.-12 Noon. Rise in temperature and fall in humidity were found to hasten anthesis.

**KEYWORDS:** Ganesh, Kandhari, Anthesis, Dehiscence, Axillary

**INTRODUCTION**

Pomegranate (*Punica granatum* L.) belonging to family punicaceae is an ancient and important fruit of tropical and subtropical region. It is grown for its delicious and juicy pink aril (outer growth of seed) which are eaten fresh (Keskar *et al.*, 1993). In India it is grown to limited extent in selected locations in state like Maharashtra, Gujarat, Rajasthan, Uttar Pradesh Haryana, Andhra Pradesh, Karnataka and Tamil Nadu.

Selection of sui cultivar is very important aspect in crop production which largely depends on the performance of the cultivar in that region. The performance of the existing cultivars depends on its breeding programme. Before taking up any programme of improvement of plants, it is necessary to learn the initial fundamental facts with regard to the floral biology. To achieve this objective, the present studies were carried out.

**MATERIALS AND METHODS**

This investigation was carried out during 2011 at Horticultural Research Centre and Department of Horticulture, Chauras Campus, H.N.B. Garhwal University Srinagar (Garhwal), Utrakhand. Srinagar is a large valley spreading on both sides of holy river Alaknanda at 540m MSL and exhibits a semi-arid, subtropical climate with dry summer and rigorous winters with fog in the morning from mid December to mid February. Methods adopted during the course of study have been described under respective topic of experimental results for the sake of convenience.

## RESULTS AND DISCUSSIONS

### • Bearing Habit

The flowers were mostly solitary borne terminally and in leaf axils and a very few flowers were found in cluster of two or three flowers. It bears axillary (mostly single) and terminal (dichasial) cymose inflorescence.

To find out the number and percentage of flowers on current as well as on one-year-old shoots, shoots were marked on experimental trees. The data recorded out of these shoots with respect to bearing habit indicated that the highest percentage of flowers were found on current season shoots (64.28% and 66.66% in Ganesh and Kandhari respectively) followed by one-year-old shoot (35.71% and 33.33% respectively). Similar findings have also been reported by Nath and Randhawa (1959a). Nalawadi *et al.* (1973), Singh *et al.* (1978), Josan *et al.* (1979a) have also reported that the flowers mostly solitary and rarely in clusters, are born on leaf axils on current season growth, bears cymose inflorescence.

### • Time and Duration of Flowering

As monthly observations the flowering under Srinagar (Garhwal) conditions commenced on March 25 and ended on May 5, 2011 in Ganesh and in Kandhari date of commencement of flowering was on March 27 and ended on May 30, 2011. Full bloom (when 75% flowers opened) was observed on April 24 in Ganesh and April 27, 2011 in Kandhari. The total flowering period recorded was 63 and 64 days respectively. In Punjab, only one flowering season was observed which lasted for about 2.5 months from April to June (Josan *et al.*, 1979a). While studying the time and duration of flowering in evergreen varieties like Muscat White, Dholka and G.B.I. Nath and Randhawa (1959b) reported that it began in the first week of March and extended until the end of August in Muscat White, while in Dholka it was over by the middle of May. In G.B.I. there are two distinct flowering seasons *viz* March-April and mid June – August. Similar behavior was noted in Japanese dwarf variety. Chadha (1983) studied the time and duration of flowering of seven cultivars and indicated that flowering commenced in first week of April in all Russian cultivars, whereas, it commenced in last week of March in all Iranian cultivars. The duration of flowering was approximately same in all the cultivars (52-58 days) except Kazkai which had a shorter flowering period (47 days).

## DEVELOPMENT OF FLOWER BUD

### • Stages of Bud Development

The whole period of flower bud development in the cultivars under study, from its first appearance to the full bloom stage has arbitrarily been divided into V stages ( 1, 2). The morphological characteristics of buds in different stages of development are discussed below:

**Stage I:** At this stage, the buds were very small, round in shape, light green in colour and completely covered with the calyx tube.

**Stage II:** The bud at this stage slightly enlarged although still looked roundish.

**Stage III:** The flower buds further enlarge and change the colour from dark red to orange. The calyx tube of buds showed cracking and dark orange coloured corolla appeared at the apex.

**Stage IV:** The calyx was starting to open and show the bright orange corolla.

**Stage V:** The petals start to open and exposing the stamens and stigma and finally the buds reached the full bloom

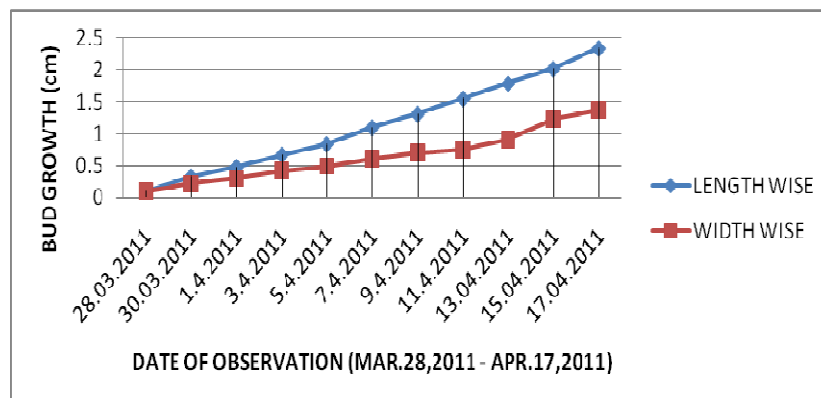
stage. The number of days required by buds to reach this stage was 20-22 days in Ganesh and 20-24 days in Kandhari.

**Table 1: Ganesh, Chronology of Bud Development Stages**

No. of Buds Observed	I-II	II-III	III-IV	IV-V	Total No of Days
1	12	6	3	1	22
2	10	5	3	2	20
3	12	4	3	1	20
4	13	5	2	2	22
5	13	4	3	1	21
6	13	6	2	1	22
7	12	6	2	1	21
8	12	6	2	1	21
9	13	5	2	1	21
10	12	6	2	1	21
<b>AV.</b>	<b>12.2</b>	<b>5.3</b>	<b>2.4</b>	<b>1.2</b>	<b>21.1</b>

**Table 2: Kandhari, Chronology of Bud Development Stages**

No. of Buds Observed	I-II	II-III	III-IV	IV-V	Total No. of Days
1	12	5	3	2	22
2	13	4	3	3	23
3	11	6	3	2	22
4	11	5	3	2	21
5	10	5	4	1	20
6	11	5	4	2	22
7	14	4	3	2	23
8	11	4	3	2	20
9	15	4	4	1	24
10	11	5	4	1	21
<b>AV.</b>	<b>11.9</b>	<b>4.7</b>	<b>3.4</b>	<b>1.8</b>	<b>21.8</b>



**Figure 1: Ganesh, Flower Bud Growth from Emergence to Anthesis**

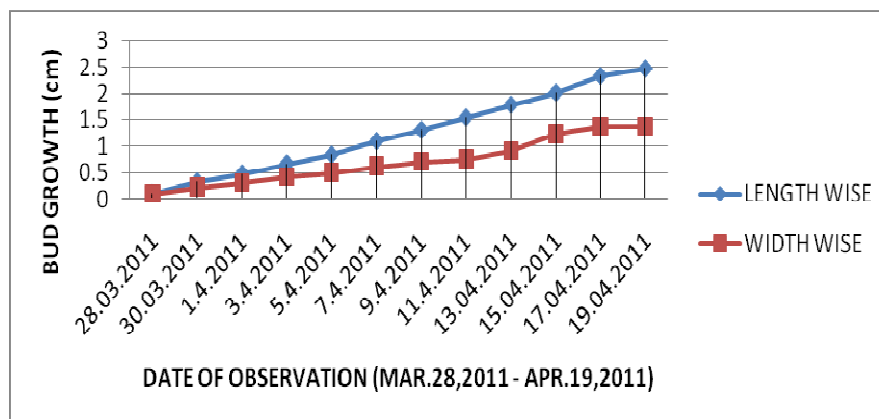


Figure 2: Kandhari, Flower Bud Growth from Emergence to Anthesis

### Bud Growth Behaviour

After recording the data separately at the alternate days, the data thus, obtained have been presented in 3 and 4 and Figure 1 and 2, Length of the buds increased faster than width and finally the buds had attained the average size of 2.33 X 1.32 cm. in Ganesh and 2.48 X 1.38 cm. in Kandhari.

### FLOWER CHARACTERS

Visual observation of freshly opened flowers of Ganesh and Kandhari reveal that the flowers are hermaphrodite, male and intermediate, actinomorphic, epigynous, sub-sessile or sessile bright crimson in colour and consist of single whorl of sepals and petals; **calyx**- Campanulate, tubular crimson on the outer surface light orange at the inner surface in Ganesh, and deep scarlet at outer surface and orange at inner surface slightly out curved when fully mature in Kandhari, lobes 6-7 triangular with acute tips; **corolla**- Petals 6-7 in numbers, brightly orange in colour distinctly clawed at the base polypetalous with imbricate aestivation, obovate, and antisepalous; **androecium**- Stamens many, polyandrous, inserted on the calyx tube below petals; anthers: monotheous, dorsifixed, introse; **gynoecium**- ovary inferior, yellowish in colour, locules-four inner, six outer in the same plane, base of style yellowish in cv Ganesh, in Kandhari ovary mustard yellow in colour, locules-two lower and six upper; style-mustard yellow near base fading near the top; inferior, disc present. Nath and Randhawa (1950) and Rawat (2006) also reported similar features for flower structure and organization in the pomegranate flowers.

### ANTHESIS

**Mode of anthesis:** Five distinct stages of anthesis in Ganesh, and Kandhari were observed and as describe below:

**Stage I:** The bud become balloon shape and the sepals start to open.

**Stage II:** A small split in the center of upper portion of bud is noticed.

**Stage III:** The split widens slowly, opening the top of the calyx tube and the stigma and petals become visible.

**Stage IV:** The calyx is completely expended and petals start to open.

**Stage V:** The flowers finally get completely opened exposing all the stamens and fully expanded pistil. The present finding with regards to the floral bud development are very much on the line with the result reported by Randhawa

*et al.*, 1960 in lemon and citron

### Time of Anthesis

It is evident from 3 that the anthesis in Ganesh started between 6-8 AM and expanded up to 6 PM in the evening with the peak period (30.94%) reaching between 10 AM to 12 Noon, followed by 12 to 2 PM (19.49%) and the minimum (9.88%) was observed between 4 to 6 PM. 4 indicated that the time of anthesis in Kandhari varied from 6 AM to 4 PM the maximum anthesis (44.42%) was occurred between 10 AM to 12 Noon followed by 12 to 2 PM with 27.18% opening and the minimum anthesis (1.99%) was occurred between 6 to 8 AM and nill at 4-6 PM. The above result are similar to Chadha (1983) while studying the time of anthesis in seven cultivars under Himachal conditions observed maximum anthesis (41.54 to 43.26%) in Kazkai, Kali Shirin, AK Anar, and Shirin from 10 AM to 12 Noon.

**Table 3: Ganesh, Time of Anthesis**

Date of Observation	Total No. of Flower Observed	Percentage of Flower 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	Max.	Mini.	
06/04/2011	31	19.35	12.90	32.25	22.58	12.90	-	28	14	16
07/04/2011	31	28.57	10.71	32.14	7.14	10.71	10.71	29	14	15
08/04/2011	31	9.67	6.45	29.03	12.90	16.12	25.80	29	17	18
09/04/2011	31	6.45	16.12	22.58	29.03	16.12	9.67	28	13	13
10/04/2011	31	3.22	16.12	38.70	25.80	12.90	3.22	24	14	17
Average	31	13.45	12.46	30.94	19.49	13.75	9.88	25.2	14.4	13.16

**Table 4: Kandhari, Time of Anthesis**

Date of Observation	Total No. of Flower Observed	Percentage of Flower 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	Max.	Mini.	
17/04/2011	15	-	13.63	45.45	27.27	13.63	-	24	14	17
18/04/2011	15	3.33	16.66	43.33	30.0	6.66	-	31	20	23
19/04/2011	15	-	24.0	40.0	32.0	4.0	-	35	18	27
20/04/2011	15	6.66	13.33	53.33	20.0	6.66	-	34	18	25
21/04/2011	15	-	6.66	40.0	26.66	20.0	-	35	18	28
Average	15	1.99	14.85	44.42	27.18	10.19	-	31.8	17.6	24.0

### DEHISCENCE

In these two cultivars, the dehiscence of anthers started just after opening of flower. The anther lobes started bursting longitudinally. All the anthers of a flower did not dehisce synchronously, some of these start dehisced just after opening of flower whereas, others did so later in the day, it take about 6-7 hours for complete dehiscence.

### CONCLUSIONS

Pomegranate cultivars Ganesh and Kandhari exhibit deciduous nature under subtropical conditions and produce hermaphrodite, male and intermediate flowers during spring season with the emergence of new growth. Flowering continue for 60-64 days and a floral bud takes 20-25 days for its development. Opening of the flowers starts early in the morning and continue up to 4.00 pm with a peak period between 10 am to 12 Noon. The anthers start dehiscence just after opening

of flower and complete dehiscence of a flower takes place within 6-7 hours. With these findings of present study it has been suggested that the breeding operations in these two cultivars of pomegranate under study should be done during spring season. For cross pollination anthers should be removed before the opening of flower

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