

Article history :

Received : 27.03.2018

Revised : 06.05.2018

Accepted : 20.05.2018

Flowering and fruiting responses of the wetland macrophytes in Birbhum district, West Bengal, India

■ Debnath Palit, Debalina Kar¹ and Ambarish Mukherjee²

Members of the Research Forum

Associated Authors:

¹Department of Conservation Biology, Durgapur Government College, Durgapur, Paschim Bardhaman (W.B.) India
Email: ka.debalina@gmail.com

²Department of Botany, Burdwan University, Burdwan, Purba Bardhaman (W.B.) India
Email: amukherjee@bot.buruniv.ac.in

Author for correspondence :

Debnath Palit

Department of Botany, Durgapur Government College, Durgapur, Paschim Bardhaman (W.B.) India
Email: debnath_palit@yahoo.com

ABSTRACT : The present investigation is an outcome of the flowering and fruiting responses of 182 angiospermic species occurring in wetlands of Birbhum district. Seven seasonal categories of flowering and fruiting responses and high number of species spreading their flowering and fruiting throughout the year were observed. This indicates temporal segregation of reproductive phases to avoid competitive exclusion.

KEY WORDS : Flowering, Fruiting responses, Angiospermic species, Wetlands, Phenological spread, Reproductive biology, Temporal segregation

HOW TO CITE THIS ARTICLE : Palit, Debnath, Kar, Debalina and Mukherjee, Ambarish (2018). Flowering and fruiting responses of the wetland macrophytes in Birbhum district, West Bengal, India. *Asian J. Hort.*, 13(1) : 8-13, DOI : 10.15740/HAS/TAJH/13.1/8-13.

Plant species differ in their phenological responses i.e. in their periodic responses to the climatic variations of a place in the calendar year. Each species has a definite period [month(s)/season(s)] during which its seeds germinate, seedlings grow and plants show vegetative growth, flowering, fruiting and death. Of these phenological events, flowering and fruiting periods are treated as essential components of plant descriptions in Floras, Monographs, Revisions and even in research publications on autoecology. The flowering seasons have been noted for 40 species of trees and 26 species of epiphytes (Mukherjee and Rai, 1984) and 172 herbs and shrubs (Mukherjee and Rai, 1985) occurring in Darjeeling. Information about these events in 214 species occurring along the bank of the Ganga basin of Nadia district, West Bengal was also given by Mondal *et al.* (1989). In conformity with the taxonomic account analysis of the flowering and fruiting periods of the 182

angiospermic species (Table A) occurring in wetlands of Birbhum was felt necessary since this information in addition to having pertinence to reproductive biology would be helpful to those interested in collecting flowers for personal use and business and for processing of pollen grains from flowers of different species for fulfillment of palynotaxonomic, melissopalynological and other academic interests as well as for evaluation of their allergenic role as biopollutants and therapeutic applications for remedy. The information about fruiting periods may be useful to those necessitating fruits and seeds for marketing and cultivation of those species having commercial prospect and for conservation of the endangered ones.

RESEARCH METHODS

During periodic visit from 2011 to 2016 to the study sites (25 wetlands in Birbhum district) adequate plant

Name of the species	Flowering and fruiting seasons			
	Pre monsoon	Monsoon	Post monsoon	Throughout the year
<i>Achyranthes aspera</i> L.	+	+		
<i>Aeschynomene aspera</i> L.		+	+	
<i>A. indica</i> L.		+	+	
<i>Alternanthera paronychioides</i> St. Hill.	+		+	
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	+			
<i>Alternanthera pungens</i> Kunth.	+		+	
<i>Alternanthera sessilis</i> (L.) DC				+
<i>Alysicarpus monilifer</i> (L.) DC.				+
<i>Amaranthus spinosus</i> L.				+
<i>Amaranthus tenuifolius</i> Willd.	+	+		
<i>Ammania multiflora</i> Roxb.				+
<i>Ampelocissus latifolia</i> (Roxb.) Planch.		+	+	
<i>Aponogeton natans</i> (L.) Engler & Krause.				+
<i>Bacopa monnieri</i> (L.) Pennell	+	+		
<i>Boerhavia diffusa</i> (L) Pennel.				+
<i>Brachiaria ramosa</i> (L.) stapf.				+
<i>Brachiaria reptans</i> (L.) Gardner & Hubbard				+
<i>Bulbostylis barbata</i> (Rottb.) Kunth ex. Clarke		+	+	
<i>Canscora decussata</i> (Roxb) Roem & Schult	+		+	
<i>Cassia sophera</i> L.				+
<i>Cayratia triflora</i> (L.) Domin var. <i>cinerea</i> (Lamk.) Babu				+
<i>Centaurium centaurioides</i> (Roxb.) Rao et Hemadri	+		+	
<i>Centella asiatica</i> (L.) Urb.	+	+		
<i>Ceratophyllum demersum</i> L.			+	
<i>Citrulus lanatus</i> Schard.	+	+		
<i>Cucumis callosus</i> Roxb.		+	+	
<i>Cucumis sativus</i> L.				+
<i>Coldenia procumbens</i> L.	+	+		
<i>Commelina bengalensis</i> L.		+	+	
<i>Commelina paludosa</i> Blumc-Erum	+	+		
<i>Coix lachryma-jobi</i> L.				+
<i>Croton bonplandianum</i> Baill	+		+	
<i>Cynodon dactylon</i> (L.) Pers				+
<i>Cyperus amabilis</i> Vall.				+
<i>Cyperus articulatus</i>				+
<i>Cyperus castaneus</i> Willd.		+	+	
<i>Cyperus compressus</i> L.		+	+	
<i>Cyperus cuspidatus</i> H B & K.	+	+		
<i>Cyperus difformis</i> L.		+	+	
<i>Cyperus distans</i> L.F.				+
<i>Cyperus exaltatus</i> Retz.				+
<i>Cyperus iria</i> L.				+
<i>Cyperus pilosus</i> Vahl.	+	+		
<i>Cyperus platystylis</i> R. Br.	+	+		
<i>Cyperus rotundus</i> L.	+	+		

Table A contd.

Flowering & fruiting responses of the wetland macrophytes

Table A Contd....

<i>Dentella repens</i> (L.) Forst.					+
<i>Desmodium gangeticum</i> (L.) DC.					+
<i>Desmodium triflorum</i> (L.) DC.					+
<i>Digittaria bicornis</i> (Lam.) Roem. & Schult,		+			
<i>Digittaria ciliaris</i> (Retz) Koeler.					+
<i>Digittaria longifolia</i> (Retz.) Pers.	+	+			
<i>Echinochloa colona</i> (L.) Link.		+	+		
<i>Echinochloa crusgalli</i> (L.) P.Beauv.		+	+		
<i>Eclipta alba</i> (L.) Hassk.					+
<i>Eichhornia crassipes</i> (Mart.) Solms					+
<i>Eleocharis artopurpurea</i> (Retz.) Presl.		+	+		
<i>Eleocharis dulcis</i> (Burm. f.) Trin ex Henschel		+	+		
<i>Enydra fluctuans</i> Lour.	+		+		
<i>Eragrostis coartata</i> Stapf.	+		+		
<i>Eragrostis gangetica</i> (Roxb.) Steudel.	+	+			
<i>Eragrostis natans</i> (Retz.) ex. Steud.					+
<i>Eragrostis tenella</i> (L.) P.Beauv. ex. Roem. & Schult.		+	+		
<i>Euphorbia dracunculoides</i> Lam.	+		+		
<i>Euphorbia hypericifolia</i> L.					+
<i>Euphorbia thymifolia</i> L.					+
<i>Evolvulus alsinoides</i> (L.)		+	+		
<i>Evolvulus nummularius</i> (L.)					+
<i>Fimbristylis aestivalis</i> (Retz.) Vahl.	+	+			
<i>Fimbristylis bisumbellata</i> (Forssk) Bub.					+
<i>Fimbristylis dichotoma</i> (L.) Vahl		+	+		
<i>Fimbristylis miliacea</i> (L.) Vahl		+	+		
<i>Flacourtia indica</i> (Burm.f.) Merr.					+
<i>Glinus lotoides</i> L.	+				
<i>Glinus oppositifolius</i> (L.) DC	+	+			
<i>Gnaphalium polycaulon</i> Pers.	+		+		
<i>Gomphrena celosioides</i> Mart.					+
<i>Grangea maderaspatana</i> (L.) Poir	+		+		
<i>Heliotropium indicum</i> L.					+
<i>Heliotropium ovalifolium</i> Forsskal	+	+			
<i>Heliotropium strigosum</i> Willd.	+	+			
<i>Hemiadelphis polysperma</i> (Heyne ex Roth) Nees					+
<i>Hemigraphis hirta</i> (Vahl.) T. Anders.					+
<i>Hibiscus cannabinus</i> L.		+	+		
<i>Hoppea dichotoma</i> Willd.	+		+		
<i>Hybanthus enneaspermus</i> (L.) F. Muell.			+		
<i>Hydrilla verticillata</i> (L.f.) Royle					+
<i>Hydrolea zeylanica</i> (L.) Vahl	+		+		
<i>Hygrophila schulli</i> (Buch. Ham.) M.R. & S.M. Almeida		+	+		
<i>Hygrophila difformis</i> (L.F.) Screen & Bennt	+		+		
<i>Hygrophila polysperma</i> T. Anders	+		+		
<i>Indigofera longifolia</i> (L.f.) Retz		+	+		
<i>Ipomoea aquatica</i> Forrsk.	+		+		

Table A contd....

Table A contd...

<i>Ipomoea carnea</i> Jacq. subsp. <i>fistula</i> (Mart. ex Choisy) D. Austin	+		+	
<i>Ipomoea obscura</i> Ker. Gawl.				+
<i>Jatropha gossypifolia</i> L.	+			
<i>Juncus menticola</i> Steud.	+	+		
<i>Justicia simplex</i> D. Don				+
<i>Kyllinga brevifolia</i> Rottb.				+
<i>Kyllinga triceps</i> Rottb.				+
<i>Lasia spinosa</i> (L.) Thwaites	+		+	
<i>Lemna acquinotialis</i> Welw. A. Pont.				+
<i>Leptochloa chinensis</i> (L.) Nees	+	+		
<i>Leersia hexandra</i> Sw.		+	+	
<i>Leucas lavandulifolia</i> Sm.	+	+		
<i>Limnophila heterophylla</i> Roxb. Benth		+	+	
<i>Limnophila indica</i> (L.)	+		+	
<i>Limnophila pulcherrima</i> Hook		+	+	
<i>Lindernia ciliata</i> (Colsm.) Pennell		+	+	
<i>Lindernia crustacea</i> (L.) F. Muel.		+	+	
<i>Lindernia oppositifolia</i> (Retz.) Mukherjee		+	+	
<i>Lindernia pusilla</i> (Willd.) Boldingh.		+	+	
<i>Lippia alba</i> (Mill.) N.E.Br. ex Britton et Wilson.	+	+		
<i>Lobelia alsinoides</i> Lam.			+	
<i>Ludwigia adscendens</i> (L.) Hara		+		
<i>Ludwigia perennis</i> L.	+	+		
<i>Mariscus aristatus</i> (Rottb.) Tang et Wang.				+
<i>Melochia corchorifolia</i> L.		+	+	
<i>Merremia emarginata</i> (Burm. f) Hallier f.		+	+	
<i>Mimosa rubicaulis</i> Lam.		+		
<i>Monochoria hastata</i> (L.) Solms				+
<i>Monochoria vaginalis</i> Presl.				+
<i>Murdania nudiflora</i> (L.) Brenan				+
<i>Najas graminea</i> Del		+	+	
<i>Nelumbo nucifera</i> Gaertn.				+
<i>Neptunea oleracea</i> Lour.			+	
<i>Nicotiana plumbaginifolia</i> Vev.				+
<i>Nymphaea nouchali</i> Burm.f.		+	+	
<i>Nymphaea pubescens</i> Willd.				+
<i>Nymphoides hydrophylla</i> (Lour. Kuntze)	+	+		
<i>Nymphoides indica</i> (L.) O.Kuntze				+
<i>Oryza rufipogon</i> Griff.			+	
<i>Ottelia alismoides</i> (L.) Pers	+	+		
<i>Panicum paludosum</i> Roxb		+	+	
<i>Panicum repens</i> L.				+
<i>Panicum trypheron</i> Schult,			+	
<i>Paspalum conjugatum</i> Berg.		+		
<i>Paspalidium flavidum</i> (Retz.) A Camus.				+
<i>Perotis indica</i> Kuntze		+	+	
<i>Phragmites karka</i> Retz. Trin ex Steud.	+		+	

Table A contd...

Flowering & fruiting responses of the wetland macrophytes

Table A contd...

<i>Phyla nodiflora</i> (L.) Greene				+
<i>Phyllanthus fraternus</i> Webster	+	+		
<i>Phyllanthus virgatus</i> Frost. F				+
<i>Pistia stratiotes</i> L.				+
<i>Polycarpon prostratum</i> (Frossk.) Asch. et Schew.	+	+		
<i>Polygala chinensis</i> L.	+	+		
<i>Polygonum barbatum</i> L.	+	+		
<i>Polygonum hydropiper</i> L.	+	+		
<i>Polygonum orientale</i> L.	+	+		
<i>Polygonum plebeium</i> R. Br	+			
<i>Portulaca oleracea</i> L.			+	
<i>Potamogeton crispus</i> L.	+		+	
<i>Potamogeton nodosus</i> Poir				+
<i>Pupalia lappacea</i> (L.) Juss.			+	
<i>Ranunculus scleratus</i> L.	+			
<i>Rotala indica</i> (Willd.) Koene.		+	+	
<i>Rumex dentatus</i> L. (ssp. <i>Klotzschianus</i> (Meish) Rech. F.	+	+		
<i>Rumex trisetifer</i> Stokes				+
<i>Sagittaria guyanensis</i> Kunth ssp. <i>Lappula</i> (D. Don) Bogin.		+	+	
<i>Sagittaria sagitifolia</i> L.		+		
<i>Saccharum spontaneum</i> L.		+	+	
<i>Schoenoplectus articulatus</i> (L.) Palla				+
<i>Sesamum indicum</i> L.	+			
<i>Setaria verticillata</i> (L.) Beauv.				+
<i>Setaria pumila</i> (Poir) Roem. et Schult.				+
<i>Sida cordata</i> (Burm. f.) Borssum				+
<i>Sida rhombifolia</i> L.				+
<i>Sphaeranthus indicus</i> L.	+		+	
<i>Spilanthes paniculata</i> Wall ex D.C.				+
<i>Spirodela polyrhiza</i> (L.) Schleiden,	+		+	
<i>Sporobolus diander</i> (Retz.) P. Beauv.				+
<i>Staurogyne glutinosa</i> (Wall. Ex Clarke) O. Kuntze	+	+		
<i>Trapa bispinosa</i> Roxb.		+	+	
<i>Trianthema portulacastrum</i> L.				+
<i>Typha domingensis</i> Pers.	+			
<i>Utricularia gibbosa</i> L. spp. <i>Exoleta</i>		+	+	
<i>Utricularia stellaris</i> L.f.				+
<i>Vallisneria spiralis</i> L. var. <i>denseserrulata</i> Makino	+	+		
<i>Vernonia cinerea</i> (L.) Less				+
<i>Veronica anagallis aquatica</i> L.			+	
<i>Vetiveria zizanioides</i> (L.) Nash				+
<i>Wolffia globosa</i> (Roxb.) den Hartig et Plas		+	+	
<i>Xanthium indicum</i> Koeing	+		+	

specimens of wetland associated macrophytes were collected. Information regarding flowering and fruiting time of the concerned macrophytes was recorded in the field note book. Some of the specimens of each species

were processed for herbarium preservation and the rest were worked out and described for identification on the basis of standard taxonomic methods.

RESEARCH FINDINGS AND DISCUSSION

Interestingly majority of the species (64 out of 182 species) enumerated in this work (Table 1) spread out their flowering and fruiting periods throughout the year. Monsoon and post monsoon seasons are inductive for as many as 40 species. The dry summer *i.e.* pre-monsoon and the rainy season *i.e.* the monsoon are utilized by 33 species for flowering and fruiting. There are 24 species which start flowering and fruiting in the winter (post-monsoon) and continue till the dry summer (pre-monsoon). There are, 7, 6 and 8 species which flower and fruit exclusively during pre-monsoon, monsoon and post-monsoon seasons, respectively. Seven seasonal categories of flowering and fruiting responses and high number of species spreading their flowering and fruiting throughout the year are indicative of phenological spread to minimize interspecific competition for pollinating and dispersing agents and to exercise their biotic potential as

Seasons	No. of Species undergoing flowering and fruiting
Pre monsoon	7
Monsoon	6
Post monsoon	8
Throughout the year	64
Post monsoon and pre monsoon	24
Pre monsoon and monsoon	33
Monsoon and post monsoon	40

much as possible. This phenological spread is likely to increase seed production and weaken the competition for occupation of space by newly produced seeds to eventually increase fitness. This temporal segregation of reproductive phases among co-occurring species was also considered by Mosquin (1971) and Waser (1978) as an adaptation to avoid competition and reduce exclusion.

Acknowledgement :

The authors are grateful to the Head of the Department of Botany, Burdwan University for providing necessary facilities.

REFERENCES

- Mondal, S., Mandal, S.K. and Datta, B.K. (1989).** Survey of plants along the banks of the Ganga basin of Nadia district, West Bengal with reference to aerobiology. *Environ. & Ecol.*, 7(1): 92-104.
- Mosquin, T. (1971).** Competition of pollination as a stimulus for the evolution of flowering time. *Oikos*, 22 : 398-402.
- Mukherjee, A. and Rai, B. (1984).** Flowering seasons of the plants of Darjeeling. *J. Beng. Nat. Hist. Soc., New Series*, 3(2): 99-103.
- Mukherjee, A. and Rai, B. (1985).** Some more information on the flowering seasons of the plants of Darjeeling. *J. Beng. Nat. Hist. Soc. (New Series)*, 4(1): 60-68.
- Waser, N.M. (1978).** Intersepcific pollen transfer and competition between two co-occurring plant species. *Oecologia*, 36 : 223-236.

★ ★ ★ ★ ★ of Excellence ★ ★ ★ ★ ★
13th Year