

# Observations on the Flora of Chandauli District, Uttar Pradesh, India

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## ABSTRACT

An observational study was conducted to assess the flora of Chandauli district which spreads over an area of 2,485 km<sup>2</sup> in Uttar Pradesh state of India. A total of 674 plant species belonging to 438 genera and 100 families are recorded from Chandauli district. The dicotyledons are represented by 511 species belonging to 341 genera and 80 families whereas the monocotyledons are represented by 163 plant species belonging to 97 genera and 20 families. Fabaceae, Asteraceae and Poaceae are the most dominant families of the flora of Chandauli district. The representation by native plant species is greater than exotic plant species in flora of Chandauli district. Furthermore, the plants of perennial life span are greater in number than plants of annual and biennial life spans in the flora of Chandauli district.

**Keywords:** Chandauli District, Exotic Plant Species, Gangetic Plains, Native Plant Species, Seasonal Vegetation, Uttar Pradesh

## I. INTRODUCTION

Flora refers to botanical composition of a region where names of different species are taken into account, is governed by the climatic and edaphic conditions of that region. Flora indicates the way different species have come to occur in a region. Studies have been conducted to explore the flora of India [1-3]. Uttar Pradesh is one of the biggest state of India comprising of 75 districts is divided into several regions such as Western Uttar Pradesh, South western Uttar Pradesh, Central Uttar Pradesh and Eastern Uttar Pradesh. Studies have been conducted to explore the flora in various districts of Uttar Pradesh [4-13]. However, there is lack of information on the flora of Chandauli district which is almost a rural district located in Eastern region of Uttar Pradesh. Therefore, the present study was undertaken with objective to explore the floristic wealth of Chandauli district which belongs to Indo-Gangetic Plain physiographic division of India. The following questions were addressed in the study: (1) how many species of angiospermic plants are hosted by the Chandauli

district? (2) which are the dominant families of the flora of Chandauli district? (3) do representation by native plant species is greater than exotic plant species in the flora of Chandauli district? and; (4) plants of which life span have greater representation in the flora of Chandauli district?

## II. METHODS AND MATERIAL

### Site description

Chandauli is a small district located in the middle Ganges valley of North India, in the Eastern part of the state of Uttar Pradesh. It extends over 2,485 km<sup>2</sup> (latitude 24°56'- 25°35' N; longitude 81°14'- 84°24' E) with an average elevation of 70 m. Chandauli district comes under Varanasi division of the Uttar Pradesh state of India. It is bounded on east by Bihar state, on the north and north east by Ghazipur district, on the south by Sonbhadra district, on the south-west by Mirzapur district and on the north-west by Varanasi district (Figure 1). River Ganges separates the district from the districts of Varanasi and Ghazipur.

Chandauli, Sakaldeooha, Mughalsarai and Chakia are four tehsils in Chandauli district. Most of the parts of Chandauli districts are rural except Mughalsarai which is an urban area due to the main junction of Northern Railways situated in the tehsil.

temperature is recorded in May, varying between 32°C and 42°C. The annual rainfall is around 1000 mm of which 90% occurs in rainy season.

### Field survey

An intensive field survey was initiated from July 2009 onward to observe and collect the various plant species growing in the Chandauli district of the Uttar Pradesh state of India. During survey visits were made to each and every corner of the district to record and collect the plant species. The field observations and collection process were completed by the December 2016. The collected specimens were identified through various sources [14-17]. The APG IV (2016) [18] classification was followed for arranging the taxa to families.

### III. RESULTS AND DISCUSSION

A total of 674 angiospermic plant species are recorded from Chandauli district belonging to 438 genera and 100 families. The dicotyledons are represented by 511 species belonging to 341 genera and 80 families whereas monocotyledons are represented by 163 plant species belonging to 97 genera and 20 families (Table 1). The number of plant species recorded in the present study of Chandauli district is lower compared to studies conducted on the flora of the other districts of the Uttar Pradesh state of India [11-13, 19].

The monocotyledons to dicotyledons ratio is 1:4.00 for families; 1:3.51 for genera and 1:3.13 for species. Furthermore, the ratio of the total number of genera to species is 1:1.53, which is lower in comparison to the ratio reported by Maheshwari (1963) [20] for the Gangetic Plains region of India (1:2.2).

The maximum number of plant species are represented by the family Fabaceae (86 species) followed by the families Asteraceae (54 species) and Poaceae (52 species) (Table 2). Thus, the study clearly indicates that Fabaceae, Asteraceae and Poaceae are

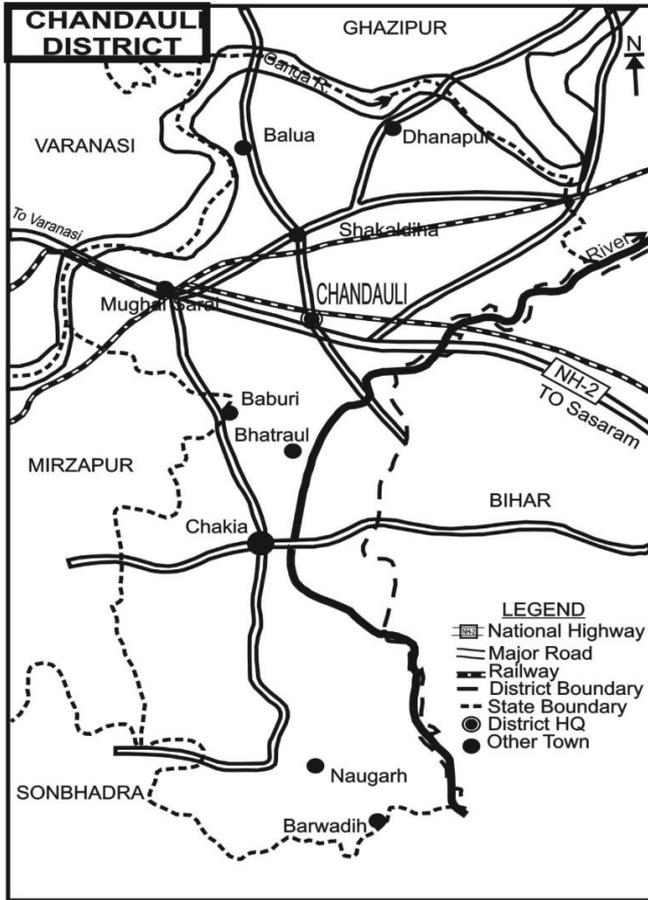


Figure 1: Map of the study site

The Chandauli district is a part of the Indo-Gangetic Plains physiographic division of India. The soil is alluvial type formed by the deposition of sediments of river Ganges. The soil is fertile with sandy loam texture.

The climate is Tropical monsoonal type with three distinct seasons; the cold (November to February), the hot (March to mid-June) and the rainy (mid-June to September), while October is regarded as strictly transitional month. The diurnal range of temperature ranges as average between 13°C and 14.5°C in the cold and hot months, respectively. The highest monthly

the three dominant families of the flora of the Chandauli district. These three families together constitute 28.49% of the flora of the district. Studies conducted on the flora of Banda district [7], Lalitpur district [9], Jalaun district [8], Hamirpur and Mahoba districts [11], Baghpat district [12] and Varanasi district [13] of the Uttar Pradesh state of India also reports the dominance of Fabaceae, Asteraceae and Poaceae families. However, study on the flora of whole India indicates the dominance of Orchidaceae, Fabaceae and Poaceae families [1]. The present study suggests that besides Fabaceae, Asteraceae and Poaceae, the other dominant families of the flora of Chandauli district includes Cyperaceae, Malvaceae, Lamiaceae, Amaranthaceae, Acanthaceae, Apocynaceae and Convolvulaceae (Table 2). Hooker (1904) [1] also reported the dominance of Cyperaceae, Malvaceae, Lamiaceae, Acanthaceae and Convolvulaceae in addition to Fabaceae, Asteraceae and Poaceae families in the flora of Gangetic Plains of India. Scrophulariaceae and Euphorbiaceae were the other two dominant families reported by him which are missing in the present study. Furthermore, the study indicates that of the top ten dominating families, only two i.e. Poaceae and Cyperaceae are represented by monocotyledonous families. This result of the present study conforms to the findings that Poaceae and Cyperaceae are the only monocotyledonous families which ranks among the top ten families of the flora of Gangetic Plains of India [1] and in other districts of the Uttar Pradesh state of India [7-9, 11-13]

The analysis on origin status of the plants in flora of Chandauli district reveals that 414 plant species are represented by the natives, while 260 plant species are represented by the exotics (Table 1). Thus, it is evident from the study that representation by native plant species is greater than exotic plant species in the flora of the Chandauli district. Contrary to the result of present study, Singh (2015) [13] reported greater

number of exotic plant species in flora of Varanasi district.

The analysis on the plants life span reveals that of the total plant species recorded from the Chandauli district, 281 plant species are represented by the annuals while 386 plant species are represented by the perennials (Table 1). Only 7 plant species are represented by the biennials. Therefore, the plants of perennial life span are greater in number compared to the plants of annual and biennial life spans in the flora of Chandauli district.

### Vegetation

The total area occupied by forest in Chandauli district is about 77,400 hectares. The forest of the area falls under Tropical Dry Deciduous Type [21]. Almost 99 % of the forest is found in Naugarh block of Chakia tehsil. The forest of the area shows the growth of trees, shrubs and herbs intermixed with climbers. The dominant trees of the forest are represented by *Anogeissus latifolia*, *Boswellia serrata*, *Butea monosperma*, *Cassia fistula*, *Diospyros melanoxylon*, *Haldina cordifolia*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Madhuca longifolia*, *Melia azedarach*, *Mitragyna parvifolia*, *Nyctanthes arbor-tristis*, *Phanera pupurea*, *Phyllanthus emblica*, *Senegalia catechu*, *Terminalia arjuna*, *Terminalia bellerica*, *Shorea robusta* and *Wrightia antidysenterica*.

**Table 1:** Analysis of species, genera, families, origin status and life span of the flora of Chandauli district, Uttar Pradesh, India

Group	Species	Genera	Families	Origin status	Life span				
				Native	Exotic	Annual	Biennial	Perennial	
Monocotyledons	163	97	20	109	54	71	1	91	
Dicotyledons	511	341	80	305	206	210	6	295	
Total	674	438	100	414	260	281	7	386	

**Table 2:** Ten dominant families of the flora of Chandauli district, Uttar Pradesh, India

S. No.	Families	Species	Genera
1.	Fabaceae	86	51
2.	Asteraceae	54	37
3.	Poaceae	52	35
4.	Cyperaceae	50	12
5.	Malvaceae	31	18
6.	Lamiaceae	23	17
7.	Amaranthaceae	19	13
8.	Acanthaceae	17	12
9.	Apocynaceae	17	14
10.	Convolvulaceae	16	8

### Seasonal Vegetation

The seasonal changes are responsible for the change of vegetation of any place. The seasonal vegetation can be classified into rainy, winter and summer seasons.

**Rainy season plants:** The hot summer produces dry and barren land but setting of rain provides fresh plant life to these lands, which become green due to luxuriant growth of herbaceous plants especially grasses and sedges. The flowering and fruiting of these plants start in month of July and August and they disappear by the end of September and October by completing their life cycle. The most common species are represented by *Acalypha indica*, *Aeschynomene indica*, *Alysicarpus monilifer*, *Alysicarpus vaginalis*, *Amaranthus spinosus*, *Alternanthera sessilis*, *Borreria articularis*, *Cassia tora*, *Cassia occidentalis*, *Cassia pumila*, *Commelina benghalensis*, *Cayratia trifolia*, *Cleome viscosa*, *Corchorus olitorius*, *Desmodium triflorum*, *Cyanotis cristata*, *Digera muricata*, *Eclipta alba*, *Euphorbia hirta*, *Euphorbia thymifolia*, *Evolvulus nummularius*, *Indigofera linifolia*, *Leucas aspera*,

*Lindernia ciliata*, *Lindernia crustacea*, *Mollugo hirta*, *Oldenlandia corymbosa*, *Orthosiphon pallidus*, *Physalis minima*, *Phyllanthus simplex*, *Polygala arvensis*, *Tephrosia pumila*, *Trianthema portulacastrum*, *Tribulus terrestris*, *Sida acuta*, *Urena lobata* and *Xanthium strumarium*. The most common grasses and sedges are represented by *Apluda mutica*, *Aristida adscensionis*, *Brachiaria ramosa*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Dichanthium annulatum*, *Eragrostis tenella*, *Panicum psilopodium*, *Bulbostylis barbata*, *Cyperus difformis*, *Cyperus iria*, *Cyperus rotundus*, *Fimbristylis ovata*, *Fimbristylis miliacea*, *Kyllinga triceps*, *Scirpus mucronatus* and *Scirpus supinus*.

**Winter season plants:** Some of the short duration plant start their flowering and fruiting in month of September and October and complete their life cycle by January and February. The most common species of this category are represented by *Acalypha ciliata*, *Celosia argentea*, *Chenopodium album*, *Hygrophila auriculata*, *Peristrophe bicalyculata* and *Evolvulus alsinoides*.

Thereafter with fall in temperature a number of species appear which are represented by *Ammania baccifera*, *Anagallis arvensis*, *Argemone mexicana*, *Fumaria parviflora* var. *indica*, *Heliotropium indicum*, *Lathyrus aphaca*, *Lathyrus sativus*, *Launaea procumbens*, *Lindenbergia indica*, *Melilotus alba*, *Melilotus indica*, *Mucuna pruriens*, *Oxalis corniculata*, *Rungia pectinata*, *Rungia repens*, *Ranunculus sceleratus*, *Sonchus oleraceus*, *Verbascum chinense* and *Veronica anagallis-aquatica*.

**Summer season plants:** Owing to increasing temperature and high velocity of wind during March and April the moisture content decreases consequently number of plants dry up. Very few plants appear in summer season. The most common plants are represented by *Abutilon indicum*, *Ageratum conyzoides*, *Amaranthus spinosus*, *Amaranthus viridis*, *Blumea eriantha*, *Blumea oxyodonta*, *Blumea obliqua*, *Chrozophora prostrata*,

*Chrozophora rottleri*, *Cynodon dactylon*, *Echinops echinatus*, *Kikxia ramosissima*, *Phyla nodiflora*, *Phyllanthus niruri*, *Potentilla supina*, *Ruellia tuberosa*, *Tridax procumbens* and *Vernonia cinerea*.

### Vegetation on Special Habitats

#### Vegetation in ravines

The most common trees growing in ravines are represented by *Holoptelea integrifolia*, *Millettia pinnata* and *Prosopis juliflora*. The common shrubs are represented by *Adhatoda zeylanica*, *Capparis decidua*, *Lantana camara* and *Lantana indica*. *Herbaceous plants growing in ravines are represented by Heliotropium supinum, Leucas aspera, Potentilla supina, Tephrosia purpurea, Tribulus terrestris, Verbascum chinense and Xanthium strumarium.*

#### Vegetation on walls and monuments

In rainy and winter season a number of plant species appear on walls of buildings and monuments. These are commonly represented by *Achyranthes aspera*, *Bidens biternata*, *Boerhavia diffusa*, *Chloris virgata*, *Eragrostis amabilis*, *Euphorbia hirta*, *Euphorbia thymifolia*, *Ficus benghalensis*, *Ficus religiosa*, *Ficus glomerata*, *Ficus virens* var. *sublanceolata*, *Lindenbergia indica*, *Peristrophe bicalyculata*, *Tridax procumbens* and *Trianthema portulacastrum*,

#### Vegetation on Aquatic and Marshy Habitats

The common habitats of aquatic and marshland plants in Chandauli district include Ganges, Karmanasha and Chandraprabha rivers, number of ponds, tanks, canals and several channels. In addition to these are ditches and depressions along road and villages. The plants inhabiting these habitats can be classified as follows:

*Free floating hydrophytes:* These hydrophytes remain in contact with water and air but not soil. They float freely on water surface. These are chiefly represented by *Eichhornia crassipes*, *Lemna minor*, *Pistia stratiotes*, *Wolffia arhiza* and *Wolffia microscopica*.

*Rooted hydrophytes with floating leaves:* In these plants, roots are fixed in mud, but leaves have long petioles which keep them floating on the water surface. The most common species of this category are represented by *Nelumbo nucifera*, *Nymphaea nouchali* and *Trapa natans* var. *bispinosa*.

*Submerged floating hydrophytes:* These plants are only in contact with water being completely submerged and not rooted in mud. These are chiefly represented by *Ceratophyllum demersum*, *Najas indica*, *Najas minor*, *Utricularia stellaris* and *Utricularia aurea*.

*Rooted submerged hydrophytes:* These plants remain completely submerged in water and rooted in soil. The most common plants to this category are represented by *Hydrilla verticillata*, *Potamogeton crispus*, *Potamogeton indicus* and *Vallisneria spiralis*.

*Rooted emergent hydrophytes:* These plants grow in shallow water which require excess of water but their shoots are partly or completely exposed to air. The root system is completely under water fixed in soil. These are mainly represented by *Ranunculus aquatilis*, *Ranunculus sceleratus* and *Sagittaria sagittifolia*.

*Amphibious hydrophytes:* These plants occur on soft wet mud or are rooted in shallow water. Most of the plants thrive well even after the soil is considerably dried up. These are commonly represented by *Ageratum conyzoides*, *Ammannia baccifera*, *Bacopa monnieri*, *Cyperus alulatus*, *Eclipta prostrata*, *Fimbristylis dichotoma*, *Fimbristylis miliacea*, *Gnaphalium polycaulon*, *Hoppea dichotoma*, *Ipomoea aquatica*, *Ludwigia adscendens*, *Ludwigia octovalvis*, *Ludwigia perennis*, *Phyla nodiflora* and *Veronica anagallis-aquatica*.

*Plants on river banks:* A number of plant occur along river banks. These are commonly represented by *Bulbotylis barbata*, *Chrozophora rottleri*, *Cyperus iria*, *Fimbristylis bisumbellata*, *Fimbristylis miliacea*,

*Gnaphalium polycaulon*, *Persicaria amphibia*, *Persicaria capitata*, *Persicaria glabra*, *Persicaria hydropiper*, *Persicaria longiseta*, *Persicaria orientalis*, *Persicaria pubescens*, *Persicaria serrulata*, *Phyla nodiflora*, *Potentilla glandulosa*, *Potentilla supina*, *Ranunculus sceleratus*, *Rumex dentatus* and *Verbascum chinense*. The shrubby plants are represented by *Adhatoda zeylanica*, *Alhagi maurorum*, *Lantana camara* and *Woodfordia fruticosa*. Some of the common trees are represented by *Dalbergia sissoo*, *Ficus glomerata*, *Terminalia arjuna* and *Vachellia nilotica*.

#### Weeds of Agricultural Fields and Gardens

Some of the common weeds growing in the agricultural fields in rainy season of Chandauli district are represented by *Alysicarpus monilifer*, *Cassia tora*, *Corchorus aestuans*, *Corchorus olitorius*, *Cyperus iria*, *Cyperus rotundus*, *Digera muricata*, *Euphorbia hirta*, *Leucas aspera*, *Phyllanthus niruri*, *Phyllanthus simplex* and *Striga asiatica*.

The common weeds growing with winter crops are represented by *Amaranthus viridis*, *Anagallis arvensis*, *Argemone mexicana*, *Asphodelus tenuifolius*, *Celosia argentea*, *Chenopodium album*, *Convolvulus arvensis*, *Desmodium triflorum*, *Gomphrena celosioides*, *Lathyrus sativus*, *Oldenlandia corymbosa*, *Rungia pectinata*, *Rungia repens* and *Fumaria parviflora* var. *indica*.

In summer season, the most common weeds of agricultural fields are represented by *Blumea oxyodonta*, *Euphorbia hirta*, *Echinops echinatus*, *Phyla nodiflora*, *Portulaca oleracea*, *Solanum virginianum* and *Vernonia cinerea*.

The common woody plants along roadsides and railway tracks of the Chandauli district are represented by *Alstonia scholaris*, *Albizia lebbeck*, *Azadirachta indica*, *Anthocephalus cadamba*, *Cassia fistula*, *Dalbergia sissoo*, *Delonix regia*, *Eucalyptus*

*globulus*, *Eucalyptus* hybrid, *Ficus benghalensis*, *Ficus religiosa*, *Ficus virens* var. *sublanceolata*, *Mangifera indica*, *Millettia pinnata*, *Moringa oleifera*, *Prosopis juliflora*, *Senna siamea*, *Tamarindus indicus*, *Terminalia arjuna* and *Vachellia nilotica*.

*Plants growing on wastelands*: The most common plant species growing on the wastelands of Chandauli district are represented by *Amaranthus spinosus*, *Argemone mexicana*, *Bothriochloa pertusa*, *Calotropis procera*, *Calotropis gigantea*, *Datura metel*, *Dichanthium annulatum*, *Parthenium hysterophorus*, *Senna angustifolia*, *Senna tora*, *Solanum virginianum*, *Peristrophe bicalyculata* and *Xanthium strumarium*.

#### IV. CONCLUSION

It can be concluded from the study that Chandauli district of Uttar Pradesh state of India hosts a large variety of plant species dominated by Fabaceae, Asteraceae and Poaceae families. The native plant species are greater in number compared to exotic plant species in the flora of Chandauli district. The plants of perennial life span exceed the number of annual and biennial life span plants in the flora of Chandauli district.

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