Integrated Pest Management of Rice in Rice-Wheat Cropping Systems

The dynamics and severity of pest attack has shifted with the adoption and spread of rice-wheat crop rotation in the Indo-Gangetic Plains during the last three decades. Excessive use of chemicals for pest control in agriculture is known to degrade the environment. Integrated Pest Management (IPM) involves a proper choice and blend of compatible tactics (cultural, mechanical, biological and chemical) so that the components complement each other to keep the pest population at manageable levels.

Implementation of IPM in Rice

Although Integrated Pest Management (IPM) is accepted in principle as the most attractive option for the protection of agricultural crops from the ravages of pests, its implementation at the farmers' level is rather limited. Pesticides still remain as the means of intervention and as an essential component of IPM strategies.

It may not be possible to avoid chemical pesticides altogether but integrating non-chemical methods in pest management can reduce dependence on chemical control. This would reduce the costs considerably besides offering protection in an ecologically sound manner. In rice, the cost of average pesticide application is Rs. 163.50 and Rs. 447.90 per hectare respectively for IPM trained and untrained farmers.

Components of Integrated Pest Management (IPM)

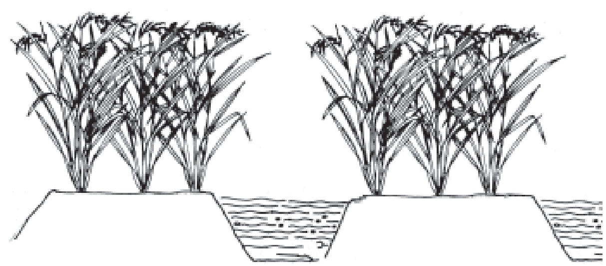
Pest-Resistant Crop Varieties

This is the easiest, effective, compatible, economical and practical method among all the pest management practices. Such crop varieties are extensively used in pest-prone areas as a principal method of IPM or as a supplement to other pest management strategies. It can counter the pest problems and is free from all adverse effects of pesticide use. A number of resistant varieties, with single or multiple resistance to insect pests, mites and nematodes, are commercially available. These varieties have high yield potential and possess desired agronomical characteristics.

Cultural Methods

These refer to good agronomic practices that enhance the crop productivity and also suppress the pest population. The cultural practices which are commonly used for rice in rice-wheat systems are:

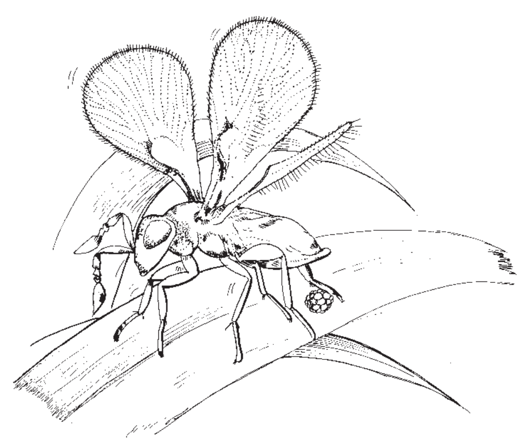
- **Proper Sanitation –** Timely removal of weeds to reduce the pest survival and reduce the chance of any carryover of the pest.
- **Proper Water Management –** Timely irrigation and good drainage system is required to control plant hoppers.
- **Proper Spacing –** Provision of alley ways of 30cm. width after 2-3m or bed planting particularly in the White backed plant hopper and Brown plant hopper prone area, proves helpful.



- **Timely Planting –** Timely and synchronous planting can reduce the occurrence of insect pests like Yellow stem borer, Gall midge, Brown plant hopper, White backed plant hopper and Green leaf hopper.
- **Balanced Fertilizer –** Judicious and optimum dose of nitrogen and other fertilizers based on soil testing is essential. Split dosage of nitrogen can also reduce the risk of Gall midge, Leaf hopper, Brown plant hopper, White backed plant hopper and Green leaf hopper.

Biological Control

Biological control is the mainstay of the IPM strategy. Out of 100 phytophagus insects having potential of becoming pests, only a few attain the pest status while the rest are kept under check by their natural enemies. Even those which attain the pest status have biological agents like predators, parasites and pathogens which decrease their population in the rice ecosystem. It is very important to conserve the natural enemies of pests in the field. Avoid the use of broad spectrum pesticides when natural enemies are abundant.



However, it is observed that inundative release of egg parasite, *Trichogramma japonicum* that *T. chilonis* is really an effective approach to decrease the Yellow stem borer or Leaf folder incidence. It is also observed that a very high count of *Trichoderma viridae* and a few bacterial antagonists are effective against fungal pests.

Chemical Control

Application of pesticides is no doubt one of the quickest and, sometimes, the only solution for the sudden outbreak of pests, specially insect pests. Their application draws the farmer to quick and visible action. However, their prophylactic usage is not economically and environmentally sound.

The IPM Approach

IPM is a knowledge-based technology and it is now an in-built component of crop improvement research and its various disciplines. Several technologies are available for implementation of IPM. Many of them are outcome or consequence of the failures of those technologies that had been in practice and/or a refinement of a successful practice. Presently, the available technologies aim to provide an ecologically-sound pest management program with sustainable use of renewable natural resources and comprise the following practices for rice in rice-wheat systems.

1. Use of the improved crop variety which is recommended for the area.
2. Sowing of seed at the proper time and at recommended rate.
3. Soil solarization in the nursery bed.
4. Seed treatment with Vitavax @ 2.5gm/kg seed, *Trichoderma sp.* @ 4gm/kg seed and *Aspergillus niger* @ 8gm/kg seed.

5. Use of balanced fertilizers, preferably as NPK granules and zinc sulphate.
6. Hand weeding/application of herbicide Butachlor @ 1.5kg/ha or Anilophos @ 0.4 kg/ha within 2-3 days of transplanting.
7. Release of egg parasite *Trichogramma japonicum* @ 150,000/ha at days interval for 2-3 times.
8. Selective application of chemicals as a last resort depending upon the pest attack.

Availability of IPM technology alone is no guarantee that it will be highly effective and economical. There is a strong need for farmer participation. The research and extension agencies have to ensure that quality inputs needed for IPM are easily and economically accessible to the farmers. Awareness must be created among farmers for community level IPM that will save their resources, manpower and environment. There is a strong need to develop forecasting and forewarning models on the basis of climatic variability.

Success Story of IPM in Basmati Rice

Many insect pests attack basmati rice in the predominantly basmati rice growing areas in the states of Haryana, Uttar Pradesh and Punjab in India. Leaf folders, *Cnaphalocrocis medinalis* and yellow stem borer, *Scirpophaga incertulas*, are the major insect pests in Haryana. Among diseases, blast is the most important one followed by bacterial leaf blight. For controlling these pests, farmers follow chemical control methods which are quite expensive and often lead to pesticide residue problems.

Pesticide residues adversely affect the export potential of Basmati rice. To overcome these problems, an IPM module was developed. The module was field tested from 1994 to 1996 by the National Center for Integrated Pest Management, New Delhi, in collaboration with Rice Research Station, Kaul, in the Haryana State of India. A popular basmati rice variety in the area, Taraori, was chosen for experimentation and raised according to normal agronomic practices followed in the region. The IPM strategy consisted of the release of *Trichogramma japonicum,* spraying of neem-based pesticide, and use of insecticidal spray only as the last resort. For blast, application of burnt rice husk, which induces resistance to the disease, and need-based application of fungicide were the main components. The IPM treatment was compared with sole pesticide treatment and untreated control. The results showed that the IPM approach reduced the infestation of leaf folder and stem borer effectively and it was almost at par with the insecticidal application during all the three years. The chemical control gave the highest yields of 31.51, 34.33 and 28.25 q/ha, compared to the 29.89, 31.96 and 28.55 q/ha in IPM treated fields during 1994, 1995 and 1996, respectively. However, economic analysis indicated that the IPM method was superior to the chemical control method, as the mean cost benefit ratio of IPM over untreated control was 1:5.70 as compared to 1:5.03 of the chemical control method.

On–farm trial of this IPM technology was carried out during the monsoon season of 1997 at Baraut, which is emerging as a potential Basmati-producing area in Uttar Pradesh State of India. The continuous monitoring of pests showed moderate to high incidence of leaf folder and low incidence of stem borer in this area. The incidence of sheath blight was also noticed but did not warrant fungicidal application. However, timely field release of *Trichogramma japonicum* in IPM fields suppressed the incidence of leaf folder and stem borer to a bare minimum. Overall, results showed the superiority of IPM over chemical method or farmers' own practices as indicated by the yield data and economic analysis.

Important Pests of Rice in Rice-Wheat Cropping System

Common name	Scientific Name	Symptoms	Intensity	Change
Insects				
Leaf folder	*Cnaphalocrosis medinalis*	Folds leaves and remains inside, scraping the green tissues between the veins making the leaves white and papery and can give scorched appearance on drying up.	*****	+
Brown plant hopper	*Nilaparvata lugens*	Plants become yellow and die. Insects congregate in large numbers, causing hopper burn in circular patches.	***	↑↑↑
White backed plant hopper	*Sogatella furcifera*	Hopperburn frequently appears uniformly over large areas. Insects suck sap causing reduced vigor, stunting, yellowing of leaves, delayed tillering and grain formation.	*****	↑↑↑

Common name	Scientific Name	Symptoms	Intensity	Change
Insects				
Green leaf hopper	*Nephotettix virescens*	Important vector of viruses that cause rice dwarf, transitory and yellowing, tungro and yellow dwarf disease.	****	↑↑↑
Rice hispa	*Dicladispa armigera*	Linear patches along the veins. The yellowish grubs mine into the leaves presenting blister spots. Feeds on the chlorophyll. As a result, irregular/longitudinal white patches/blotches are produced.	**	↓↓
Diseases				
Bacterial blight	*Xanthomonas oryzae*	Typical vascular wilt disease. The partial or total blighting of leaves or complete wilting of affected tillers leads to unfilled grains.	*****	↑↑↑
Blast	*Pyricularia oryzae*	Reduces the number of mature panicles, grain and straw weight. Main attack is between seedling and maximum tillering stages and often plants die.	*****	↑↑↑
Sheath blight	*Rhizoctonia solani*	Seedling may be infected in the nursery. Infection starts at the base of plant and death of the seedling is observed. Seedling often observed only in patches.	****	↑↑
Brown spot	*Helminthosporium oryzae*	Innumerable dark brown elliptical spots are comon on leaves, stem and glumes. At maturity, these lesions/spots may exhibit a dark or reddish brown margin with light brown or grey centre.	***	↑
Falsesmut	*Ustilaginoides virens*	The affected grains are transformed into greenish black masses and in general only a few grains in a panicle are infected.	***	↑
Rice tungro virus	*RTV*	Stunting of the plant and discoloration of leaves characterize the infection. It reduces tillering, number and length of panicles and number of spikelets and also delays maturation.	**	↑
Nematode		Sedentary endoparasites of roots.		
Root-knot nematode	*Meloidegyne graminicola* *M. triticoryzae* *Rarely,* *M. javanica,* *M. incognita*	Hyperplasia of root protophloem and abnormal xylem proliferation causing swollen knots in stele; disruption and hypertrophy of root cortex; small galls with many females, curly or club shaped galls on root tips; stunted plants with chlorotic leaves; curling of leaves along midribs; poor tillering; shorter earheads with fewer poorly filled grains. Damage more in nursery, upland direct seeded rice and transplanted rice in well drained soils	**	+

* Very low to ***** very high intensity
\+ minor pest, becoming a major problem
↑↑↑ major pest increasing in economic importance
↓↓ major pest declining in economic importance
↑ increasing trend

Adapted from:

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