STATUS OF RICE PESTS AND MEASURES OF CONTROL IN THE DOUBLE CROPPING AREA OF THE MUDA IRRIGATION SCHEME, MALAYSIA

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ABSTRACT

Double cropping of rice has resulted in the increase of the cropping intensity, modification of the field microclimate, and changes in the species dominance of rice pests in the Muda Scheme. Tungro, which caused important damage in 1981-1983, has been the most devastating disease since the introduction of double cropping.

However, its occurrence has decreased thereafter due to the implementation of integrated pest management. Rice blast is second in importance, and generally more problematic in the second (wet) season. While the incidence of stemborers has declined after double cropping, the brown planthopper and the white-back planthopper took over and have emerged as major insect pests since 1978, causing widespread attacks in 1979, 1982 and 1983. Stink bugs, i.e. *Scotinophara* and *Nezara* species, have been more frequently observed since 1983 due to the adoption of staggered planting. The incidence of rice bugs, i.e. *Leptocorisa* species, also increased in the direct-seeded fields, where barnyard grasses served as alternate hosts. Rodent occurrence often reaches epidemic proportions once in 3 years, with *Rattus argentiventer* being the main agent. Continuous baiting with anticoagulants has received greater acceptance in large scale group farming projects. Integrated pest management should be further promoted to stabilize rice production.

Introduction

The Muda irrigation scheme is the largest traditional rice bowl area of Malaysia. As much as 50% of the national rice production comes from the Muda area. Double cropping was first implemented in 1970. Since 1974, almost 92% of the 96,000 ha operated by 63,000 farm families could be double-cropped.

The increase in the cropping intensity since 1970 has resulted in the modification of field habitats and changes in the field microclimate, which in turn affected the types and occurrence of rice pests, as well as the severity of their infestation in the Muda area. Thus, the incidence of pests is one of the most important constraints to stabilize rice yield in this area.

A surveillance system was proposed and approved by the Malaysian Government in 1979 (OOI, 1982). The system was implemented first in the Muda area in 1980 among the irrigation schemes. Since then, surveillance and forecasting activities have been carried out by the staff of the Department of Agriculture (DOA) in Kedah and Perlis, and the Muda Agricultural Development Authority (MADA), together with technical advice by the Malaysian Agricultural Research and Development Institute (MARDI), Alor Setar. Ideas and concepts of integrated pest management (IPM) have been adopted as much as possible in the Muda area as well as in the other major irrigation schemes (CHANG, 1981; LEE, *et al.,* 1984).

Diseases

1 Blast

Before the introduction of rice double cropping, rice blast caused by *Pyricularia oryzae* was

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considered by farmers to be the most important disease in the Muda area. This is because the humid conditions during the wet season are very conducive to the dissemination of blast conidia. After double cropping was implemented, rice blast remained the most important disease in the 1970s, with its occurrence being more common in the main season (i.e. the second season which is rainfed) because of the wet conditions. The worst incidence of seedling blast occurred in September and October, 1979 when 202 ha were infected (HO, *et al.*, 1979).

In the 1980s, seedling and foliar blast became insignificant, as more farmers are aware of the importance of seed treatment and early application of fungicides after detection of disease symptoms. Nevertheless, panicle blast incidence has increased sharply in recent years; 25 ha of MR 1 variety were badly infected with 80% yield loss in the 2/'83 season (HO, 1984). In 1985, the newly released variety MR 73 (improved MR 1) was found to be susceptible to neck rot.

Fungicides used by the farmers include edifenphos, blasticidin-S, benomyl, and tricyclazole. The action threshold recommended by MARDI is 15% of foliar infection at the nursery stage and 5% at the vegetative and reproductive stages in the paddy fields (CHIN *et al.*, 1985).

2 Tungro

Tungro virus disease, so called "penyakit merah" virus (PMV) in Malay, was the most important disease in the 1980s. The disease is transmitted by the green leafhoppers (GLH, *Nephotettix* spp.) in a semi-persistent manner.

Although tungro-like symptoms had been observed in the Muda area during the single cropping as well as the early double cropping days, the presence of tungro disease was not confirmed until 1981. Initially, tungro affected 5,884 ha mainly in the southern part of the Muda area in 1981 (Table 1). The disease subsequently inflicted more severe damage in 5,839 ha in 1982 over the entire Muda area. In 1983, tungro infection reached its peak with 8,655 ha

Table 1 Status of major pest occurrence in the Muda area during 1970–1985 (hectares)

Crop year[a]	Tungro	BPH/WBPH[b]	Rodents	Other pests[c]	Total	pest index[d]
1970	0	0	N.A.[e]	N.A.	N.A.	–
1971	0	0	N.A.	N.A.	N.A.	–
1972	0	0	485	383	868	1.00
1973	0	2	564	401	967	1.11
1974	0	0	604	499	1,103	1.27
1975	0	0	691	515	1,206	1.39
1976	0	0	120	205	325	0.37
1977	0	240	354	688	1,282	1.48
1978	0	266	1,100	810	2,176	2.51
1979	0	21,492	156	1,021	22,699	26.12
1980	0	668	547	1,200	2.415	2.78
1981	5,884	615	2,633	998	10,130	11.67
1982	5,839	7,761	100	650	14,350	16.53
1983	8,655	11,874	1,116	2,043	23,688	27.29
1984	501	1,106	7,693	3,478	12,778	14.72
1985	94	2,191	883	1,331	4,499	5.18

[a] Crop year comprises 2 seasons: 1st season or off season (February/March to July/August) and 2nd season or main season (August/September to January/February).
[b] BPH: brown planthopper and WBPH: white-back planthopper.
[c] Other pests include blast, bacterial leaf blight, bacterial leaf streak, stemborers, and bugs.
[d] Pest index uses 1972 pest occurrence hectarage as base line for comparison.
[e] N.A.: not available.

being affected. The value of crop loss from 1981-1983 was estimated to be US$10 million. Factors contributing to the absence of tungro before 1981, were the low population of GLH and the species composition. In the past, more than 60% of the GLH collected from light traps in the Muda area included *N. nigropictus,* a poor vector of the virus, compared with almost 100% *N. virescens* in the Krian district where tungro was endemic (LIM *et al.,* 1974). Increase in tungro incidence after 1981 was due to staggered planting in 1981-1983, resulting in prolonged and delayed nursery periods at the scheme level. GLH populations were not only much higher but also consisted predominantly of *N. virescens,* and these factors probably played a significant role in the outbreaks of tungro in the Muda area (HEONG and HO, 1985).

Large scale campaigns were organized by MADA to control the tungro disease. Awareness was created among the farmers of the importance of integrated pest management. As a result of concerted efforts by MADA, DOA, and MARDI, the spread of tungro was checked. Tungro-infected hectarage decreased to 501 ha and 94 ha in 1984 and 1985, respectively (Table 1). In 1986, tungro symptoms were virtually undetectable over the entire Muda area.

MADA attributes the reduction in tungro occurrence to the combined efforts of: 1) Large scale adoption of GLH resistant or moderately resistant varieties, e.g. IR 42, MR 71, MR 73, MR 77, and MR 84; 2) Effective surveillance and forecasting activities; 3) Implementation of one month fallow period to interrupt continuous cropping; 4) Destruction of inoculum sources by widespread burning of ratoons, straws, and stubbles, and by dry rotovation after the second season harvest; and 5) Judicious and timely applications of insecticides for vector control.

Field surveys carried out in early 1986 revealed that the relative population density of *N. virescens* after harvest of rice was in the descending order of volunteer seedlings in the unplowed fields > ratoons in the unplowed fields > volunteer seedlings in the plowed fields > grasses in the surrounding of fields. This observation further substantiated the fact that the fallow period together with dry plowing is effective in reducing the GLH populations and lowering the incidence of tungro infection (HIRAO and HAMADA, 1986).

3 Other diseases

The incidence of other diseases such as bacterial leaf blight (*Xanthomonas oryzae*), bacterial leaf streak (*Xanthomonas translucens*), narrow brown spot (*Cercospora oryzae*), brown spots (*Helminthosporium oryzae*), false smut (*Ustilaginoidea virens*), leaf scald (*Rhynchosporium oryzae*) and sheath blight (*Rhizoctonia solani*) has increased in recent years. However, most of these diseases were sporadic in occurrence, and seldom culminated in epidemics. It was also noted that bakanae disease (*Giberella fujikuroi*) was for the first time identified by MARDI and TARC in two localities of the Muda area in November, 1985.

Insect pests

1 Planthoppers

The most important insect pests are the brown planthopper (BPH, *Nilaparvata lugens*) and the white-back planthopper (WBPH, *Sogatella furcifera*). Both planthoppers damage the rice plants by excessive feeding and cause severe wilting known as "hopperburn" especially in the case of the BPH.

The first occurrence of BPH after the introduction of double cropping of rice in the Muda area was recorded in 1973 (HO *et al.,* 1979), and then 266 ha were affected in 1978 (Table 1). In 1979, a severe outbreak of WBPH occurred in the first season, affecting 21,492 ha or 22% of the whole Muda area. However, quick action taken by MADA and DOA enabled to contain the epidemic within 3 weeks, and thereby crop loss was negligible. Outbreaks of the planthoppers also occurred in 1982 and 1983. In the 2/'83 season, the Muda area experienced the worst recorded hopperburn; 347 ha out of 3,310 ha affected were hopperburnt. Such severe outbreaks are due to staggered planting, increased hectarage of direct seeding, and problems in contacting non-resident farmers to carry out field treatments. It is noteworthy that up to the end of 1981, the planthopper population in the hopper-infested fields consisted predominantly of WBPH. From 1982 onwards, however, BPH had become dominant, and therefore the incidence of hopperburn increased with increasing dominance of BPH.

Monthly records of planthoppers in light traps showed two peaks, January to February and July to August (Fig. 1), and the latter peak was higher than the former one. The two peaks coincided with the harvesting period of the first and the second season crops, respectively. Affected areas also corresponded to the population size in the two seasons.

After the implementation of the one month fallow period in 1984, the incidence of the planthoppers declined. In 1985, only 50 ha out of the 2,191 ha affected were hopperburnt in both seasons. IR 42, resistant to BPH, was widely cultivated especially in 1984 which probably contributed to the reduction of BPH occurrence.

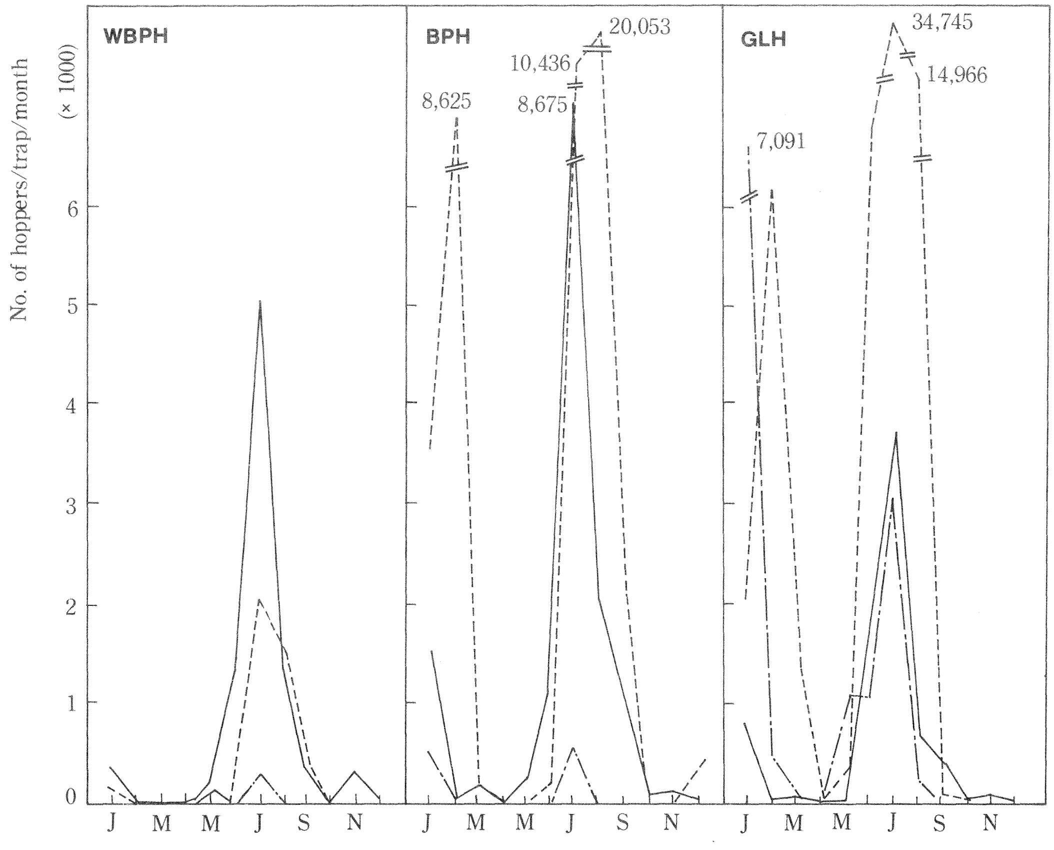

Fig. 1 Seasonal fluctuation of hoppers in a light trap in recent years. No. of hoppers is averaged by 27 traps in the Muda area. WBPH: white-back planthopper, BPH: brown planthopper and GLH: green leafhopper. ——— : 1981, ------- : 1983 and —·— : 1985.

Source: Crop Protection Branch, Federal Department of Agriculture, Telok Chengai, Alor Setar, Kedah.

The most common insecticides used by the farmers are MTMC + phenthoate in dust formulation and BPMC. The EC formulated chemicals are more commonly used during the tillering stage, while dusts are used after the maximum tillering stage. To overcome the problems of thick canopy in direct-seeded fields, the use of systemic insecticides in the form of heavy dusts or micro-granules may gain popularity in the future. Buprofezin, a growth inhibitor, was registered by the government in 1986 and is going to be used in this area from the 2/'86 season onwards.

2 Leafhoppers

As mentioned earlier, *N. virescens* is much more important because of its high efficiency in transmitting tungro and high population compared with *N. nigropictus*. LIM and HEONG (1977) noted that two peaks of GLH were observed in double cropping areas instead of one in single cropping areas. In the Muda area, two peaks also occur in January-February and in June-August. The latter peak is higher than the former (Fig. 1). This indicates that late-transplanted fields in June in the first season are exposed to the higher population of GLH, resulting in the high incidence of tungro. It is noteworthy that the population density of GLH has declined drastically since 1983 and that the tungro incidence has been significantly reduced since 1984 (Table 2). This is due to the effects of the fallow period and the widely cultivated IR 42, which is resistant to GLH.

As far as control measures are concerned, carbofuran granules are applied in the nursery beds. For standing crops, carbamate insecticides such as BPMC, MIPC, and carbaryl are applied as early as possible when disease symptoms are detected.

Table 2 Annual light trap catches of green leafhoppers (GLH) and areas affected by tungro in the Muda area in recent years

Year	Average no. of GLH/trap/year				Affected area (ha)	
	District I	II	III	IV	1st season	2nd season
1980	3,916	8,229	6,240	17,083	0	0
1981	495	6,060	8,246	10,896	5,870	14
1982	58,133	122,765	88,202	208,319	5,570	269
1983	8,114	30,004	42,017	182,757	8,460	195
1984	3,878	13,579	26,972	53,857	437	64
1985	170	7,435	26,105	23,700	93	0.3

Source: Crop Protection Branch, Federal Department of Agriculture, Telok Chengai, Alor Setar, Kedah.

3 Rice bugs

The important rice bugs are the Malayan black bug (*Scotinophara coarctata*), southern green stink bug (*Nezara viridula*), and rice stink bug (*Leptocorisa oratorius*). These bugs were regarded as minor pests of rice in the past but have become important in the Muda area. Outbreaks of these bugs have occurred more frequently in recent years.

The Malayan black bug feeds at the base of tillers throughout the growth period of rice, and is more abundant in the direct-seeded fields due to closer planting and closed plant canopy. These conditions render the habitats suitable for the bug.

The highest incidence of the bug was recorded in 1984; a total of 2,364 ha were affected in both seasons. "Bugburn" occurs occasionally, resulting in complete loss of yields like hopperburn caused by BPH.

The stink bugs attack immature panicles. Barnyard grasses (*Echinochloa* spp.) are the alternate host of both bugs. The weed matures one to two months earlier than rice plants and serves as breeding habitat before the infestation on rice plants. Therefore, these stink bugs are rampant in the direct-seeded fields where weeds grow abundantly. Normally, early- or late-planted fields suffer the most severe attacks by the stink bugs.

The late crops of the 2/'82 season were severely damaged by the southern green stink bug; 192 ha suffered 40-60% yield loss. In the 1/'83 season, another 65 ha were affected. *Leptocorisa* stink bug affected 126 ha in the 1/'83 season and 351 ha in the 1/'85 season.

As control measures, host weeds should be cleared from the rice fields and their surrounding areas to reduce bug reproductive habitats. Synchronous planting is useful to minimize bug attack. Insecticides recommended for the control of the Malayan black bug are acephate, fenthion, fenithrothion + lindane, and propoxur, while those for stink bugs include carbamate chemicals such as BPMC and carbaryl.

4 Stemborers

Stem borers have not been important in recent years as they used to be. Studies in the Muda area have shown low incidences of stemborers after the implementation of double cropping (OOI, 1974; PHANG and YEOH, 1977). This is attributed to double cropping which modified the microclimate and habitat in the fields and to the complete adoption of short term varieties, thereby allowing natural enemies to exert biological control in a more effective way. Among the four species of stemborers, the yellow stemborer (*Scirpophaga incertulas*) is dominant, followed by the dark-headed striped borer (*Chilo polychrysus*).

It is generally observed that when dusting is carried out in the first season to control hoppers, the incidence of stemborers is higher in the second season than in the first season. The highest incidence in recent years was recorded in 1983; 254 ha and 297 ha were affected by the mixed population of *Scirpophaga* and *Chilo* species in the first and the second seasons, respectively. The affected areas had more than 5% white heads during the reproductive stage of rice plants in most of the fields.

Stemborers at the nursery stage are effectively controlled by carbofuran, gamma BHC, and endosulfan in granular formulations. These insecticides are also effective in the paddy fields at the active tillering stage.

5 Other insect pests

Leaf feeders such as the leaf folder (*Cnaphalocrocis medinalis*), caseworm (*Nymphula depunctalis*), armyworm (*Spodoptera mauritia*) occur only sporadically. However, the leaf folder has a tendency to increase in severity with increasing hectarage under direct seeding. The rice whorl maggot (*Hydrellia philippina*) occurs during the one month period after planting. The rice thrips (*Stenchaetothrips biformis*) and spider mite (*Oligonychus oryzae*) attack the seedlings in the nursery as well as rice plants at the active tillering stage in the paddy fields.

Rodents

In the Muda area, *Rattus argentiventer* is the most common rat species in the paddy field while *Bandicota indica* is only encountered occasionally. Rat damage to rice plants had been reported during single cropping days. Nevertheless, the introduction of double cropping and the continuous presence of a food source in the fields created an environment which is more conducive to the multiplication of rats. LAM (1978) noted that double cropping areas showed a bimodal reproductive activity in comparison with a unimodal one in the single cropping areas. His observation also indicated that the nests were only found in the batas (levees or field ridges) at least six inches above the water level and with a width of one foot. With the launching of the Muda II project in 1979, the increase in canal density has corrrespondingly increased the levee density in the fields. Therefore, the incidence of rat damage will escalate further in the future if concerted efforts are not made.

The worst incidence of rats occurred in 1984 when 7,693 ha in both seasons were affected (Table 1). The major factors contributing to the rat build-up include staggered planting, increasing hectarage under direct seeding, poor sanitation in the fields and kampongs resulting in undisturbed breeding, farmers' complacency, and lack of vigilance, etc. (HO, 1984, 1986). In 1985, a large scale campaign for rat control was conducted. This included physical rat killing, followed by 8 week continuous baiting with anticoagulants. Dusting rat holes with warfarin was carried out when necessary.

Zinc phosphide is the most popular rodenticide used by the Muda farmers. However, as most farmers tend to apply zinc phosphide individually without the practice of prebaiting, bait shyness takes place among the rats, and consequently its efficacy is limited. A MADA survey indicated that in the 1/'84 season 91% of the Muda farmers used zinc phosphide. Only 2% used various forms of anticoagulants, i.e. warfarin, coumatetralyl, and brodifacuom. The remaining 7% did not use any rodenticides. Chlorophacinone has been introduced since 1985. This anticoagulant was very promising in group farming projects where continuous baiting was actively carried out by the farmers.

Conclusion

To overcome the instability of rice production due to pests as well as other constraints, NOZAKI *et al.* (1984) proposed a new double cropping system in the Muda area. The system includes the implementation of one month fallow period (February) over the whole Muda area in the dry season to break the year-round presence of some pests. Since the establishment of the fallow period in 1984, a marked decline has been observed in the incidence of important pests such as planthoppers, leafhoppers and tungro disease (refer to tables). Integrated pest management should be further promoted to stabilize rice production.

Changes in the cropping pattern usually cause changes in the pest populations and sometimes in the species composition. Owing to the labor shortage problems in the Muda area, farmers have adopted direct seeding and volunteer cropping where shattered seeds from the previous corps are allowed to grow. In the 1/'86 season, 65% of the fields were direct-seeded. These cropping methods, especially volunteer cropping, cause severe weed problems. Thick canopy and lack of in-field walking space in the direct-seeded fields are the main factors allowing pest multiplication to escape early detection. Besides, pesticide application is also more difficult and less effective in the direct-seeded fields.

In view of the above-mentioned problems, the formation of crop protection brigades as part of the group farming surveillance activities is definitely a positive step to stabilize rice production in the Muda area.

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Discussion

Omura, T. (Japan): 1. What is the reason for the change in the ratio of *Nephotettix virescens* and *N. nigropictus* during the period 1968-1982 in the Muda area? 2. Do you have any information on the difference in the incidence of *N. virescens* and *N. nigropictus* before and after the establishment of direct seeding in the Muda area? Indeed the ecology of the two insects is different as rice is the only host plant of *N. virescens,* the vector of tungro disease, whereas rice as well as other grasses including weeds are the host plants of *N. nigropictus,* the main vector of rice gall dwarf virus which caused extensive damage to rice in China in 1982. The increase in weeds associated with direct seeding may well contribute to an increase in the incidence of *N. nigropictus* in future unless attention is given to control weeds, and epidemics of rice gall dwarf may possibly occur.

Answer: 1. I have no information on the factors affecting the changes of species composition. 2. Could some of the participants from MADA answer the second question?

Dato' Syed Ahmad Almahdali (Malaysia): There is no indication at the moment as to the relationship between the increase of direct seeding and the increase of the *Nephotettix* population in the Muda area. One factor is that it is more difficult to apply insecticides in areas with direct seeding as plants are not arranged in rows to enable the farmers to walk in the fields. The implementation of the complete fallow period from early January to February may be an effective method of control.

Dat Van Tran (FAO): Could you explain what factors affect the populations of BPH and GLH?

Answer: I once asked a Malaysian entomologist why the hopper populations are higher in the dry than in the wet season only in Malaysia, unlike in Thailand, Vietnam, Indonesia, etc. I was told that natural enemies are much more active in the wet season, resulting in the suppression of the hopper populations.

Dato' Syed Ahmad Almahdali (Malaysia): Since there is less precipitation during the dry season cropping, the insect nymphs develop faster. However in the wet season due to heavy rainfall the nymphs are washed off before they become adults, hence the low incidence of insect outbreaks.

Khush, G.S. (IRRI): I would like to make a comment on the discussion regarding the occurrence of the brown planthopper in Malaysia during the dry season only. This situation is not peculiar to Malaysia. In other countries such as the Philippines, Indonesia, India and Sri Lanka it has been observed that the incidence of the brown planthopper during the dry season is much higher also. This is probably because the nymphs of the brown planthopper are washed off in the water with heavy rain during the rainy season and the population of the insect remains low.