International Journal of Botany Studies
ISSN: 2455-541X; Impact Factor: RJIF 5.12
Received: 27-10-2020; Accepted: 27-12-2020: Published: 16-02-2021
www.botanyjournals.com
Volume 6; Issue 1; 2021; Page No. 525-531

Herbarium based study of *Sida* genus collected from western region of Uttar Pradesh, India

Dushyant K Singh[1*], Parikshit K Singh[2], Rajesh K Pandey[1], Rajneesh K Agnihotri[3]
[1] Department of Botany, Faculty of Science, Bundelkhand University, Jhansi, Uttar Pradesh, India
[2] Department of Botany, Digvijay Nath P. G. College, D. D. U. University, Gorakhpur, Uttar Pradesh, India
[3] Department of Botany, School of Life Sciences, Dr. B. R. Ambedkar University, Agra, Uttar Pradesh, India

Abstract
A herbarium is a major source of systematic collection of dried and mounted plants specimens which are usually collected from natural habitat, mounted on sheets, and classify with their proper scientific information about the flora and described valuable significance in plant taxonomy which considered as a backbone of Botany. The present investigation was carried out on herbarium based taxonomic revision of *Sida cordifolia* L., *Sida acuta* Burm. f., *Sida cordata* Burm. f. and *Sida rhombifolia* L. were collected from different locality of Agra city. Multivariate analysis of specimens were also studied. The prepared specimens were identified and get relevant authentic information from Regional Ayurveda Research Institute, Jhansi. This study aimed to provide proper taxonomic and biogeographical information on *Sida* species which will be useful for future study in teaching and botanical research.

Keywords: herbarium, hierarchy, malvaceae, *Sida*, specimens, taxonomy revision

Introduction
A herbarium, house of collection of plant specimens dried and mounted on herbarium sheets, identified, classified and labelled with their proper taxonomic knowledge according to some authorized agencies. Herbarium of the colleges and universities mostly have plant specimens for the botanical teaching. Linnaeus was the first introduced to the practice of mounting plant specimens to paste on sheets and storing them horizontally. Across the world listed 3001 active herbaria are in the worldwide that have 387,007,790 specimens, stored by the thousands of botanists (Thiers, 2018) [1].

Taxonomy is the science of describing classification with the help of plant characteristics. It is the best way to exactly specify to plant base of different feature. Greek philosopher Theophrastus gave the first classification of species based on shrubs, Herbs and trees. Carolus Linnaeus or Carl von Linn (1707-1718) given firstly a systematic classification in order and binomial naming of plants was developed. According to his theory plants having a scientific name made up of two Latin names namely genus and species. His thought on the new classification of plants was given in the book "*Systema Naturae*". Their system of classification, the binomial nomenclature of organism is used to till date.

Studies of the specimens for taxonomic purposes in laboratory and herbarium are essentially used to comparison with newly collected material. The taxon naming is known as nomenclature, the name of Genus is given in capital and species in the small text. The correct sequence of the taxonomic hierarchy is Kingdome, Phylum, Class, Order, Family, Genus and Species. In classification, the species is very specific and the lowest level shows the highest level of similarities. The naming activity of plant species is under the ICNafp (International Code of Nomenclature for algae, fungi and plants) and authorized by the International of Plant taxonomy. The taxonomy has four basic component, characterization, identification, nomenclature and classification in a sequence which is very important for exact information of species and their link with the environment. The specimens and their related compilation data and information are priceless for the researchers who are interested in the history of past campaign (Wolcott and Renner, 2017) [2].

The conventional role of herbaria is very important to research in botany include description of new species, revision of systematic relationships, updated nomenclature routinely, documentation and biodiversity study. The current and use of new herbaria specimens fundamentally expected reliable as over the time, the study is based on a description of potential application of specimens (Funk, 2003; Heberling and Isaac, 2017) [3,4]. The herbarium specimens can be also a source of biological material include pollen grains, flowers, leaves, fruits and seeds for studies on anatomy and plant morphology (Sukhorukov and Kushunina, 2016) [5]. As a part of herbarium specimens observation, the specimens of *Sida cordifolia* L., *Sida acuta* Burm. f., *Sida cordata* Burm. f. and *Sida rhombifolia* L. were selected and studied which aimed to provides proper taxonomic, morphological and biogeographical information.

Materials and Methods
Collection Area
All these plants were collected from the different locality of Agra city and nearby the region of Yamuna river. *S. cordifolia* collected from roadside of Sikandra sabzi mandi, *S. cordata* from shady and roadside of Sector 16 near Kartar Hospital, *S. acuta* from shady and damage garden of K. K. Nagar, and *S. rhombifolia* from disturb side of University Campus Khandari. Agra district is situated 27.25 deg.

letitude N and 77.0 deg. to 78.45 deg. longitude E. (Fig. 1). Its elevation is 169 m above the mean sea level. Topographically the Agra district occupies most of the plain area is under the Braj region of western region of Uttar Pradesh where the Yamuna river flows through Agra and has limited forest area include *Accacia arabica* (Babool), *Azadirachta indica* (Neem), *Ficus religiosa* (Peepal) and *Ziziphus mauritiana* (Ber). Due to the Yamuna river, the soil is very fertile, loose, sandy, therefore the many ethnomedicinal, herbs and shrub plants found here. Semi-arid and humid subtropical climates are features of Agra weather including dry and hot summers, mild winters, and low monsoon season. Rainfall mostly from the South West monsoon and notice average rainfall 658.6 millimeters (June to September), temperature around 43-46°C goes in summer and in winter 8 to 10°C respectively.

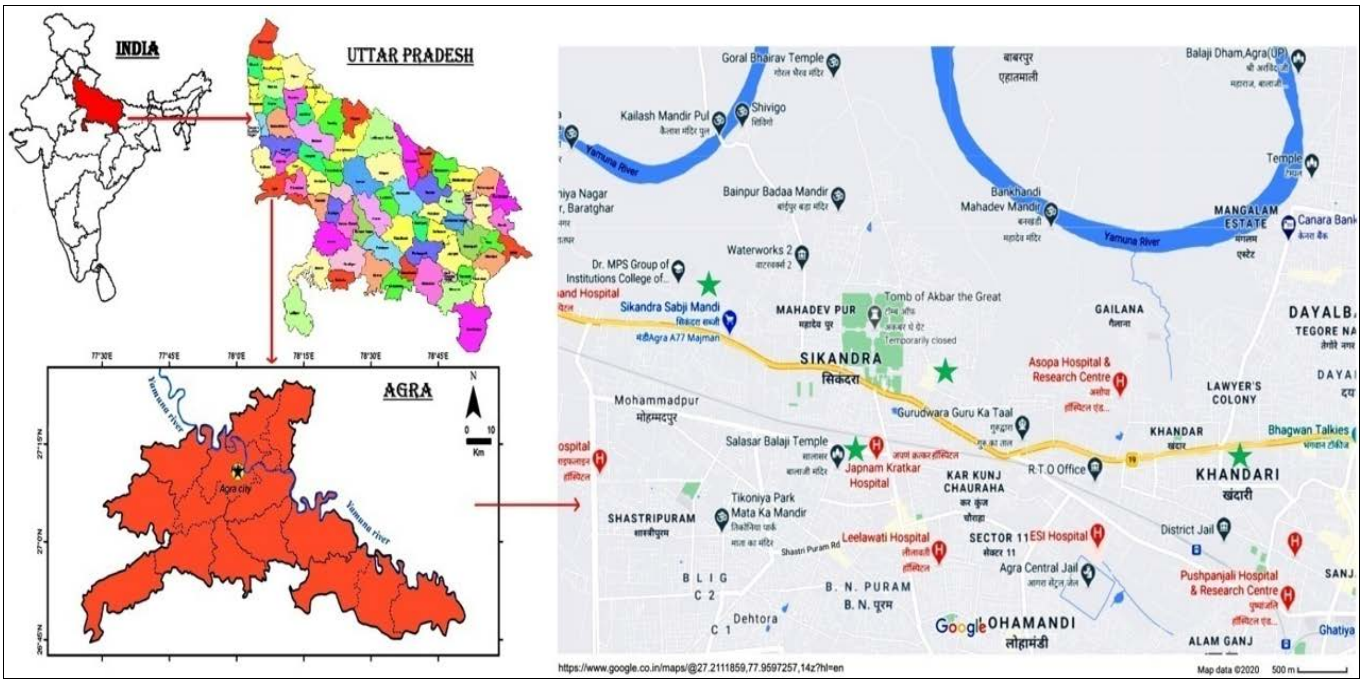

Fig 1: Figure showing site of sample and collections area ( ) of *Sida* species.

Preparation of Herbarium

The fresh plants with flowers, leaves and roots were carefully collected during the vegetative growth and reproductive period from site as presented in Fig. 1 and carefully upright put into the cloth bag so that plants do not be damage. After this, the these plant were immediately pressed between the old newspaper before they wilting and paper sheets were changed regularly after two to four days due to climate conditions then plants were dried with an electric iron by keeping them in between layers of newspaper. After drying, the plants were mounted on the white heavy herbarium sheets of 32 X 25 cm and fastened to the sheets by glue. The method was used for making herbarium file according to previous work (Tucker and Calabrese, 2005; Pandey, 2019) [6,7]. After successfully mounted, the plant specimens were labeled, identified and obtained relevant information by Herbarium, Regional Ayurveda Research Institute, Central Council for Research in Ayurvedic Sciences (Ministry of AYUSH, Govt. of India), Gwalior road, Jhansi, Uttar Pradesh. The systematical scientific information and taxonomic literature on the related study were collected from various libraries, and used major search engines to get the related information. The earlier published related work over the region were also consulted.

Results and Discussion

The present investigation focused on the study of herbarium of four *Sida* specimens viz: *S. cordifolia*, *S. acuta*, *S. cordata* and *S. rhombifolia* belongs to the family Malvaceae. These plants have a great medicinal value which are widely using in the Indian system of traditional medicine from ancient time. These plants were collected from the different places of Agra city in the year 2018.

Botanical description and Taxonomic Hierarchy

***S. cordifolia* L. (Specimen serial No. 28152)**

S. cordifolia is a small wild herb under shrubs known as Bala or Vatya or heartleaf *Sida* that grows around up to 1 meter height found in tropical and subtropical regions. It is growing in roadsides and dry waste areas in Agra city. Leaves are alternate, simple and heart-shaped. Stem is cylindrical and branched. Flowers are small and light yellow. Fruits are glabrous, smooth, and brown. Flowering and fruiting take place all year round (Fig. 2).

Kingdom: Plantae
Subkingdom: Viridiplantae
Superdivision: Embryophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Class: Magnoliopsida
Order: Malvales
Family: Malvaceae
Genus: *Sida*
Species: *cordifolia* (https://www.itis.gov)

Fig 2: Specimen of *S. cordifolia*

***S. acuta* Burm. f. (Specimen serial No. 27744)**

It is a perennial or annual herb known as Baraira in Hindi and morning mallow in English. This grows around up to 1.4 meter in the garden side and waste areas. It is native of Central America, Mexico and occurred in the whole World (Parsons and Cuthbertson, 2001) [8]. Leaves are alternate, simple and sword-shaped. Stem is slightly woody, herbaceous and branched. Flowers are small and yellow. Fruits are glabrous and brown. Availability of flowering and growth period throughout the year (Fig. 3).

Kingdom: Plantae
Subkingdom: Viridiplantae
Superdivision: Embryophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Class: Magnoliopsida
Order: Malvales
Family: Malvaceae
Genus: *Sida*
Species: *acuta* (https://www.itis.gov)

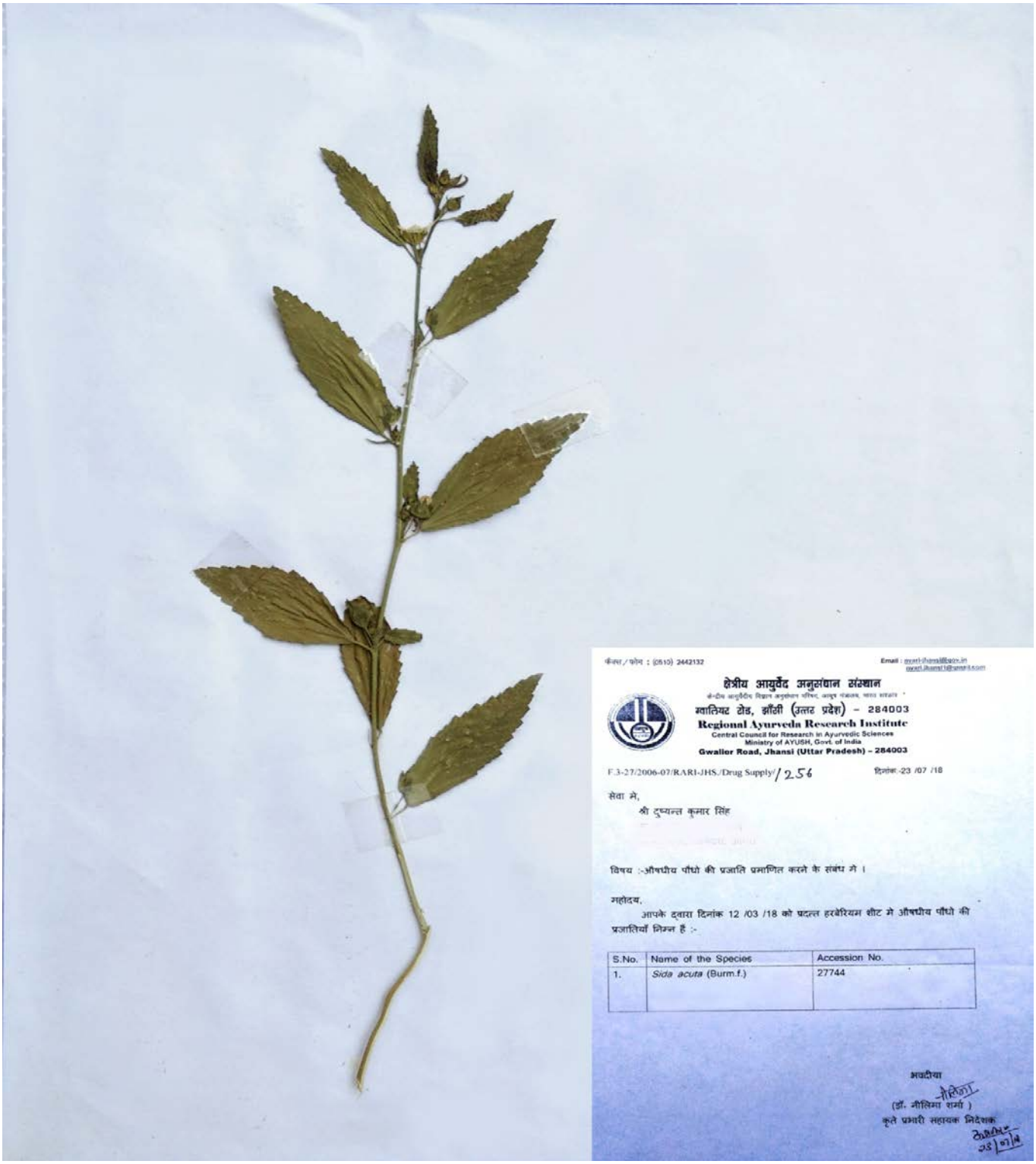

Fig 3: Specimen of *S. acuta*

***S. cordata* Burm. f. (Specimen serial No. 27745)**

S. cordata is a perennial ascending non-woody herbs plant known as long stalk *Sida* and locally known as Nagbala growing in moist and shady place of roadside around up to 1 meter height. It is native of India and generally found in the tropical plains area of India, Pakistan and Srilanka. Leaves are alternate, simple, heart-shaped and cordate. Stem is climber and branched. Flowers are small and yellow with long stalk. Fruits are brownish in color. Reproductive phase depending on local environment (Fig. 4).

Kingdom: Plantae
Subkingdom: Viridiplantae
Superdivision: Embryophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Class: Magnoliopsida
Superorder: Rosanae
Order: Malvales
Family: Malvaceae
Genus: *Sida*
Species: *cordata* (https://www.itis.gov)

Fig 4: Specimen of *S. cordata*

***S. rhombifolia* L. (Specimen serial No. 27746)**

It is a perennial erect under shrub plant known as Arrow leaf *Sida* and Mahabala or Sahadeva in Hindi. It grows in damage shady place and roadside side around up to 1-1.5 meter height and distributed in temperate regions over the countries. Leaves are simple, alternate, jelly, and rhomboid. Stem is flexible and branched. Small flower contain yellowish five petals and fruit is trigonous (Fig. 5).

Kingdom: Plantae
Subkingdom: Viridiplantae
Infrakingdom: Streptophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Class: Magnoliopsida
Superorder: Rosanae
Order: Malvales
Family: Malvaceae
Genus: *Sida*
Species: *rhombifolia* (https://www.itis.gov)

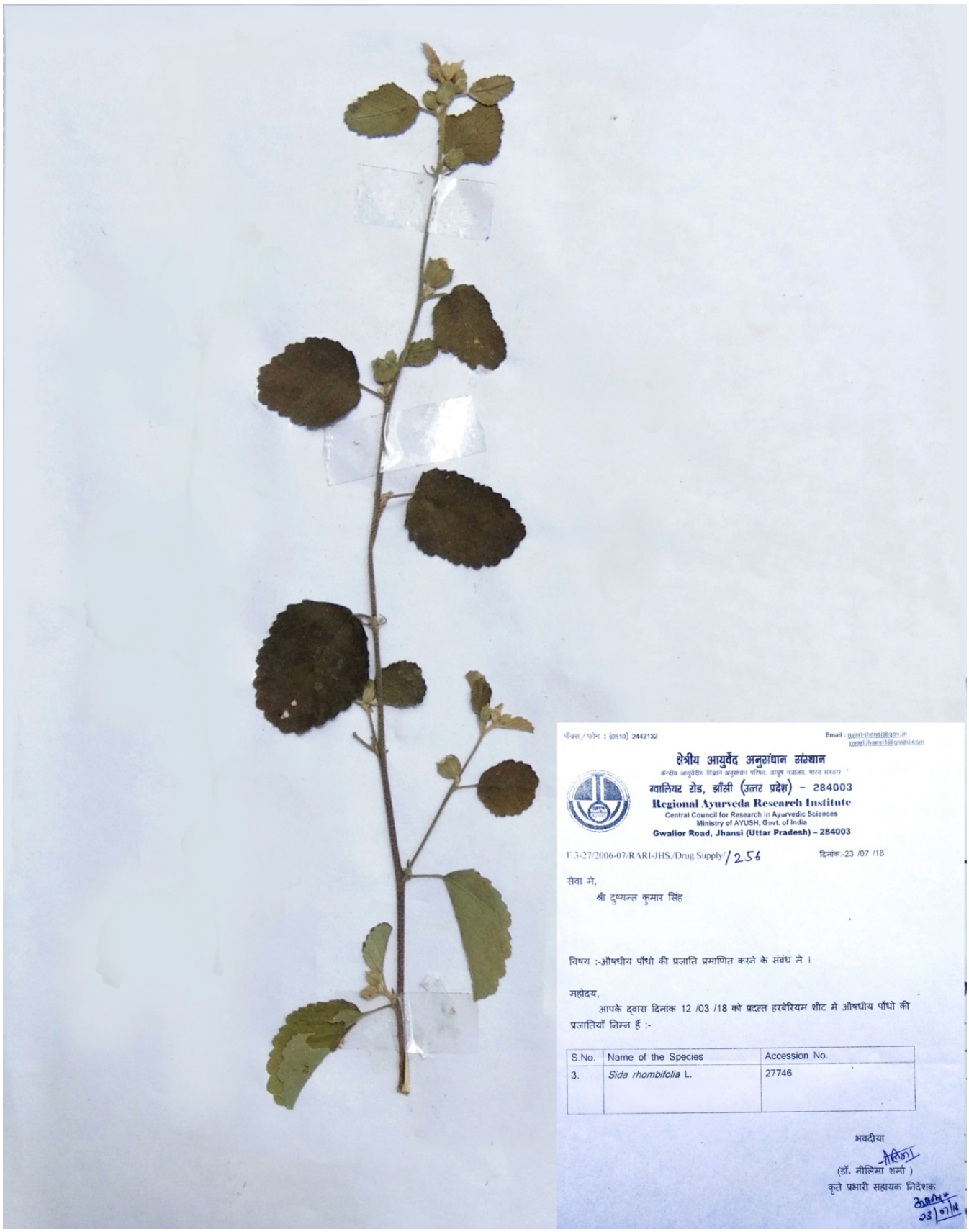

Fig. 5: Specimen of *S. rhombifola*

Malvaceae is a globally distributed family of herbs, shrubs and small trees known as Mallow family. About 244 genera distributed in the temperate region all over the world with 4225 species and *Sida* is the largest genera about 200 species occurred in temperate regions of the world. (Shivranjan and Pradeep, 1996; Christenhusz and Byng, 2016) [9, 10]. In Agra, four species of *Sida* genus viz: *S. cordifolia*, *S. acuta*, *S. cordata* and *S. rhombifolia* are growing in shady damage garden and roadside and used by local people for many traditional medicine and for fibers. Rahman and Gondha, (2014) [11] studied 9 species of 6 genera for taxonomy and traditional medicine practices of Rajshahi, Bangladesh of the family Malvaceae. Tambde *et al.*, (2016) [12] have been also reported 11 species of *Sida* genus from Maharashtra state and taxonomically described and included description of distribution, flowering, and fruiting. Similarly, Erarslan and Kocyigit, (2019) [13] and Ruggiero *et al.*, (2015) [14] analyzed important taxonomic characteristics of the family Malvaceae and herbarium specimens in ISTE (Herbarium of the Faculty of Pharmacy of Istanbul University) and briefly studied on a higher level classification of all living organism from Super kingdom to Order (Prokaryota and Eukaryota). Kolanowska *et al.*, (2016) [15] reported biogeography taxonomy and ecology studies based on herbarium of *Psilochilus* (Orchidaceae). Kishor and Nandikar, (2018) [16] reported similar result in Lectotypification of five names in *Grewia* (Malvaceae-Grewioideae) based on the plant specimens. Junjarrao *et al.*, (2015) [17] studied the digital herbarium of angiospermous tree species, about 535 tree species from the Western Ghats of Maharashtra has been recorded.

Recently, Besnard *et al.*, (2018) [18] and Pandey, (2019) [7] reported many applications, importance, and benefit of herbarium science in the twenty first century and useful for the study of morphological variation, ethnobotanical records, plant distribution, crop evolution, and crop modulation. Our results of the present study are accordance with the previous similar work mentioned above.

Conclusion

Herbarium is a major source of taxonomic information of specimens distributed valuable significance. The key role of a herbarium is important to design local flora, provides a correct ranking of specimens, and conservation approach to biodiversity protection. This work focused on herbarium specimens studies of four species of *Sida* genus of the family Malvaceae collected from Agra city of the western Uttar Pradesh. That work was aimed to provides taxonomic biogeographical information and comparative material that is necessary for studies of taxonomy, morphology, ecology, biodiversity, ethnobotany, conservation biology, systematics, nomenclature, ecology, phenology, forestry, plant communities, paleoethnobotany, and economic botany as well as being used for future study in botanical research and teaching.

Acknowledgement

The authors are grateful thanks to the Director and team, Herbarium, Regional Ayurveda Research Institute, Jhansi (Ministry of AYUSH, Govt. of India) for the identification of plants and provided authentic taxonomic information for the study.

References

1. Thiers BM. The World's Herbaria 2017: A summary report based on data from index herbariorum. 2018; 2(1):1-19.
2. Wolcott KA, Renner SS. Jan Vilem Helfer's (1810–1840) Collections from India, the Andaman Archipelago and Burma. Archives of natural history. 2017; 44 (2):292-302.
3. Funk V. 100 Uses for a herbarium (Well at Least 72). American Society of Plant Taxonomists Newsletter. 2003; 17(2):17-19.
4. Heberling JM, Isaac BL. Herbarium specimens as exaptations: New uses for old collections. American Journal of Botany. 2017; 104(7):963-965.
5. Sukhorukov AP, Kushunina M. Taxonomic revision and distribution of *Herbaceous paramollugo* (Molluginaceae) in the Eastern Hemisphere. Phyto Keys. 2016; 73:93-116.
6. Tucker AO, Calabrese L. The use and methods of making a herbarium/plant specimens: An HSA guide, Revised edition, 2005, 1-20.
7. Pandey A. Herbarium management: Methods and current trends. The training manual, ICAR-National Bureau of Plant Genetic Resources, New Delhi, India. 2019.
8. Parsons WT, Cuthbertson EG. Noxious weed of Australia (2.ed), CSIRO Publishing, Australia. 2001; 58-509.
9. Shivranjan VV, Pradeep KA. Malvaceae of southern peninsular India: A taxonomic monograph. Daya publication house. New Delhi, India, 1996.
10. Christenhusz MJM, Byng JW. The number of known plants species in the world and its annual increase. Phytotaxa. 2016; 261(3):201-217.
11. Rahman AHMM, Gondha R. Taxonomy and traditional medicine practices on Malvaceae (Mallow Family) of Rajshahi, Bangladesh. Open Journal of Botany. 2014; 1(2):19-24.
12. Tambde GM, Gore RD, Sardesai MM. A synopsis of the genus *Sida* L. (Malvaceae) from Maharashtra, India. Taiwania. 2016; 61(3):243-252.
13. Erarslan ZB, Kocyigit M. The important taxonomic characteristics of the family Malvaceae and the herbarium specimens in ISTE. Turkish Journal of Bioscience and Collections. 2019; 3(1):1-7.
14. Ruggiero MA, Gordon DP, Orrell TM, Bailly N, Bourgoin T, Brusca RC, Smith TC, Guiry MD, Kirk PM. A higher level classification of all living organisms. Plos One. 2015; 10(4):1-60.
15. Kolanowska M, Naczk AM, Jasku1a R. Herbarium based studies on taxonomy, biogeography and ecology of *Psilochilus* (Orchidaceae). PeerJ. 2016; 4:2-60.
16. Kishore KC, Nandikar MD. Lectotypification of five names in *Grewia* (Malvaceae-Grewioideae). Rheedea. 2018; 28(1):42-45.
17. Junjarrao RS, Barmukh RB, Kindre AS. Digital herbarium of angiospermic tree species from Western Ghats regions of Maharashtra. Gyanmay. 2015; 11-13.
18. Besnard G, Gaudeul M, Lavergne S, Muller S, Rouhan G, Sukhorukov AP, Vanderpoorten A, Jabbour F. Herbarium based science in the twenty first century. Botany Letters. 2018; 165(3-4):323-327.