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RESEARCH ARTICLE

Ecological study of wild medicinal plants in a dry tropical peri-urban region of Uttar Pradesh in India

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Abstract: Medicinal plants and knowledge of their use provide a vital combination to human and livestock health care throughout the world. The present study focused on investigating the structure of medicinal weeds in an anthropogenic peri-urban region and its relationship belowground (seed bank) and aboveground (standing vegetation). The phytosociological study of vegetation was carried out by quadrat method in different seasons and seed bank study was done by seedling emergence method. The number of plant species in standing vegetation was much higher (76 belonging to 32 families) compared to seed bank (38 species distributed over 15 families). The top dominants differed in the field and seed bank. Medicinal properties of plants were also described.

Keywords: Medicinal plants; invasive species; phytosociological study; aboveground vegetation; soil seed bank.

Introduction

Disturbed areas are considered rich repository of medicinal plants due to the wild and weedy nature of species comprising them. Such areas often show a high degree of diversity, possibly due to the replacement of native species by alien ones (Zerbe et al. 2003). These invasive species should not always be considered unwanted because of some unique characteristics associated with them e.g. they hold up together top soil particles, pull up water and nutrients, provide food, help control insects and also have important medicinal properties to counter several diseases. Most of these weeds with medicinal values belong to common families like Asteraceae, Fabaceae, Convolvulaceae, Euphorbiaceae, Chenopodiaceae, Malvaceae and Solanaceae (Stepp and Daniel 2001).

In recent years, these medicinal plants have been assumed as considerably important component of ecosystem. The reproductive materials of these plants collected from the nature can be cultivated in the field, but the habitat is one of the most important aspects of a plant where it grows, develops and competes with other neighbouring ones **(**Ram et al. 2010). This hypothesis lends support to the soil seed bank study of medicinal plants. A soil seed bank comprises of buried but viable seeds either near the surface or in the lower strata **(**Cartner and Unger 2000; Leck et al. 2003) with a potential to predict future floristic composition of an area (Saulei and Swaine 1998). Thus, it may be considered indicator of future vegetation. Some of such reasons have motivated researchers across the world to compare the surface vegetation composition with seed reserves hidden in the soil.

The traditional medicinal floras have always overlooked weeds despite their important medicinal significance (Choudhary et al. 2011). Earlier studies on medicinal plants also revealed that the economically backward local and tribal people prefer folk medicines due to their low cost and sometimes often due to these being a part of their social life and culture. But the knowledge of medicinal plants is limited to traditional healer, herbalists and elderly persons who are living in rural areas (Muthu et al. 2006). Due to lack of interest among the younger generations there is a possibility of losing this wealth of knowledge in the near future. Thus, it becomes necessary to acquire knowledge and preserve this traditional system of medicine by proper documentation and identification of specimens of these areas. Studies regarding distribution of medicinal species in the soil seed banks are meager and not available particularly

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in urban and peri-urban areas that are recognized as highly stressed ecosystems. Thus, it is very important to investigate the germination success of the medicinal weeds and understand their ecological amplitude. This becomes vital for preserving this wealth of nature.

The objective of the present work was to study the structure of medicinal weeds and investigate their structural relationship aboveground and belowground in a peri-urban region and also documentation of medicinal properties of weeds.

Materials and methods

Study area

The present study conducted in Bulandshahr (28º24' N lat. and 77º51' E long.), western part of Uttar Pradesh, is located in the upper doab of the Ganges and Yamuna rivers. A study site was established here in and around grazing land located near a dairy milk industry where cows, goats, buffaloes, horses etc. frequently grazed. Three permanent plots (each 4 m x 4 m) for intensive work were randomly selected.

The climate is semi-arid having three seasons: winter (November-February), summer (March-June) and rainy (July-October). Annual mean temperature was 31°C. (data collected at Bulandshahr research station of Sardar Vallabh Bhai Patel University of Agriculture & Technology). Annual mean rainfall (2001-2005, based on data available at Bulandshahr district head quarter) was 528 mm, of which about 87% occurred in rainy season.

Vegetation sampling

Floristic composition of the study site was recorded at monthly intervals from January 2003 to December 2005. The plant species were identified according to Sharma (1980) and Gaur (1999). The phytosociological study was carried out by quadrat method. A total of 180 quadrats (each of size 25 cm x 25 cm) were randomly sampled in different seasons. In each quadrat, species were identified, total number of their individuals counted, and basal diameter estimated. The data were quantitatively analyzed for density, frequency and basal cover according to Curtis and Mc Intosh (1951) and Muller Dombois & Ellenberg (1974). The relative values of density, frequency and dominance were determined following Phillips (1959). These quantities were summed to represent Importance Value Index (IVI) of individual species.

Seed bank study

Soil samples were collected in June 2003, each from the center of half of the size of permanent plots (i.e. 4 m × 2 m) to determine the taxonomic position and size of soil seed bank. Six soil samples (each of the size of 25 cm × 25 cm x 15 cm) were collected with the help of knife and spoon. Seed density was estimated by seedling emergence method. This technique is considered effective for assessing both the transient and persistent component of seed bank (Thompson & Grime 1979). The surface of the soils was cleared off the existing live plant parts, the litter, debris etc. before the collection of soil samples. The soil was air-dried and sieved through 2 mm sieve to remove vegetative fragments. The soil was then spread uniformly in round earthen pots (size: 20 cm upper diameter, 18 cm bottom diameter and 5 cm deep). Pots were arranged in a shaded house with transparent roof and iron-netted walls. The pots were watered regularly. The seedling emergence was investigated for nine months to record the late emergents too. The total number of seedlings counted in each soil sample during the study period was considered as seed density of the sample seed bank, corresponding to available viable seeds. The seedlings were allowed to grow to the identifiable stage and then eliminated. Density of dominant species of both above/belowground flora was compared. The IK record (indigenous knowledge) of weed species for different medicinal purposes was also described according to Useful Plants of India (CSIR Publication).

Soil analysis

The surface soil samples (0-5 cm) were collected seasonally from each of the permanent plots, air-dried and sieved (2 mm). The soil moisture content and pH were estimated according to Piper (1950). Soil organic carbon was es-

timated by Walkley and Black method (Piper 1944).

Results

Vegetation study

A total number of 76 medicinal plants distributed over 32 families were identified in standing vegetation during the study period. These species represented the weedy and ruderal flora of this region. Of these only 9 species were native and > 88 % were aliens. The most dominant family was Asteraceae comprising of 9 species followed by Poaceae and Malvaceae (7 species each) and Amaranthaceae (6) (Appendix 1). The density of top dominant species of study site changed with changing seasons (Table 1). Rainy season showed higher plant density (494.5 individuals/m²) as compared to winter and summer season with distinct dominants. *Cynodon dactylon* dominated in rainy season as well as summer season with highest density and IVI, whereas *Stellaria media* dominated in winter season followed by *Chenopodium murale* and *Cynodon dactylon*. However, lowest plant density was recorded in summer season (145/m²). The top dominant species of the site in summer season was *Cynodon dactylon* (78.5/m²) and *Parthenium hysterophorus* (18/ m²) (Table 1).

Seed bank study

The flora of seed bank comprised of 38 medicinal plant species distributed over 15 families. The density of 18 plant species here accounted for more than 50% of the total seed bank density (Table 2). Total seed bank density was 3425 seeds/m². The top dominant family in seed bank was Malvaceae (6 species) followed by Amaranthaceae (5) and Poaceae (4). The top dominant species was *Dactyloctenium aegypticum* (347 seeds/m²) followed by *Paspalidium flavidum* (299 seeds/m²) and *Chenopodium murale* (273 seeds/m²) (Table 2).

The variation in densities of 12 dominant species that were common in both seed bank and standing vegetation is shown in Figure 1. Highest variation was recorded for *Cynodon dactylon*. It showed relatively much high density in field as compared to seed bank. On the other hand, some species as *Dactyloctenium aegypticum*, *Chenopodium murale*, and *Anagallis arvensis* showed comparatively less difference in density aboveground and belowground. *Phyllanthus fraternus* showed nearly parallel density above/below ground. A total of 9 plant species showed high density in field whereas 3 plant species showed high density in seed bank.

Table 1: Dominant species of study site across three seasons. First values against species indicate their density (D) (no. of individuals m^{-2}) and second values indicate Importance Value Index (IVI), in different seasons

Species	Winter		Rainy		Summer	
	D	IVI	D	IVI	D	IVI
Cynodon dactylon	68	27	209.75	63	78.5	61
Dactyloctenium aegypticum	5	3.75	92	26.5	-	-
Stellaria media	81.25	17	-	-	-	-
Cyperus rotundus	9.25	6.88	66.25	20.25	3.75	4.25
Chenopodium murale	46.25	22.25	6.5	7.75	11	33.25
Paspalidium flavidum	-	-	35.25	14.5	-	-
Euphorbia hirta	2	2.5	37.75	12.75	1.5	2.5
Parthenium hysterophorus	14	12.75	9	10.65	18.25	45.25
Anagallis arvensis	37	11.25	-	-	-	-
Oxalis corniculata	24.75	6.75	-	-	-	-
Medicago sativa	17.5	9.25	-	-	-	-
Sida acuta	3.75	5.25	11.25	11	2	6.75
Senebiera didyma	14.25	4.75	-	-	0.75	5.75
Digitaria adscendens	-	-	14.5	12.25	-	-
Alternanthera sessilis	13	7.75	-	-	-	-
Croton bonplandianum	2.25	4.78	4.5	-	5.25	14.43
Digera muricata	-	-	6.5	-	-	-
Phyllanthus fraternus	-	-	-	-	6.25	2.33
Spergula arvensis	6.25	5.25	-	-	-	-
Cannabis sativa	3	3.5	-	-	2.75	6.5
Saccharum munja	3.75	25.75	1.25	8	0.75	11.5
Alternanthera pungens	-	-	-	-	5.25	12.25
Blumea lacera	4.25	2.25	-	-	-	-
Boerhavia difusa	-	-	-	-	2.5	6.75
Rumex dentatus	2.5	17.75	-	-	-	-
Malva sylvestris	2.25	4.36	-	-	-	-
Sisymbrium irio	1.25	7.75	-	-	-	-
Total field density	**361.5**		**494.5**		**144.75**	

Table 2: Total seed density (SD, no. of seedling emergents m^{-2}) of plant species in soil seed bank (0-15 cm depths)

Dominant species	Seed density	Other minor species
Dactyloctenium aegypticum	347	*Malva sylvestris*
Paspalidium flavuidum	299	*Ocimum odorum*
Chenopodium murale	273	*Commelina benghalensis*
Anagallis arvensis	102	*Achyranthus aspera*
Cyperus rotundus	93	*Gnephalium luteo-album*
Cynodon dactylon	75	*Euphorbia hirta*
Sida rhombifolia	64	*Spergula arvensis*
Parthenium hysterophorus	57	*Nicosiana plumbaginifolia*
Argemone Mexicana	54	*Alternanthera pungens*
Cassia obtusifolia	41	*Amaranthus viridis*
Rumex dentatus	31	*Sida cordifolia*
Digitaria adscendens	27	*Malvastrum tricuspidatum*
Phyllanthus fraternus	23	*Oxalis corniculata*
Setaria glauca	23	*Silene conoidea*
Sida acuta	22	*Solanum nigum*
Croton bonplandianum	21	*Digera muricata*
Cassia occidentalis	20	*Blumea lacera*
Alternanthera sessilis	15	*Abutilon indicum*
		Stellaria media
		Trianthemma portulacastrum
Total seed density	1587	3425

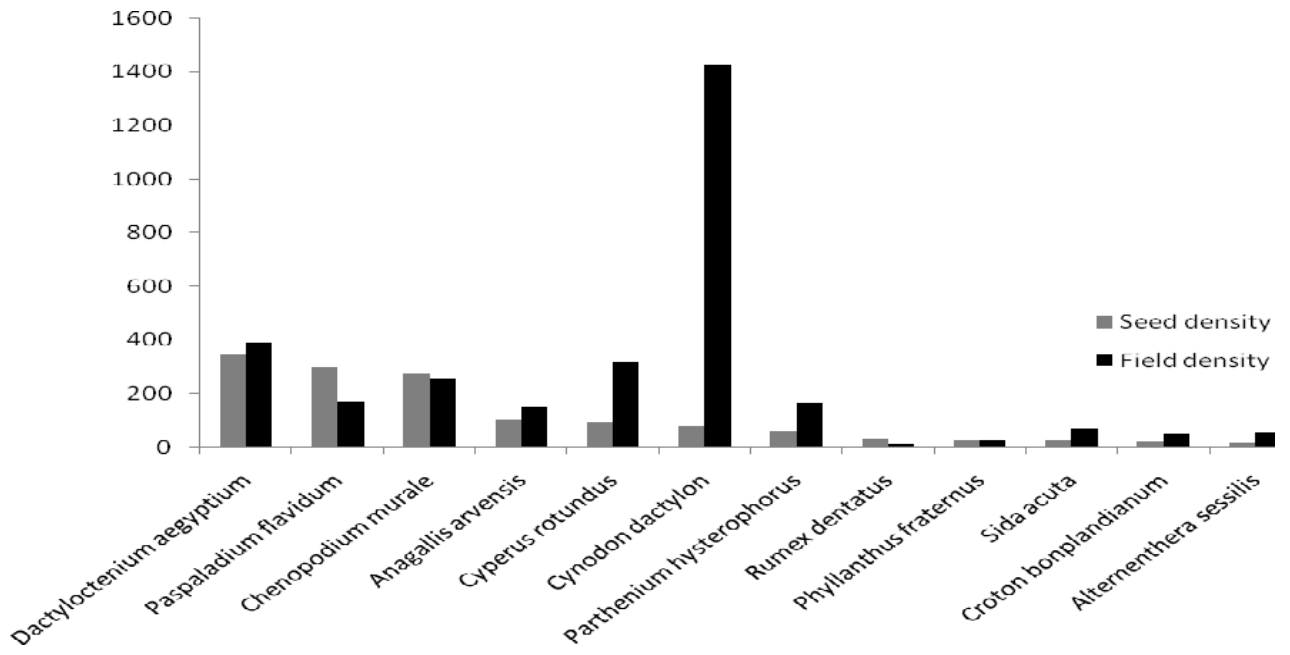

Figure 1: Comparision of density of dominant flora across soil seed bank and standing vegetation

Soil characteristics

The soil was slightly alkaline (pH 7.2-7.19). The range of organic carbon was comparable (0.79 to 1.33%). Summer soil showed significantly lower moisture content (2.48%) compared to rainy season (13.5%). C:N ratio did not show much variation (Table 3).

Table 3: Characteristics of the surface soils of site (Mean ± SD) in different seasons

GL	Summer	Winter	Rainy
Soil pH	7.34 ± 0.44	7.91 ± 0.64	6.91 ± 0.61
Soil moisture (%)	2.48 ± 1.34	11.25 ± 0.24	13.5 ± 0.22
Soil organic carbon (%)	1.33 ± 0.24	1.30 ± 0.31	0.79 ± 0.42
C:N ratio	17 ± 0.51	17.5 ± 0.58	18 ± 0.71

Discussion

The present ecological investigation in a dry tropical peri-urban area of Bulandshahr revealed that considerably a sizeable number of alien flora (88 %) have made this anthropogenic area a natural home of survival and establishment. Occurrence of 76 weedy species with high potential of medicinal value indicated that the study area has plenty of medicinal plants to treat a wide spectrum of human ailments.

The ecological conditions of heterogeneous peri-urban areas in terms of soil characteristics, rainfall and temperature may be considered apt for production of a large of these annual weedy plants (Tilman 1983). However, their growth appears largely influenced by seasonality. The highest density in rainy season in standing vegetation could be due to high soil moisture that favored large number of herbaceous plant population in the semi-arid climate of this area (Sharma and Upadhyaya 2002). Low plant density observed in summer probably was due to harsh weather conditions. The growing dominance of non palatable species such as *Chenopodium murale, Stellaria media a*nd others in the grazing land is probably an indication of adaptation against herbivory and adverse climatic conditions (Batish et al. 2002). Grasses are predominant in rainy season because of being sensitive indicators of environment. Herbs are often considered highly responsive to small scale environmental changes. Lososova et al. (2004) also showed the temporal dynamics in weed community on the scale of seasonal changes. Despite the realized significance of seasonality a few species occurred throughout the study period e.g. *Parthenium hysterophorus, Cynodon dactylon, Sida acuta and Cyperus rotundus* evidently due to the wide ecological amplitude of these species under the prevailing heterogeneous regimes (Gupta & Narayan 2006).

The number of plant species in soil seed bank (38) was half of that in the standing vege-

tation. This may be due to certain antropogenic stress that restricted their entry in soil seed bank. Even biotic influence e.g. animal grazing and human movements could be attributed to the huge difference between the belowground and aboveground flora.

Seed bank density was comparatively lower than the overlying vegetation which may be due to the over grazing, environmental degradation and anthropogenic factors. The top dominants of seed banks were mostly grasses, reflecting the result of grazing pressure. It has been suggested that most graminoids grow by increasing their tiller and persist for long time and finally maintain high cumulative density of perennials and annuals (Shrivastva & Singh, 2005). The top dominant species in the seed bank comprising of species like *Dactyloctenium aegyptium*, *Paspalidium flavidum* and *Chenopodium murale* could be due to their characterstics of producing small seeds in large number with short life span (Baskin and Baskin 1998). It increases their chance to germinate in seed bank because of low requirements of resources.

The presence of *Nicotiana* species in seed bank but not in standing vegetation could be a consequence of seed dispersal from adjacent areas or of seed persistence in the soil after the death of an adult plant (Esmailzaden et al. 2011). The dominance of 12 common plant species in both seed bank and standing vegetation revealed that these species are strong competitors and have potential to exist for next generations in community (Fig 1). The variable density pattern of these species in both above/below ground flora indicated that the seed bank structure is greatly influenced by factors external to the standing vegetation. Several workers opine the existence of poor similarity between surface and underground flora (Bossuyt and Honnay, 2008; Ma et al. 2010).

In the present study a large number of the weeds are invasive alien species introduced from different biogeographical regions of the world who have adapted to Indian environmental conditions and are fast naturalizing to become part of our natural ecosystem. Some weeds have high medicinal values as compared to native weed species according to our traditional knowledge. The present work showed that the studied area has rich diversity of plants and there is an urgent need to conserve these available plant genetic resources for medicinal purposes. However, the ecology of natural distribution of weedy plants and their assembly would be important aspect for the production and conservation of medicinal plants and should be investigated for more details in these areas.

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Appendix 1. Floristic list of plants with their medicinal properties in grassland of peri-urban region.

Family	Species	Nativity	Medicinal properties as per UPI, CSIR Publication
Acanthaceae	*Peristrophe bicalyculata* (Retz.)	TAF	Anti-bacterial, snake bite, fever, cold, cough, ear and eye treatment
Aizoaceae	*Trianthema portulacastrum* L.	TAM	Asthma, amenorrhea, liver problem, dropsy
Amaranthaceae	*Achyranthes aspera* L.	AMN	Diuretic, renal dropsies,
	Alternanthera pungens Humb., Bonpl & Kunth	SAM,TAM	Diuretic, gonorrhea
	Alternanthera sessilis (L.) DC.	TAM	Night blindness, galactagogus properties
	Amaranthus viridis L.	TAF	Anthelmic, dysentery, diuretic, gonorrhea
	Amaranthus spinosus L.	TAM	Febrifuge, fever, emollient, eczema
	Digera muricata (L.) Martius	SWA,NAM	Urinary disorder
Asclepediaceae	*Calotropis gigantean* (L.) Dryander	TAF	Leprosy
	Calotropis procera (Aiton) Dryander	TAF	Swelling in rheumatic joints and filarisis, wound healing, skin disease, piles.
Asteraceae	*Ageratum conyzoides* L.	MX,SAM,	Styptic nervine tonic, diarrhoea, dysentery, colic, gastrointestinal ailments
	Blumea lacera (Burm.F.) DC	IND,TAM	Anthelmic against thread worms, diuretic, antiscorbic
	Gnaphalium luteo - album L.	TAM	Astringent
	Launaea aspleniifolia (Willd.) Hook. F	IND	Galactagogus drug
	Parthenium hysterophorus L.	TAM	Toxic, febrifuge, emmenagogue
	Sonchus asper (L.) Hill	MR	Wound and boils
	Tridax procumbens L.	TAM	Bronchial catarrha, dysentery, diarrhoea, hemorrhage
	Vernonia officinalis (L.)	MR .AF	Diaphoretic, expectorant, astringent
	Xanthium strumarium L.	TAM	Urino-genital disease, herpes, **erysipebes**, cancer and scrofula, extract applied to ulcer, boils
Brassicaceae	*Sisymbrium irio* L.	EUR.	Asthma
Cannabaceae	*Cannabis sativa* L.	IND,BHU,MID. AS	Rubbed over wasp sting
	Spergula arvensis L.	MR. AF	Diuretic, pulmonary diseases, tuberculosis
	Stellaria media (L.) Villars	MR. AF	Conjunctivitis, constipation, insect bites and psoriasis
Chenopodiaceae	*Chenopodium murale* L.	GR. BRIT.	as a Pot herb
	Chenopodium ambrosioides L.	MX	Anthelmintic against intestinal, parasitic
Commelinaceae	*Commelina benghalensis* L.	GERONT. TROP.	As demulcent, refrigerate, in leprosy
Cleomaceae	*Cleome gynandra L.*	TAM	Head and ear ache, fever, dysentery, paratyphoid, bronchitis and gonorrhea. removing and round worm
Convolvulaceae	*Convolvulus arvensis* L.	EUR	Cathaltic
	Ipomoea pes-tigridis L.	TAF	Sores, pimples and carbuncles
Cyperaceae	*Cyperus iria* L.	TAM	Stimulant, tonic, astringent, stomachic
	Cyperus kyllingia Endl.	AM., AUST.	diuretic, refrigerate, tonic, fever, diabetes
	Cyperus rotundus L.	COSMOP.	Diuretic, astringent
Euphorbiaceae	*Croton bonplandianum* Baillon	SAM	Rich in fatty acid , cake used as manure
	Euphorbia hirta L.	CAM,TAM	Cough and asthma, colic, dysentery, latex applied in gentio-urinary tract
	Euphorbia thymifolia L.	AMPHIG. TROP.	Stimulant, astringent, anthelmic and laxative bowl complaints for children
	Phyllanthus fraternus Webster	ASIA	Astringent, deabostruent, stomachic, diuretic, urino-genital disease In jaundice,
	Ricinus communis L.	MR AF	Castor oil used for dropsy, burns and lactogogue; and for oiling the dry shoes.
Lamiaceae	*Anisomeles indica* (L.) Kuntze	IND	Astringent and carminative, oil useful in uterine affection
	Ocimum odorum (L.)	AT TROP.	Source of camphor, Decamphorized oil possesses insecticidal properties and used as a mosquito repellent.
Fabaceae	*Medicago sativa* L.	EUR, W. ASIA	Source of Vit. A,C,E, useful for bee postulate
	Vicia hirsuta (L.) S.F. Gray	N. HEM	As Pot herb, Extract in non-specific aggulating reaction with human blood
Fumariaceae	*Fumaria indica* (Haussknecht) Pugsley	GERONT. TROP.	Blood disease
Caesalpinaceae	*Cassia obtusifolia* L.	TAM	Snakebite, Skin disease as ring worm and itching, ulcer
	Cassia occidentalis L.	SAM	Purgative, seeds for external use for skin
Mimocaseae	*Prosopis juliflora*.(Swartz)DC.	MX	Highly nutritive-protein, Seeds as stock feed
Malvaceae	*Abutilon indicum* (L.) Sweet	S. ASIA	Used for venereal diseases
	Malva sylvestris L.	EUR	Pulmonary and urinary affection flower in gargles, mouth wash
	Malvastrum tricuspidatum (R.Br.) A.Gray	TAM	Emollient, dysentery, diaphoretic
	Sida acuta Burm.F.	TAM	Astringent, nerving tonic, urinary troubles and liver revitalize. Stomachic and anti pyretic. Demulcent and diuretic- applied to testicular swelling and elephantiasis
	Sida cordifolia L.	SAM	Dysentery, Astringent, diuretic, urinary trouble, cystitis
	Sida rhombifolia L.	AMPHIG.TROP	Rheumatism and tuberculosis ,Demulcent, emolluent, skin trouble, diuretic
	Urena lobata L.	TAM	Diuretic, Expectorant, decoction of stem and roots is flatulent colic
Nyctaginaceae	*Boerhavia diffusa L.*	IND	Expectorant, diuretic, asthma
Oxalidaceae	*Oxalis corniculata L.*	EUR	Used in time of scarcity, dyspepsia, piles, anemia, tympanities, opacity of cornea

Papaveraceae	*Argemone mexicana* L.	W.I ,SAM	Cutaneous troubles, plant juice in scabies and ophthalmic
Poaceae	*Cynodon dactylon* (L.) Persoon	COSMMOP	Used to offer water to gods used in religious folk method of curing jaundice
	Digitaria adscendens	ASIA	Nervous system
	*Eleusine coracana(*L) Gaertner	AS,AF	Tonic and astringent, used as a diabetic food
	Paspalidium flavidum	TROP.ASIA	Skin disease, eye-teeth, skin itching, liver, heart disease, dropsy and prevent abortion
	Saccharum bengalense Roxb.	IND	Diabetes
	Setaria glauca	EUR	Flour is used to make sweet that is given to patient suffering skin disease and chickenpox
	Dactyloctenium aegyptium	NAF,AS	Seeds used for making chapaties or haluwa, as fodder
Polygonaceae	*Polygonum barbatum* L.	IND	Wild edible
	Polygonum plebium R.Br.	G.TROP	As vegetable, bowl complaints, pneumonia
	Rumex dentatus L.	IND	Rich in Vit A & C, β carotene, cutaneous disorder
Primulaceae	*Anagallis arvensis* L.	EUR	Expectorent, stimulent, diaphoretic and vulnery properties, dropsy, leprosy & cerebral disease.
:rophulariaceae	*Majus japonicus*	ASIA	Infusion of plants is given as tonic, aperitive and antifibrile
Solanaceae	*Datura stramonium* L.	MX, SAM	Stromonium, drug, asthma
	Solanum nigrum L.	TAM	Hydrocele, antiseptic, antidiurectic & laxative. Berries are used in fever, diarrohea, eye diseases and hydrophobia. Plant juice is hydragogue, catharatic given in chronic enlargement of liver, blood spitting, piles and dysentery.
	Withania somnifera (L.) Dunal	MR AF	Leaves are applied on boils, wounds. Given as infusion in fever. Root and stem powder in insomnia and as a brain tonic. Root is diuretic, tonic, narcotic, abortifacient and useful in rheumatism, consumption.
Sterculiaceae	*Melochia corchorifolia* L.	TAM	Dysentery
Tiliaceae	*Corchorus aestuans* L.	TAF	Stomachic
	Corchorus olitorius. L.	IND,TAF	Tonic, febrifuge, cystic, dysuria
	Triumfetta rhomboidea Jacquin	TAM	Diarrhoea Dysentery, Intestinal ulcer
Verbenaceae	*Lantana camara* L.	TAM	Antiseptic for wound, leprosy, Tumors, decoction given in tetanus, malaria rheumatism
Zygophyllaceae	*Tribulus terrestris* L.	TAM	Stomachic, lithontriptic, Tonic and diuretic

Abbreviations: SAM, South America; TAM, Tropical America; NAM, North America; CAM, Central America; EU, Europe; TAF, Tropical Africa; NAF, North Africa, AS, ASIA; WI, West Indies; MR, Mediterranean region; AF, AFRICA; MX, Mexico; IND, India; AUST, Australia; GERONT., Gerontia; TROP, Tropical; AMPHIG, Amphigean; COSMOP., Cosmopolitan; G. BRIT, Great Britain; BHU, Bhutan; N. HEM, North Hemisphere.