AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 04 (April, 2026)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Weed Seed Bank: A Problems and Its Management

*Shivanshu Ladohia, Pankaj Chopra, Sandeep Manuja, G.D. Sharma, Rijula and Akash Ojha
Department of Agronomy, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh, India
*Corresponding Author's email: ladohiashiv@gmail.com

The primary reason for weed survival within agronomic systems is the weed seed bank. The factors determining its dynamics are seed losses via germination, predation, microbial decay, and mortality among seedlings, together with the continued addition of new seeds via the process of seed rain. The goal of management is to enhance the natural seed loss process while reducing seed additions. This challenge becomes compounded due to the extended viability period, diversity, herbicide resistance, and climate variability of weeds. Ecological approaches, modeling, and precision agriculture offer exciting possibilities for the future management of the weed seed bank.

Key words: Weed seed bank, Seed bank dynamics, Germination, Seed bank fate, Precision agriculture, Modelling

Introduction

Weeds are significantly affecting Indian agriculture by increasing production costs and causing substantial yield losses. These losses impact major crops, such as rice, wheat, maize, and soybean, with yield losses commonly estimated at approximately 25–26% and 18–25% for kharif and rabi crops, respectively. In India, the estimated economic loss as a result of weeds is around ₹92,000 crore annually (Anonymous, 2023). One of the key contributors is the weed seed bank, which serves as a reservoir of viable seeds and vegetative propagules that reside in the soil. Over time, weed seeds build up and continue to provide an ongoing source of infestation, create competition for crops, and lead to weed emergence. When the density of the seed bank is high, there will be greater weed pressure, and therefore, it will lessen the effectiveness of control techniques. The agricultural soil may contain thousands of seeds density per unit area, making the seed bank a significant future source of weed infestations. Therefore, it is imperative to manage the weed seed bank, particularly by preventing additional seed inputs, as this is an integral component of sustainable weed control and greater crop productivity.

Types of Weed Seed Bank

The weed seedbank can be categorized based on its distribution and longevity. Seedbanks could either be aerial, which refers to the seeds that still cling to the plant before their dispersal (such as *Bidens pilosa*), or soil seedbanks, wherein the seeds that survive in the soil for many years belong (like *Chenopodium album*). Considering longevity, the seedbanks could either be transient means seeds survive for less than a year, like *Amaranthus palmeri* and persistent survive for many years, *Amaranthus retroflexus*.

Dynamics and Fate of Weed Seed Bank: The weed seed bank is dynamic, with continuous addition and removal of seeds. Seeds are deposited in the soil from seed rain and can go into dormancy and then germinate once the environmental conditions are suitable. Losses of seeds occur from microbial decomposition, predation, germination to death, and poor establishment of seedlings, which contribute to depletion of weed seeds germination. Thus, continual seed

dispersal replenishes the weed seed bank, so preventing the accomplishment of that will be fundamental to effective weed control.

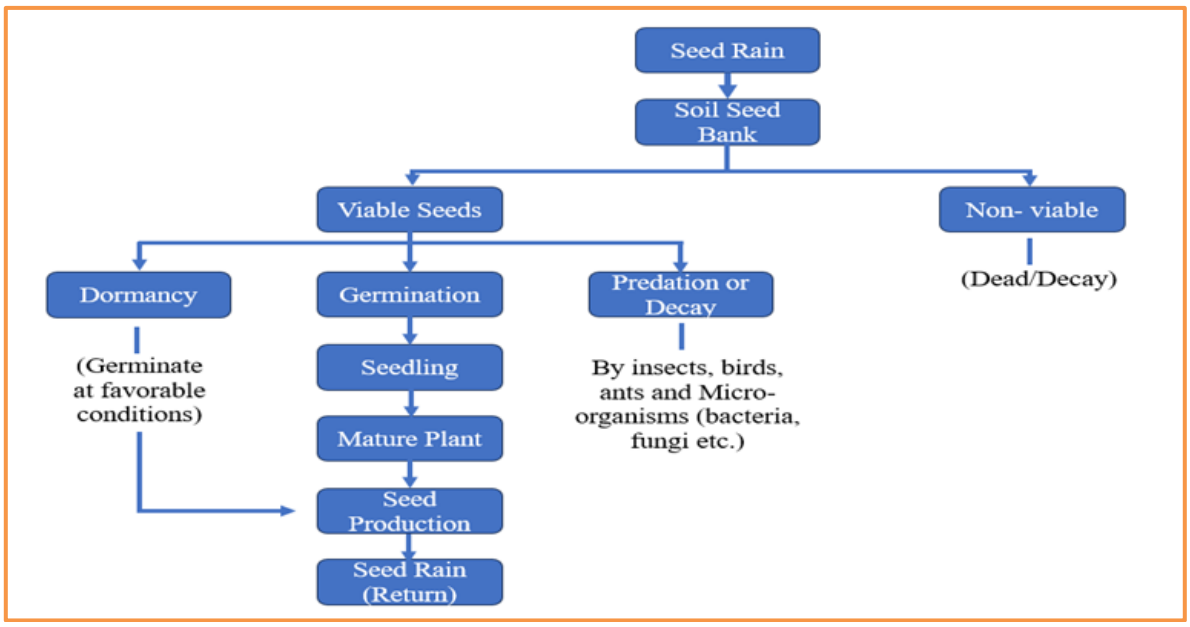

Fig.1: Weed Seed Bank Dynamics and Fate

Management of Weed Seed Banks:

The main objective of weed seed bank management is to prevent the addition of new seeds and to enhance natural seed loss in the soil. Various methods are non-chemical, chemical, and biological methods.

Non-Chemical Methods

Crop rotation: Using crop rotation will prevent seed banks from building up and it will disrupt the weeds' life cycles. Many weeds such as *Amaranthus palmeri* & *Chenopodium album* thrive under the monocrop system. However, diverse rotation by adding small-grain or forage crops interrupts life cycle of the weeds and fewer seeds will be produced.

Cover crops: Cover crops help manage the weed seed bank by reducing the growth of weeds and reducing the number of weed seeds added to the soil. Hairy vetch provides 30–50% suppression while cereal rye provides 75 –90% suppression of weed emergence.

Stale Seed bed technique: Stale Seedbed is a pre-planting method used to allow weed seedlings to germinate prior to sowing and using tillage and herbicides to kill emerged weeds. This technique has been successful in reducing early-emerging weed seedlings by 50–80%.

Tillage: Seeds are redistributed in the soil profile due to tillage. Tillage often buries most of the weed seed deep in the soil profile, while in a no-till system weed seeds remain near the soil surface. Deep burial reduces germination but increases seed survival, leading to long-term persistence in the soil.

Microwave and thermal treatments: Microwave and thermal treatments that use heat to kill off the weed plant tissue are examples of new non-chemical methods of managing weeds. These techniques require a lot of energy at first, but because of thermal runaway or rapid self-heating, they become much more efficient and have shorter treatment times.

Summer ploughing and Soil solarization: Solarization and summer ploughing reduce the number of weed seeds present in the soil seed bank by subjecting the seeds to high temp., Predation and heat, hence help in lowering the existing seed bank.

Mulching: Mulching is used to control the growth of weeds by keeping crop debris on the surface of the soil. It reduces light penetration, moderates soil moisture and temperature and releases allelochemicals to inhibits weed seed germination.

Harvest Weed Seed Control (HWSC): These methods prevent weeds from spreading their seeds to the soil through their residues during the harvesting period. Although HWSC can

remove 80-95% of weed seeds, thereby reducing the seed bank and preventing the emergence of weeds in the next season.

Chemical Methods

Herbicide: Herbicides reduce weed populations and prevent seed production, lowering the weed seed bank. Pre-harvest use of Glyphosate further limits seed viability and long-term build-up.

Biological Methods

Seed Predation and seed decay: Microbial breakdown and seed predation are the natural processes that reduce the weed seed bank. Some surface weed seeds are consumed by insects, mice, and birds under favourable conditions, soil microbes (bacteria and fungi) will degrade and diminish the viability of Weed seeds.

Bio herbicides: Bioherbicides are non-toxic environmentally benign substances made from microorganisms or plants that target weed and reduce seed production under favourable conditions 40-80 controll is achieved. Examples of bioherbicides include Devine, Collego, BioMal and Chontrol.

Challenges in Weed Seed bank Management

Seed longevity is long (5 to 40 years), there are many different types of weeds, and have staggered emergence patterns due to their growth habits and climate change, create a challenge for managing the weed seed bank. Herbicide-resistance promotes the addition and persistence of resistant seeds in weed seed bank. Tillage redistributes the seeds effecting their germination and persistence. Collectively these challenges make the Management of WSB difficult.

Opportunities and Future Perspectives of WSBM

Development in modelling technology through the use of artificial intelligence improves accuracy of predictions of weed emergence and allows for timely actions. Climate-smart methods coupled with the use of precision farming techniques (remotely sensed data and UAV technology), along with harvest weed seeds control (HWSC), are among the technologies that allow site-specific seed bank reduction. Biological processes and seed biology offer new avenues of achieving weed seed bank depletion.

Conclusion

The weed seed bank is the major factor contributing to weed persistence, and is a significant barrier to the productivity of agricultural crops. It is extremely difficult to totally eradicate due to its longevity and continued replenishment. However, the farmer can reduce it slowly through such strategies as mulching, crop rotation, stale seedbed, HWSC, bioherbicides etc. Integrated strategies will promote natural seed loss and reduce new seed additions, thereby helping to successfully reduce the weed seed bank over time.

References

1. Anonymous. (2023). Weed management in Indian agriculture: Challenges and opportunities. *Federation of Seed Industry of India*, New Delhi, India.
2. Chauhan, B.S. (2020). Grand challenges in weed management. *Frontiers in Agronomy*, 1: 3.
3. Hasamuddin, H., Kaur, S., Kaur, N. and Bhullar, M.S. (2021). Weed seedbank dynamics under different tillage practices in organic basmati rice. *Indian Journal of Weed Science*, 53(4): 336–340.
4. Kumar, S., Rana, S.S., Hetta, G. and Rana, N. (2024). Understanding and managing weed seed banks: A review. *Agricultural Reviews*, 45(3): 508–513.
5. Storkey, J., Helps, J., Hull, R., Milne, A. E., & Metcalfe, H. (2021). Defining integrated weed management: A novel conceptual framework for models. *Agronomy*, *11*(4), 747.