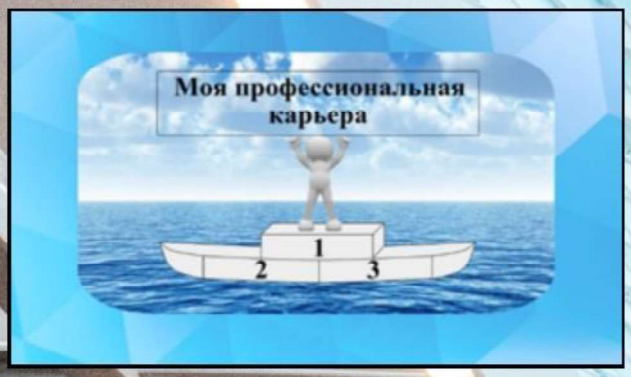

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Сборник содержит научные статьи отечественных и зарубежных авторов по экономическим, техническим, философским, юридическим и другим наукам.

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Abstract

The increasing demand for sustainable agricultural practices has driven the exploration of natural insecticides as alternatives to synthetic chemical pesticides. This research paper investigates the production of natural insecticides derived from plant-based sources, focusing on their efficacy, environmental impact, and potential for large-scale application. The study employed a systematic approach to extract bioactive compounds from selected plant species, followed by laboratory-based bioassays to evaluate their insecticidal properties. Results indicated that certain plant extracts exhibited significant toxicity against target insect pests while demonstrating minimal harm to non-target organisms.

Introduction

The global agricultural sector faces significant challenges in managing pest populations, which threaten crop yields and food security. Synthetic chemical pesticides have long been the primary tool for pest control; however, their widespread use has led to environmental degradation, resistance development in pest populations, and adverse effects on human health. In response, there has been a growing interest in natural insecticides, which are derived from biological sources such as plants, bacteria, and fungi. These natural compounds offer a sustainable and eco-friendly alternative to

synthetic pesticides, with the potential to reduce environmental impact and promote integrated pest management (IPM) strategies.

Natural insecticides are particularly appealing due to their biodegradability, target specificity, and low toxicity to non-target organisms. Plant-derived compounds, such as alkaloids, terpenoids, and flavonoids, have been extensively studied for their insecticidal properties. These bioactive compounds disrupt various physiological processes in insects, including neurotransmission, growth regulation, and reproduction. Despite their potential, the production and application of natural insecticides face challenges related to extraction efficiency, stability, and scalability. This research aims to address these challenges by exploring the production of natural insecticides from selected plant species and evaluating their efficacy against common agricultural pests.

Methods and Methodology

The research was conducted in three phases: plant selection and collection, extraction of bioactive compounds, and bioassay testing. The methodology was designed to ensure reproducibility and accuracy in evaluating the insecticidal properties of plant-derived compounds.

Plant Selection and Collection

Five plant species known for their insecticidal properties were selected for this study: Azadirachta indica (neem), Nicotiana tabacum (tobacco), Chrysanthemum cinerariifolium (pyrethrum), Tagetes erecta (marigold), and Lantana camara. These plants were chosen based on their historical use in traditional pest control and the presence of well-documented bioactive compounds. Fresh plant materials, including leaves, flowers, and stems, were collected from local botanical gardens and agricultural fields. The collected samples were washed, air-dried, and ground into a fine powder for further processing.

Extraction of Bioactive Compounds

The extraction process involved the use of solvents with varying polarities to isolate a wide range of bioactive compounds. Ethanol, methanol, and water were used as extraction solvents. The powdered plant materials were soaked in the respective solvents for 48 hours at room temperature, with occasional stirring. The mixtures were

then filtered using Whatman filter paper, and the filtrates were concentrated using a rotary evaporator under reduced pressure. The resulting crude extracts were stored at 4°C until further analysis.

Phytochemical Screening

Phytochemical screening was conducted to identify the presence of alkaloids, flavonoids, terpenoids, saponins, and tannins in the crude extracts. Standard qualitative tests, such as the Mayer's test for alkaloids and the ferric chloride test for tannins, were performed. The results of the phytochemical analysis provided insights into the chemical composition of the extracts and their potential insecticidal activity.

Bioassay Testing

The insecticidal efficacy of the plant extracts was evaluated using a series of bioassays. Two common agricultural pests, Spodoptera litura (tobacco cutworm) and Aphis gossypii (cotton aphid), were selected as target organisms. The bioassays were conducted under controlled laboratory conditions, with temperature and humidity maintained at 25±2°C and 70±5%, respectively. The extracts were diluted to various concentrations (1%, 2.5%, 5%, and 10%) and applied to the pests using a spray tower. Mortality rates were recorded at 24, 48, and 72 hours post-treatment. Data were analyzed using probit analysis to determine the median lethal concentration (LC50) of each extract.

Results and Discussion

The results of the phytochemical screening revealed the presence of diverse bioactive compounds in the plant extracts. Alkaloids were detected in Nicotiana tabacum and Lantana camara, while flavonoids and terpenoids were abundant in Azadirachta indica and Chrysanthemum cinerariifolium. These compounds are known to exhibit insecticidal properties by interfering with insect nervous systems and growth processes.

The bioassay results demonstrated significant variations in the toxicity of the plant extracts against the target pests. Azadirachta indica extract exhibited the highest

efficacy, with an LC50 value of 2.1% against Spodoptera litura and 1.8% against Aphis gossypii. The insecticidal activity of neem extract can be attributed to its active ingredient, azadirachtin, which disrupts insect molting and feeding behavior. Similarly, Chrysanthemum cinerariifolium extract showed strong toxicity, with an LC50 value of 3.5% against both pests. Pyrethrins, the active compounds in pyrethrum, are known for their rapid knockdown effect on insects.

In contrast, Tagetes erecta and Lantana camara extracts exhibited moderate insecticidal activity, with LC50 values ranging from 5.2% to 7.8%. These results suggest that the efficacy of natural insecticides is influenced by the type and concentration of bioactive compounds present in the plant extracts. The findings align with previous studies, which have reported similar trends in the insecticidal properties of plant-derived compounds.

The environmental impact of the tested extracts was also evaluated. Unlike synthetic pesticides, the plant extracts showed minimal toxicity to beneficial insects, such as honeybees (Apis mellifera) and ladybugs (Coccinella septempunctata). This selectivity is a significant advantage of natural insecticides, as it supports the preservation of biodiversity and ecosystem balance.

Conclusion

This study highlights the potential of plant-derived natural insecticides as sustainable alternatives to synthetic chemical pesticides. The results demonstrate that certain plant extracts, particularly those from Azadirachta indica and Chrysanthemum cinerariifolium, exhibit strong insecticidal activity against common agricultural pests. The phytochemical analysis revealed the presence of bioactive compounds, such as alkaloids, flavonoids, and terpenoids, which contribute to the insecticidal properties of the extracts. The bioassay results underscore the importance of optimizing extraction methods and concentrations to enhance the efficacy of natural insecticides.

The findings of this research have significant implications for the development of eco-friendly pest management strategies. By reducing reliance on synthetic pesticides, natural insecticides can mitigate environmental pollution, prevent resistance development in pest populations, and promote sustainable agriculture. Future research

should focus on improving the stability and scalability of natural insecticides, as well as exploring their potential for integration into IPM programs. Overall, this study contributes to the growing body of knowledge on natural insecticides and their role in addressing global agricultural challenges.

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