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Cultural Control of Rice Crop Production

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Abstract

It has been suggested that weedy fields increase the brown plant hopper population Experiments at the International Rice Research Institute show that near rice crop maturity, the plant-hopper tends to be more abundant in weedy than in weeded plots, probably because the dense vegetation of weedy fields provides an environment suitable for the insect.

Keywords: Plant hoppers; Green leafhopper; Harvested rice; Field planting; Relative humidity; Rice fields

Introduction

After harvest the insect usually transfers to weeds and grasses but does not hibernate. Since the survival of the brown plant-hoppers population in the next rice season may depend on alternate host plants, it is important to determine whether certain weeds and grasses serve as alternate hosts on which the insect can breed and feed during both the rice season and the off -season. Definitions of plant-hopper host plants differ. Mochida and Okada compiled more than 90 plant species other than Oryza sativa L. that belong to various families and are believed to serve as host and ovi-position plants for the brown plant-hoppers in Japan. They doubt, however, that all are satisfactory host plants for the insect. They consider a real host plant as one on which the insect could develop for at least one generation in the field [1]. Oka caged 34 species of weeds and grasses individually and infected each with 200 brown plant-hoppers adults. The survival rate on all plants was very low, and by the third week after infestation nearly all the insects were dead. Although they produced a few nymphs on all the test plants, all nymphs were dead 15 days after infestation. Knowing the real alternate hosts for any insect pest is important in sanitation programs. Sanitation aims to remove all breeding or hibernating sites and sources of food of the insect [2]. In Okayama, Japan, epidemics of the rice dwarf virus transmitted by the green leafhopper were almost completely subdued within 2 years by winter plowing to control weeds such as Alopecurus aequalis Sobol, an alternate host for the green leafhopper. A sanitation program to control the brown plant-hoppers should aim mainly at destroying the stubble and ratoon remaining in a harvested rice field, because the insect can survive in great numbers in the off -season and in fallow period on stubble and ratoon, which may serve as a source of inoculum for the grassy stunt virus and the ragged stunt virus. Stubbles should be ploughed under immediately after harvest and the field prepared for the next planting.

Discussion

Israel and Kulshreshtha suggest burning stubble and straw after the punja crop. That practice, carried out in North Sumatra right after harvest, helps reduce the pest population. But during wet weather the intensive schedule does not permit drying and, therefore, burning. Burning the stubble may also destroy most of the arthropod populations that play an important role in decomposing plant remains. Burning also eliminates the available nitrogen in the plant remains. Moreover, nutrient loss by leaching is much higher after burning. Weed sanitation in rice fields is, of course, needed, particularly when the rice plant is somewhat older. It makes a microclimate that is less favorable for the insect. However, weeds and grasses from the ditches and fallow fields do not have to be completely removed because they may shelter natural enemies of the brown plant-hoppers. Moreover, weeds are not an ideal habitat of the pest. More research is needed to determine the role of weed grasses in the interaction of the insect pest with its natural enemies. The brown plant-hoppers prefer lowland to upland rice. It multiplies near the plant base where the microenvironment is humid and shaded. Rice fields with standing water have been found to encourage the multiplication of the brown plant-hoppers. Experiments at IRRI with continuously flooded plots developed two large peaks of brown plant-hoppers population [3]. But when the field was kept saturated but not flooded, only one moderate peak developed. Stapley also reported that the brown plant-hoppers problem in the Solomon Islands increased when irrigated rice cultivation replaced dry rice cultivation. In Japan, the insects are numerous in humid lowlands. Good water management could be a means of controlling the plant-hopper. Miller and Pagden reported that several outbreaks of the insect in Malaysia were suppressed by draining the fields for about 2 days. In the Philippines farmers stop irrigating infested fields that are almost mature, and spread the plants apart every few rows to help dry the field [4]. Draining rice fields at the proper time and withholding irrigation water for a while also effectively control the rice water weevil. Excess water also hinders development of the brown plant-hoppers. Esaki and Sameshima found that the insect's eggs perished if kept on leaves at 100% relative humidity. Raising the water level can destroy eggs laid in the leaf sheaths. In Taiwan, Iso and Grist reported that the insect was controlled by deep irrigation early in the morning, followed by the addition of a certain amount of kerosene to the water. The plants are shaken to cause the insect to fall into the water. An oil-dropping method with whale oil was used in Japan as early as 1670 to control rice plant-hoppers [5]. Raising the water level was a common practice in Indonesia to control the brown plant-hoppers. Sand or sawdust containing 0.25 litre kerosene for every 100 sqm was broadcast on the raised water level and the plants were shaken. In Fiji raising the water level as the plants grow is also suggested to drown eggs and drive the insect from its favoured location on the lower stems. With closely spaced plants microenvironments were slightly cooler and more humid. Mochida reported that 20 macropterous females laid a total of

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2,967 eggs in late August and 2,798 in late September. Temperatures were higher in August than in September [6]. Cooler temperature in the closely spaced plants may not be the main cause of the brown plant-hoppers populations. More important might be the fact that a shaded and humid microenvironment is unfavourable for the development of the natural enemies of the insect. Close planting, particularly when associated with repeated foliar sprays of parathion enhanced the development of the brown plant-hoppers at IRRI in 1976. That may be because foliar sprays may not reach insects that are protected by the thick canopy of the rice crop, but they destroy natural enemies inhabiting the foliage. Aerial spraying of phosphamidon and fenitrothion on the thick canopy of rice failed to check a hopper infestation in Kerala, India. Little sunshine reaches the bases of closely spaced rice plants [7]. Since the brown plant-hoppers are negatively phototaxic, such a dark habitat is an ideal place for it to congregate and multiply. Suenaga reported that solar and ultraviolet radiation act abiotically against the brown plant-hoppers and restrain its increase. Spacing that allows some sunshine to reach the basal area of the rice plants for some part of the day may thus be another reason for smaller insect populations. The most appropriate spacing would let enough sunshine penetrate to prevent pest increase, but would provide a suitable habitat in which biological control agents could develop [8]. It would allow insecticide sprays, if necessary, to reach the area where the insects congregate. Kulshreshtha suggested planting the crops in rows 15 to 20 cm apart. More studies are needed to determine how plant spacing influences the complex interrelationships of environmental factors, the brown plant-hoppers, its natural enemies, and rice production. While some insect species responded negatively to increased nitrogen fertilization of crops, the populations of many others certain aphid species and spider mites significantly increased with nitrogen level. The rice stem borer Chilo suppressalis Walker and gall midge Orseolia oryzae were significantly more plentiful in fields receiving high rates of nitrogen. High rates of nitrogenous fertilizers may result in more protein and amino acid synthesis by the rice plant [9]. The proteins and amino acids are among the essential requirements for growth and development of immature insects and are often needed by adults for the reproductive process. Although reducing the amount of applied nitrogen may lower brown plant-hoppers populations, large amounts are essential for high rice yields. It is, therefore, not realistic to recommend less fertilizer use even if pest problems are exaggerated. Integrating the use of fertilizer -responsive brown plant-hoppers -resistant varieties with other control methods should achieve both high rice production and brown plant-hoppers control. Manipulation of planting time can provide effective control of some pests. For example, epidemics of the Hessian fly Mayetiola destructor on winter wheat are avoided by late fall sowing. Late planting of rice minimizes infestation by the white rice stem borer Tryporyza innotata. At Cuttack, India, Israel reported that crops planted by the end of July suffered little from leafhoppers and plant-hoppers, but crops planted later were severely attacked. Gradual buildup of the brown plant-hoppers population from the beginning of the rice season could cause severe damage to late-planted rice [10]. Early planting also implies simultaneous planting over wide areas, early in the season. In Sri Lanka the susceptible short - duration varieties Bg 34 -8 and Bg 94-2, planted in April or up to about 10 May, escaped serious plant-hopper damage. But 130 day varieties like IR26 were destroyed when planted in the same period. Only two generations of the insect occur on short duration varieties, while three full generations occur on long-duration cultivars.

Conclusion

In areas with staggered planting patterns, the short-duration varieties may be damaged because the brown plant-hoppers population is continuously high. Therefore, their use should be integrated with such other control measures as simultaneous planting. Little experimental work has been carried out on cultural control of the brown plant-hoppers.

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Conflict of Interest

None

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