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Impact of Pesticides in Rice Ecosystem

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Abstract

Rice is an important food crop and attacked by various insect pests. There are few insect pests which affect the yield and productivity of the crop. Use of insecticides inevitable for the rice pest management. However, use of chemicals in the rice ecosystem had several problems and need to be addressed to save the wetland ecosystems. Use of common chemicals by the farmers in rice and various issues related to resistance, resurgence and residue were discussed.

Introduction

Among food crops, Rice is an important crop and staple food for more than 60 percent of the people in Asian countries. Self-sufficiency is achieved in the production of rice in our country; however, the growth rate of rice production does not match the growing population. Rice crop harbour relatively large number of insect pests especially in tropical regions. Since the crop is attacked by pests and diseases right from the time of sowing till harvested, inadequate crop protection in India has been causing an annual loss to the time of nearly 36% by insect pests alone (Verma and Gupta, 2001). About one-fifth of them are considered as important or major pests causing enormous loses to rice crop. It has been estimated that rice crop alone suffers damage due to pests and diseases to the extent of Rs. 100 crores annually. However, among them 8-10 insect species are more common and causing serious damage in rice crop. Pesticides are one of the principle components in the pest management of rice. In overall rice crop stands second place in the consumption of insecticides behind cotton crop.

Insecticides as a Major Tool in Rice Pest Management

Rice is attacked by several groups' insect pests including sucking insects, borers as well as defoliators. Among the sucking insects, thrips, green leafhopper, brown planthopper, white backed planthopper, white leafhopper, mealy bug, earhead bugs, black bug are common in India. Thrips and green leafhopper damage is mostly noticed nursery areas. Recently black bug and leaf mite is also causes severe damage during early vegetative stage of the crops. Such new insect pests can be managed by already available systemic insecticides. Brown planthopper is still continued its dominance in several part of out country. Though several resistant varieties are released, once the incidence appear in severe form there is very little alternate to chemicals. Recently this pest attack noticed late stage of the crops also in some of the areas where rice grown continuously. Similarly borers and defoliator insects are also noticed outbreak like situation when climate and weather in the local areas conducive.

Some of the commonly used insecticides in rice ecosystem for the pest management are list below.

Table 1: Chemicals used in rice pest management

Commonly used by farmers	Recently used by farmers
Cypermethrin 10 EC	Imidacloprid 17.8 EC
Dimethoate 30 EC	Cartap hydrochloride 50 SP
Endosulfan 35 EC	Buprofezin 25 SC
Fenthion 100 EC	Fipronil 5 SC
Quinalphos 20 EC	Chlorantraniliprole 18.5SC
Profenophos 25 EC	Triazophos 40 EC
Carbofuran 3 G	Thiamethoxam 25 WG
Carbaryl 50 WP	Dinotefuran 20 EC
Acephate 75 SP	

Among the chemicals some of the chemicals were already banned and should not utilize in rice ecosystems. In the state wide surveys conducted at different districts it was revealed that still farmers use the synthetic pyrethroids (Table 1). Moreover most of the farmers use tank mixture of 2 or 3 insecticides, fungicides and growth regulators. This kind of unawareness among the farmers leads the out break of insect pest time to time and related problems. The insecticide use pattern in rice crop reveals that upto 40 days of transplanted crops receives more insecticides. Usually after panicle emergence stage insecticide use has been restricted. Very few pest are noticed after flowering and also depend upon the severity. Earhead bug incidence is usually experienced at later stage of rice crops which require one round of insecticide.

The usual problems associated with pesticides are resistance, resurgence and residue. The development of insecticide resistance is common in the pesticides used for sucking pests particularly brown planthopper. Resistance in chlorpyriphos as well as newer compound imidacloprid is recorded in Tamil Nadu (Anagha *et al.,* 2016). Insecticide resistance in leaffolder is also noticed recently in rice growing regions of Tamil Nadu. Changes in the level detoxifying enzymes in such insect population were demonstrated. The enzymes involved in the resistant development were mixed function oxidases, glutathione-S-transferase and carbaxylesterase (Nayak *et al.,* 2018).

The resurgence problem associated with insecticides mostly killing of natural enemies. Use of more synthetic pyrethroids, quick knock down, broad spectrum chemicals completely eliminate the natural enemies in the ecosystem particularly in rice ecosystem. Some of these chemicals also induce the gonads of reproducing organs and leads more egg laying capacity.

The harvest time residue analysis revealed that low amount or low detectable residues from the grains and straw when endosulfan, chlorpyriphos and monocrotophos treated crop. These chemicals left terminal residue at below detectable level (BDL). This might be due to more time gap between pesticide application and harvest. If adequate time allowed for insecticide degradation the residues will not be issue. Quinalphos left residues in straw only, whereas malathion residues were detected in all the paddy fractions. The interval between spraying of quinalphos (42 days), malathion (28 days) and harvest was less, which may not be adequate for complete degradation of these residues.

Impact of Insecticides in Wetland Ecosystems

Wetland is typical system which harbours aquatic and terrestrial fauna which is essential for balancing the ecology. It is important to preserve the aquatic fauna to maintain the balance between insect pests as well as natural defenders. Most of the bioindicator insects are present in wetland system. These insects will provide information about the ecological balance and impact of pollution and other activities over long period of time. Bioindicator can be defined as species or species group that reflects the abiotic or biotic state of the wetland environment represents the impact of environmental change on a habitat, community or ecosystems, or indicates the diversity of other species. Entomofauna studies to furnish information about ecosystems conversation status their productivity and levels of water contamination and pollution. Therefore bioindicator species identification is essential, due to the important role that these organisms have as transformers and regulators of ecosystems.

The bioindicator insects in wetland systems are dragonflies, damselflies, bugs (water bugs) and midges. The few other insects such as mayflies, caddisflies, stoneflies are considered as fresh water indicators. When the wetland water flow into the lake or fresh water bodies these insects also had influence due to the chemicals used at the wetlands. Among the midges chironomids are important group of insects which had potential value in assessing the impact in rice ecosytems.

Several aquatic insect groups can be used as aquatic environment bioindicators. Odonata species are very sensitive to changes caused to their habitat, especially lakes and flooded drainage areas. Several other species of the families Gyrinida, Dytiscidae, Hydrophilidae, Notonectidae, Velidae and Plecoptera and Ephemeroptera orders have high adaptive capacity colonizing most of the environmental and occurring through the year, reflecting ecological and geographical changes and hence their conversation status. The tolerance of aquatic organisms to heavy metals has been explained by the metallothioneins formation in many aquatic organisms. If the presence of metallothioneins is a measure of metal tolerance, the measurement of metallothioneins could provide clues about the tolerance in this organisms and possible toxic agents responsible for environmental stress. However, insects are less used as pollution by metals, although species of the genus Halobates are suitable for bioindicators of cadmium and mercury. Odonata and Mollusca were used as bioindicators to assess pollution in the river Narmada basin, India. Some species of dragonfly were used as indicators for assessing general species richness.

Use of chemical in the rice ecosystem for the management of rice insects indirectly alters the vector physiology and there is every possibility of developing resistance in these vectors especially mosquitoes. Various techniques have been suggested for the vector management instead of insecticides. Alternate wetting and drying, periodic quick flushing, wetland-dryland crop rotation are few of the methods suggested for the control of vectors at break their life cycle in wetland waters. Growing of azolla plants is also suggested to prevent the adult female to lay eggs in the water.

Conclusion

Growing knowledge about saving the ecosystems, environmental conservation leads to utilization of holistic integrated pest management techniques paves way to change the attitude that insecticides are one of the option but not the only option for rice cultivation systems. Developing new pest management techniques like pheromone trap or augmentation of biological control agents are some of the alternate resources to minimize the use of pesticides in the rice ecosystems.

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