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Biological Weed Control

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SUMMARY

Biological control of weeds is the deliberate use of natural enemies to reduce the density of a particular weed to a tolerable level. The objective of biological weed control is not eradication but simply the reduction of the weed population to an economically low level In fact for biological control to be continuously successful, small numbers of the weed host must always be present to assured the survival of the natural enemy.

INTRODUCTION

Utilization of natural living organism, such as insects, herbivorous fish, other animals, disease organisms and competitive plants to limit their growth. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. This method is not useful to control all types of weeds. Introduced weeds are best targets for biological control. The control Opuntia spp (prickly pear) in Australia and lantana in Hawai with certain insect bioagents are two spectacular examples of early period biological control of weeds.

Advantages

1) Least harm to the environment
2) No residual effect
3) Relatively cheaper and comparatively long lasting effect
4) Will not affect non-targeted plants and safer in usage
5) It is very effective in control of weeds in non-cropped areas
6) Besides this some of the fish, snails and other animals convert weed vegetation into seafood.

Disadvantages

1) Multiplication is costlier
2) Control is very slow
3) Success of control is very limited
4) Very few host specific bio-agents are available at present.

Bio control started in the year 1900.There is 2 approaches in biological control.

1. Classical biological control approach.
2. Bio-herbicide philosophy approach.

1. Classical biological control

Main objective of classical biological weed control is restoring balance between target alien weed and its natural enemies in the ecosystem by introduction of suitable, exotic bio-agent. Successful bio-agent reduce the weed population first then the Bio-agent population due to starvation of food. After some time the bio-agent population may recover. This process continues in cyclic fashion till the bio-agent and weed population gets established at a low level. This method is a slow operating and currently used in non-cropped areas. In crop fields, the bio-agent will not get opportunity to work on host weed due to frequent use of insecticides and fungicides in modern agriculture. Otherwise ***Cyperus rotundus*** can be controlled in crop fields with moth "*Bactra verutana"* and selective bio control of ***Ludwigia parviflora*** (water purslane) by Haltica cyanea (steel blue beetle) in rice fields.

2. Criteria / Characteristics of successful bio-agent

A. Host-specific
B. Bio agent hardiness
C. Feeding habit and ease of multiplication

A.Host-specific

Bio-agents should be host specific and they should not attack other economic plant spp. They should **pass starvation test** i.e. they prefer to starve to death rather feed upon other than host weeds. Lantana was controlled by "*Teleonemia scrupulosa*" insect bio-agent. But in India it is likely to damage teak (*Tectona grandis*) and sesame (*Sesamum indicum*). *Zygogramma bicolarata* is an effective leaf eating bio-agent against *Parthenium* (carrot grass). But it is found to attack sunflower in India.

B.Bioagent hardiness

Bio-agent should free from its own parasites and predators. Bio-agent should withstand starvation for short or long periods of food shortage when the target weed population is brought to low level. But carp can't survive even a short period of starvation.

C.Feeding habit

Bio-agents are more efficient in controlling weeds if they attack either flowers or seeds of the weed or bore into the stems than root and leaf feeders. But root-feeding insects are more effective in controlling perennial weeds.

Ease of multiplication

Bio-agent should have high rate and ease of natural reproduction. It is very important for insects, pathogens, snails and competitive plants. But it is not desirable with carp as its increased population compete with natural fish.

Kinds of Classical Bio-Agents

Bio agent may be either specific or non-specific. Specific bio agent attack only one or two specific weeds, while non-specific bio agent feed upon a variety of vegetation. Specific bio agents are insects, plant pathogens and competitive plants. Non-specific bio agents are Carp fish, snails and mites.

Six kinds of Bio-agents were used to Control Weeds.

They are Insects, Carp fish, Fungi, Competitive plants, Snails and mites

1.Insects

These are largely host specific i.e. one insect spp is employed to destroy the only one weed sp. First successful example reported from Hawai in 1902 "*Lantana camara*" controlled by Moth "*Crocidosema lantana*". Insects that were found effective belong to Lepidoptera, Hemiptera, Coleoptera and Diptera.

2.Carp fish:

Certain fresh water Carp fish consume large quantities of aquatic weeds. Whiteamur (Chines grass carp) "*Ctenopharyngodon idella*" is promising spp for aquatic weed control. This can grow more than its body weight i.e. 5kg / year and attaining up to 50kg at its full size. Herbivorous fish are not food specific. Where as the common carp (*Cyprinus carpio*) a non-herbivorous fish used to control submerged aquatic weeds.

3.Plant pathogen

Many fungi attack specific weed spp. For instance"Acacia glauca "controlled by spore suspension of "Cephalosporium zonatum". Skeleton weed (*Chondrilla juncia*) controlled by rust causing fungi "*Puccinia chondrillana*."

4.Competitive plants

Parthenium The mite "*Tetranychus desertorum*" controls prickly pear "*Opuntia dellini*" Certain plants spp are very competitive in suppressing specific weeds. Slender spike rush ("*Eleocharis acicularis*") aquatic plant can cover the canal bottom and it is not allowing to establish destructive tall weeds. *Typha spp* can be controlled

by "*Panicum purpurascens*" or "*Brachiaria mutica*" (Para grass). Marigold has potential to displacing Parthenium spp. *Cassia sericea* also suppressed the Parthenium.

5.Snails

The large tropical fresh water snail "*Marisa cornuarietis*" feed on aquatic weeds. Marisa feed on roots of water hyacinth, water lettuce and leaves of "Salvinia".

6.Mites

The mite "Tetranychus desertorum" controls prickly pear "Opuntia dellini"

Outstanding example of classical bio control

1. Lantana Camera:

Lantana was the first weed controlled successfully with certain insect bio agents in Hawaii. Of this Crocidosema lantana, a moth was found to be promising in destroying flowers and seeds of lantana. In Australia, three successful insect biocontrol agents are hispine beetles (*Octotoma scabripennis* and *Uroplata girardi*) and tingid /lantana bug (Teleonemia scrupulosa).

2. Prickly pear (*Opuntia spp*):

In Australia biocontrol of "*Opuntia inermis*". With a moth "*Cactoblastis cactorum* ".In Tamilnadu and Maharashtra 40,000 ha land was recovered from the weed *Opuntia delini* by releasing "*Dactyloplius tomentosus*". a Cochineal scale insect.

3. Alligator weed (*Alternanthera philoxeroides*) controlled by flee beetle: *Agasicles hygrophyla* and alligator weed thrips: *Anynothrips andersoni.*

4. Water hyclinth:

(*Eichornea crassipes*) it is worldwide aquatic weed infested transplanted paddy fields including India. Hyacinth moth *Sameodes albiguttalis* feed up on young leaves and apical buds. Besides this beetles *Neochetina bruchii* and *N. eichorniae* are also damaging the water hyacinth.

5. Salvinia (*Salvinia molesta*):

In Kerala (India) curculionid beetle *Cytrobagous salviniae* used to clear the fresh water courses and paddy fields. They feed on terminal buds and rhizomes and petioles of salvinia.

Some other examples

Weed	Weed	Reporting Country	Kind of bioagent
Chondrilla juncea	*Puccina chondrillina*	Australia	Plant pathogen
Cyperus rotundus	*Bactra verutana*	India, Pakistan, USA	Shoot boring moth
Eupatorium riparium	*Entyloma compositarum*	USA	Plant pathogen
Hydrilla verticillata	*Hydrellia pakistanae*	USA	Shoot fly
Orobanche cernua	*Sclerotinia spp.*	USA	Plant pathogen
Parthenium hysterophorus	*i)Zygogramma bicolorata* *ii)Epiblema strenuana* *iii) Conotrachelus sp.*	India Australia Australia	Leaf eating beetle Stem galling insect Stem galling insect

Bioherbicide

Bioherbicides are pathogens cultured artificially and made available in sprayable formulations; just like a chemical herbicide. The pathogen selected for the purpose is usually from the native place of the weed, but it

could also be from other places. The bioherbicides are also sometimes called mycoherbicides. A mycoherbicides can be both specific and non-specific.

Bio herbicide remains active only on the current weed population, without any chance of cyclic perpetuation of the weed (or of the bio gent); each new flush of the weed thus requiring retreatment with it. Bio herbicide can be developed for selective control of weeds in a crop just like any other selective herbicide, which is not the case with the classical philosophy bio agents. The development of bio herbicides is of great interest to industrialists since it involves every season requirement of the product for field use. In variance with it, the classical biological control approach has no incentive to the private, profit-oriented organizations; it must depend solely upon public sector support.

Some Commercial Mycoherbicides in Use Abroad

Product	Content	Weed Controlled
De-Vine	A liquid suspension of fungal spores of *Phytophthora palmivora* It causes root rot in the weed.	Strangler-vine. (*Morrentia odorata)* in citrus orchards.
College	Wettable powder containing fungal spores of *Colletotrichum gloesporiodes* Sub sp. *aeschynomone*	Jointvetch (*Aeschynomone spp*). In rice fields. The bioherbicide causes stem and leaf blight in the weed.
Bipolaris	A suspension of fungal spores of *Bipolaris sorghicola*	Johnson grass (*Sorghum halepense*)
Biolophos	A microbial toxin produced as fermentation product of *Streptomyces hygroscopicus*.	Non-specific, general vegetation.
Luboa-2	*Colletotrichum gloesporiodes* spp. Cuscuta	Cuscuta

CONCLUSION

Biological control has been used successfully as a practical and economically affordable weed control method in many situations. Classical biological control, which is biological control of non-native invasive weeds with natural enemies originating from the native range of the weed, has proven a viable strategy for managing weeds in areas subjected to low-intensity management, such as rangelands, forests, preserved natural areas and some waterways.

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