CHECKLIST AND KEY TO THE AVERRHOACEAE, ELAEOCARPACEAE, LINACEAE, MALPIGHIACEAE, OXALIDACEAE, PORTULACACEAE, TAMARICACEAE AND ZYGOPHYLLACEAE OF BIHAR

Onkar Nath Maurya[1], Ashutosh Kumar Verma[1] and Kumar Avinash Bharati[2]*

[1]Central Regional Centre, Botanical Survey of India, Prayagaraj – 211 002

[2]Central National Herbarium, Botanical Survey of India, Howrah–711103

E-mail: avinash.bharati@bsi.gov.in

Received April15, 2023 Accepted August 29, 2023

ABSTRACT: Diversity in Averrhoaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Oxalidaceae, Portulacaceae, Tamaricaceae and Zygophyllaceae of Bihar has been documented and a checklist has been prepared with the help of relevant literatures and herbarium specimens deposited in Central National Herbarium, herbarium of Ranchi University and National Botanical Research Institute. All the genus, species and varieties are enumerated with identification keys. The generic diversity at global, national and state level has been provided. The valid names of the species along with author(s), flowering and fruiting time and occurrence at district level are mentioned. The purpose of the checklist is to document the diversity of the Averrhoaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Oxalidaceae, Portulacaceae, Tamaricaceae and Zygophyllaceae families in Bihar and taxonomic key is to offer students and botanist a means for identification.

Keywords: Averrhoaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Oxalidaceae, Portulacaceae, Tamaricaceae, Zygophyllaceae, Biodiversity, Checklist, Flora, Bihar.

Historically, Bihar was important centre of civilization many ancient Janpadas were situated in the state like, Magadha, Mithila, Vaishali, Anga, etc. It produces Chandragupta Maurya, Ajatshatru and Asoka like kings. During that period Budhist monasteries' was very common the state, it was also mentioned by Fahien and Yuan Chawang has mentioned the word "vihar" for Budhist monks resting house. It is believe that name "Bihar" has been originated from "vihar". Present political boundary of Bihar is encompass a geographic area of 94,163 km^2, it is an entirely land-locked state in eastern part of India in between lat $21^0$58' 10" N and $27^0$31'15" N and long 83^0 16' E and 88^0 30' E. The state shares boundary with Nepal in north, Jharkhand in the south, West Bengal in the east, Uttar Pradesh and Madhya Pradesh in the west.

Ganga and its tributaries forms vast stretch of plains and these alluvial plains of the state are fertile, the Ganges flows from west to east and split Bihar in to northern plains and southern plains. However, southern plain is comparatively narrow than northern plains and also it has some small hills and Plateaus, for example the Rajgir hills, Kaimur plateau, etc. In addition to river Ganges, major rivers of Bihar are Gandak, Sone, Koshi, Bagmati, Phalgu and Bhudi Gandak. Mainly three types of soil are found in Bihar: (1) Piedmont Swamp Soil (northern area of West Champaran district), it rejuvenated every year by deposition of sand, silt and clay, (2) Terai Soil (terai areas of Himalayan foot hills), clayey in composition, rich in humus content and high water retain capacity, (3) Gangetic Alluvium (most of the area of Bihar), it is flat stretch of land formed by deposition of sediment by Ganges and its tributaries over a long period of time. In colonial period, Britishers were used fertile land of Bihar for plantation of indigo, jute, etc. it was used as raw material to support economic interest of East-India Company.

The state has monsoon type climate and three seasons are well demarked, winter is from November to February, summer is from April to June and rainy season is from July to September. In summer temperature may reach up to 44 ºC in Gaya district and minimum temperature may falls up to 4 ºC in West Champaran district. The average annual rainfall varies from 100 to 125 cm. Comparatively, forest cover in Bihar is less than national average, just 7.6% (7305 sq. km) and the dense forest is 3280.32 sq. km. Most of forest area in Bihar is found in the district of West Champaran. A total of 21 wildlife sanctuaries and 1 national park are in the state and Valmiki National Park is only national park. Champion and Seth (1968) has classified the forest types, the state has ten forest types viz. Cane Brakes, Bhabar Dun Sal Forest, West Gangetic Moist Mixed Deciduous Forest, Eastern Wet Alluvial Grassland, Dry Siwalik Sal Forest, Dry Peninsular Sal Forest, Northern Dry Mixed Deciduous Forest, Dry Deciduous Scrub, Boswellia Forest and Dry Bamboo Brakes. Main species of Bihar forests are *Shorea robusta, Terminalia tomentosa, T. arjuna, Anogeissus latifolia, Gmelina arborea, Madhuca longifolia, Dillenia pentagyna, Abrus precatorius, Biophytum sensitivum, Costus speciosus, Vanda tessellata, Murraya paniculata, Colebrookea oppositifolia, Petalidium barlerioides, Urena lobata, Uraria rufescens, Saccharum procerum, S. bengalense, Ophiuros megaphyllus, O. exaltatus, Arundinella bengalensis, Hydrilla verticillata, Ottelia alisnoides, Vallisneria spiralis, Potamogeton nodosus, Nymphaea nouchali, N. pubescens, Euryale ferox, Nelumbo nucifera, Aeschynomene indica, A. aspera, Ipomoea aquatica, Polygonum barbatum, Crotalaria acicularis, C. angulata, etc.*

Review of Literature

Buchanan-Hamilton was first taxonomist who collected plant in Bihar from 1809-1813 and was Hooker (1848) was the 2nd taxonomist who had collected plants from Gaya, Kymore hills, Purnea, etc. Checklist on the plant species of Bihar was published by Anderson (1863).

Haines has done remarkable publication on the flora of undivided Bihar and Orissa, he had collected plants mainly in Jharkhand and Orissa and published "The Botany of Bihar and Orissa" in six volumes in between 1921-1925. Mooney (1941; 1950) published "Supplement to the Botany of Bihar and Orissa". However, his most of the studies were belongs to present Jharkhand. Publications on Champaran district (Thothathri, 1965; Banerjee and Banerjee, 1969; Bhattacharya & Krishnendu, 1998), Udaipur forest of Champaran district (Thothathri, 1966; Maurya *et al*., 2021); Bhagalpur (Paul, 1967; 1981); A sketch of the vegetation of Champaran district of North Bihar by Banerjee and Banerjee (1969); useful plants of Bihar and vegetation of Muzaffarpur, Purnea, Saran, Champaran, Patna by Srivastava (1955-58), vegetation of Darbhanga district by Thakur (1963), Patna (Singh, 1986) and West Champaran (Bhattacharya & Krishnendu, 1998) are major contributions on the plants of Bihar. Other publications worth to mention are Sanyal (1957), Thakur (1963), Mishra (1969-1971), Mishra (1985), Mishra & Jha (1972), Jain *et al.* (1975), Paul (1966, 1973), Saxena (1976, 1978), Srivastava *et al.* (1966), Uniyal & Datta (1984) and Bhattacharya *et al.* (2011), Bharati and Maurya (2018), Bharati (2019), Maurya and Bharati (2019) and Maurya *et al*., 2021. It has been observed that the state doesn't have any separate comprehensive account on Averrhoaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Oxalidaceae, Portulacaceae, Tamaricaceae and Zygophyllaceae families, therefore, the present study was undertaken.

The main objective of the study was to prepare a checklist of Averrhoaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Oxalidaceae, Portulacaceae, Tamaricaceae and Zygophyllaceae families with key to the genera and species; it will help in assessment of diversity at district level, state level and identification of species.

Methodology

Documentation of the taxa was initiated with gathering of information on the said families with help of relevant literatures like, the Botany of Bihar & Orissa (1921–1925), some additions to the Botany of Bihar & Orissa (1941), Supplement to the Botany of Bihar & Orissa (1950), Flora of Bihar analysis (2001) and Flora of west Champaran district Bihar (1998) were referred. In addition, the specimens deposited in Central National Herbarium (CAL), herbarium of Ranchi University and National botanical research Institute (LWG) were consulted. Worldwide distribution of species was verified through Mabberley (2008, 2017). The National level and state level distribution was taken from databases like, Plants of the World Online (https://powo.science.kew.org), Flora of India (https://efloraindia.bsi.gov.in/) and district level distribution was verified from Flora of Bihar analysis (2001). The nomenclatures were updated through International Plant Name Index (http://www.ipni.org). The Benthum and Hooker's system of classification was followed and a diagnostic generic and species key have also been framed for easy identification of taxa.

Results and discussion

Total 24 species and 1 variety under 12 genera are documented in present study, the distribution of genera and species in families are as follows: Averrhoaceae (1 genus and 2 species), Elaeocarpaceae (1 genus and 1 species), Linaceae (1 genus and 1 species), Malpighiaceae (2 genera and 2 species), Oxalidaceae (2 genera and 7 species), Portulacaceae (1 genus and 5 species), Tamaricaceae (1 genus and 3 species) and Zygophyllaceae (3 genera and 3 species) (Fig. 1).

Key to the genera

1a. Leaves scale like Tamaricaceae
1b. Leaves not scale like 2
2a.Tree 3
2b. Herb or shrub 4
3a. Stipules caduceus; stamens many; disc nectariferous; fruit drupe **Elaeocarpaceae**
3b. Stipules absent; stamens 10; disc not nectariferous; fruit berries **Averrhoaceae**
4a.Climber
Malpighiaceae
4b. Not climber **5**
5a. Fruit spinous **Zygophyllaceae**
5b. Fruit not spinous **6**
6a. Undershrubs; stamens 5; staminodes 5 **Linaceae**
6b. Herbs; stamens 8 or more; staminodes absent **7**
7a. Inflorescence cymose or umbellate **Oxalidaceae**
7b. Inflorescence absent (flower solitary) or capitula Protulacaeae.

PORTULACACEAE: The family Portulacaceae has 1 genus and 116 species, cosmopolitan, distributed especially in West America (Mabberley, 2017); 1 genus and 6 species in India (Rao, 1993); 1 genus, 5 species and 1 variety in Bihar.

PORTULACA L.

About 116 species in tropical & warm regions (Mabberley, 2017); 6 species in India (Rao, 1993); 5 species and 1 variety in Bihar.

Key to the species

1a. Nodal appendages present 2
1b. Nodal appendages absent **2. P. oleracea**
2a. Leaves opposite 3
2b.Leaves spiral 3
a. Petals 5; stamens numerous **1. P. grandiflora**

3b. Petals 4; stamens 8–12 **4. P. quadrifida**

4a. Roots not tuberous; flowers pink or red-purple **3. P. pilosa**

4b. Roots tuberous; flowers **5. P. tuberosa**

1. Portulaca grandiflora Hook. in Curtis, Bot. Mag. 56: t. 2885. 1829; Haines, Bot. Bihar Orissa 47. 1921 (Repr. ed. 1: 48. 1961); S.K Varma, Fl. Bhagalpur 67. 1981; M.P. Singh, Fl. Patna 59. 1986; M.K.V. Rao in B.D Sharma & Sanjappa, Fl. India 3: 3. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 88. 1998; N.P. Singh et al., Fl. Bihar, Analysis 53. 2001.

Fl. & *Fr.:* Throughout the year. Bhagalpur, Patna, West Champaran.

2. Portulaca oleracea L., Sp. Pl. 445. 1753; Dyer in Hook.f., Fl. Brit. India 1: 246. 1874; Haines, Bot. Bihar Orissa 47. 1921 (Repr. ed. 1: 48. 1961); S.K. Varma, Fl. Bhagalpur 66. 1981; M.P. Singh, Fl. Patna 60. 1986; M.K.V. Rao in B.D Sharma & Sanjappa, Fl. India 3: 4. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 86. 1998; N.P. Singh et al., Fl. Bihar, Analysis 53. 2001.

Key to the varieties

1a. Leaves linear, subterete; seeds 55–75 per capsule **2.1** var. **linearifolia**

1b. Leaves spathulate, obovate; seeds 20–25 per capsule **2.2** var. **oleracea**

2.2. var. **linearifolia** Sivar. & Manilal in New Bota. 4: 30. 1997; Sivar. in J. Bombay Nat. Hist. Soc. 78: 258. 1981.

Fl. & *Fr.:* April–October. Patna

2.2 var. **oleracea**

Fl. & *Fr.:* Throughout the year. Throughout the state.

3. Portulaca pilosa L., Sp. Pl. 445. 1753; S.K. Varma, Fl. Bhagalpur 67. 1981; M.K.V. Rao in B.D. Sharma & Sanjappa, Fl. India 3: 6. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 86. 1998; N.P. Singh et al., Fl. Bihar, Analysis 53. 2001.

Fl. & *Fr.*: July–October. Bhagalpur, West Champaran.

4. Portulaca quadrifida L., Mant. Pl. 73. 1767; Dyer in Hook.f., Fl. Brit. India 1: 247. 1874; Haines, Bot. Bihar Orissa 47. 1921 (Repr. ed. 1: 48. 1961); Mooney, Suppl. Bot. Bihar & Orissa 24. 1950; S.K Varma, Fl. Bhagalpur 66. 1981; M.P. Singh, Fl. Patna 60. 1986; M.K.V. Rao in B.D Sharma & Sanjappa, Fl. India 3: 6. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 88. 1998; N.P. Singh et al., Fl. Bihar, Analysis 53. 2001.

Fl. & *Fr.:* July–October. Bhagalpur, Darbhanga, Patna, Samastipur, West Champaran.

5. Portulaca tuberosa Roxb., Fl. Ind. ed. 1832, 2: 464. 1832; Dyer in Hook.f., Fl. Brit. India 1: 247. 1874; Haines, Bot. Bihar Orissa 46. 1921 (Repr. ed. 1: 48. 1961); Mooney, Suppl. Bot. Bihar & Orissa 24. 1950; M.K.V. Rao in B.D. Sharma & Sanjappa, Fl. India 3: 7. 1993; N.P. Singh et al., Fl. Bihar, Analysis 54. 2001. *Portulaca pilosa* L. var. *tuberosa* (Roxb.) Sivar. in J. Bombay Nat. Hist. Soc. 78: 259. 1981.

Fl. & Fr.: July–October. Munger, Rajgir. Rare.

TAMARICACEAE

About 5 genera and 88 species in Africa, Europe & Asia especially Miditerranean to central Asia (Mabberley, 2017); 3 genera and 16 species in India (Shetty & Pandey, 1993); 1 genus and 3 species in Bihar.

TAMARIX L.

About 60 species in Africa Europe & Asia (Mabberley, 2017); 9 species in India (Shetty & Pandey, 1993); 3 species in Bihar.

Key to the species

1a. Flowers uni
1. T. dioica
1b. Flowers bisexual 2
2a. Stamens 10
2. T. ericoides
2b. Stamens 5
3. T. indica

1. Tamarix dioica Roxb. ex Roth, Nov. Pl. Sp. 185. 1821; Dyer in Hook.f., Fl. Brit. India 1: 249. 1874; Haines, Bot. Bihar Orissa 51. 1921 (Repr. ed. 1: 52. 1961); S.K. Varma, Fl. Bhagalpur 67. 1981; M.P. Singh, Fl. Patna 60. 1986; B.V. Shetty & R.P. Pandey in B.D. Sharma & Sanjappa, Fl. India 3: 24. 1993; N.P. Singh et al., Fl. Bihar, Analysis 54. 2001.

Fl. & *Fr.:* September–January. Bhagalpur, East Champaran, Patna, Saran, West Champaran.

2. Tamarix ericoides Rottl. & Willd. in Neue Schriften Ges. Naturf. Freunde Berlin 4: 214, t. 4. 1803; Dyer in Hook.f., Fl. Brit. India 1: 249. 1874; Haines, Bot. Bihar Orissa 51. 1921 (Repr. ed. 1: 52. 1961); B.V. Shetty & R.P. Pandey in B.D. Sharma & Sanjappa, Fl. India 3: 25. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 125. 1998; N.P. Singh et al., Fl. Bihar, Analysis 54. 2001.

Fl. & *Fr.:* August–November. West Champaran.

3. Tamarix indica Willd. in Neue Schriften Ges. Naturf. Freunde Berlin 4: 214. 1803; Haines, Bot. Bihar Orissa 51. 1921 (Repr. ed. 1: 53. 1961); B.V. Shetty & R.P. Pandey in B.D. Sharma & Sanjappa, Fl. India 3: 25. 1993; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 127. 1998; N.P. Singh et al., Fl. Bihar, Analysis 54. 2001. *Tamarix gallica* L. var. *indica* (Willd.) Ehrenb. in Linnaea 2: 268. 1827; Dyer in Hook.f., Fl. Brit. India 1: 248. 1874. *Tamarix gallica* sensu Dyer in Hook.f., Fl. Brit. India 1: 248. 1874, non L., 1753.

Fl. & *Fr.:* August–December. West Champaran.

ELAEOCARPACEAE

The family Elaeocarpaceae has 12 genera and 550 species in tropical and warm regions of the world

excluding Africa; 2 genera and 33 species in India (Murti, 1993); 1 genus and 1 species in Bihar.

Elaeocarpus Burm. ex L.

About 290 species in tropical and warm old world regions excluding Africa (Mabberley, 2017); 29 species in India (Murti, 1993); 1 species in Bihar.

Elaeocarpus robustus Roxb., Fl. Ind. ed. 1832, 2: 597. 1832; Masters in Hook.f., Fl. Brit. India 1:402.1874, *p.p.*; Haines, Bot. Bihar Orissa 96. 1921 (Repr. ed. 1: 100.1961). *Elaeocarpus tectorius* auct. non (Lour.) Poir., 1812: Murti in Sharma & Sanjappa, Fl. India 3: 559. 1993, p.p.; N.P. Singh et al., Fl. Bihar, Analysis 83. 2001, p.p.

Fl. & Fr.: May–October. Undivided Bihar (Murti, *l.c.*)

Cultivated species

1. **Elaeocarpus angustifolius** Blume
2. **Elaeocarpus floribundus** Blume

LINACEAE

The family Linaceae has 10 genera and 250 species, compolitan (Mabberley, 2017); 5 genera and 12 species in India (Hajra, 1993); 1 genus and 1 species in Bihar.

REINWARDTIA Dumort.

About 3 species in Indian Subcontinent to China and Indo-China (POWO, 2021); 2 species in India (Hajra, 1993); 1 species in Bihar.

Reinwardtia indica Dumort., Comment. Bot. 19. 1822. *Linum trigynum* Roxb. ex Hardw. in Asiat. Res. 6: 357. 1799, non L., 1753, nom. illeg. *Reinwardtia trigyna* Planch. in London J. Bot. 7: 522. 1848; Hook.f., Fl. Brit. India 1: 412. 1874; Haines, Bot. Bihar Orissa 150. 1921 (Repr. ed. 1: 155. 1961); N.P. Singh et al., Fl. Bihar, Analysis 84. 2001.

Fl. & *Fr.*: September–February. Throughout the state.

Cultivated species

Linum usitatissimum L.

MALPIGHIACEAE

The family Malpighiaceae has 74 & 1300 species in tropical & warm regions of the world especially South America (Mabberley, 2017); 8 genera and 36 species (6 genera and 13 species cultivated) in India (Srivastava, 1997); 2 genera and 2 species in Bihar.

Key to the genus

1a. Flowers actinomorphic; styles 3; samaras surrounded by a disk-like lateral wing **1. Aspidopterys**

1b. Flowers zygomorphic; styles 1–2; samaras with one long median wing and two shorter lateral wings **2. Hiptage**

1. ASPIDOPTERYS A.Juss. ex Endl.

The genus Aspidopterys has 15–20 species in Indo-Malesia (Mabberley, 2017); 14 species in India (Srivastava, 1997); 1 species in Bihar.

Aspidopterys nutans (Roxb. ex DC.) A.Juss. in Ann. Sci. Nat., Bot., sér. 2, 13: 267. 1840; Hook.f., Fl. Brit. India 1: 421. 1874, p.p.; R.C. Srivastava in Hajra et al., Fl. India 4: 9. 1997; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 232. 1998; N.P. Singh et al., Fl. Bihar, Analysis 84. 2001. *Hiraea nutans* Roxb. ex DC., Prodr. 1: 585. 1824.

Fl. & Fr. : November–March. West Champaran.

2. HIPTAGE Gaertn.

The genus *Hiptage* has 20–30 species in Asia to Fiji (Mabberley, 2017); 9 species in India (Srivastava, 1997); 1 species in Bihar.

Hiptage benghalensis (L.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 136. 1874; S.K. Varma, Fl. Bhagalpur 8. 1981; M.P. Singh, Fl. Patna 81.1986; R.C. Srivastava in Hajra et al., Fl. India 4: 14. 1997; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 232. 1998; N.P. Singh et al., Fl. Bihar, Analysis 85. 2001. *Banisteria benghalensis* L., Sp. Pl. 427. 1753. *Hiptage madablota* Gaertn., Fruct. Sem. Pl. 2: 169. t. 116. 1791; Hook.f., Fl. Brit. India 1: 418. 1874; Haines, Bot. Bihar Orissa 152. 1921 (Repr. ed. 1: 157. 1961). *Madhulata* (Hindi).

Fl. & Fr.: January–April. Throughout the state.

Cultivated species

Galphimia gracilis Bartl.

ZYGOPHYLLACEAE

The family Zygophyllaceae has 27 genera and 300 species in tropical and warm regions of the world especially in arid areas (Mabberley, 2017); 8 genera, 18 species and 4 varieties in India (Singh & Singh, 1997); 3 genera and 3 species in Bihar.

Key to the species

1a. Leaves simple; fruits capsular 2. Peganum

1b. Leaves compound; fruits schizocar 2

2a. Fruits spinous, split into 4–5 mericarps 3. Tribulus

2b. Fruits not spinous, split into 10–12 mericarps

1. Kallstroemia

1. KALLSTROEMIA Scop.

About 17 species in tropical regions and warm America (Mabberley, 2017); 1 species in India and Bihar (Singh & Singh, 1997).

Kallstroemia pubescens (G. Don) Dandy in Kew Bull. 10: 138. 1955; S.K. Varma, Fl. Bhagalpur 87.1981; P. Singh & V. Singh in Hajra et al., Fl. India 4. 45. 1997; N.P. Singh et al., Fl. Bihar, Analysis 86. 2001. *Tribulus pubescens* G. Don, Gen. Hist. 1: 769. 1831.

Fl. & Fr.: July–September. Bhagalpur.

2. PEGANUM L.

The genus *Peganum* has 5–6 species in Mediterranean region to Mongolia and South-North

America (Mabberley, 2017); 1 species in India (Singh & Singh, 1997).

Peganum harmala L., Sp. Pl. 444. 1753; Hook.f., Fl. Brit. India 1. 486. 1874; Haines, Bot. Bihar Orissa 154. 1921 (Repr. ed. 1: 159. 1961); P. Singh & V. Singh in Hajra et al., Fl. India 4: 48. 1997; N.P. Singh et al., Fl. Bihar, Analysis 86. 2001. *Harmal* (Hindi).
Fl. & Fr.: March– October. North Bihar.

3. TRIBULUS L.

About 25 species in tropical & warm regions of the world (Mabberley, 2017); 5 species in India (Singh & Singh, 1997); 1 species in Bihar.

Tribulus terrestris L., Sp. Pl. 387.1753; Edgew. & Hook.f., Fl. Brit. India 1: 423. 1874; Haines, Bot. Bihar Orissa 153. 1921 (Repr. ed. 1: 159. 1961); S.K. Varma, Fl. Bhagalpur 87. 1981; M.P. Singh, Fl. Patna 82. 1986; P. Singh & V. Singh in Hajra et al., Fl. India 4. 55. 1997; N.P. Singh et al., Fl. Bihar, Analysis 86. 2001. *Tribulus lanuginosus* L., Sp. Pl. 387. 1753; P. Singh & V. Singh in Hajra et al., Fl. India 4. 51. 1997; N.P. Singh et al., Fl. Bihar, Analysis 86. 2001.
Fl. & Fr.: Throughout the year. Throughout the state.

Cultivated species

Guaiacum officinale L.

OXALIDACEAE

About 5 genera and 565 species in tropical to temperate regions of the world (Mabberley, 2017); 2 genera and 20 species in India (Manna, 1997); 2 genera and 7 species in Bihar.

Key to the genus

1a. Leaflets pinnate; capsules dehiscing into valves without leaving a central axis **1. Biophytum**

1b. Leaflets digitate; capsules with valves remaining attached to central axis **2. Oxalis**

1. BIOPHYTUM DC.

About 50 species in tropical regions (Mabberley, 2017); 12 species in India (Manna, 1997); 3 species in Bihar.

Key to the species

1a. Leaflets overlapping, midrib arched; peduncles absent **3. B. umbraculum**

1b. Leaflets not overlapping, midrib straight or oblique; peduncles present 2

2a. Midrib of leaflets straight; sepals almost equal to capsules **1. B. reinwardtii**

2b. Midrib of leaflets oblique; sepals much exceeding capsules **2. B. sensitivum**

1. Biophytum reinwardtii (Zucc.) Klotzsch in Peters, Naturw. Reise Mossambique 6(Bot., 1): 85. 1861; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 437. 1874; Haines, Bot. Bihar Orissa 156. 1921 (Repr. ed. 1: 162. 1961); Manna in Hajra et al., Fl. India 4: 236. 1997; N.P. Singh et al., Fl. Bihar, Analysis 87. 2001; T.K. Sarma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau 129. 2002. *Oxalis reinwardtii* Zucc. in Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 1: 274. 1830. *Lajauri* (Santhali).
Fl. & Fr.: October–December. Muzaffarpur. Leaves and roots are used for insomnia.

2. Biophytum sensitivum (L.) DC., Prodr.1: 690. 1824; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 436. 1874; Haines, Bot. Bihar Orissa 156.1921 (Repr. ed. 1: 161. 1961); S.K. Varma, Fl. Bhagalpur 88. 1981; M.P. Singh, Fl. Patna 82. 1986; Manna in Hajra et al., Fl. India 4: 238. 1997; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 249. 1998; N.P. Singh et al., Fl. Bihar, Analysis 88. 2001; T.K. Sarma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau 130. 2002. *Oxalis sensitiva* L., Sp. Pl. 434. 1753.
Fl. & Fr.: October–January. Throughout the state.

3. Biophytum umbraculum Welw., Apont. 590. 1859. *Biophytum petersianum* Klotzsch in Peters, Naturw. Reise Mossambique 6(Bot., 1): 81, t. 15. 1861; Manna in Hajra et al., Fl. India 4: 235. 1997; N.P. Singh et al., Fl. Bihar, Analysis 87. 2001. *Oxalis apodiscias* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 36(1): 430. 1863. *Biophytum apodiscias* (Turcz.) Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 437. 1874; Haines, Bot. Bihar Orissa 156. 1921 (Repr. ed. 1: 161. 1961).
Fl. & Fr.: January–October. Begusarai, Khagaria, Munger.

2. OXALIS L.

About 500 species, cosmopolitan especially in South America & Cape (Mabberley, 2017); 10 species in India (Manna, 1997); 4 species in Bihar.

Key to the species

1a. Plants caulescent; bulbs absent **1. O. corniculata**

1b. Plants acaulescent; bulbs present 2

2a. Leaflets fishtail-shaped, broadly deltoid **3. O. dehradunensis**

2b. Leaflets obcordate 3

3a. Leaves appressed hairy, membranous; flowers violet **2. O. debilis**

3b. Leaves glabrous, semi-succulent; flowers yellow **4.** O. **pes-caprae**

1. Oxalis corniculata L., Sp. Pl. 435. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 436. 1874; Haines, Bot. Bihar Orissa 157. 1921 (Repr. ed. 1: 162. 1961); S.K. Varma, Fl. Bhagalpur 89. 1981; M.P. Singh, Fl. Patna 83. 1986; Manna in Hajra et al., Fl. India 4: 242. 1997; P.K. Bhattach. & K. Sarkar, Fl. West Champaran 250. 1998; N.P. Singh et al., Fl. Bihar, Analysis 88. 2001.
Fl. & Fr.: March–December. Throughout the state.

2. Oxalis debilis Kunth, Nov. Gen. Sp. Nov. Gen. Sp. 5: 236. 1822. *Oxalis corymbosa* DC., Prodr. 1: 696. 1824;

S.K. Varma, Fl. Bhagalpur 89. 1981; Calder in Rec. Bot. Surv. India 6: 337. 1919; Hajra et al., Fl. India 4. 246. 1997; N.P. Singh et al., Fl. Bihar, Analysis 88. 2001.

Fl. & Fr.: September–December. Bhagalpur.

3. Oxalis dehradunensis Raizada, Suppl. Fl. Gangetic Plain 5: 37. 1976; Manna in Hajra et al., Fl. India 4: 246. 1997; N.P. Singh et al., Fl. Bihar, Analysis 88. 2001. *Oxalis richardiana* Babu, Herb. Fl. Dehra Dun 104. 1977. *Oxalis intermedia* A. Rich., Hist. Phys. Cuba, Pl. Vasc. 315. 1841 (non Steud., 1841). *Oxalis latifolia* auct. non Kunth, 1822: Calder in Rec. Bot. Surv. India 6: 335. 1912; S.K. Varma, Fl. Bhagalpur 90. 1981; M.P. Singh, Fl. Patna 83. 1986.

Fl. & Fr.: May–October. Bhagalpur, Patna.

4. Oxalis pes-caprae L., Sp. Pl. 1: 434. 1753; M.P. Singh, Fl. Patna 83. 1986.

Fl. & Fr.: November–May. Patna.

AVERRHOACEAE

About 16 species in Malesia, Madagascar, Myanmar and S. America (Manna, 1997); 1 genus and 2 species in India and also in Bihar (Manna, 1997).

AVERRHOA L.

About 2–4 species in Brazil or Malaysia and cultivated in pantropical region (Mabberley, 2017); 2 species in India (Manna, 1997); 2 species in Bihar.

Key to the species

1a. Panicles cauliflorous; seeds exaxillate **1. A. bilimbi**

1b. Panicles axillary; seeds arillate **2. A. carambola**

1. Averrhoa bilimbi L., Sp. Pl. 428.1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 439. 1874; Haines, Bot. Bihar Orissa 157. 1921 (Repr. ed. 1: 163. 1961); M.P. Singh, Fl. Patna 84. 1986; Manna in Hajra et al, Fl. India 4: 256. 1997; N.P. Singh et al., Fl. Bihar, Analysis 88. 2001.

Fl. & Fr.: March–May. Patna.

2. Averrhoa carambola L., Sp. Pl. 428. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 439. 1874; Haines, Bot. Bihar Orissa 157. 1921 (Repr. ed. 1: 162. 1961); S.K. Varma, Fl. Bhagalpur 90. 1981; M.P. Singh, Fl. Patna 84. 1986; Manna in Hajra et al., Fl. India 4: 257. 1997; N.P. Singh et al., Fl. Bihar, Analysis 89. 2001. *Kamrakh*, *Karmal* (Hindi).

Fl. & Fr.: March–August. Bhagalpur, East Champaran, Patna, West Champaran.

Conclusions

A total of 24 species and 1 variety belong to Portulacaceae, Tamaricaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Zygophyllaceae, Oxalidaceae and Averrhoaceae families are documented. The distributions at global and national level of associated taxa have been provided. This data will be ready references to assess the diversity of enlisted families in the state of Jharkhand. The study will facilitate strategies for management of wild species and conservation in terms of plant diversity and resource management.

Acknowledgements

The work has been undertaken during the period of 2020 – 2021 under internal research programme of BSI. Authors are thankful to the Director, BSI and Head of the Office, Central National Herbarium, Howrah for constant encouragements and facilities.

Reference

Anderson, T. 1863. On the flora of Bihar and the mountains of Parasnath with a list of species collected by Messrs Hooker, Edgeworth, Thomson and Anderson. J. As. Soc. Beng., 32: 187–218.

Banerjee, S.P. and Banerjee, R.N. 1969. A sketch of the vegetation of Champaran district of North Bihar. Bull. Bot. Soc. Beng., 23: 167–170.

Bharati K.A. and Maurya O.N. 2018. A checklist of angiosperms in eco-sensitive zone of Nakti dam Bird Sanctuary, Jamui District, Bihar. *Phytotaxonomy* 18: 69 – 77.

Bhattacharya, P.K. and Krishnendu S. 1998. Flora of west Champaran district Bihar, Botanical Survey of India, Calcutta.

Bhattacharya, R.P., Pal, D.C. and Patil, B.R. 2011. Aquatic and wetland Monocotyledons of Bihar and Jharkhand states. J. Econ. Taxon. Bot., 35(3):486-496.

Buchanan-Hamilton, F. 1928. An account of the districts of Bihar and Patna in 1811–1812. The Bihar and Orissa Research Society. Calcutta Oriental Press, Calcutta.

Champion, H.G. and Seth, S.K. 1968. A revised forest types of India. Govt. of India Publications, New Delhi.

Haines, H.H. 1910. A Forest Flora of Chota Nagpur including Gangpur and the Santal Parganas. Superintendent, Government Printing, Calcutta.

Haines, H.H. 1921–25. The Botany of Bihar and Orissa, pts.I-VI. Adlard & Son & West Newman Ltd., London.

Hooker, J.D. 1848. Observations made when following Grand Trunk Road across the hills of Upper Bengal, Parasnath, etc. in the Soan Valley and on the Kumaon branch of the Vindhya hills. J. As. Soc. Beng., 17: 255–411.

International Plant Name Index, accessed June 6, 2023, http://www.ipni.org

Jain, S.K., Banerjee, D.K. and Pal, D.C. 1975. Grasses of Bihar, Orissa and West Bengal. J. Bombay Nat. Hist. Soc., 72: 758–773.

Kumar, A., Sachan, S., Shil, T., & Maurya, O. N. 2020. An annotated checklist of the vascular plants of the Udaipur wildlife sanctuary, West Champaran, Bihar, India. *Tropical Plant Research*, *7*, 209-228.

Mabberley, D. J. 2008. Mabberley's Plant-Book A Portable Dictionary of Plants, their Classification and Uses, 4th Edition. Cambridge University Press, Cambridge.

Mabberley, D. J. 2017. Mabberley's Plant-Book A Portable Dictionary of Plants, their Classification and Uses, 4th Edition. Cambridge University Press, Cambridge.

Maurya O.N. and Bharati K.A. 2019. Floristic diversity of Eco-sensitive zone of Nagi dam Bird Sanctuary, Bihar. *Indian Journal of Forestry* 42(2): 109 – 115.

Maurya, O N, Kumar A and Sachan S. 2021. The Flora of the Udaipur Wild Life Sanctuary, West Champaran, Bihar, India. Botanicalm Survey of India, Kolkata.

Mishra, A. 1969. Angiosperm flora of Darbhanga (Mithila, North Bihar) – I. Bull. Bot. Sur. India, 11: 322–329.

Mishra, A. 1970. Angiosperm flora of Darbhanga (Mithila, North Bihar) – II. Bull. Bot. Sur. India, 12: 132–138.

Mishra, A. 1971. Angiosperm flora of Darbhanga (Mithila, North Bihar) – III. Bull. Bot. Sur. India, 13: 212–216.

Mishra, K.K. 1985. New plant record from Bihar. J. Econ. Taxon. Bot., 6: 410–412.

Misra, S.K. and Jha, D. 1972. Floristic in Darbhanga. Planta, 2: 136–143.

Mooney, H.F. 1941. Some additions to the Botany of Bihar and Orissa. Indian For. Rec., 3: 63–119.

Mooney, H.F. 1950. Supplement to the Botany of Bihar and Orissa. Catholic Press, Ranchi.

Paul, S.R. 1966. Rice field weed flora of Bhagalpur district (Bihar). Pro. Bihar Acad. Agr. Sci., 15: 15–24.

Paul, S.R. 1967. Studies on the grasses of Bhagalpur district (Bihar). Indian For., 93: 169–179.

Paul, S.R. 1973. On the Aquatic and Marsh Flora of Monghyr, Bihar. Botanique 4: 143–152.

Plants of the World Online, accessed June 6, 2023, https://powo.science.kew.org

Sanyal, A. 1957. Additional notes on the Botany of Bihar and Orissa by H.H. Haines and its supplement by Dr. H.F. Mooney. Indian For., 83: 230-235.

Saxena, H.O. 1976. Notes on the Flora of Bihar and Orissa. Indian For., 192: 195–197.

Saxena, H.O. 1978. Additions to the Flora of Bihar and Orissa. J. Bombay Nat. Hist. Soc., 75(3): 941–942.

Singh, M.P. 1986. Flora of Patna (Dicotyledones). International Books and Periodicals Supply Service, New Delhi.

Singh, N.P., Mudgal, V., Khanna, K.K., Srivastava, S.C., Sahoo, A.K., Bandapadhyay, S., Aziz, N., Das, M., Bhattacharya, R.P. and Hajra, P.K. 2001. Flora of Bihar Analysis. Botanical Survey of India, Calcutta.

Singh, RK. 2005. Addition to the flora of west champaran district, Bihar. Journal of Economic and Taxonomic Botany 29(1): 187-189.

Srivastava, D.P., Paul, S.R. and Sinha, B.C. 1966. Weed of wheat fields in Bihar. Proc. Bihar Acad. Agri. Sci., 15: 1–10.

Srivastava, J.G. 1955. Vegetation of Purnea. In: the Gazetteer for the district Purnea, Patna.

Srivastava, J.G. 1956. The vegetation of Patna District (Bihar). J. Indian Bot. Soc., 35: 391-401.

Srivastava, J.G. 1958. The vegetation of Champaran district. In: Revised district Gazetter, Champaran.

Thakur, V. 1963. The weed flora of Darbhanga 1. Paddy field weeds. 40th Proc. Indian Sci. Cong. III. Abst. 315.

Thothathri, K. 1965. A Contribution on some Plants from Champaran District, North Bihar. Indian For., 91: 743–746.

Thothathri, K., Shetty, B.V. and Hajra, P.K. 1966. A contribution to the Flora of Udaipur forest in Champaran District, North Bihar. Bull. Bot. Sur. India, 8: 133–141.

Tropicos, accessed June 11, 2023, https://www.tropicos.org

Uniyal, B.P. and Datta, R. 1984. Additionals to the grasses of Bihar, Orissa and West Bengal. J. Bombay Nat. Hist. Soc., 80: 262.

Varma, S.K. 1981. Flora of Bhagalpur (Dicotyledones). Today and Tomorrow's Printers and Publishers, New Delhi. Kumar Avinash Bharati. 2019. Checklist of angiosperms in Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali district, Bihar, India. *Indian Journal of Forestry* 42(1): 91 – 98.

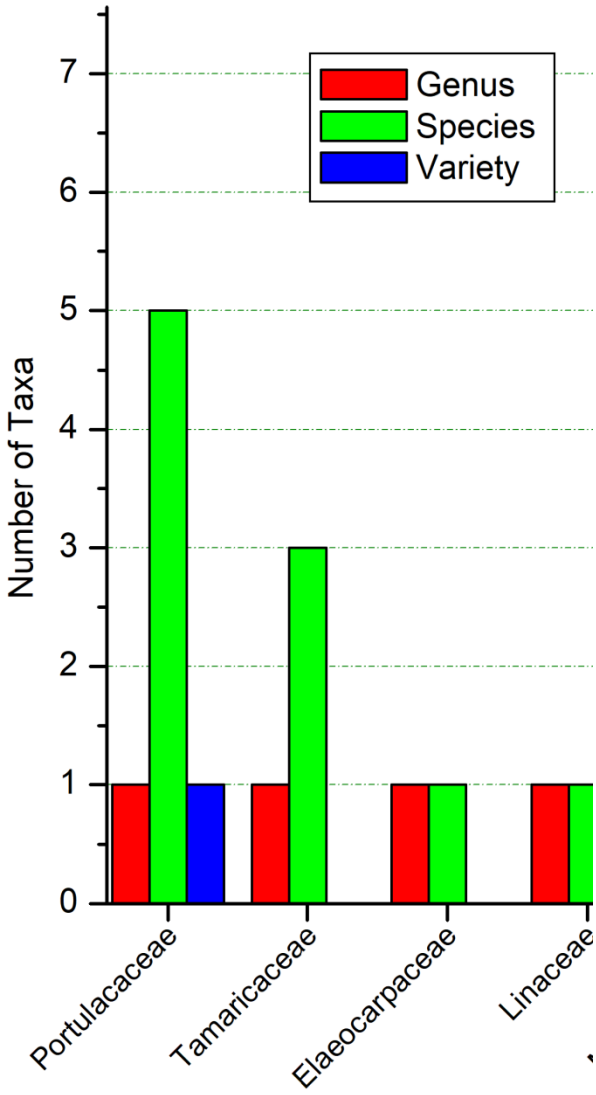

Fig.-1:Diversity in Portulacaceae, Tamaricaceae, Elaeocarpaceae, Linaceae, Malpighiaceae, Zygophyllaceae, Oxalidaceae and Averrhoaceae