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Mini Review Article

Sustainable utilization of *Emex australis*: A dual approach to invasive species control and healthcare support

Seema Devi[1], Poonam Sharma[2,*]

[1]Assistant Professor, Department of Botany, Government College for Women, Gohana – 131301, Haryana, India
[2]Assistant Professor, Department of Botany, Chaudhary Dheerpal Government College, Badli – 124105, Haryana, India
*Corresponding author, E-mail: saraswatpoonam30@gmail.com

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ABSTRACT
Emex australis is characterized by hard fruits with three sharp spines, prostrate or spreading stems, and triangular to ovate leaves. *Emex australis* actively competes with wheat for space, light, water, and nutrients, particularly nitrogen. *E. australis* can significantly impair wheat development, tillering, and grain formation at moderate to high infestation levels, resulting in yield losses that can surpass 40–60% in strongly infested fields. In some cultures, young leaves of *E. australis* were traditionally eaten to treat biliousness, dyspepsia, and to increase appetite, demonstrating the intersection between food and diuretic properties. Around 200 species of the genus *Rumex* have long been utilized for their anti-inflammatory, antioxidant, antibacterial, antiviral, anticancer, and gastroprotective properties all over the world. Quercetin, emodin, chrysophanol, and other secondary metabolites are involved in these functions. Extracts from *E. australis* have demonstrated antioxidant activity, enzyme inhibition, and potential pharmacological effects, supporting its historic use in folk medicine. Combining ethnobotanical knowledge with contemporary agronomic methods may offer new strategies for the long-term management of invasive weeds like *E. australis*.

1. Introduction

The annual herbaceous plant *Emex australis* Steinh., also called doublegee or southern three-corner jack, is a member of the Polygonaceae family. This native of southern Africa has spread around the world, especially in Asia, Australia, and the Americas, where it has become invasive and widely naturalized [1]. *Emex australis* is distinguished by its triangular to ovate leaves, prostrate or spreading stems, and hard fruits with three sharp spines. The seeds can travel great distances because the plant produces hard, prickly fruits (achenes) with three sharp barbs that readily cling to livestock, animal fur, human clothing, and footwear. These spines travel quickly throughout fields and regions because they stick to farm equipment, trucks, and machinery. During harvesting, transportation, and trade, tainted crop seed, hay, and grain spread seeds throughout agricultural systems [2]. Additionally, both aerial and subterranean seeds are produced by *Emex australis*. Because underground seeds can germinate easily even when buried and survive at or below the soil surface, populations may persist despite efforts to suppress them [3]. After disturbance, aerial seeds can remain dormant in the soil for several years, establishing a persistent soil seed bank with the capacity for re-infestation [4]. When combined with its ability to grow quickly and thrive in open, disturbed habitats, these dispersal strategies allow *Emex australis* to spread successfully throughout agricultural areas and natural ecosystem. *Emex australis* is a native of southern Africa that has expanded to Australia due to human activities, agricultural trade, and its efficient seed dispersal mechanisms [5]. The weed was first reported in India in the Santhal Pargana region of the former undivided Bihar in 1984 and in Jammu & Kashmir in 1987. It was found in the upper Gangetic plains of Uttar Pradesh in 2016 [6]. Infected imported wheat grain and crop seed are the most likely source of introduction because India imports and trades agricultural products with countries where *E. australis* is already widespread, especially Australia. The prickly fruits (seeds) may blend in with grain bags and go unnoticed during storage and transit. After being introduced, the seeds began to sprout in fields, particularly in wheat-growing areas of northern India like Haryana and parts of the Indo-Gangetic plains [7]. Due to soil disturbance, livestock movement, irrigation water, and agricultural machinery, *Emex australis* spread locally when it was first introduced. It quickly established itself in Indian agro-ecosystems thanks to its ability to produce both aerial and subterranean seeds as well as a persistent soil seed bank. It was recognized as a growing invasive species in Indian agriculture due to favorable climatic conditions that were similar to those in its invaded land worldwide. *Emex australis* mostly lowers wheat production by intense competition, harvesting disruption, and crop contamination [8].

First, *Emex australis* actively competes with wheat for space, light, water, and nutrients, particularly nitrogen. It appears early, develops quickly, and suppresses wheat seedlings by forming a dense mat near the ground. Research indicates that *E. australis* can significantly impair wheat development, tillering, and grain formation at moderate to high infestation levels, resulting in yield losses that can surpass 40–60% in strongly infested fields. *E. australis* competition is

estimated to reduce wheat output by 44% to 62% at high numbers [9].

An invasive weed known as *Emex australis* (Polygonaceae) is becoming more prevalent in wheat fields in 25 villages in the Haryana district of Faridabad. According to the study, throughout the January–April wheat growing season, the species grew gregariously in patches within wheat crops. They emphasized the damage to the region's wheat output and the invasive potential of the species, observing that population levels varied throughout communities [10[. Second, agriculture operations are disrupted by the plant's prickly fruits. These sharp, hard seeds can harm harvesting equipment and contaminate harvested wheat grain, lowering grain quality. The low price of contaminated grain can result in further financial losses in addition to the decrease in yield. Soil and livestock: According to some reports, unmanaged sharp spines can hurt animals and negatively affect grazing [11]. Lastly, *Emex australis* alters the crop environment by increasing weed pressure and seedbank survival. Infestations can happen year after year because to its long-lived soil seed bank, which makes control difficult and prolongs crop losses if maintenance is not carried away. Overall, unchecked *Emex australis* infestations may significantly reduce the quantity and quality of wheat produced.

2. Traditional use of *Emex australis*

In traditional African cultures, young *Emex australis* leaves have been prepared and consumed similarly to spinach. When cooked, they are regarded as a tolerably nice green and used as a potherb. The leaves are edible, according to local reports, although consuming big quantities of them may cause mild diarrhea (laxative) due to organic chemicals such oxalates [12]. In some cultures, these young leaves were traditionally eaten to treat biliousness, dyspepsia, and to increase appetite, demonstrating the intersection between food and medicine. It is said that the herb has diuretic properties. As a vegetable or spinach, leaves are used to boost appetite, relieve dyspepsia, and cure biliousness [13]. In nutritional research from KwaZulu-Natal, South Africa, *Emex australis* was listed among 20 traditional leafy vegetables, indicating that it was taken into consideration for its nutritious content together with other native greens. The inclusion of *E. australis* in the abstract indicates that it is recognized as an useful food source in rural diets, even though the study focused on general nutritional profiles rather than specific levels of nutrients [14]. Root decoctions have long been used to treat digestive issues and stomach cramps, while leaves may have laxative properties Particularly for *E. australis*, very little published pharmacological data is available [15].

Although there have been few researches on the phytochemistry of *Emex australis*, those that have been conducted have shown that the plant contains a range of bioactive substances, primarily flavonoids, phenolics, and other secondary metabolites having antioxidant properties. Its traditional usage in folk medicine supported by extracts from *E. australis* that have shown enzyme inhibitory actions against α-amylase and α-glucosidase, which are targets associated to antidiabetic activity; tyrosinase, which is an enzyme related to the skin; and cholesterases, which are significant to neurological health. these biological activities imply that *E. australis* might be a source of natural antioxidants and enzyme inhibitors, which are relevant in situations like diabetes, oxidative stress, skin pigmentation disorders, and neurodegeneration antioxidant activity, enzyme inhibition, and possible pharmacological effects which indicate *Emex australis* have medicinal, Pharmacological properties Suggesting the plant have therapeutic potential [16]. While research on closely related *Rumex* species supports the notion that plants in this group contain bioactive chemicals (anthraquinones, flavonoids, etc.) with therapeutic potential, not all studies concentrate only on *E. australis* [17].

Around 200 species of the genus *Rumex* have long been utilized for their anti-inflammatory, antioxidant, antibacterial, antiviral, anticancer, and gastroprotective properties all over the world. Quercetin, emodin, chrysophanol, and other secondary metabolites are involved in these functions [18]. In rat models, methanolic extracts of *E. spinosa* demonstrated antidiabetic, analgesic, and anti-ulcer properties. suggests potential gastroprotective and analgesic qualities that are pertinent to traditional use [19].

However, this is preliminary in vitro evidence rather than clinical validation. Though more thorough research is required to completely identify its chemical ingredients, *Emex australis* is generally considered a weed, but its phytochemical profile suggests that it contains bioactive chemicals with potential medical and industrial uses.

3. Strategies for controlling *Emex australis*

Depending on the type of crop, local ecology, and infestation severity, several nations have created a range of ways to stop the spread of *Emex australis*, using mechanical, chemical, biological, and cultural means [20, 21].

Indirectly yet effectively, this kind of research helps control *Emex australis* by converting knowledge of ethnobotany, phytochemistry, and pharmacology into workable management plans instead of just describing the weed. The plant has traditional applications are highlighted in ethnobotanical literature, which promotes utilization-based control by purposefully removing the plant before seed set. This can help reduce soil seed banks and assist community-led weed management.

By identifying the toxic and bioactive substances that cause stress tolerance and cattle injury, phytochemical analyses assist in developing specific, environmentally safer control strategies including allelopathic crop rotations and bioherbicides. Investigating *E. australis* potential for therapeutic use encourages controlled removal by supporting weed-to-resource strategies that lessen the need for chemical pesticides and provide financial incentives for early eradication.

4. Discussion

Comparative analysis with similar *Rumex* species identifies common biological characteristics and susceptibilities, enhancing taxonomic accuracy to prevent unnecessary actions and facilitating the use of traditional control methods. When taken together, these observations enhance integrated weed management frameworks by enhancing mechanical control timing, lowering chemical inputs, and promoting ecologically sustainable methods for long-term *Emex australis* eradication. However, there are inherent limitations to using medications as a weed control technique. *E. australis* produces a huge amount of biomass in extensively infested wheat fields, yet the demand for

therapeutic plant material is typically low. Additionally, because fruits are spiky, improper plant handling and harvesting—especially after seed production—may indirectly encourage in the spread of seeds. Additionally, the presence of oxalic acid and other anti-nutritional compounds limits the amount of medicinal or dietary usage, suggesting careful consumption. These factors limit the effectiveness of employing pharmaceuticals as a stand-alone weed control strategy.

5. Conclusions

The use of *Emex australis* medicinally cannot take the place of traditional weed control techniques, it may be useful as an additional environmentally friendly strategy that promotes early weed eradication and seed bank reduction. To measure the effects of regulated medicinal harvesting on the dynamics of weed populations and to evaluate its socioeconomic viability, more investigation is needed. Modern agronomic techniques combined with ethnobotanical expertise may provide novel approaches to the sustainable control of invasive weeds like *E. australis.*

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Authors' contributions

The authors read and approved the final manuscript.

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