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Harnessing Nature's Allies: Biological Weed Control Strategies for Sustainable Agriculture

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Abstract
The agriculture environment was negatively impacted by weeds, which pose a continuing danger to agricultural land and other area production. A combination of bioagents and bioherbicides, known as integrated weed management, may control weed populations with little harm to the environment. We want to pave the way for more sustainable weed control practices that can supplement agricultural production systems with less herbicide. To manage weeds in non-cropped regions, biological methods are very successful, have little to no residual impact, are inexpensive, and have a reasonably long-lasting effect. They are also safe for non-targeted plants. This organism serves as a model for traditional biocontrol and bioherbicide practices.

Introduction
Weed control is a crucial agronomic activity in agricultural production. Weeds are plants that pose significant limitations in agricultural output. Weed-induced reductions in agricultural output may significantly differ based on the crop type, methods used to control weeds, types of weeds present, duration of infestation, and environmental conditions. Weed may reduce crop productivity by competing for natural resources such as water, light, nutrients, and by the generation of allelopathic substances. Weed management has been a major issue for crop producers since the inception of agriculture. Weeds impede the development of crops, leading to production reductions of 15-66% in direct-seeded rice, 18-65% in maize, 50-76% in soybean, and 45-71% in groundnut (Gharde et al., 2018). By using natural enemies, chemicals, or agents, biological weed management reduces germination and development of weed populations to a commercially feasible level.

The use of pesticides to control weeds has the potential to greatly raise the price of harvesting crops. The use of pesticides to control weeds has the potential to greatly raise the price of harvesting crops. Herbicide-resistant weed ecotypes are rapidly evolving owing to increased herbicide use, posing a significant danger to agricultural productivity (Holt and Lebaron, 1990). Hence, there is a pressing need to provide an alternate weed management approach for agroecosystems. Chemical herbicide is a very effective quick fix for most weed issues; however, it may not always be the optimal approach. Some fungi can effectively manage weeds and, in some instances, outperform chemical methods. It is well acknowledged that plant diseases have the ability to cause the death of plants. According to McFadyen, the conventional method is the main strategy for weed biocontrol. According to him, the traditional way of pest management involves spreading exotic insects, mites, or diseases for permanent control, whereas the inundative approach is similar to the classical method in that it involves releasing predators.

Advantage of biological weed control

1. Biological control is ecologically beneficial since it does not cause environmental contamination.
2. It is cost-effective in the long term despite the significant initial financial expenditure.
3. It is a self-perpetuating and self-sustaining bio-herbicide.
4. It may be successful in locations that are not reachable by humans.
5. Preserving biodiversity is challenging because achieving 100% weed control with biological agents is difficult.

Disadvantage of biological weed control

1. High cost: It necessitates a greater initial investment.
2. Economic crops damage: If screening and identification of bio-agents are not conducted correctly, they might harm valuable crops or be used to manage economically important weed species in different locations.
3. Biological control has limited effectiveness in agricultural fields with a diverse weed population.
4. Extremely sluggish in performance.
5. Limitations imposed by the environment

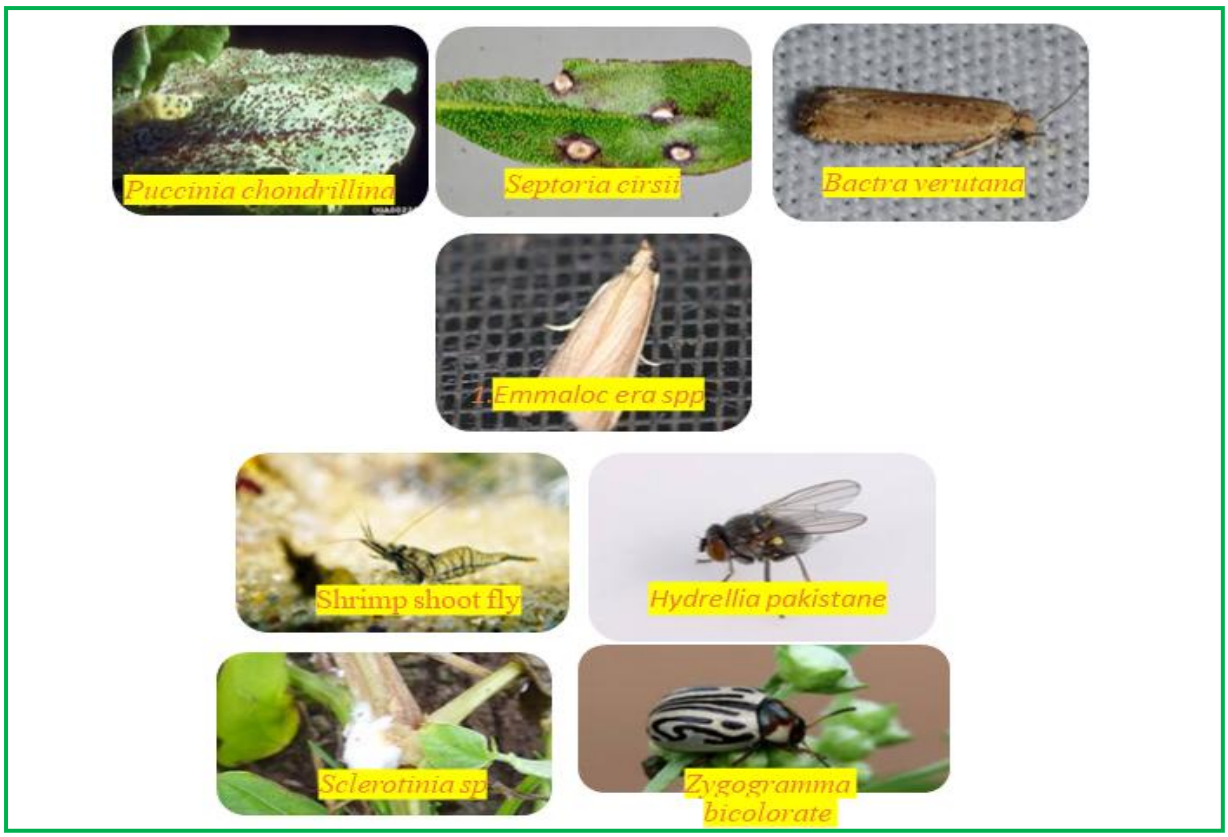
Biological weed control: A sustainable alternative to chemical method

1. Biological weed management does not leave any toxic residue in crops, unlike chemical control which may leave dangerous levels of residues in the crop.
2. Weeds do not acquire resistance when there is no resistance in the herbicide they are exposed to.
3. Biological control is environmentally friendly and more sustainable than chemical treatments, since it does not cause pollution.
4. It is more environmentally friendly, sustainable, and cost-effective in the long run compared to chemical methods.

Bio-agent for biological weed control

Table 1 Outstanding examples of classical biocontrol (Cock and Seier, 1999)

Weeds	Bio-agent	Reporting country	Kinds of bio-agents
Chondrilla juncea	*Puccinia chondrillina*	Australia	Plant pathogen
Cirsium arvense	*Septoria cirsii*		Plant pathogen
Cyperus rotundus	*Bactra verutana*	India, Pakistan, USA	Shoot boring moth
Echinochloa spp.	*Emmaloc era spp., Trpos spp.*		Stem boring moth, Shrimp shoot fly
Hydrilla verticillata	*Hydrellia pakistane*	USA	Shoot fly
Orobanche cernua	*Sclerotinia sp.*	USA	Plant pathogen
Parthenium hysterophorus	*Zygogramma bicolorate*	India	Leaf eating beetle
Rumex spp.	*Uromyces rumicis*	USA	Plant pathogen
Tribulus terrestris	*Microlarrinus kareynii and M. lypriformi*	USA	Pod weevil
Lantana camara	*Octotoma scabrispennis Uroplata giraldi*	Australia	Beetles
Opuntia	*Dactylopius tomusentos*	India	Scale insect
Eupatorium riparium	*Entyloma compositarum*	USA	Plant pathogen



The Bioherbicide Approach to Sustainable Weed Management

When compared to the conventional biocontrol idea, the bioherbicide philosophy has several major differences. Microbes, insects, or plant extracts derived phytotoxins, pathogens, or bacteria make up bioherbicides. They are an all-natural way to keep weeds at bay. Weed management may be achieved with the use of bioherbicides, which are substances that exist naturally. The discovery of mycoherbicides in the mid-1970s marked the first development of bioherbicides.

Table 2: Bioherbicide and their respective sources, registered name and, target weeds

Source	Registered name	Target Weeds
Colletotrichum gloeosporioidesaeschynomene	Collego	*Aeschynomene virginica* L.
Alternaria cassiae	CASST	*Cassia obtusifolia* L.
Phytophthora palmivora	Devine	*Morrenia odorata* (Hook. &Arn.) Lindl.
Phoma macrostoma	Phoma	*Reynoutria japonica* Houtt
Cymbopogon citratus (DC.) Stapf	GreenMatch EX	*Euphorbia* spp
Citrus sinensis (L.) Osbeck	GreenMatch	*Solanum nigrum* L.
Syzygium aromaticum (L.) Merr. & L.M.Perry and *Cinnamomum verum* J. Presl	WeedZap®	*E. crus-galli*
S. aromaticum	Weed Slayer®	*E. crus-galli*
Citrus limon (L.) Osbeck	Avenger® Weed Killer	*D. sanguinalis*

Source: T.K. Das

Future challenges

Future problems are approaching in the quest for sustainable agriculture using biological weed control. Adapting to change climatic pattern and growing weed resistance provides substantial difficulties, necessitating novel solution to retain effectiveness. Successfully managing regulatory challenges and minimizing ecological effect from biocontrol agents requires thoughtful deliberation and cooperation. Balancing technical progress with ethical considerations is crucial for overcoming problems and using nature's resources for a more sustainable and resilient future in agriculture.

Conclusion

To achieve additional expansion in agricultural productivity, new issues must be addressed effectively and promptly. Many nations, including India, are experiencing a plateau in agricultural output owing to modern farming practices. The excessive use of artificial fertilisers and pesticides is causing environmental concerns. Biological control may serve as an alternative approach that plays a crucial part in accomplishing agricultural goals.

References

1. Afaq, U. 2023. Weed Bio-Control Agents. In *Insect Predators in Pest Management* (pp. 297-305). CRC Press.
2. Ani, O., Onu, O., Okoro, G., and Uguru, M. 2018. Overview of biological methods of weed control. *Biological Approaches for Controlling Weeds*, ***5***(5).
3. Bailey, K.L. The bioherbicide approach to weed control using plant pathogens. In *Integrated Pest Management*; Academic Press: Cambridge, MA, USA, 2014; pp. 245–266
4. Cock, M. J., & Seier, M. K. (1999). Biological control of weeds with particular reference to Parthenium hysterophorus in Ethiopia. In *Proceedings of the 5th annual conference of Ethiopian Weed Science Society (Arem 5), Addis Ababa, Ethiopia* (pp. 14-26).
5. Devi, N. M., Mayanglambam, B., and Thangjam, B. 2020. Biological control of weed. *Biotica Research Today*, ***2***(5), 341-344.
6. Gharde, Y., Singh, P. K., Dubey, R. P., and Gupta, P. K. 2018. Assessment of yield and economic losses in agriculture due to weeds in India. *Crop Protection*, *107*, 12-18.
7. Hasan, M., Ahmad-Hamdani, M. S., Rosli, A. M., and Hamdan, H. 2021. Bioherbicides: An eco-friendly tool for sustainable weed management. *Plants*, ***10***(6), 1212.
8. Holt, J. S., and Lebaron, H. M. 1990. Significance and distribution of herbicide resistance. *Weed technology*, ***4***(1), 141-149.
9. McFadyen, R. E. C. 1998. Biological control of weeds. *Annual review of entomology*, ***43***(1), 369-393.
10. Mohammadi, G. R. 2013. Alternative weed control methods: a review. *Larramendy Weed and Pest Control-Conventional and New Challenges*, 117-159.
11. Roberts, J., Florentine, S., Fernando, W. D., and Tennakoon, K. U. 2022. Achievements, developments and future challenges in the field of bioherbicides for weed control: A global review. *Plants*, ***11***(17), 2242.
12. Templeton, G. E., TeBeest, D. O., and Smith Jr, R. J. 1979. Biological weed control with mycoherbicides. *Annual Review of Phytopathology*, ***17***(1), 301-310.