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Phenological study in papilionoid taxa in Dhule and Nandurbar districts of Maharashtra (India)

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How to cite: Patil DA. 2019. Phenological study in papilionoid taxa in Dhule and Nandurbar districts of Maharashtra (India). J New Biol Rep 8(2): 148- 154.

ABSTRACT

Importance of phenology has increased in view of global climate change. Reproductive phenology is responsible for success in seed production and thereby perpetuation of a species. Phenological studies are far from satisfaction especially in the state of Maharashtra. Phenology is not paid required attention during routine floristic investigation. The present author, therefore, re-observed particularly papilionoid taxa phenologically in Dhule and Nandurbar districts (Maharashtra). The phenophases *viz.*, leafing, flowering and fruiting and leaf fall are observed for 116 papilionaceous taxa belonging to 113 species and 45 genera. They are examined for wild, cultigens and indigenous as well as exotic species. The regular phenological period of majority of taxa is pointed out, besides variations in phenophases of some arborescent and cultivated species. This investigation provides a phenological database especially for ecologically, environmentally and economically important group of leguminous taxa. This database can be also utilized, besides the aforesaid importance, in future, in planning and management of conservational measures in the region.

Key words: Phenology, Papilionaceae, Dhule-Nandurbar districts.

INTRODUCTION

Plant phenology is the timing of major events in the life history of the plant in reference to seasons (Grime *et al.*, 1988). It thus emphasizes the significant timing of biological events occurring in an annual cycle of the plant and explains seasonal aspect of an ecological phenomenon (Leith, 1970). Plants responded to climatic factors like rainfall, humidity and temperature. Phenological study provides knowledge related plant growth pattern and also gives an idea about the effect of selective pressure and environment on flowering and fruiting of the species (Zhang, *et al.*, 2006). It is important as such for conservation of genetic resources, forestry management, characterization of vegetative types understanding regularities in course of life of

plants and for knowing the onset and duration of growing seasons, etc. (Opler *et al.*, 1980; Shimwell, 1972).

Linnaeus (1751) gave first annual plant calendars of vegetative and reproductive phenology in his 'Philosophia Botanica'. Hopkins (1938) explained 'bioclimatic law' about south to north progress of spring phenological events in the climatic zones of the US indicating postponement by four days for each 400 feet increase in altitude. In India, various regions have been also investigated phenologically e.g. Garhwal Himalaya (Sundriyal, 1990); Manipur (Kikim and Yadava, 2001). Uttar Pradesh (Singh and Kushwaha, 2006). Western Ghats (Sunderapandian *et al.*, 2005); Coromandel coast and Rajasthan (Yadav and Yadav, 2008), Karnataka (Nanda *et al.*, 2010), etc.

As far as state of Maharashtra is concerned, the phenological studies are few and far between (cf. Ghate and Kumbhojkar, 1991; Kasarkar and Kulkarni, 2011; Kukade and Tidke, 2013). The erstwhile Dhule district (presently Dhule and Nandurbar districts) are investigated floristically (Patil, 2003). However, customary routine floristic studies generally pay cursory attention to detailed phenological observations. This area is revisited for phenological studies in the last decade by the present author, the results of which particularly on papilionaceous taxa are being presented in this communication.

MATERIALS AND METHODS

The erstwhile Dhule district is divided into two districts viz., Dhule and Nandurbar districts. These are situated at the north-western border of Maharashtra state. It stretches between 70°47' and 75°11' east longitudes and 20°38' and 22°3' north latitudes. The forests are tropical, dry deciduous type. Climate in this region is markedly periodic with three seasons (rainy, winter and summer). It receives ca 674.0 mm average rainfall, winds being light to moderate (Anonymous, 1974).

The study area is botanized phenologically in all seasons of a year covering forested areas, aquatic places, wastelands, cultivated fields and different plantations. The particulars of leafing, flowering and fruiting, apart from leaf fall are recorded carefully in monthwise different phenophases. The plant specimens have been deciphered using state, regional and district floras (Cooke, 1958; Singh *et al.*, 2000, 2001; Naik, 1988; Patil, 2003; Kshirsagar and Patil, 2008). The information is tabulated alphabetically with necessary phenophases. The recent nomenclature has been adapted. The results are analysed and commented critically based on field observations.

RESULTS AND DISCUSSION

The family Papilionaceae is economically an important leguminous alliance as it provides many food crops, timber and medicinally significant source, besides its role in nitrogen-fixation through root-nodules. It was, therefore, thought worthwhile to extend phenological observations especially in this part of the state of Maharashtra. This investigation provided a detailed report about leafing, flowering and fruiting and leaf fall occurring throughout a year. This region harbours considerable diversity of papilionoid floral elements. This attempt divulged as many as 116 taxa belonging to 45 genera, 113 species, besides three varieties. There is also fair diversity based on habitat ground. Of these, herbaceous papilionoids constitute major segment represented by 64 taxa. The other habitat groups are thus found: (i) 14 tree taxa (ii) shrubs and undershrubs 18 species (iii) lianas 05 taxa and (iv) twiners and climbers 15 taxa. It is interesting to note that out of total 116

taxa, 22 taxa are found exclusively under cultivation, three taxa being either wild or cultivated. Major share of wild papilionoid elements is represented by 91 taxa. The herbaceous papilionoids predominate the biodiversity of this region.

Out of total 116 taxa, following taxa are exotic and brought, introduced or naturalized in this region as in other parts of India. Their nativity and literary sources are mentioned in parenthesis: (1) *Cicer arietinum* (South Europe, Patil, 1990), (2) *Clitoria ternatea* (Tropical America, Purseglove, 1968), (3) *Sesbania grandiflora* (Indonesia, Patil, 1995), (4) *Sesbania sesban* (South Africa, Rajagopal and Panigrahi, 1965), (5) *Sesbania bispinosa* (Tropical America, Patil, 2017), (6) *Indigofera grandulosa*, *I. hirsuta*, *I. linifolia*, *I. linnae* and *I. trita* (Tropical and South America, Patil, 2017; Reddy, 2008), (7) *Melilotus alba* (Europe, Patil, 201; Reddy, 2008), (8) *Lens culinaris* (Western Temperate Asia, De Candolle, 1959; Patil, 2017), (9) *Pisum sativum* (West Asia, Patil, 1995), (10) *Trigonella foenum-graecum* (South Europe, Patil, 1995), (11) *Vigna unguiculata* (Africa, Xiong, *et al.*, 2016), (12) *Arachis hypogaea* (South America, De Candolle, 1959; Purseglove, 1968), (13) *Glycine max* (Eastern Asia, Probably Cochin, China, Japan and Java, Purseglove, 1968), (14) *Medicago polymorpha* (Europe, Rajagopal and Panigrahi, 1965), (15) *Medicago sativa* (South-West Asia, De Candolle, 1959), (16) *Phaseolus vulgaris* (South Mexico, Central and South America (Patil, 2003), and (17) *Vigna trilobata* (Afro-Asian, Patil, 2003).

The above resume indicates that these taxa originally belong to of various parts of the world. But they appear to have introduced, acclimatized and adapted to the prevailing ecological conditions in this region and elsewhere in Indian subcontinent. They appear at home phenologically as well since they are being cultivated since long past. Few taxa e.g. *Clitoria ternatea*, *Dolichos trilobus*, etc. have naturalized well and also run wild in the region.

The observations recorded in Table-1 indicate certain salient features about phenophases of papilionoid taxa in Dhule and Nandurbar districts of Maharashtra state. Each plant taxa has to go through phenophases viz., leafing, flowering and fruiting and leaf fall. Thus phenology is both vegetative and reproductive. The peak period of leafing in the family is found to be in the months from July to August (84 taxa), followed by July to September (13 taxa). Other taxa, however, exhibit variation from this salient feature. Some taxa being cultivated as crops, they vary phenologically. Some crops are cultivated throughout a year e.g. *Cyamopsis tetragonoloba*, *Trigonella foenum-quaezum*. Some are purely Kharif crops (monsoon rainfed crops) e.g. *Lens culinaris*. Other crops species e.g. *Arachis hypogaea* are cultivated in both seasons as Kharif crops and Rabbi (Summer) crop, and hence its leafing period is observed twice

viz., July to August and November to December. *Cicer arietinum* is purely a winter crop and hence leafing is observed in November to December. Other wild taxa also show varied phenological features e.g. (i) Species of *Canavalia* bear leaves during September to December, (ii) *Dalbergia paniculata* and *D. sisso* produce foliage during

April to July, (iii) Likewise, species of *Erythrina* bear leaves in summer month (during hot period), (iv) *Tephrosia purpurea* show longer period of leafing from July to December. It appears that arborescent taxa have different leafing period as compared to herbaceous papilionoid taxa.

Table 1. Phenological observations on Family Papilionaceae.

Sr. No. 1	Plant Name 2	Habit 3	Leafing 4	Flowering & Fruiting 5	Leaf Fall 6
1.	\$ <i>Abrus precatorius</i> L.	Twiner	Jul-Aug	Aug-Feb	Feb-Apr
2.	<i>Aeschomene indica</i> L.	Herb	Jul-Aug	Aug-Dec	Jan-Feb
3.	<i>Alysicarpus bupleurifolius</i> (L.) DC.	Herb	Jul-Aug	Aug-Nov	Dec-Jan
4.	<i>Alysicarpus longifolius</i> Wight & Arn.	Herb	Jul-Aug	Sep-Nov	Dec-Jan
5.	<i>Alysicarpus monilifer</i> (L.) Wight & Arn.	Herb	Jul-Aug	Aug-Nov	Dec-Jan
6.	<i>Alysicarpus monilifer</i> (L.) DC. var. <i>manilifer</i>	Herb	Jul-Aug	Aug-Nov	Dec-Jan
7.	<i>Alysicarpus procumbens</i> (Roxb.) Schinl.	Herb	Jul-Aug	Aug-Oct	Nov-Jan
8.	<i>Alysicarpus roxburghianus</i> Toth. Et Pramanik	Undershrub	Jul-Aug	Sep-Nov	Dec-Jan
9.	<i>Alysicarpus rugosus</i> (Willd.) DC.	Herb	Jul-Aug	Sep-Nov	Dec-Jan
10.	<i>Alysicarpus tetragonolobus</i> Edgew.	Herb	Jul-Aug	Aug-Oct	Nov-Dec
11.	<i>Alysicarpus vaginalis</i> (L.) DC.	Herb	Jul-Aug	Sep-Oct	Nov-Dec
12.	<i>Arachis hypogaea</i> L.	Herb	Jul-Aug & Nov-Dec	Aug-Dec & Jan-May	Collected when leafy
13.	<i>Butea monosperma</i> (Lamk.) Taub.	Tree	Apr-May	Mar-Jun	Dec-Feb
14.	* <i>Cajanus cajan</i> (L.) Millsp.	Undershrub	Jul-Sep	Oct-Dec	Dec-Feb
15.	<i>Cajanus platycarpus</i> (Benth.) Van der Maesen	Harb	Jul-Aug	Aug-Nov	Dec-Jan
16.	<i>Cajanus scarabaeoides</i> (L.) de Petit Thouars	Harb	Jul-Aug	Aug-Nov	Dec-Jan
17.	<i>Cajanus sericeus</i> (Benth. ex Baker) van der Maesen	Shrub	Jul-Aug	Sep-Nov	Dec-Jan
18.	<i>Canavalia cathartica</i> Thouars	Lianas	Apr-Jun	Sep-Dec	Mar-Apr
19.	\$ <i>Canavalia gladiata</i> (Jacq.) DC.	Lianas	Jul-Aug	Sep-Dec	Jan-Mar
20.	* <i>Cicer arietinum</i> L.	Herb	Nov-Dec	Oct-Feb	Feb-Mar
21.	<i>Clitoria annua</i> J. Graham. (Syn. <i>C. biflora</i> Dalz.)	Herb	Jul-Aug	Aug-Oct	Nov-Jan
22.	\$ <i>Clitoria ternatea</i> L.	Twiner	Jul-Aug	Aug-Sep	Mar-Jun
23.	<i>Crotalaria albioda</i> Roth.	Herb	Jul-Aug	Aug-Nov	Dec-Feb
24.	<i>Crotalaria bifaria</i> L. f.	Herb	Jul-Aug	Aug-Oct	Nov-Dec
25.	<i>Crotalaria calycina</i> Schrank.	Herb	Jul-Aug	Aug-Oct	Nov-Dec
26.	<i>Crotalaria chinensis</i> L.	Herb	Jul-Aug	Aug-Oct	Nov-Dec
27.	<i>Crotalaria filipes</i> Benth.	Herb	Jul-Sep	Oct-Dec	Dec-Jan
28.	<i>Crotalaria hebecarpa</i> (DC.) Rudd. [Syn. <i>Goniogyna hirta</i> (Willd.) Ali.]	Herb	Jul-Aug	Sep-Oct	Nov-Jan
29.	<i>Crotalaria hirsuta</i> Willd.	Herb	Jul-Aug	Aug-Nov	Dec-Jan
30.	<i>Crotalaria hista</i> Willd.	Herb	Jul-Aug	Sep-Oct	Nov-Jan
31.	* <i>Crotalaria juncea</i> L.	Herb	Aug-Oct	Nov-Jan	Jan-Feb

Sr. No. 1	Plant Name 2	Habit 3	Leafing 4	Flowering & Fruiting 5	Leaf Fall 6
32.	<i>Crotalaria medicaginea</i> Lamk.	Herb	Jul-Aug	Aug-Nov	Dec-Jan
33.	<i>Crotalaria Montana</i> Roth	Herb	Jul-Aug	Aug-Oct	Nov-Dec
34.	<i>Crotalaria mysorensis</i> Roth	Herb	Jul-Aug	Sep-Oct	Nov-Dec
35.	<i>Crotalaria nana</i> Burm. f.	Herb	Jul-Aug	Sep-Oct	Nov-Dec
36.	<i>Crotalaria orixensis</i> Willd.	Herb	Jul-Aug	Sep-Dec	Dec-Jan
37.	<i>Crotalaria pusilla</i> DC.	Herb	Jul-Aug	Aug-Oct	Nov-Dec
38.	<i>Crotalaria triquetra</i> Dalz.	Herb	Jul-Aug	Sep-Dec	Dec-Jan
39.	<i>Crotalaria vestita</i> Baker	Herb	Jul-Aug	Sep-Oct	Nov-Jan
40.	<i>Cullen corylifolium</i> (L.) Medik. (Syn. <i>Psoralea corylifolia</i> L.)	Herb	Aug-Sep	Oct-Feb	Feb-Mar
41.	* <i>Cyamopsis tetragonoloba</i> (L.) Taub.	Herb	Throughout Year	Aug-Nov and Dec-Apr	Throughout year
42.	<i>Dalbergia lanceolaria</i> L. f.	Tree	Jul-Aug	Mar-May	Apr-May
43.	<i>Dalbergia latifolia</i> Roxb.	Tree	Jul-Aug	Feb-Nov	Feb-Apr
44.	<i>Dalbergia melanoxylon</i> Guill. & Perr.	Tree	Jul-Aug	May-Sep	Feb-Apr
45.	<i>Dalbergia paniculata</i> Roxb.	Tree	Apr-Jul	Mar-Jun	Jan-Feb
46.	* <i>Dalbergia sisso</i> Roxb. ex DC.	Tree	Apr-Jul	Feb-Nov	Jan-Apr
47.	<i>Desmodium dichotomum</i> (Willd.) DC.	Undershrub	Jul-Aug	Sep-Oct	Dec-Jan
48.	<i>Desmodium gangaticum</i> (L.) DC.	Undershrub	Jul-Aug	Aug-Dec	Jan-Feb
49.	<i>Desmodium laxiflorum</i> DC.	Undershrub	Jul-Aug	Aug-Oct	Dec-Jan
50.	<i>Desmodium oojeinense</i> (Roxb.) H. Ohashi [Syn. <i>Ougeinia oojeinensis</i> (Roxb.) Hochr.]	Tree	Jul-Aug	Mar-May	May-Jun
51.	<i>Desmodium procumbens</i> (Mill.) Hitch.	Herb	Jul-Aug	Sep-Oct	Nov-Dec
52.	<i>Desmodium repandum</i> (Vahl.) DC.	Herb	Jul-Aug	Sep-Oct	Nov-Dec
53.	<i>Desmodium triflorum</i> (L.) DC.	Herb	Jul-Aug	Sep-Nov	Dec-Jan
54.	<i>Desmodium velutinum</i> (Willd.) DC.	Undershrub	Jul-Aug	Aug-Nov	Dec-Jan
55.	<i>Dolichos trilobus</i> L.	Herb	Jul-Aug	Aug-Dec	Dec-Jan
56.	<i>Dunbaria glandulosa</i> (Dalz. & Gibs.) Prain	Lianas	Jul-Aug	Aug-Oct	Dec-Jan
57.	<i>Eleiotis monophyllos</i> (Burm. f.) DC.	Herb	Jul-Aug	Aug-Nov	Nov-Dec
58.	<i>Erythrina suberosa</i> Roxb.	Tree	May-May	Mar-Oct	Dec-Jan
59.	* <i>Erythrina variegata</i> L.	Tree	Apr-May	Feb-May	Dec-Jan
60.	* <i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Tree	Jun-Jul	Jan-Jun	Apr-Jun
61.	* <i>Glycine max</i> (L.) Merr.	Twiner	Jul-Aug	Aug-Nov	Dec-Jan
62.	<i>Indigofera angulosa</i> Edgew.	Undershrub	Jun-Aug	Sep-Dec	Dec-Jan
63.	<i>Indigofera cassioides</i> DC.	Shrub	Jul-Sep	Oct-Nov	Dec-Feb
64.	<i>Indigofera cordifolia</i> Heyne ex Roth	Herb	Jul-Aug	Aug-Dec	Dec-Jan
65.	<i>Indigofera glandulosa</i> Wendl.	Herb	Jul-Aug	Aug-Nov	Nov-Dec
66.	<i>Indigofera hirsute</i> L.	Undershrub	Jul-Aug	Sep-Nov	Nov-Jan
67.	<i>Indigofera hoshstetteri</i> Baker	Herb	Jul-Aug	Aug-Nov	Dec-Jan
68.	<i>Indigofera linifolia</i> (L.f.) Retz. var. <i>linifolia</i>	Herb	Jul-Aug	Aug-Dec	Dec-Jan
69.	<i>Indigofera linifolia</i> (L.f.) Retz. var. <i>campbellii</i> Wight ex Baker	Herb	Jul-Aug	Aug-Dec	Dec-Jan
70.	<i>Indigofera linnaei</i> Ali	Herb	Jul-Aug	Aug-Dec	Dec-Jan

Sr. No. 1	Plant Name 2	Habit 3	Leafing 4	Flowering & Fruiting 5	Leaf Fall 6
71.	<i>Indigofera parviflora</i> Heyne ex Wight & Arn.	Undershrub	Jul-Aug	Sep-Dec	Dec-Jan
72.	<i>Indigofera trifoliata</i> L.	Herb	Jul-Aug	Aug-Nov	Nov-Dec
73.	<i>Indigofera trita</i> L. subsp. <i>Subulata</i> var. <i>subulata</i> (Vahl ex Poir.) Ali	Undershrub	Jul-Aug	Sep-Dec	Dec-Jan
74.	* <i>Lablab purpureus</i> (L.) Sweet	Twiner	Jul-Aug	Oct-Jan	Jan-Feb
75.	* <i>Lens culinaris</i> Medic.	Herb	Sep-Oct	Dec-Mar	Mar-Apr
76.	* <i>Macrotyloma uniflorum</i> (Lam.) Verdc. (Syn. <i>Dolichos uniflorus</i> Lam.)	Twiner	Jul-Aug	Sep-Nov	Nov-Dec
77.	<i>Medicago polymorpha</i> L.	Herb	Jul-Sep	Oct-Dec	Dec-Jan
78.	* <i>Medicago sativa</i> L.	Herb	Jul-Aug	Throughout year	Collected during leafy state
79.	<i>Melilotus alba</i> Medik ex Desr.	Herb	Jul-Sep	Dec-Mar	Mar-Apr
80.	<i>Milletia extensa</i> (Benth.) Baker	Lianas	Jun-Aug	Mar-Oct	Jan-Feb
81.	<i>Mucuna prurans</i> (L.) DC.	Undershrub	Jul-Aug	Aug-Mar	Jan-Mar
82.	<i>Paracalyx scariosa</i> (Roxb.) Ali (Syn. <i>Cylista Scariosa</i> Roxb.)	Lianas	Jul-Sep	Nov-Feb	Feb-Mar
83.	* <i>Phaseolus vulgaris</i> L.	Herb	Jul-Aug	Aug-Dec	Dec-Jan
84.	* <i>Pisum sativum</i> L. subsp. <i>arvense</i> (L.) A.&G. Back. & Bokh. f.	Climber	Aug-Sep	Dec-Feb	Dec-Jan
85.	* <i>Pisum sativum</i> L. subsp. <i>Sativum</i>	Climber	Aug-Sep	Nov-Feb	Dec-Jan
86.	\$ <i>Pongamia pinnata</i> (L.) Pierre	Tree	May-Jul	Mar-Jun	Jan-Mar
87.	<i>Pterocarpus marsupium</i> Roxb.	Tree	Aug-Sep	Apr-Oct	Mar-Apr
88.	<i>Pueraria tuberosa</i> (Willd.) DC.	Twiner	Jul-Sep	Feb-Apr	Apr-Mar
89.	<i>Rhynchosia bracteata</i> Benth. Ex Baker	Twiner	Jul-Aug	Aug-Dec	Dec-Jan
90.	<i>Phynchosia minima</i> (L.) DC. var. <i>laxiflora</i> (Caumb.) Baker	Twiner	Jul-Aug	Aug-Dec	Dec-Jan
91.	<i>Rhynchosia minima</i> (L.) DC. var. <i>minima</i>	Twiner	Jul-Aug	Aug-Dec	Dec-Jan
92.	<i>Rothia indica</i> (L.) Druce	Herb	Aug-Nov	Feb-Jun	Apr-May
93.	<i>Sesbania bispinosa</i> (Jacq.) Wight	Herb	Jul-Aug	Aug-Dec	Feb-Apr
94.	* <i>Sesbania grandiflora</i> (L.) Pers.	Tree	Jul-Aug	Oct-Feb	Feb-Apr
95.	* <i>Sesbania sesban</i> (L.) Merr.	Tree	Dec-Jan	Oct-Mar	Apr-May
96.	<i>Smithia conferta</i> J.E. Sm.	Herb	Jul-Aug	Sep-Dec	Jan-Feb
97.	<i>Smithia purpurea</i> Hook.	Herb	Jul-Sep	Oct-Dec	Dec-Feb
98.	<i>Smithia setulosa</i> Dalz.	Herb	Jul-Aug	Sep-Oct	Dec-Feb
99.	<i>Stylosanthes fruticosa</i> (Retz.) Alst.	Herb	Jul-Aug	Aug-Nov	Dec-Feb
100.	<i>Taverniera cuneifolia</i> (Roxb.) Ali	Undershrub	Jul-Aug	Sep-Dec	Dec-Feb
101.	<i>Tephrosia apollinea</i> (Del.) Link	Herb	Jul-Aug	Aug-Oct	Nov-Jan
102.	<i>Tephrosia pumila</i> (Lamk.) Pers.	Herb	Jul-Aug	Sep-Feb	Feb-Mar
103.	<i>Tephrosia purpurea</i> (L.) Pers.	Undershrub	Jul-Dec	Jul-Dec	Dec-Feb
104.	<i>Tephrosia subtriflora</i> Hochst. ex Baker	Herb	Jul-Aug	Sep-Nov	Dec-Feb
105.	<i>Tephrosia tinctoria</i> (L.) Pers.	Undershrub	Jul-Aug	Sep-Oct	Dec-Feb
106.	<i>Tephrosia villosa</i> (L.) Pers.	Undershrub	Jul-Sep	Jul-Jan	Jan-Mar
107.	<i>Teramnus labialis</i> (L.f.) Spreng.	Twiner	Aug-Sep	Oct-Mar	Jan-Feb
108.	* <i>Trigonella foenum-graecum</i> L.	Herb	Throughout year	Throughout year	Collected at leafy state

Sr. No. 1	Plant Name 2	Habit 3	Leafing 4	Flowering & Fruiting 5	Leaf Fall 6
109.	<i>Uraria picta</i> (Jacq.) DC.	Undershrub	Jul-Aug	Sep-Nov	Dec-Jan
110.	* <i>Vigna aconitifolia</i> (Jacq.) Marechal	Herb	Jul-Aug	Sep-Oct	Oct-Nov
111.	* <i>Vigna mungo</i> (L.) Wilczek. var. <i>sublobata</i> (Roxb.) Verdc.	Herb	Jul-Aug	Aug-Oct	Nov-Jan
112.	* <i>Vigna radiate</i> (L.) Wilczek. var. <i>sublobata</i> (Roxb.) Verdc.	Herb		Sep-Oct	
113.	<i>Vigna trilobata</i> (L.) Verdc.	Twiner	Jul-Aug	Aug-Oct	Nov-Jan
114.	* <i>Vigna unguiculata</i> (L.) Walp. Subsp. <i>Cylindrica</i> (L.) Eseltine	Twiner	Jul-Aug	Aug-Nov and Dec-Apr	Usually throughout year
115.	<i>Vigna vexillata</i> (L.) A. Rich.	Twiner	Jul-Aug	Aug-Nov	Nov-Jan
116.	<i>Zornia diphylla</i> (L.) Pers.	Herb	Jul-Aug	Aug-Nov	Dec-Feb

Note: (i) *= Cultivated, (ii) \$=Cultivated and wild, (iii) E=Exotic

Reproductive phenophase is an important event in the life cycle of a plant. Since it is directly concerned with the perpetuation of species itself. This phase in case of Angiosperms consists of flowering and fruiting, the former period is generally followed by later period. Although go, it these two periods, in nature, are not strictly compartmented. They may go hand-in-hand on the same plants. Flowering generally starts from August and may continue upto September and mostly fruiting phase begins in October onwards and may extend upto December. This is generally so for rainy-seasoned taxa. There are some other taxa which flower and fruit after rainy season, especially when temperature rises in this part of the state e.g. *Butea monosperma* (March-June), *Dalbergia lanceolaria* (March-May), *D.latifolia* (February-November), *D.melanoxyton* (May-September), *D.paniculata* (March-June), *D.sisso* (February-November), *Desmodium oojainense* (March-May), *Erythrina suberosa* (March-October), *E.variegata* (February-May), *Gliricidia sepium* (January-June) and *Pongamia pinnata* (March-June). These are all arborescent taxa and they generally favour the hot months of a year to complete their life history. Some other wild species have peculiar phenophases e.g. (i) *Pueraria tuberosa* bear leaves in rainy season but reproduction phenophase is observed during February to April (hotter period). (ii) *Rothia indica* is a small herb inhabiting ditches, ponds and such other water bodies. It appears especially when the water recedes in their place of habitat. Therefore, their vegetative and reproductive phenophase is observed especially when rainy season is over. (iii) *Teramnus labialis* is generally found under shade of trees and obviously its phenological period is different from other herbaceous papilionoids. The cultigens pointed out earlier flower and fruit as and when they are sown, once or twice in a year.

Leaf fall is generally followed as and when the fruiting phase is over. Few species,

however, have characteristic of period of defoliation and reproductive phase e.g. (i) in *Butea monosperma* flowering starts with leaf fall, (ii) in *Erythrina* species, flowering is observed when the tree is totally leafless, (iii) In *Clitoria ternatea*, *Dalbergia lanceolaria*, flowering occurs even when the old foliage is still on the plant body. Period of maturation of fruit in few cases is different from other papilionoid taxa e.g. *Dalbergia sissoo*, *Pongamia pinnata*, *Sesbania grandiflora*, *S., sesban*, *Tephrosia purpurea*, etc. require longer period of fruit maturation and remain on the plant until next phenophases begin. This period also depends on visits of pollinating vectors and fluctuation in abiotic factors prevailing in a year. In a nutshell, phenological activity from leafing to reproductive phenophase to defoliation is consistent and uniform in majority of taxa. However, arborescent species do not follow this typical pattern. Cultivated species are under the control of mankind, season required and abiotic factors in the region. Phenological study is not generally paid attention carefully and completely. The observations during floristic studies are cursory. It is, therefore, necessary to have a separate phenological database as it is connected intimately with ecology, environment and economy of a region.

ACKNOWLEDGEMENTS

I am thankful to the authorities of S.S.V.P.Sanstha (Dhule) for necessary facilities extended during tenure of research.

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