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Flowering, fruiting and seed maturity of common plantation tree species in Bangladesh

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ABSTRACT

Flowering, fruiting and seed maturity are important aspects in the life span of a plant or plant community. These phenological characteristics have great significance in plantation program. A study was carried out from January, 2011 to March, 2012 with a view to explore these phenological affairs of 65 commercially important plantation tree species. The research was conducted covering wide area of hill forest and plain land Sal forests of Bangladesh through repeated field visits and review of literature. The results showed that flowering, fruiting and seed maturity period varied from species to species. The findings of the study represent that most of the studied species bear flowers (32 - 33 species) and fruits (26 - 29 species) during March-May and April-June respectively. The flowering period varied from 3 to 5 months among the species. The results also showed that viable recalcitrant seeds of most of the species can be collected between May and June with, while for very few species seeds can be collected between September and October. The findings will be helpful to the nursery owners, small scale planters and forest managers to know the information of fruit setting and time of seed collection for raising nursery with desired plant species.

Key words: Phenology, tree species, flowering, fruiting and seed collection

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I. Introduction

Plantation forests were initiated because of the gradual loss of natural forest as establishment of plantation would cover the deforested area as well as reduce or eliminate the need to exploit the natural forest. Reforestation through plantation requires a constant supply of high quality seeds (Owens, 1994). Seeds are produced through plant physiological process maintaining a complicated series of flowering, fruiting, and finally seed development and maturity. Phenology is the calendar of events in the life history of plants. The Swedish Botanist Carolus Linnaeus systematically recorded flowering times for 18 locations in Sweden over many years (NEON, 2015). Plant phenological study has great significance because it not only provides knowledge about plant growth but also supportive to the afforestation programs (Nath, 2012).

Collection of mature and healthy seeds from disinfected, vigor, healthy and disease free mother plants is essential for raising good quality seedlings. Recalcitrant seeds loss their viability soon after their

maturity. So, it requires for the collector to determine when seeds are matured and time of harvest accordingly (Beniwal, 1987). The interval between bud formation and maturity of seeds and fruits varies greatly. Many trees (for example, *Acacia* spp., *Cassia* spp.) shed their seeds within weeks of maturity, while others retain fruits and seeds for months (for example, *Delonix regia*) or years (for example, *Eucalyptus*). In most of the species, flowering and fruiting occur during definite time of the year in Bangladesh. Again, this period vary within species from place to place (Ng and Loh, 1974). Many species have similar phenological pattern. Most species flower during the dry season and fruits mature just before or during the early part of the rainy season (Schmidt, 2000). The phenology of some of the tree species in Tankawati natural forest of Chittagong south forest division was studied by Motaleb and Hossain (2010). Research based report and literature on phenology of the plantation tree species in respect of Bangladesh are available only for few specific species. The flowering, fruiting and seed collection time along with morphological characteristics and germination of several species was reported by Sheikh and Matin (2007), Alam et al. (2005) and Hasan (1971). It is necessary to have a research based phenological chart which will inform the foresters about time of fruiting and seed maturity as well as guide them to collect desired seeds at right course of time. The significance of having detail phenological information motivated to conduct the study on time of flowering, fruiting and seed maturity of plantation tree species in Bangladesh. Therefore, this study will give a brief index on flowering, fruiting and seed maturity of 65 common plantation tree species in Bangladesh.

II. Materials and Methods

The study was carried out throughout the country generally on plantation sites, mostly covered Jessore, Jhenidah, Kushtia, Rajshahi, Mymensingh, Tangail, Sylhet and Chittagong districts of Bangladesh from January, 2011 to March, 2012. A total of 65 plantation tree species belonging to 45 genera and 23 families were selected considering their uses in plantation program. Tree species composition of different natural forests reported by Alam et al. (1995), Dutta et al. (2014), Hossain et al. (2013), Hossain and Hossain (2014) and Uddin et al. (2010) were reviewed to verify the targeted species from different natural forests. The selected trees for each species were then observed in the field during the study periods. Frequent field visit were made on the same forests to observe the changes in phenological affairs of the plants. Sometimes data on phenological affairs were collected from field guides when field visits could not be made.

The periods of flowering, fruiting and seed collection were observed at different places for each species. The recorded data were then verified with the existing reports (Beniwal, 1987; Motaleb and Hossain, 2010; Hasan, 1971; Hossain and Ahmed, 2008; Ghazali and Rahim, 1985; Heining, 1925; Khan, 1958; Brandis, 1906) and finally listed down (Table 01). For graphical presentation the findings are arranged with their flowering, fruiting and seed maturity period.

III. Results and Discussion

The study revealed that the selected 65 plant species produce flowers, fruits and seeds round the year. Each of the 65 plant species produces flowers once in a year except *Acacia nilotica*, which flower twice a year. Flowering, fruiting and seed collection time of each of the 65 species were represented in Table 01.

Flowering period of the observed 65 plant species revealed that most of the plant species (33 species, 50.8% of 65 species) bloomed in March followed by April (32 species, 49.2% of 65 species) and May (29 species, 44.6% of 65 species) (Figure 01). The figure showed that the peak flowering time for most of the species was March and May depending on site and climatic condition. Very few plants were found to bloom during the months of August to December. Longest flowering period was observed in *Cassia fistula* (April to September) whereas lowest flowering period was found in 30 species. Lowest flowering period varied from one to two months. Moreover, flowering period of 25 species were observed 3 months followed by 5 species for 4 months and 3 species for 5 months. The flowering periods for most of the species were similar to the reports of Yap (1982) who found most of the flowering tree species of lowland dipterocarp forest of Malaysia bear flowers in February to March.

Table 01. Flowering, fruiting and seed collection time of 65 plantation tree species

Sl. no.	Scientific name	Local name	Family	Flowering period	Fruiting period	Seed collection time
1	<i>Acacia auriculiformis</i>	Akashmoni	Mimosaceae	Dec-Jan	Feb-Mar	Jan-Mar
2	<i>Acacia catechu</i>	Khair	Mimosaceae	Apr-May	June-July	Aug-Sep
3	<i>Acacia hybrid</i>	Hybrid acacia	Mimosaceae	Jan-Feb	Feb-Mar	Mar-Apr
4	<i>Acacia nilotica</i>	Babla	Mimosaceae	Jun-Sep & Dec-Jan	Feb-Apr & Jul-Oct	Mar-May & Oct-Jan
5	<i>Adina cordifolia</i>	Haldu	Rubiaceae	Mar-Jul	Sep-Oct	Feb-Mar
6	<i>Albizia chinensis</i>	Tetuyakoroi	Mimosaceae	May-Jun	Aug-Jan	Feb-Mar
7	<i>Albizia lebbeck</i>	Kalokoroi	Mimosaceae	Mar-Jul	Aug-Nov	Dec-Jan
8	<i>Albizia odoratissima</i>	Chakuakoroi	Mimosaceae	Apr-Jun	Sep-Dec	Feb-Mar
9	<i>Albizia procera</i>	Silkoroi	Mimosaceae	Sep-Oct	Nov-Feb	Feb-Mar
10	<i>Albizia saman</i>	Randikoroi	Mimosaceae	May-Jun	Mar-Apr	Mar-Apr
11	<i>Anisoptera scaphula</i>	Boilam	Dipterocarpaceae	Dec-Jan	Mar-Apr	Apr-Jun
12	<i>Aphanamixis polystachya</i>	Pitraj	Meliaceae	Oct-Nov	Feb-Mar	Mar-Apr
13	<i>Anthocephalus chinensis</i>	Kadam	Rubiaceae	Feb-Jun	Jun-Aug	Sep-Oct
14	<i>Artocarpus chaplasha</i>	Chapalish	Moraceae	Mar-Apr	May-Jun	Jul-Aug
15	<i>Artocarpus heterophyllus</i>	Kanthal	Moraceae	Jan-Mar	Feb-Jun	Apr-Jul
16	<i>Artocarpus lacucha</i>	Barta	Moraceae	Mar-Apr	Jun-Jul	Aug-Sep
17	<i>Cassia fistula</i>	Sonalu	Caesalpiniaceae	Apr-Sep	Sep-Oct	Nov-Dec
18	<i>Dalbergia sissoo</i>	Sissoo	Mimosaceae	Feb-Mar	May-Aug	Dec-Feb
19	<i>Delonix regia</i>	Krishnachura	Caesalpiniaceae	Feb-Apr	Apr-May	May-Jun
20	<i>Dipterocarpus costatus</i>	Baittyagarjan	Dipterocarpaceae	Dec-Feb	Feb-May	Jun-Jul
21	<i>Dipterocarpus gracilis</i>	Dhuligarjan	Dipterocarpaceae	Dec-Mar	Mar-Apr	May-Jun
22	<i>Dipterocarpus turbinatus</i>	Tellyagarjan	Dipterocarpaceae	Mar-Apr	Apr-May	May-Jun
23	<i>Duabanga grandiflora</i>	Bandarhola	Sonneratiaceae	Feb-Mar	Mar-Apr	Apr-May
24	<i>Elaeocarpus tectorius</i>	Jalpai	Elaeocarpaceae	May-Jun	Jun-Aug	Sep-Nov
25	<i>Feronia limonia</i>	Kotbel	Rutaceae	May-Jul	Oct-Nov	Dec-Jan
26	<i>Ficus benghalensis</i>	Bot	Moraceae	May-Jun	Jun-Jul	Jul-Aug
27	<i>Gliricidia sepium</i>	Gliricidia	Fabaceae	Jan-Mar	Mar-May	Apr-May
28	<i>Gmelina arborea</i>	Gamar	Verbenaceae	Feb-Apr	Apr-May	May-Jul
29	<i>Hevea brasiliensis</i>	Rubber	Euphorbiaceae	May-Jun	Jun-Aug	Aug-Sep
30	<i>Hopea odorata</i>	Telsur	Dipterocarpaceae	Mar-Apr	Apr-May	May-Jun
31	<i>Lagerstroemia macrocarpa</i>	Bansuajarul	Lythraceae	Not on record	Not on record	Aug – Sep
32	<i>Lagerstroemia parviflora</i>	Sidhajarul	Lythraceae	Apr-Jun	Sep-Jan	Jan-Mar
33	<i>Lagerstroemia speciosa</i>	Pannyajarul	Lythraceae	Apr-Jun	Aug-Nov	Nov-Jan
34	<i>Leucaena leucocephala</i>	Ipil-Ipil	Leguminosae	May-Jul	Jul-Nov	Jan-Feb
35	<i>Lithocarpus acuminata</i>	Kalibatna	Fagaceae	Jan-Mar	Feb-Oct	May-Nov
36	<i>Lithocarpus elegans</i>	Talbatna	Fagaceae	Feb-Apr	Mar-Sep	May-Oct
37	<i>Lithocarpus pachyphylla</i>	Kantabatna	Fagaceae	Feb-Apr	Mar-Aug	Jul-Oct
38	<i>Lithocarpus polystachya</i>	Sadabatna	Fagaceae	Nov-Feb	Jan-Jun	Apr-Jul
39	<i>Madhuca longifolia</i>	Mohua	Sapotaceae	Mar-May	Apr-Jun	May-Jul
40	<i>Mangifera indica</i>	Am	Anacardiaceae	Jan-Mar	Apr-May	May-Jun
41	<i>Manilkara zapota</i>	Safeda	Sapotaceae	Year round	Year round	Year round
42	<i>Melaleuca leucadendron</i>	Melaleuca	Myrtaceae	May-Jul	Jun-Aug	Aug-Sep
43	<i>Melia sempervirens</i>	Goraneem	Meliaceae	Mar-May	Apr-Jul	Jun-Sep
44	<i>Mesua ferrea</i>	Nageshwar	Guttifereae	May-Jun	Jul-Aug	Aug-Sep
45	<i>Mimusops elengi</i>	Bokul	Sapotaceae	Mar-Jun	Apr-Aug	Aug-Sep
46	<i>Oroxylum indicum</i>	Kanaidingi	Bignoniaceae	May-Aug	Jul-Sep	Feb-May
47	<i>Pterocarpus dalbergioides</i>	Paduak	Fabaceae	Mar-Apr	Apr-Jun	May-Jun
48	<i>Schima wallichii</i>	Kanak	Theaceae	Apr-May	Jun-Aug	Oct-Nov
49	<i>Shorea robusta</i>	Sal	Dipterocarpaceae	Feb-Apr	Apr-May	May-Jun
50	<i>Sonneratia apetala</i>	Keora	Sonneratiaceae	Apr-Jun	Jun-Jul	Jul-Sep
51	<i>Stereospermum colais</i>	Dharmara	Bignoniaceae	May-Jul	Aug-Jan	Feb-Apr

52	<i>Stereospermum suaveolens</i>	Parul	Bignoniaceae	Mar-Apr	Apr-May	May-Jun
53	<i>Swietenia mahagoni</i>	Mahagoni	Meliaceae	Apr-May	May-Dec	Jan-Feb
54	<i>Syzygium cumini</i>	Kalojam	Myrtaceae	Feb-Mar	Apr-May	Jun-Jul
55	<i>Syzygium fruticosum</i>	Putijam	Myrtaceae	Mar-Apr	Apr-May	May-Jun
56	<i>Syzygium grandis</i>	Dhakijam	Myrtaceae	Feb-Mar	Mar-Apr	May-Jun
57	<i>Swintonia floribunda</i>	Civit	Anacardiaceae	Jan-Mar	Mar-Apr	Apr-May
58	<i>Tamarindus indica</i>	Tentul	Caesalpinaceae	Apr-Jun	Aug-Oct	Jan-Mar
59	<i>Tectona grandis</i>	Shegun	Verbenaceae	Aug-Sep	Oct-Nov	Dec-Feb
60	<i>Terminalia bellirica</i>	Bohera	Combretaceae	Mar-May	Aug-Dec	Jan-Feb
61	<i>Terminalia chebula</i>	Haritoki	Combretaceae	Apr-May	Sep-Mar	Mar-Apr
62	<i>Toona cilita</i>	Toon	Meliaceae	Mar-Apr	May-Jun	May-Jul
63	<i>Trewa nudiflora</i>	Pitali	Euphorbiaceae	Jan-Mar	Apr-Jun	Jun-Jul
64	<i>Ziziphus mauritiana</i>	Boroi	Rhamnaceae	Sep-Nov	Nov-Jan	Jan-Mar
65	<i>Xylia xylocarpa</i>	Lohakat	Mimosaceae	Mar-Apr	Dec-Jan	Mar-Apr

The field observation revealed that April is the noticeable fruiting time as most of the species (29 species) bear fruits at this time. In May, a total of 26 species was observed to bear fruits followed by June, the third most peak fruiting period. The lowest fruiting time was checked up in November i.e. 9 species produced fruits (Figure 02). *Manilkara zapota* was found to bear fruits almost throughout the year. *Lithocarpus acuminata* bear fruits for maximum period (9 months) extending from February to October. Moreover, duration of fruiting was also higher for *Swietenia mahagoni* (8 months) followed by *Lithocarpus elegans* (7 months) and 6 months for *Terminalia chebula*, *Albizia chinensis*, *Lithocarpus polystachya*, *Lithocarpus pachyphylla* and *Stereospermum colais*.

Seed collection time comes after fruit maturity when fruit ripe and become suitable for harvesting. Generally seeds are collected from a tree when most of the seeds become suitable for collection. This peak period of maturity may be considered for future seed collection. Period of seeds retained in trees after fruit maturity varies between species. The results showed that the seed collection time was between May and June for most of the studied species with seed viability and can be sown immediately, while very few species were found to have seed collection time between September and October (Figure 02). Seeds collected at that time need to be stored for propagation in the next year. [Motaleb and Hossain \(2010\)](#) reported that most of the fruits and seeds become available for collection in May to September. [Schmidt \(2000\)](#) represented seed collection time of a number of tropical and subtropical species which is also comparable to the present study. [Hasan \(1971\)](#) reported that seeds of most of the tree species may be collected during May to June.

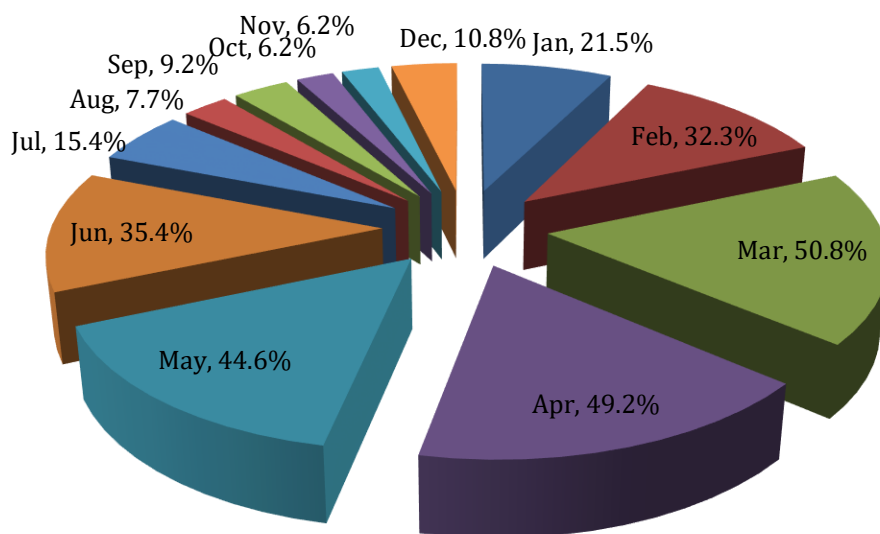


Figure 01. Month wise peak flowering intensity (%) of the 65 major plantation species.

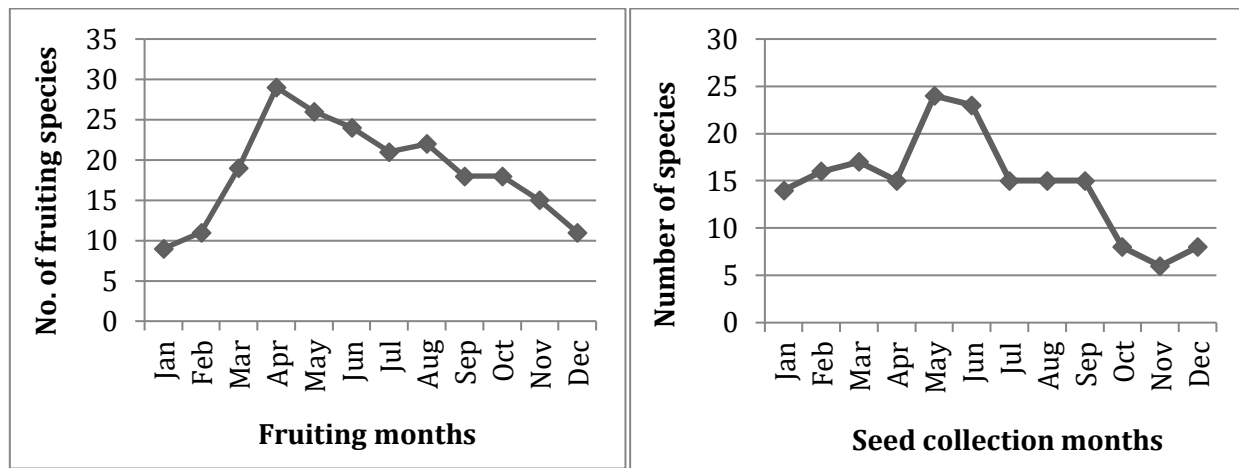


Figure 02. Month wise peak fruiting intensity (left) and seed collection time (right) of the 65 major plantation species.

Seed is the most important productive part for introducing a plant in any area through establishing plantation. Production of seeds in sufficient quantities will go in vain if plant propagators do not know the seed collection time of desired species. So, knowing of flowering, fruiting and seed maturity time is the prior factor in the seed collection. A number of species take a longer time for fruit maturity and also contain viability but there are also some low viability seeds which mainly belong to *Dipterocarpus* spp., *Syzygium* spp. and *Swintonia floribunda* (Beniwal, 1987; Hasan, 1971; Ng and Loh, 1974). For raising nursery with future seed source fruits need to be collected as soon as they fall and should be immediately planted in a nursery (Ghazali and Rahim, 1985) or proper restoration site. For this purpose flowering, fruiting and seed collection times are of prime need in any sense (Beniwal, 1987). Results of this study is in line with the published reports of Hossain and Ahmed (2008), Schmidt and Jøker (2000), Malik et al. (2010), Benthall (1933) and NAS (1979) who studied on single or a few species along with seed biology. The findings of the study provide a crystal idea about the species wise phenological response which will be supportive for quality seed supply and raising plantations.

VI. Conclusion

The present study provides information on flowering, fruiting and seed collection time for 65 commercially important plant species. The nursery owners, forest managers and small scale planters proceed with seed collection program each year. The findings will be helpful to those stakeholders informing them about right time of seed collection of important plantation species in Bangladesh. The studied phenological affairs of the 65 tree species will help to elucidate the future changes in relation to climate change and other environmental stresses

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