RICE PESTS AND THEIR MANAGEMENT IN SRI LANKA

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Introduction

One of the primary objectives of the Government of Sri Lanka over the past three decades has been the attainment of self-sufficiency in rice—the staple food of the 14 million inhabitants of the island. The national average has doubled during this period from about 1,400 kg. per ha. in 1950 to 2,800 kg. per ha. in 1976. The national production now represents about 70 percent of the total requirement of rice.

Currently the area under rice cultivation is about 770,000 hectares. These rice lands fall into 2 categories: around 65 percent of the lands have a more or less stable environment where the soils and water are optimal for rice. The balance 35 percent of the area has an unstable environment prone to one or several of the following stresses—iron toxicity, low phosphorus, salinity, alkalinity, cold temperature, drought and flood stress.

The new improved varieties have moved very swiftly into the stable environment, but only the more adaptable old improved hybrids, selections and indigenous cultivars are able at present to cope with the stresses in the unstable environment. The traditional varieties like the heenatis, suduru sambas and devaderri with average yields of 1,100 kg. per ha. are found in about 10 percent of the rice lands, while the old improved varieties such as H4, H105 occupy the remainder of the "unstable" rice lands.

The production thrust in rice until recently, favoured varietal and agronomic components that could exploit the full genetic potential of the high yielding varieties. The combination of increased irrigation resources, with year-round cropping of a few photo nonsensitive high yielding varieties and the wide-spread use of nitrogen with little or no application of phosphate and potash fertilizers have vastly changed the rice field environment into a habitat for the build-up of certain pest species which were economically less important in the past.

Pests of economic importance and control measures

The major pests of rice in Sri Lanka are the brown planthopper *Nilaparvata lugens*, the rice leaf folder *Cnaphalocrocis medinalis*, the gall midge *Orseolia oryzae*, the white backed planthopper *Sogatella furcifera*, the rice field mole rat *Bandicota bengalensis* and the paddy bug *Leptocorisa varicornis*. In certain areas the yellow stem borer *Tryporyza incertulas* still has a major status while the rice thrips, *Baliothrips biformis* causes high losses in late season plantings of rice. From time to time and in localized areas minor rice pests such as the case bearer *Nymphula depunctalis*, the rice swarming caterpillar *Spodoptera mauritia*, the rice stem fly *Atherigona exigua* and the rice field crabs of the genus *Partelphusa* have flared into prominence. Though some of the environmental factors that promote pest build-up are known, manipulation of these is not always practicable. Once the insect numbers reach economically damaging levels chemical measures are the only dependable tool.

Data from trial plots where the crop had received insecticidal coverage throughout its growth has shown increases in yields ranging from 17-61 percent. It is therefore apparent that efforts to reduce pest damage would to a large extent bridge the current gap of 30 percent in attaining self-sufficiency in rice.

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The responsibility for dealing with pest problems lies with the Research and Extension branches of the Department of Agriculture. The Division of Entomology of the Central Agricultural Research Institute, Gannoruwa, Peradeniya, spearheads the basic and applied research on insects and other pests of rice. Breeding of rice for resistance to pests is one of the primary objectives of the Rice Varietal Improvement Program headquartered at the Central Rice Breeding Station, Batalagoda. The Plant Protection Division of the Extension Services is instrumental in handing down the research findings to the farmers. Their services consist of identifying pest problems, advising on aspects of plant protection and organizing field control operations in the event of pest outbreaks. The Plant Protection Officers and twenty-two Agricultural Instructors (Plant Protection) work in close association with the District Extension Staff and Training Division of the Department of Agriculture in training and educating both departmental and other public officers and cultivators on crop protection.

Control of the major pests of rice until recently had been achieved entirely by applying chemicals. However, a beginning has been made with the integration of a few straightforward techniques which embody the basic principles of Integrated Pest Control.

The change over from routine spray schedules for the control of the stem borer—the then major pest of rice—to intentional or timed treatments was made in the mid-sixties. This approach could be considered as a first step towards integration of pest control measures. The next major step was taken when the search for genes resistant to pests of major importance was initiated. As a consequence new varieties possessing resistance genes to the gall midge and the brown planthopper have been developed by our scientists. Detailed information on the ecology of the key pests is by no means complete but data on the impact of agronomic practices, natural enemies and the growth stage or duration of the host plant on the population dynamics of certain pests has been accumulating. These findings have enabled entomologists to modify their recommendations so as to avoid some of the adverse effect of pesticides.

The current recommendations for the control of pests of rice advocate scheduled treatments only in very few instances. These are:

(1) The recommendation of a preventive treatment for the nursery based on the fact that seedlings are likely to become loci or reservoirs for pests that have migrated from rice stubbles, ratoons or weeds in adjacent fields. The area so treated is small in relation to the area covered by seedlings at transplanting.

(2) The gall midge *O. oryzae* infests all stages of the crop when environmental conditions are conducive to its propagation. Generally the build-up of this pest tapers off after maximum tillering as parasite activity reaches a peak. Based on the necessity to protect the productive tillers and the 3-week delay in the appearance of damage symptoms scheduled treatments are recommended for gall midge endemic areas.

(3) In the wet zone the paddy bug *L. varicornis* is a recurrent pest. A routine control measure is the application of two insecticidal treatments 7-10 days apart after the crop flowers.

For all other rice pests, insecticides are recommended on a need basis. Many of the chemicals recommended for the control of rice insects have a broad spectrum of activity, however, compared to Endrin and Parathion, the currently recommended chemicals are inherently less toxic compounds. Further, some of these broad spectrum insecticides like BHC, Diazinon and Carbofuran, are recommended for use in an ecologically selective manner so that their greatest effect or impact is on the target species e.g.:

(1) Using granular formulations for the control of the rice stem borer, the gall midge and the brown and white backed planthoppers.

(2) Timing the application of the pesticide so that it coincides with the most critical stage of the pest. Insecticidal spray applications for the rice stem borer based on the light trap data are so timed as to control the first instar larvae. In the case of the paddy field mole rat, the timing of control measures is to reduce the rat population before the peak in reproductive activity.

(3) Timing the application of insecticides to coincide with the most susceptible stage of the host plant. The application of insecticide granules for the control of the gall midge is timed to protect the productive tillers of the rice plant. In the case of the paddy bug treatments give coverage during the milky stage of the crop.

(4) The use of pesticides only in restricted areas to reduce environmental pollution eg: baits for crabs, mole rats and birds and the protective insecticidal coverage given to rice nurseries.

Preservation of natural enemies

A careful study of the various natural enemies of the yellow stem borer (*Tryporyza incertulas*) in Sri Lanka has indicated that of the nine species parasitizing the immature stages of the host, only the egg parasites play a major role in regulating or limiting the pest. The recommendation of broadcasting granules of Diazinon, BHC or Carbofuran into standing water in rice fields, controls the borer feeding inside the plant, leaving the balance in favour of the beneficial species developing within the egg masses deposited on the leaves.

In regulating planthopper populations, predatory spiders and the mirid bug act in a density-dependent manner. The first symptom of hopper damage is generally the appearance of localized patches of dead or dying plants. Close examination will reveal high pest numbers and usually significant populations of the predators especially the green mirid bug. If these areas are very few and if they appear before grain hardening the steps recommended are the monitoring of such sites over a two-week period to enable natural control mechanisms to operate. However, if signs indicate the spread of hopperburn or widespread build-up of the pest in the tract immediate action is to be taken to treat the field chemically. Both granules and spray formulations are recommended. If the field conditions are suitable a granular application is indicated, as it is ecologically preferable to a spray formulation which could have adverse effects on non-target organisms such as the natural enemies of the rice leaf folder.

Resistant cultivars

1 Gall midge

Several hybrids in all three age classes-3, 3-1/2 and 4-4-1/2 months have been bred from HYV and GM resistant donor material. Repeated laboratory, greenhouse and field screenings have indicated the high degree of resistance that has been incorporated into these lines. Currently 2 lines have been released—Bg 400-1 and Bg 276-5.

2 Brown planthopper

Reports on the development of biotypes on resistant varieties indicate that the brown planthopper has a high level of adaptiveness to the host variety. It is therefore necessary to develop varieties with polygenic resistance. One of the donors used in evolving BPH resistant hybrids in Sri Lanka is Ptb 33 which has two genes for resistance. Laboratory and greenhouse studies have indicated that the resistant progenies do not possess the same degree of resistance as the donor parent. Currently several of these lines are being observed for field resistance in demonstration plots sited in areas endemic to the pest. As it is the third generation of BPH that causes extensive damage in the longer aged cultivars, the strategy that will be adopted is the release of 3-3 1/2-month resistant varieties wherever it is found to be feasible. Should more virulent biotypes develop on these lines they would still escape damage as the duration of the crop in the field is not sufficient for the build-up of the pest.

Cultural practices

Several cultural practices used in rice cultivation are compatible with the above mentioned techniques for controlling specific pests.

(1) The cleaning and reforming of bunds necessary for efficient water management have an adverse effect on crabs and mole rats.

(2) Weeding of fields and slashing of weeds on bunds prior to flowering, remove the alternate hosts of the gall midge, brown planthopper and paddy bug.

(3) Manipulation of the water level is very effective in limiting populations of planthoppers, swarming caterpillars, case bearers and stem fly.

(4) The adoption of the transplanting of seedlings, instead of broadcasting the seed, leads to a natural reduction in brown planthopper populations. (The reverse holds for the whorl maggot *Hydrellia phillippina*—a potential pest). However, both stem borer and gall midge in endemic areas could be more widely dispersed under transplanted conditions, if preventive measures are not taken during the nursery period. Further, as transplants are under water stress thrips can be more damaging at this stage than plants of similar age growing under broadcast conditions. Although farmers have been educated on the need to eliminate staggered planting in irrigated areas and late planting in the wet zone, as a first step in preventing the build-up of thrips, brown planthopper, stem borer and paddy bug, yet, their socio-economic conditions at times force them to resort to such practices.

Based on the available knowledge and in the absence of an effective system of pest surveillance or forecasting to guide pest control, the following practices have been recommended for the control of pests in rice cultivation.

(1) The use of resistant or short aged varieties in areas endemic to the gall midge and BPH respectively.

(2) Staggered planting to be avoided.

(3) The balanced use of fertilizer, sound agronomic practices like spacing and weeding with the use of high yielding short aged varieties.

(4) Cultural practices that minimize pest problems—the manipulation of the water level, slashing of weeds on the bunds and clean weeding—to be encouraged.

(5) Nurseries to be raised (where feasible) and chemically protected to obtain pest-free seedlings.

(6) Use of insecticides only on a need basis and where possible in a selective manner for the control of the brown planthopper and stem borer.

(7) BPH and stem borer to be monitored (by insect counts, light traps or egg mass counts) for the timing of insecticide application.

Constraints to the application of IPC

In spite of the identification of practices that could be integrated threre is need for more sustained action to develop and implement a program of Integrated Pest Control in rice. The major constraints in developing such a program are:

(1) The lack of trained manpower and the organizational infrastructure for regular pest surveillance and monitoring.

(2) The paucity of research information on:

- (a) Pest ecology in relation to crop physiology and phenology.
- (b) Crop loss assessments.
- (c) Sampling techniques for pests.
- (d) Host parasite inter-relationships for the major and potential pests of rice.
- (e) Economic thresholds of pest populations for recommended rice varieties in different cropping systems.
- (f) Agronomic practices which are optimal for IPC.

(3) The socio-economic conditions of the large number of small farmers involved in rice cultivation.

(4) Inadequate control of water issues in the major irrigation schemes which encourage staggered planting of rice crops.

However, on the information and expertise currently available in Sri Lanka a pilot project on Integrated Pest Control for rice pests should be established on a modest scale. The thrust of the pest control package of resistant varieties, timed insecticidal applications and potential agronomic practices, should be directed towards controlling the brown planthopper, the gall midge, the leaf folder and the paddy field mole rat. Such a project would serve

(1) as a site for testing out the applied value of the available components of the IPC method.
(2) to point out the areas where the national capabilities and activities need to be strengthened.
(3) a "demonstration plot" to familiarize extension workers, farmers and key administrators and politicians who could wield influence on the development and implementation of a program that would lead to the use of more effective and economical crop protection measures.