



The Insecticidal Function of Rotenone: An Important Evaluation

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Insecticides have been present in agriculture for centuries, keeping pest populations in check so that crops grow tall and good in quality. Among the myriad insecticides used in organic farming and insect pest control, rotenone is an old, natural substitute for chemical insecticides. From such crops as the Derris crop and Lonchocarpus crop, rotenone has been around for decades, employed to control a variety of insect pests. Although its uses have diminished with contemporary agriculture due to fear of being toxic and causing environmental damage, information on how rotenone is utilized as a pest controller, how it acts, and its dangers is critical for farmers and consumers. This paper is going to discuss the application of rotenone as an insecticide and its history, effectiveness, and environmental concerns. It is going to discuss its continued application in some of the agricultural processes and other pest control operations.

Rotenone History and Source

Rotenone is a botanical insecticide, which has been isolated from root and stem bases of various genera of plants, including plants in the genera Derris and Lonchocarpus. The tropics have employed the plants for numerous centuries both for trapping fish and as an insecticide. Rotenone is a very potent chemical, which is the basis for the insecticidal effect of the plant, and acts against insect cellular respiration. Early in the 20th century, the insecticidal effect of rotenone was recognized, and rotenone found extensive application in horticulture and agriculture. Its use expanded as a natural insecticide versus man-made chemical insecticides, particularly during the mid-1900s when the general public's concern over the health and environmental effects of chemical insecticides, including DDT, started rising.

Mode of Action

Rotenone inhibits the activity of mitochondrial enzymes involved in cellular respiration. Rotenone inhibits the electron transport chain, which is a critical component of energy production in living things. Inhibiting this, rotenone starves the insect or animal of the energy it requires to live and kills it. This action is very specific in some organisms. While rotenone is toxic to many insects, it is even more toxic to those with a very high rate of metabolism as well as to those that depend upon extensive aerobic respiration. It is very potent thus, for insect pests such as aphids, fleas, ants, and beetles. Moreover, rotenone extends its impact more broadly to water organisms. Rotenone is poisonous to aquatic life and fish that breathe in oxygen. Before, it has been used in "rotenone fishing" techniques to sedate fish for easier capture. This has nonetheless caused severe ecological issues since rotenone contributes to poisoning an entire aquatic habitat.

Effectiveness of Rotenone

Rotenone has performed excellently on most insect pests of commercial and household garden crops. Rotenone is excellent in the control of soft-bodied insects that are resistant to other chemical modes of control like the aphids, mealybugs, and whiteflies. Rotenone has

also performed well in the control of soil insects like the root maggots, and in controlling pests infesting tree fruits and ornamental crops. Rotenone as a pesticide is generally applied by spraying or dusting directly on the pest populations. It is applied most often in organic farming systems due to its perception as a natural pesticide. Nonetheless, despite being effective, it has been losing ground because newer and more selective insecticides have been developed, and more attention is paid to its safety profile.

Environmental and Health Issues

Even though rotenone is of natural origin, it is also not hazard-free regarding health and environmental impacts. There have been various studies in the past that have raised an eyebrow over its non-target toxicity as well as its impact on human health. Its non-target toxicity is an enormous concern with rotenone. As mentioned earlier, it is highly destructive for fish and other aquatic organisms. When rotenone is over-applied or washed off into water bodies, it can be extremely harmful to aquatic organisms. The substance is also harmful to various animals like mammals, birds, and beneficial insects like bees and honeybees. While it is usually less toxic than man-made chemicals in terms of long-term persistence in the environment, its acute toxicity is still potentially dangerous to local wildlife if not properly managed.

The Decline in Rotenone Use

Use of rotenone as an insecticide fell into disfavour in the later part of the 20th century when less toxic, more targeted compounds were found. Contemporary synthetic insecticides like pyrethroids and neonicotinoids are more selective in action, killing fewer beneficial insects and wildlife. In addition, biological controls, for example, releasing natural enemies like ladybugs and parasitoid wasps, are used routinely in integrated pest management (IPM) systems. With growing awareness of the risks of pesticides, consumers and regulatory bodies began to demand substitutes that were not only effective but also less environmentally toxic. Though rotenone is still available to organic farmers, its use is being questioned more and more in the light of safer and more environmentally conscious alternatives in pest control.

Rotenone in Organic Farming

Even though it is out of widespread usage, rotenone is still an accepted organic insecticide within some organic food production systems. The United States Department of Agriculture (USDA) National Organic Program (NOP) allows the use of rotenone in organic agriculture but under stringent controls. Organic farmers can apply rotenone in cases of severe pest infestations, particularly where other controls such as biological controls or non-toxic chemicals are not sufficient. Under such circumstances, the use of rotenone presents a means of controlling pest populations without the application of synthetic chemicals. Its use is normally reserved for special cases, and farmers are encouraged to incorporate it into integrated schemes of pest management that minimize its impact on the environment and non-target organisms.

Alternatives to Rotenone

The growing problems of rotenone use have prompted the development of alternative pest control strategies. Biological control is one of the most effective techniques of integrated pest management (IPM). It entails the introduction or encouragement of the natural predators of pests, e.g., ladybugs, lacewings, and predatory beetles, which control the pest population. Moreover, newer and less toxic chemical insecticides like insecticidal soaps and diatomaceous earth provide more secure pest management. They affect pests directly without being excessively harmful to human health and the environment. Other natural insecticides, neem oil and pyrethrin, obtained from the chrysanthemum plant, are increasingly being used as substitutes for rotenone. These substitutes are less harmful to mammals and useful insects but very effective for controlling pests. Their use conforms to the principles of organic agriculture, where sustainability and reducing footprints in the environment take precedence over everything else.

Conclusion

Rotenone has been a useful pest control chemical for decades, particularly in organic farming and biological pest management systems. Its wide range of activity against insect pests made it a useful addition to the farmer's toolkit. However, its toxicity to aquatic organisms, wildlife, and potential human health impairment has led to its reduced application in favor of safer and more environmentally friendly alternatives. Though undesirable, rotenone's role in the history of agriculture cannot be denied. As farmers struggle with pests, the information that has been gained through rotenone can be used to shape the solutions of tomorrow. Though still an option in certain organic systems of agriculture, the trend toward more environmentally and health-friendly approaches to pest control is evident. Lastly, the secret to successful pest control is in the balance between efficacy and sustainability. By applying a combination of many different control practices—chemical and non-chemical—farmers can control pest infestations without harming the environment or human health. Along the way, the past of rotenone can continue to offer a better more responsible pest control strategy for the future.

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