

First record of new ‘invasion’ in northeast India by *Centaurea cyanus* L. (Asteraceae)

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Abstract

*The region of northeast India boasts sizeable flora of non-native species which has arrived during last few centuries. Whilst several of these species have escaped in wild and naturalized, others have mingled in the flora and remain oblivious. Some species have gained dominance and replaced native flora and these are considered “invasive”. This article reports the first record of an herbaceous plant, *Centaurea cyanus* L. of Asteraceae family from northeast India. The plant was found in the summer of 2020 in the campus of North-Eastern Hill University, Shillong while it was competing with several other non-native species on poor substratum. An extensive search in the floras of the region revealed that the plant has not been reported previously. It is probable that the plant has arrived here either as a companion with the supplies of packaged seeds of garden flowers procured by the residents from various sources or through some other carrier from nearby villages where it has made presence. Only time will answer if the plant remains oblivious or turns invasive.*

Keywords: *Centaurea cyanus*, cornflower, invasive species, medicinal plants.

Introduction

The flora of northeastern region of India has been invaded by a number of plants during the nineteenth and twentieth centuries. The invading species predominantly belong to Asteraceae and are detected only after they have gained dominance in the landscape (Shankar *et al.*, 2011). Many of these species have naturalized and mixed up with the local flora (Anandhapriyan and Shankar, 2018; Sarma *et al.*, 2019). However, several of the invasive species pose a serious threat to the productivity of crops, cause toxicity in the soil and are responsible for health hazards of animals as well as humans (Reddy *et al.*, 2008; Bhatt *et al.*, 2011).

Recently, a beautiful pinkish-flowered herbaceous plant was noticed in the campus of the North-Eastern Hill University, Shillong. Since the plant appeared new, the pictures of the plant were shared with a few taxonomist colleagues. The lead to the generic name was offered by Professor B.K. Datta of Tripura University and with some effort, it was confirmed as *Centaurea cyanus* L. which is popularly known as ‘cornflower’. After a reconnaissance of botanical literature, it was concluded that the plant had not been

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reported in the floras of the northeastern region (Hooker, 1872-1887; Kanjilal *et al.*, 1934, 1936, 1938, 1940; Balakrishnan, 1981-1983; Deb, 1981-1983; Joseph, 1982; Haridasan, 1985-1987; Hajra and Verma, 1996; Hajra *et al.*, 1996; Chowdhury, 2005; Giri *et al.*, 2008; Chowdhery *et al.*, 2009; Singh *et al.*, 2000, 2002; Boro and Sarma, 2013; Barooah and Ahmed, 2014; Mao *et al.*, 2016, 2017). The ASSAM herbarium houses one sheet of *C. cyanus* collected by N.L. Bor (Collection No. 18317) on 24.03.1938 from Botanical Garden of New Forest (now FRI), Dehradun. Aroused with interest, *in situ* growth of three plants for several weeks was followed, to develop taxonomic diagnosis and illustrations, and review literature on this plant.

Although *Centaurea cyanus* is known to humanity for millennia, its description in the floras is unfinished (Keil, 2012). Notwithstanding, sizeable literature has emerged on its culinary and medicinal properties in last few years (Table 1). The plant is known to have come out from its native range and spread widely in northern hemisphere, but it is not notorious for invasive possessions. Probably, due to its weak competitive ability (Karlsson, 2019), the natural populations of *C. cyanus* have declined drastically in Europe (Anonymous, 2007). The review of literature reveals that the future research on its phytochemistry shall pave the way for proliferation in its utilization for human consumption.

Table 1. Some culinary and therapeutic uses of *C. cyanus* recorded in the literature.

Sl.	Plant part used	Culinary and medicinal uses	Source
1.	Flowers	Aromatic acids and sugars	Swiatek and Zadernowski (1994)
2.	Flower-heads	Anti-inflammatory effect	Garbacki <i>et al.</i> (1999)
3.	Flowers	Anthocyanin	Takeda and Tominaga (1999)
4.	Seeds	Indole alkaloids	Sarker <i>et al.</i> (2001)
5.	Leaves	Cooked as vegetable	Kültür (2008)
6.	Flowers	Mineral element	Rop <i>et al.</i> (2012)
7.	Flowers	Astringent herb used for skin cleansing and eye ailments (conjunctivitis and blepharitis)	Al-Snafi (2015)
8.	Ray florets	Infusions, garnish and natural food colorant, antioxidant activity, soothing, and used in ocular inflammation	Fernandes <i>et al.</i> (2017)
9.	Dried flowers	Carbohydrates	Pires <i>et al.</i> (2019)
10.	Ray florets	Decoration of dishes and desserts	Matyjaszczyk and Śmiechowska (2019)
11.	Flowers	Antioxidant power	Kalemba-Drożdż (2019)
12.	Flower	Antibacterial activity against species like <i>Listeria monocytogenes</i> and methicillin-susceptible <i>S. aureus</i> (MSSA)	Lockowandt <i>et al.</i> (2019)

This study reports the first record of the plant, *Centaurea cyanus* L. of Asteraceae, from northeastern region of India along with taxonomic diagnosis. The principal objective is to draw attention of the people, especially students of plant taxonomy and herbal practitioners for utilization and management of a non-native species in the native landscapes.

Material and methods

This study focuses on *C. cyanus* L. of Asteraceae growing in the campus of the North-Eastern Hill University, Shillong (25°36'56" N latitude and 91°54'21 E longitude) at 1460 m in the State of Meghalaya in northeast India. The plant was growing in the company of other invasive weeds such as *Bidens pilosa* L., *Erigeron annuus* (L.) Pers., *Galinsoga parviflora* Cav., *Persicaria capitata* (Buch.-Ham. ex D.Don) H.Gross, *Tagetes erecta* L. on a thin layer of deposited soil in crevices on road (Figure 1). The flowering is non-synchronous, i.e., inflorescences developing in succession one after another. The flowering continued until last observed in the first week of July, 2020 (Figure 2). Interestingly, *C. cyanus* was competing well with the dense growth of other invasive species. The blooming twigs with flower heads were collected for taxonomic diagnosis and preparation of herbarium specimen. The ray and disc florets were dissected for evaluation. The habitat, habit and plant parts were photographed adequately. The species was confirmed online with the sheets of Kew Herbarium (Figure 3). The herbarium sheet of the collected specimen (*vide* Collection No. US00901, Accession No. 96548) has been deposited in the ASSAM Herbarium of the Botanical Survey of India at Shillong.



Figure 1. Habitat and habit of *C. cyanus* (the plant with pinkish flower in the dense growth) in the North-Eastern Hill University, Shillong recorded in May, 2020.

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Figure 2. An *in situ* overhead view of the inflorescence or capitulum of *C. cyanus* showing radiating ray florets and centered disc florets (Picture taken on May 18, 2020).



Figure 3. The herbarium specimens of *C. cyanus*:

a) K000914405 accessed online from Kew Herbarium

b) US005001-01 collected in this study and sheet deposited to ASSAM Herbarium.

Results and discussion

1. Distribution

The native range of *Centaurea cyanus* L. (cornflower) is in Central and East Mediterranean region and southern Europe, including Albania, Bulgaria, East Aegean Is., Greece, Italy, Lebanon-Syria, Romania, Sicilia, Turkey, Turkey-in-Europe, Yugoslavia (Beentje, *et al.* 2005, Figure 4). The plant is cultivated in northern hemisphere and has been introduced into United States of America, Canada, Mexico, Europe, Russia, Korea and Siberia (POWO, 2020). In Indian Subcontinent, *C. cyanus* has arrived in Nepal (at 3700 m, Press *et al.*, 2000, Mallick, 2019), and in western regions of India (Tomar, 2017). Although the global distribution by Kew (Fig. 4) shows its presence in Pakistan, and the Himalayan region, the e-flora of Pakistan (Anonymous, 2020), and our search in floras of Himalayan region of India show no documented record. The species is unknown in northeastern region of India and eastward to China and Southeast Asia, although it is reported from Vietnam (Figure 4).



Figure 4. Global distribution of *C. cyanus* L. worked out by the Kew, UK. The regions with green wash show the native range, those with purple wash show the geographies where plant has made presence as non-native, and the uninhabited terrestrial regions are in white (POWO, 2020).

The recent studies in United Kingdom have suggested a decline in much of its range in Europe. For instance, it was once widespread throughout Britain, but is now restricted to small scatter of ‘natural’ populations mainly in the south and east of England and has now been classified as ‘Least Concern’ species (Anonymous, 2007). The main causes of decline include the intensification of arable farming, loss of certain crops such as rye and flax in which it was frequent seed contaminate, improved seed cleaning and the introduction of broad-spectrum herbicides, and probably low competitive ability (Karlsson, 2019). This species is listed as ‘Priority Species’ under the UK Biodiversity Action Plan (Anonymous, 2007).

2. Etymology and synonymy

The species was first published by Linneaus in Sp. Pl. 2: 911 (1753). The generic name *Centaurea* was derived after Greek mythology character, centaur Chiron, who was famous for his knowledge of medicine and was the teacher of Achilles, Asclepius and Hercules. Chiron could heal Achilles after he was wounded with a poisoned arrow (by Herakles), by applying cornflower plants (Al-Snafi, 2015). The species epithet *cyanus* was derived from the vivid colours of the flowers. The common name 'cornflower' comes from the fact that the plant grew wild in the grain fields of southern Europe. In Christian symbolism, cornflower became a symbol of the Queen of Heaven, Mary, and Christ. The cornflower has also been used as a symbol of tenderness, of fidelity, and of reliability.

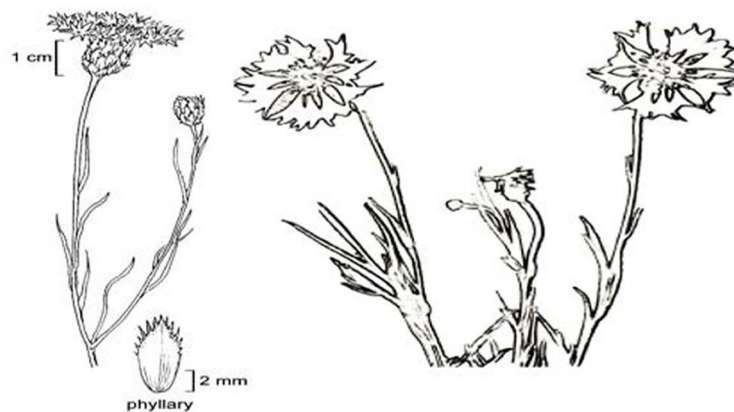


Figure 5. Diagrammatic illustration of the habit of *C. cyanus* as recorded in America by Keil (2012) on the left, and in northeast India in this study on the right.

There are a number of botanical synonyms for cornflower (Barkley, 2006; Bernal *et al.*, 2015; POWO, 2020): *Centaurea concinna* Steud., *Centaurea cyaneum* St.-Lag., *Centaurea cyanocephala* Velen., *Centaurea cyanus* subsp. *coa* Rech.f., *Centaurea cyanus* var. *denudata* Suksd., *Centaurea hortorum* Pau, *Centaurea lanata* Roxb., *Centaurea pulcherrima* Willd., *Centaurea pulcherrima* Wight ex DC., *Centaurea pulchra* DC., *Centaurea rhizocephala* Trautv., *Centaurea segetalis* Salisb., *Centaurea umbrosa* A.Huet ex Reut., *Cyanusa rvensis* Moench, *Cyanus cyanus* Hill, *Cyanus dentato-folius* Gilib., *Cyanus segetum* Hill, *Cyanus vulgaris* Delarbre, *Jacea segetalis* Lam. ex Steud., *Jacea segetum* Lam., *Leucacantha cyanus* Nieuwl. & Lunell, *Setachna cyanus* Dulac.

3. Taxonomic diagnosis

Habitat: agricultural fields, grasslands, woodlands, forests, roadsides, other disturbed sites.

Altitudinal Range: Broad range from about sea level to temperate regions, i.e., 10 to 3700 m. Recorded at 25°36'56" N and 91°54'21 E, 1460 m in the present study.

Habit: Annual herb, 20 cm to 100 cm (Figure 5).

Stem: Weakly erect, often branched distally, up to 3 or 4 mm in diameter, fistular, longitudinally furrowed, pubescent, olive-green, not winged (Figure 6a).

Leaf: Linear-lanceolate with a prominent central vein, densely pubescent on both surfaces, adaxial surface ash-grey and abaxial surface olive-green, lower or basal leaves longer (up to 10 cm) than much-smaller upper ramal and cauline leaves (<3 cm) (Figure 6 h,i). Petiole short, 1-2 mm.

Inflorescence: Each capitulum or head is composed of a ring of radiating ray florets and centrally clustered disc florets. In overhead view (Figure 6b), the diameter of cymiform arrays is 3-4 cm. Capitulum slender-pedunculate with involucre 10-16 mm, campanulate, ovoid or bell-shaped. The hard ovoid involucre of the capitulescence is formed by numerous phyllaries (involucral bracts) arranged in 3-4 whorls (Figure 6c). Each phyllary, 4-6 x 3-4 mm in size, is spear-shaped, olive-green, fringed with brown or deep-purple margins and a tip appendage (Figure 6d). Odour is faint, pleasantly aromatic.

Flower: Flowering in succession (asynchronous) as the plant continues to grow in growth period from May through September. A single plant may produce 20 or more flowers in a season. Florets of both types are pink to fuchsia in colour (Figure 6e,f). Ray florets up to 2 cm in length, sterile, consist of fused petals with 5-8 lobes (Figure 6e). In the disc florets, five petals are fused into a tube with five apical lobes, up to 1 cm in length (Figure 6f). Disc florets are bisexual, containing both fertile anthers and a fertile pistil. Pollen mass white.

Fruit: Cypselae stramineous (straw-colored), 4-5 mm (Figure 6g), linear-oblique (triangular by Rakizadeh *et al.*, 2019), finely short-hairy; pappi of many unequal stiff bristles, 1-3 mm; pappus longer than the seed.

Chromosomes: $2n = 24$ (Beentje *et al.*, 2005)

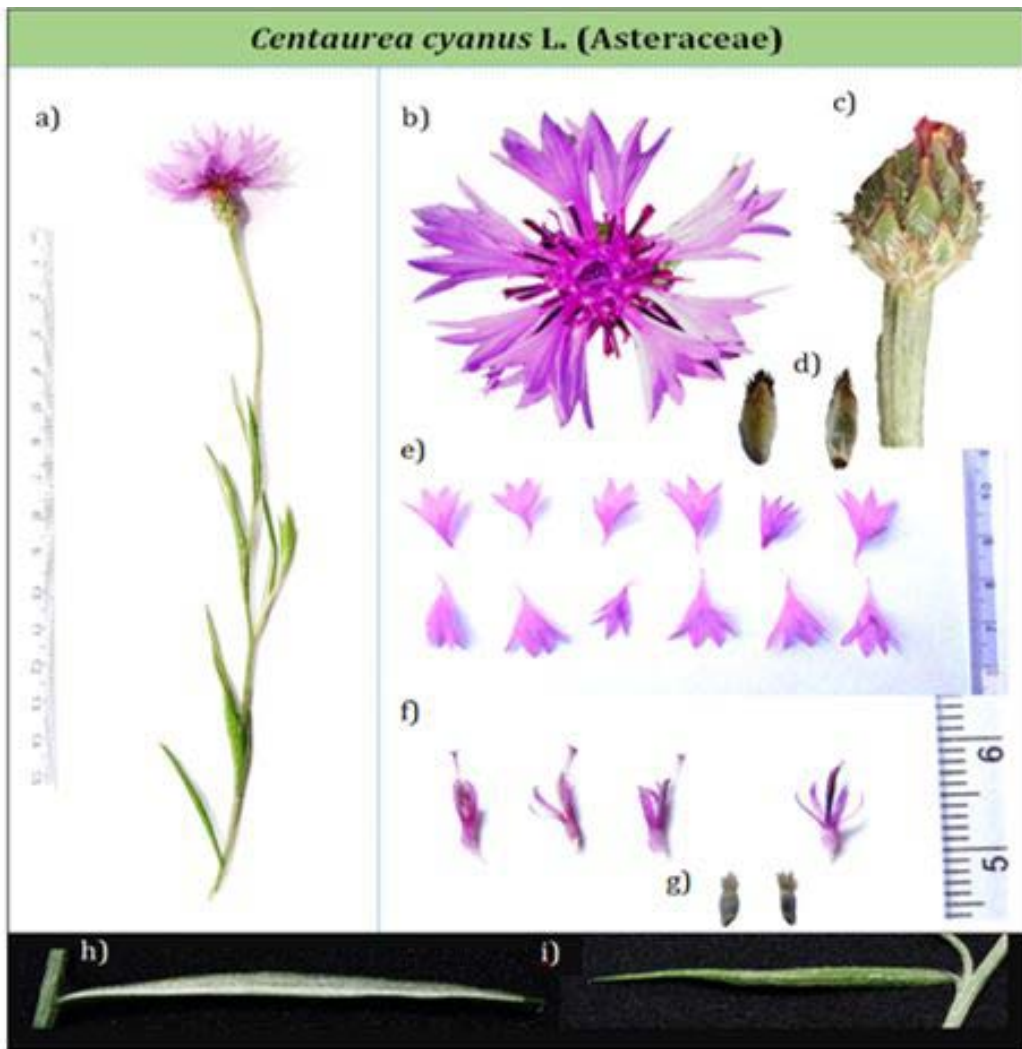


Figure 6. Photographic illustration of *C. cyanus*: a) flowering twig, b) overhead view of the inflorescence or capitulum showing a ring of spreading ray florets and centrally clustered disc florets, c) arrangement of phyllaries, d) abaxial and adaxial sides of a phyllary, e) ray florets retrieved from a single head, f) disc florets showing development of cypselae from the left-most to the right-most flower, g) cypselae with pappi, h) adaxial surface, and i) abaxial surface of narrowly-lanceolate leaf.

Conclusions

The cornflower is an affable herb in Europe and has a long history of cultivation and use for decoration, culinary and medicinal purposes. In America, it has escaped in natural habitats via common route of spread through wildflower mixes. Although native of cooler climate of temperate habitats, cornflower has descended to very low altitudes in the plains of northern India and also in Nepal. It has not been reported from Bhutan,

Eastern Himalaya, northeast India and Myanmar, but seems to be making inroads in these territories as shown by its presence in this study. The habit and morphology of the plant is described from the newer habitat. The precise route of arrival in the recorded habitat remains enigmatic.

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