INSECT PESTS OF PADDY IN MALAYSIA

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Introduction

Malaysia covers an area of 333,000 sq km, of which 132,000 sq km are in the 11 states of Peninsular Malaysia and the remaining 60% in the Borneo states of Sabah and Sarawak. Rice cultivation in Malaysia ranks third after rubber and oil palm in terms of acreage, but great emphasis is placed on the rice crop as it is the country's staple food. The total area under rice cultivation is about 534,186 ha, with about 380,405 ha in Peninsular Malaysia 40,469 ha in Sabah, and 113,312 ha in Sarawak. About 50% of the total area is double-cropped at present.

In Peninsular Malaysia, much of the increase in rice production since 1957 when Malaysia gained independence (55% self-sufficient) to the present status of about 85% self-sufficiency is due to the physical increase in area under double-cropping, and increase in yield through improved agronomic practices and crop protection techniques, coupled with the large-scale cultivation of high yielding varieties. The average yield for Peninsular Malaysia in 1976 was about 3.2 tonnes per ha.

Rice pests, including insects, diseases, weeds, rodents, birds and other harmful organisms, have been estimated to cause an annual crop loss of about 10-15% in Malaysia. With the increasing acreage of paddy coming under double-cropping together with the large-scale planting of high yielding varieties and their associated agronomic and crop protection techniques especially pesticide application, pests in paddy can be expected to be an important constraint to rice production in Malaysia. This factor of reduced yield due to pests is worsened if in some years, serious pest outbreaks were to occur over large areas resulting in widespread losses. For example, the planthoppers *Nilaparvata lugens* and *Sogatella furcifera* had only been sporadically recorded to cause serious damage to paddy in the past, but they have taken prominence since 1977 when the brown planthopper *N. lugens* destroyed 1,829 ha in Tanjong Karang, one of the major irrigation areas in Peninsular Malaysia. The planthoppers have been recorded to cause damage every year since.

This paper reports on the status of the current paddy insect pest problems with emphasis on Peninsular Malaysia.

Major insect pests

Malaysia has a relatively uniform equatorial climate with the mean monthly temperature varying from 22° to 28°C and the relative humidity varying between 82-86%. This allows the development of an abundant number of paddy insects both in individuals and in species diversity. The following insect species listed in Table 1 are recognised as important pests of paddy in Malaysia, and can be grouped under stem borers, planthoppers, leafhoppers, leaf-feeding caterpillars, and rice bugs.

1 Stem borers

Rice stem borers have generally maintained a low profile in recent years, but they generate a widespread, chronic yield loss. The dominant species at present is *Tryporyza incertulas*, with *Chilo polychrysus* being more common than *Sesamia inferens*. *C. polychrysus* used to be the dominant species before the introduction of double-cropping. Lim and Heong (1977) pointed out that since the change in cropping pattern was associated with the introduction and widespread planting of high yielding varieties, it is difficult to determine the precise cause of the change in dominance. It is probable that both factors have contributed significantly.

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Table 1 Major insect pests of paddy in Malaysia

1.	Stem borers	*Tryporyza incertulas*
		Sesamia inferens
		Chilo polychrysus
2.	Planthoppers	*Nilaparvata lugens*
		Sogatella furcifera
3.	Leafhoppers	*Nephotettix virescens*
4.	Leaf-feeding caterpillars	*Cnaphalocrosis medinalis*
		Nymphula depunctalis
		Spodoptera mauritia
5.	Rice bugs	*Leptocorisa oratorius*
		Nezara viridula
		Scotinophora coarctata

The change-over from single to double-cropping also had a suppressive effect on the overall stem borer population, attributed to staggered planting whereby a high level of natural enemy activity could be maintained (Lim and Heong, 1977). Although the effects of insecticides can not be totally excluded, it was unlikely that they played a significant role since the quantity used then was relatively small (Yunus and Lim, 1971).

Control measures:

The practice of burning the rice stubble appears to be ineffective for destroying the residual borer population (Ooi, 1975). Most of the late instar larvae or pupae especially of *T. incertulas* were well protected at the extreme bases of the tillers about 1-3 inches below the soil surface and had been observed to survive the burning. In any case, the straw is heaped in patches in the harvested fields thus allowing a great proportion of the stubble to be unaffected.

Out of 653 varieties evaluated for stem borer resistance in the field, TKM6, IR22 and Mahsuri were found to be less preferred by stem borers. Among the local Malaysian varieties, Mahsuri, Murni, and Jaya were less preferred than SM2, Malinja and Bahagia (Heong, 1978) (Table 2). At present, there is no active programme to screen for stem borer resistance due to problems of low and uneven field infestations.

Several parasites and predators attacking the different life stages of various stem borer species have been recorded (Rothschild, 1971; Manley, 1973; Heong, 1978). In addition, a nematode parasite was recovered from larvae of *T. incertulas*. Subsequent rearing of field-collected larvae showed that as many as 26% were infected. One *C. polychrysus* larva was also parasitized by the nematode (MARDI, 1979). The importance of conserving and augmenting the natural enemies of stem borers and other insect pests has been emphasized by Lim (1970, 1974).

A number of chemicals have been found to be effective against stem borers in Malaysia since the 1950s. At present, granular formulations of BHC, endosulfan and carbofuran are favoured for their efficacy, ease of application, and presumed less detrimental effects on natural enemies as compared to spray formulations especially if larger areas were to be treated. However, spot sprays of BHC and endosulfan are also recommended for localized attacks.

2 Planthoppers

Outbreaks of planthoppers in Malaysia have been comparatively rare in the past. Miller and Pagden (1930) observed two outbreaks of white backed planthopper *S. furcifera* in Krian in 1925 and 1929. The next recorded outbreak took place 38 years later in 1967 when 5,263 ha were destroyed by

Table 2* Susceptibility of some selected varieties to stem borer damage

Variety	% Dead Heart 30 DAT**	% Dead Heart 60 DAT**	% White Head
TKM 6	8.4	4.5	2.0
Tadukan	8.5	8.5	4.8
IR22	2.9	10.2	7.1
Mahsuri	9.9	12.5	3.6
Murni	9.9	10.2	1.3
Jaya	10.4	15.0	7.8
Masria	10.5	13.9	6.2
PMI	12.6	11.2	6.5
Ria	13.6	11.5	6.9
IR20	13.9	8.6	7.6
Bahagia	14.1	15.7	6.4
Malinja	14.6	9.4	1.0
SM2	18.1	17.2	6.4
Rexoro	21.5	20.2	23.7
Karta	23.9	17.9	11.1

* From Heong, 1978

** DAT = Days After Transplanting

a mixed population of brown planthopper *N. lugens* and *S. furcifera* in Trengganu (Lim, 1971). From 1974 onwards, there were records of small outbreaks of these pests in several locations in Peninsular Malaysia, with a gradual increase in area attacked. In 1977, *N. lugens* occurred over 20,000 ha and destroyed 1,829 ha in Tanjong Karang (Lim *et al.*, 1978). The attacks in 1978 were not as serious as in 1977 but in 1979, 21,492 ha in the MUDA Irrigation Scheme were affected by a mixed population of the planthoppers with *S. furcifera* clearly dominant. Rapid action in initiating chemical control measures resulted in only 1,976 ha being lost eventually (Ooi and Rahim, 1979). Affected fields after treatment were able to recover from the predominantly white backed planthopper attack which appeared to be relatively less serious than that of the brown planthopper. Fig. 1 shows the rice-growing areas in Peninsular Malaysia and the location of major planthopper outbreaks.

In Malaysia, the largest acreage lost in a year to planthoppers so far was only 5,263 ha in 1967, or about 1% of the total rice-growing area. Although this figure is comparatively lower than in many other countries, the planthoppers do pose a serious threat to rice production in the country. Furthermore, ragged stunt virus and grassy stunt virus diseases have been confirmed in Malaysia, but the incidence so far has been low (Habibuddin, 1978; Habibuddin *et al.*, 1978; Ooi *et al.*, 1979).

Visual counts of a field population of *N. lugens* in the first cropping season (off-season) 1978 in the Province Wellesley area showed that it completed 3 generations on the transplanted rice in that season (Fig. 2). Fig. 3 shows the light trap catch of the planthoppers at the Rice Research Station at Bumbong Lima, Province Wellesley, from May 1978 to July 1979. The population is usually higher in the first cropping season (off-season) from May to August than in the second cropping season (main season) from November to March.

Control measures:

Lim *et al.* (1978) drained water from brown planthopper-infested fields in the Tanjong Karang outbreak in 1977. This brought the population down but this method may have its limitations where water management is poor or if water is a scarce resource especially if the affected crop has not matured enough. They also found that fluorescent light traps may be useful to remove large numbers of macropterous adults from infested fields. As many as 92.16×10^6 brown planthoppers weighing 130.9 kg (20,000 individuals weighed about 28.4 g) were caught by 15 such traps in 4-1/2 hr of operation between 1900 to 2330 hr in one instance. There is also a possibility of changing planting dates over large areas to avoid an influx of immigrating planthoppers if we know for sure that there are significant migratory macropterous adults in the air at a certain time. This suggestion is based on the speculation that the brown planthoppers in the 1977 outbreak in Tanjong Karang could have migrated across the Straits of Malacca from Sumatra which is only 200 miles away. There was also the simultaneous coincidence of severe brown planthopper infestation in Sumatra at that time coupled with prevailing Southwest monsoon winds. However we do not have enough information yet on the migratory behaviour of the planthoppers. A boat trip was made in July 1979 in an attempt to trap planthoppers in the Straits of Malacca using high-suspended net-traps, but was unsuccessful due to unexpected adverse weather conditions (MARDI, 1980).

Screening for resistance to *N. lugens* was initiated in 1977. Of about 1,750 accessions in the Malaysian germplasm material, only 1 variety, Pandan Gelap, showed a level of resistance equal to that of Mudgo. The plants were not only resistant as seedlings but also in later growth phases. Preliminary studies indicate that Pandan Gelap has a strong antibiosis effect. Brown planthopper-resistant varieties have not yet been released in Malaysia but it is possible that biotype differences may exist based on differences in varietal reactions to brown planthoppers in the East and West Coasts of Peninsular Malaysia. (Table 3). IR26 which was resistant in Bumbong Lima and Tanjong Karang on the West Coast was susceptible at Kelantan and Trengganu on the East Coast. However, the screening results were not consistent (Habibuddin *et al.*, 1980).

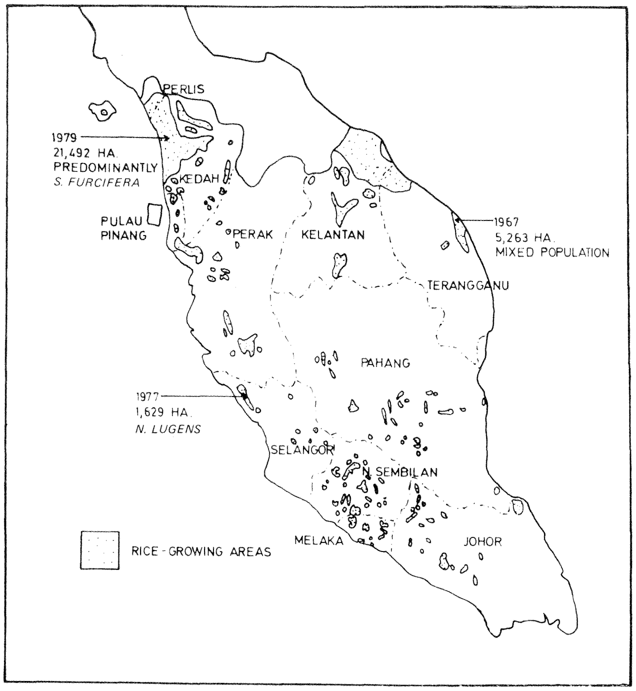

Fig. 1 Paddy-growing areas in Peninsular Malaysia and the location of major planthopper outbreaks

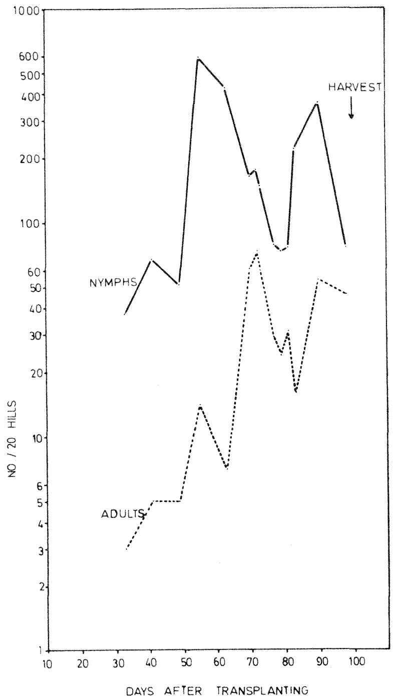

Fig. 2 Population change of *Nilaparvata lugens* at Pinang Tunggal, Province Wellesley, Penisular Malaysia, First Crop (Off-season), 1978

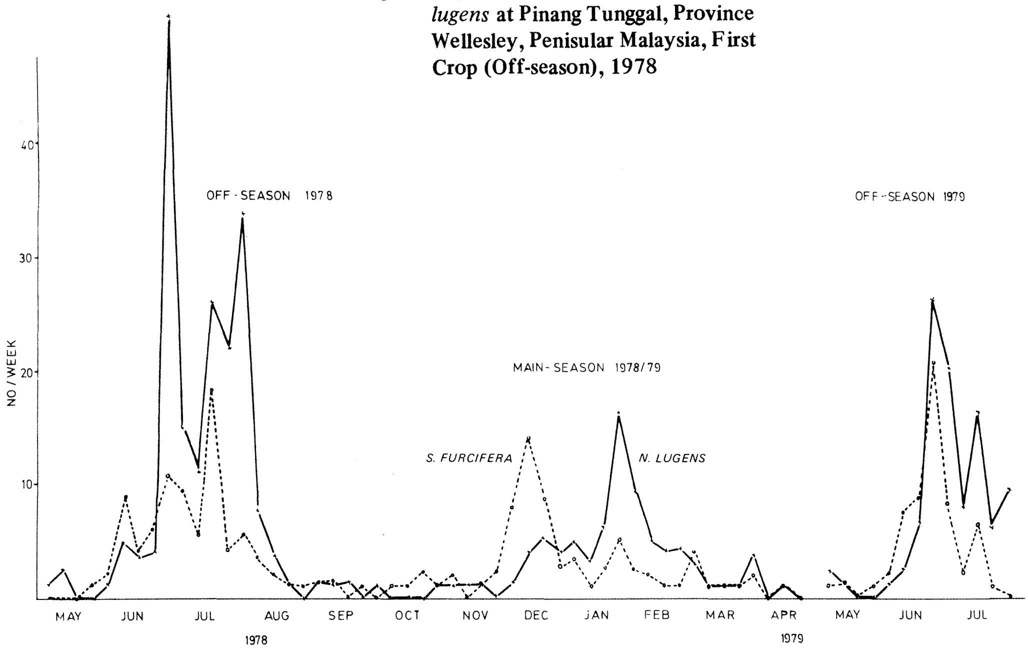

Fig. 3 Weekly light trap catch of planthoppers at Bumbong Lima, Province Wellesley, Peninsular Malaysia, May 1978 to July 1979

Table 3* **Reactions of some IRRI varieties against *Nilaparvata lugens* collected from different localities in Peninsular Malaysia**

Area *N. lugens* collected	Varieties									Year
	IR20	IR22	IR24	IR26	IR28	IR30	IR34	IR36	TN1	
Bumbong Lima	S	S	–	R	–	–	R	R	S	1977
Bumbong Lima	–	–	–	R	R	R	R	R	S	1979
Tg. Karang	S	S	–	R	–	–	R	R	S	1977
Telok Anson	S	S	–	R	–	–	R	R	S	1977
Kelantan	S	S	S	MS	R	MS	MS	R	S	1978
Kelantan	S	S	S	R	R	R	R	R	S	1978
Trengganu	S	S	S	MS	MS	MS	S	R	S	1979

R = Resistant; MS = Moderately susceptible; S = Susceptible

* From Habibuddin *et al.*, 1980

A number of effective predators, parasites, and diseases common to both planthopper species have been observed in Malaysia (Table 4).

Table 4 Some common natural enemies of planthoppers in Malaysia

	Order	Family	Genus/Species
Predators:	Hemiptera	Miridae	*Cyrtorhinus lividipennis* Reuter.
	Coleoptera	Carabidae	*Casnoidea interstitialis* Sch.
		Staphylinidae	*Paederus fuscipes* Curt.
		Coccinellidae	*Coccinella arcuata* F.
	Araneida	Lycosidae	*Lycosa pseudoannulata*
Parasites:	Hymenoptera	Dryinidae	Unidentified
		Mymaridae	*Anagrus* sp.
	Strepsiptera	Unidentified	–
Pathogens:	Eubacteriales	Pseudomonadaceae	*Pseudomonas aeruginosa*
		Micrococcaceae	*Micrococcus* sp.

A farmer's field in Province Wellesley was regularly examined visually for planthoppers and some of their natural enemies in the first season (off-season) 1979. The results are presented graphically in Fig. 4 together with the results of monitoring for *Anagrus* sp. by exposing brown planthopper eggs for parasitism in the field (MARDI, 1980). An increase in the abundance of predators and *Anagrus* was closely associated with a decrease in the planthopper population. The spider population together with *Anagrus* probably played the dominant role in planthopper reduction during that season.

Planthoppers, notably *N. lugens*, are often difficult to control with chemicals due to their habit of feeding and aggregation at the base of the rice plant, especially when the crop canopy has closed. Several authors including Lim *et al.* (1978) and Heinrichs (1977) emphasized the need to get the chemicals to the base of the plants. However, this is often impractical with conventional sprayers for large areas. In Malaysia, a number of chemicals screened in the field were found to be effective both

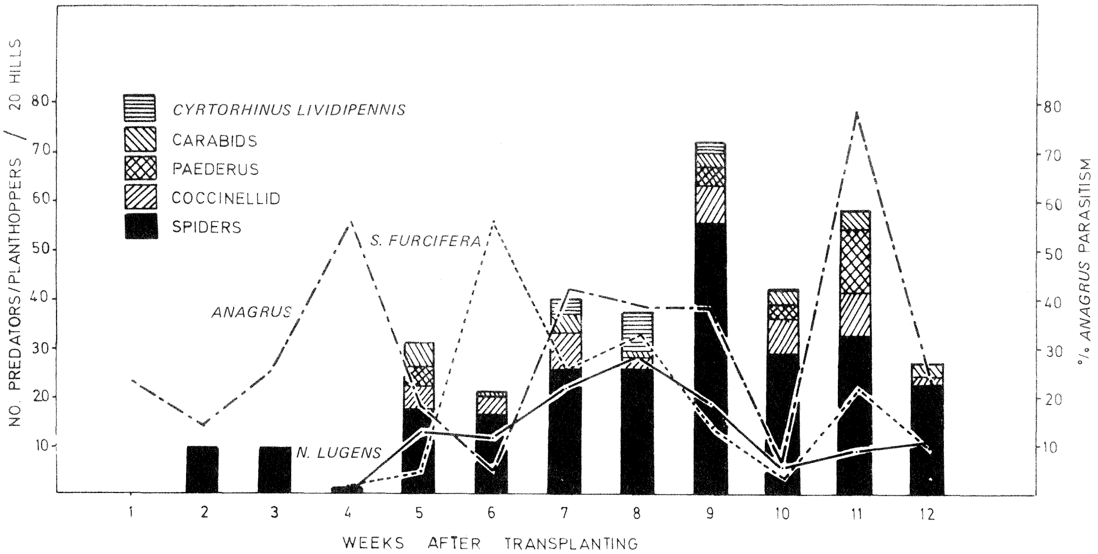

Fig. 4 Visual counts of planthoppers/predators and % prasitism by *Anagrus* at Pinang Tunggal, Province Wellesley, Penisular Malaysia, First Crop (Off-season), 1979

as a basal and as a foliar spray. The compounds were MIPC, propoxur and BPMC. These had far superior fumigation effects compared to other chemicals when tested in a pot experiment where planthoppers caged in ventilated mylar cages were exposed to suspended quadrants of filter paper dipped in various chemicals (Habibuddin *et al.*, 1980). Dusting using motorized dusters with extended vinyl pipes with dust formulations of MTMC + phenthoate, BPMC, propoxur, and MTMC have been found to be effective against the planthoppers. This method affords rapid coverage and is of great advantage in outbreak situations.

3 Leafhoppers

The most common leafhoppers in Malaysia are *Nephotettix virescens* and *N. nigropictus*. Two other species are known to occur, namely *N. malayanus* and *N. parvus*. *N. virescens* is the most important vector of tungro (Penyakit Merah Virus) and yellow dwarf (Padi Jantan) (Ou *et al.*, 1965; Singh, 1967; Lim, 1969; Ting and Paramsothy, 1970). *N. nigropictus* is also a vector of tungro but is much less efficient compared to *N. virescens*. The leafhoppers are only important in the Krian area of Peninsular Malaysia where tungro is frequently encountered. The reasons for this confinement are not completely clear. Recently in early 1980, about 800 ha had been affected by tungro in Sabah (Wong Put-Ham, pers. comm.). Yellow dwarf is of even less significance compared to tungro since its occurrence is even more sporadic.

Control measures:

Lim *et al.* (1974) concluded that for a tungro outbreak to occur, the following factors have to occur simultaneously;

(1) availability of susceptible crop stage of a susceptible variety,
(2) abundance of the insect vectors, their species composition and transmissive ability,
(3) availability of the virus source, and
(4) varietal susceptibility to the vector.

Since staggered planting provides an extended period when nurseries or the susceptible plant stage is present and encourages the build-up of leafhoppers, synchronized planting over wide areas tends to reduce the tungro problem.

Screening for varietal resistance in more than 500 varieties revealed that only 7 varieties possessed some kind of resistance: Pankhari 203, Anak Ikan, Anak Kuching, Brondol Puteh, Nangkeo, Ringke, and Tjahaja. At present, there is no active programme to incorporate leafhopper resistance into released varieties.

Not much is known about natural enemies of leafhoppers other than that the leafhoppers are predated upon by spiders, *Cyrtorhinus lividipennis, Paederus fuscipes, Casnoidea cyanocephala, C. interstitialis*, and other predators (Manley, 1973).

Chemical control of the leafhoppers has been evaluated by Lim and Goh (1969), Lim *et al.* (1974), and Heong and Ng (1978) as a means of combatting tungro incidence. Some of the insecticides found to give good protection were BPMC, MIPC, MTMC, Malathion + carbaryl, and MTMC + carbaryl.

4 Leaf-feeding caterpillars

Cnaphalocrosis medinalis, Nymphula depunctalis and *Spodoptera mauritia* occur sporadically and may cause serious defoliation. Whorl maggot damage has been observed quite frequently but the symptoms disappear after maximum tillering. Precise yield loss studies have not been conducted but observations on a *C. medinalis* attack during the first crop (off-season) 1979 at Bumbong Lima, Penang, where more than 90% of leaves were damaged at close to harvest, showed up to 30% yield loss (MARDI, 1980). Of late, *C. medinalis* has been observed to be more common, infesting the crop up to harvest and damaging the flag leaves. Otherwise, leaf-feeding caterpillars are not generally a problem. The chemicals commonly used against these pests are carbaryl and endosulfan. The gall midge has not been found to occur in Malaysia so far.

5 Rice bugs

The important rice bugs in Malaysia are *Leptocorisa oratorius*, *Nezara viridula*, and *Scotinophora coarctata*. *L. oratorius* is one of at least 9 spp. of *Leptocorisa* recorded in Malaysia (Heong, 1978), and together with *N. viridula*, causes serious yield losses at the milking stage especially in single-crop rainfed areas as well as double-cropped irrigated areas with adjoining scrubland or secondary jungle. In hill rice, *L. biguttata* and *L. acuta* are most common (Rothschild, 1970a). *S. coarctata*, the Malayan black rice bug, is a plant-sucking insect feeding at the base of the tillers. It has become quite common in Peninsular Malaysia in recent years and large numbers have been observed attracted to lights. In the field, a sudden influx of adults can result in as high as 60 adults per hill. In many cases, the numbers rapidly declined in the following weeks without any control action taken (MARDI, 1980). However, the insect is potentially a serious pest and has been observed to completely destroy a crop through its feeding.

Control measures:

Synchronized planting over as large an area as possible is a useful cultural method to avoid losses to the grain-sucking bugs but their ability to move over large distances and to harbour in secondary plant hosts in adjoining scrubland presents a problem for their control.

Not much is known of varietal resistance to grain-sucking bugs except that certain awned varieties are less prone to *Leptocorisa* attack.

Rothschild (1970a, b) estimates that only about 7% of the *Leptocorisa* eggs managed to survive to the last nymphal instar. The egg parasite, *Gryon flavipes*, attacked up to 70% of egg masses and between 11-75% of the eggs were parasitized. The main predators were the gryllid *Anaxipha* spp., the tettigonid *Conocephalus* spp., the dragonflies *Neurothermis fluctuans* and *Agrocaemis* sp., and the coccinellid *Verania discolor*. Not much is known of the natural enemies of *N. viridula* and *S. coarctata*.

A number of chemicals have been found to be effective against the grain-sucking bugs. Among them, carbaryl and BHC are effective both against *Leptocorisa* and *N. viridula* (Heong, 1978).

Chemical control against *S. coarctata* is difficult because of their cryptic habit of hiding among the bases of the tillers and their thick integument, but studies are currently being made to screen for effective insecticides against this pest.

Conclusion

In Malaysia, the relative importance of the various rice insect pests has changed with time, due to changes in cropping pattern, cultural and agronomic practices including changes in varieties and fertilization techniques. Other less obvious factors, for example the weather pattern, will also contribute to the changing pest spectrum. The tropical Malaysian rice agro-ecosystem is always conducive to rapid insect population increase, and given the appropriate conditions, a particular species may break loose from natural control factors to attain pest status.

Insect pest control in Malaysia has largely been centered on the *ad hoc* use of chemical insecticides during outbreak situations without a proper appreciation of the complexities in the rice agro-ecosystem. At present, the level of insecticide use is still low consisting of spot treatment rather than blanket and prophylatic applications. Jegatheesan (1975) found that only about 46% of the farmers in the MUDA irrigation scheme apply some insecticides. Perhaps this is one of the reasons why pest problems in rice in Malaysia are relatively mild compared to other neighbouring countries as this has allowed the natural enemy population to exert its effects.

However, it is expected that insecticide use will increase in the future along with the increasing insect pest problems. The awareness of the problems associated with the over-reliance on any single-factor control approach has led to the realization of the need for an integrated pest control approach in Malaysia. There is an urgent need to refine the use of insecticides in terms of timing of application based on insect counts, dosage, selective toxicity, and method of application. This judicious use of insecticides together with the possible deployment of cultural methods and varietal resistance, aimed at the conservation and augmentation of natural enemies and their activities, will form the basic structure of an integrated pest control system which can contribute to the overall stability of the rice agro-ecosystem. With this approach, it is likely that Malaysia can avoid the potentially severe yield losses to the spectrum of rice insect pests.

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Discussion

Oka, I.N. (Indonesia): At present I do not accept nor deny the possibility of migration of the brown planthopper between Indonesia and Malaysia. This is an interesting subject and I would like to suggest that a joint study program on migration of the brown planthopper be set up among Asian countries so that each of us would know in advance what biotypes,when and how many of them are likely to move in and out and strike certain parts of the respective countries.

Answer: I fully agree with you.