

THE GRASSY SCRUB VEGETATION OF KHANDWA PLATEAU, MADHYA PRADESH

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ABSTRACT

This paper deals with a floristic and ecological account of the grassy scrub vegetation of Khandwa plateau and its environs. Our knowledge regarding the vegetation of this tract is scanty and, therefore, the present study was undertaken by the author during the years 1958 and 1959.

The physiognomy of the vegetation during the year is discussed. General observations on plant communities and ecological aspects of the vegetation are added. At the end, an Appendix gives an annotated list of 248 species of plants, comprising the grassy scrub vegetation of the area.

INTRODUCTION

A number of small plateaus, generally denuded of the original forest, occur in the vicinity of the town of Khandwa. They bear only thorny scrub and grassland type of vegetation under intense grazing and human interferences. As our knowledge regarding the vegetation of this tract is scanty, the present study was undertaken by the author during the years 1958 and 1959. It deals with a floristic and ecological account of the grassy scrub vegetation of Khandwa and its environs.

GEOGRAPHY

The Khandwa plateau is situated between $21^{\circ}50'-22^{\circ}25' N$ and $75^{\circ}57'-77^{\circ}13' E$ of Greenwich, in

the Narbadda Division of Madhya Pradesh, occupying an area of 3,690 sq. km. It is bounded on the north by the old Indore State, on the west by Indore and the Khandesh district of Bombay, on the south by Khandesh, Amraoti and Akola districts of new Bombay State and on the east by the Hoshangabad and Betul districts (Fig. 1). The fertile valleys of the Abna and Sukta Rivers lie in the southern part of the Khandwa district. The main range of the Satpuras crosses the district in the southern part, with a width of about eleven miles and rather low elevation, from which a few peaks including that of Asirgarh rise conspicuously. The Khandwa plain has an elevation of about 260 m. above main sea-level.

GEOLOGY AND SOIL

The whole district is covered by the trap rocks of Deccan, with an exception in a few spots near the Narbadda River. The town of Khandwa stands on a sheet of basalt rock covered with shallow surface soil and owing to the proximity of the rock to the surface, there is a noticeable absence of trees.

The soil is chiefly formed from the disintegration of the underlying trap-rock. The process may still be seen going on wherever railway cuttings etc. have laid bare the previously unexposed rock. The surface soil, as might be expected in a tract mainly covered with trap is usually that described as black cotton soil. On the higher lands, it often has a sprinkling of boulders over its surface. Recent deposits of alluvium are among the alien formations which are commonly found in the district.

The soil of Khandwa is roughly divided by the revenue department into four classes: (1). *Gatta*—the rich black mould of low lying lands, capable of growing two crops without irrigation; (2). *Gohali* or *Thawar*—a black soil of flat lands, which will yield a rabi crop (wheat etc.) without irrigation; (3). *Mal*—a brown soil,

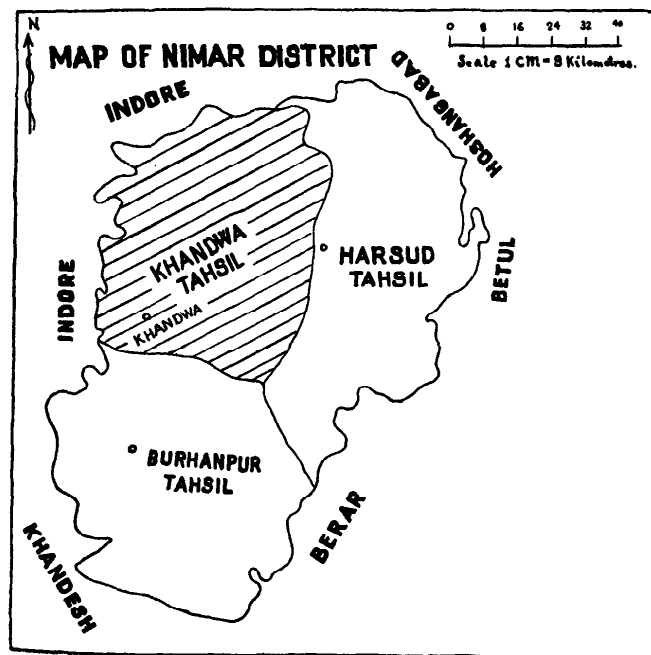


FIG.1: GEOGRAPHIC POSITION OF KHANDWA

admixture of fine sand, grits and pebbles, yields the best kharif (rain) crops such as cotton ; (4). *Kharda*—a highly poor soil of little depth intermixed with limestone nodules and trap pebbles, yields only kharif crops and is often left fallow.

CLIMATIC CONDITIONS

The climate of Khandwa is somewhat cooler than Nagpur in the summer and has practically the same temperature during the rains. The cold weather though not bracing, is distinctly pleasant and lasts from the beginning of November to the middle of March. The hot winds usually begin about the middle of April and blow steadily from directions between north-west and west. TABLE I gives the climatic data on rainfall and temperature for the year 1956.

The area is one of the driest in the State and is characterized by low relative humidity. The average rainfall for the years 1940 to 1957 is 35.7 inches or 906.8 mm., of which about three-fourth falls between June and October. January is the coldest month of the year. The highest maximum temperature of 43.2°C was recorded in the month of May, 1954. The scorching heat of this month and the hot winds make the weather during day very trying. The diurnal range of temperature in Khandwa is high, ranging between 13 to 19°C during the relatively dry months of November to May ; the highest value occurring in February while the lowest value of 6 to 7°C occurs during July and August.

TABLE I

Climatological Data of Khandwa (1956)*

Month	Temperature in degrees °C.		Rainfall in mm.	
	Mean Maximum	Mean Minimum	Diurnal range	Monthly rainfall
January	29.7	12.9	16.8	—
February	32.2	13.2	19.0	—
March	37.5	18.9	18.6	—
April	40.2	23.8	16.4	—
May	40.9	27.7	13.2	—
June	34.7	25.3	9.4	256
July	29.3	23.1	6.2	77
August	29.8	22.7	7.1	477
September	31.5	22.8	8.7	102
October	32.8	19.4	13.4	—
November	28.9	14.8	14.1	152
December	29.4	11.1	18.3	—

GENERAL DESCRIPTION OF VEGETATION

The forest vegetation is of the dry deciduous type. It is a tropical, thorny, secondary forest which owes its existence to the degradation under human influences. To this must be added the natural changes taking place in new or disturbed soils with the passage of time. Such forests are widely distributed in the arid and semi-arid zones of the earth where the total rainfall ranges from

50-100 cm. They are especially characteristic of trap areas and black cotton soils. The vegetation presents a very open, park-like appearance so that the trees and shrubs are widely spaced and consist to a large extent thorny species belonging to the Mimosaceae, Celastraceae, Rhamnaceae and Flacourtiaceae. The grasses and other herbs are dominant in this type of vegetation, while woody plants are represented by small trees and big bushes, scattered or in small groups, covering on the whole less than 50 per cent of the ground. The grasses dominate the botanical landscape, even though small trees, big bushes and palms, e.g. *Acacia nilotica* var. *tomentosa* Cuf. (Syn. *A. arabica* Willd.), *A. leucophloea* Willd., *A. caesia* Wight & Arn., *A. senegal* Willd., *A. chundra* Willd., *Dichrostachys cinerea* Wight & Arn., *Mimosa hamata* Willd., *M. rubicaulis* Lam., *Butea monosperma* Taub. var. *monosperma*, *Maytenus senegalensis* Exell (Syn. *Celastrus senegalensis* Lam.), *Calotropis gigantea* R. Br., *Carissa spinarum* L., *Phoenix sylvestris* Roxb., *P. acaulis* Roxb., *Zizyphus nummularia* Wight & Arn., *Z. mauritiana* Lam., *Clerodendrum phlomidis* L. f., *Lantana camara* var. *aculeata* Mold., *L. indica* Roxb., *Securinega leucopyrus* Muell.-Arg., *Grewia tiliaefolia* Vahl, *G. hirsuta* Vahl, *Flacourtia indica* Merr., *Opuntia dillenii* Haw., *Xeromphis spinosa* Keay (Syn. *Randia dumetorum* Lam.) and *Asparagus racemosus* Willd., are conspicuous features in the physiognomy of the vegetation. The grasses may be densely procumbent or matted, or may grow in patches, tussocks or clumps. They may completely cover the soil surface or be thinly scattered so that the ground is visible between the grass clumps or mats. Besides, a number of annual and perennial twiners and climbers belonging to the Convolvulaceae, Asclepiadaceae, Cucurbitaceae, Papilionaceae and Ampelidaceae add to the monsoon vegetation of the plateau. Among the commoner are: *Ipomoea pentaphylla* Jacq., *I. pes-tigridis* L., *I. muricata* Jacq., *I. angulata* Lam. (Syn. *I. coccinea* Clarke), *I. obscura* Ker., *I. tropica* Sant. & Pat. (Syn. *I. calycina* Clarke), *Rivea hypocrateriformis* Choisy, *Coccinia cordifolia* Cogn., *Melothria maderaspatana* Cogn., *Bryonopsis laciniosa* Naud., *Cayratia carnosa* Gagnep., *Cissus repanda* Vahl (Syn. *Vitis repanda* Wight & Arn.), *Ampelocissus latifolia* Planch. (Syn. *Vitis latifolia* Roxb.), *Cryptostegia grandiflora* R. Br., *Pergularia daemia* Chiov. (Syn. *Daemia extensa* R. Br.), *Telosma pallida* Craib (Syn. *Pergularia pallida* Wight), *Leptadaenia reticulata* Wight & Arn., *Hemidesmus indicus* R. Br., *Dregea volubilis* Benth. ex Hook. f., *Passiflora foetida* L., *Cissampelos pareira* L., *Cocculus hirsutus* Diels, *Abrus precatorius* L., *Atylosia platycarpa* Benth., and *Teramnus labialis* Spreng.

The physiognomy of vegetation is associated with topography, type of soil, period of year and the degree and kind of grazing. Grazing by domestic and wild animals is the primary cause of the existence and modification of these grassy scrubs. Climate also aids by remaining dry for seven or eight months, thus not allowing the more mesic type of forest vegetation to grow.

* The data were supplied by the District Statistical Office, Nimar, M.P.

The vegetation is characterized by a seasonal phase ; the optimum period of growth for the plants being the rainy season. The optimum temperature and moisture conditions for plant growth are obtained during the months of July and August, when the vegetation attains luxuriant monsoon aspect and the whole ground becomes carpeted with a variety of herbs and grasses. These plants complete their life history in three to four months after the rains. They help in increasing the humus content of the soil and extending the vegetation to barren areas. The commonest and most successful annuals belong to the families Papilionaceae, Compositae, Acanthaceae, Amaranthaceae, Euphorbiaceae, Commelinaceae and Gramineae. Following the first fall of rains towards the end of June or early July, the almost bare ground begins greening up. The finer particles of rocky substrata are washed down to lower levels. *Scilla indica* Baker, comes out first from its previous years' bulb. It is the most abundant and prominent species of the plateau at this time. *Borreria stricta* Sch., also grows up from the seeds in dense patches. Among other pioneer plants, mention may be made of *Cassia tora* L., *Euphorbia hirta* L., *Trianthema portulacastrum* L., *Brachiaria ramosa* Stapf, *Cynodon dactylon* Pers., *Cyperus triceps* Endl., *Heylandia latebrosa* DC., and *Xanthium strumarium* L. The grass-scrub growth is found at its best at the end of September and early October, when the sky gets cleared and provides longer hours of sunshine.

The general habitat may be classified into two types, depending on the depth and the character of the soil lying on them. The deep-soil-type locality is recognized by light coloured, sandy loam, having at least 60 cm. of depth of the upper soil. The characteristic species on this type in the rainy season are: *Bothriochloa pertusa* A. Camus, *Iseilema laxum* Hack., *Chloris virgata* Sw., *Heteropogon contortus* Beauv. ex Roem. & Schult., *Tragus biflorus* Schult., *Sehima nervosum* Stapf, *Polygala chinensis* L., *P. crotalarioides* Buch.-Ham., *Cyperus triceps* Endl., *Alysicarpus tetragonolobus* Edgew., *Zornia diphylla* Pers., *Indigofera linifolia* Retz., *Crotalaria medicaginea* Lam., *Heylandia latebrosa* DC., *Cassia pumila* Lam., *Boerhaavia diffusa* L., *Cleome monophylla* L., *Orthosiphon pallidus* Royle ex Benth., and *Biophytum sensitivum* DC. *Heylandia latebrosa* DC. grows profusely in this habitat. Early in the dry cold season, these plants are followed by *Andropogon pumilus* Roxb., which is readily recognized by its copper-coloured appearance. The thin-soil-type locality consists of a thin (5-10 cm.) deposit of colluvial soil lying on loose boulders of varying size, with the interstitial spaces filled up with the same matter. It has poor vegetational cover and the species are generally depauperated. The dominant species of the type during the rainy season are: *Indigofera cordifolia* Heyne ex Roth, *Glossocardia bosvallea* DC., *Borreria stricta* Sch., *Boerhaavia diffusa* L., *Cyanotis fasciculata* Schult. f., *Cyperus triceps* Endl., *Melanocenchrus jacquemontii* J. & S., *Aristida funiculata* Trin. & Rupr., *A. depressa* Retz.,

Oropetium thomaeum Trin., and *Digitaria adscendens* Henr.

The number of rainy days during the winter is significant, as it effects growth especially when the temperature is not too low for it, the minimum rarely falling below 10°C. There is an increase in the intensity of biotic factors in the cold season on account of grazing, and many grasses and herbs dry up on exposed situations but persist among the bushy shrubs and shades of trees, where the top soil is moist for a slightly longer period. As the winter season ensues, the monsoon vegetation disappears with the same rapidity as it came during the rains. The common species of this season are: *Launaea nudicaulis* Hook. f., *Vicoa indica* DC., *Borreria stricta* Schum., *Enicostemma verticillatum* Engl., *Psoralea corylifolia* L., *Merremia emarginata* Hall. f., *Eremopogon foveolatus* Stapf, *Setaria tomentosa* Kunth, *Dichanthium annulatum* Stapf, *D. caricosum* Camus, *Heteropogon contortus* Beauv. ex Roem. & Schult., *H. insignis* Thwaites, *Ischaemum rugosum* Salisb., *Andropogon pumilus* Roxb., *Cymbopogon martinii* Wats., *Themeda quadrivalvis* Kuntze, *T. triandra* Forsk. and *Sorghum deccanense* Stapf ex Raiz.

The real hot season starts in about the middle of April when the conditions for plant growth become very severe. The soil being argillaceous and thin, loses most of the moisture. The plants during these dry months of the year show various xeromorphic features such as thorns, woolly tomentum or stellate hairs, coating of wax, thick cuticle, leathery foliage etc. The common ones are: *Tridax procumbens* L., *Echinops echinatus* Roxb., *Datura innoxia* Mill., *Solanum xanthocarpum* Schrad. et Wendl., *Xanthium strumarium* L., *Argemone mexicana* L., *Chrozophora rotleri* Klotzsch., *Heliotropium eichwaldi* Steud. ex DC., *Bothriochloa pertusa* A. Camus, and *Dichanthium annulatum* Stapf. The ground, by this time, becomes bare and only small patches of dry, brown vegetation can be seen here and there. With the increase in the velocity of dry wind, sheet erosion of the exposed surface soil also begins.

The ragged, undulating grounds are not so frequently visited by the grazing animals. A large number of herbs and shrubs are found in this habitat in all seasons.

PLANT COMMUNITIES

In areas with dry, shallow soils and exposed rocks, *Cyanotis fasciculata* Schult. f., *Oropetium thomaeum* Trin., and *Melanocenchrus jacquemontii* J. & S., appear to be the first stage of colonization. The next stage is the establishment of *Aristida* species (*A. funiculata* Trin. & Rupr., and *A. depressa* Retz.) with the annual form of *Heteropogon contortus* Beauv. ex Roem. & Schult. A large portion of the unprotected lands on the plateau remain in the *Aristida* stage, with scattered patches of all stages down to the bare rock. In areas where such grass species have not become established, weeds and ruderal plants occupy much of the ground. These include *Glossocardia bosvallea* (L. f.) DC., *Borreria stricta* (L. f.)

Schum., *Zornia diphylla* Pers., *Vicoa indica* (Willd.) DC., and *Scilla indica* Baker.

In over-grazed, dry, eroded tracts, *Xanthium strumarium* L., occupies large stretches of land and often forms a pure community. *Cassia tora* L., *C. occidentalis* L., *Tephrosia purpurea* Pers., and *Crotalaria medicaginea* Lam., are also found in similar situations. Soon after the early monsoon showers, *Cassia tora* L. spreads like wild fire and often grows to the exclusion of all other annual herbs. With the approach of winter, it is gradually replaced by *Xanthium strumarium* L., till the latter completely dominates the vegetation.

The grasslands show different grass associations in different habitat features. The important types are:

(1) **Black cotton soil**: The characteristic species of the grasslands on the black cotton soil are: *Sehima sulcata* A. Camus, *S. nervosum* Stapf, *Ischaemum pilosum* Hack., *Chrysopogon fulvus* Chiov., *Dichanthium annulatum* Stapf, *D. caricosum* A. Camus, *Heteropogon contortus* Beauv. ex Roem. & Schult., *H. insignis* Thwaites, *Iseilema laxum* Hack., and *Bothriochloa pertusa* A. Camus.

(2) **Low-lying lands**: Here the soils are generally alluvial, although that formed out of trap rock is quite frequent. The grass association in these tracts is composed of *Themeda quadrivalvis* Kuntze, *T. triandra* Forsk., *Dichanthium annulatum* Stapf, *D. caricosum* A. Camus, *Ischaemum rugosum* Salisb., and *I. indicum* Merr. (Syn. *I. aristatum* Auct., non Linn.).

(3) **Canal banks**: *Coix lachryma-jobi* L., dominates the vegetation of pastures along canal banks, forming pure and mixed communities. In the latter case, it is associated with *Scleria tessellata* Willd., *Cyperus alopecuroides* Rottb., *Echinochloa colona* Link, *Leptochloa panicea* Ohwi, *Eriochloa procera* Hubb., and *Alysicarpus bupleurifolius* DC.

(4) **Hilly areas**: The hilly areas of Asirgarh consist principally of *Cymbopogon martinii* Wats., *Themeda quadrivalvis* Kuntze, *T. triandra* Forsk., *Heteropogon contortus* Beauv. ex Roem. & Schult., *Ischaemum indicum* Merr. (Syn. *I. aristatum* Auct., non Linn.), *Sehima nervosum* Stapf, *Apluda mutica* L. var. *aristata* Pilger, *Eremopogon foveolatus* Stapf, and *E. tuberculatus* Camus. This type has following sub-types:

(i) **Cymbopogon sub-type**: The dominant grass is *Cymbopogon martinii* Wats., which frequently occupies large areas of open plateau lands. This type has poor grazing value. It yields the commercial Rusa grass oil.

(ii) **Themeda sub-type**: *Themeda quadrivalvis* Kuntze, and *T. triandra* Forsk., are the principal species of this sub-type. The species are gregarious in growth, covering large tracts of land to the exclusion of all other grasses and give a characteristic appearance to the hilly slopes.

(iii) **Heteropogon sub-type**: It arises following periodic burning and covers large tracts of land. The principal species is *H. contortus* Beauv. ex Roem. & Schult., confined more to open, hilly slopes.

(iv) **Eremopogon sub-type**: The dominant species of

this sub-type is *Eremopogon foveolatus* Stapf, covering large tracts of ragged, undulating grounds. This type has good fodder value, both in the green and dry states.

ECOLOGICAL ASPECTS

The consensus of opinion among ecologists is that the grassy scrub vegetation in Madhya Pradesh owes its existence to the degradation under human influences (Troup, 1921; Champion, 1939; Whyte, 1957; Puri, 1959; Bhatia, 1959). Since the post-glacial period through pre-historic and historic times, the climax ever-green vegetation over most parts of India has suffered greatly from natural changes and anthropogenic interferences. The general effect is degradation of the high forest to savannah types with open tree cover and herbaceous or shrubby undergrowth; the latter dominated by weeds, aliens and grasses. Thus, in considering the ecological status of the forest of this plateau, the factor of greatest importance would include man himself. He changed the indigenous flora by fire, grazing and cutting, and by general deterioration of the soil (clearing, cultivation, after-abandonment, periodic burning etc.). It seems clear from the evidence that if the retrogressive influence of the biotic factors were removed, the vegetation would pass through progressively higher forest stages.

ENUMERATION OF SPECIES

A complete list of plants collected by the author from Khandwa plateau is given below. The classification of Bentham and Hooker is followed and the species under each family are arranged in an alphabetical manner. Data on the frequency of their occurrence and relative abundance during the year are also added. (The three seasons are denoted by R, W and S. a=abundant; c=common; f=frequent; Cd=co-dominant; O=occasional; r=rare).

Name of the Species	Phenology		
	R	W	S
DICOTYLEDONS			
MENISPERMACEAE			
<i>Cissampelos pareira</i> L.	c	c	—
<i>Cocculus hirsutus</i> Diels	O	c	—
PAPAVERACEAE			
<i>Argemone mexicana</i> L.	—	f	f
CAPPARIDACEAE			
<i>Cleome monophylla</i> L.	c	—	—
<i>C. viscosa</i> L.	O	—	—
FLACOURTIACEAE			
<i>Flacourtia indica</i> (Burm. f.) Merr. (<i>F. sepiaria</i> Roxb.; <i>F. ramontchi</i> L'Hérit.)	O	O	O

Name of the Species	Phenology		
	R	W	S
POLYGALACEAE			
<i>Polygala chinensis</i> L.	f	—	—
<i>P. crotalarioides</i> Buch.-Ham.	f	—	—
PORTULACACEAE			
<i>Portulaca oleracea</i> L.	f	f	f
MALVACEAE			
<i>Abelmoschus ficulneus</i> (L.) Wight & Arn. (<i>Hibiscus ficulneus</i> L.)	O	—	—
<i>Abutilon indicum</i> (L.) Sweet	O	O	O
<i>Hibiscus micranthus</i> L. f.	O	—	—
<i>Malvastrum coromandelianum</i> (L.) Garcke (<i>M. tricuspidatum</i> A. Gray)	O	—	—
<i>Sida spinosa</i> L.	O	—	—
<i>S. veronicifolia</i> Lam.	f	r	—
TILIACEAE			
<i>Corchorus fascicularis</i> Lam.	O	—	—
<i>C. olitorius</i> L.	O	—	—
<i>C. tridens</i> L.	O	—	—
<i>C. trilobularis</i> L.	O	—	—
<i>Grewia hirsuta</i> Vahl	O	O	O
<i>G. tiliacifolia</i> Vahl	O	O	O
<i>Triumfetta bartramia</i> L.	O	—	—
<i>T. rotundifolia</i> Lam.	O	O	—
ZYGOPHYLLACEAE			
<i>Tribulus terrestris</i> L.	f	r	—
GERANIACEAE			
<i>Biophytum sensitivum</i> (L.) DC.	c	r	—
CELASTRACEAE			
<i>Maytenus senegalensis</i> (Lam.) Exell (<i>Gymnosporia montana</i> Benth.)	c	c	c
RHAMNACEAE			
<i>Zizyphus mauritiana</i> Lam. (<i>Z. jujuba</i> Lam., non Mill.)	O	O	O
<i>Z. nummularia</i> (Burm. f.) Wight & Arn. (<i>Z. rotundifolia</i> Lam.)	f	f	f
AMPELIDACEAE			
<i>Ampelocissus latifolia</i> Planch. (<i>Vitis latifolia</i> Roxb.)	O	—	—
<i>Cayratia carnosa</i> Gagnep.	c	—	r
<i>Cissus repanda</i> Vahl (<i>Vitis repanda</i> Wight & Arn.)	c	—	r
SAPINDACEAE			
<i>Cardiospermum halicacabum</i> L.	O	—	—
PAPILIONACEAE			
<i>Abrus precatorius</i> L.	c	O	—
<i>Alysicarpus bupleurifolius</i> DC.	f	O	—
<i>A. longifolius</i> Wight & Arn.	f	O	—
<i>A. monilifer</i> DC.	f	O	—
<i>A. pubescens</i> Law.	O	O	—
<i>A. rugosus</i> (Willd.) DC.	f	O	—
<i>A. tetragonolobus</i> Edgew.	f	O	—
<i>A. vaginalis</i> (L.) DC.	f	O	—
<i>Atylosia platycarpa</i> Benth.	c	c	—
<i>Butea monosperma</i> (Lam.) Taub.	O	O	O
<i>B. monosperma</i> var. <i>lutea</i> Maheshw.	r	r	r
<i>Crotalaria medicaginea</i> Lam.	c	r	—
<i>C. orixensis</i> Willd.	f	—	—
<i>Desmodium parvifolium</i> DC.	O	O	—
<i>D. triflorum</i> (L.) DC.	c	O	—
<i>Heylandia latebrosa</i> DC.	a	O	O
<i>Indigofera cordifolia</i> Heyne ex Roth	a	O	—
<i>I. enneaphylla</i> L.	f	—	—
<i>I. glandulosa</i> Willd.	O	O	—

Name of the Species	Phenology		
	R	W	S
<i>Indigofera hirsuta</i> L.	O	—	—
<i>I. linifolia</i> Retz.	c	—	—
<i>I. trifoliata</i> L.	O	O	—
<i>I. trita</i> L.	O	O	—
<i>Lathyrus aphaca</i> L.	—	O	—
<i>L. sativus</i> L.	—	O	—
<i>Mucuna pruri</i> Hook.	O	O	—
<i>Phaseolus trilobus</i> Ait.	O	—	—
<i>Psoralea corylifolia</i> L.	—	f	O
<i>Rhynchosia capitata</i> DC.	O	O	—
<i>R. minima</i> (L.) DC.	f	O	—
<i>Tephrosia pumila</i> Pers.	c	—	—
<i>T. purpurea</i> (L.) Pers.	c	O	O
<i>T. strigosa</i> (Dalz.) Sant. & Maheshw. (<i>T. tenuis</i> Wall.)	O	O	—
<i>Teramnus labialis</i> (L. f.) Spreng.	c	O	—
<i>Zornia diphylla</i> (L.) Pers.	f	O	—
CAESALPINIACEAE			
<i>Cassia occidentalis</i> L.	O	—	—
<i>C. pumila</i> Lam.	f	r	—
<i>C. tora</i> L.	c	—	—
MIMOSACEAE			
<i>Acacia caesia</i> Wight & Arn.	O	O	O
<i>A. chundra</i> Willd. (<i>A. sundra</i> DC.)	O	O	O
<i>A. leucophloea</i> Willd.	O	O	O
<i>A. nilotica</i> var. <i>tomentosa</i> (Benth.) Cuf. (<i>A. arabica</i> Willd.)	O	O	O
<i>A. senegal</i> Willd.	O	O	O
<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	O	O	O
<i>Mimosa hamata</i> Willd.	c	c	c
<i>M. rubicaulis</i> Lam.	O	O	O
COMBRETACEAE			
<i>Combretum ovalifolium</i> Roxb.	—	O	O
PASSIFLORACEAE			
<i>Passiflora foetida</i> L.	c	—	—
CUCURBITACEAE			
<i>Bryonopsis laciniosa</i> Naud.	c	—	—
<i>Coccinia cordifolia</i> (L.) Cogn.	c	O	—
<i>Melothria maderaspatana</i> (L.) Cogn.	c	—	—
CACTACEAE			
<i>Opuntia dillenii</i> Haw.	O	O	O
MOLLUGINACEAE			
<i>Mollugo nudicaulis</i> Lam.	O	—	—
AIZOACEAE			
<i>Trianthema portulacastrum</i> L.	c	O	—
RUBIACEAE			
<i>Borreria stricta</i> (L. f.) Schum.	a	f	r
<i>Xeromphis spinosa</i> (Thunb.) Keay (<i>Randia dumetorum</i> Lam.)	O	O	O
<i>X. uliginosa</i> (Retz.) Maheshw. (<i>Randia uliginosa</i> DC.)	O	O	O
COMPOSITAE			
<i>Acanthospermum hispidum</i> DC.	O	r	—
<i>Bidens biternata</i> (Lour.) Merr. & Sherff (<i>B. pilosa</i> Auct., non L.)	O	—	—
<i>Blainvillea latifolia</i> (L.) DC. (<i>B. rhomboidea</i> Cass.)	O	O	—
<i>Blumea lacera</i> (Burm. f.) DC.	—	O	r
<i>B. obliqua</i> (L.) Druce (<i>B. amplexans</i> DC.)	—	O	—
<i>B. obliqua</i> var. <i>arenaria</i> (DC.) Maheshw.	—	O	—
<i>Echinops echinatus</i> Roxb.	f	f	f

Name of the Species	Phenology			Name of the Species	Phenology		
	R	W	S		R	W	S
<i>Eclipta prostrata</i> L. (<i>E. alba</i> Hassk.; <i>E. erecta</i> L.)	O	O	O	MARTYNIACEAE			
<i>Emilia sonchifolia</i> (L.) DC.	—	O	—	<i>Martynia annua</i> L.	O	—	—
<i>Glossocardia bosvallea</i> (L. f.) DC. (<i>G. linearifolia</i> Cass.)	c	O	—	ACANTHACEAE			
<i>Lagascea mollis</i> Cav.	c	c	—	<i>Andrographis echinoides</i> (L.) Nees	f	f	—
<i>Launaea nudicaulis</i> Hook. f.	—	f	—	<i>Blepharis maderaspatensis</i> (L.) Heyne ex Roth	—	O	—
<i>Sonchus arvensis</i> L.	—	f	—	(<i>B. boerhaviaefolia</i> Pers.)	—	O	—
<i>Tridax procumbens</i> L.	c	c	c	<i>B. molluginifolia</i> Pers.	—	O	—
<i>Vernonia cinerea</i> (L.) Less.	c	c	—	<i>Hemigraphis dura</i> T. Anders.	—	O	O
<i>Vicoa indica</i> (Willd.) DC. (<i>Inula indica</i> Willd.)	—	f	—	<i>Justicia simplex</i> D. Don	O	—	—
<i>Volutarella ramosa</i> (Roxb.) Sant.	O	—	O	<i>Lepidagathis cristata</i> Willd.	—	f	f
<i>Xanthium strumarium</i> L.	c	O	f	<i>Peristrophe bicalyculata</i> (Retz.) Nees	O	O	—
PRIMULACEAE				<i>Rungia repens</i> (L.) Nees	f	O	—
<i>Anagallis arvensis</i> ssp. <i>arvensis</i> (<i>A. arvensis</i> Auct. indic.)	—	O	—	VERBENACEAE			
APOCYNACEAE				<i>Clerodendrum phlomidis</i> L.f.	c	c	c
<i>Carissa spinarum</i> L.	O	O	O	<i>Lantana camara</i> var. <i>aculeata</i> (L.) Mold. (<i>L. camara</i> Auct., non L.)	c	c	c
ASCLEPIADACEAE				<i>L. indica</i> Roxb.	O	O	O
<i>Calotropis gigantea</i> (L.) R. Br.	O	O	O	LABIATAE			
<i>C. procera</i> R. Br.	O	O	O	<i>Leucas procumbens</i> Desf.	—	f	f
<i>Cryptostegia grandiflora</i> R. Br.	c	c	c	<i>Ocimum americanum</i> L.	O	r	—
<i>Dregea volubilis</i> Benth. ex Hook. f.	O	O	O	<i>Orthosiphon pallidus</i> Royle ex Benth.	f	O	—
<i>Hemidesmus indicus</i> R. Br.	c	c	—	NYCTAGINACEAE			
<i>Leptadenia reticulata</i> Wight & Arn.	c	c	—	<i>Boerhaavia diffusa</i> L.	c	c	O
<i>Oxystelma esculentum</i> R. Br.	O	—	—	AMARANTHACEAE			
<i>Pergularia daemia</i> (Forsk.) Chiov. (<i>Daemia extensa</i> R. Br.)	c	O	—	<i>Achyranthes aspera</i> var. <i>porphyristachya</i> Hook. f.	O	O	O
<i>Telosma pallida</i> (Roxb.) Craib (<i>Pergularia pallida</i> Wight & Arn.)	c	O	—	<i>Alternanthera repens</i> (L.) Kuntze	O	O	—
GENTIANACEAE				<i>Amaranthus gracilis</i> Desf. (<i>A. viridis</i> Hook. f., non L.)	f	—	—
<i>Canscora diffusa</i> R. Br.	—	O	—	<i>A. spinosus</i> L.	f	O	—
<i>Enicostemma verticillatum</i> (L.) Engl. (<i>E. littorale</i> Blume)	c	f	—	<i>Celosia argentea</i> L.	O	—	—
<i>Exacum pedunculatum</i> L.	—	O	—	<i>Digera alternifolia</i> (L.) Asch. ap. Schwfth. (<i>D. arvensis</i> Forsk.)	f	—	—
<i>Hoppea dichotoma</i> Willd.	—	O	—	<i>Pupalia lappacea</i> (L.) Juss.	O	O	—
BORAGINACEAE				POLYGONACEAE			
<i>Heliotropium eichwaldi</i> Steud. ex DC.	O	—	f	<i>Polygonum plebeium</i> R. Br.	f	f	f
<i>H. strigosum</i> Willd.	f	O	—	ARISTOLOCHIACEAE			
<i>Trichodesma indicum</i> (L.) R. Br.	O	—	—	<i>Aristolochia bracteata</i> Retz.	f	O	—
CONVOLVULACEAE				EUPHORBIACEAE			
<i>Convolvulus pluricaulis</i> Choisy	O	O	O	<i>Acalypha ciliata</i> Forsk.	O	—	—
<i>Evolvulus alsinoides</i> L.	f	O	—	<i>A. indica</i> L.	f	—	—
<i>Ipomoea angulata</i> Lam. (<i>I. coccinea</i> Clarke)	—	c	r	<i>Chrozophora rotleri</i> Klotzsch.	—	—	f
<i>I. muricata</i> (L.) Jacq.	c	O	—	<i>Croton bonplandianum</i> Baill. (<i>C. sparciflorum</i> Morong.)	O	—	—
<i>I. obscura</i> (L.) Ker.	c	—	—	<i>Euphorbia hirta</i> L.	c	c	O
<i>I. pentaphylla</i> Jacq.	c	—	—	<i>E. hypericifolia</i> L.	c	O	—
<i>I. pes-tigridis</i> L.	c	—	—	<i>E. prostrata</i> Ait.	c	c	c
<i>I. tropica</i> Sant. & Pat. (<i>I. calycina</i> Clarke, non Meissn.)	c	—	—	<i>E. thymifolia</i> L.	O	O	O
<i>Merremia emarginata</i> Hall. f.	f	f	—	<i>Phyllanthus fraternus</i> Webst. (<i>P. niruri</i> Hook. f., non L.)	f	—	—
<i>Rivea hypocrateriformis</i> Choisy	c	O	—	<i>P. maderaspatensis</i> L.	O	—	—
SOLANACEAE				<i>P. simplex</i> Retz.	O	—	—
<i>Datura innoxia</i> Mill. (<i>D. metel</i> Sims., non L.)	—	O	O	<i>Securinega leuco-pyrus</i> (Willd.) Muell. -Arg.	f	f	f
<i>D. metel</i> L. (<i>D. fastuosa</i> L.)	—	O	O	(<i>Flueggea leucopyrus</i> Willd.)	f	f	f
<i>Nicotiana plumbaginifolia</i> Viv.	—	—	O	<i>Tragia hildebrandtii</i> Muell.-Arg.	O	—	O
<i>Physalis minima</i> L.	O	—	—	(<i>T. involucreta</i> L. var. <i>cannabina</i> Muell. -Arg.)	O	—	O
<i>Solanum nigrum</i> L.	—	O	O				
<i>S. xanthocarpum</i> Sch. & Wendl.	O	O	O				
SCROPHULARIACEAE							
<i>Striga densiflora</i> Benth.	O	r	—				
<i>S. euphrasiodes</i> Benth.	O	r	—				

Name of the Species	Phenology		
	R	W	S
MONOCOTYLEDONS			
LILIACEAE			
<i>Asparagus racemosus</i> Willd.	O	O	—
<i>Scilla indica</i> Baker	f	—	—
COMMELINACEAE			
<i>Commelina benghalensis</i> L.	c	—	—
<i>C. forskalaiei</i> Vahl	O	—	—
<i>C. obliqua</i> Buch.-Ham.	O	—	—
<i>Cyanotis axillaris</i> (L.) Schult. f.	—	O	—
<i>C. fasciculata</i> Schult. f.	O	O	—
PALMACEAE			
<i>Phoenix acaulis</i> Roxb.	c	c	c
<i>P. sylvestris</i> Roxb.	O	O	O
CYPERACEAE			
<i>Cyperus alopecuroides</i> Rottb.	f	f	—
<i>C. compressus</i> L.	c	O	—
<i>C. rotundus</i> L.	c	O	—
<i>C. triceps</i> (Rottb.) Endl.	c	O	—
<i>Scleria tessellata</i> Willd.	f	O	—
GRAMINEAE			
<i>Alloteropsis cimicina</i> (L.) Stapf	O	—	—
<i>Andropogon pumilus</i> Roxb.	O	c	—
<i>Apluda mutica</i> var. <i>aristata</i> (L.) Pilger	c	O	—
<i>Aristida depressa</i> Retz.	a	O	—
(<i>A. adscensionis</i> Hook. f., non L.)			
<i>A. funiculata</i> Trin. & Rupr.	a	O	—
<i>Bothriochloa pertusa</i> (L.) Camus	c	O	r
<i>Brachiaria eruciformis</i> (J. E. Sm.) Griseb.	f	O	—
<i>B. ramosa</i> (L.) Stapf	a	O	—
<i>Chloris barbata</i> (L.) Sw.	f	O	—
<i>C. virgata</i> Sw.	f	O	—
<i>Chrysopogon fulvus</i> (Spreng.) Chiov.	f	O	—
(<i>C. montanus</i> Trin.)			
<i>Coix lachryma-jobi</i> L.	c	a	O
<i>Cymbopogon martinii</i> (Roxb.) Wats.	—	Cd	f
<i>Cynodon dactylon</i> (L.) Pers.	a	c	O
<i>Dactyloctenium aegyptium</i> (L.) Beauv.	f	O	—
(<i>Eleusine aegyptiaca</i> Desf.)			
<i>D. scindicum</i> Boiss.	f	O	—
(<i>Eleusine aristata</i> Ehrenb.)			
<i>Dichanthium annulatum</i> (Forsk.) Stapf	f	f	f
<i>D. caricosum</i> (L.) Camus	—	f	—
<i>Digitaria adscendens</i> (H.B. & K.) Henr.	c	O	—
<i>D. setigera</i> Roth apud Roem. & Schult.	c	O	—
<i>Echinochloa colona</i> (L.) Link	c	O	—
<i>Eragrostis cilianensis</i> Link ex Lutati	c	—	—
<i>E. pilosa</i> (L.) Beauv.	c	—	—
<i>Eremopogon foveolatus</i> (Del.) Stapf	a	c	—
<i>E. tuberculatus</i> (Hack.) Camus	c	c	—
<i>Eriochloa procera</i> (Retz.) Hubb.	c	O	—
<i>Hackelochloa granularis</i> (L.) Kuntze	f	O	—
(<i>Manisuris granularis</i> L. f.)			
<i>Heteropogon contortus</i> Beauv. ex Roem. & Schult.	f	f	r
<i>H. insignis</i> Thwaites	O	c	O
<i>Imperata cylindrica</i> (L.) Beauv.	f	—	—
<i>Ischaemum indicum</i> (Houtt.) Merr.	f	—	—
(<i>I. aristatum</i> Auct., non L.)			
<i>I. laxum</i> R. Br.	f	—	—
<i>I. pilosum</i> Hack.	c	O	—
<i>I. rugosum</i> Salisb.	—	c	—
<i>Iseilema laxum</i> Hack.	c	O	—
<i>Leptochloa panicea</i> (Retz.) Ohwi	c	O	—
(<i>L. filiformis</i> Beauv.)			
<i>Melanocenchrus jacquemontii</i> J. & S.	a	—	—
(<i>Gracilea royleana</i> Hook. f.)			

Name of the Species	Phenology		
	R	W	S
<i>Mnesithea laevis</i> (Retz.) Kunth	—	O	—
(<i>M. perforata</i> Haines)			
<i>Oropetium thomaeum</i> Trin.	a	—	—
<i>Saccharum spontaneum</i> L.	O	O	—
<i>Sehima nervosum</i> (Rottl.) Stapf	c	—	—
(<i>Ischaemum laxum</i> R. Br.)			
<i>S. sulcata</i> (Hack.) A. Camus	c	—	—
(<i>Ischaemum sulcatum</i> Hack.)			
<i>Setaria glauca</i> (L.) Beauv.	f	—	—
<i>S. tomentosa</i> (Roxb.) Kunth	c	f	—
(<i>S. intermedia</i> Roem. & Schult.)			
<i>S. verticillata</i> (L.) Beauv.	f	O	—
<i>Sorghum deccanense</i> Stapf ex Raiz.	—	c	—
(<i>Andropogon purpureo-sericeus</i> Hook. f.)			
<i>S. halepense</i> (L.) Pers.	O	c	r
<i>Sporobolus diander</i> (Retz.) Beauv.	c	O	—
<i>S. marginatus</i> Hochst. ex A. Rich.	—	O	c
<i>Tetrapogon tenellus</i> Chiov.	c	O	—
(<i>Chloris tenella</i> Koenig)			
<i>Themeda quadrivalvis</i> (L.) Kuntze	Cd	Cd	O
<i>T. triandra</i> Forsk.	Cd	Cd	O
(<i>Anthistiria imberbis</i> Retz.)			
<i>Tragus biflorus</i> (Roxb.) Schult.	c	O	—
(<i>T. racemosus</i> Hook. f., non All.)			

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