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Reduce Losses to Rice Yield Caused by Bacteria, Viruses, or Fungi

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Introduction

Agronomic practices include growing of resistant and early maturing varieties, early sowing of seeds, proper/close plant spacing, avoiding rice hotspot areas of viruses especially of grassy stunt virus and Tungro virus, crop and field sanitation/hygiene, ploughing after harvesting that helps to bring eggs to soil surface and abolish them, judicious use of fertilizers, flooding of fields in order to save irrigated crops and after forecasting etc. For biological control of insects and pests, numerous natural enemies of insects and pests are used. These living entities attack insects and pests and destroy them. A wide variety of insecticide and pesticides are used as chemical control, according to the extent of attack and crop growth stages. Several viral, bacterial and fungal diseases have been noticed. Disease damage can greatly affect growth and yield of rice crops and can sometimes completely destroy the crop. It is observed that destructive viral diseases are not present in any of the rice growing regions of the world, but fungal and bacterial diseases are widely spread and are very destructive.

Some effects of diseases as direct losses include the spotted kernels, low number of grains, lodging, reduction in plant stands and a general plant efficiency reduction while indirect losses include the application costs of fungicides used to control the disease, yield reduction along with special agronomic practices that not only decrease the disease effect but may not be conducive to higher yield production. The physiological disorders such as zinc deficiency, straight ahead, salt damage, cold injury and nutrient deficiencies are sometimes misunderstood as disease symptoms. Management is necessary in order to avoid damage caused by the diseases. Toward disease management, the first step is the identification of disease followed by field scouting so that extent of disease can be determined. Stem borers are the most severe rice pests in the world. Three families; Noctuidae, Diopsidaem and Pyralidae, have been documented as rice stem borers.

Description

The pyralid borers possess high host specificity. They are most common and destructive. In Asia, the most destructive and widely distributed are *Scirpophaga incertulas, Chilo suppressalis, Sesamia inferens, Scirpophaga innotata* and *Chilo polychrysus*. In Asia, *Chilo suppressalis* and *Scirpophaga incertulas* cause a damage of 5-10% of the total rice crop. *Scirpophaga incertulas* is distributed in the temperate and tropics areas. It is the dominant species in Pakistan, Malaysia, in the republic of Korea, Bangladesh, Sri Lanka, India, Philippines, Vietnam, Thailand, and some parts of Indonesia. The underlying feeding and boring by hatchlings in the leaf sheath cause vast, longitudinal, whitish, stained zones at bolstering destinations, however just infrequently do they bring about shriveling and drying of the leaf-cutting edges. At the point in the middle of the vegetative period of the plant, the focal leaf whorl does not unfurl, but rather turns tanish and gets dry, in spite of the fact that the lower leaves stay green. This situation is recognized as the dead heart and the infected tillers dry off without panicles. Crop agronomic practices show an intense effect on the population of stem borer. High rates of nitrogen fertilizer will provide more plant nutrition and result in higher yield. However, it also increases the incidence of bacterial and fungal diseases by increasing tiller density and tissue susceptibility and boosts the stem borer's multiplication. Insects generally grow larger and faster, produce more offspring by completing more generations per crop and cause more damage when high nitrogen is applied. Stem borer moth's ovi-position occurs favorably under high nitrogen fertilizers. For its management, nitrogen is applied as a split application at optimal rates. Splitting the nitrogen application, and use of slow nitrogen release forms of fertilizers helps to attain higher crop yields and lower chances of pest attack. Silica application helps to increase crop resistance against stem borer. Slag application increases the silica content and makes it resistant to stem borer attack. Clipping the seedlings tip before transplantation is done to eradicate the egg masses. This method is used only for mature seedlings. Crop harvest at ground level reduces the number of larvae. Harvested crop height is an important factor that determines the larvae percentage, left in stubble. Removal and destruction of stubbles from rice field, which will help in the destruction of egg masses. To destroy those remaining eggs, flooding and ploughing of fields and burning and decomposition of rice stubble are suggested. For decomposition, calcium cyanide is used in low amount. Ploughing and flooding are most effective apparently. Uniform burning of stubble is also difficult in a field. Burning of stubbles is effective only when larvae migrate to subsurface soils. In many countries, postponing of sowing and transplanting time is considered a good practice in escaping moths first-generation and it can also decrease the density as well as damage of stem borers both in directly seeded and transplanted rice fields. Changing planting time is not always effective because of other agronomic attention. In Pakistan, planting date is scheduled by canal water release only after the emergence of *Scirpophaga incertulas* moths. This late-planted crop is less affected by moths than early field plantation receiving tube-well irrigation. Delayed planting is an effective practice against *Scirpophaga incertulas* since emergence is also delayed with planting date. The number of generations of stem borer is dependent on the crop growth period. Thus, change in planting time has a slight effect in areas where rice cropping is practiced continuously. Light traps are used for collection and destruction of moths. Catching of moths by light traps shows a variation from a uni-model to a bi model pattern in first and second broods. The frequency vibration based pest lamps used to kill the stem borers. They are installed at 200 m distance from each other in a checkerboard pattern and 1.3 m to 1.5 m above the ground. These

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lamps are switched on during the light period when immigration of stem borers occurs. However, a disadvantage of these lamps is that it will also cause damage to beneficial insect pests. High insecticidal activities of Bt rice are observed against stem borers. Successful control involves repeated foliar applications. Granular insecticides, particularly diazinon and gamma BHC, are most effective than foliar sprays, specifically in high rainfall environments. Gamma BHC is a fumigant that kills inactive moths. In the dead hearts of young crops, granules fertigation is effective in preventing stem borer. The insecticide is dissolved partially in the water and is transported between the stem and leaf sheath by capillary action, to make contact with young larvae. The limitation in the use of this method is cost and water supply. Granules are costly to transport. Stable and deep water levels are required for control. A combination of chemo-sterilant and sex attractant also shows the potential of pest control. Biological control of stem borers in Africa and tropical Asia mostly comes from native parasites, predators, and entomo-pathogens. Over 100 species of these parasitoids have been recognized. The management and protection of these parasitoids are essential in the development of successful and stable integrated pest management systems against stem borer.

Conclusion

The essential genera include; *Trichogramma, Telenomus*, and *Tetrastichus*, *Telenomus* wasps parasitize stem borer eggs before the eggs are covered by the hair while the moth is in the oviposition stage. The wasp detects the female moth, gets attached near ovipositor. Many predators, crickets; *Anaxipha longipennis*, and *Metioche vittaticollis*, and *mirid*; *Cyrtorhinus lividipennis* feed on *Chilo suppressalis*. The long-horned grasshopper preys rapaciously on yellow stem borer eggs. Some important predators are carabid beetles such as *Ophionea* sp., *coccinellid beetles*; *Micraspis crocea* and *Harmonia octomaculata* that attack small larvae of stem borers. *Mesovelia vittigera* and *Microvelia douglasi atrolineata* prey on young larvae when they fall on the water. Ants and many other predators prey on larvae of stem borer. Several fungal species can attack the larvae and ingest them at the stem base the *Cordyceps* sp. Fungus feeds on the body of stem borers. Spiders attack adult moths when resting on foliage. Bats are effective at dusk while birds and dragonflies are active predators at daytime. Spinetoram, Spinosad, Empedobacter brevis and *Beauveria bassiana* possess greater insecticidal effects on stem borers. Another popular biological insecticide, Bt agent, is recommended in China to control rice stem borers.