



Superweeds: A silent Threat to India's Food Security

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Abstract

Superweeds are weeds that survive herbicides that once controlled them effectively. They develop naturally through repeated use of the same herbicide, where a few tolerant weeds survive, produce seeds, and gradually dominate the field. Factors such as climate change, monocropping, and continuous herbicide exposure accelerate this process. As a result, herbicides lose their effectiveness, making weed control more difficult, expensive, and risky for crop production. In India, where agriculture supports millions of livelihoods and ensures national food security, herbicide resistance has become a serious concern. Intensive cropping systems like rice–wheat, along with heavy reliance on chemical weed control, have contributed to the spread of resistant weeds. A notable example is *Phalaris minor*, which developed resistance to isoproturon. Weeds already cause significant yield losses by competing for nutrients, water, and light, leading to large economic losses for farmers and the agricultural economy. To address this challenge, Integrated Weed Management (IWM) offers a sustainable solution. Preventive measures, herbicide rotation, correct application practices, crop diversification, and non-chemical methods such as mechanical weeding and mulching can reduce resistance development. Long-term management of the weed seed bank and regular field monitoring are essential. Adopting IWM can help control superweeds effectively and protect India's food security.

Keywords

Herbicide resistance, Selection pressure, Monocropping, Integrated Weed Management

Introduction

Weeds are one of the major constraints to crop production because they compete with crops for water, nutrients, light and space. Farmers are increasingly turning to herbicides to control them quickly and effectively, especially in intensive cropping systems. However, the repeated use of the same herbicide or similar herbicides has led to a new problem — herbicide-resistant weeds, commonly called “superweeds.” Weeds can survive treatments that were formerly effective and can gradually become dominant in agricultural fields. This problem is especially important in India



in intensive systems such as rice-wheat where continuous cropping and heavy reliance on chemical weed control can increase selection pressure. Resistant weeds can increase production costs, decrease yields from crops, and threaten long-term food security.

What are Superweeds?

Superweeds are weeds that do not die even after spraying herbicides that once controlled them easily. In simple words, they are “tough weeds” that have learned how to survive chemicals used to kill them.

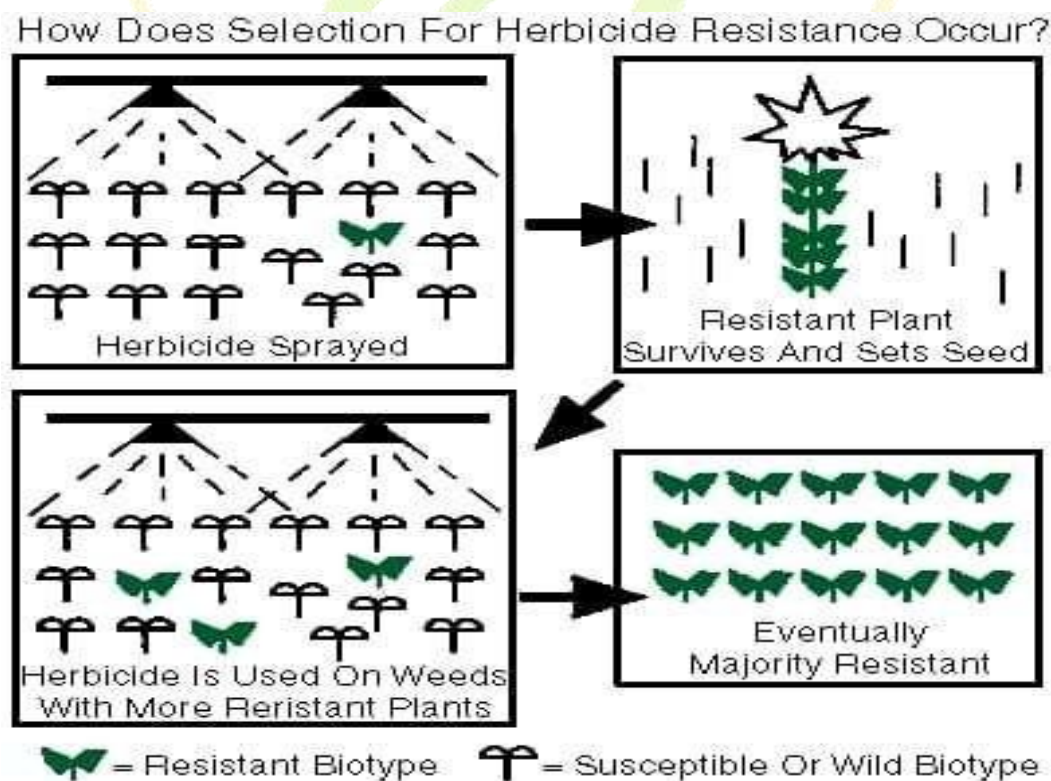
In science, the word superweed is used for weeds that have become resistant to more than one herbicide, even when those herbicides work in different ways. Because of this, these weeds become very difficult and expensive to control.

How do Superweeds develop?

Superweeds are not created in laboratories and they are not artificial. They develop naturally.

When the same herbicide is used again and again for many years, most weeds die. But a few weeds may survive because they naturally have a small tolerance to that chemical. These surviving weeds produce seeds and increase in number.

Over time, these resistant weeds spread in the field, and the herbicide stops working effectively. This process is called natural selection.





What makes superweeds more dangerous?

- Climate change:
Changing temperatures and weather help weeds adapt faster and survive stress.
- Repeated herbicide exposure:
Using the same herbicide again and again kills weak weeds but allows naturally tolerant ones to survive.
- Monocropping:
Growing the same crop year after year creates a uniform system where the same weeds face the same control methods.
- Intense competition / selection pressure:
These conditions “select” only the toughest weeds—those that can resist control measures.

Result :-

Herbicide effectiveness reduces. Herbicides stop working properly, making weed control more difficult, costly, and risky for food production.

Why herbicide resistance is a serious issue for Indian agriculture?

Weed control is very important for successful farming in India, especially in major crops like rice, wheat, soybean, and cotton. In intensive cropping systems such as the rice–wheat system of Punjab and Haryana, farmers have depended heavily on herbicides for many years. Because of repeated use of the same herbicide, some weeds have slowly learned to survive these chemicals. A well-known example is *Phalaris minor*, which has developed resistance to the commonly used herbicide isoproturon (Yadav et al., 2017). Over time, these resistant weeds have also become difficult to control with other herbicides, making weed management more complicated.

Across India, weeds already cause large crop losses every year. Due to competition with crops for nutrients, water, and light, weeds reduce yields and increase the cost of cultivation. Studies estimate that annual economic losses due to weeds in India are more than ₹92,000 crore, which puts a heavy burden on farmers and the agricultural economy (Gharde et al., 2018).

Another growing concern is the use of herbicide-tolerant crop varieties. These crops can survive certain herbicides, making weed control easier in the beginning. However, if the same herbicide is used repeatedly in such crops, weeds may develop resistance even faster. This can lead to the emergence of stronger and more difficult-to-control weed populations in the long run (Duke, 2012; Norsworthy et al., 2014).



Herbicide-Resistant Weeds Reported in India

Sl.	Species	Common Name	First Reported Year	Herbicide Site of Action
1	<i>Phalaris minor</i>	Little seed canary grass	1991	PSII inhibitors – Serine 264 binders (C1/C2)
2	<i>Phalaris minor</i>	Little seed canary grass	1994	Acetyl-CoA Carboxylase (ACCase) inhibitors (Group A)
3	<i>Phalaris minor</i>	Little seed canary grass	2006	Multiple resistance: ACCase (A) + ALS (B) + PSII (C)
4	<i>Phalaris minor</i>	Little seed canary grass	2013	Acetolactate Synthase (ALS) inhibitors (Group B)
5	<i>Rumex dentatus</i>	Toothed dock	2014	Acetolactate Synthase (ALS) inhibitors
6	<i>Cyperus difformis</i>	Smallflower umbrella sedge	2017	Acetolactate Synthase (ALS) inhibitors
7	<i>Echinochloa crus-galli</i> var. <i>crus-galli</i> (Grassy weed)	Barneyardgrass	2017	Acetolactate Synthase (ALS) inhibitors

A path forward: Integrated Weed Management

The first line of defense is prevention. Using clean seed, preventing the movement of contaminated soil or machinery, and removing weed escapes before seed set can significantly slow resistance development. Farmers should avoid repeated use of the same herbicide and instead rotate herbicides with different modes of action. Applying herbicides at the recommended dose and correct growth stage is equally important, as under-dosing often allows tolerant weeds to survive. Cropping system diversification plays a key role. Crop rotation, competitive crop varieties, proper spacing, and timely sowing help suppress weed growth naturally. Non-chemical methods such as hand weeding, mechanical intercultivation, mulching, and stale seedbed techniques further reduce weed pressure.

Managing the weed seed bank by preventing seed production ensures long-term control. Regular field monitoring helps detect unusual weed survival early. Ultimately, Integrated Weed Management (IWM) — combining chemical, cultural, and mechanical methods — offers the most sustainable strategy for controlling superweeds and protecting India's food security.



Conclusion

Superweeds are becoming a serious problem, but they can be controlled with proper care. Farmers should not depend on only one herbicide again and again. Using different weed control methods, such as crop rotation, correct herbicide use, and mechanical weeding, can help reduce the risk. Awareness, timely action, and good management are very important. Scientists, extension workers, and farmers must work together to prevent weeds from spreading and becoming stronger. With smart and sustainable practices, we can protect crop yields, reduce losses, and ensure food security. If we act early and wisely, superweeds can be managed and will not threaten Indian agriculture in the future.

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