Mannan, M.A.; Islam, K.M.A. ; Islam, M.R and Khan, S.A.K.U. 2006. Floral biology of off-season jackfruit in south-west region of Bangladesh. *Khulna University Studies*, Special Issue (1st Research Cell Conference): 75-82.

Khulna University Studies, Special Issue (1st Research Cell Conference): 75-82, 2006

RESEARCH ARTICLE **LIFE SCIENCE**

FLORAL BIOLOGY OF OFF-SEASON JACKFRUIT IN SOUTH-WEST REGION OF BANGLADESH

M.A. Mannan*, K. M. Ashraful Islam, M.R. Islam and S.A.K.U. Khan

Agrotechnology Discipline, Khulna University, Khulna 9208, Bangladesh

Abstract: An investigation on floral biology of off-season jackfruit germplasms was carried out during mid July 2003 to mid November 2003 at the village Shakharipara, Rupdia, Jessore. This region is considered to be the largest jackfruit growing region of South-western region of Bangladesh. Six germplasms of more or less same aged have been selected for this study. The period for the floral bud development varied from 33 to 42 days with an average 36.8 days. Six distinct sequences of spike opening was observed on foot stalk. The availability of pollen grains and receptivity of female spike ranged from 3 to 6 days (average 4.5 days) and 8 to 12 days (average 10.26 days), respectively. Emergence of anther, stigma and dehiscence of anther occurred during day and at night. The peak emergence of anther and its dehiscence occurred during 2-4 A.M. and 4-6 P.M., respectively and the peak emergence of stigma at 8-10 A.M.

Key words: Floral biology, off-season, jackfruit.

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam) is one of the most popular and important fruits and gained the position of national fruit in Bangladesh. It is considered to be the largest fruits in the world (Naik, 1949; Sturrock, 1959). Floral biology relates to the time of flowering, blooming pattern, time of anthesis and anther dehiscence, period of availability of pollen grain and receptivity of stigma. Jackfruit is a tree, bears male and female spikes separately on the same tree. Each female spike can produce a sorosis type multiple fruit. (Sambamurty and Ramalingam, 1954).

In Bangladesh there is no named or recommended horticultural variety of jackfruit. On the other hand there are many unidentified types of jackfruit in this country. Among the different available types, individual trees differ in the shape and size of fruit, color of pulp, edible portion, nutrient content, brix percent, bearing habit, time of pollination. But it has not been possible to perpetuate these plants as standard varieties due to lack of proper knowledge about the floral biology. The accumulation of the maximum number of desirable traits into one or a few forms is possible by the breeding program. So, if some information could be gathered about the floral biology of jackfruit, the findings could be utilized in plant improvement program for screening and improving the unidentified local and off-season germplasms. Studies pertaining to floral biological phenomena constitute the basic information required for plant improvement program. The present study was initiated with a view to obtaining detail information about the floral biology of off-season jackfruit. It was hoped that the information would contribute to a great extent to the purpose of improvement of some of the types to establish as variety in due course of time which ultimately improve the yield and quality of jackfruit by developing a off-season variety.

* Corresponding author: Phone: 720171-3/383 (off); 810017 (Res), < mannanku@bttb.net.bd>

DOI: https://doi.org/10.53808/KUS.SI.FRCC.2006.101-107-ls

Materials and Methods

The study was carried out during first week of July 2003 to end of November 2003 at the village Shakharipara, Rupdia, Jessore. Six of more or less same aged (18-22 years) healthy germplasms were selected for this study. Spikes on the trunk and primary branches of selected trees were tagged. Observation was made regularly at an interval of two hours during the flowering period. The following parameters were studied in the experiment.

Time required for floral bud development: The period of time that was required from the initiation of foot stalk to just before opening of the spike from spathes was considered as the time for the development of floral bud.

Flowering period and peak flowering period*:* Flowering period of off-season jackfruit was considered as the duration between emergence of first spike (male or female) to the dehiscence of anther on last male spike or withering of stigma on last female spike, while the period of maximum number of available spike on the plant was the peak flowering period**.**

***Sequence of spike opening on footstalk, and number of spike per stalk and leafy shoot*:** During the flowering period the tree develops special fruiting branchlets that grow out of the trunk and branches called foot stalk. Each foot stalk bears male and female spikes. The sequence of male and female spike opening, and number of spike per stalk and leafy shoot were observed.

Time required between two successive spike opening: At the time of opening each bud was tagged in a footstalk and time period of two successive spike opening was recorded.

Period from initiation of spike opening to shedding of spathe: The period from initiation of spike opening to shedding of spathe was considered as the time between opening and shedding of spathe from the spike. It was determined through day to day observation.

Duration between male spike opening and anthesis: The time period between male spike opening and anthesis (emergence of anther) was recorded. The anthesis was determined by observing the selected spike in every day.

Duration of availability of pollen grains on male spike*:* Duration of availability of pollen grains on male spike was considered as the dehiscence of the first anther and dehiscence of the last anther on the male spike. It was determined by daily observation.

Time of anthesis and dehiscence of anther*:* Time of anthesis and dehiscence of anther of the individual flower were studied during 24 hours. Male spikes were tagged in each plant and observed at 2 hrs interval from 6 A.M. to 6 P.M., finally the cumulative number of emergence of anther and dehiscence of anther were counted next morning (6 A.M.) with the help of a magnifying glass.

Duration between female spike opening and protrusion of stigma*:* Duration between female spike opening and protrusion of stigma was considered as the time between opening of the spikes from the spathe and the emergence of first stigma on the female spike. It was observed by using magnifying glass.

Duration of receptivity of stigmas on female spike: Duration of receptivity of female spike was considered as the number of days required for the emergence of first stigma and withering of last stigma on the same female spike. The start of receptivity of stigma was indicated by stickiness and completion by withering of individual flower on a spike. It was done by day to day observation by using magnifying glass.

Rate of emergence of stigma and duration of receptivity of flower*:* The rate of emergence of stigma was observed by using a magnifying glass. It was made at 2 hours interval from 6 A.M. to 6 P.M., finally the cumulative number of emergence of stigma was counted next morning (6 A.M.). The start of receptivity of stigma was indicated by stickiness. The duration of receptivity of stigma was considered as the time between the stickiness and withering of a stigma on female spike.

Results

Time required for the floral bud development: The period from the initiation of flowering shoot to reach the stage of opening of the spike coming out from spathes was considered as the time for the development of floral bud. This time varied among the six germplasms. The period ranged from 33 to 42 days with an average of 36.8 days (Table 1).

Flowering period: It was observed that male spike emerged in the third week of July and continued up to third week of October. On the other hand, female spike emerged first week of August and continued up to second week of October. Peak emergence of male spike was observed in the first week of August to first week of October and that of female spike during the third week of August to second week of September (Table 2). The duration of availability of male spikes ranged from 76 to 86 days and that of female spikes was 47-68 days. Peak duration of male spikes availability ranged from 43-70 days but that of female spikes was 17-20 days (Fig. 1).

Sequence of spike opening on footstalk, and number of spike per stalk and leafy shoot: Male spikes were borne on footstalk as well as leafy shoot, and female spikes only on footstalk. A large numbers of footstalk beared only male spike and the rest bear both the male and female spike among the germplasm. Footstalk bearing both male and female spike were larger in size than those bear only male spike. A footstalk may bear one or more spikes (only male or both male and female) emerging in a certain sequence which is presented below.

i) Male spikes; ii) Male, male, female, male, female, male; iii) Male, male, female, female; iv) Male, male, female; v) Male, female, male, female and vi) Female, male, male, female, male.

Time required between two successive spike opening: Both male and female spikes took 15 to 25 days with an average 20.46 days between two successive spike opening (Table 3). The period varied with the different germplasms and probably due to prevailing climatic condition.

Period from initiation of spike opening to shedding of spathe: Both male and female spikes took 7 to 13 days with a mean of 10.3 days from initiation of spike opening to shedding of spathe (Table 4).

Duration between male spike opening and anthesis**:** The protrusion of anther on the surface of male spike after spike opening out of the spathe ranged from 12 to 26 days having an average of 18.93 days (Table 5).

Duration of availability of pollen grains on male spike: The period from the appearance of the first anther and dehiscence of the last anther on male spike ranging from 3 to 6 days with an average value of 4.5 days (Table 6).

Time of anthesis and dehiscence of anther: The emergence of anther on the smooth surface of staminate spike occurred during the day (6 A.M.-6 P.M.) as well as at night (6 P.M.-6A.M.) that was 82.84% and 17.16%, respectively. During the day minimum emergence of anther was observed at 6-8 A.M. (3.48%) and thereafter increased gradually having peak during 2-4 P.M. (28.95%) (Fig. 2). It decreased sharply after 4 P.M. during the rest period of the day.

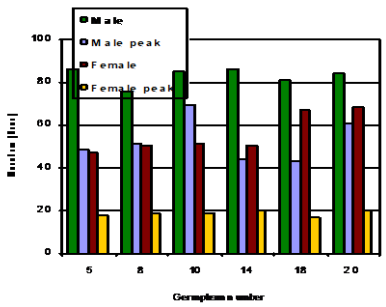

Fig. 1. Bar graph showing duration and peak duration of male and female spike availability in flowering season among germplasms.

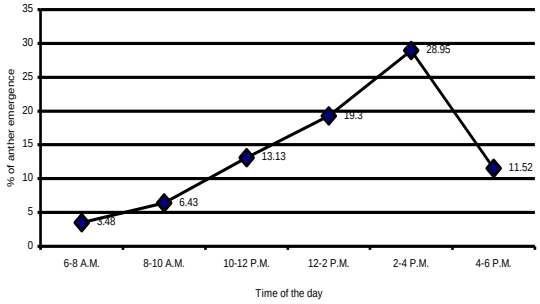

Fig. 2. Percentage of anther emergence at different time of the day.

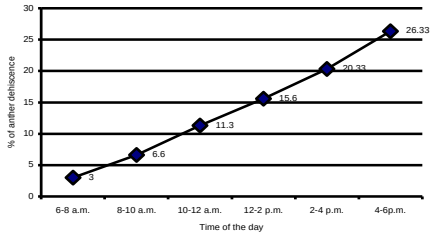

Fig. 3. Percentage of anther dehiscent at different time of the day.

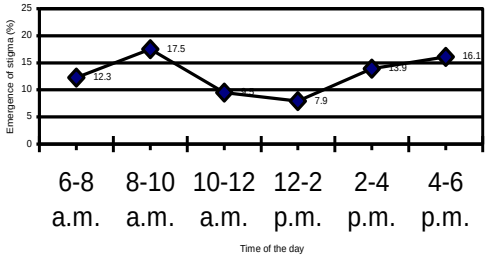

Fig. 4. Emergence of stigma on the surface of female spike in different time of the day.

Dehiscence of anther also occurred during the day as well as night to the extent of 83.33% and 16.67%, respectively. Minimum dehiscence of anther was observed during 6-8 A.M. (3%), then it was increased gradually in all the germplasms and became peak during 4-6 P.M. (26.33%) (Figure 3).

Dehiscence of anther after anthesis took an average 2.28 hours. However, the range of dehiscence time was from 2.0 to 3.0 hours among the germplasms (Table 7).

Duration between female spike opening and protrusion of stigma: The period of protrusion of stigma from female spike opening was ranged from 4-7 days with an average 5.43 days (Table 8).

Duration of receptivity of stigma on a female spike: The receptivity period of stigma varied from 8 to 12 days with an average value of 10.26 (Table 9).

Emergence of stigma and duration of receptivity: The emergence of stigma was occurred on the surface of female spike during the day (6 A.M.- 6 P.M.) as well as at night (6 P.M.- 6 A.M.) that was found 77.21% and 22.79%, respectively. The rate has a peak (17.54%) at 8-10 A.M. and then decreased and was minimum (7.86%) at 12-2 P.M. which increased gradually up to 6 P.M. (Figure 4).

Duration of receptivity of any stigma was found to be about 38.17 hours having a range of 29 to 44 hours (Table 10).

Discussion

The period of bud development varied among the germplasms and ranged from 33 to 42 days with an average of 36.8 days. Similar results also reported by Mannan *et al.* (1990) and Sinha (1975). A footstalk may bear one or more spikes (only male or both male and female) emerging in a certain sequence which is similar to the findings of Azad (1989). Both male and female spikes took 15 to 25 days with an average 20.46 days between two successive spike opening. Azad (1989) found the period for two successive spike opening was 9.5 to 15.3 days with an average of 12.5 days.

Both male and female spikes took 7 to 13 days with a mean of 10.3 days from initiation of spike opening to shedding of spathe. Gopinathan et al. (1983) the male spike shedded 6-16 days after opening with an average of 12.4 days which was in agreement to the present finding. The protrusion of anther on the surface of male spike after spike opening out of the spathe ranged from 12 to 26 days having an average of 18.93 days. Majumder (2002) found the duration 9-25 days with an average of 17.45 days which has similarity to the result of present study.

The period from the appearance of the first anther and dehiscence of the last anther on male spike ranging from 3 to 6 days with an average value of 4.5 days. Mannan *et al.* (1990) observed that the availability of pollen grains ranged from 7 to 10 days with an average of 8 days. Sambamurty and Ramalingam (1954) found that a male spike possessed pollen grains for about 7 days. All these findings are not in agreement with the present finding.

The emergence of anther on the smooth surface of staminate spike occurred during the day (6 A.M.-6 P.M.) as well as at night (6 P.M.-6A.M.) that was 82.84% and 17.16%, respectively. During the day minimum emergence of anther was observed at 6-8 A.M. (3.48%) and thereafter increased gradually having peak during 2-4 P.M. (28.95%). It decreased sharply after 4 P.M. during the rest period of the day. All of these results were in agreement with the findings of Mannan *et al.* (1990) and Azad (1989) and Samaddar (1985).

Dehiscence of anther also occurred during the day as well as night to the extent of 83.33% and 16.67%, respectively. Minimum dehiscence of anther was observed during 6-8 a.m. (3%), then it was increased gradually in all the germplasms and became peak during 4-6 p.m. (26.33%). Dehiscence of anther after anthesis took an average 2.28 hours. However, the range of dehiscence time was from 2.0 to 3.0 hours among the germplasms. These are in agreement with Majumder (2002).The period of protrusion of stigma from female spike opening was ranged from 4-7 days with an average 5.43 days.. The receptivity period of stigma varied from 8 to 12 days with an average value of 10.26 . The present finding is similar to those of Mannan *et al*. (1990).

The emergence of stigma was occurred on the surface of female spike during the day (6 A.M.- 6 P.M.) as well as at night (6 P.M.- 6 A.M.) that was found 77.21% and 22.79%, respectively. The rate has a peak (17.54%) at 8-10 a.m. and then decreased and was minimum (7.86%) at 12-2 p.m. which increased gradually up to 6 p.m. Duration of receptivity of any stigma was found to be about 38.17 hours having a range of 29 to 44 hours Mannan *et al.* (1990), Ray (1997) and Majumder (2002) found the peak emergence of stigma during 8-10 a.m. which was similar with the present findings.

Conclusion

The results of the present study have provided some basic information on the floral biology, fruiting behaviour and fruit setting of off-season jackfruit. There were variations in different aspects of the study among the germplasms. However, among six germplasms in the present study, germplasm no. 5, 14 and 18 were found to be better in respect of time required for floral bud development, duration of receptivity of stigma on female spike, etc. Further trial on physico-

chemical analysis is necessary to recommend the above mentioned off-season germplasms as varieties.

References

Azad, A.K. 1989. Studies on floral biology, Pattern of fruit setting and quality of fruit borne in different sections of jackfruit plants. M. Sc. Thesis, Department of Horticulture, Bangladesh Agricultural University, Mymensingh, 76 pp.

Gopinathan, R.; Kumari, S. P. and Kumaran, K. 1983. Spike characteristics, anthesis and pollen viability in Jack. *South Indian Horticulture*, (4 & 5) : 178-180.

Majumder, S. 2002. Studies on blossom biology, sex ratio, fruiting behaviour and fruit drop in jackfruit (*Artocarpus heterophyllus* Lam). M.Sc. (Ag) thesis, Department of Horticulture, Bangladesh Agricultural University, Mymensingh, 86 pp

Mannan, M.A.; Haque, M.A. and Hossain, M.A. 1990. Studies on floral biology of jackfruit. *Bangladesh Journal of Agriculture*, 15 (4) : 233-238.

Naik, K.C. 1949. *South Indian Fruits and Their Culture*. P. Varadachery, 1st edn. Madras, 300-302 pp.

Samaddar, H.N. 1985. Jackfruit. pp. 488-496. In. T.K. Bose and B. Mitra (Edited),. *Fruits of India: Tropical and Subtropical*. 1st edn., Naya Prakash, 206 Bidhan Sarani, Calcutta, India.

Sambamurty, K. and Ramalingam, V. 1954. Preliminary studies in blossom biology of Jack (*Artocarpus heterophyllus* Lam.) and pollination effects. *Indian Journal of Horticulture*, 11 (1) : 24-29.

Sinha, M. M. 1975. Studies in floral biology in Jackfruit (*Artocarpus heterophyllus* Lam.). *Progressive Horticulture*, 3 : 69-73.

Sturrock, D. 1959. *Fruits of Southern Florida*. South Eastern Printing Co., Stuart, Florida. 114 pp.

Table 1. Time required for the floral bud development.

Germplasm no.	Number of buds observed	Range	Mean ± SD	Average (days)
5	5	35-38	36.4±1.14	
8	5	38-42	39.6±1.51	
10	5	34-38	35.4±1.61	36.8
14	5	33-36	34.2±1.30	
18	5	35-39	36.6±1.51	
20	5	37-41	38.6±1.51	

Table 2. Flowering period of off-season jackfruit germplasms.

Germ-plasm No.	Male		Female	
	Flowering period	Peak period	Flowering period	Peak period
5	20.7.2003- 12.10.2003	05.08.2003-28.9.2003	14.8.2003-29.9.2003	26.8.2003-12.9.2003
8	25.7.2003-14.10.2003	13.8.2003-03.10.2003	17.8.2003-06.10.2003	27.8.2003-14.9.2003
10	18.7.2003–11.10.2003	04.8.2003–12.09.2003	12.8.2003-02.10.2003	24.8.2003-11.9.2003
14	28.7.2003–22.10.2003	18.08.2003-27.9.003	21.8.2003-9.10.2003	25.8.2003-13.9.2003
18	15.7.2003- 04.10.2003	01.8.2003-12.9.2003	02.8.2003-07.10.2003	18.8.2003-03.9.2003
20	17.7.2003– 9.10.2003	03.8.2003-24.9.2003	05.8.2003-11.10.2003	21.8.2003-09.9.2003

Table 3. Time required between two successive spike openings.

Germplasm no.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	15-22	18.6±2.70	
8	5	18-25	21.2±2.86	
10	5	18-24	21.5±2.41	
14	5	19-25	22.2±2.38	20.46
18	5	17-23	20.4±2.40	
20	5	16-22	19±2.44	

SD = Standard deviation

Table 4. Period from initiation of spike opening to shedding of spathe.

Germplasm no.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	7-11	9±1.58	
8	5	9-12	10.8±1.30	
10	5	9-13	11±1.58	10.3
14	5	9-11	9.8±0.83	
18	5	10-13	11.2±1.30	
20	5	8-12	10±1.58	

Table 5. Duration between male spike opening and anthesis.

Germplasm no.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	20-26	22.6±2.40	
8	5	20-25	22.8±1.92	
10	5	12-16	14.2±1.48	18.93
14	5	18-21	19.2±1.30	
18	5	14-17	15.8±1.30	
20	5	18-20	19±1.00	

Table 6. Duration of availability of pollen grains on male spike.

Germplasm no.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	3-5	4.0±0.70	
8	5	5-6	5.4±0.54	
10	5	4-6	4.8±0.83	4.5
14	5	3-5	4.2±0.83	
18	5	4-5	4.4±0.54	
20	5	4-5	4.2±0.83	

Table 7. Time taken for anther dehiscence.

Germplasm No.	Number of flower observed	Range	Mean ± SD	Average (days)
5	5	2-3	2.3±0.44	
8	5	2-2.5	2.2±0.27	
10	5	2-2.5	2.3±0.27	2.28
14	5	2-3	2.4±0.42	
18	5	2-3	2.3±0.44	
20	5	2-2.5	2.2±0.27	

Table 8. Duration between female spike opening and protrusion of stigma.

Germplasm No.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	5-7	5.8±.83	
8	5	4-6	5.2±.83	
10	5	4-7	5.4±1.14	5.43
14	5	5-7	5.6±.96	
18	5	4-7	5.8±1.30	
20	5	4-6	4.8±.83	

SD= Standard deviation

Table 9. Duration of receptivity of stigma on female spike.

Germplasm no.	Number of bud observed	Range	Mean ± SD	Average (days)
5	5	9-11	9.6±1.14	
8	5	8-11	9.2±1.30	
10	5	9-12	10.4±1.14	10.26
14	5	9-12	10.4±1.51	
18	5	10-12	11.2±0.83	
20	5	9-12	10.8±1.30	

Table 10. Duration of receptivity of an individual stigma.

Germplasm no.	Number of flower observed	Range	Mean ± SD	Average (hours)
5	5	35- 42	38.2±2.70	
8	5	36-41	38.8±1.92	
10	5	36-43	39.2±2.58	38.17
14	5	37-44	40.6±2.70	
18	5	38-41	39.4±1.14	
20	5	29-34	32.8±2.58	

SD= Standard deviation