

Botanicals and Agriculture: Relation and Future Prospective

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Introduction:

The use of agrochemicals has increased in recent decades to produce more food for a growing human population. However, this has led to harmful food, soil, air, and water residues. It has also led to the development of resistance to pests and negatively impacted soil quality. To meet the increasing demand for food production, it is necessary to find sustainable and safe ways to produce more food using limited resources, such as arable land and water. This has led to an increased interest in alternative substances that are less harmful to the environment and human health while ensuring food safety. One promising alternative is the use of compounds derived from aromatic plants for pest control. These compounds are highly effective, with multiple mechanisms of action and low toxicity towards non-target organisms. However, their large-scale application is limited by their poor stability and other technological issues. Pyrethrum and neem are two commercially well-established pesticides that have been used for a long time. Recently, new pesticides based on plant essential oils have also been introduced in the market. However, the use of rotenone seems to be decreasing. Despite the advantages of botanicals, several factors seem to restrict their success, especially regulatory barriers and the availability of competing products such as newer synthetic pesticides, fermentation products, and microbials. These newer products are not only cost-effective but also relatively safer compared to their predecessors. Botanical insecticides are highly suitable for agricultural pest management in organic food production systems in industrialized countries. However, their use can be extended to a much greater extent in developing countries for the production and post-harvest protection of food.

In recent history, synthetic insecticides have taken over the role of botanicals in agriculture. However, the use of these synthetic insecticides has led to several unforeseen problems and consequences. These problems include acute and chronic poisoning of

applicators and consumers; destruction of fish, birds, and other wildlife; disruption of natural biological control and pollination; extensive groundwater contamination that may threaten human and environmental health; and the evolution of resistance to pesticides in pest populations. Plants contain essential bioactive compounds for their environments and have known pest and disease-fighting properties, according to ethnobotanical reports.

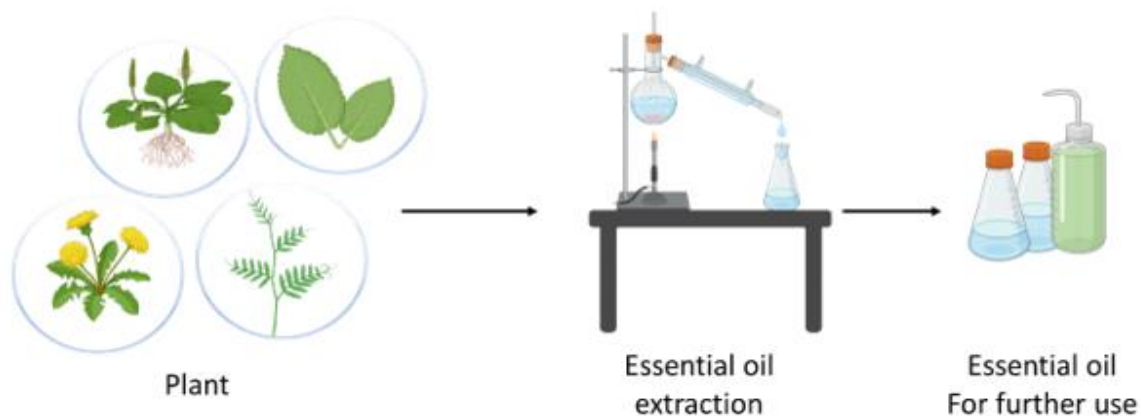


Fig: Extraction of essential oils from plant diversity

Botanical pesticides:

The primary botanical pesticides are essential oils produced as secondary metabolites in plants. These oils play vital roles in the plant life cycle by acting as defenses against pathogen and herbivore attacks, or by attracting pollinators and disseminating seeds. (Isman, 2000a, 2006; Pavela and Benelli, 2016; Regnault-Roger et al., 2012).

Application of Botanical Pesticides:

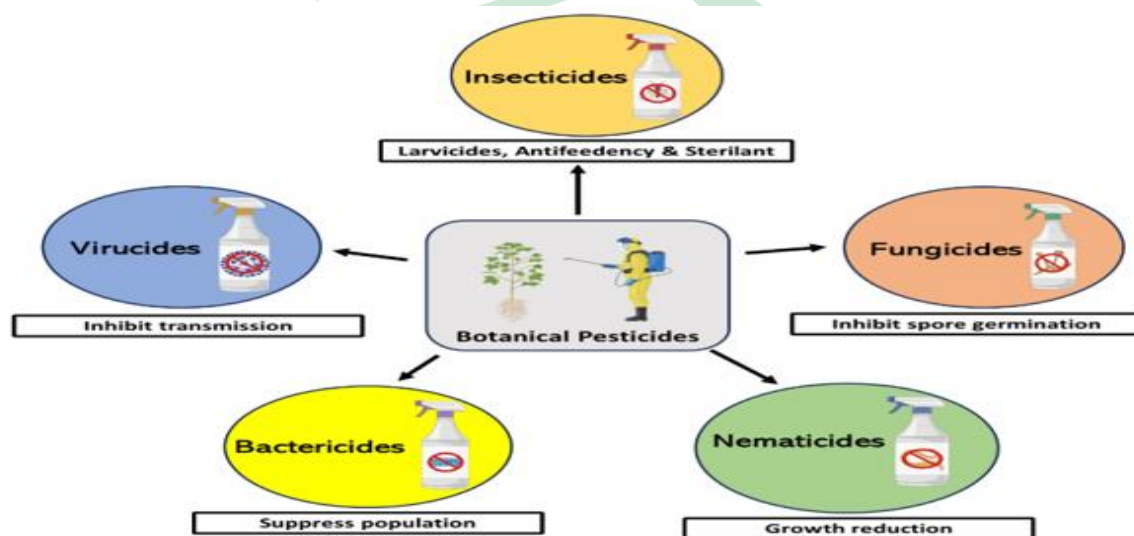


Fig: Illustration of different types of botanicals in relationship with Agriculture

Numerous plant-based pesticides have been discovered, but a significant amount of them have not been isolated and analyzed to identify their bioactive ingredients. These abundant sources of botanicals have been underutilized and neglected as pesticide agents to manage many destructive pests and diseases. Therefore, researchers have studied the application of botanicals as pesticidal agents and their effectiveness as alternative pest management in sustainable agriculture and related fields. These botanicals are used as insect repellents, antifeedants, insecticides, and insect growth inhibitors. Additionally, these botanical bioactive ingredients are applied as nematicides, fungicides, bactericides, and virucides. Several plants have pesticidal potential, and extensive research has been conducted to confirm their efficacy (Ngegba, P.M.; Cui, G.; Khalid, M.Z.; Zhong, G., 2011).

Challenges of Botanical Pesticides:

Although plant-based pesticides compete with synthetic ones, they are not as common in the market. The effectiveness of plant-based pesticides is highly dependent on environmental and weather conditions, which makes them easily degradable in the field. There are several problems with contamination, preparation potency, attenuation of pesticide activity, and shelf life. It can be challenging to standardize dosages of botanical pesticides due to variations in growth habitats, varietal differences, harvest duration, extraction methods, and storage conditions. The appropriate formulation is also difficult to achieve because multiple bioactive constituents are present in one plant species, which differ in their chemical properties.

There are significant barriers to commercializing plant-based pesticides, such as:

- a) limited availability of raw botanical materials
- b) inadequate quality assurance and standardization of the necessary active components
- c) problems relating to regulatory clearance, such as the pricey toxicological assessment of the herbicide
- d) less knowledge about botanicals in the community
- e) it doesn't give instant results as synthetic

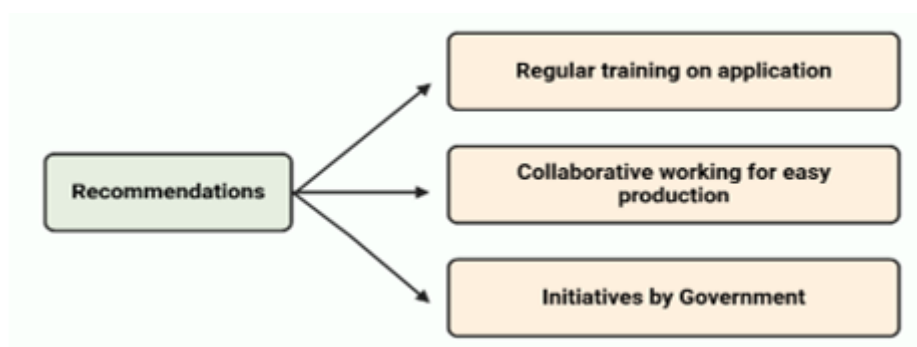


Fig: Few Suggestions to Improve Botanicals Use Case

Conclusion:

It is crucial to employ botanical pesticides to manage economically damaging pests in agriculture due to their renewability, environmental safety, and human welfare. Plant-based pesticides are commonly utilized in low-income and developing countries as they are affordable, easily obtainable, accessible, and simple to use. However, the identification of active ingredients from pesticidal plants remains in its early stages.

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