

Biological control of Horse purslane (*Trianthema portulacastrum*)

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Horse purslane also known as *Trianthema portulacastrum* L. (Aizoaceae), hogweed, itcit, or santha, is a cultivated pantropical weed. Horse purslane is succulent, prostrate herb with ovate green leaves that has an annual life cycle and grows indeterminately. It is considered the most troublesome weed in various states of the country, infesting various important agricultural crops like maize, soybean, cotton, sugarcane, pulses etc. Though chemical herbicides are the most effective and immediate method for the majority of weeds, however, the excessive use of chemical herbicides can pollute the soil and groundwater, which can adversely affect the crops. In recent years, there has been a major emphasis on biological control of weed. When a fungus is used for the production of a biopesticide, the product is referred to as 'mycoherbicide'. Many native fungi are pathogenic to specific weed species. These fungi are used to selectively kill weeds and eliminate them from the area. *Gibbago trianthemae*, fungus, was identified as the causative agent of necrotic lesions on the leaves, petioles and stems of *Trianthema portulacastrum* L. (Horse purslane).

Keywords: Biological control, Formulations, Mycoherbicide, *Trianthema portulacastrum* (Horse purslane)

IN agricultural field, weed population are the primary cause of crop yield reduction. Approaches of weed control can take several forms, but today it primarily relies on the use of synthetic herbicides. In all agricultural and horticultural systems, plant diseases are a major constraint in crop production. All crops are susceptible to pathogen-caused diseases (bacteria, fungi and viruses). Horse purslane [*Trianthema portulacastrum* L. (Aizoaceae)] hogweed, itcit, or santha, is a cultivated pantropical weed. *T. portulacastrum* is succulent, prostrate herb with ovate green leaves that has an annual life cycle and grows indeterminately. It is considered the most troublesome weed in various states of the country, infesting important agricultural crops and reducing yield by 50-80% when left untreated.

Biological control is the suppression of disease through the application of a biocontrol agent to the plant or soil, which is typically

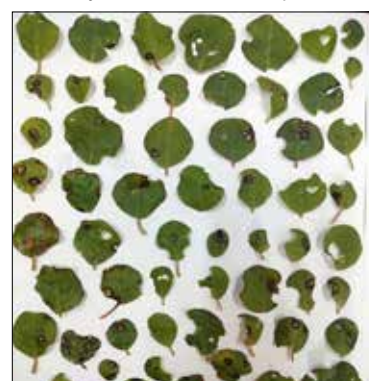


Different (vernacular) names

English	Horse purslane
Hindi	Sabuni, Santhi, Vishakhapara, Lal-sabuni, Svet-sabuni
Sanskrit	Shvetapunarnava, Chiratika, Dhanapatra, Upothaki
Tamil	Sharunnai, Shavalai
Mumbai	Svetapunarnava
Punjab	Bishkapra, Itsit
Bengal	Gadabani
Madras	Mukkarattai
Marathi	Pundharighetntuli



Healthy leaves of Horse purslane



Infected leaves of Horse purslane

a fungus, bacterium or virus, or a combination of these. The main benefit of using a biocontrol agent is that it is highly specific for a pathogen and thus considered harmless to non-target species. The use of fungal plant pathogens to control weeds has gained support as a viable, safe and environmentally beneficial strategy in the agriculture ecosystem. Many native fungi are pathogenic to specific weed species. These fungi are used to selectively kill weeds and eliminate them from the area. These fungi that kill weeds are known as mycoherbicides.

Mycoherbicides and their mode of action

Mycoherbicides are a type of weed management where fungi are introduced as weed pathogens that are expected to destroy the weeds by toxins produced by fungi. Fungal pathogens are considered to have the most potential as biological weed controllers among microorganisms. Mycoherbicides typically only require a single application, and unlike chemical herbicides, which must be used annually or seasonally, they remain active on a given weed for years. Mycotoxins and phytotoxins, which are produced by fungi, are harmful toxins that disrupt the life cycles of weeds and eventually kill them.

Mycotoxins - Mycotoxins, which are secondary metabolites with significant levels of toxicity for plants as well as for humans and other animals, are produced by some fungal species including *Fusarium*, *Aspergillus*, *Phoma*, *Penicillium*, etc. *Fusarin C*, *citrinin*, aflatoxins, cytochalasins, fusaric acid, patulin, ochratoxins, and a number of additional mycotoxins are among them. Since the beginning of the 20th century, mycotoxins and their effects on plants have been extensively researched.

Phytotoxins - Phytotoxins are chemicals that are produced by fungus and include sesterterpenoids, sesquiterpenoids, peptides, diketopiperazine, polyketides, and isocoumarin. Usually lethal and destructive, these substances operate pathologically on plants. The capacity of fungi to naturally

produce toxic chemical substances as their secondary metabolites has been explored and applied to the control of noxious weeds. Any fungus that produces phytotoxins must exhibit certain features in order to qualify as a potential mycoherbicide. These include the ability to destroy weeds, quick growth, easy industrial development, ability to be packaged, transported, and effectively marketed. Fungal genera like *Botrytis*, *Alternaria*, *Fusarium*, *Phoma*, and *Helminthosporium* have all been extensively researched and recognised for producing phytotoxic compounds.

Biocontrol efficacy of plant pathogen

Weed biology, ecology, and management cannot be the same across different geographical areas. As a result, weed management techniques vary depending on the agro-ecological zones. In order to lower the production costs, weed control methods must constantly be developed and improved. This is crucial in the context of both changing global agricultural trade regulations and the socio-economic circumstances of the farmers. Crop production systems must include weed control strategies. Plant pathogens are known for their ability to cause severe, destructive epidemics in the presence of an inoculum source, susceptible hosts population, and the right environmental circumstances. Unlike chemical pesticides, biological agents can continue to function after inoculation and beyond their monocyclic development. Weed biocontrol has not demonstrated effective use of this biological property of self-perpetuation. A 'mirror-image' of efforts to manage plant diseases is the application of biological agents to control weeds. Weed biological control (biocontrol) has a long history and a high percentage of efficiency. The intentional use of living organisms (biologic agents) to reduce weeds' vigour, reproductive potential, density, or negative effects on crops is known as biological control of weeds. Selected plant pathogenic fungi that produce

anthracnose, leaf blights, leaf spots, and rust on weeds have been used in the development of bioherbicides. One of the fungal pathogen *Gibbago trianthema*, has shown the potential to be used as a successful biocontrol agent for horse purslane. The phaeodictyoconidial hyphomycetes fungus *Gibbago trianthemae* Simmon, which causes leaf spot on horse purslane, was originally discovered in the USA in 1986. It was then discovered in Kurukshetra, India, in 1990, on the infected plants. When used as a foliar spray under regulated field circumstances, *Gibbago trianthemae* may be capable of suppressing horse purslane.



Irregular with margin pure colony of *Gibbago trianthema*

Formulation of a mycoherbicide

Formulation is the blending of active chemicals, such as fungal spores, with inert carriers, such as diluents and surfactants. In order to change the physical properties of the formulation to a more desirable form, the mycoherbicide may be diluted to a common potency, stabilised and/or biologically active, improved for mixing and spraying, and perhaps even integrated into a pest control strategy. The application method of mycoherbicides is frequently determined by the method of production.

Liquid based formulations

Water is regarded as the 'universal carrier' for mycoherbicides, just as it is the 'universal solvent' for chemicals. This is due to the fact that water is cheap, easily available, easy to handle, and essential to the survival

of all plant pathogens. The fungus enclosed in and sprayed in water is the most basic mycoherbicide delivery technique. It is difficult to apply aqueous substances like mycoherbicides evenly because many weeds have waxy cuticles that prevent water from spreading equally. Surfactants help spread the fungus spores throughout the spray mixture and moisten the plants. Since mycoherbicide spores are limited in number, it is crucial to cover the surface area with the substance as evenly and uniformly as possible. Research on mycoherbicides has employed a variety of surfactants. Preliminary tests should be performed to determine the surfactant's impact on the potential mycoherbicide because some surfactants may be harmful to the growth and/or germination of fungus.

Solid based formulations

With a few exceptions, liquid mycoherbicide formulations are best utilised as post emergence sprays and are mostly employed to promote leaf and stem diseases. On the other hand, a solid, or

granular, formulation is probably the best way to deliver pathogens that infect at or below the soil line. Granular formulations are more suitable for use as pre emergence mycoherbicides than spray formulations because they provide a buffer from environmental extremes; can act as a food source for the fungus and are less likely to be washed away from the treated areas than spores. Sodium alginate has also been used to produce granular formulations of numerous biocontrol fungus. This procedure involves dripping fungal mycelium into a 0.25 M calcium chloride solution together with sodium alginate, different fillers, and kaolin clay. Gel beads are produced as soon as the Ca^{2+} ions interact with the sodium alginate. After a brief period of time in the calcium chloride solution, the beads can be removed, cleaned, and air dried.

CONCLUSION

In general, weeds are the major threat in crop production. Despite the development of several techniques for weed eradication, weed control is still a significant problem in

modern agriculture. *Trianthema portulacastrum* (Horse purslane) is considered as the most troublesome weed in various states of the country. Plant pathogenic fungi are emerging as an effective and eco-friendly alternative to conventional weed control methods. *Gibbago trianthema* has shown the potential to be used as a successful biocontrol agent for horse purslane. The main benefit of using a biocontrol agent is that it is highly specific for a species and thus considered harmless to non-target species. It is crucial that the introduction of biological control be done only after a thorough assessment of the benefits, drawbacks, and hazards. The safety of the biological control agent towards non-target organisms and the avoidance of contaminants, therefore, are the main concerns associated with biological control introductions. Host specificity screening can reduce the first, and careful screening done before exportation can reduce the second.

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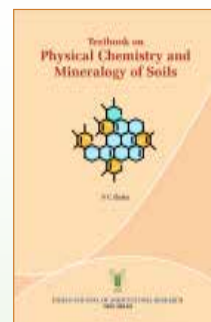
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