MAJOR RICE INSECT PESTS AND THEIR MANAGEMENT IN THAILAND

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For the sake of practical convenience and importance we classify the major rice insect pests of Thailand as follows:

Defoliators: *Cnaphalocrocis medinalis, Nymphula depunctalis, Pelopidas mathias, Methimna separata,* etc.

Stem borers: *Chilo polychrysus, Scirpophaga nivella, Scirpophaga gilviberbis, Tryporyza incertulas, Sesamia inferens,* etc.

Hoppers: *Nephotettix* spp., *Nilaparvata lugens,* etc.

Gall midge: *Orseolia oryzae*

Rice weevil: *Hydronomidius molitor*

Problems of severe outbreaks of major rice insect pests in Thailand are increasing very rapidly. These are due to the fact that the farmers are using rice varieties with short type as well as to the high rate of fertilization, the numerous applications of insecticides, the change in cultural methods by growing a second crop of rice or crop rotation in the irrigated areas all the year round. These rapid changes cause environmental conditions suitable for the growth and multiplication of rice insect pests especially in the areas which have rice cultivation practised as mentioned above. Outbreaks of rice insect pests in Thailand vary from location to location, season to season and depend on the stages of growth of the rice plants themselves. Major control measures obtained from research for rice insect pests in Thailand are:

(1) Chemical control
(2) Use of resistant varieties
(3) Cultural methods
(4) Biological, ecological and quantitative analyses of natural enemies of rice pests

In the utilization and conservation of natural enemies of rice pests, consideration should be given to the selection of insecticides (if possible, systemic insecticides), their timing of application, formulation and application selectivity. The adverse effect to insecticides upon natural enemies has been well investigated in many parts of the world. The wide-spectrum organic synthetic insecticides destroy natural enemies completely and directly. While some insecticides tend to weaken the fecundity of female natural enemies others shorten the longevity of natural enemies. Some natural enemies may try to avoid the environment polluted with insecticides and their ability or activity to search for their host pests may thus become very weak.

To prevent such adverse influence, it is most desirable to use the granular formulations of insecticides directly in paddy water or soil. These granular type insecticides are less toxic to the operator than spray or dusts. Application can be broadcast in the same manner as fertilizers or seeds are. Furthermore, insecticides of granular formulation may not affect the natural enemies nor are they toxic to fish which are a very important protein source for the farmers in Thailand. The timing of insecticide application should correspond to the stage or position of the pests when they are most susceptible or accessible to the insecticides. Partial or spotted treatments of rice fields to control rice pests are also needed to avoid the unnecessary application of insecticides and the wasted use of insecticides or to save the natural enemies as much as possible. At any rate, in the rice fields, insecticide should be applied only in case of need when the population of a certain pest tends to increase above the level of economic injury and only in the area where its application is desirable. In addition, the dosage should be as low as possible with minimum side-effects.

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At present the Entomology and Zoology Division, Department of Agriculture is recommending the use of the following insecticides to the farmers only when insecticide use is necessary (Table 1).

Table 1 Insecticides currently recommended to the farmers and their application methods in Thailand

Pest	Insecticide and its formulation	Dosage used	Date of application after transplanting
Rice stem borers	Carbofuran (Furadan) 3% G	1–2 kg/ha	20,40 and 60 days
	Caldan (Padan) 4% G	1–2 kg/ha	20,40 and 60 days
	Triazophos (Hostathion) 5% G	1–2 kg/ha	20,40 and 60 days
	Birlane 10 % G	1–2 kg/ha	20,40 and 60 days
	BHC 6% G	1–2 kg/ha	20,40 and 60 days
	Monocrotophos (Azodrin) 56% W.S.C.	1 kg/ha	20,40 and 60 days
Rice gall midge	Cytrolane 2% G	1–2 kg/ha	15 and 30 days
	Dyfonate 5% G	1–2 kg/ha	15 and 30 days
	Carbofuran (Furadan) 3% G	1–2 kg/ha	15 and 30 days
	Triazophos (Hostathion) 5% G	1–2 kg/ha	15 and 30 days
Defoliators and Leaf-rollers	Fenitrothion (Sumithion) 80% E.C.	40 ml/20 1	In case of need
	Carbaryl (Denapon, Nac, Sevin) 85% W.P.	40 ml/20 1	In case of need
Plant- and leaf hoppers	MIPCIN (MIPC) 50% W. P.	40 gr/20 1	10,20 and 30 days
	Bassa (BPMC) 50% E. C.	40 gr/20 1	10,20 and 30 days
	Carbofuran (Furadan) 2% F	100 ml/20 1	10,20 and 30 days
	Carbofuran (Furadan) 3% G	1 kg/ha	30 and 50 days
Nephotettix spp	Carbaryl (Denapon, Nac, Sevin) 85% W. P.	40 gr/20 1	10,20 and 30 days

The development and use of rice varieties resistant to pests and diseases have been regarded as the most effective components of integrated rice pest and disease control. Many studies along this line have been and are now under investigation and trial in the rice growing countries. Thailand is not an exception. In Thailand, the Rice Division (Breeding Group), Department of Agriculture, Ministry of Agriculture and Cooperatives is responsible for this field and has developed some varieties of rice resistant to *Nephotettix spp., Nilaparvata lugens, Orseolia oryzae*, blast, bacterial leaf blight, tungro virus and brown spot diseases.

As pointed out by Horber (1972), "Breeding resistant crops is neither simple nor quick. The insect host plant relationship requires intricate knowledge of the physiology and behaviour of insects, morphology, physiology and genetics of plants. Several genes must be combined and their frequency increased to confer the resistance required in the majority of the plant population. Resistance developed to a pest may not be permanent, or may leave the plant unprotected from another pest".

Insect resistance is said to be divided into three categories: "(1) Non-preference, rendering the plant unfit to attract insect pests as food, for oviposition, or shelter; (2) Antibiosis, adversely affecting growth, survival or reproduction of the pest; and (3) Tolerance, imparting ability to withstand, or to recover from injury, in spite of supporting a pest population that would severely damage susceptible hosts". As mentioned by Horber (1972), the proper balance of the three categories of resistance in the same variety can be achieved and evaluated in pest management programs involving a large area over extended periods. "Unfortunately, the present resistant cultivars of rice plant have been developed and tested rather in a very narrow area in one country under comparatively shorter period".

It has been a well-known fact that the improved varieties of cultivated plants vary in their characteristic susceptibility to insect pests very often, affected by such factors as climate (seasons included), cultivation methods, nutritional conditions of the plants, areas, etc. There are many examples in which some resistant cultivars were not resistant any longer when they were used in areas other than the place where they were screened and bred and they suffered severe damage from the pests. For example, several resistant varieties of rice plant which were said to be very resistant to the brown planthopper were introduced and cultivated widely in the Solomon Islands several years ago. These were screened at IRRI. These cultivars were prompfly attacked by the pest in question and severe infestation of rice plants occurred on the islands. In such cases, plant breeders and the applied entomologists involved in this problem express the opinion that a special biotype of the pest might have been created, to which the new cultivar is not resistant at all. Many other entomologists simply follow such opinion without raising any questions. Why should we consider the problem and make speculations only from the side of insect pests? It seems that the plant breeders and the applied entomologists consider firmly the susceptibility of the new cultivar as definite. Therefore, the attack by insect pests of the new so-called resistant cultivar is thought to be caused by the new biotype of insect pests. We should not forget to consider or analyze the problem also from the angle of the rice plant.

In this connetion, one experiment conducted by Hidaka *et al.* (1979) on the rice gall midge is of great interest. In Thailand, RD4 is a cultivar resistant to the rice gall midge. Trays of 25 days old rice seedlings were kept in three big insect cages in the insect rearing room and female midges were released in these cages at a rate of 5,15 and 30 individuals, respectively. These rice seedlings were dissected 30 days after larval penetration into the growing points for checking adult emergence, larval development and gall formation. The number of tillers was more abundant in the 30-adult plot than in the 5- and 15-adult plots and the tillers also increased more in the 15-adult plot than in the 5-adult one. Galls were formed more abundantly in the 30-adult plot than in the other plots. The number of adults was observed to be larger in the 30-adult plot than in the other plots. The number of larvae penetrating into the rice plants was also larger in the 30-adult plot than in the other two. Thus, it was revealed that the resistant cultivar RD4 was seriously damaged under high population density of the gall midge and the degree of damaged tillers was positively proportional to the level of population density of the adults released, so far as this experiment is concerned.

The fact that in the case of heavy outbreak of a pest under the pressure of high population of the insect pest even the cultivar normally resistant to the pest in question has no ability to withstand its attack may make us raise a few questions: (1) The unreliability of the cultivar as a resistant variety or the resistant gene(s) not being well fixed or screened, and (2) The higher the population of the pest, the higher the possibility of creating more aggressive populations. It seems desirable that before designating a new cultivar as resistant to a certain pest, we cultivate the new cultivar in rather large areas (possibly in the heavy outbreak areas) continuously for several years to prove its real resistance to the pest.

In conclusion, one of the most important applications of cultural methods to avoid the infestation of rice pests is closely related to the amount of precipitation or water supply. Shortage of rain during certain critical months may greatly influence the emergence of the rice gall midge. Relatively early transplanting of rice plants in the rice field after the flooding of water may stimulate the break of diapausing fully grown larvae of stem borers to emerge at the most appropriate time to infest the rice plant. Even in the rice field where one crop of rice is cultivated per year, late transplanting four weeks or more after the flooding of rain water is recommended for a comparatively large acreage, particularly when the damage caused by rice stem borers was severe in the previous year. There is a urgent need to study the relation between the occurrence or incidence of rice pests and the water supply or rainfall more extensively in the future to determine the planting date so as to avoid the pest attack. Irrigation or fertilization regimes may have a great impact on pest populations.

The use of granular form insecticides is strictly necessary to save the population and not to disturb the activity of natural enemies. Thereby, the effect of natural enemies upon the pest population may be more strongly increased. Efforts should be made to discover less expensive insecticides.

The breeding or utilization of resistant varieties of rice against rice pests has some of the same limitations as chemical control does. The shifting of physiological races of the pest poses the same problem for the plant breeder as insecticide resistance does for the entomologist. Also it may take an average of ten to fifteen years to develop a firmly fixed resistant variety, which implies a relatively expensive and slow response to immediate problems. Furthermore, we must bear in mind that even if the plant breeder can develop a plant highly resistant to one insect, there is a high probability that the plant may become susceptible to another pest.

References

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Discussion

Sadji, P. (Indonesia): What is your opinion about the efficacy of Quinalphos (insecticide also known under the name of Ekalux or Bayrusil) for the control of the rice gall midge?

Answer (Hidaka, T., Japan): This insecticide is fairly effective against the rice gall midge but it cannot be used readily owing to its high degree of toxicity.

Saxena, R.C. (International Rice Research Institute, the Philippines): We all know that the occurrence or development of pest biotypes is a serious threat to the stability of resistant varieties. What is the potential of the gall midge developing biotypes which could overcome the resistance of currently grown resistant varieties?

Answer: In Thailand we do not have any biotypes of the rice gall midge, so far.

Saxena, R.C. (International Rice Research Institute, the Philippines): Are the local resistant varieties extensively planted in Thailand?

Answer: Yes they are, in particular in the northeastern and northern parts of Thailand where farmers like glutinous rice and where the rice gall midge problem is serious.

Mochida, O. (Japan): It appears from your presentation that Carbofuran 3G which is fairly expensive should be applied three times, 20, 40 and 60 days after transplanting. Are the farmers actually following such a schedule?

Answer The applications depend on the intensity or presence of pest outbreaks. If the population of the pest is not beyond the economic threshold, insecticides need not be applied at all.

Litsinger, J. (International Rice Research Institute, the Philippines): What do you mean in stating that it may take 10 to 15 years to develop a resistant variety?

Answer: I mean that it may take time to achieve 100% immunity in any variety.

Saxena, R.C. (International Rice Research Institute, the Philippines) **Comment**: The problem is to know whether it is possible to achieve 100% immunity. Do we need it after all?

Chang, P.M. (Malaysia): In Malaysia it takes 5 years to develop a resistant variety. For the gall midge it may be different owing to the breeding conditions of this insect.

Ito, Y. (Japan): As Carbofuran is highly toxic is it applied by individual farmers or by trained specialists?

Answer: It is applied by both. However farmers will be allowed to use this insecticide only if they have been trained by extension officers previously.

Chang, P.M. (Malaysia) **Comment:** In Malaysia several cases of poisoning have been recorded among untrained farmers who used Carbofuran to control brown planthopper outbreaks.

Chang, P.M. (Malaysia): What is the situation of pesticide regulations in Thailand?

Answer: The Government of Thailand has enacted regulations regarding pesticide use. However only 70 to 80 pesticides are presently under control. Some abuses are from time to time being recorded.

Otake, A. (Japan): As the consumption of high quality rice is being promoted in Thailand is the injury caused by stink bugs a major problem in your country?

Answer: Rice stink bug is also a pest responsible for severe damage to the rice plants, particularly when rice is in the milky stage. However it is a pest with sporadic outbreaks.

Dyck, A.V. (International Rice Research Institute, the Philippines): I heard about an integrated pest management (IPM) demonstration plot in Thailand. What did this program include and was it successful in showing the farmers how to control pests according to IPM principles?

Answer: There are two demonstration plots on integrated pest management. One is located in Nakon Patom Province and the other in Chachoengsao Province. We set up plots and planted rice resistant varieties while minimizing pesticide applications (the economic threshold was used) and preserving the natural enemies as much as possible. Pest surveillance, particularly for the brown planthopper was also carried out. Farmers appreciate very much our initiative and extension officers are participating in this program.