

# **An Approach to Integrated Pest Control of Rice**

NALLINI WICKRAMASINGHE

*Central Agricultural Research Institute, Gannoruwa, Peradeniya*

## **SUMMARY**

In its efforts towards self sufficiency in the staple food, Sri Lanka's intensification of rice culture has caused an aggravation of rice pests. Yield losses due to insect damage recorded in experiments range between 17-61%. There is thus an immediate need for a proper pest control program if rice production increases are to be sustained. Insecticides alone cannot achieve this. They have to be used in combination with other control techniques, so as to avoid adverse side effects of these chemicals. A strategy known as integrated pest control could achieve this end but there are several constraints that prevent its early implementation. However, research findings indicate that several pest control techniques could be harmoniously combined so as to reduce over reliance on chemicals. In the absence of a pest monitoring system seven practices are recommended for insect control in the rice crop, which would discourage the build up of pests.

## **INTRODUCTION**

The urgent need for self-sufficiency in the staple diet over the last two decades has led to intensification of rice cultivation in Sri Lanka. The major inputs have been new varieties, balanced fertilizer applications and pesticide use. Rice yields have increased substantially from an average of 26 bushels per acre in the early fifties to 58 bushels per acre for the Maha cropping season in 1979/80. However, the extension of areas with double and triple cropping; the widescale replacement of hundreds of indigenous varieties with comparatively fewer high-yielding varieties; the increased usage of nitrogenous fertilizers and the indiscriminate use of persistent insecticides have caused an aggravation of the pest situation in the land.

The extent to which the rice crop is damaged by insect and other pests varies greatly in time and place. On the basis of field plots where the crop had received insecticidal protection throughout its growth, yield increases due to pest control ranging from 17-61 percent are possible. It is therefore apparent that a concerted effort to reduce pest damage would to a large extent bridge the current gap of 30% in attaining self-sufficiency in rice. But a pest control program to effect a significant and sustained increase in rice production cannot rely on routine pesticide schedules. The development of resistant strains of pest species, the upsurge of secondary pests the impact on non-target organisms and the spiralling cost of pesticides, limit their use.

*Pests of Rice in Sri Lanka*

The major pests of rice in Sri Lanka are the Brown plant hopper *Nilaparvata lugens*, the rice leaf folder *Cnaphalocrocis medinalis*, the gall midge *Orzeolia oryzae*, the paddy thrip *Baliothrips biformis*, the yellow stem borer *Tryporyza incertulas*, the white backed plant hopper *Sogatella forcifera*, the paddy field mole rat *Bandicoota bengalensis* and the paddy bug *Leptocorisa varicornis*. From time to time and in localized areas, minor pests such as case bearer *Nymphula depunctalis*, the swarming caterpillar *Spodoptera mauritia*, the paddy stem fly *Atherigona exigua* and paddy field crabs of the genus *Paratelpusa* have flared into prominence. Though certain of the environmental factors that permit specific insect species to achieve pest status are known, the manipulation of these are not practicable. The rational approach is to manage the rice crop so as to reduce the build up of pests by all the practical methods now available, but once insect numbers reach economic damage levels, chemical measures are the only dependable tools. However, alternative techniques (based on the ecology of the pest species) which would selectively affect the target organism alone, are available only for specific situations.

*Intergrated Pest Control*

The ecological approach to minimize pest damage is far from new, nevertheless, as an aftermath of the over reliance on chemicals during the post, World War II era, this concept was relabelled as intergrated pest control (Smith and Reynolds 1966). An incisive definition made by Van den Bosch *et al* 1971 is as follows:-

“Intergrated control is a pest population management system that utilizes all suitable techniques either to reduce pest populations and maintain them at levels below those causing economic injury, or to so manipulate the populations that they are prevented from causing such injury. Integrated control achieves this ideal by harmonizing techniques in an organized way, by making the techniques compatible and by blending them into a multifaceted flexible system. In other words, it is an holistic approach aimed at minimizing pest impact while simultaneously maintaining the integrity of the ecosystem.” The underlying principle is comprehensible and convincing. However, intergrated pest control cannot always be immediately realized in practice as a high level of expertize is essential for the execution of such a programme (FAO 1966). Background knowledge even at a minimum level is required on

- a. the bionomics of the key pests,
- b. the approximate threshold levels of the pest population at which crop protection measures are required,
- c. the significant natural enemies and the times and places of their occurrence,

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- d. the impact of control measures on the significant parasite predator or pathogen species.

Further, in order to establish an integrated programme, the monitoring of pests and ecological changes must be continued to detect the need for the establishment or modification of control procedures (Corbet & Smith 1976)

The high level of scientific background and the development of the feedback mechanism from the field, requires trained and permanent personnel at all levels of crop protection—research, surveillance, extension and administration. The lack of these is the major constraint in adopting a comprehensive programme of integrated control. Nevertheless, a beginning has been made with integration of a few straightforward techniques which embody the basic principles of integrated control.

### *The IPC Perspectives in Entomological Research*

Twenty five years of nonselective pesticide use have shown that the management of pests exclusively in terms of pesticidal efficacy was not technically sound. The change over from the routine prophylactic spray schedules for the control of stem borer—the then major pest of paddy—to intentional timed sprays was made in the mid sixties. Steiner (1965) considers the progressive decrease in the amount of pesticide applied to the environment as a first step towards integration. the next major step may have been taken when the search for genes resistant to insects and diseases of major importance was initiated. As a consequence, new varieties which have resistant genes to blast, gall midge, brown and white backed plant hoppers have been or are being developed by our scientists. Detailed information on the ecology of the key pests are 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 have been accumulating. These findings have enabled entomologists to modify their recommendations so as to avoid some of the adverse effects of pesticides which however will remain as the main weapon in reducing pest outbreaks to sub economic levels.

### *Available IPC Techniques*

For the regulation of major pests at levels that will not lead to substantial yield losses, the various techniques available are: (i) the selective use of chemicals; (ii) The preservation of natural enemies; (iii) the use of resistant varieties and (iv) several cultural and agronomic practices. These must be integrated in the manner advocated by Smith (1967), to achieve the “fullest practical utilization of the existing mortality and suppressive factors.” i.e. the integration of techniques with the naturally regulating and limiting parameters of the environment.

*The Selective Use of Pesticides*

Many of the recommended chemicals for controlling rice insects have a broad spectrum of activity, but their efficacy has been evaluated in terms of the degree of pest damage controlled, than on their ability to give 100% kill. Compared to Endrin and Parathion, the recommended chemicals are inherently less toxic compounds. Further, certain of these broad-spectrum insecticides BHC, Diazinon and Carbofuran, are used in an ecologically selective manner so that their greatest effect or impact is on the target species. This has been done by using granular formulations (for stem borer, gall midge and brown plant hopper) timed to coincide with either the most critical stage of the pest (stem borer and baits for paddy field mole rat) or of the host plant (gall midge, paddy bug) and in a restricted manner. The recommendation of a preventive treatment for nurseries was based on the fact that these are likely to become loci or reservoirs for pests that have migrated from ratoons, rice stubble or weeds in adjacent fields. The area so treated is small (usually about 1/10) in relation to the area that may require treatment once the pest is dispersed with the seedlings at transplanting. This tactic of using pesticides in restricted areas is also apparent in the use of chemicals in baits for crabs, mole rats and birds.

*Preservation of Natural Enemies*

Not all the natural enemies of a pest are significant in regulating pest populations. Before one makes an effort to protect beneficial organisms from the impact of chemical control measures, one has to determine which species are really suppressive. The identification and the evaluation of biological agents for their capacity to control pests has to be carried out. If they are efficient all efforts must be made to make full use of this factor which contributes to pest mortality.

The sporadic outbreaks of populations of the pentatomid bug, paddy swarming caterpillar and the rice leaf folder, in those high-risk rainfed tracts where fertilizer inputs are minimal and the crop is usually left unprotected or receives only partial protection, is mainly due to adverse environmental factors affecting the usually very efficient parasites of these pest species.

A careful study of the various natural enemies of the yellow stem borer 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. (Fernando 1970). The recommendation of broadcasting granules of Diazinon, BHC or Carbofuran into the standing water of rice fields, controls the borer feeding inside the plant leaving the balance in favour of the beneficial forms developing within the egg masses deposited on the leaves.

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In regulating plant hopper populations predatory spiders and the mirid bug act in a density dependent manner. The first symptom of hopper damage is generally 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 or if they appear after grain hardening they should be observed over a two week period, giving a chance for the predators to operate. If, however, there be any sign of the damage spreading, or if there be widespread build-up of the pest in the tract, immediate action must be taken to treat the fields chemically. As the hoppers colonize the base of the plant, a granular application with a chemical having systemic or fumigant action would be ecologically preferable to the use of a spray which could have effects on non-target organisms such as the natural enemies of the rice leaf folder.

### *Resistant Varieties*

The breeding of high-yielding varieties with genes for resistance to a few key pests has been a heavy research input. Rice varieties in all three age-classes having gall midge resistance are in the pre-release stage. Varieties with Bph resistance are in yield trials this year. However, for those insect species which are highly adaptive to the host variety, there are indications that varietal resistance will not prove to be the major control strategy. This has been so in the case of Bph control in the Philippines, where biotypes have developed on resistant varieties. In this context in Bph endemic areas 3-3 1/2 month age resistant varieties would be suitable. Even if biotypes develop, the plants will escape injury, as the duration of the crop in the field is not sufficient for damaging populations of the third generation hoppers to develop.

### *Cultural Practices*

Several cultural practices used in rice cultivation are compatible with the above-mentioned techniques for controlling specific pests. The clearing and reforming of bunds necessary for efficient water management has an adverse effect on crabs and mole rats. Weeding of fields and slashing of weeds on bunds prior to flowering removes alternate hosts of gall midge, brown plant hopper and the paddy bug. Manipulation of the water level is very effective in limiting populations of plant hoppers, swarming caterpillars, case bearers and stem fly. The adoption of the transplanting method, instead of broadcasting seed, leads to natural reduction in brown plant hopper populations. The reverse holds for a minor pest-the whorl maggot. The optimal spacing for high yields and low hopper population for Bg 34-6 is 6"x6". 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 water stress is experienced by transplants, thrips can be more damaging at this stage than under broadcast con-

ditions. The practice of multiple cropping or growing of an alternate Yala crop in the intermediate and dry zone tracts leads to marked reduction-populations of stem borer, whorl maggot and case bearer due to scarcity of their food source, while an increase in rat population is to be expected.

*Practices recommended for Rice Pest Control*

Rice is a low-value crop, and under rainfed conditions prone to high risk. To protect such a crop every measure should be taken to reduce the annual input of effort and money. The techniques to be used must meet the needs of the farmer and their adoption will be conditioned by climate, the existing cropping systems, the local pest species, the weed flora, the efficiency of water management and socio-economic factors.

Based on the available knowledge and in the absence of a surveillance or forecasting system to guide pest control, the following practices are strongly recommended for the rice crop:

1. Use resistant or tolerant varieties in areas endemic to specific pests.
2. Avoid staggered planting.
3. Use agronomic practices of spacing, fertilizer-level and high-yielding short-age varieties judiciously.
4. Encourage cultural practices that minimize pest problems-deep ploughing, manipulation of water level, slashing of weeds on bunds and clean weeding.
5. Raise nurseries (where feasible) and apply chemicals to obtain pest-free seedlings.
6. Use insecticides only on a need basis and when possible in a selective manner for Bph and stem borer.
7. Monitor Bph (by actual counts in the fields) and stem borer (by light traps or egg mass counts) for timing of insecticides.

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