



**Full Length Article**

## First Record of *Monochoria hastata*: A new Alien Weed of Rice in Pakistan

Mubarak Ali, Asad Shabbir\* and Iram Mujahid

Ecology and Evolution Lab, Department of Botany, University of the Punjab, Lahore 54590 Pakistan

\*For correspondence: asad.iags@pu.edu.pk

### Abstract

*Monochoria hastata* (L.) Solms. of family Pontederiaceae is the first time reported as a new species in the alien weed flora of Pakistan. *M. hastata* has been found in flooded rice fields, ponds and swampy places in the District Narowal of the Province Punjab, Pakistan. It has been also reported as a weed of rice fields in many countries of South and Southeast Asia and is an aggressive weed that reproduces both sexually (seed) and vegetatively (stolons). The comprehensive morphometric description, preliminary distribution, importance and resemblance with closely related plants species, *M. vaginalis* (Burm.f.) C. Presl ex Kunth are presented. At present, this exotic weed is not widespread in Pakistan hence, it is may be possible to eradicate it before it is widely established and difficult to control. © 2018 Friends Science Publishers

**Keywords:** Leaf pondweed; Exotic species; Naturalized plant; Flooded rice weed; *Monochoria hastata*

### Introduction

The family Pontederiaceae consists of widespread annual or perennial aquatic herbs which are floating or rooted in substrate consist of 6 genera and about 40 species widespread in tropical and sub-tropical regions of the world (Holscher *et al.*, 2006). The genus *Monochoria* of Pontederiaceae family is represented by eight species reported from Africa, Asia and Australia (Nasir and Ghanzanfar, 1977). Plants in this genus are glabrous aquatic herbs with erect stems and creeping rootstocks. Out of eight species, only one representative member *Monochoria vaginalis* is reported previously in the flora of Pakistan (Nasir and Ghanzanfar, 1977).

*Monochoria hastata* (L.) Solms, commonly known as arrow pond weed is first time reported from Pakistan. It is a perennial aquatic herb found growing near the wetlands and inside the rice fields of District Narowal, Punjab Pakistan. *M. hastata* is native to Southeast Asia and northern Australia commonly found in fresh water habitats including rice fields (Gupta, 2013). It is a semi-aquatic weed growing profusely throughout the year in North Eastern parts of India where it is reported as a fast-growing perennial herb found in ponds, lakes and moist reservoirs (Srivastava, 1976).

The plant is edible in some parts of the world for example, as a whole is eaten as vegetable in Java, Indonesia (Guofang and Hom, 2000). Also in India, above ground parts of *M. hastata* are used in making traditional dish (Subramanyam, 1962). Further, different parts of *M. hastata* plant are used for treating ailments such as

toothache, asthma, cough, cold, fever, but also for stomach and liver disorders, haemorrhage, hepatitis, anemia, scurvy and diabetes (Ileperuma *et al.*, 2015). Phytoremediation potential of *M. hastata* is recently investigated in India, Switzerland and Bangladesh and is a bioaccumulator of Cadmium (Cd), Arsenic (As) and Mercury (Pb) and plays effective role in reclamation of contaminated area (Islam *et al.*, 2013; Claudia *et al.*, 2014; Hazra *et al.*, 2015; Buruah *et al.*, 2017). Despite it has some uses, *M. hastata* has also been reported as noxious aquatic weed in South Carolina, the US and is listed as a Federal Noxious Weed (Anonymous, 2017). Moreover, it is also found growing in rice fields and considered as serious weed in South East Asia (DiTomaso and Healy, 2003). Considering the above facts, the main objectives of the study are to report first time *M. hastata* as a new weed of rice fields and an addition to the naturalized alien flora of Pakistan.

### Materials and Methods

The specimens of *M. hastata* were collected from *Nala Baien* (small seasonal water stream) in the District Narowal (32° 12' 6" N 75° 7' 7" E; 268 m asl), Punjab-Pakistan during different field surveys carried out in July, 2016 (Table 1). The necessary measurements and photographs of plant specimens were taken at various sites in the field. All the plant specimens were brought back to the Ecology and Evolution Laboratory at University of the Punjab, Quaid-e-Azam Campus, Lahore where morphological characters (such as vegetative and

**Table 1:** Some ecological attributes of *M. hastata* in Pakistan

Plant species	Plant status	Locations	GPS coordinates	Habitat
<i>Monochoria hastata</i>	Naturalized (Alien)	Nala Baien in tehsil Shakargarh, Narowal	32°23'38.8"N 75°09'45.8"E Elevation: 271m	Water stream, flooded rice fields; loamy soil

reproductive) were recorded.

For identification and details such as perianth, dimorphic stamens, filament, placentation, capsule and seed, specimens were studied under a stereomicroscope. A complete specimen of the species was preserved on a herbarium sheet and submitted to the MS Zahoor Herbarium, Department of Botany, University of the Punjab, Lahore.

## Results

**Description:** The main distinguishing characteristics of *M. hastata* are its leaves that are 'hastate', i.e. basal lobes scheme backwards from connection of petiole and leaf lamina, and the inner margin of each lobe diverges laterally followed by inward bending creating an arrowhead appearance (Fig. 1). Roots are fibrous, adventitious stem: submerged and 40 to 70 cm long (Fig. 1a). Leaves are with floating hastate blades, 12–20 cm long and 1.5–10 cm wide, sheathing at the base of petiole 10.5–17 cm long but it varies with depth of water (Fig. 1d). Inflorescence of plant is dense corymbose raceme of 5–7.5 cm long with 25–52 flowers, subtended by a spathe-like leaf – sheath (Fig. 1c). Flower is pedicellate having 3–3.5 cm long stalk, actinomorphic parianth, bisexual, purplish blue, 1–1.5 cm long and 0.5 cm wide, segments 6 free, petaloid. Stamens are dimorphic 6, 7–10 mm long, one blue anther and other five are yellow in colour, inserted on the sepals, anthers 5–6 mm long (Fig. 1e). There are three carpels, polycarpellary, syncarpous, style hairy at apex, ovary superior 3-locular, with axial placentation numerous ovules. Fruit is a capsule 6–7 mm long and 4–5 mm in diameter (Fig. 1f).

**Common names:** Arrow pond weed, hastate pondweed.

**Flowering period:** May–November

**Native range:** India, Sri Lanka, South East Asia, Australia and Pacific Islands.

**Habitat:** Ditches, swampy grounds, ponds, lakes and moist reservoirs, rice fields.

**Synonym:** *M. hastifolia*

In Pakistan, the species closely resembles with *M. vaginalis*. However; these can be distinguished from each other on the basis of size of rhizome, leaf shape, number of flowers in the raceme, time of opening of flowers and length of pedicels (Fig. 2). The rhizome in *M. vaginalis* is short whereas it is large, well developed and branched in *M. hastata*. The leaves of *M. vaginalis* are heart shaped and of *M. hastata* are arrow head shape. *M. hastata* has

more flowers in the raceme than *M. vaginalis*. Unlike *M. vaginalis*, the flowers of *M. hastata* do not open simultaneously and the pedicels are unequal in length (lower ones are longer) as well as flower pedicels of *M. hastata* are 2–2.5 cm longer than *M. vaginalis* (Holm et al., 1977).

## Discussion

In Pakistan, the problem of alien weed species is not well recognized and several of alien species introduced either deliberately or unintentionally, become problematic weeds of agriculture or environment (Nasim and Shabbir, 2012). Some classic examples of deliberate introductions are paper mulberry (*Broussonetia papyrifera* L. L'Her. ex Vent.) lantana (*Lantana camara* L.) and mesquite (*Prosopis juliflora* Sw. DC.) while parthenium weed (*Parthenium hysterophorus* L.), wild oats (*Avena fatua* L.) and little seed canary grass (*Phalaris minor* Retz.) are considered as accidental introductions.

*M. hastata* is first time reported from District Narowal, Punjab, Pakistan. According to local peoples of the district, *M. hastata* is non-native plant to Pakistan and introduced to their area in just last few years. The source of introduction of this plant to Pakistan is unknown to local people and non-existent in the literature. However, it is suspected that it invaded from India where it has been reported already (Subudhi et al., 2015). Further, this plant was found as a floating species in Nala Baien (a river tributary) which enters Pakistan from India near the village Nalooya therefore it is likely that its seeds or whole plant may have introduced from India through this water channel or flood water.

During the field work, *M. hastata* was also found growing in the flooded rice fields near Tehsil Shakargarh of district Narowal. The occurrence of this plant inside rice fields is of concern for local rice growers who are already battling against many other problematic weeds of rice crop. This plant is already reported as a weed of rice fields in many other countries such as, India (Subudhi et al., 2015), Bangladesh (Hassan et al., 2010), Thailand (Cruz-Garcia and Price, 2011), Malaysia (Hakim et al., 2013), Indonesia (Backer and Bakhuizen van den Brink, 1968) and Fiji (Parham, 1958).

The common mode of reproduction of *M. hastata* is through seeds, and likely through stolons, which are produced in large quantities and deposited in the soil after dispersion. This plant is likely to spread further during flooding events of monsoon and expected to invade more rice growing areas of Pakistan.



**Fig. 1:** *Monochoria hastata* in its natural habitat (a) Inflorescence emerging from a spathe-like leaf sheath opposite to leaf direction (b) Cluster of buds and violet colored pedicillate flowers (c) Plant showing its arrow head leaves (d) Flower with bending style opposite to the dissimilar anthers 5 yellow, and 1 blue (e) Corymbose raceme showing fruiting stage in which petals of mature flowers curved to form spiraloid structure around (f)



**Fig. 2:** 1-3, *Monochoria vaginalis* 1- flowering plant, 2 - unbranched rhizome, 3- seed; 4-6, *Monochoria hastata*. 4 - flowering plant, 5-branched rhizome, 6 - seed

## Conclusion

*M. hastata* is an exotic weed, which is first time reported from Pakistan growing in wetlands and rice fields. Since this plant is already reported as a problematic rice weed in many countries authorities need to be vigilant and take action to manage it and stop its further spread.

## References

- Anonymous, 2017. *Invasive Aquatic Plant Management in South Carolina*. Aquatic nuisance species program, South Carolina Department of Natural Resources <http://www.dnr.sc.gov/invasiveweeds/img/plantmgmtprogrambrochure.pdf> Date accessed 13.08.2017
- Backer, C.A. and R.C. Bakhuizen van den Brink, 1968. *Flora of Java*, Vol. 3, pp: 761. N.V.P. Noordhoff, Groningen, The Netherlands
- Claudia, C., R. Flück, N. Regier and V.I. Slaveykova, 2014. Effects of macrophytes on the fate of mercury in aquatic systems. *Environ. Toxicol. Chem.*, 33: 1225–1237
- Cruz-Garcia, G.S. and L.L. Price, 2011. Ethnobotanical investigation of ‘wild’ food plants used by rice farmers in Kalasin, Northeast. *Thai. J. Ethnobot. Ethnomed.*, 7: 33–21
- DiTomaso, J.M. and E.A. Healy, 2003. *Aquatic and Riparian Weeds of the West*, Vol. 3421. University of California, Division of Agriculture and Natural Resources, UCANR Publications, United States
- Guofang, W. and C.N. Hom, 2000. Pontederiaceae. *Flora Chin.*, 24: 40–42
- Gupta, A.K., 2013. *Monochoria hastata*. The IUCN Red List of Threatened Species 2013.e.T168865A6543142. <http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T168865A6543142.en> Date accessed: 08–08-2017
- Hakim, M.A., A.S. Juraimi, M.R. Ismail, M.M. Hanafi and A. Selamat, 2013. A survey on weed diversity in coastal rice fields of Sebarang Perak in peninsular Malaysia. *J. Anim. Pl. Sci.*, 23: 534–542
- Hassan, M.N., S. Ahmed, M. JasimUddin and M.M. Hasan, 2010. Effect of weeding regime and planting density on morphology and yield attributes of transplant Aman Rice cv. Brridhan. *Pak. J. Weed Sci. Res.*, 16: 363–377
- Hazra, M., K. Avishek and G. Pathak, 2015. Phytoremedial potential of *Typha latifolia*, *Eichornia crassipes* and *Monochoria hastata* found in contaminated water bodies across Ranchi City (India). *Int. J. Phytol.*, 17: 835–840
- Holm, L.G., D.L. Plucknett, J.V. Pancho and J.P. Herberger, 1977. *The World's Worst Weeds. Distribution and Biology*, p: 609. University of Hawaii Press, Honolulu, Hawaii, USA
- Holscher, D., M. Reichert, H. Gorus, O. Ohlenschlager, G. Bringmann and B. Schneider, 2006. Monolaterol, the first configuration assigned phenylphenalenone derivative with a stereogenic center at C-9 from *Monochoria elata*. *J. Nat. Prod.*, 69: 1614–1617
- Ileperuma, V., S. Udage, D. Yakandawal, L. Jayasingh, S. Kumarand and A. Ratnalilleke, 2015. Does ingestion of plants from a phonetic group of *Monochoria* (Diyahabarala) cause hepatotoxicity? *Celon. Med. J.*, 60: 28–30
- Islam, M.S., M.W. Zaman and M.M. Rahman, 2013. Phytoaccumulation of Arsenic from Arsenic Contaminated Soils by *Eichornia crassipes* L., *Echinochloa crusgalli* L. and *Monochoria hastata* L. in Bangladesh. *Int. J. Env. Prot.*, 3: 17–27
- Nasim, G. and A. Shabbir, 2012. Invasive weed species-a threat to sustainable agriculture. In: *Crop Production for Agricultural Improvement*, pp: 523–556. Ashraf, M., M. Öztürk, M.S.A. Ahmad and A. Aksoy (eds.). Springer, The Netherlands
- Nasir, E. and S.A. Ghazanfar, 1977. *Flora of West Pakistan No. 114*. Pontederiaceae, Stewart Herbarium, Islamabad, Pakistan

- Parham, J.W., 1958. *The weeds of Fiji*, Bulletin No. 35. p: 196. Department of Agriculture, Fiji
- Srivastava, T.N., 1976. *Flora Gorakhpurensis*, p: 320. Today and Tomorrow's, New Delhi, India
- Subramanyam, K., 1962. *Aquatic Angiosperms: A Systematic Account of Common Indian Aquatic Angiosperms*, Botanical Monograph No. 3, p: 190. Council of Scientific and Industrial Research, New Delhi, India
- Subudhi, H.N., P. Panda, P.K. Behera and C. Patnaik, 2015. A check list of weeds in rice fields of coastal Orissa. *Ind. J. Agric. Sci.*, 7: 207–216

**(Received 05 April 2017; Accepted 05 September 2017)**