ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 13, Issue, 06, pp.17698-17701, June, 2021

DOI: https://doi.org/10.24941/ijcr.41543.06.2021

RESEARCH ARTICLE **OPEN ACCESS**

INVASION ALERT FOR THE ALIEN PLANT *XANTHOSOMA SAGITTIFOLIUM* (L.) SCHOTT (ARACEAE) IN THE EAST BARDHAMAN DISTRICT OF WEST BENGAL, INDIA

***Kaustuv Bhattacharyya**

Assistant Professor in Botany, Life Science Laboratory, Department of Teacher Education, WBUTTEPA, (erstwhile David Hare Training College), 25/3 Ballygunge Circular Road, Kolkata, W.B. - 700019, India

ARTICLE INFO

Article History:
Received 24th March, 2021
Received in revised form
15th April, 2021
Accepted 18th May, 2021
Published online 26th June, 2021

Key Words:
Xanthosoma sagittifolium, Alien Species, Invasive, Management, East Bardhaman District.

ABSTRACT

Tania or, *Xanthosoma sagittifolium* (L.) Schott, native to northern South America and a fast-growing herb from the Liliopsid family Araceae, has been intentionally introduced in many regions of the globe as an alien species - to be used as a food crop and fodder. There it subsequently became invasive. Within India, the plant is already been reported from Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and erstwhile undivided district of Bardhaman in West Bengal. Here, some insights into existing nomenclature of the species, knowledge on food uses, potential pathway causes for invasion and needs for immediate application of necessary control measures are being discussed with the anticipation that this study may be helpful to policymakers for the management of this alien plant species before it becomes invasive in West Bengal, India and in the East Bardhaman district of West Bengal, in particular.

Citation: Kaustuv Bhattacharyya. "Invasion alert for the alien plant *Xanthosoma sagittifolium* (*L.*) Schott (Araceae) in the East Bardhaman district of West Bengal, India*", 2021. International Journal of Current Research, 13, (06), 17698-17701.*

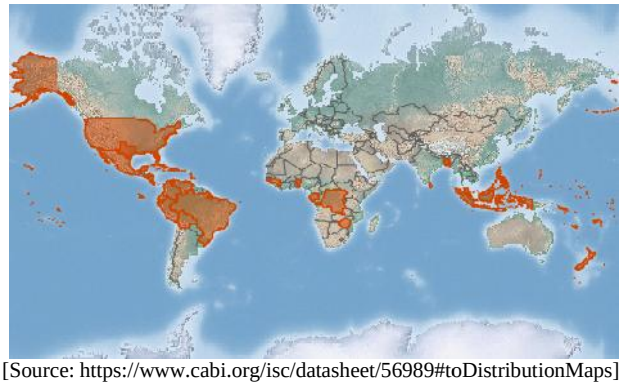
INTRODUCTION

"The second worst threat is the biological invasion of alien species"
-Convention for Biological diversity, 1992

Invasive plant species are considered a major threat to biodiversity, ecosystem functioning, and human wellbeing worldwide. While India talks about the impacts of developmental projects on biodiversity, *Xanthosoma sagittifolium* (L.) Schott i.e., Tania - an alien plant species with immense potential to become invasive, has already laid its foundation within the geopolitical limits of this country. In India, the plant is already been reported from Karnataka, Kerala and Tamil Nadu in peninsular India (Rao *et al.* 2019). It is also reported to be naturalised in Andhra Pradesh (Prameela *et al.*, 2020). This plant is a fast-growing tuber yielding herb, which is food for over 400 million people worldwide and is the most consumed aroid in West Africa. It is mainly cultivated for its starchy tubers and corms, but the leaves are also consumed. The corms are mostly used to feed animals or are dried, peeled and ground to produce flour.

***Corresponding author: Kaustuv Bhattacharyya,**
Assistant Professor in Botany, Life Science Laboratory, Department of Teacher Education, WBUTTEPA, (erstwhile David Hare Training College), 25/3 Ballygunge Circular Road, Kolkata, W.B. - 700019, India

They are also used to produce starch (Manner, 2011). In Africa, *X. sagittifolium* is also medicinally applied against burns. Sometimes the species is used as an intercrop in cocoa and coffee plantations. However, it remains an underexploited food resource till date. The native distribution range of *X. sagittifolium* is unclear, but it is suggested that it is native to northern South America including Colombia, Peru, Ecuador and Venezuela (Manner, 2011). It is widely naturalized in the West Indies, Central America, tropical Africa, tropical Asia and islands in the Pacific Ocean (Govaerts, 2013). *X. sagittifolium* has been intentionally introduced in many regions to be used as a food crop and fodder (Manner, 2011; FAO, 2013), and subsequently it has escaped from cultivated areas into natural areas where it becomes invasive (Langeland *et al*., 2008). Around India, *X. sagittifolium* is distributed in Bangladesh, Indonesia, Malaysia, Philippines and Sri Lanka (as shown in Figure - 1). Now, the genus *Xanthosoma* Schott is represented globally by 195 species (POWO 2020). Most authorities agree that this genus originated in tropical rainforest ecosystems and species have been widely naturalized in wet and humid ecosystems (Manner, 2011). The FAO datasheet for *X. sagittifolium* says: "The taxonomic position of the *Xanthosoma* species cultivated for their underground stems is unclear. The cultivated varieties have been allocated to four species: *X. atrovirens*, *X. caracu*, *X. nigrum* (*X. violaceum*) and *X. sagittifolium*, but some cultivars are not assignable to any of these" (FAO, 2013).



[Source: https://www.cabi.org/isc/datasheet/56989#toDistributionMaps]

Figure 1. Global distribution of *Xanthosoma sagittifolium*

The recent tendency has been to give the name of *X. sagittifolium* to all cultivated clones of *Xanthosoma* until a modern revision of the genus clarifies the taxonomic situation of the species mentioned (FAO, 2013). *X. sagittifolium* has several adaptations that help it survive and spread. It has the ability to reproduce both sexually by seeds and vegetatively by corms, tubers, and root suckers, and it is also adapted to grow in a great variety of substrates and habitats ranging from full sun to deep shaded areas beneath the canopy of natural forests (Langeland *et al*., 2008; Manner, 2011). *X. sagittifolium* is included in the Global Compendium of Weeds (Randall, 2012). This species can form mature plants from corms within 14-20 weeks. Once established, mature plants can produce large amount of foliage in the first 6-9 months, and may also produce up to 10 or more corms within 10 months (Langeland *et al*., 2008). Now, the critical role of indigenous crops in the socio-economic growth of developing nations necessitates accelerated exploration of alien invasive plant species of any such region. In this context, it is to be said that while exploring the Liliopsids [*sensu* Takhtajan, 2009] of the erstwhile undivided district of Bardhaman [Bhattacharyya, 2019], the author came across an interesting *Xanthosoma* species from the Burdwan town (at Tikorhat in Lakurdi area), which was later identified as *Xanthosoma sagittifolium* (L.) Schott. Arriving in Burdwan town, probably as an ornamental plant, this plant has already escaped from private gardens and has taken over shelters in rare pockets of the town.

MATERIALS AND METHODS

This study reviewed some of the existing literature and also made use of frequent field visits by the author to provide some insights into the existing nomenclature of the species, knowledge on food uses and needs for immediate application of necessary control measures of the aroid *X. sagittifolium* from the East Bardhaman district in West Bengal, India before it becomes invasive.

RESULTS AND DISCUSSION

Perusal of relevant literature and consultation with some renowned plant taxonomists in India revealed that the genus *Xanthosoma* Schott was not reported from the erstwhile undivided district of Bardhaman in West Bengal, India.

Table - 1: Prominent differentiating characters of *Xanthosoma sagittifolium* (L.) Schott with that of *Colocasia esculenta* (L.) Schott

Xanthosoma sagittifolium (L.) Schott	*Colocasia esculenta* (L.) Schott
Latex is present	Latex is absent
Leaves are not peltate	Leaves are peltate
Basal two lobes of leaves acute	Basal two lobes of leaves rounded
Rhizomes usually completely running below ground	Rhizomes usually emerging and running for most of their length above or below ground.

However, it has been reported by the author in an earlier publication [Bhattacharyya, 2019] as a Liliopsid from that region in West Bengal, in India. Therefore, this study reaffirms the extension of its distribution to Burdwan town, in West Bengal, India - along with the regions mentioned before. Reference to the validating original literature, detailed description, relevant notes and photographs [Figure - 2] are provided here to facilitate easier identification of the plant in the field.

Nomenclature

Xanthosoma sagittifolium (L.) Schott, Meelet. Bot. 19. 1832. *Arum sagittifolium* L., Sp. Pl. 966.1753.

Vernacular Names

The plant bears the following vernacular names in different parts of the world, some of which (except the Indian names which are documented here from Rao *et al*., 2019) are mentioned below after retrieving them from the GRIN Taxonomy website by Wiersema (2019).

In English: Arrowleaf elephant's ear, New cocoyam, Tania, Callaloo.
In Spanish: Malanga, Ocumo, Tiquisque blanco, Yautía, Yautía blanca.
In French: Chou Caraïbe, Malanga marron, Taye, Tayove.
In German: Tania, Tania-Goldnarbe.
In Swedish: Tannia.
In Kannada (India): Govekesu.
In Malayalam (India): Palchembu, Seemachembu

Description of the plant: The plant is not seen by the author in its flowering or in fruiting conditions at the study site. However, the following standard description of the plant is from the relevant webpage of the Global Biodiversity Information Facility (i.e., GBIF). Herb up to 2 m tall, robust. Stems hypogeous in young plants, erect, cylindric, 7-9 cm in diameter, densely covered by brown fibers, producing cormels that are cylindric at base and globose at apex, adult plant producing a stout columnar stem, up to 15 cm diam. Leaves 4-7 per plant; petioles 80-160 cm long, green, poorly waxy, sheathed up to 1/2 of its length, sheath margins erect to slightly convolute; leaf blade 60-97 x 30-44 cm, subhastate in young plants, sagittate and ovate in mature plants, reflexed to sub-patent, semi-matte dark green adaxially, paler matte green abaxially, primary lateral veins 5-8 per side, arising at an angle of 45-80°, poorly discolorous to concolorous adaxially, concolorous abaxially, apex acuminate; basal ribs not denuded at all, basal lobes acute to cuneate at apex. Inflorescence 1-3 per axil, peduncle 16-17 x 1.5-2 cm, spathe 23-32 cm long, tube ovoid, 7-10 x 4-5 cm, clear green and moderately waxy outside, whitish green inside, lamina 15-16 x 5.0-6.5 cm, ivory white in both surfaces, spadix 17-25 cm long, fertile male portion 9.5-13 x 1.3-2.2 cm, tapering to the apex to obtuse, sterile male portion 3-5 x 1.7-2.5 cm, white, only weakly dimorphic, female portion conoid, 4-6 x 1.5-2 cm, pale yellow.

The plant is allied to *Colocasia esculenta* (L.) Schott but it can be distinguished by its latex, leaves, and rhizomes as shown in the Table - 1.

History of Introduction and Spread: According to the FAO (2013), the cultivation of *X. sagittifolium* must be very old in the New World. When the Europeans arrived to America, the cultivation of this plant species was known from Central America to Bolivia, but more intensive in the West Indies (FAO, 2013). From the Americas, *X. sagittifolium* reached West Africa probably during the seventeenth or eighteenth centuries, associated with the slave trade. In Africa, this species has traditionally been a subsistence crop (FAO, 2013).

Risk of Introduction: *X. sagittifolium*, as a fast-growing herb, has escaped from cultivation and has become invasive in tropical and subtropical regions of the world.

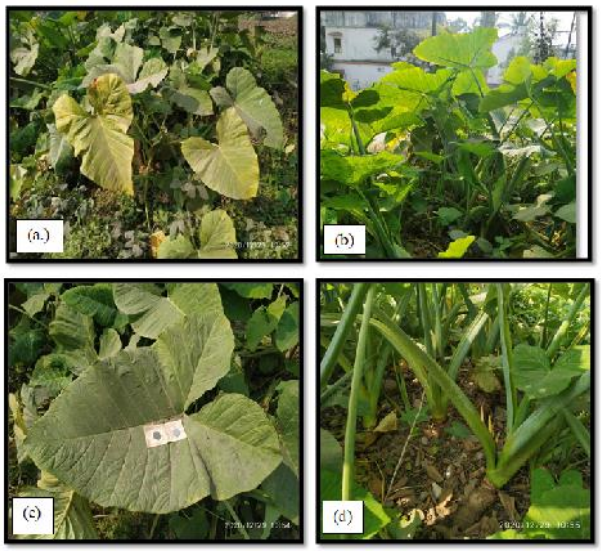


Figure - 2: (a) Plant habit of *Xanthosoma sagittifolium*(L.) Schott.(b)Abaxial view of the leaves.(c) A fully grown leaf.(d)Petioles and part of root of the plant.

This plant produces underground corms and stems which can produce new plants very quickly. In addition, corms may remain dormant in very heavy shade and resprout when a light gap is formed (Langeland *et al*., 2008). In consequence, the probability of invasion of this species, especially in areas near to cultivated fields, remains high. Now, the East Bardhaman district, where the plant has been located by the author, being economically dependent on agriculture mainly - the *X. sagittifolium* holds immense potential for its rapid invasion.

Habitat: *X. sagittifolium* grows best in humid tropical rainforest climates and can be found naturalized along stream banks and in moist shady areas (Manner, 2011). It can be found in disturbed wetlands, wet ditches, and adjacent to freshwater swamps and springs (Langeland *et al*., 2008).

Physiology and Phenology: Being a fast-growing perennial herb, new mature *X. sagittifolium* plants can be produced from a small portion of corm or stem. Root formation and rapid root growth take place immediately after planting, followed by rapid growth of the shoot, and after 14-20 weeks it is possible to have complete mature plants. Corms can remain viable underground and survive through unfavourable environmental conditions such as drought. Corms can also be stored for up to 18 weeks or more in dry conditions, but unplanted corms can sprout within a few weeks in hot, humid conditions (Langeland *et al*., 2008; Manner, 2011).

Environmental Requirements: *X. sagittifolium* can withstand annual precipitations greater than 150 cm. It is well adapted to grow in shaded conditions (Manner, 2011). *X. sagittifolium* grows in a wide range of soils except hard clay or pure sands. It does not tolerate waterlogged soils and does best in moist, well-drained organic soil with pH of 5.5 – 6.5 (Langeland *et al*., 2008; Manner, 2011). Leaves may die back, but corms can continue to grow in water-stressed conditions (Langeland *et al*., 2008).

Pathway causes: It has been estimated that over 70% of all invasive, exotic terrestrial plant species in the world were intentionally introduced into the new areas now invaded (Pasiecznik *et al*., 2004) with crops second only in importance to ornamental species. Regarding spread once introduced, Anderson (2007) noted that intentionally introduced crops were, and still are, bred for superior performance and survival in a specific environment. Thus, introduced crops that are invasive will have a greater probability of spread than non-crop species that are unintentionally introduced. Followings are some of the established pathway causes for rapid global introduction of *X. sagittifolium*:

- Crop production
- Escape from confinement or garden escape
- Horticulture
- Live food or feed trade
- Medicinal use
- Ornamental purposes

Environmental Impact: *X. sagittifolium* is an invasive fast-growing herb with the potential to displace native vegetation. It has become naturalized outside its native distribution range and has the potential to form dense thickets along rivers, lake shores, and wetlands (Langeland *et al*., 2008).

It has immense potential to displace native vegetation mainly in disturbed areas along roadsides where dense populations are able to emerge near cultivation areas.

Invasiveness

The invasiveness of this plant species can be ascribed as follows:

- Proved invasive outside its native range
- Has a broad native range
- Highly adaptable to different environments
- Is a habitat generalist
- Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc
- Tolerant of shade
- Benefits from human association (i.e., it is a human commensal)
- Long lived
- Fast growing
- Has high reproductive potential
- Reproduces asexually

Impact outcomes

If one considers the impact outcomes of this invasion by the *X. sagittifolium*, then those can be enlisted as follows:

- Altered trophic level
- Damaged ecosystem services
- Ecosystem change/ habitat alteration
- Monoculture formation
- Reduced native biodiversity
- Threat to/loss of native species

CONCLUSIONS

Climatically suitable ranges for invasive plant species are expected to expand due to future climate change (Adhikari *et al.*, 2019). The identification of current invasions and potential range expansion of invasive plant species is required to plan for the management of these species. Invasive plants have aroused attention globally for causing ecological damage and having a negative impact on the economy and human health. However, it can be extremely challenging to rapidly and accurately identify invasive plants based on morphology only because many plant materials lack sufficient diagnostic characteristics during border inspections. It is, therefore, urgent to evaluate candidate loci and build a reliable genetic library to prevent invasive plants from being introduced in India and in any other region whatsoever (Song-Zhi *et al.*, 2017). The negative impacts on biodiversity, ecosystem dynamics, and economy caused by invasive plant species become high if preventive and eradication measures are not employed immediately. Biological invasions are a defining feature of the Anthropocene, but the factors that determine the spatially uneven distribution of alien plant species are still poorly understood. However, to meet international biodiversity targets and halt the detrimental consequences of plant invasions, it is essential to disrupt the connection between socio-economic development and plant invasions by improving pathway management, early detection and rapid response. Past research studies for developing eradication methods were often limited in duration (only one or two years) and habitats (one site).

Control projects for invasive species, offer a logical, long-term solution but none have been seriously attempted in India. Hence, the high investments and long-term research required for control programs have been lacking in India. Crucial aspects of alien plant ecology that influence control strategies are as follows (Sudhakar Reddy *et al.*, 2008):

- Invasive aliens continue to spread because natural predators were not imported from the plants' home range and native predators unsuitable.
- After an alien plant is introduced there is a lag phase of decades to centuries before an exponential spread phase. Thus, some species that currently appear non-invasive may eventually begin to spread rapidly.
- Invasive alien plants can prevent or retard natural succession and reforestation by forming dense infestations.
- Invasion by aliens continues to decrease biological diversity.
- Because many disturbed habitats occur in cities, alien plants can present severe problems for urban forestry programs, which is made more difficult by alien species mixtures.
- Allelopathic effects by some alien species retard the growth of other native species.
- The invasions potentially lead to an increase in species richness, as invasive species are added to the existing species pool of an area. But also leads to extinction of native species, resulting in decrease of species richness. The negative interaction is primarily the competition with natives for food and sustenance, which may not allow coexistence.

Thus, this study may be helpful to policymakers for the management of *Xanthosoma sagittifolium* (L.) Schott as an invasive plant species and conserve the unique biodiversity of India and West Bengal in particular.

ACKNOWLEDGEMENTS

The author is ever grateful to Prof. Prasanta Kumar Bhattacharyya (Former Professor of Botany, University of Burdwan) for constantly motivating him to conduct the study and also for providing necessary guidance. He is also thankful to the native people of Burdwan town for providing every possible help in conducting the study.

REFERENCES

Adhikari P., JeonJa-Young, Kim HW, Shin Man-Seok, Adhikari P. and Seo C. 2019. Potential impact of climate change on plant invasion in the Republic of Korea. *Journal of Ecology and Environment*, 43:36

Anderson NO, 2007. Prevention of invasiveness in floricultural crops. In: *Flower Breeding and Genetics* [ed. by Anderson, N. O.]., The Netherlands: Springer, 177-214.

Bhattacharyya K. 2019. Nature's cornucopia: An inventory of the Liliopsid Plants *sensu* Takhtajan, 2009 in the erstwhile undivided Bardhaman District of West Bengal, India. *International Journal of Current Research*, 11(9), 7408 - 7418.

CABI, 2021. *Xanthosoma sagittifolium (elephant ear)* [original text by Julissa Rojas-Sandoval & Pedro Acevedo-Rodríguez]. In: Invasive Species Compendium. Wallingford, UK: CAB International. Retrieved from https://www.cabi.org/isc/ datasheet/ 56989

FAO 2013. *FAO statistical yearbook. World food and agriculture*. Food and Agriculture Organization of the United Nations, Rome, Italy.

GBIF Secretariat: GBIF Backbone Taxonomy. 2021.Accessed via https://www.gbif.org/species/5330901

Govaerts R 2013. *World Checklist of Araceae*. Richmond, UK: Royal Botanic Gardens, Kew. http://apps.kew.org/wcsp/

Langeland KA; Cherry HM; McCormick CM; Craddock Burks KA 2008. *Identification and Biology of Non-native Plants in Florida's Natural Areas*. Gainesville, Florida, USA: University of Florida IFAS Extension.

Manner HI 2011. Farm and forestry production and marketing profile for Tannia *(Xanthosoma spp)*. In: *Specialty crops for Pacific Island Agroforestry* [ed. by Elevitch, C. R.]. Holualoa, Hawaii, USA: Permanent Agriculture Resources PAR, 1-16.

Pasiecznik NM, Harris PJC, Smith SJ 2004. *Identifying tropical Prosopis species: a field guide* [ed. by Pasiecznik, N. M.\Harris, P. J. C.\Smith, S. J.]. Coventry, UK: International Research Department, HDRA.

POWO 2020. *Plants of the World Online.*
Retrieved from http://www.plantsoftheworldonline.org/Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet.

Prameela, R., Swamy, J. &Prakasa Rao, J. 2020. Notes on distribution of Xanthosoma sagittifolium L. Schott Araceae in Penninsular India, *Journal Indian botanical Society*, 100 (1 & 2), 87 - 90.

Randall RP 2012. *A Global Compendium of Weeds*. Perth, Australia: Department of Agriculture and Food Western Australia. http://www.cabi.org/isc/FullTextPDF/2013/20133109119.pdf

Sankara Rao, K., Raja K Swamy, Deepak Kumar, Arun Singh R. and K. Gopalakrishna Bhat 2019. *Flora of Peninsular India*. http://peninsula.ces.iisc.ac.in/plants.php?name=Xanthosoma sagittifolium.

Sudhakar Reddy, C., Bagyanarayana,G., Reddy, K.N. & Raju, Vatsavaya S. 2008. *Invasive Alien Flora of India*. National Biological Information Infrastructure, Usgs, USA.

Wiersema JH 2019. *Xanthosoma sagittifolium* L. Schott in GRIN Taxonomy. US National Plant Germplasm System. Checklist dataset. https://doi.org/10.15468/ao14pp

XuSong-Zhi,LiZhen-Yu, JinXiao-Hua 2017. DNA barcoding of invasive plants in China: A resource for identifying invasive plants. *Molecular Ecology Resources.*

****