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RESEARCH ARTICLE

Taxonomic diversity of rainy season weeds in different agricultural ecosystems in the Moradabad district, Uttar Pradesh, India

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Abstract

A detailed study of rainy season weeds was done in agricultural land in the Moradabad district (28°-21' to 28°-16' Latitude North and 78°-4' to 79° Longitude East) from May 2021 to June 2022. The study looked at five main crops: three cereals, one sugar-producing crop, and one oil-producing crop. During the research period, 144 weed species (97 broad leaf weeds, 41 grassy weeds, and 6 sedge weeds) were recorded from 32 angiosperm phylogenetic group families. Sugarcane fields had the most weed species collected (136), followed by maize fields (83), Mentha (68), pearl millet (63), and rice fields (58). A floristic and systematic examination of weeds finds that the top seven weed families, with Poaceae (40 species), are the most dominant. 22 weed species were common in all the aforementioned five crops, and they generally belong to the different plant families. Poaceae (10 species), the worry weed species families were also organised in this part based on the APG-IV classification system and the concern grade system. Commelinids account for the biggest percentage (33%), followed by Fabids (15%), Lamiids (14%), Superasterids (14%), Campanulids (12%), Malvids (10%), Eudicots (1%), and Asterids (1%). In the floristic study of different crops, maximum weeds flowering is reported in the month of August by different (33) weed species and minimum flowering in the month of January by (1) weed species, whereas maximum fruiting is reported in the month of December by (28) weeds and minimum in the months of May (1sp.) and July (1sp.).

Keywords: Agriculture; APG –IV; Flowering; Moradabad; Rainy season; Weeds

1. Introduction

Variation in flowering time relative to vegetative phenology, especially leafing events (Singh and Kushwaha, 2006), is induced by a variety of factors (significant rain in winter/summer, decreasing or increasing photoperiod, or drought-induced leaf fall) and results in a number of flowering patterns in tropical trees (Borchert et al., 2004). Phenological studies provide information on plant functional rhythms and plant communities (Ralhan et al., 1985). Environmental conditions, both biotic and abiotic, can time various phenological events (Estabrook et al., 1982). The success of weed management programs that are based on ecological principles and weed biology depends largely upon a better understanding of how environmental factors affect the life history traits, growth, and competitive interactions of crops and weeds, and particularly upon the ability to predict crop and weed phenology (Ghersa and Holt, 1995). Weeds cause around one-third of all agricultural pest losses (DWR, 2015). In addition to microbes (parasites, microorganisms), insects, rodents, nematodes, mites, birds, and other less serious animal pests, weeds often pose the greatest threat to declining agricultural output (Oerke, 2006). Weeds can contaminate crops and make harvesting difficult, reducing crop quality (Sonawane and Patil, 2024). Invasive species like weeds reduce agricultural yields, raise farming costs, and cause major ecological damage (Rao et al., 2020). Weeds have a considerable impact on agricultural output, and inadequate treatment can compound the problem. Reducing weed intensity is critical for maintaining and enhancing crop output (Rao et al., 2020). Weeds play a significant role in agricultural productivity. Weeds compete with crops for resources such as water, space, nutrients, and light. This fight between weeds and agricultural plants reduces yields and affects production quality (Sonawane and Patil, 2024). Ruderals are weed plants that thrive around rubbish heaps, urban wastes, docks, footpaths, railways, road edges, and other areas extensively touched by human habitation, industry, and trade (Frenkel, 1977). Effective weed management is crucial for crop yield, quality, and long-term agricultural productivity (Kumar et al., 2024). The absence of native predators or the presence of novel weapons like allelopathic have been cited as reasons for plant species' success in alien environments (Hierro and Callaway, 2003). Agro-ecosystems are environments where invasive weed species have a real financial impact because they reduce crop yields (Cousens and Mortimer, 1995). Certain alien species imported for human benefit are known to inflict devastation on the ecosystem and economy (Souza et al., 2018). The Indian flora comprises around 40% foreign species, with 25% being invasive alien species (Singh, 2005). The proliferation of alien species causes serious ecological damage to native species richness and accelerates the loss of rare and sensitive taxa (Reddy, 2008; Yadav et al., 2016). Weeds often have a lot of seeds that can spread, which helps them become naturalised and spread into the surrounding areas (Pyšek et al., 2009). This makes biological invasions more likely to happen in the environment. Weed invasion into agricultural and natural environments is considered a primary cause of productivity loss in agriculture and biodiversity decline globally (Rai, 2022; Storkey et al., 2021). It is dangerous to bring new weed species into India because of the number of weed seeds that are present in damaged imported grain, as well as the types of weeds that are present and how likely they are to be able to find a suitable place to live and grow (Nagaraju et al., 2021; Sreekanth et al., 2022). Weeds are inadvertently seeded, annoying, difficult plants that thrive in undesirable locations (Sagar et al., 2023). In India, weeds have caused in excess of eleven billion dollars in revenue losses in only ten crops (Gharde et al., 2018). Climate change, causing rising CO_2 levels, higher temperatures, and more weather events, is expected to exacerbate issues in weed control (Clements and Jones, 2021; Malhi et al., 2021). Weed is not evenly spread across the landscape, and stains or dense woody structures reflect the infestation and spatial heterogeneity (Izquierdo et al., 2009; Iwara et al., 2011).

2. Material and methods

Moradabad district is situated in western U.P. between 28°-21´ to 28°-16´ Latitude North and 78°-4´ to 79° Longitude East. The Ramganga and Sot rivers divide it into three subdivisions within the great Gangetic plain. In the context of river systems, Moradabad is situated on the banks of the Ram-Ganga River, which originates from the Doodhatoli ranges and is a part of the Namik Glacier. From May 2021 to June 2022, planned, intensive field studies were done over a number of months and weather conditions in order to get the most accurate picture of weed species in different crops grown in the Moradabad district. These studies took place in eight blocks across four tehsils, looking at the phenological, biological, and diversity of different weeds (ruderals and agrestals). Information regarding phenological, biological spectrum and diversity of the weeds was collected from the field's survey of different types of ecosystems in the different villages of Moradabad district. The information was also gathered from knowledgeable locals, including landowners and elders. Field notes were taken on the plant, detailing its eco-botanical diagnostic charter. The collected weeds were identified using the documentation that was available, including the Flora of Uttar Pradesh vol. I. (Singh et al., 2016) and vol. II (Sinha and Shukla, 2020), Handbook on Weed Identification (Naidu, 2012), weeds just reported from the Global Compendium of Weeds (Randall, 2017). The collected weeds were arranged in different APG-IV families and grades according to the modern system of classification (Chase et al., 2016).

3. Results and discussion

The study of weeds in different agricultural crops of the Moradabad district shows 144 weed plants belonging to 32 families (Table 1) have been documented in the present study. Representation of the top-dominated families, among the plants studied, most of them belonged to the Poaceae (40 spp.), Asteraceae (16 spp.), Amaranthaceae (14 spp.), Fabaceae (11 spp.), Malvaceae (10 Spp.), Cyperaceae (6 Spp.), & Euphorbiaceae (4 spp.), and the rest of the species belonged to the Lythraceae (2), Lamiaceae (2), Papaveraceae (2), Nyctaginaceae (1), Cannabaceae (1), Apocynaceae (1), Apiaceae (2), Cucurbitaceae (3), Cleomaceae (1), Commelinaceae (1), Acanthaceae (3), Convolvulaceae (4), Verbenaceae (2), Plantaginaceae (3), Primulaceae (1), Solanaceae (3), Onagraceae (1), Rubiaceae (2), Oxalidaceae (1), Phyllanthaceae (1), Rhamnaceae). Commelinids grade represent three families, i.e. Poaceae, Cyperaceae and Commelinaceae; Fabids grade-seven families, i.e. Euphorbiaceae, Fabaceae, Cannabaceae, Cucurbitaceae, Oxalidaceae, Phyllanthaceae and Zygophyllaceae; Lamiids grade-eight families, i.e. Lamiaceae, Plantaginaceae, Apocynaceae, Acanthaceae, Convolvulaceae, Verbenaceae, Solanaceae and Rubiaceae; Superasterids grade-six families, i.e. Amaranthaceae, Nyctaginaceae, Plumbaginaceae, Polygonaceae, Portulacaceae and Aizoaceae; Campanulids grade-two families, i.e. Asteraceae and Apiaceae; Malvids grade-four families i.e. Malvaceae, Lythraceae, Cleomaceae and Onagraceae; Eudicots grade-one family, i.e. Papaveraceae and Asterids grade-one family, i.e. Primulaceae. In our study we also use the APG-IV system of classification, and the concern families and weed species are also arranged according to the concern grade system in this section, Grade Commelinids show the (33% weed spp.), followed by Fabids (15%), Lamiids (14%), Superasterids (14%), Campanulids (12%), Malvids (10%), Eudicots (1%) and Asterids(1% weed spp.). In this study (20) reported weed species belongs to Lamiids, (22) Fabids, (20) Superasterids, (47) Commelinids, (18) Campanulids, (14) Malvids, (02) Eudicots, (1weed sp.) Asterids grade of APG-IV.

In the present study, 67% of the reported species are broad leaves weeds, 29% grassy weeds, and 04% sedge weeds. In the present study, 33% of the reported species were found in sugarcane crops followed by 20% in maize, 17% in mentha, 16% in pearl millet, and 14% in rice crops. In this botanical study, 22 weed species from different families were reported that were common in all the five reported crops. In the floristic study of different crops weeds, maximum flowering is reported in the month of August by 33 weed species, & minimum flowering is in January (1weed) month in the other hand the maximum fruiting is reported in December (28 weeds) month and minimum in May (1) and July (1) month. In the above floristic study of the weeds, 29 weeds show the flowering & fruiting around the year. With the help of the Global Weed Compendium, we also looked into where weeds came from. The results showed that 31% of weeds came from the TAF, followed by 25% from the AF, 15% from N/A, 8% from SAM, 5% from EU, 3% from NAM, 2% from TAF, CAM, COS, EA, and 1% from CA, AU, MX, and BZ. Wanjari et al (2001) reported the following weed species in the rainy season crop *Helianthus annus* from the Indian Agricultural Research Institute's Research Farm in New Delhi: *Trianthema portulacastrum, Digera arvensis, Acrachne racemosa, Dactyloctenium aegyptium, Digitaria sanguinalis, Echinochloa colonum, Eragrostis tenella, Tribulus terrestris, Commelina benghalensis,* and *Cyperus rotundus*. Thakur et al (2006) reported the following weed species from Madhya Pradesh: *Echinochloa colonum, Cyprus rotundus, Digera arvensis, Euphorbia geniculata, Amaranthus viridis,* and *Commelina benghalensis*. According to Duary and Mukherjee (2013), the most common weed species in wet season paddy fields in almost all nine districts of West Bengal were *Ludwigia parviflora, Cynodon dactylon, Digitaria sanguinalis, Echinochloa colonum, Eclipta alba, Cyperus iria, Cyperus compressus*, and *Alternanthera philoxeroides. Croton bonaplandianum, Cynodon dactylon, Cassia tora, Parthenium hysterophorus, Blumea lacera, Euphorbia hirta, Ageratum conyzoides, Xanthium strumarium,* and *Aerva lanata* were found in all districts of South Bengal, while *Pteris sp., Lantana camara, Tephrosia purpurea, Cassia occidentalis, Cannabis sativa,* and *Parthenium hysterophorus* were found in nine districts of West Bengal. Khan et al (2018) identified 285 rainy season weed species in Aligarh district (Uttar Pradesh, India) in four key crops. Tiwari et al (2020) reported phenological diversity of 57 weed species of 19 Angiospermic families from paddy fields of Mandakini valley, Uttarakhand, India. Following weed species were common in all the reported crops of the Moradabad district, i.e., *Acrachne racemosa, Alternanthera sessilis , Amaranthus spinosus , Amaranthus virdis , Boerhavia diffusa, Cynodon dactylon, Cyperus compressus, Cyperus difformis, Cyperus rotundus, Dactyloctenium aegyptium, Dichanthium annulatum, Digitaria ciliaris, Echinochloa crus-galli, Eleusine indica, Eragrostis unioloides, Euphorbia hirta, Oenothera laciniata, Parthenium hysterophorus, Phyllanthus amarus, Scoparia dulcis, Urochloa ramosa* and *Urochloa reptans*.

4. Conclusion

Phenological and systematic study of weeds in agricultural crops in the Moradabad district revealed 144 weed plants belonging to 32 families. The top-dominated families were Poaceae, Asteraceae, Amaranthaceae, Fabaceae, Malvaceae, Cyperaceae, and Euphorbiaceae. Apocynaceae, Apiaceae, Cucurbitaceae, Cleomaceae, Commelinaceae, Acanthaceae, Convolvulaceae, Verbenaceae, Plantaginaceae, Primulaceae, Solanaceae, Onagraceae, Rubiaceae, Oxalidaceae, Phyllanthaceae, and Rhamnaceae were the other families that had species. The study used the APG-IV system of classification, with Grade Commelinids representing 33% of weed species. The majority of the reported species were broad leaves weeds, 29% grassy weeds, and 4% sedge weeds. The study found 22 weed species common in all five crops. The floristic study revealed maximum flowering in August and minimum fruiting in January. The current study provides the deep insight and basic knowledge of different types of weed in agricultural crops. Research findings will also helpful to understand the distribution and eco-taxonomical aspect of the weed species with their phenological status with current taxonomical aspect.

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Author's contribution
Conceptualization of research work and designing of experiments (Sachin Sharma, S. P. Joshi); Execution of field experiments and data collection (Sachin Sharma, Manisha Pandey); Analysis of data and interpretation (Sachin Sharma, S. P. Joshi, Manisha Pandey); Preparation of manuscript (Sachin Sharma, S. P. Joshi, Manisha Pandey).

Conflict of interest: Authors have no conflict of interest.

Table 1. Rainy season weeds in different agro-ecosystem of Moradabad district, U.P, India.

Botanical Name	Family	FL	FR	APG-Grade	Origin	Crops Name					Types of weeds		
						Zm	Pa	So	Mp	Os	GW	SW	BLW
Abutilon indicum (L.) Sweet.	Malvaceae	Aug	Mar	Malvids	AF	*	*	So	*	*	-	-	BLW
Acalypha indica L.	Euphorbiaceae	Jul	Nov	Fabids	AF	*	*	So	*	*	-	-	BLW
Acanthospermum hispidum DC.	Asteraceae	Jul	Nov	Campanulids	BZ	*	*	So	*	*	-	-	BLW
Achyranthes aspera L	Amaranthaceae	Aug	Feb	Superasterids	NAF	*	*	So	*	*	-	-	BLW
Acrachne racemosa (B. Heyne ex Roth) Ohwi	Poaceae	Aug	Dec	Commelinids	AF	Zm	Pa	So	Mp	Os	GW	-	-
Aerva javanica (Burm.f.) Juss. ex Schult	Amaranthaceae	Aug	Jan	Superasterids	TAM	*	*	So	*	*	-	-	BLW
Aeschynomene indica L.	Fabaceae	Aug	Dec	Fabids	NAM	*	*	So	*	*	-	-	BLW
Ageratum conyzoides L.	Asteraceae	TY	TY	Campanulids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Ageratum houstonianum Mill.	Asteraceae	TY	TY	Campanulids	TAM	Zm	Pa	So	*	*	-	-	BLW
Alternanthera paronychioides A. St.-Hil.	Amaranthaceae	TY	TY	Superasterids	TAM	*	*	So	*	Os	-	-	BLW
Alternanthera philoxeroides (Mart.) Griseb.	Amaranthaceae	Apr	Oct	Superasterids	TAM	*	*	So	Mp	Os	-	-	BLW
Alternanthera pungens Kunth	Amaranthaceae	TY	TY	Superasterids	TAM	Zm	Pa	So	*	*	-	-	BLW
Alternanthera sessilis (L.) R.Br. ex DC.	Amaranthaceae	TY	TY	Superasterids	TAM	Zm	Pa	So	Mp	Os	-	-	BLW
Alysicarpus monilifer (L.) DC.	Fabaceae	Aug	Feb	Fabids	N/A	*	*	So	*	*	-	-	BLW
Amaranthus spinosus L.	Amaranthaceae	TY	TY	Superasterids	TAM	Zm	Pa	So	Mp	Os	-	--	BLW
Amaranthus viridis L.	Amaranthaceae	May	Oct	Superasterids	TAM	Zm	Pa	So	Mp	Os	-	-	BLW
Ammannia auriculata Willd.	Lythraceae	Oct	Dec	Malvids	NAM	*	*	*	*	Os	-	-	BLW
Ammannia baccifera L.	Lythraceae	Oct	Mar	Malvids	TAF	*	*	So	*	Os	-	-	BLW
Anisomeles indica (L.) Kuntze	Lamiaceae	Aug	Mar	Lamiids	N/A	*	*	So	*	Os	-	-	BLW
Argemone mexicana L.	Papaveraceae	Feb	Oct	Eudicots	SAM	Zm	Pa	So	*	*	-	-	BLW
Argemone ochroleuca Sweet	Papaveraceae	Feb	Jun	Eudicots	MX	Zm	Pa	So	*	*	-	-	BLW
Axonopus compressus (Sw.) P.Beauv.	Poaceae	Sep	Nov	Commelinids	TAM	Zm	Pa	So	Mp	*	GW	-	-
Bacopa monnieri (L.) Wettst.	Plantaginaceae	Sep	Apr	Lamiids	N/A	*	*	So	*	Os	-	-	BLW
Bidens pilosa L.	Asteraceae	Aug	Dec	Campanulids	TAM	Zm	Pa	So	*	*	-	-	BLW
Blumea lacera (Burm.f.) DC.	Asteraceae	Nov	Jan	Campanulids	TAM	*	*	*	*	Os	-	-	BLW
Boerhavia diffusa L.	Nyctaginaceae	Nov	Apr	Superasterids	AF	Zm	Pa	So	Mp	Os	-	-	BLW
Bothriochloa pertusa (L.) A.Camus	Poaceae	TY	TY	Commelinids	EU	Zm	Pa	So	*	Os	GW	-	-
Bulbostylis barbata (Rottb.) C.B.Clarke	Cyperaceae	Aug	Nov	Commelinids	AF	Zm	Pa	So	*	*	-	SW	-
Caesulia axillaris Roxb.	Asteraceae	Sep	Nov	Campanulids	N/A	*	*	So	Mp	Os	-	-	BLW
Cajanus scarabaeoides (L.) Thouars	Fabaceae	Sep	Feb	Fabids	AF	*	*	So	*	*	-	-	BLW
Cannabis sativa L	Cannabaceae	Mar	Dec	Fabids	N/A	Zm	Pa	So	Mp	*	-	-	BLW
Catharanthus pusillus (Murray) G. Don	Apocynaceae	Aug	Oct	Lamiids	TAM	*	*	So	Mp	Os	-	-	BLW
Celosia argentea L	Amaranthaceae	Aug	Dec	Superasterids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Cenchrus biflorus Roxb.	Poaceae	Nov	Apr	Commelinids	AF	*	*	So	*	*	GW	-	-
Cenchrus ciliaris L.	Poaceae	Dec	Apr	Commelinids	N/A	Zm	Pa	So	*	Os	GW	-	--
Centella asiatica (L.) Urb.	Apiaceae	Oct	Apr	Campanulids	SAM	*	*	So	*	*	-	-	BLW
Chamaecrista pumila (Lam.) V.Singh	Fabaceae	Aug	Nov	Fabids	TAM	*	*	So	*	*	-	-	BLW
Chenopodiastrum murale (L.) S.Fuentes, Uotila & Borsch	Amaranthaceae	Dec	Mar	Superasterids	EA	Zm	*	So	*	*		-	BLW
Chenopodium album L.	Amaranthaceae	Sep	Mar	Superasterids	AF	*	*	So	*	*	-	-	BLW
Chloris barbata Sw.	Poaceae	Sep	Jan	Commelinids	TAM	*	*	So	Mp	Os	GW	-	-
Chloris radiata (L.) Sw.	Poaceae	Oct	Jan	Commelinids	CAM	*	*	So	*	Os	GW	-	-
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	May	Nov	Fabids	AF	Zm	Pa	So	*	*	-	-	BLW
Cleome viscosa L.	Cleomaceae	Jul	Nov	Malvids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Coccinia grandis (L.) Voigt	Cucurbitaceae	Aug	Dec	Fabids	N/A	*	*	So	*	*	-	-	BLW
Commelina benghalensis L	Commelinaceae	Jun	Nov	Commelinids	AF	Zm	Pa	So	Mp	*	GW	-	-
Corchorus aestuans L.	Malvaceae	Aug	Feb	Malvids	TAM	Zm	Pa	So	*	Os	-	-	BLW
Crotalaria medicaginea Lam.	Fabaceae	Sep	Nov	Fabids	TAM	Zm	*	So	*	Os	-	-	BLW
Cucumis maderaspatanus L.	Cucurbitaceae	Aug	Jan	Fabids	N/A	*	Pa	So	*	*	-	-	BLW
Cyanthillium cinereum (L.) H.Rob.	Asteraceae	TY	TY	Campanulids	AU	Zm	Pa	So	*	Os	-	-	BLW
Cymbopogon coloratus (Hook.f.) Stapf	Poaceae	Mar	Dec	Commelinids	N/A	*	*	So	*	*	GW	-	-
Cynodon dactylon (L.) Pers.	Poaceae	TY	TY	Commelinids	N/A	Zm	Pa	So	Mp	Os	GW	-	-

Cyperus compressus L.	Cyperaceae	May	Dec	Commelinids	COS	Zm	Pa	So	Mp	Os	-	SW	-
Cyperus difformis L	Cyperaceae	July	Oct	Commelinids	AF	Zm	Pa	So	Mp	Os	-	SW	-
Cyperus iria L.	Cyperaceae	Aug	Jan	Commelinids	TAM	Zm	*	So	Mp	Os	-	SW	-
Cyperus rotundus L	Cyperaceae	TY	TY	Commelinids	AF	Zm	Pa	So	Mp	Os	-	SW	-
Dactyloctenium aegyptium (L.) Willd	Poaceae	Aug	Nov	Commelinids	AF	Zm	Pa	So	Mp	Os	GW	-	-
Dichanthium annulatum (Forssk.) Stapf	Poaceae	TY	TY	Commelinids	N/A	Zm	Pa	So	Mp	Os	GW	-	-
Dicliptera paniculata (Forssk.) I. Darbysh.	Acanthaceae	Sep	Apr	Lamiids	TAM	*	*	So	*	*	-	-	BLW
Digera muricata (L.) Mart.	Amaranthaceae	Jul	Apr	Superasterids	NAM	*	*	So	Mp	*	-	-	BLW
Digitaria ciliaris (Retz.) Koeler	Poaceae	Jul	Oct	Commelinids	N/A	Zm	Pa	So	Mp	Os	GW	-	-
Digitaria ischaemum (Schreb.) Muhl.	Poaceae	Oct	Dec	Commelinids	N/A	*	*	*	*	Os	GW	-	-
Digitaria sanguinalis L. (Scop.)	Poaceae	Sep	Nov	Commelinids	EU	Zm	Pa	So	Mp	*	GW	-	-
Dinebra retroflexa (Vahl) Panz.	Poaceae	Sep	Feb	Commelinids	TAM	Zm	Pa	So	Mp	*	GW	-	-
Dysphania ambrosioides (L.) Mosyakin & Clemants	Amaranthaceae	Feb	Apr	Superasterids	CAM	Zm	*	So	*	Os	-	-	BLW
Echinochloa crus-galli (L.) P.Beauv.	Poaceae	Oct	Dec	Commelinids	SAM	Zm	Pa	So	Mp	Os	GW	-	-
Eclipta prostrata (L.) L.	Asteraceae	TY	TY	Campanulids	TAM	*	*	So	Mp	Os	-	-	BLW
Eleusine indica (L.) Gaertn.	Poaceae	TY	TY	Commelinids	N/A	Zm	Pa	So	Mp	Os	GW	-	-
Emilia sonchifolia (L.) DC.	Asteraceae	Feb	Mar	Campanulids	TAM	*	*	So	*	*	-	-	BLW
Eragrostis minor Host	Poaceae	TY	TY	Commelinids	AF	Zm	*	So	Mp	Os	GW	-	-
Eragrostis pilosa (L.) P. Beauv	Poaceae	TY	TY	Commelinids	EA	Zm	*	So	Mp	Os	GW	-	-
Eragrostis tremula Hochst. ex Steud.	Poaceae	TY	TY	Commelinids	AF	*	*	*	Mp	Os	GW		
Eragrostis unioloides (Retz.) Nees ex Steud.	Poaceae	TY	TY	Commelinids	AF	Zm	Pa	So	Mp	Os	GW	-	-
Erigeron bonariensis L.	Asteraceae	June	Jan	Campanulids	SAM	Zm	*	So	*	*	-	-	BLW
Euphorbia hirta L	Euphorbiaceae	Aug	Nov	Fabids	TAM	Zm	Pa	So	Mp	Os	-	-	BLW
Euphorbia thymifolia L.	Euphorbiaceae	Aug	Dec	Fabids	SAM	*	*	So	Mp	*	-	-	BLW
Evolvulus nummularius (L.) L	Convolvulaceae	Jul	Apr	Lamiids	TAM	*	Pa	So	Mp	*	-	-	BLW
Fimbristylis dichotoma (L.) Vahl	Cyperaceae	Jan	Sep	Commelinids	AF	*	*	So	*	Os	-	SW	-
Gnaphalium polycephalum L.	Asteraceae	Mar	Apr	Campanulids	N/A	Zm	Pa	So	*	*	--	-	BLW
Gomphrena celosioides Mart.	Amaranthaceae	Jun	Apr	Superasterids	SAM	Zm	Pa	So	*	Os	-	-	BLW
Grangea maderaspatana (L.) Poir	Asteraceae	Dec	May	Campanulids	SAM	*	*	So	*	*	-	-	BLW
Hygrophila auriculata (Schumach.) Heine	Acanthaceae	Sep	Mar	Lamiids	EA	*	*	So	*	Os	-	-	BLW
Imperata cylindrica (L.) P.Beauv.	Poaceae	Oct	Jan	Commelinids	TAM	*	*	So	*	*	GW	-	-
Indigofera linnaei Ali	Fabaceae	Sep	Mar	Fabids	TAF	Zm	*	So	*	*	-	-	BLW
Ipomoea aquatica Forssk.	Convolvulaceae	Nov	Mar	Lamiids	AF	*	*	So	*	Os	-	-	BLW
Ipomoea nil (L.) Rotho	Convolvulaceae	Aug	Dec	Lamiids	CAM	*	*	So	*	*	-	-	BLW
Ipomoea pes-tigridis L.	Convolvulaceae	Aug	Nov	Lamiids	TAF	*	*	So	Mp	*	-	-	BLW
Lantana camara L.	Verbenaceae	TY	TY	Lamiids	TAM	*	*	So	*	*	-	-	BLW
Launaea procumbens (Roxb.) Ramayya & Rajagopal	Asteraceae	Mar	Sep	Campanulids	N/A	Zm	Pa	So	*	Os	-	-	BLW
Leptochloa chinensis (L.) Nees	Poaceae	Jul	Sep	Commelinids	AF	Zm	*	So	Mp	*	GW	-	-
Leptochloa panicea (Retz.) Ohwi	Poaceae	Jul	Sep	Commelinids	EU	Zm	*	So	Mp	Os	GW	-	-
Leucas cephalotes (Roth) Spreng	Lamiaceae	Jul	Apr	Lamiids	CA	*	Pa	So	*	*	-	-	BLW
Limnophila indica (L.) Druce	Plantaginaceae	TY	TY	Lamiids	N/A	*	*	*	*	Os	-	-	BLW
Lysimachia arvensis (L.) U.Manns & Anderb.	Primulaceae	Dec	Apr	Asterids	EU	*	*	So	Mp	Os	-	-	BLW
Malva parviflora L.	Malvaceae	Oct	Mar	Malvids	AF	*	*	So	*	*	-	-	BLW
Malvastrum coromandelianum (L.) Garcke	Malvaceae	Sep	Jan	Malvids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs	Poaceae	Apr	Sep	Commelinids	AF	Zm	*	So	Mp	*	GW	-	-
Mimosa pudica L.	Fabaceae	Sep	Nov	Fabids	BZ	Zm	*	So	Mp	*	-	-	BLW
Moorochloa eruciformis (Sm.) Veldkamp	Poaceae	Apr	Sep	Commelinids	AF	Zm	*	So	*	*	GW	-	-
Nicotiana plumbaginifolia Viv.	Solanaceae	Apr	Jul	Lamiids	TAM	*	*	*	Mp	*	-	-	BLW
Oenothera laciniata Hill	Onagraceae	TY	TY	Malvids	NAM	Zm	Pa	So	Mp	Os	-	-	BLW
Oldenlandia corymbosa L.	Rubiaceae	Aug	Mar	Lamiids	AF	*	*	So	Mp	*	-	-	BLW
Oplismenus burmanni (Retz.) P.Beauv.	Poaceae	Aug	Dec	Commelinids	COS	Zm	Pa	So	Mp	*	GW	-	-
Oplismenus compositus (L.) P.Beauv.	Poaceae	Aug	Dec	Commelinids	COS	Zm	*	*	*	*	GW	-	-
Oxalis corniculata L.	Oxalidaceae	Mar	Dec	Fabids	EU	Zm	Pa	So	Mp	*	-	-	BLW
Parthenium hysterophorus L.	Asteraceae	Oct	Mar	Campanulids	TAM	Zm	Pa	So	Mp	Os	-	-	BLW
Paspalum conjugatum P.J.Bergius	Poaceae	Oct	Dec	Commelinids	AF	*	*	So	Mp	Os	GW	-	-
Paspalum distichum L.	Poaceae	TY	TY	Commelinids	AF	Zm	*	So	Mp	*	GW	-	-

Paspalum scrobiculatum L.	Poaceae	Oct	Nov	Commelinids	AF	*	*	*	Mp	Os	GW	-	-
Paspalum vaginatum Sw.	Poaceae	Oct	Dec	Commelinids	AU	Zm	*	So	*	Os	GW	-	-
Phyla nodiflora (L.) Greene	Verbenaceae	TY	TY	Lamiids	N/A	Zm	*	So	Mp	*	-	-	BLW
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae	Aug	Dec	Fabids	AF	Zm	Pa	So	Mp	Os		-	BLW
Physalis angulata L.	Solanaceae	Sep	Mar	Lamiids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Plumbago zeylanica L.	Plumbaginaceae	Sep	Apr	Superasterids	AF	Zm	Pa	So	*	*	-	-	BLW
Polygonum plebeium R.Br.	Polygonaceae	Nov	Jun	Superasterids	AF	*	*	So	*	*	-	-	BLW
Polypogon monspeliensis (L.) Desf.	Poaceae	Sep	Apr	Commelinids	EU	Zm	Pa	So	Mp	*	GW	-	-
Portulaca oleracea L.	Portulacaceae	TY	TY	Superasterids	SAM	Zm	*	So	Mp	Os	-	--	BLW
Portulaca quadrifida L.	Portulacaceae	TY	TY	Superasterids	TAM	Zm	*	So	Mp	*	-	-	BLW
Ricinus communis L.	Euphorbiaceae	TY	TY	Fabids	AF	*	*	So	*	*	-	-	BLW
Ruellia tuberosa L.	Acanthaceae	Aug	Nov	Lamiids	TAM	*	*	So	*	*	-	-	BLW
Scoparia dulcis L.	Plantaginaceae	TY	TY	Lamiids	TAM	Zm	Pa	So	Mp	Os	-	-	BLW
Senna obtusifolia (L.) H.S.Irwin & Barneby	Fabaceae	Aug	Apr	Fabids	TAM	Zm	*	So	*	*	-	-	BLW
Senna occidentalis (L.) Link	Fabaceae	Aug	Nov	Fabids	SAM	Zm	Pa	So	Mp	*	-	-	BLW
Senna tora (L.) Roxb.	Fabaceae	Aug	Dec	Fabids	SAM	Zm	Pa	So	*	*	-	-	BLW
Seseli diffusum (Roxb. ex Sm.) Santapau & Wagh	Apiaceae	Mar	Jun	Campanulids	N/A	*	*	So	*	*	-	-	BLW
Setaria pumila (Poir.) Roem. & Schult.	Poaceae	June	Oct	Commelinids	AF	*	*	So	*	*	GW	-	-
Setaria verticillata (L.) P.Beauv.	Poaceae	Jun	Oct	Commelinids	N/A	*	*	So	*	*	GW	-	-
Setaria viridis (L.) P.Beauv.	Poaceae	June	Oct	Commelinids	N/A	*	*	So	*	*	GW	-	-
Sida acuta Burm.f.	Malvaceae	Aug	Nov	Malvids	TAM	Zm	*	So	*	*	-	-	BLW
Sida cordata (Burm.f.) Borss.	Malvaceae	Aug	Dec	Malvids	SAM	*	*	So	*	*	-	-	BLW
Sida rhombifolia L.	Malvaceae	Sep	Dec	Malvids	AF	*	*	So	Mp	*	-	-	BLW
Solanum americanum Mill.	Solanaceae	Sep	Apr	Lamiids	TAM	Zm	Pa	So	Mp	*	-	-	BLW
Spermacoce hispida L.	Rubiaceae	Jul	Dec	Lamiids	TAM	*	*	So	*	*	-	-	BLW
Tephrosia purpurea (L.) Pers.	Fabaceae	TY	TY	Fabids	N/A	Zm	Pa	So	*	*	-	-	BLW
Trianthema portulacastrum L.	Aizoaceae	Jul	Oct	Superasterids	AF	Zm	Pa	So	Mp	*	-	-	BLW
Tribulus terrestris L.	Zygophyllaceae	TY	TY	Fabids	TAM	Zm	Pa	So	*	*	-	-	BLW
Tridax procumbens L	Asteraceae	TY	TY	Campanulids	TAM	Zm	Pa	So	*	*	-	-	BLW
Triumfetta rhomboidea Jacq.	Malvaceae	Aug	Dec	Malvids	TAM	*	*	So	Mp	Os		-	BLW
Urena lobata L.	Malvaceae	July	Oct	Malvids	TAM	Zm	Pa	So	*	*	-	-	BLW
Urochloa deflexa (Schumach.) H.Scholz	Poaceae	Jul	Dec	Commelinids	AF	Zm	*	So	*	*	GW	-	-
Urochloa panicoides P. Beauv	Poaceae	Aug	Dec	Commelinids	AF	Zm	Pa	So	*	*	GW	-	-
Urochloa ramosa (L.) T.Q.Nguyen	Poaceae	Jul	Dec	Commelinids	AF	Zm	Pa	So	Mp	Os	GW	-	-
Urochloa reptans (L.) Stapf	Poaceae	Jun	Sep	Commelinids	EU	Zm	Pa	So	Mp	Os	GW	-	-
Waltheria indica L.	Malvaceae	July	Sep	Malvids	TAM	Zm	*	So	Mp	*	-	-	BLW
Xanthium strumarium L.	Asteraceae	Mar	Dec	Campanulids	EU	Zm	Pa	So	Mp	*	-	-	BLW

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[A] TY = Throughout the year, **[B]** AF= Africa, BZ= Brazil, NAF= North Africa, TAM= Tropical America, NAM= North America, TAF= Tropical Africa, SAM= South America, MX= Mexico, EU= Europe, EA= Eastern Asia, CAM= Central America, AU= Australia, COS= Cosmopolitan, CA= Central America, N/A= Not applicable**.[C]** BLW= Broad leaf weed, GW= Grassy weed, SW= Sedges weed, (So: *Saccharum officinarum* L., , Pa: *Pennisetum americanum* (L.) Leeke , Zm: *Zea mays* L , Os: *Oryza sativa* L. & Mp: *Mentha piperata*), [*]= weed species absent in that crop.

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