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Changes in Rice Cultivation Led to Accentuation of Pest and Disease Problems

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Abstract

Rice, being the principal food for majority of the overall human population plays a crucial role in the Indian economy and livelihood. It is the agricultural commodity with the third-highest worldwide production. However, modern high yielding varieties were developed and introduced during the mid-1960s which could cope up with a range of biotic and abiotic stress. These varieties were photo-insensitive and could be cultivated in non-traditional areas also.

Keywords: Agricultural commodity; Weather variables; Human nutrition; Labour-intensive; Agro-ecosystem; Climatic variability

Introduction

Further, the farmers started growing the varieties of crop with different genetic backgrounds in a mosaic fashion, meaning existence of several varieties in the field during the crop season with low or no fertilizer use probably, which was the major reason for the maintenance of pest populations at low level. Insect-pests are yield-limiting factors of rice production with an estimated yield loss of about 25% describing the pest population in relation to environmental weather variables [1]. The pest complexity of rice that attacks the crop from nursery till maturity necessitates the use of 22% of pesticide share in India even when the ecological approach of integrated pest management is in focus. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one-fifth of the calories consumed worldwide by humans [2]. There are many varieties of rice and edible preferences that tend to vary regionally. Rice, being the labour-intensive crop to cultivate and as it requires ample water, is well-suited to cultivate in the countries and regions with low labour costs and high rainfall [3]. However, rice can be grown anywhere, even on mountain area or on a steep hill with the use of water-controlling terrace systems. Centuries of trade and exportation have made rice common in many cultures worldwide, although its parent species are native to Asia and certain parts of Africa [4]. Integrated pest management is an adaptation to the life cycle of the insect and its behaviour. For developing a successful integrated pest management plan, it is essential to know the farmer's agricultural practices and knowledge of pest species in a given agro-ecosystem [5].

Methodology

A farmer's practices and a well-designed integrated pest management plan should be closely linked in rice ecosystems. An ecosystem level understanding of pest life cycles provides the basis for successful design and implementation of an integrated pest management strategy. The primary focus of the National integrated pest management program of any country in the world is to protect the crop against the pesticide-induced pest resurgence [6]. A successful integrated pest management plan accounts for the protection of beneficial insects, secondary pest outbreaks, spread of disease, contamination of air, water and soil resources and pest resurgence as shown in (Figure 1). Weather-based forecasts of insect pests provides information on the timing and intensity of the pest infestation beforehand that guides the farmers to take up timely, cost-effective and eco-friendly protection measures in addition to enhanced resilience to climatic variability [7]. The farmers in the number of countries could be benefitted on a large scale by the vast scale adoption of integrated pest management in rice agro-ecosystem. In the past, agricultural production increased through area expansion and increasing use of high yielding seeds, chemical fertilizers, pesticides and irrigation water. Over the next three decades, production of food grains in India has increased to about approx. 2 million tonnes a year to meet the food demand of the growing population. There are multiple definitions of integrated pest management issued by government, research organization, NGOs and Universities [8]. Integrated pest management is a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all the feasible techniques and methods in a compatible manner as possible and maintains the pest population at levels below those causing economically unacceptable damage or loss. Thus integrated pest management is the best combination of cultural, biological and chemical measures that provides the most cost effective, environmentally sound and socially acceptable method of managing diseases, insects, weeds and other pests. Crop Monitoring is the basis of integrated pest management and keeps the track of the insect-pests and

Figure 1: Pest resurgence.

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Figure 2: Crop monitoring.

their possible damage on the crop as shown in (Figure 2). It is helpful in selecting the best possible combinations of the pest management methods, also provides knowledge about the current pests and crop situation [9]. There are several crop monitoring tools, but Pheromone traps being light and sticky have got advantage over the other tools. They have proved their importance in large scale integrated pest management validations in cotton, basmati rice, chickpea and pigeon pea, being selective to specific pest [10].

Discussion

Crop rotation, fallowing, manipulation of planting and harvesting dates, manipulation of plant and row spacing and destruction of old crop debris are a few examples of cultural methods that are used for management of the pests. The important management techniques include Planting of cover crops, nectar producing plants and inter-planting of different crops to provide habitat diversity to beneficial insects. It includes crop production practices that make crop environment less susceptible to pests. A cover crop can also be used as a green manure, which is incorporated in the soil to provide nitrogen and organic matter to the subsequent crop [11]. Cultural controls are selected based on knowledge of pest biology and their development. Physical or Mechanical Controls Hand picking of insect pests is perhaps the simplest physical method to control the pest. Mechanical control methods are based on the knowledge of pest behaviour. Placing plastic-lined trenches in potato fields to trap migrating Colorado potato beetles is one example of the physical control. Shaking of the pigeonpea plant to remove Helicoverpa larvae is a common practice in pigeonpea growing areas [12]. Installation of dead as well as live bird perches in cotton and chickpea fields has proved effective in checking the bollworm infestation. Using mulches for smoothening weeds and providing row covers to protect plants from insects are other examples of such control methods. A number of microorganisms such as Trichoderma spp., Verticillium spp., Aspergillus spp., Bacillus spp. And Pseudomonas spp. that attack and suppress the plant pathogens have been exploited as biological control agents. Biological control includes augmentation and conservation of natural enemies of pests such as insect predators, parasitoids, parasitic nematodes, fungi and bacteria. The native natural enemy populations are conserved in IPM programmes and non-native agents may be released with utmost caution. Trichogramma spp. is the most popular parasitoids being applied on a number of host crops [13]. When the pests cannot be controlled by other means, pesticides are used to keep the pest populations below economically damaging levels. A wide range of man-made chemicals are included in the Synthetic pesticides which are fast-acting, easy to use and relatively inexpensive. Because of their potential negative effect on the environment, ideally pesticides should be used as a last resort in integrated pest management programmes. Pesticides with the least negative impacts on non-target organisms and the environment are most useful. Fortunately, new generation pesticides with low environmental effects and novel modes of action are being developed and registered for use. Pesticides that are short-lived or act on one or a few specific organisms fall in this class [14]. There is much research, that has been done to determine the damage thresholds for a variety of crops and pest situations, yet the studies are inconclusive. Economic threshold assessment is based on the concept that most plants can tolerate at least some pest damage. In an integrated pest management programme where the economic threshold is known, chemical controls are applied only when the pest's damaging capacity is nearing to the threshold, despite application of other alternative management practices. Some botanicals are broad-spectrum pesticides and can be prepared in multiple ways as raw crushed plant leaves, extracts of plant parts, and chemicals purified from the plants. Pyrethrum, neem, tobacco, garlic and pongamia formulations are few examples of botanicals and are generally less hazardous to transport and less harmful to the environment because of their quick degrading property. The major advantage is that these can be formulated on-farm by the farmers themselves. Pest Resistant Varieties Breeding for pest resistance is a continuous process. At the same time the pests also, particularly the plant pathogens, co-evolve with their hosts. Thus, gene transfer technology is useful in developing cultivars resistant to insects, plant pathogens and herbicides. An example of this is the incorporation of genetic material from Bacillus thuringiensis, a naturally occurring bacterium, in cotton, corn, and potatoes, which makes the plant tissues toxic to the insect pests. Scientific community is impressed by its huge potential in managing the pests, but is also concerned about the possibility of increased selection pressure for resistance against it and its effects on non-target natural fauna. However, due to ethical, scientific and social considerations, this potential technology has been surrounded by controversies. Integrated pest management in rice is now strongly based on its interaction with soil nutrients and varieties and ecological understanding of the crop.

Conclusion

The rice ecosystem in Asia is primitive to the region as rice was first domesticated before the recorded history, perhaps more than 6000 years ago, while reaching cultivation similar to that of modern days in the sixteenth century. This lengthy time period shows that the rice crop, pests and their natural enemies have existed together and coevolved for thousands of generations. Rice ecosystems, during the season with regular flooding from irrigation or rainfall, typically include both a terrestrial and an aquatic environment.

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Conflict of Interest

None

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