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Impact of Weather Parameters on Flowering Behaviour of Different Mango Varieties in Central Plain Zone of Uttar Pradesh

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A B S T R A C T

A field experiment was conducted to study the impact of temperature and relative humidity on flowering and fruiting behaviours of different mango varieties in Central Plain Zone of Uttar Pradesh during the fruiting year 2017-18 in the Garden of the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in Randomized Block Design with 3 replications. Seven varieties of mango were taken into consideration. Flowering and fruiting attributes as influenced of temperature and relative humidity differed significantly in different varieties. Dasheri initiated first panicle on 20th January and taken maximum days in panicle initiation and open flower first and reached to 50% and 100% flowers opening earliest among all varieties, followed by local. Dasheri recorded longest panicle size (31.4cm) among all mango varieties followed by Chausa (27.1 cm) and Amrapali (25 cm). Dasheri recorded highest number of male (831.7) and hermaphrodite (361.7) flowers followed by Amarapali, Chausa and Local. The maximum sex ratio was noted under Bombay Green that may be due to more number of hermaphrodite flowers as compared to male flowers. It is concluded that mango variety Dasheri being emerged first panicle and taken maximum days in panicle initiation, open first flower first and reached to 50% and 100% flowers opening earliest with record longest panicle size among all mango varieties with highest numbers of male and hermaphrodite flowers and hence, found most suitable for this region.

Introduction

Mango is one of the choicest fruit in the world (De Condolle, 1904 and Popenoe, 1972) popularly cultivated in the tropics and the subtropics for its economic and nutritional values. Indian subcontinent has rich diversity of mango and hence, the India is considered to be the centre of origin of mango (Ravishankar *et al.,* 1979). Mango reflects Indian culture, nature, festivals, history of India that's why the mango is a national fruit

of India. On account of its nutritive value, taste, attractive fragrance and health promoting qualities it is also known as the "king of fruits" (Dutta *et al.*, 2013). Mangoes are well established commodity of international trade because of their high quality (Iqbal *et al*., 2012). Right from the mountain valley to the plains, mango is extensively cultivated in India.

Although, it is grown all over the world in many countries on a commercial basis but still it does not have the same status as it is enjoying in India, such as apple enjoying by Americans (Akter, 2013).

India produces 21253 thousand MT of mango from an area of 2288 thousand hectares with the productivity of 9.28MT per ha (Anonymous, 2017-18). Worldwide India is the largest producer of mango accounting 18 million tonnes during 2012-13 contributing about 50% of the global production (Welfare, 2016).

The leading mango producing states of India are Uttar Pradesh producing 4540.23MT from an area of 264.93 thousand hectares followed by Andhra Pradesh producing 3163.32 MT from an area of 332.97 thousand hectares (Anonymous, 2016-17). Although production is high in India but productivity is the concern.

Many scientist reported that, due to irregular bearing, recurrent flowering, heavy fruit drop, more pseudo fruit formation, more number of pest and disease occurrence and change in pest status are some major bottle neck for lower productivity.

Looking to above fact, it was realized to study the performance of different mango varieties growing under the agro-climatic conditions of Uttar Pradesh for different phenological and reproductive development.

Therefore, the present experiment was carried out to determine the flowering behaviour of different mango cultivars. The information generated from this study will enable the effective utilization of mango genetic resources especially breeding programme for improvement of mango.

Materials and Methods

The experiment was conducted at Chandra Shekhar Azad University of Agriculture and Technology Kanpur in the Garden of Department of Horticulture, during November 2017 to July 2018.

Well established healthy and uniform trees of 7 varieties of mango namely; Dashehari, Chausa, Amrapali, Husnara, Gaurjeet, Bombay Green, and Local were selected for the experiment. The experiment was laid out in Randomized Block Design (RBD) in three replications.

All the package of practices was followed as per crop need. Observations related to date of panicle initiation, date of first flower opening, date of 50% and 100% flowering noted as per the crop stage. Male, hermaphrodite and total number of flowers was counted from the 15 panicles of each variety from all the directions.

The flowers were counted after anthesis daily and removed with the help of forceps at each counting. The counting of the flowers is done till anthesis of last flower on the panicle. The average number of male (staminate) flowers per panicle was calculated, and by subtracting it from total number of flowers, total number of female flowers is obtained. Meteorological observations are depicted graphically in Fig.1. Total number of marble size fruit and mature fruits were also counted in different varieties as per required stage.

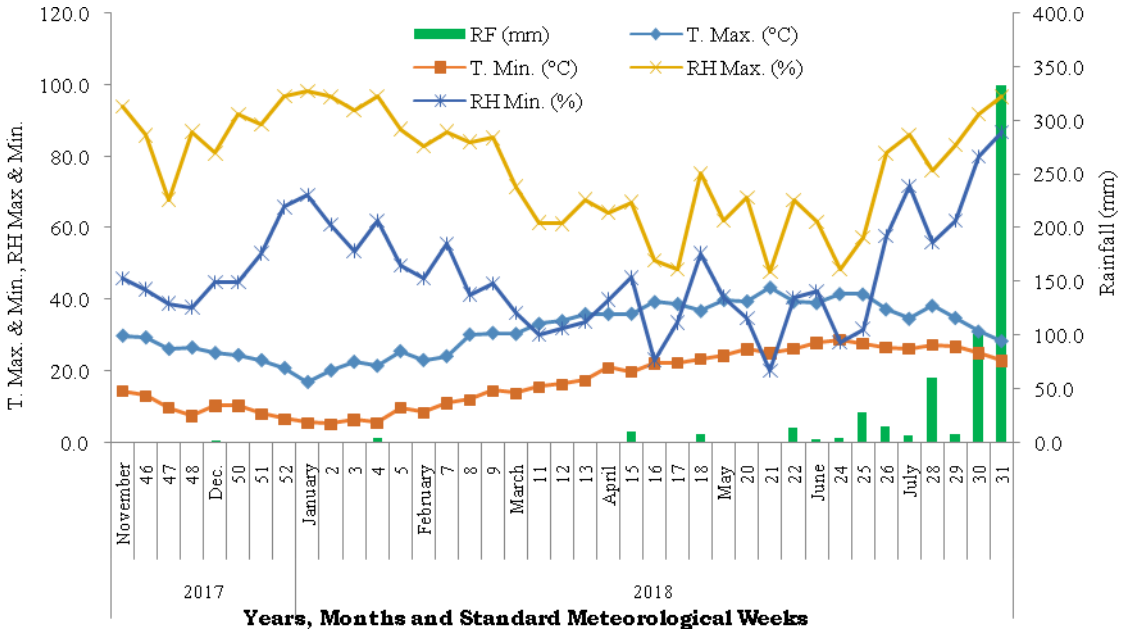

Fig.1 Graphical presentation of the meteorological observations during the trial period

Results and Discussion

Days of panicle initiation and first flower opening

Results (Table 1) indicates that the variety Dasheri initiated panicle on 20th January followed by local that started to emerge from 31st January. Chausa started to emerge from 2nd February followed by Amrapali 3rd February, Bombay Green from 6th February and Husnara 7th February. Gaurgeet started very delayed panicle iniation among all varieties from 9th February.

Table.1 Average dates of Panicle initiation and its relation with weather parameters (temperature and relative humidity

Varieties	Average date of panicle emergence	Range of dates	Total period taken in panicle emergence	T. Max.	T. Min.	T. Ave.	RH Max.	RH Min.	RH Ave.
Dasheri	20-Jan	14Jan.-28 Jan.	15	22.2	6.0	14.1	95.1	57.3	76.2
Chausa	02-Feb	29Jan.- 05 Feb.	8	25.4	9.6	17.5	87.3	50.6	68.9
Amrapali	03-Feb	31 Jan.-7 Feb	8	24.7	10.6	17.6	83.9	47.4	65.6
Husnara	07-Feb	03 Feb -14 Feb	12	23.6	9.6	16.6	83.6	48.9	66.2
Gaurjeet	09-Feb	7 Feb-16 Feb	10	23.3	9.5	16.4	85.5	52.3	68.9
B Green	06-Feb	31 Jan.-11 Feb	12	24.5	9.4	16.9	85.8	45.8	65.8
Local	31-Jan	24 Jan-5 Feb	13	23.5	8.3	15.9	91.5	57.2	74.3

Table.2 Average dates of flower opening and its relation with weather parameters (temperature and relative humidity

Varieties	Average dates of flower initiation	Range of dates	Total period taken in flower initiation	T. Max.	T. Min.	T. Ave.	RH Max.	RH Min.	RH Ave.
Dasheri	10-Feb	5 Feb-22Feb	18	24.9	10.0	17.4	84.9	48.6	66.7
Chausa	24-Feb	21Feb-26Feb	6	31.1	13.3	22.2	85.0	40.8	62.9
Amrapali	23-Feb	20feb-26Feb	7	30.5	12.6	21.6	85.1	41.0	63.1
Husnara	28-Feb	24Feb-6Mar	11	30.7	14.6	22.6	83.9	45.1	64.5
Gaurjeet	26-Feb	24Feb-4Mar	9	31.0	14.5	22.8	85.0	45.3	65.2
B Green	26-Feb	21Feb-2Mar	10	31.0	13.7	22.3	85.2	42.8	64.0
Local	19-Feb	13Feb-24Feb	12	27.5	11.5	19.5	86.8	45.9	66.3

It has been observed that variety Dasheri taken maximum days (15) in panicle initiation in all tagged branches (from 14th January to 28th January). Dasheri opened first flower on 10th February (average date) followed by local (Table 2) that started to flower from 19th February. Rest of the variety started delayed flowering.

It has also been observed that the variety Dasheri taken maximum period (18 days) in first flower opening (from 5th Feb-22nd Feb), because average temperature (Max. & Min.) during this period was 24.88 and 9.97°C which was recorded lowest and the average Relative Humidity (Max. & Min.) 84.88 and 48.55% was found highest (Table 2).

Likewise, Local also taken more period (12 days) in first flower opening (from 13th Feb-24th Feb). Therefore, it is clear that the flower started very rapidly as the temperature (max. & min.) increased as 31.1 & 13.3°C and 30.5 & 12.6°C and averaged RH reduced 85/40.8% and 85.1/41% as in case of Chausa and Amrapali respectively, that taken only 6 & 7 days in first flower opening in all tagged panicle.

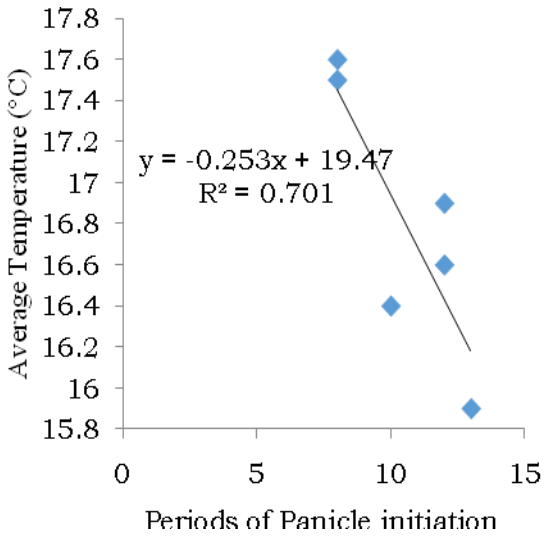

Fig.2a

Shu (1999) reported that warm temperatures hastened growth rates of panicles and flowers. The similar temperature and RH relation were found in rest of the varieties. The periods of panicle initiation (Fig.2a) and first flower opening (Fig. 2c) was negatively correlated with average temperature and positively correlated with average relative humidity (Fig. 2b and Fig. 2d).

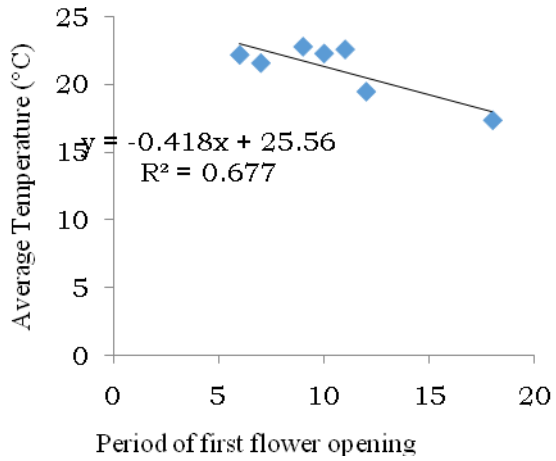

Fig.2a

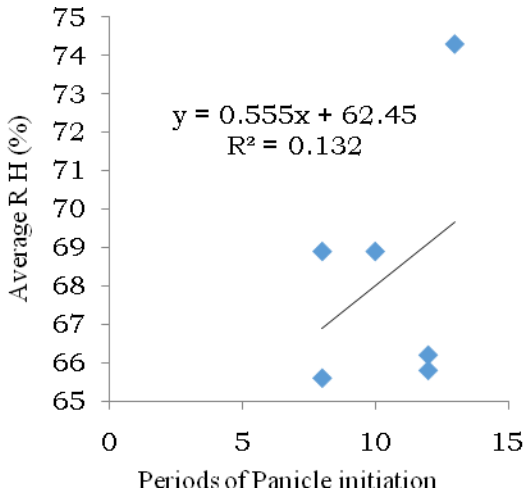

Fig.2b

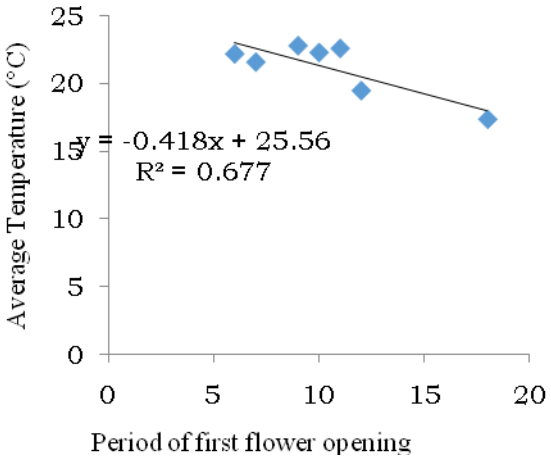

Fig.2c

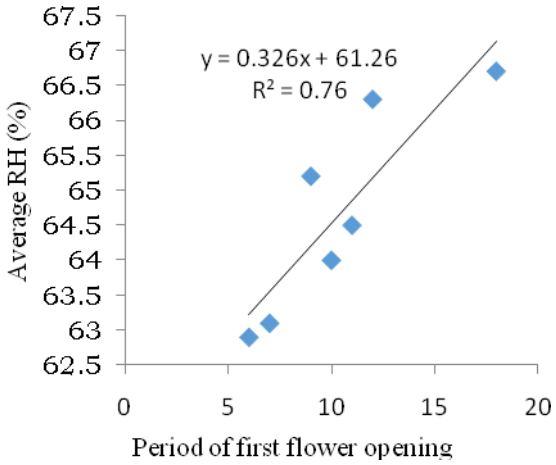

Fig.2d

Fig.2 Relation of average temperature and Relative Humidity with period of panicle initiation and first flower initiation

Date of 50% and 100% flowering

50% flowering were observed (Table 3) in Dasheri up to 17th February, which was recorded earliest among all mango varieties under study followed by Local that reached to 50% flower opening up to 27th February. Likewise, Chausa and Amrapali flowered 50% up to 2nd March, Gaurjeet and Bombay Green up to 7th March and Husnara up to 9th March.

It has been observed that Dasheri taken maximum period (17 days) in 50 % flower opening (from 13th Feb - 1st March). During this period the average (Max. & Min.) temperature (28.2 and 12.3°C) was recorded lowest and the average Relative Humidity, (Max. & Min.) was (86.3 and 46.2%) found highest. Likewise, Local variety also taken comparatively more period (13 days) in 50 % flower opening (from 20th Feb-4th March).

Table.3 Average dates of 50% flower opening and its relation with weather parameters (temperature and relative humidity

Varieties	Dates of 50% flower opening	Range of dates	Days taken in 50% flowering	T. Max.	T. Min.	T. Ave.	RH Max.	RH Min.	RH Ave.
Dasheri	17-Feb	13Feb-01Mar	17	28.2	12.3	20.3	86.3	46.2	66.2
Chausa	02-Mar	28Feb 5Mar	6	31.3	14.9	23.1	85.5	45.3	65.4
Amrapali	02-Mar	27Feb-6Mar	8	30.7	14.7	22.7	83.4	44.9	64.1
Husnara	09-Mar	5Mar-14Mar	10	31.7	14.4	23.0	67.0	34.5	50.8
Gaurjeet	07-Mar	5Mar-15Mar	11	31.8	14.9	23.4	67.3	34.7	51.0
B Green	07-Mar	2Mar-11Mar	10	30.9	14.3	22.6	75.3	38.7	57.0
Local	27-Feb	20Feb-4Mar	13	30.8	13.6	22.2	85.0	42.9	64.0

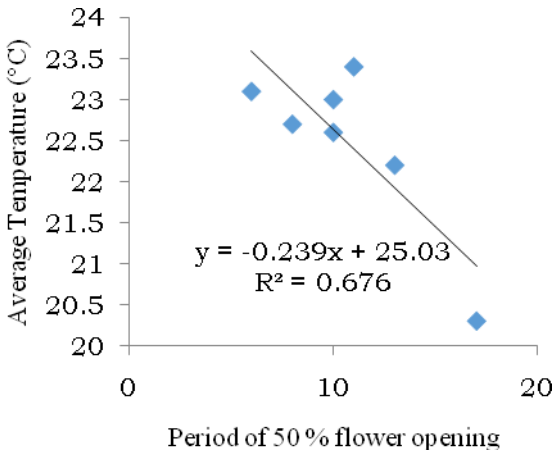

Fig.3a

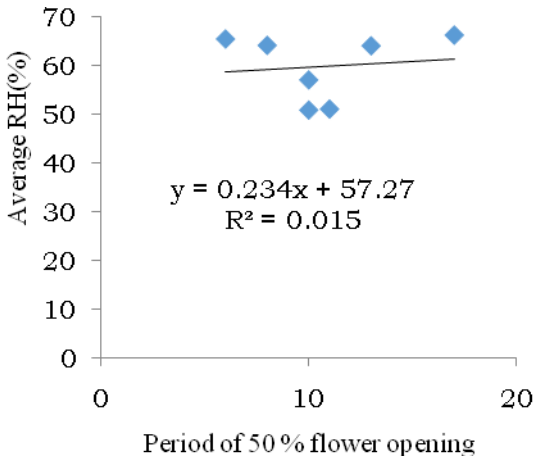

Fig.3b

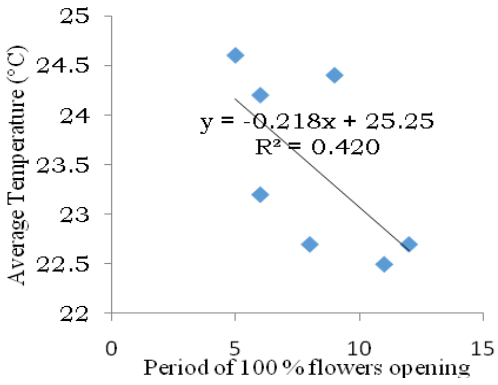

Fig.3c

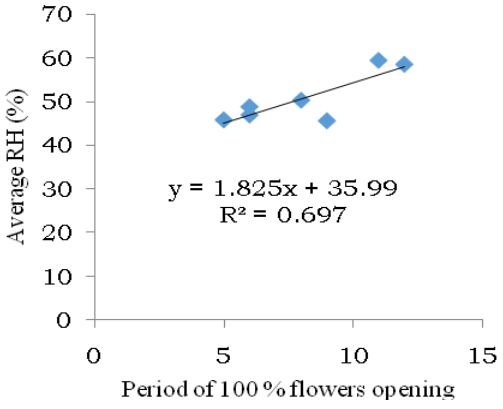

Fig.3d

Fig.3 Relation of average temperature and Relative Humidity with period of 50 % and 100 % flower opening

Table.4 Average dates of 100% flower opening from 50% flowering and its relation with weather parameters (temperature and relative humidity)

Varieties	Dates of 100% flower opening	Range of dates	Days taken in 100% flowering	T. Max.	T. Min.	T. Ave.	RH Max.	RH Min.	RH Ave.
Dasheri	02-Mar	28Feb-11Mar	12	31.0	14.4	22.7	77.4	39.8	58.6
Chausa	10-Mar	28Feb 5Mar	6	32.3	14.0	23.2	66.0	31.8	48.9
Amrapali	09-Mar	6Mar-13Mar	8	31.4	14.1	22.7	67.5	33.3	50.4
Husnara	17-Mar	15Mar-20Mar	6	32.9	15.4	24.2	63.7	30.3	47.0
Gaurjeet	15-Mar	14Mar-18Mar	5	33.1	16.0	24.6	61.4	30.4	45.9
B Green	16-Mar	12Mar-20Mar	9	33.4	15.4	24.4	61.2	30.2	45.7
Local	07-Mar	28Feb-10Mar	11	30.9	14.2	22.5	78.5	40.5	59.5

Table.5 Panicle length (cm) and flowering behaviour of different mango varieties

	Length of	Total No. of	Total No. of	Total No. of	Sex Ratio
Dasheri	31.4	831.7	361.7	1193.3	30.3
Chausa	27.1	676.7	312.2	988.8	31.6
Amrapali	25.0	749.0	288.2	1037.2	27.8
Husnara	11.5	391.3	132.9	524.2	25.4
Gaurjeet	11.4	351.7	131.0	482.6	27.1
B Green	21.8	500.3	251.0	751.3	33.4
Local	21.5	732.0	248.4	980.4	25.3
SE(d)	3.2	85.9	37.4	123.0	0.2
CD (P=0.05)	7.1	187.3	81.5	268.1	0.4

Although, the varieties Chausa and Amrapali open 50 % flowers very rapidly during the temperature (Max. & Min.) regime of (31.3 and 14.9°C and 30.7 and 14.7°C and averaged RH 85.5 & 45.3% and 83.4 & 44.9% respectively, that taken only 6 & 8 days in all tagged panicle. Singh, (1960) also reported that the variability of mango flowering depends on cultivar, tree age, environmental conditions and growth conditions in the dry or humid tropics or subtropics. The periods of 50 % flowers opening was negatively correlated with average temperature (Fig. 3a) and positively correlated with average relative humidity (Fig. 3b). Dasheri reached to full bloom (100% flower opening) first, among all varieties of mango on 2nd March followed by Local on 7th March. Amrapali reached to full bloom on 9th March followed by Chausa on 10th March (Table 4).

It has been observed (Table 4) that the Dasheri taken maximum period (12 days) to reach 100% flower opening from 50 % flower opening. During this period the average (22.7) temperature (Max. & Min.) 31.0 & 14.4°C was recorded lowest and the average (58.6%) Relative Humidity (Max. & Min.) 77.4 & 39.8% was found highest. Although, the varieties Gaurjeet open 100 % flowers very rapidly (within 5 days) from 50% flowering, it is due to higher (24.6) temperature (Max. & Min.) regime of (33.1 & 16.0°C and was comparatively low averaged (45.9%) RH 61.4 & 30.4%. The periods of 100 % flowers opening was negatively correlated with average temperature (Fig. 3c) and positively correlated with average relative humidity (Fig. 3d).

Lowest number of male flowers observed in Gaurjeet and Husnara which was 351.7 and 391.3 respectively. The maximum sex ratio was noted under Bombay Green (33.4) followed Chausa (31.6), Dasheri (30.3).

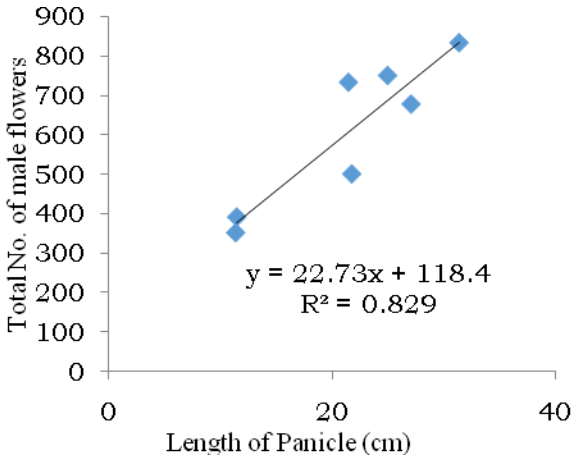

Fig.4a

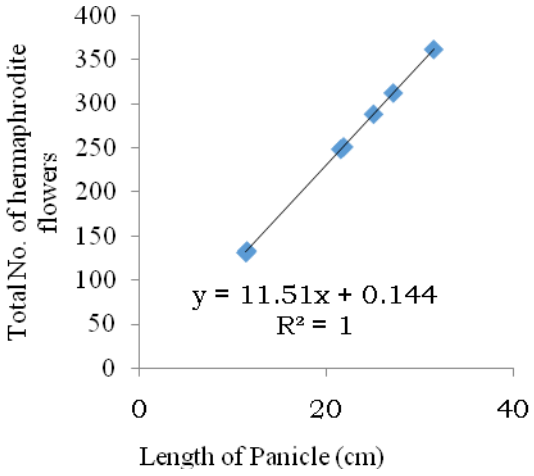

Fig.4b

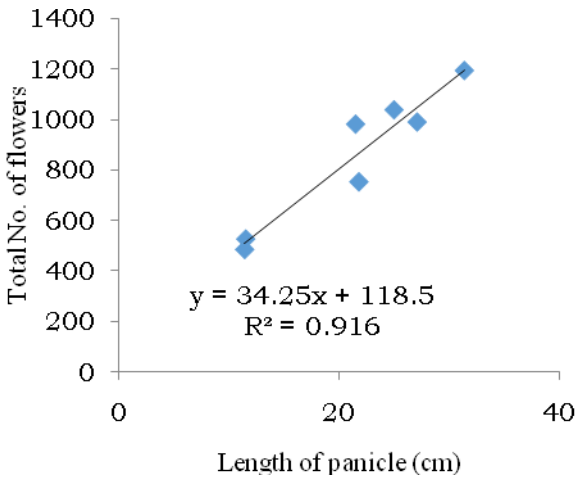

Fig.4c

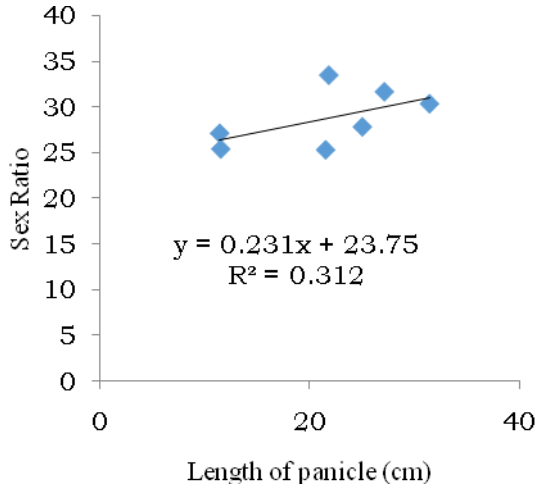

Fig.4d

Fig.4 Study of correlation between the panicle length and total no. of male flowers (a), total no. of hermaphrodite flowers (b), total no. of male flowers (c) and sex ratio (d)

It has been observed (Table 4) that the Dasheri taken maximum period (12 days) to reach 100% flower opening from 50 % flower opening. During this period the average (22.7) temperature (Max. & Min.) 31.0 & 14.4°C was recorded lowest and the average (58.6%) Relative Humidity (Max. & Min.) 77.4 & 39.8% was found highest.

Although, the varieties Gaurjeet open 100 % flowers very rapidly (within 5 days) from 50% flowering, it is due to higher (24.6) temperature (Max. & Min.) regime of (33.1 & 16.0°C and was comparatively low averaged (45.9%) RH 61.4 & 30.4%.

The periods of 100 % flowers opening was negatively correlated with average temperature (Fig. 3c) and positively correlated with average relative humidity (Fig. 3d).

Lowest number of male flowers observed in Gaurjeet and Husnara which was 351.7 and 391.3 respectively. The maximum sex ratio was noted under Bombay Green (33.4) followed Chausa (31.6), Dasheri (30.3) The minimum sex ratio was noted under Local (25.3) followed by Husnara (25.4), Gaurjeeti (27.1) and Amrapali (27.8).

Shu, (1999) reported that warm temperatures shortened flowering duration and life span of individual flowers, and decreased the number of hermaphrodite and male flowers.

The number of male (Fig.4a) and hermaphrodite ((Fig.4b) flowers were positively correlated with panicle length. The number of total flowers (Fig.4c) and sex ratio (Fig.4d) of each variety were also positively correlated with panicle length.

In addition to this, (Naik and Rao, 1943; Singh *et al.*, 1966) reported that yearly variation also affects the time of flowering in a maximum and minimum temperatures during panicle development that have profound effect on the percentage of hermaphrodite flowers.

Although, the maximum sex ratio was noted under B Green that may be due to more number of hermaphrodite flowers as compared to male flowers.

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