International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
ISSN: 2457-0362
www.ijarst.in

# AN EFFICACY STUDY OF ALTERNATE HOSTS FOR INSECT PESTS AND DISEASES

**GLORY BODDUPALLY**
**Research Scholar Monad University, Delhi Hapur Road Village & Post Kastla, Kasmabad, Pilkhuwa, Uttar Pradesh**
**DR. KAPIL KUMAR**
**Research Supervisor Monad University, Delhi Hapur Road Village & Post Kastla, Kasmabad, Pilkhuwa, Uttar Pradesh**

## ABSTRACT

Several researchers have recommended using parasitoids, predators, resistant kinds, and bio-rational procedures as alternatives, and this study aims to investigate those options as well as others. On the other hand, the extent of cultural practises and insecticidal treatment in the field is limited by the insistence on filthy field method to preserve predators and parasitoids. It is also hypothesised that the rice crop eco-microclimate, system's fauna variety, and plants' compensating capacity might all lend a hand to the slow activities of botanicals and fungal formulations in pest control. To combat major insect pests like Scirpophaga incertulas (Walker), Cnaphalocrocis medinalis (Guenee), and Nilaparvata lugens (Stal) on rice in the Cauvery delta region (The rice bowl of Tamil Nadu), the research will focus on plant-based traditional formulations/extracts and myco-insecticide formulations, both singly and in combinations.

**KEYWORDS:** Botanicals Management, Insecticides, bio-rational procedures, insecticidal treatment

## INTRODUCTION

Millions of people rely on rice (Oryza sativa L.) as a consistent source of nutrition. About 90% of the world's 148 million hectares (FAO, 2012) dedicated to rice farming are located in Asia, yielding 483 million tonnes.

When it comes to both white and brown rice, India is the world's second-largest producer. In 2011–2012, India planted 44.31 million hectares of rice and harvested 155.74 million metric tons (FAO, 2012).

In Tamil Nadu, rice is king, thus farmers there focus on perfecting their rice fields above everything else. Tamil Nadu devotes over 35% of its total cropped land to the cultivation of rice, which is grown across the state during eight distinct growing seasons (Thiyagarajan and Kalaiyarasi, 2012). One and a half million and fifty thousand hectares are dedicated to rice farming in Tamil Nadu (FAO, 2012).

More than 300 species of insects are known to cause havoc in tropical rice fields, but the vast majority of these pests are not economically damaging enough to warrant the use of any management practices, thanks to the robust compensatory abilities of rice plants in the vegetative stage to recover from injuries (Rubia et al., 1996). Yet, agricultural losses can be caused by a select few insect pest species, especially in large numbers. This poses a serious danger to food security.

Insect pests on rice might have a bigger or smaller impact in different countries. Serious difficulties with various insect pests have been reported in major rice-producing countries including China, Vietnam, India, and Thailand. Weeds, insect pests, and diseases were estimated to account for 10.2%, 15.1%, and 12.2% of the global loss of rice output, respectively (Oerke, 2006). Sucking pests (Rajendran et al., 1986) and borers and leaf feeders (Lal, 1996) were found to diminish the potential rice harvest by as much as 80% and 21%-51%, respectively, in India.

Rice is commonly attacked by Cnaphalocrocis medinalis (Guenee), a leaf folder, during the early phases of crop development, resulting in obvious leaf damage. Normal PS II activity and relative water content of leaves were also reduced by 23% after leaf folding injury, while chlorophyll content was reduced by 57%. If there are more than three larvae per hill at the peak tillering stage, the crop will have a lower relative water content of 23 percent, a lower PS II activity of 28 to 57 percent, and up to 20 percent empty grains. Damage to the flag leaf area of 25% or more during the blooming stage directly reduces rice output by 50% or more due to empty grains (Padmavathi et al., 2013).

Most tropical and subtropical regions are dominated by the monophagous yellow stem borer, Scirpophaga incertulas (Walker), whereas the striped stem borer, Chilo suppressalis (Walker), is found mostly in temperate rice. S. incertulas attacks rice at every stage of its life cycle. Losses in yield due to borer infestation have been estimated at 30%–70% during epidemic years and 2%–20% during off-outbreak years in Bangladesh and India, respectively. Loss of yield averages 1.3% for every 1% of white ear present (Satpathi et al., 2012).

In various places, a spike in the population of the brown plant hopper, Nilaparvata lugens (Stal), has led to significant crop losses during specific times of the year. Damage on a massive scale has been documented in India, Indonesia, the Philippines, and Sri Lanka as a result of this bug. A brown plant hopper infestation can cause a production loss of up to 60% in rice varieties that are vulnerable to the pest. The grassy stunt disease that N. lugens spreads might add even more difficulty to tending and protecting your crops. For example, significant N. lugens outbreaks have been recorded to be followed by grassy stunt epidemics in India, Indonesia, and the Philippines.

**Weeds as alternate hosts for insect pests and diseases**

At least 155 weed species, according to Islam and Catling, act as alternate hosts for the principal rice insect pests, while more than 80 weed species act as alternate hosts for the major rice illnesses that affect Oryza sativa, the crop used for human consumption. Grass accounts for 63%, sedges for 10%, broad-leaved plants for 6%, and other field crops for 21% of all insect food sources. These four plant families account for almost the same share of disease incidence. Echinochloa spp. is the most important grass for rice insect hosts, although seven species of Oryza wild rices, six species of Panicum, and five species of Paspalum also play a role. Four of the most common grass species and eight types of Oryza rice are also major vectors for rice-borne pathogens. Many species of the genus Cyperus are the most significant sedges in terms of their importance to insects and illnesses, and the gramineous crops maize, wheat, sugarcane, and millet are the most important crops connected with rice.

**Rice-weed competition**

Weeds are significant biotic restrictions because of the damage they do to rice fields. Because of their shared genetics and developmental needs, rice and weeds are aggressive competitors. Factors such as edaphic (soil) parameters including nutrients, weed density, rice variety, period of rice and weed development, and crop age when competition begins all influence the level of competition. A specific rice habitat has a limited supply of light, water, and nutrients, and once those resources are used, they cannot be replenished.

Light competition occurs throughout plant development, and light needs change with crop stage. Weeds outcompete rice by outgrowing it and shadowing its leaves with larger, horizontal leaves. While plants are young, the impact of shadows is greatest. A substantial weed competition occurs between 30 and 45 days after planting, and between 45 and 60 days, rice plants are able to resist subsequent sprouting weeds. After blooming, rice dry matter falls when light levels are too low.

Reduced crop yield results from water stress at any time during crop development, but especially during reproduction. C3 photosynthesis is typical of rice. Yet, many hardy dry land weeds are C4 plants with greater photosynthetic capacity and lower water requirements, making them stronger competitors than rice in dryland circumstances. C4 plants are mostly replaced by C3 plants as a result of floods because C3 plants are less of a threat to rice. The root dispersion and elongation rate of rice and weeds, as well as their genetic tolerance for low water availability in plant tissue, and their capacity to regulate water loss via transpiration, all contribute to their distinct levels of drought resistance.

Growth and yield are mostly controlled by three nutrients: nitrogen, phosphorus, and potassium. Several weed species absorb nutrients at a rate comparable to rice yet make better use of those nutrients. As plants are able to take in water efficiently, they are also better able to take in nutrients.

**Characteristics of successful weeds**

Weed out prosperity and competition. For the purpose of expansion and maturity, weeds have evolved a wide variety of methods. Some weeds have big seeds that germinate quickly, while others are climbers that outcompete rice in every way (height, photosynthesis, growth rate, leaf size, root depth) (enabling the exploitation of nutrients). Weeds are also very resilient in the face of environmental shifts (climate change and global warming) [89], allowing them to flourish and spread.

Spreading by means of offspring. Several weeds, such as red rice, have non-synchronous maturation of their seeds, which causes them to shatter before the rice crop is ready [90]. There are many generations of annual weeds because of their brief life periods. The reproductive organs of perennial weeds are located underground, allowing for both sexual and vegetative reproduction. Even under ideal conditions, many weed seeds never germinate. Due to their high reproductive output and extended period of dormancy, many seeds are able to overwinter in the soil. Mature weed seed and fruits are dispersed by wind, water, animals, and people [91]. Wildflower seeds may easily

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

disperse in rice fields if water is allowed to flow through them.

**Weed severity and losses**

Weeds are opportunistic invaders that will take over any plantable area. A catastrophic crop failure might be the result of their constant danger to the rice harvest. While growing rice, weeds can diminish productivity in various ways:

- They compete with rice for nutrients, soil moisture, and sunshine, all of which reduce yield.
- Raise production and processing expenditures by increasing the cost of control, replacing nutrients and water loss.
- Lower rice grain quality by causing admixtures of wild rice and other weed seeds that reduce the market value of rice.
- Reduce flow of water in irrigation and drainage channels resulting in seepage, flooding and breaks in canal banks.

Weeds are a major factor in the worldwide decrease in rice productivity. Weed damage costs differ from nation to country because of differences in weed flora and agronomic practices. There are two instances that illustrate the scope of the issue. China loses 10 metric tons (MT) of rice every year to weed competition [93]. This amount of rice is enough to feed at least 56 million people for one year. Weeds account for 30-40% of yield losses in rice cultivation in Sri Lanka, despite the fact that the nation is often regarded as rice self-sufficient.

Parasitic weeds are extremely difficult to eradicate from a region in West Africa. Striga asiatica, Striga aspera, Striga hermonthica, and Rhamphicarpa fistulosa are the most common parasitic weeds of rice. An estimated 950,000 rural families in Africa are affected by these parasitic weeds, which invaded 1.34 million hectares of rainfed rice in Africa and thrive by siphoning off water and nutrients from host crops. Intensified agricultural productivity and climatic shifts are exacerbating the problem.

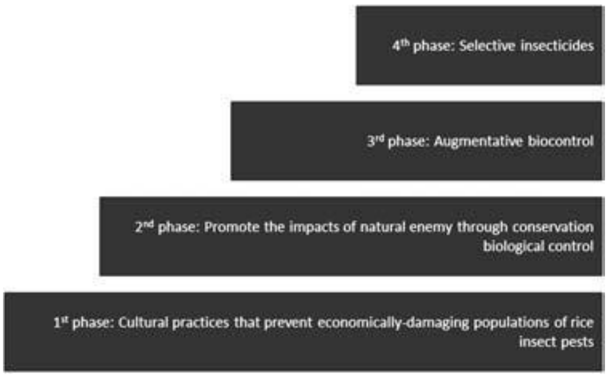


**Figure 1 Conceptual framework for rice IPM (adapted from Zehnder et al.)**

Some of the world's poorest farmers reside in regions hit hard by parasitic weeds. AfricaRice and its partners have conducted studies showing that women farmers in Africa are disproportionately impacted by parasitic weeds because they are often compelled to cultivate rice on the most marginal and parasite weed-infested plots.

At least 28 of Africa's countries that rely on rainfed rice production are currently facing difficulties due to parasitic weeds. Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Madagascar, Mali, Nigeria, Sierra Leone, Tanzania, and Uganda are some of the worst hit. Parasitic weeds are rapidly growing in the rainfed rice area, and researchers from AfricaRice warn that if nothing is done to stop them, the annual damage would rise to almost US $30 million.

**MANAGEMENT OF RICE PESTS**

**Concepts and options for rice IPM**

Rice pests can cause serious losses in yield before harvest. This holds true in particular during times of pest outbreak. It has been demonstrated that irrigated rice is an agroecosystem that supports a diverse array of organisms and a robust food web. When pesticides are overused, it has a domino effect on irrigated rice ecosystems, harming natural enemy communities, shortening food chains, and increasing the likelihood of pest outbreaks. To reduce the risk of pest outbreaks while still reducing the vulnerability of rice production, a new framework for insect pest management is required.

The conceptual framework for arthropod pest management in organic crop production was proposed by Wyss et al. and Zehnder et al (Figure 1). The methods used to control these insects are divided into four distinct "stages" in this model. The framework gives preference to pest management strategies that lower the risk of infestation (stages 1 and 2) and reduce the need for damage control (stage 3 and 4). We will adopt and modify this conceptual framework to structure the discussion on various rice pest management options in rice ecosystems.

**Cultural practices**

Cultural methods that directly target insect pest populations are called primary practices, and crop husbandry practices that have indirect impacts on pest populations are called tertiary practices (secondary practices). Insect and rodent control by physical and mechanical means is among the earliest forms of pest management in rice. These procedures usually require a lot of manual effort. One may further categorize these cultural activities based on the optimal geographical scale: Two types of businesses are distinguished by their scale of operation: (1) single-field businesses and (2) community-based businesses (i.e. covers multiple fields within a locale). Litsinger compiled a list of cultural activities that stop economically destructive populations of rice pests from expanding, and we divide them into categories in Table 9 based on their main purpose (primary vs. secondary practices) and ideal geographical size. Primary cultural activities like host plant resistance deployment and secondary cultural practices like fertilizer management are the bedrock of creating a rice ecosystem with less susceptibility to insect pests.

Strategies for deploying host plant resistance against insects and diseases. There has been a lot of effort put towards locating resistance genes and breeding them into elite cultivars. Sources of resistance against various insect pests and diseases that plague rice crops have been found, particularly in Asia.

The biggest difficulty in using host plant resistance to combat rice insect pests is ensuring that the resistance will last. Rapid adaptation of rice pest populations to the used resistant cultivars was observed. There is a lot of evidence for this in rice-brown planthopper ecosystems.

Mundt outlined a few broad deployment options, including gene rotation, field combination of resistance genes, and gene pyramiding, to increase the longevity of resistance genes against pests and illnesses. Gene rotation is deploying a resistance gene in a specific location, keeping an eye on local pest virulence and adaptation to the gene, and switching to a different resistance gene once adaption is seen. This deployment strategy has been shown to be practical in extending resistance to rice blast disease. The difficulty is in detecting the target pest's adaptability to the released gene through the installation of regional monitoring programs.

Field deployment of a variety of varieties is similar to gene rotation in that it exposes the same cropping space to two or more resistance genes over time, but it exposes different sections of the cropping space to two or more varieties with varying degrees of resistance at the same time. The severity of rice blast was decreased and the requirement for fungicide use was cut in half in large-scale studies conducted in China. Unfortunately, the research did not track how well the method worked to make resistance to rice blast persist longer.

Several studies found that when two or more resistance loci were pyramided together, the resulting lines were more resistant to the target pest in terms of feeding, settling, survivability, population expansion, and damage to host plants compared to monogenic lines. On the other hand, a pyramided line (with both Bph1 and bph2 genes for brown planthopper resistance) was shown to be equally resistant as introgression lines with Bph1 alone by Sharma et al.. Nevertheless, the effects of pyramiding resistance genes on the long-term stability of resistance were not examined in any of these trials.

Despite the success in identifying resistance genes against rice pests, there is still a lack of understanding of their function and the resistance mechanisms connected with them [104]. Adaptation of pests to resistant rice cultivars is a complex issue, with little consensus on the underlying processes and genetic/physiological bases. It's hard to know how different deployment techniques will affect the rate of insect adaption toward resistant rice cultivars without these data.

Pesticide and fertilizer control. Insect pest populations in rice fields can be influenced by careful fertilizer management because it changes the plants' attractiveness and appropriateness to herbivorous insects. The leaffolder's larval development time and oviposition rate both increased with the amount of nitrogen in the soil (C. medinalis). Female leaffolder moths were more likely to deposit eggs on rice plants with greater fertilizer rates than on plants with lower rates. According to the results of a small-scale field experiment, the quantity of leaffolder eggs on plots with a high fertilizer rate (150 kg/Ha) was greater than that on plots with lower fertilizer rates (0 and 75 kg/Ha). Additionally, plots receiving large doses of nitrogen fertilizer had the greatest rates of leaffolder larval survival since this factor adversely associated with the frequency of natural enemies of these pests.

**Conservation biological control**

The insect population in irrigated rice fields is kept under check by nature. Irrigated rice represents a complex ecosystem with a large number of species and a highly redundant food web, even among farmed plants. Insects from many different orders and families, including as araneae, orthopterans, coleopterans, aquatic and terrestrial heteropterans, hymenopterans, strepsipterans, and dipterans, feed on and parasitize herbivorous insects at all phases of their life cycles in rice habitats.

Early in the cropping season, generalist predators including spiders and mirid bugs were plentiful over all irrigated rice producing fields in Java, as demonstrated by Settle et al. Preseason organic matter increases led to more decomposers, which in turn raised predator populations. These associations suggested that, before the appearance of phytophagous insects, predators in rice ecosystems turned to decomposer communities as a source of alternative prey. Staggered planting, a common technique in places with high rice output, might further guarantee the constant supply of prey and hosts in rice fields, leading to a thriving population of natural enemies.

The conservation biological management of rice ecosystems builds on and expands the natural pest regulation offered by these common natural enemy populations. The natural habitat for natural enemies is sometimes highly disturbed by annual monoculture agricultural systems. One of the perturbations impacting natural enemy populations in these farming systems is the heavy use of pesticides [138]. Another is the probable absence of adult food supply and refuge. The goal of conservation biological control is to improve natural enemy populations and reduce the need for pesticides by modifying agricultural environments and spreading the word about selective insecticides.

The impact of pesticide use on beneficial and harmful insects. Schoenly et al. [96] reported a striking difference in pest and natural enemy populations between sprayed and unsprayed fields in a descriptive study of insect population dynamics as modified by early pesticide treatment (20-50 days after transplanting). There were more natural enemies in the untreated field by midseason than in the treated one. Yet, at midseason, herbivorous insect populations were larger in the field that had received three early doses of pesticide. When authors developed food webs for the two types of fields, they discovered that the mean length of the food chain was shorter in the fields that had been treated with insecticides earlier. Around 40 days after the initial spraying, the shortening of the food chain persisted. Even while natural enemy populations subsequently expanded in fields where insecticide was used early, the damage caused by midseason herbivore proliferation may have already been done.

This sudden explosion in pest numbers can be attributed to at least two factors, the first of which is the use of insecticides too soon. The first study to establish this connection was conducted by Schoenly et al., and they found that the presence of herbivores increased rapidly following the administration of insecticides, which had previously reduced the number of natural enemies. The temporary liberation of herbivores from natural enemies following early pesticide treatments has been credited with contributing to the growth in the herbivore population.

Fitness in the ecological sense is the second mechanism. The brown planthopper's reproductive rate increased in response to a sub-lethal dosage of pesticide, as reported by Chelliah et al. and Chelliah and Heinrichs. Hormesis refers to the phenomenon wherein a sub-lethal dosage of a certain pesticide improves the ecological fitness indices of some insects. New researches on the effectiveness of hormesis against a variety of rice pests employing a wide range of active substances have recently been published. The second way by which pesticide treatment might increase pest populations is the stimulation of ecological fitness factors by a sub-lethal dosage of the chemical.

**CONCLUSION**

This research aims to examine the various alternatives that have been proposed by scientists. When compared to strategies like using parasitoids, predators, resistant varieties, and bio-rational techniques, the accessibility and versatility of botanicals obtained from plant sources and fungal formulations make them preferable. Nevertheless, the use of cultural techniques and insecticides in the field are limited by the filthy field approach that is adamantly defended in the sake of conserving predators and parasitoids. It is also hypothesized that the rice crop ecosystem's microclimate, fauna variety, and plants' compensating capacity might all lend a hand to the slow, steady, effective work of botanicals and fungal formulations for pest control. To combat major insect pests like Scirpophaga incertulas (Walker), Cnaphalocrocis medinalis (Guenee), and Nilaparvata lugens (Stal) on rice in the Cauvery delta region (The rice bowl of Tamil Nadu), the study area will focus on plant-based traditional formulations/ extracts and myco-insecticide formulations individually and in combinations.

**REFERENCES**

Abdel-Baky, N.F., N.S. Arafat and A.H. Abdel-Salam. 1998. Three *Clasporium* spp. as promising biological control candidates for controlling whiteflies (*Bemisia* spp.) in Egypt. **Pak. J. Biol. Sci., 1(3):** 188-195.

Abdul Rehman Dhuyo and Naheed M. Soomro. 2008. Pathogenicity of *Beaveria bassiana* (Deuteromycota: Hyphomycetes) against the yellow stem borer, *Scirpophaga incertulas* (Lepidoptera: Pyralidae) under laboratory conditions. **Pak. Entomol., 30 (1):** 37-42.

Abou-Bakar, H. 1997. *Metahrizium anisopliae* (Metsch.) Sorokin, a potential entomogenous fungus for controlling cotton leaf worm, *Spodoptera littoralis* (Boised.) in clover fields. **Egypt. J. Biol.Contr., 7(1-2):** 111-114.

Al-Deghairi, M.A. 2008. Bioassay evaluation of the entomopathogenic fungi, *Beauveria bassiana* against eggs and nymphs of *Bemisia tabaci* Gennadius (Homoptera: Aleyrodidae). **Pak. J. Biol. Sci., 11(12):** 1551-1560.

Alice, J., R.P. Sujeetha and L. Nadarajan. 2004. Occurrence of entomogeneous fungi on rice pests on Karaikal region. **Insect. Environ., 9:** 192.

Alves, S.B., R.M. Pereira, R.B. Lopes and M.A. Tamai. 2003. Use of entomopathogenic fungi in Latin America. In: Upadhyay, R.K. (ed.), Advances in microbial control of insect pests. Kluwer, New York, pp.193-212.

Amaugo, G.O. and S.O. Emosairue. 2005. Effect of neem seed kernal extracts on stem borer damage and yield of upland rice in southeastern Nigeria. **Int. Rice Res. Notes., 30:** 24-25.

Ambethgar, V. 1996. Occurrence of white muscardine fungus *Beauveria bassiana* (Bals) on the rice leaf folder *Cnaphalocrocis medinalis.* **Ann. Plant Prot. Sci., 4:** 183-184.

Ambethgar, V. 2009. Potential of entomopathogenic fungi in insecticide resistance management (IRM): A review. **J. Biopest., 2(2):** 177-193.

Ambethgar, V., M. Swamiappan and R.J. Rabindran. 2007. Pathogenicity of certain indigenous isolate of entomopathogenic fungi against rice leaf folder *C. medinalis*. **Ann. Plant Prot. Sci., 16:** 35-39.

Amer, M.M., T.I. El-Sayed, H.K. Bakheit, S.A. Moustafa and Y.A. ElSayed, 2008. Pathogenicity and genetic variability of five entomopathogenic fungi against *Spodoptera littoralis*. **Res. J. Agric. Sci., 4(5):** 354-367.

**ol., 54(1):** 85-92.

Anand, R. and B.N. Tiwary. 2009. Pathogenicity of entomopathogenic fungi to eggs and larvae of *Spodoptera litura*, the common cutworm.**Biocontrol Sci. Technol., 19(9):** 919-929.

Anand, R., B. Prasad and B.N. Tiwary. 2008. Relative susceptibility of *Spodoptera litura* pupae to selected entomopathogenic fungi.**Biocontr**