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RESEARCH ARTICLE

An Overlooked Weed "Purpletop Vervain" *Verbena incompta* P. W. Michael (Verbenaceae) Forms a New Record to the Flora of India

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Abstract

Verbena incompta P. W. Michael (Verbenaceae) an invasive species from Brazil is reported here as a new record for the flora of India. This species was observed growing as weeds along agricultural fields in western Uttar Pradesh, India and profusely flowering and fruiting with high seed number. It is morphologically similar to *V. brasiliensis* Vell. and *V. bonariensis* L. but clearly distinct from the latter species in leaf and inflorescence characters. The present account provides detailed botanical description and comparative account between three allied species, namely *Verbena incompta* P.W. Michael, *V. brasiliensis Vell. and V. bonariensis* L. along with identification key. Weed risk assessment indicated *V. incompta* as a "serious weed" with high invasive potential.

Keywords: *Verbena incompta*, Exotic species, Weed risk assessment, India, Invasive potential.

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Introduction

The biggest threat to biodiversity from various anthropocentric activities is associated with many invasive plant and animal species. The appearance of exotic weed plants species in any new geographical areas is linked to the introduction. They occupy natural wastelands and habitats that are considered suitable sites for invasive weeds. Among many weed taxa, the ones belonging to the genus *Verbena* L. are globally known to invade or naturalize newer habitats.

The Indian region includes three wild species of *Verbena, V. bonariensis* L.*, V. officinalis* L., *V. rigida* Spreng and nine cultivated species *viz*. *V. aubletia* Jacq., *V. chamaedryfolia* Juss., *V. hastata* L., *V. incisa* Hk., *V. peruviana* Druce, *V., phlogiflora* Cham., *V. platensis* Spreng., *V. tenuisecta* Briq. and *V. hybrid* Voss occasionally occurring in India (Rajendran and Daniel, 2002). *V. officinalis, V. bonariensis* and *V. rigida* are reported for their medicinal value in India (Ambasta, 1986). Cultivated species *V. bonariensis* is reported to run as an escape in states (districts in parenthesis) Tamil Nadu (Nilgiris), Himachal Pradesh (in Kangda, Madi); and *V. officinalis* in Himachal Pradesh (Cahmba, Kangda, Kinnaur, Kullu) (Hooker, 1885; Collett, 1902; Gamble, 1924; Chowdhury and Wadhwa, 1984).

The present paper describes the occurrence of *Verbena incompta* P.W. Michael, observed during an exploration undertaken in parts of Uttar Pradesh and adjoining areas of Haryana during October, 2020, forming a new record for India. Distinctive characters from existing *Verbena* species that are reported from India have confirmed its status as "new taxon" for the region. An identification

key is provided in light of a comparative account with three closely related non-native species of *Verbena*. Description of *Verbena incompta* with morphology, distribution, habitat details and identification key are provided. Invasive behavior through weed risk analysis is discussed in this paper to support concern for the weedy potential of *Verbena incompta* in India.

Materials and Methods

A weed species was recorded during exploration in parts of Uttar Pradesh and adjoining areas of Haryana in October, 2020. Upon critical examination of the species, comparing with three taxa occurring in India and other exotic allied species, and validating the information available in Indian floras, the taxon was confirmed as species not recorded in India.

Observations were made during visit to the site in 2020, followed by a revisit to the site in 2021 to ascertain the population spread. The virtual herbarium of BM, E, K, P, PE and NHCP (Thiers, 2019) and the global databases viz. National Gene Bank (NGB), Global Biodiversity Information Facility (GBIF), Germplasm Resources Information Network (GRIN), Kew Catalogue, etc. were studied for eco-geographic records. A comparative study was also undertaken using herbarium specimens of allied taxa available in the CNH, DD and National Herbarium of Cultivated Plants (NHCP)] and the online resources and supplemented with relevant literature to establish it as new record for India. Voucher herbarium specimens (HS23146, 23147, 23150) were prepared as per standard methods and deposited in the National Herbarium of Cultivated Plants (NHCP), ICAR-NBPGR, New Delhi.

Weed risk assessment was based on a standard format as prescribed by Singh *et al*. (2013). This tool was subjected to provide status of the species invasiveness based on defined biological and ecological parameters through a questionnaire containing 49 questions. The resultant question-based scoring was assessed to define the "weediness status" level. As per data on field assessment, the response to the questions generated a numerical score with a positive correlation to weediness (Annexure 1).

Results and Discussion

Distribution and Habitat Details

The genus *Verbena* (family Verbenaceae) is represented by 250 species which are mainly spread in sub-tropical and tropical countries of America, also in Europe, Asia, Africa and Australia (Yeo, 1990; Rajendran and Daniel, 2002).

Verbena incompta P.W. Michael locally called "Purpletop Vervain" is presumed to be a taxon of South American origin (Brazil, Argentina, Paraguay). It is widely distributed in sub-tropical and warmer temperate parts of the world; it grows as an invasive weed in grasslands, agricultural fallow lands, range lands, urban areas preferring humid habitats (Mikeladze *et al*., 2017). *V. incompta* is reported to be naturalized in Italy and Spain, invasive weed in Belgium (Verloove, 2006; 2011) and a declared noxious weed in many temperate and subtropical areas worldwide. Its adaptation for drought and heat tolerance and predominantly on disturbed habitats along roadsides, new forest plantations, forest edges, dry or moist river beds, ditches, road verges, and more rarely in ruderal make it the most successful taxon as a weed.

V. incompta was described as a species new to science (Michael, 1995). It occurs in parts of Europe and elsewhere along with other species, *V. bonariensis* and/or *V. brasiliensis*. Due to its great affinity with the related species, *V. brasiliensis* Vell. and *V. bonariensis* L. there are several identity-related issues (Perry, 1933; Verloove, 2011). *V. incompta,* much more reputed as a weed than *V. bonariensis* and without any ornamental value. The remarkable concentration of *V. incompta* around agricultural areas is accounted for inadvertent introduction along with foreign seeds, soil, and other objects. *V. incompta* has been possibly confused with *V. bonariensis* in southern Europe where the latter is claimed as a naturalized alien (Verloove, 2011; Gleason and Cronquist, 1991); Liendo *et al*., 2016).

Three species occurring in India, namely *V. officinalis*, *V. bonariensis*, and *V. rigida* did not match with the presently reported taxon. After critical morphological observations, comparison with the herbarium specimens and validation from relevant literature, the identity of the species was confirmed as *Verbena incompta*.

V. incompta very clearly differs from other *Verbena* species in India. *V. bonariensis* is reported from Himachal Pradesh and Uttarakhand and is distinguished by the erect stem, sessile and glandular leaves, longer inflorescence having not showy corolla tubes and shorter mericarps. The second species namely, *V. officinalis* L. has an erect stem, petiolate ovate-lanceolate, papery leaves, margin variously toothed, acute apex, inflorescence with flowers lax in slender panicle, showy blue-pink corollas. This species occurs widely across different states, Punjab, Uttar Pradesh, Andhra Pradesh, Bihar, Himachal Pradesh, J&K, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland. The third species, *V. rigida* has a rhizomatous creeping stem, leaves oblong-lanceolate, adnate at base, coarsely serrate margins, acute apex, spikes terminal, corolla pink, dark purple-blue-violet (is an escape in Karnataka and Tamil Nadu).

New Distribution Record

The newly reported species *Verbena incompta* was is distributed along with natural vegetation in disturbed habitat in village Barauli, district Baghpat, Uttar Pradesh, India. The authors recorded a population in present locality in village Barauli, Baghpat district, Uttar Pradesh, India, during field survey and germplasm collection of crop wild relatives and potential taxa. Plant populations were densely

spread across wider habitats ranging from dry agricultural fellow land, ditches along roadsides, wet land along the field margin. Over 6 to 7 populations in around 200 m area were observed to flower and seed ripening simultaneously. The plants were not located beyond the reported area, indicating its introduction as a weed in recent past.

The global germplasm resource databases (NGB, GBIF, GRIN/USDA) did not report this species from Uttar Pradesh, India. Recent report on the occurrence of *Verbena brasiliensis* from Himachal Pradesh (BSI 2020-21) was found to be closer to *V. incompta*. (https://sites.google.com/site/efloraofindia/species/m---z/v/verbenaceae/verbena/verbena-brasiliensis). This may indicate that this taxon has been largely overlooked due to similarity with other taxa. The present report is new distributional record of *Verbena incompta* in India from Uttar Pradesh.

Botanical Description

Erect herb grows as annual to perennial, 50 to 200 cm tall. Stem sharply 4-angled, hispid on the angles. Leaves simple, sessile, opposite, decussate, semi-amplexicaul-subauriculate, lanceolate, up to 15 x 3 cm, sharply and irregularly serrate, entire towards the base, rugose-scabrous on both surfaces. The inflorescence is corymbose to spicate. Spikes sub-cylindrical, 3 to 10 in number, up to 5 to 7 cm long and up to 5 mm wide at maturity. Flowers small, and numerous, opening together in a circle immediately below the apex of the spike. Floral bracts ovate-lanceolate, 2 to 3 mm long, glandular or with minute and very sparse stalked glands. Calyx 5-angled, pubescent, 5-toothed at apex. Corolla small mouve/blue-purple, limb c.2.75–3.75 mm wide, tube 2.75 to 3.25 mm long, slightly curved and hardly exceeding the calyx tube. Upper anthers are inserted above the middle of the corolla tube. Fruit included in the persistent calyx tube, glabrous, splitting into 4 cylindrical-oblong brown mericarps, mericarps-1.3 to 1.5 mm long, ribbed on the outside, weakly reticulate.

Location

Baghpat district, Uttar Pradesh): collector no. ANP-7-1, village Barauli, Baghpat district, Uttar Pradesh, India (with average altitude 28.59.821; 77.13.457 and 29.04.159; 77.13.570); October 6, 2020.

Ecology

Other wild taxa *Cenchrus ciliaris* L., *Cynodon dactylon* (L.) Pers., and *Chenopodium album* L., *Achyranthus aspera* L. co-occur in the open grassy fallow land.

Flowering and Fruiting

October-November (present study); October-January (Michel, 1995).

Figure 1: *Verbena incompta:* (top row L-R) plant population; newly emerging plants with typical leaves; (bottom row L-R) flower showing close-up; mature plants with dried inflorescence (inset).

Use

The species was unfamiliar to local people; no use of this species was noted in the area of collection.

Notes: Plants were noted with compact elongated spikes with sprinkling small mouve/ blue-purple flowers. The plant populations were noted in vegetative, flowering, seeding, and shattering stages simultaneously and dried spikes amongst the fresh plant growth (Figure 1).

Identity Confusion with Other Taxa

The genus *Verbena* includes reputed environmental weeds such as *V. brasiliensis* Vell. And also popular ornamentals such as *V. bonariensis* L. and *V. rigida* Spreng. Despite the existence of a recent revisionary works, the taxonomy and nomenclature of the *V. bonariensis* complex remain unclear (Munir, 2002; Michael, 2008; Nesom 2010).

V. incompta resembles very much with *V. bonariensis* as well as *V. brasiliensis*. With the former it has the sessile-amplexicaul leaves in common, whereas the characteristics of inconspicuous corollas, long spike inflorescence and small mericarps are shared with *V. brasiliensis* (Verloove, 2011). Like *V. brasiliensis*, it lacks ornamental value due to inconspicuous corollas (Yeo, 1990). The corollas of *V. brasiliensis* and *V. incompta* are only slightly narrower than those in *V. bonariensis* (c. 2.75 to 3.75 mm versus 4.25 to 5.5 mm (Yeo, 1990), but they are hardly expanded from the calyx tube and most become even virtually invisible in herbarium specimens. The ripe mericarps of *V. incompta* and *V. brasiliensis* are smaller than in *V. bonariensis*. Three species, *V. incompta* and *V. brasiliensis* and *V. bonariensis* can be delineated on the basis of micro-morphological characters; *V. incompta* and *V. brasiliense* have minute stalked glands on calyx tube and absent on pedicels (or very sparse) whereas *V. bonariensis* has abundant glands (Yeo, 1990; Michael, 1995; 2008). *Verbena incompta* appear to be intermediate between *V. bonariensis* and *V. brasiliensis* (Verloove, 2011). The identification key for three *Verbena* species is presented below:

1. Leaves distinctly tapering to base ..... ***V. brasiliensis***
1. Leaves not tapering to base
2. Corolla not showy, hardly exserted from calyx tube; inflorescence spikes slender and sub-cylindrical, usually up to 5 to 7 cm long ..... ***V. incompta***
2. Corolla showy, well exserted from calyx tube; inflorescence spikes usually short and thick, frequently congested at maturity, rarely more than 1.5 cm long..... ***V. bonariensis***

Weed Risk Analysis

Many garden plants of exotic origin pose a high risk of naturalization and potential as a weed in the area of cultivation (Groves *et al*., 2005; Pandey *et al*., 2018). Species of *Verbena* have reports of invasiveness in many countries (http://fnai.org/Invasives/FNAI.pdf) coupled with adaptation to diverse soil types ranging from wetland to drought affected regions that poses risk of establishment as naturalization. The plant traits such as luxuriant growth, plants remaining green all through the year, high-fruit bearing and high seed number/fruit, perennating root stocks, no natural predators (not eaten by animals) and dispersal through movement of animals/soil to influence fast spread of the species have favoured invasiveness in the newer areas. The species may gradually dominate and completely replace other natural/native vegetation.

V. incompta is a declared noxious weed in many temperate and subtropical areas worldwide (GISD, 2007; Verloove, 2011). Keeping this in view, weed risk assessment was made based on standard procedure (Singh *et al*., 2013). A question-based scoring of '18' for this species revealed its potential as "serious weed" in cultivable/agricultural land (Annexure 1). Appropriate and timely monitoring for its future spread was indicated.

Conclusions

This is the first report on occurrence of *V. incompta* recorded by the authors in the territory of village Barauli, district Baghpat, Uttar Pradesh in India. The present study adds to our understanding on new distributional record and weedy potential of the species. Besides, visual observations on its spread as a weed in areas near cultivation sites and weed risk analysis has raised the risk of fast invasiveness through escaping from areas of naturalization. Monitoring of *V. incompta* population in the present locality and spread elsewhere seems timely.

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Annexure 1: Weed risk assessment questionnaire Answer yes (y) or no (n), or don't know (leave blank or?), unless otherwise indicated

Common name: Family name:		*Botanical name: Verbena incompta P.W. Michael*			*Outcome:*	*Reject*
		Purpletop Vervain				
		Verbenaceae		*Your name: Dr. Anjula Pandey*		
History/Biogeography						
A	1	Domestication	1.01	Is the species highly domesticated. If answer is 'no' go to question 2.01		n
C		Cultivation	1.02	Has the species become naturalized where grown		
C			1.03	Does the species have weedy races		
	2	Climate and	2.01	Species suited to Indian climates (0-low; 1-intermediate; 2-high)		y; 1
		Distribution	2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)		0
C			2.03	Broad climate suitability		y
C			2.04	Native or naturalized in regions with extended dry periods		y
			2.05	Does the species have a history of repeated introductions outside its natural range		?
C	2	Weed	3.01	Naturalized beyond native range		y
E		elsewhere	3.02	Garden/amenity/disturbance weed		y
A			3.03	Weed of agriculture/horticulture/forestry		y
E			3.04	Environmental weed		
			3.05	Congeneric weed		
Biology/Ecology						
A	4	Undesirable	4.01	Produces spines, thorns or burrs		n
C		traits	4.02	Allelopathic		
C			4.03	Parasitic		

A			4.04	Unpalatable to grazing animals	
C			4.05	Toxic to animals	
C			4.06	Host for recognised pests and pathogens	
C			4.07	Causes allergies or is otherwise toxic to humans	
E			4.08	Creates a fire hazard in natural ecosystems	
E			4.09	Is a shade tolerant plant at some stage of its life cycle	
E			4.10	Grows on infertile soils	y
E			4.11	Climbing or smothering growth habit	y
E			4.12	Forms dense thickets	y
E	5	Plant type	5.01	Aquatic	
C			5.02	Grass	
E			5.03	Nitrogen fixing woody plant	
C			5.04	Geotype	y
C	6	Reproduction	6.01	Evidence of substantial reproductive failure in native habitat	
C			6.02	Produces viable seed	y
C			6.03	Hybridises naturally	
C			6.04	Self-fertilisation	
C			6.05	Requires specialist pollinators	
C			6.06	Reproduction by vegetative propagation	y
C			6.07	Minimum generative time (years)	y
A	7	Dispersal	7.01	Propagules likely to be dispersed unintentionally	y
C		mechanisms	7.02	Propagules dispersed intentionally by people	y
A			7.03	Propagules likely to disperse as a produce contaminant	y
C			7.04	Propagules adapted to wind dispersal	
E			7.05	Propagules have dormancy	
E			7.06	Propagules bird dispersed	
C			7.07	Propagules dispersed by other animals (externally)	y
C			7.08	Propagules dispersed by other animals (internally)	
C	8	Persistence	8.01	Prolific seed production	y
A		attributes	8.02	Evidence that a persistent propagule bank is formed (>1 yr)	
A			8.03	Well controlled by herbicides	
C			8.04	Tolerates or benefits from mutilation, cultivation or fire	
E			8.05	Effective natural enemies present in India	

A=agricultural, E=environmental, C=combined

Score: 18