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# Allelopathic and Biological Weedicides for Organic Vegetable Cultivation

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A food crisis may arise in the upcoming years as agricultural land declines due to population expansion. That's why there is an urgent need of high agricultural output with updated and secure practice. There are numerous agrochemicals available to combat various crop pests. These agrochemicals have the ability of controlling a variety of crop pests, including weeds, diseases, fungus, and insects. The biggest pest issue among these is weed growth, which reduces crop yield by 34%.

Weeds are one of the most problematic, time-consuming, and expensive production issues for organic vegetable growers. The main factor responsible for reducing crop productivity is weeds. Synthetic chemical herbicides are quite effective in reducing weeds to a great extent, but when resistance develops, they lose some of their weed-controlling power. Integrated weed management (IWM) is the answer of all the concerns. The goal of (IWM) is to lessen reliance on a single weed management strategy by combining the use of chemical, cultural, genetic, biological, and mechanical practices. Existing weed management techniques have some drawbacks and are inadequate for ensuring the sustainability of modern agricultural practices. As a result, researchers are looking at new weed management techniques that are both eco-friendly and effective at eliminating weed problems. Emerging weed control products include bio-herbicides.

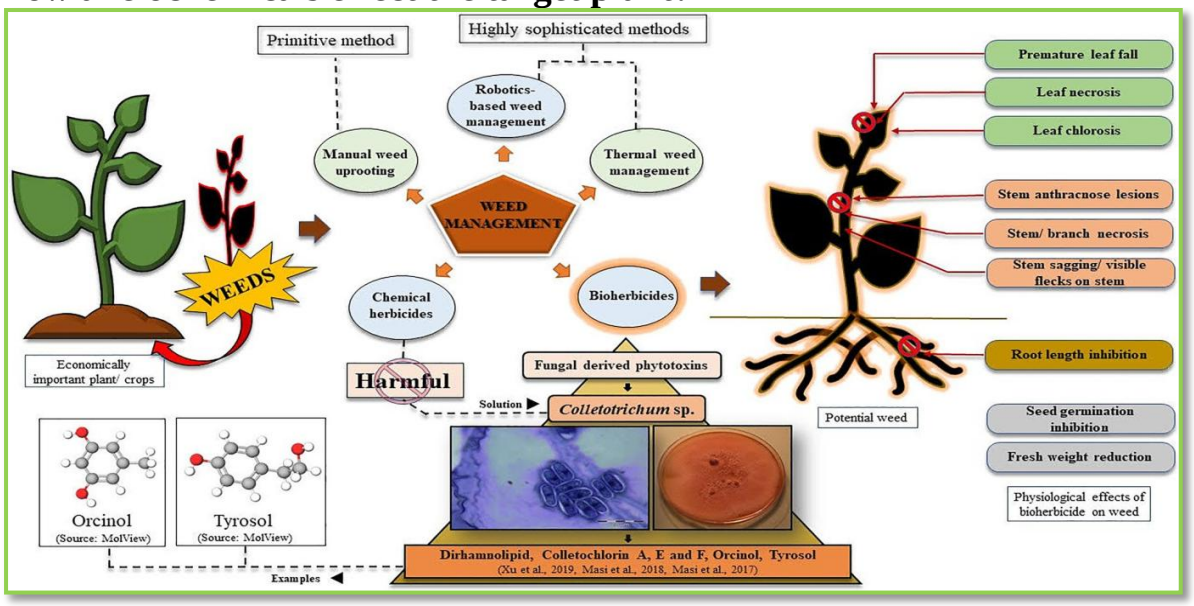
## The issue of weeds in organic vegetable production

- The ever increasing population
- Global issue for food security
- Reduction in crop productivity
- Chemicals herbicides and mechanical approaches have overcome weed problem on one hand but also destroy the environment on the other hand
- Weeds causing great yield loss
- Labor expensive
- Weeds competes for nutrients and water provided to crops and producing chemicals that suppress crop growth

## What is Allelopathy?

Allelopathy is a biological phenomenon in which one or more biochemical produced by a microbe or plant affect the germination, growth, survival, and reproduction of other organisms and plants in natural and agricultural ecosystems. Allelochemicals are available in a wide variety of chemical forms, including terpenes, alkaloids, non-proteinaceous amino acids, phenols, and sugars/glycosides (Farooq *et al*., 2011).

## How allelochemicals effect the target plant?




## Biological Approach

Biological control is the introduction of organisms into an environment with the purpose of regulating one or more undesired species. Biological controls have been developed for weed management *via* implementing either living organisms, including insects, nematodes, bacteria, or fungi and organic compounds.

## Main approaches to biological weed control

- **Classical biological control**
- **Bioherbicide approach**

**Classical biological control:** In this approach, microorganisms establish, grow, disperse, and endure in the ecosystem for the infestation against the target weed (Shaw *et al.*, 2009). Instead of eradication, the major goal of this technique is to keep the weed population below the critical level.

In the inundative control technique, fungal spores or bacterial suspension are applied to the weed population to eradicate it. However, these applications are not permanent (Auldetal, 2003; Caldwell *et al.*, 2012).

**Bioherbicides:** Bio-herbicides are the substances that inhibit the growth of weeds by utilizing bio-organisms such as microbes, pathogens or natural metabolites. Bio herbicides are the novel approach to reducing the drawbacks of the current conventional herbicides.

## Registered pathogens for weed control

| Registered bioherbicide | Pathogen Name | Target weed |
|---|---|---|
| **Devine ™** | *Phytophthora Palmivora* | *Morrenia Odorata* (strangler vine) |
| **Collego TM(1982)** | *Colletotrichum gloeosporiodes* | *Aeschynomen virginica (*weed for legume) |
| **Biomal$^{R}$** | *Collectrotrichum gloeosporiodes* | *Malva pusilla* (malva) |
| **Wood Warrior $^{R}$** | *Pucciniathlaspeos* | *Isatistinctoria* (wild spp. of cruciferaea family) |

| | | |
|---|---|---|
| **Mycotech™** | *Chondrosterempurpureum* | *PrunosSerotine Populous euramericana* (weed for dicot plants) |
| **SmoulderR** | *Sclerotinia minor* | *Dicot weeds* |
| **Comperico** | *Xanthomonas Compesteris* | *Poaannoa L. In turf* |
| **Organo –sol R** | *Lactobacillus casei Rhaminouslactis sp.* | *Trifolium repensL. (White clover) Trifolium pretense. Lotus* |
| **PseloukaR** | *Rape seed oil nonanoic acid Pelargonic acid* | *Weeds of potatoes,grapewmes* |

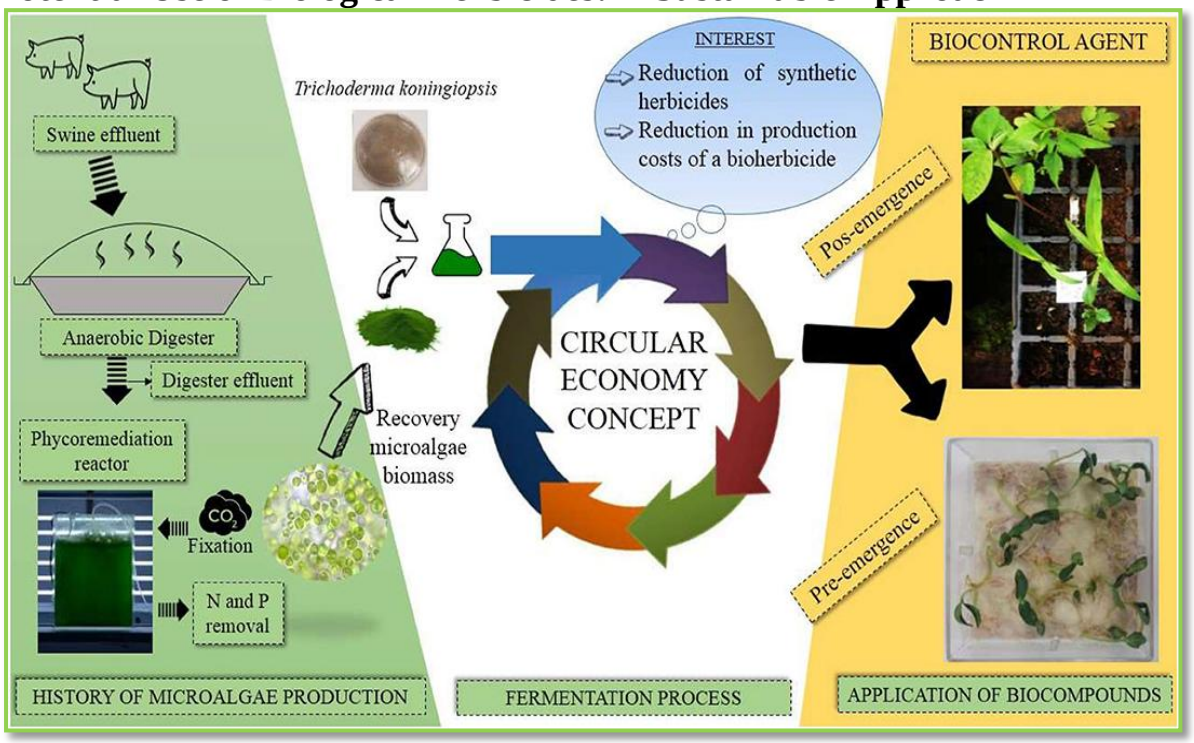
## Formulations of Bio-Herbicide

Bioherbicide formulation involves mixing of an active component with inert ingredients for effective delivery of herbicide dose to the target host weed plant (Rhodes, 1993). These formulations are very beneficial for enhancing application, survivability, efficacy, retaining viability during storage, and minimizing the moisture needed for germination (Green *et al.*, 1998).

**Liquid formulation:**-Liquid formulation is a sprayable formulation which includes suspension emulsions, emulsions, and polymer-based products (Womack *et al.*, 1996). In these formulations, water serves as the transport medium, while the adjuvants assist the active ingredient migrate through the weed plants.

**Solid formulation:-** Solid formulations are mostly applied to soil in the form of granular or encapsulated formulations. A few examples of inert material are grains, clay alginate, charcoal, and polymers. Although it's a controlled release formulation, they perform best when used prior to emergence and have a longer duration of action. Compared to liquid formulations, solid formulations have a longer shelf life. Granular formulations can effectively suppress weeds by 75%.

## Potential Use of Biological Herbicides: A Sustainable Approach



## Proposed benefits to this strategies

- Reduced environmental impact
- Reduced development costs compared to conventional herbicides
- The identification of novel herbicidal mechanisms
- Sustainable, low cost, and environmentally-friendly approach to complement conventional methods

## Future prospects of bioherbicides

- Acquisition of in-depth knowledge on allelopathic mechanisms like weed defense and phytotoxins production by microbes.
- Due to their limited host range, host specificity is the most detrimental element of microbial pathogens as bioherbicides, and further research is needed to address this issue.
- Additional efforts are needed to cover a broad host range using new generation formulations, synergistic combinations, and other biotechnological techniques.

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