



e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



ORIGINAL RESEARCH ARTICLE



Taxonomic diversity of weed flora in pulse crops growing field at south-western part of Bangladesh

Md. Shahriar Kobir^{1*} , Suchana Paul¹, Pradip Hajong¹, Md. Harun-Or-Rashid² and Md. Hafijur Rahman¹

¹Bangladesh Agricultural Research Institute, BANGLADESH

²International Maize and Wheat Improvement Center (CIMMYT), BANGLADESH

*Corresponding author's E-mail: shahriar1302027@gmail.com

ARTICLE HISTORY

Received: 25 September 2021
Revised received: 29 November 2021
Accepted: 16 December 2021

Keywords

Bangladesh
Pulse crop
Taxonomy
Weed

ABSTRACT

Pulses are important field crops in Bangladesh and weed infestation in pulses field is a great concern now a days. So, a rigorous field survey was conducted throughout the pulses growing season at pulses grower farmers' field of south-western part of Bangladesh to know the present status of weed infestation in pulses field. During the survey, fresh samples were collected along with other related information e.g., habitat, location, collection date, flowering time, crop/plant association. Fresh samples were dried well for making herbarium specimens. A sum of 13 weed species under 12 genera and 08 families were collected and documented their uses in various ailments. Among the families, Amaranthaceae is the highest-represented family with 03 species. Among the genera, the largest genera *Amaranthus* represented by 2 species. *Cyperous rotundus*, *Cynodon dactylon*, *Chenopodium album*, *Amaranthus spinosus*, *Croton bonplandianum*, *Coccinia grandis* are the common and major weed species in pulse crop growing field in south-western part of Bangladesh. The knowledge generated from the present research would be helpful for the management practices of pulse crop associated weeds as well as for getting high economic benefits from beneficial species.

©2021 Agriculture and Environmental Science Academy

Citation of this article: Kobir, M.S., Paul, S., Hajong, P., Harun-Or-Rashid, M., & Rahman, M.H. (2021). Taxonomic diversity of weed flora in pulse crops growing field at south-western part of Bangladesh. *Archives of Agriculture and Environmental Science*, 6(4), 436-440, <https://dx.doi.org/10.26832/24566632.2021.060404>

INTRODUCTION

The undesirable plants which are interfere with the land and water resources utilization and adversely affect human wellness are called weeds (Rao, 2000). Throughout the whole world about 1570 weed species are recognized as weeds whereas 350 species from Bangladesh's crop field (Wiersema and Leon, 1999). About 25-80% yield may be reduced due to uncontrolled weed growth during the initial crop establishment (Kashem *et al.*, 2009). Moreover about \$40 billion losses happened due weed infestation into crop field (Kashem *et al.*, 2009). Beside their negative issues weeds can be used as cover crop, nutrient cycling manager and possess many ethno-botanicals uses. Weeds used as traditional medicinal floras may be the source of new drugs for human diseases (Stepp and Moerman, 2001).

Appropriate management approaches are much more essential than controlling weeds in order to conserve environment, natural balance, reduce cost of production and so on. Information related to morphology and identification, habitat, flowering behavior, viability and dormancy etc. is essential to select an effective management program (Kashem *et al.*, 2009). But elaborate taxonomic study and phenology of weed is neglected in Bangladesh especially in the southern part by the plant taxonomist. We do not have any information of the weeds of different crops in agronomy literature in greater Kushtia-Jashore region of Bangladesh (Islam, 2014; Akter *et al.*, 2018; Shabi *et al.*, 2018). Pulse crops are one of the most important field crops which are cultivated all over Bangladesh (Hazong *et al.*, 2021). Pulses play a key role in fulfilling the daily protein requirement of Bangladeshi people (Kobir *et al.*, 2019). Moreover, about 2.2 part of the

total cultivable land is covered by pulse crop (BBS, 2019). The pulse crop is grown under varying types of soil in Jashore region like plain land and slightly undulated area which facilitates a wide range of habitats for weed prevalence. To make a complete weed flora species diversity documentation including their habitat, flowering period and ethno-botanical uses in pulses growing field in Jashore region this study had conducted and hence it may be beneficial to undesired plant management approaches and to get higher commercial benefits.

MATERIALS AND METHODS

A rigorous field survey was conducted throughout the pulses growing season at pulses grower farmers' field of greater Kushtia-Jashore region (Figure 1) during the survey, fresh samples were collected along with other related information e.g., habitat, location, collection date, flowering time, crop/plant association by frequent field visit (once in a week). Fresh samples were dried well for making herbarium specimens. The collected weed specimens, fresh or dried, were identified by matching with herbarium specimens or published literature (Ahmed et al., 2008a, 2008b, 2009) or consulting with experienced personnel. All the specimens are preserved in Agronomy laboratory as

herbarium at Regional Agricultural Research Station, Jashore. The major literature consulted was "Encyclopedia of Flora and Fauna of Bangladesh (Siddiqui et al., 2007) and other taxonomy related books (Sarwar and Prophan, 2011). The information related to ethno-botanical uses were collected from the published literature (Hastings, 1990; Kumar and Sane, 2003; Uddin, 2006; Ahmed et al., 2008a; 2008b; Dansi et al., 2008; Ahmed et al., 2009; Khan et al., 2013; Gutiérrez et al., 2014; Kumar et al., 2019).

RESULTS AND DISCUSSION

Pulse crops like lentil, field pea, grass pea and chickpea in Bangladesh grow in Rabi season and 10, 07, 07 and 11 different weed species were found from lentil fields, field pea fields, grass pea fields and chickpea fields, respectively. Black gram is cultivated in Kharif-2 and mung bean is cultivated in year rounds. From black gram fields 08 weed species were collected and from mung bean fields 09 weed species were collected. From the survey it is revealed that some of these weeds are very common and major weeds in the pulse crop growing field of south-western part of Bangladesh (Table 1) in different crop association. Then it can be concluded that association of weed-crop is not only crop wise but also environment and soil basis (Patterson, 1995).



Figure 1. Map showing studied areas in Bangladesh.

Table 1. Associated pulse crop-wise distribution of the recorded weed species.

Lentil	Chickpea	Black gram	Mung bean	Field pea	Grass pea
<i>Cyperus rotundus</i> L.	<i>C. rotundus</i> L.	<i>C. rotundus</i> L.	<i>C. rotundus</i> L.	<i>C. rotundus</i> L.	<i>C. rotundus</i> L.
<i>Cynodon dactylon</i> L.	<i>C. dactylon</i> L.	<i>E. crus-galli</i> (L.) P.Beauv.	<i>C. dactylon</i> L.	<i>C. dactylon</i> L.	<i>C. dactylon</i> L.
<i>Chenopodium album</i> L.	<i>C. album</i> L.	<i>C. dactylon</i> L.	<i>E. crus-galli</i> (L.) P.Beauv.	<i>C. album</i> L.	<i>C. album</i> L.
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	<i>E. crus-galli</i> (L.) P.Beauv.	<i>Lindernia crustacea</i> (L.) Muell.	<i>A. viridis</i> L.	<i>E. crus-galli</i> (L.) P.Beauv.	<i>C. bonplandianum</i> Baill.
<i>Physalis heterophylla</i> Nees.	<i>P. heterophylla</i> Nees.	<i>A. sessilis</i> (L.) R.Br. ex DC.	<i>Coccinia grandis</i> (L.) Voigt.	<i>L. crustacea</i> (L.) Muell.	<i>A. sessilis</i> (L.) R.Br. ex DC.
<i>Amaranthus spinosus</i> L.	<i>A. spinosus</i> L.	<i>A. spinosus</i> L.	<i>C. bonplandianum</i> Baill.	<i>Solanum americanum</i> Mill.	<i>L. crustacea</i> (L.) Muell.
<i>Lindernia crustacea</i> (L.) Muell.	<i>L. crustacea</i> (L.) Muell.	<i>C. bonplandianum</i> Baill.	<i>P. niruri</i> L.	<i>C. bonplandianum</i> Baill.	<i>S. americanum</i> Mill.
<i>Solanum americanum</i> Mill.	<i>S. americanum</i> Mill.	<i>Phyllanthus niruri</i> L.	<i>A. sessilis</i> (L.) R.Br. ex DC.		
<i>Croton bonplandianum</i> Baill.	<i>C. bonplandianum</i> Baill.		<i>C. album</i> L.		
<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	<i>A. sessilis</i> (L.) R.Br. ex DC.				
	<i>Amaranthus viridis</i> L.				

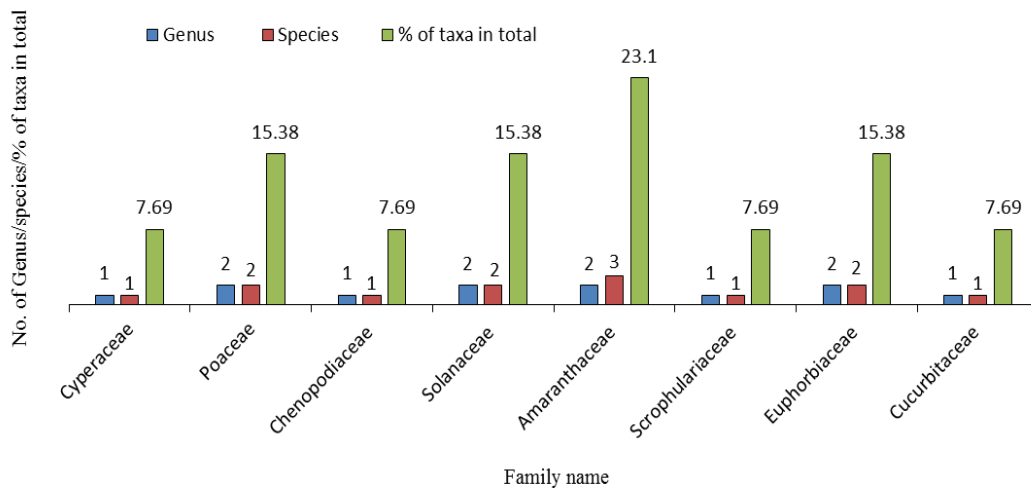


Figure 2. Family-wise distribution of the recorded weed species.

Table 2. Taxonomic diversity of the recorded weed species in pulse crop field in Jashore area.

Botanical name	Common name	English name	Family	Flowering period	Habitats
<i>C. rotundus</i> L.	Mutha/ Vadailla	Purple nutsedge	Cyperaceae	May-September	Road sides, waste places, open or slightly shaded grounds
<i>C. dactylon</i> L.	Durba	Bahama grass, Bermuda grass	Poaceae	July-December	Cultivated lands moist or dry waste places, roadsides, lawn, and riversides
<i>C. album</i> L.	Bathua	Lambsquarter	Chenopodiaceae	Dec-Mar	Rabi crops fields, levees, irrigation channel
<i>E. crus-galli</i> (L.) P.Beauv.	Shama	barnyard grass, Jungle rice	Poaceae	May- September	Paddy fields, wastelands, fallow lands and shallow marshes
<i>P. heterophylla</i> Nees.	Foska Begun	Clammy ground cherry	Solanaceae	Feb-Apr	Crop fields, roadsides
<i>A. spinosus</i> L.	Katanotey	Spiny pigweed	Amaranthaceae	Year-round	Waste lands, roadsides, fields, gardens
<i>L. crustacea</i> (L.) Muell.	Chapra	Brittle false, pimpernel	Scrophulariaceae	Feb-Apr	Roadsides and levee of crop fields
<i>S. americanum</i> Mill.	Tit Begun	Black nightshade	Solanaceae	Sep-Dec	Crop fields, roadsides, fallow lands
<i>C. bonplandianum</i> Baill.	Bon Morich	Bonplant's croton	Euphorbiaceae	Year-round	Roadsides, levee of crop fields, dry & sandy exposed areas
<i>A. sessilis</i> (L.) R.Br. ex DC.	Chanchi	Sessile Joyweed	Amaranthaceae	Year-round	Wet paddy fields, ditches to dry roadside banks, gardens or other disturbed grounds
<i>A. viridis</i> L.	Shaknotey	Pigweed	Amaranthaceae	Year-round	Waste & disturbed grounds, roadsides
<i>P. niruri</i> L.	Hajar/Sato dana	Gale of the wind	Euphorbiaceae	Aug-Oct	Paddy fields, roadsides, levee of crop fields, fallow lands
<i>C. grandis</i> (L.) Voigt.	Telakucha	Scarlet-fruited gourd	Cucurbitaceae	Jan-Sep	Roadsides, fallow & waste lands

An enumeration of the recorded weed species was presented with botanical name, common name(s), English name, family, flowering time and habitat in (Table 2). In this present paper, the occurrence of 13 weed species belongs to 12 genera and 08 families had been reported (Tables 2 and Figure 2). Among the families, Amaranthaceae is the highest-represented family with 03 species followed by Poaceae, Solanaceae and Euphorbiaceae (two species in each). Cyperaceae, Chenopodiaceae, Scrophulariaceae and Cucurbitaceae were represented by single species (Figure 2). Among the genera, the largest genera *Amaranthus* represented by 2 species followed by *Cyperus*, *Cynodon*, *Chenopodium*, *Echinochloa*, *Physalis*, *Lindernia*, *Solanum*, *Croton*, *Alternanthera*, *Phyllanthus* and *Coccinia* represented by single species (Figure 2). *Cyperus rotundus* was the predominant

species in lentil and chickpea growing field in Jashore region which is followed by *Cynodon dactylon* (Nag and Rahman, 2013). Within the six years of previous study the predominance species have been changed. This may be happened as favorable weather condition had changed for that weed. Among the families (Figure 2), Amaranthaceae is the highest percentage of taxa (23.1%) in total followed by Poaceae, Solanaceae and Euphorbiaceae (15.38% each). Cyperaceae, Chenopodiaceae, Scrophulariaceae and Cucurbitaceae were represented by the lowest percentage of taxa (7.69%). Cyperaceae had the highest percentage of taxa in lentil and chickpea growing field of Jashore region which was followed by Poaceae (Nag and Rahman, 2014) which is more or less similar to our present study.

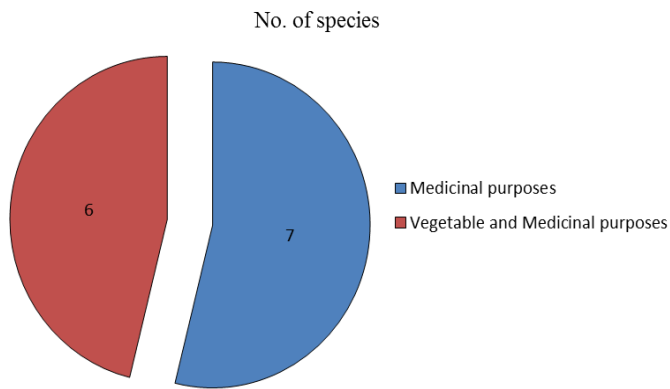


Figure 3. Ethno-botanicals use of recorded weed species.

The habitat diversity varied from crop fields along with its levees to roadsides, fallow lands, play grounds, waste lands, edges of drains, dry lands, shallow water bodies, etc. (Table 2). Based on the phenology (flowering times), identified weed species belong to eight distinct groups i.e., flowering occurs during the month of May-Sep (2 species), July-Dec (1 species), Dec-Mar (1 species), Feb-Mar (2 species), Year-round (4 species), Aug-Oct (1 species), Jan- Sep (1 species), Sep-Dec (1 species) (Table 2). This information of habitat and flowering period of different weed species that grown in the pulses field of south-western part of Bangladesh will help us to maintain weed population below the economic threshold limit by choosing appropriate management practices before/during flowering (Hasanuzzaman, 2015). The study revealed that the weeds from the crop fields and wastelands possess multiple medicinal and vegetable uses. The ethno-botanical uses of the reported weeds are much diversified (Table 3) and also recorded in different ethno-botanical references.

Table 3. Ethno-botanical uses of the recorded weed species.

Botanical Name	Ethno-botanical uses
<i>C. rotundus</i> L.	Young tubers eaten as food (sometimes), tubers used in leprosy, thirst, fever, blood diseases, biliousness, dysentery, pruritus, pain, vomiting, urinary concertinas, stomach disorder and irritation of the bowels.
<i>C. dactylon</i> L.	The plants contain trieterpenoids, proteins, carbohydrates and many organic acids. It is used as uretic. Leaf juice is used in inflamed tumours, whitlows toothache, eczema, menstruation and to stop bleeding
<i>C. album</i> L.	Vegetable; Medicinal uses – Hepatic disorders, spleen enlargement, dysentery, piles & hiccup, laxative, aphrodisiac & tonic, jaundice, urinary diseases
<i>E. crus-galli</i> (L.) P.Beauv.	Used in internal haemorrhage.
<i>P. heterophylla</i> Nees.	Medicinal uses – Ear problems, inflammations, cancer, skin diseases, urinary purgative
<i>A. spinosus</i> L.	Vegetables; Medicinal uses – Bronchitis, biliousness, blood diseases, burning sensation, hallucination, piles, leprosy, mouthwash, toothache
<i>L. crustacea</i> (L.) Muell.	Medicinal uses – Dysentery, ring worm, indigestion
<i>S. americanum</i> Mill.	Medicinal uses – Skin disease, jaundice & hears diseases
<i>C. bonplandianum</i> Baill.	Medicinal uses – Jaundice, abscesses, headache, venereal sores, cough, fever, vomiting, cholera, venereal sores, scabies
<i>A. sessilis</i> (L.) R.Br. ex DC.	Vegetables; Medicinal uses – Lactagogue, febrifuge, intestinal cramps, cooling hair wash, eye diseases, body cool, ulcer
<i>A. viridis</i> L.	Vegetables; Medicinal uses – Demulcent, diuretic and also in snakebites, skin diseases, blood pressure
<i>P. niruri</i> L.	Medicinal uses – Gonorrhoea& other ailments of genito-urinary tract, jaundice, dysentery, bruises & wounds, scabby infections, stomach-ache
<i>C. grandis</i> (L.) Voigt.	Vegetables; Medicinal uses – Psoriasis, ringworm, itching, small pox, skin diseases, ulcer, scabies, diabetes, asthma, bronchitis, dysentery, vomiting, cough and cold

The information related to ethno-botanical uses were collected from the published literature (Hastings, 1990; Kumar and Sane, 2003; Uddin, 2006; Ahmed et al., 2008a; 2008b; Dansi et al., 2008; Ahmed et al., 2009; Khan et al., 2013; Gutiérrez et al., 2014; Kumar et al., 2019).

Out of 13 weed species, a total of 07 species has the medicinal properties/uses while 06 species used both as vegetable and medicinal purposes (Figure 3). Several weeds contain medicinal active ingredient like glycosides, resins, flavonoids, fatty acids, steroids, tannins, alkaloids that can be used in curing many diseases of human (Immanuel and Elazabeth, 2009). Moreover, weed species provide allelopathic, medicinal and food values (Bhattachariya and Borah, 2008).

Conclusion

A sum of 13 species under 12 genera and 08 families were collected and documented their use in various ailments. Among the families, Amaranthaceae is the highest-represented family with 03 species. Among the genera, the largest genera *Amaranthus* represented by 2 species. *Cyperous rotundus*, *Cynodon dactylon*, *Chenopodium album*, *Amaranthus spinosus*, *Croton bonplandianum*, *Coccinia grandis* are the common and major weed species in pulse crop growing field in Jashore. The flowering period of these weeds will be helpful for the management of weed population. A good number of these weeds have various economic, ethnomedicinal and other uses.

ACKNOWLEDGEMENT

We are very much thankful to Bangladesh Agricultural Research Institute, Regional Agricultural Research Station, Jashore authority for their tremendous support in funding and other technical support to complete the study. We are also grateful to Department of Agricultural Extension, Bangladesh for their support during the survey.

Open Access: This is an open access article distributed under the terms of the Creative Commons Attribution NonCommercial 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) or sources are credited.

REFERENCES

- Ahmed, Z. U., Begum, Z. N. T., Hassan, M. A., Khondker, M., Kabir, S. M. H., Ahmad, M., Ahmed, A. T. A., Rahman, A. K. A., & Haque, E. U. (eds.). (2008a). *Encyclopedia of Flora and Fauna of Bangladesh. Angiosperms: Dicotyledons (Acanthaceae – Asteraceae)*. Asiatic Society of Bangladesh, Dhaka, 6, 1-408.
- Ahmed, Z. U., Begum, Z. N. T., Hassan, M. A., Khondker, M., Kabir, S. M. H., Ahmad, M., Ahmed, A. T. A., Rahman, A. K. A., & Haque, E. U. (eds.). (2008b). *Encyclopedia of Flora and Fauna of Bangladesh. Angiosperms: Dicotyledons (Balsaminaceae – Euphorbiaceae)*. Asiatic Society of Bangladesh, Dhaka, 7, 1-546.
- Ahmed, Z. U., Begum, Z. N. T., Hassan, M. A., Khondker, M., Kabir, S. M. H., Ahmad, M., Ahmed, A. T. A., Rahman, A. K. A., & Haque, E. U. (eds.). (2009). *Encyclopedia of Flora and Fauna of Bangladesh. Angiosperms: Dicotyledons (Fabaceae – Lythraceae)*. Asiatic Society of Bangladesh, Dhaka, 8, 1-478.
- Akter, F., Begum, M., & Salam, M. A. (2018). In situ and ex situ floristic diversity of weed seedbank in rice at farmers' fields. *Journal of Research in Weed Science*, 1, 75-89.
- BBS. (2019). Yearbook of agricultural statistics, Bangladesh bureau of statistics. Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh. Retrieved from: <http://www.bbs.gov.bd/site/page/3e838eb6-30a2-4709-be85-40484b0c16c6/->.
- Bhattachariya, D.K., & Borah, P.C. (2008). Medicinal weeds of crop fields and role of women in rural health and hygiene in Nalbari district, Assam. *Indian Journal of Traditional Knowledge*, 7, 501-504.
- Dansi, A., Adjatin, A., Adoukonou-Sagbadja, H., Faladé, V., Yedomonhan, H., Odou, D., & Dossou, B. (2008). Traditional leafy vegetables and their use in the Benin Republic. *Genetic Resources and Crop Evolution*, 55, 1239-1256, <https://doi.org/10.1007/s10722-008-9324-z>
- Gutiérrez, A. D. M., Bah, M., Garduño, R. M. L., Mendoza, D. S. O., & Serrano, C. V. (2014). Anti-inflammatory and antioxidant activities of methanol extracts and alkaloid fractions of four Mexican medicinal plants of Solanaceae. *African Journal of Traditional, Complementary and Alternative Medicine*, 11, 259-267, <https://doi.org/10.4314/ajtcam.v11i3.36>
- Hasanuzzaman, M. (2015). Life cycle and morphology of weed. https://hasanuzzaman.weebly.com/uploads/9/3/4/0/934025/life_cycle_and_morphology.pdf
- Hastings, R. B. (1990). Medicinal legumes of Mexico: Fabaceae, Papilionoidea, part one. *Economic Botany*, 44, 336-348, <https://doi.org/10.1007/BF03183915>
- Hazong, P., Rahman, M. H. Kobir, M. S., & Paul, S. (2021). Socio economic determination and profitability of BARI Mung bean varieties in some selected areas of Bangladesh. *International Journal of Sustainable Agricultural Research*, 8(2), 71-79, <https://doi.org/10.18488/journal.70.2021.82.71.79>
- Immanuel, R. R., & Elizabeth, L. L. (2009). Weeds in ecosystem: a source of medicines for human healthcare. *International Journal of Pharmtech Research*, 1, 375-385.
- Islam, M. M. 2014. Research advances of jute field weeds in Bangladesh: a review. *ARPN Journal of Science and Technology*, 4, 254-268.
- Kashem, M. A., Faroque, M. A. & Bilkis, S. E. (2009). Weed management in Bangladesh: Policy issues to better way out. *Journal of Science Foundation*, 7, 59-67.
- Khan, J., Khan, R., & Qureshi, R. A. (2013). Ethnobotanical study of commonly used weeds of district Bannu, Khyber Pakhtunkhwa (Pakistan). *Journal of Medicinal Plants Studies*, 1, 1-6.
- Kobir, M.S., Paul, S., & Harun-Or-Rashid, M., (2019). Efficacy of locally available plant seed oils against pulse beetle infesting blackgram. *Journal of Bioscience and Agriculture Research*, 22 (01), 1823-1828, <https://doi.org/10.18801/jbar.220119.224>
- Kumar, S., & Sane, P. V. (2003). Legumes of South Asia: A Checklist. Royal Botanic Gardens, Kew, England, 221-245.
- Kumar, S. J. U., Chaitanya, K. M. J., Semotiuk, A. J., & Krishna, V. (2019). Indigenous knowledge of medicinal plants used by ethnic communities of South India. *A Journal of Plants, People and Applied Research*, 18, 1-112, <https://doi.org/10.32859/era.18.4.1-112>
- Nag, B. L., & Rahman, M. H. (2014). Integrated weed management in chickpea and lentil. Research report 2013-2014, Bangladesh Agricultural Research Institute, 173-177.
- Nag, B. L., & Rahman, M. H. (2013). Integrated weed management in chickpea and lentil. Research report 2012-2013, Bangladesh Agricultural Research Institute, 227-232.
- Patterson, D. T. (1995). Effect of Environmental stress on weed/crop interaction. *Weed science*, 43, 483-490.
- Rao, V. S. (2000). Principles of Weed Science, 2nd ed., Science Publishers, New Hampshire.
- Sarwar, A. K. M. Golam & Prodhan, A.K.M.A. (2011). Study on the Cyperaceous weeds of Bangladesh Agricultural University campus. *Journal of Agroforestry and Environment*, 5, 89-91.
- Shabi, T. H., Islam, A. K. M. M., Hasan, A. K., Juraimi, A. S. & Anwar, M. P. (2018). Differential weed suppression ability in selected wheat varieties of Bangladesh. *Acta Scientifica Malaysia*, 2, 1-7.
- Siddiqui, K. U., Islam, M. A., Ahmed, Z. U., Begum, Z. N. T., Hassan, M. A., Khondker, M., Rahman, M. M., Kabir, S. M. H., Ahmad, M., Ahmed, A. T. A., Rahman, A. K. A., & Haque, E.U. (eds). (2007). *Encyclopedia of Flora and Fauna of Bangladesh, Angiosperms: Monocotyledons (Agavaceae-Najadaceae)*. Asiatic Society Bangladesh, Dhaka, 11, 1-399.
- Stepp, J. R., & Moerman, D. E. (2001). The importance of weeds in ethnopharmacology. *Journal of Ethnopharmacology*, 75, 19-23,
- Uddin, S. N. (2006). Traditional Uses of Ethnomedicinal Plants of the Chittagong Hill Tracts. *Bangladesh National Herbarium*, Mirpur, 1-891.
- Wiersema, J. H., & León, B. (1999). *World Economic Plants: A Standard Reference*. CRC Press, New York. <https://doi.org/10.1201/9781482274431>