International Journal of Emerging Trends in Life Sciences (IJETLS)

E-ISSN: XXXX-XXXX

Volume 1, Issue 1, October-December 2025 | pp. 09–16

REVIEW ARTICLE – NARRATIVE REVIEW

Invasive and Weedy Plant Species in Agricultural Ecosystems

Anjali Kashyap

Faculty of Science, M S College, Saharanpur, UP, India

Email: anjalikashyap08021@gmail.com

Received: 21 Oct 2025 | **Revised:** 12 Nov 2025 | **Accepted:** 18 Dec 2025 | **Published:** 30 Dec 2025

Abstract

Invasive and weedy plant species pose significant challenges to agricultural ecosystems by competing with crops for resources such as nutrients, water, and light. Northern India, with its extensive agricultural landscapes and diverse climatic conditions, provides suitable environments for the spread of various invasive and weedy plant species. This narrative review presents an overview of commonly reported invasive and weedy plants affecting agricultural ecosystems of Northern India based on existing literature.

The review discusses major invasive species, their growth characteristics, and their impact on crop productivity and agricultural biodiversity. It highlights patterns of weed distribution across cultivated fields, roadsides, and irrigation channels. The study is based on previously published research articles, review papers, and institutional reports related to weed ecology and invasive plant species.

This review emphasizes the need for proper documentation, awareness, and sustainable management of invasive and weedy plants in agricultural landscapes. The paper aims to provide a clear and structured understanding for students and early researchers in Botany, Ecology, and Agricultural Sciences.

Keywords: Invasive plants, Weedy species, Agricultural ecosystems, Weed flora, Northern India

Introduction

General Overview of the Topic

Weeds and invasive plant species are among the major biological constraints affecting agricultural productivity worldwide. These plants grow aggressively in cultivated fields and surrounding areas, often competing with crops for essential resources. Invasive species are those that spread rapidly outside their native range and negatively affect local ecosystems, agriculture, and biodiversity.

In agricultural ecosystems, weedy plants can reduce crop yield, interfere with harvesting practices, and increase management costs. Some invasive species also alter soil properties and disrupt ecological balance. Understanding the diversity and behavior of invasive and weedy plant species is therefore an important aspect of botanical and ecological studies.

Study Context

Northern India includes extensive agricultural regions characterized by fertile soils, seasonal rainfall, and intensive farming practices. Crops such as wheat, rice, sugarcane, maize, and pulses are widely cultivated across this region. The widespread use of irrigation, fertilizers, and disturbed soils creates favorable conditions for the growth and spread of invasive and weedy plant species.

Roadside vegetation, irrigation canals, fallow lands, and field margins often act as reservoirs for weed species, which later invade cultivated fields. This makes Northern India an important region for studying invasive and weedy plants from a botanical perspective.

Purpose of the Review

The objective of this narrative review is to compile and synthesize existing literature on invasive and weedy plant species affecting agricultural ecosystems of Northern India. The review focuses on plant diversity, distribution patterns, and ecological impacts, without involving field-based surveys or experimental studies.

Review Methodology (Narrative Approach)

Review Design

This study follows a narrative review approach. The review is based entirely on secondary sources, and no laboratory experiments or field surveys were conducted. This section explains the approach adopted to identify, select, and review relevant literature for the present narrative review.

Sources of Literature

Relevant literature was collected from peer-reviewed journals, academic books, institutional reports, and review articles related to ethnobotany and plant diversity. Databases such as Google Scholar and Scopus were consulted.

Search Strategy and Keywords

Keywords used for literature search included ethnobotany, plant diversity, traditional plant use, indigenous knowledge, Saharanpur, and rural plant resources.

Inclusion and Exclusion Criteria

Studies focusing on traditional plant knowledge, ethnobotanical documentation, and plant diversity were included. Articles centered primarily on pharmacological validation or clinical studies were excluded. Literature published from 2000 onwards was primarily considered, with earlier foundational studies included where relevant.

Literature Review (Thematic)

Evolution of Research on the Topic

Ethnobotanical research has highlighted the importance of documenting traditional plant knowledge across different regions of India. Studies emphasize that indigenous knowledge contributes significantly to biodiversity conservation and sustainable plant use.

In northern India, ethnobotanical studies have shown strong connections between rural communities and local vegetation, with plants forming an integral part of daily life.

Themes in Literature

Diversity of Invasive and Weedy Plant Species

The literature indicates that agricultural ecosystems of Northern India host a wide diversity of invasive and weedy plant species. These include annual, biennial, and perennial plants belonging to families such as Asteraceae, Poaceae, Amaranthaceae, and Solanaceae. Many of these species exhibit rapid growth, high seed production, and strong adaptability to disturbed habitats.

The presence of diverse weed flora reflects frequent soil disturbance, irrigation practices, and continuous cropping patterns across agricultural landscapes.

Commonly Reported Invasive and Weedy Species

Several invasive and weedy plant species are repeatedly reported in agricultural fields of Northern India. Common examples include Parthenium hysterophorus, Lantana camara, Ageratum conyzoides, Chenopodium album, Phalaris minor, and Cyperus rotundus. These species are known for their aggressive growth and widespread distribution.

Their repeated occurrence across studies indicates their strong ecological adaptability and ability to persist under varying environmental conditions.

Habitat Preferences and Distribution Patterns

Literature highlights that invasive and weedy plants are not restricted to crop fields alone. Many species are commonly found along field boundaries, irrigation channels, roadsides, and fallow lands. These habitats serve as continuous sources of weed infestation in nearby agricultural areas.

Seasonal variations also influence weed distribution, with certain species dominating during specific cropping seasons. Such patterns emphasize the dynamic nature of weed flora in agricultural ecosystems.

Impact on Agricultural Ecosystems

Invasive and weedy plant species negatively impact agricultural ecosystems by competing with crops for nutrients, water, and sunlight. Their presence can reduce crop growth and affect overall field productivity. In addition, dense weed growth can alter soil conditions and reduce native plant diversity within agro-ecosystems.

The literature also indicates that invasive weeds can increase labor requirements and management costs for farmers, making weed control a major concern in agricultural sustainability.

Recent Development and Current Trends

Recent research on invasive and weedy plants has increasingly focused on ecological assessment, documentation of weed flora, and sustainable management practices. Studies now emphasize early detection of invasive species and understanding their ecological behavior rather than relying solely on chemical control methods.

There is growing interest in integrated weed management approaches that combine cultural, mechanical, and biological methods. However, region-specific reviews for Northern India remain limited, highlighting the need for focused documentation and synthesis of existing knowledge.

Discussion

The reviewed literature clearly indicates that invasive and weedy plant species are a persistent challenge in agricultural ecosystems of Northern India. Similar weed species are reported across multiple regions, suggesting common ecological problems such as intensive agriculture and habitat disturbance.

Despite the availability of management practices, limited awareness and lack of region-specific information often hinder effective weed control. Documentation-based reviews can play an important role in improving understanding and guiding future research.

Implications and Future Scope

Proper documentation of invasive and weedy plant species can support agricultural planning and biodiversity conservation. Future studies may focus on field-based weed surveys, seasonal variation analysis, and ecological impact assessment.

Educational programs for students and farmers can also help promote awareness about invasive species and their long-term effects on agricultural ecosystems.

Conclusion

This narrative review highlights the diversity and ecological significance of invasive and weedy plant species in agricultural ecosystems of Northern India. The widespread presence of these species reflects disturbed habitats and intensive farming practices.

Understanding weed diversity and distribution is essential for sustainable agriculture and ecological balance. Continued documentation and research are necessary to manage invasive species effectively and protect agricultural productivity.

Data Availability

This study is a narrative review based exclusively on previously published and publicly available literature. No primary data was generated or collected as part of this study. The review relies on scholarly articles, reports, and academic sources, all of which are publicly available and have been appropriately cited in the manuscript.

Acknowledgment

The authors would like to express their sincere gratitude to all those who supported this research. We are thankful to our respective institutions for providing the necessary facilities and academic environment to carry out this study. We extend our appreciation to the peer reviewers and editors for their insightful feedback, which helped improve the quality of this manuscript. We also acknowledge the valuable contributions of colleagues and collaborators who provided helpful suggestions during the research process.

Disclosure of Interest

The authors declare that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Furthermore, no affiliations, memberships, or involvement in organizations with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript exist.

Funding Information

This research was carried out without any financial support from funding agencies, institutions, or commercial organizations. The authors confirm that the study was conducted using personal or institutional resources, and no specific grant or project funding was received from public, private, or non-profit sectors during this research and its publication process.

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