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CROP PROTECTION AND IPM IN RAINFED CROPPING SYSTEMS IN NORTHEAST THAILAND

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The Northeast region of Thailand contains about one-third of the nation's population and land with a total area of 17 million hectares of which 8.3 million hectares are cultivated and less than 5 percent is irrigated. The region faces several constraints including highly variable rainfall resulting in crop losses from both flooding and drought. The soils are sandy, with low organic matter and clay (predominantly kaolinitic) contents and have low cation-exchange and water-holding capacities. Over 50 percent of the cultivated area is planted to rice, while cassava, kenaf and maize are the major field crops. The area in sugar cane, cotton, and peanut has fluctuated widely in recent years (1). Agricultural productivity and farm incomes in the region are very low.

Agronomic inputs and pesticide usage are generally low in the region due to the severe environmental conditions limiting crop production. Although some crops are not usually attacked by pests at economic levels, others are always severely damaged and pest control is economically justified. Pests and diseases are important production constraints of the crops grown in the region and weeds are severe in rice in low-rainfall years. The potential benefits from pesticide application, however, should be carefully examined, particularly for low-yielding crops that can survive under these stressed conditions as extensive, low-return systems. Monocropped, wet-season rice is the dominant cropping system of the region and is a good example of the low-input, low-return cropping strategies commonly practised by Northeastern farmers. Furthermore, many pests such as paddy crabs, rats, birds and even insects are important sources of food for farm families and any proposed control measures should take careful consideration of this fact both from safety and subsistence standpoints.

The RTG/USAID-funded Northeast Rainfed Agricultural Development (NERAD) Project was initiated in 1981 to address the aforementioned problems of the region. It follows a problem-oriented, interdisciplinary, approach working through eight departments in the Thai Ministry of Agriculture and Cooperatives (MOAC) with the purpose of strengthening departmental capability and stimulating research and extension activities more appropriate to the development of rainfed farming systems within the region.

FARMER'S PEST CONTROL PRACTICES

Northeastern farmers' knowledge of pests is generally very poor with the exception of some common rice insects such as the

stem borer (Scirpophaga incertulas Walker) and army worm (Spodoptera mauritia Boisduval) with which most farmers are familiar. Pest-damage identification by farmers is commonly incorrect and many farmers attempt to control beneficials. Farmers rarely use more than two and often only one type of insecticide for all pests of all crops and the compound used is commonly one with which they have experienced satisfactory control of a pest in the past. Pesticides are also often used at rates much higher or much lower than those recommended by the manufacturer. Almost without exception, farmers in the region are very poor and use simple, cheap sprayers such as the two-handed piston type resulting in poor coverage and inadequate applicator safety. Carbofuran is the most commonly used insecticide on rice where it is mainly applied only to the nursery beds. It is often used at less than a quarter of the recommended rate. In the case of upland crops and vegetables, there has been a long history of using methyl parathion, methamidophos, monocrotophos and methamyl and resistance is suspected in some pest species. Serious pesticide misuse is also evident and includes such practices as spraying without adequate protective clothing, infringement of harvest intervals and addition of pesticides to livestock rations for parasite control.

IPM WORKING GROUP

Prior to the establishment of the working group for pest management in Cropping Systems, NERAD was severely lacking in expertise on pest control. No formal channels were available for assistance with problems as they arose, and responsibility for pest control generally fell on site supervisors, agronomists, or field assistants who had no specialist expertise in pest control. In 1984, a pest management working group was established within NERAD to overcome these problems and to more effectively address the pest problems of the region. This group consists of regional and Bangkok representatives from the Department of Agriculture (DOA), Department of Extension (DOAE), Khon Kaen University (KKU), NERAD and the Northeast Regional Office of Agriculture (NEROA). Its purpose is to review currently available crop protection technologies and research results in Thailand and elsewhere in South East Asia and develop an appropriate IPM program for the Project's cropping systems component. The Work Group has responsibility for:

a) Formulating plans for research and extension activities in pest control.

b) Assisting in the implementation and monitoring of the project's pest control programs.

c) Conducting training programs for project staff in pest control methods and monitoring techniques.

d) Assisting in the analysis of data generated by the project's pest control research and in the dissemination of the results to government agencies and farmers.

Before NERAD's pest management working group was established there was very little information available for identifying major pests of the region and as a consequence yield loss assessment trials had not been systematically conducted for key pests making it impossible to set economic thresholds and make control recommendations. The working group therefore had the task of integrating the following IPM components into the pest management program for each important crop within the cropping systems research and extension trials:

(a) Chemical control of the entire pest complex, including insects, diseases, weeds, birds and rodents.

(b) Selection of appropriate varieties, cultural and agronomic practices and biological agents for reducing economic pest losses.

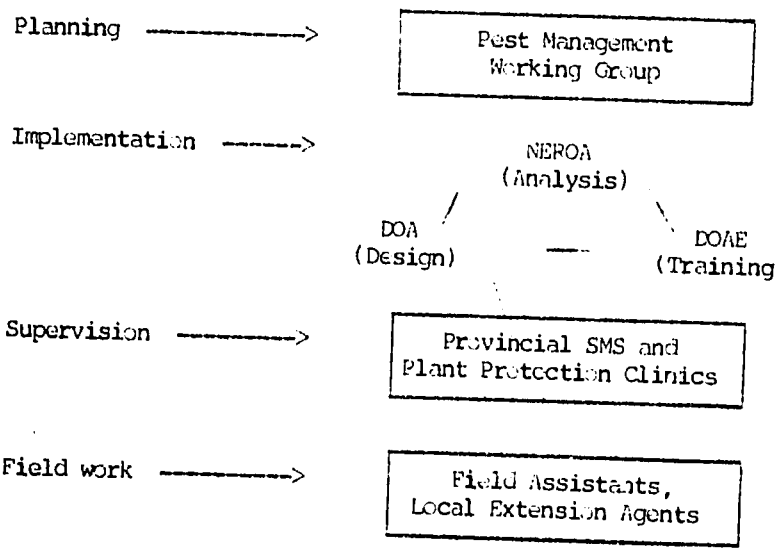
(c) Identification, ranking and conservation methods for important pest parasites and predators.

(d) Development of appropriate techniques for data collection and analyses to set economic treatment levels for key pests.

(e) Publication of handbooks, bulletins and other training aids for farmers on pest control recommendations, pesticide application, safety and pesticide resistance.

These activities are implemented on a pilot basis within NERAD (Figure 1) in order to test and further develop them for future adoption in the MOAC's regular programs in the region.

Figure 1. Organizational Structure and Inter-Agency Responsibilities of the NERAD Pest Management Working Group.



The IPM working group also attempts to communicate regional pest control problems to agencies with the appropriate expertise necessary for their solution. These efforts include forging links not only with the relevant technical departments in Thailand's Ministry of Agriculture but also with international agencies such as Cornell University in the United States on the study of papaya ringspot virus control (2) and with the International Rice Research Institute in the Philippines with a feasibility study on microbial insecticide use in Northeast Thailand (3).

IDENTIFICATION OF MAJOR PEST PROBLEMS

In order to identify the major pest problems facing farmers and to select sites for a pilot IPM program for the project, the IPM working group conducted an informal rapid rural appraisal study of all project sites in April, 1984 (4). They observed pest problems well over economic threshold levels at every site visited and farmer interviews revealed a history of economic insect pest damage on rice and upland crops. The Work Group concluded that pest problems are already one of the most serious constraints to cropping systems development in the region and they recommended that yield loss assessment trials be implemented within NERAD as the basis for pest control recommendations in the future.

TRAINING PROGRAMS

During the development of a practical pest control program for use in the cropping systems component of the project, the IPM working group conducted a training program for the project site supervisors, field assistants, plant-protection-clinic staff and TEA's working in villages in the project area. This dealt with identification of key pests and beneficials, pest monitoring techniques and control measures. It soon became obvious that for IPM trials to be successfully implemented in the field by staff with no formal pest control background, then further regular visits of the Pest Management Working Group were necessary to give follow-up, hands-on training in the field.

The working group also designed a simplified training course for participating and other interested farmers in the cropping systems trial sites aimed at overcoming the problems caused by farmers' lack of knowledge on pest control as identified by the Working Group.

YIELD LOSS ASSESSMENT TRIALS

These trials were implemented using the 'superimposed trials' technique whereby 4 treatments (complete control, recommended practices, zero control and farmer practices) are superimposed on the regular cropping system trials so that pest populations and damage levels can be assessed. The trials were conducted in 4 project sites chosen to be representative of the region. Each trial was replicated over 6 farms and sub-plot size was 20 x 20m. Participating farmers received training in IPM principles and

some farmers were subsequently capable of sampling their own fields themselves. The project technicians and local extension agents, under the supervision of the provincial SMS and staff of the plant protection clinics, worked directly with the farmers in the trial plots to ensure that they were frequently and correctly monitored to determine pest incidence and damage levels. During the trials, farmers were advised of the environmental hazards of pesticide-use and taught proper safety precautions. In later stages of the project, farmers will be encouraged to manage and monitor their fields without assistance from project personnel.

Initial IPM trials on rice indicated that insect pest and disease levels were relatively low, gall midge (Orseolia oryzae Wood-Mason), stem borer (Scirpophaga incertulas Walker) and brown plant hopper (Nilaparvata lugens Stal) were observed in trial plots and nearby fields. Complete control and IPM recommendations increased yields but did not significantly increase farmers' profits. Carbofuran applications gave an apparent stimulation of rice yields (5), but recommendations for this input need to be adjusted in order to maximize profits (Table 1).

Table 1: Economics of IPM Trials on rice (Average from 3 sites)

Treatment	Yield (kg/rai)	Crop Value (B/rai)*	Pest Control Cost (B/rai)	Net Returns (B/rai)
Complete control	535	1,400	287	1,113
Recmd. practices	461	1,203	60	1,143
Farmer practices	436	1,131	0	1,131
No control/check	447	1,164	0	1,164

* Selling Price = 2.60 Baht/kg

The results of the kenaf and peanut yield-loss-asssessment trials were similar to those of rice. There were no consistent trends in pest populations among different treatments but yields were substantially higher in the complete control and recommended practices than those in the farmer-practices and control treatments. Assuming that pest control treatments did affect production, then yields in the complete control and recommended practices plots are quite similar. However, the obvious conclusion is that using lower pesticide inputs should be considered in an attempt to maximize profits.

PAPAYA RINGSPOT VIRUS CONTROL

In their first report (4) NERAD's IPM Work Group identified papaya ringspot virus (PRV) as severely limiting production of

this important subsistence crop in the Northeast. The virus infects cucurbits and papaya and is transmitted non-persistently by a number of aphid species. PRV eradication programs in the region gave only limited success in the control of this virus (6) and integration with other control measures was therefore considered necessary.

Mild-strain, nitrous-acid-induced mutants of a severe PRV strain were isolated in 1982 (7) and showed promise as potential cross protection strains (cross protection is a method of protecting plants against damage from severe strains of a virus by infecting them with a mild strain of the same virus). These isolates were brought to Thailand under the sponsorship of NERAD's IPM Working Group for evaluation in June 1986 and experiments to test the effectiveness of cross protection in papaya at the greenhouse, nursery and limited village level were initiated.

Results to date have demonstrated that papaya can be satisfactorily infected with the mild PRV strains in Northeast Thailand although high temperatures at certain times of the year can produce poor infection rates. Mild-strain-infected plants grew as well as uninfected plants but the growth of plants experimentally-infected by the severe Thai strain was drastically reduced. Trial results have so far shown that the effectiveness of cross protection against mechanical-challenge-innoculation by the severe strain is dependent on inoculum pressure (Table 2).

Table 2. Reaction of mild-strain-protected papaya challenge inoculated with severe strain at varying pressure.

TREATMENT	DAYS AFTER CHALLENGE	PLANTS WITHOUT SEVERE SYMPTOMS AT VARIOUS LEAF POSITION CHALLENGES :			
		3	3+4	3+4+5	ALL
HA 5-1 mild-strain	0	5	5	5	5
	10	5	5	5	3
	21	4	3	0	2
	30	4	2	0	0
HA 6-1 mild-strain	0	5	5	5	5
	10	5	3	1	4
	21	5	2	0	0
	30	4	1	0	0
Unprotected	0	5	5	5	5
	10	0	0	0	0
	21	0	0	0	0
	30	0	0	0	0

Source: Consalves, 1986 (8).

Nursery trials to assess the effectiveness of cross protection against natural aphid challenge are giving promising results

(Table 3) but the true potential of the technology will only be clear once the results of village level tests under severe, moderate and no disease pressure are available later this year.

Table 3. Reaction of mild-strain-protected papaya under natural aphid-challenge conditions.

TREATMENT	NUMBER OF PLANTS	PLANTS WITH SEVERE STRAIN SYMPTOMS (Days after transplanting)			
		0	12	46	86
Protected	13	13	13	12	12
Unprotected	20	20	20	9	7

Source: Gonsalves, 1986 (8).

Cross protection is not expected to solve the papaya ringspot virus problem in the Northeast on its own just as eradication, although showing early promise, was unable to give satisfactory control. It is anticipated, however, that cross protection integrated with eradication and possibly also combined with a breeding program for resistance may give satisfactory levels of control at an acceptable cost to subsistence farmers.

Research on cross protection against papaya ringspot virus is no longer funded under the NERAD IPM program. The working Group's objective of identifying a significant regional pest problem, stimulating research and integrating the efforts of the relevant agencies, in this case the Northeast Regional Office of Agriculture, Department of Agriculture, Department of Extension and Khon Kaen University, has been achieved.

IPM IN FARMING SYSTEMS RESEARCH

One of the most promising farming systems technologies developed by NERAD is a method of raising fish in rice paddies under rainfed conditions. Not only is farmer income supplemented by the sale of fish but rice yields are also considerably increased (Table 4) and farmers are already adopting this technology on a significant scale.

Joint research between the Department of Fisheries (DOF) and DOA was initiated this year to determine what was causing the increases in rice yields. Beneficial fish-pest interactions were hypothesized as likely to contribute to rice improvement and therefore insect, disease and weed populations were monitored in the trials by the IPM Work Group. Unfortunately, results of the pest population analyses are not yet available but plot observations would suggest that weed populations were considerably reduced by fish due to inclusion of herbivorous Carp in the

released fish population. It is anticipated that results of this IPM activity will assist DOF in determining the relative proportions of the various fish species that they should recommend to optimize pest control in this rice system.

Table 4. Rice yields in paddies with and without fish from on farm and research station trials.

TREATMENT	NUMBER OF REPLICATES	RICE YIELD (Kg/Rai)	NET RETURNS (Baht/Rai)
Farmer Fields:			
WITH FISH	6	576	1092
WITHOUT FISH	6	506	925
Research Station:			
WITH FISH	4	367	729
WITHOUT FISH	4	291	539

EXTENSION ACTIVITIES

The IPM working group follows the NERAD approach of integrating the efforts of various government agencies to better respond to farmers' pest control problems. NERAD's extension activities are based on the IPM program's research and problem identification components and include the following:

IPM Demonstration Plots

Thirty rice farmers in each site were selected and trained in pest surveillance procedures. The total surveillance area in each site is 80 hectares and is divided into 5 plots. Pest populations and damage levels are monitored on about 1.5 hectares every 15 days. These data are then used to decide pest control measures using the previously established ETL's. In most cases this year, pest populations were below thresholds (Figure 2) and control measures were unnecessary.

Plant Protection Information Centers

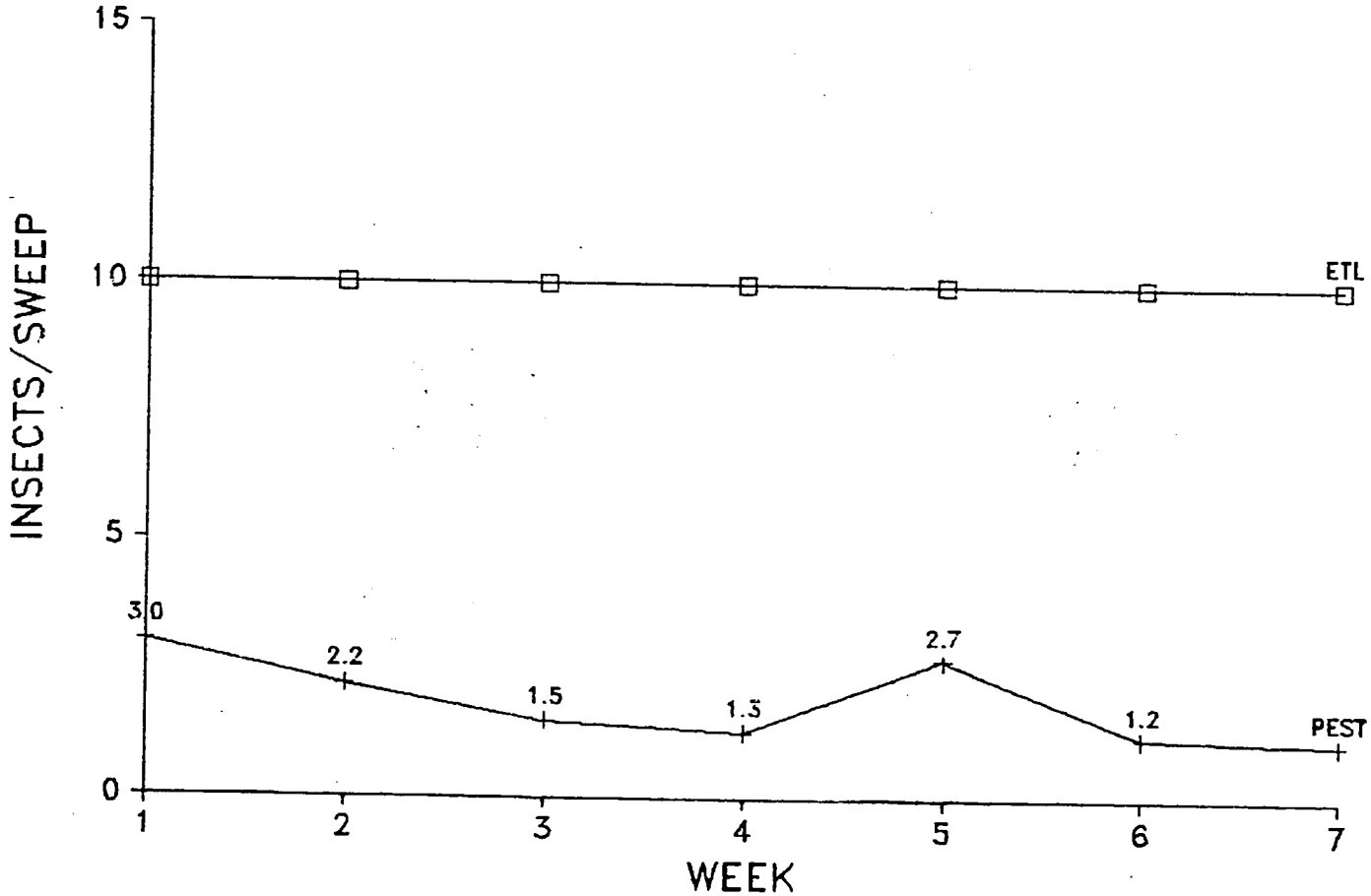
Information on plant protection including pesticide recommendations, application-procedures, pesticide safety precautions, and other technical aids including pest and disease specimens are provided at the NERAD Site Offices. Pest forcasting bulletins are distributed every 15 days to participating and other farmers.

Training and Visit System

In order to monitor the IPM program, the local Plant Protection Clinics hold farmer training sessions and follow-up visits every month.

FIGURE 2. GREEN LEAFHOPPER INFESTATION

IPM TRIALS, SRISAKET, 1986.



CONCLUSIONS

Crop protection programs for rainfed agricultural systems in the Northeast region need careful consideration particularly as agronomic inputs and pesticide usage are generally low because of the severe environmental constraints to crop production. Cooperation among the government agencies involved is essential for the successful implementation of any IPM program and NERAD's efforts in this respect have resulted in DOA and DOAE fully cooperating right from the initial planning and implementation stages in the project's IPM program.

REFERENCES

1. Craig, I.A. and Pisanu, U. 1985. Overview of Rainfed Agriculture in Northeast Thailand. Proceedings of the International Dryland Soils and Water Management Conference. February 24 - March 1, 1985. Khon Kaen University, Thailand.

2. Gonsalves, D. 1986. Papaya Ringspot Virus and Cross Protection. NERAD Short Term Consultancy Report. 25pp.

3. Tyron, E.H. 1986. Feasibility of using a locally produced microbial insecticide in Northeast Thailand. NERAD Short Term Consultancy Report. 47pp.

4. Katanyukul, W., Amaritsut, W., Keerati-Kasikorn, M. and Craig, I.A. 1984. Working Group for Pest Management Report of a Study Tour, NERAD Working Paper. 36pp.

5. Reissig, H. 1986. Summary of IPM Activities in the NERAD Project and Recommendations for the Future. NERAD Short Term Consultancy Report. 13pp.

6. Prasartsri, W., Amaritsut, W., Chompronutprapa, K., Surai, S. and Fukiatpaiboon, A. 1985. Papaya Ringspot Virus in N.E. Thailand and methods of control. Paper Presented at the 2nd Workshop on Plant Viruses and Mycoplasmas, August 4 to 8, 1985. Bangkok Thailand.

7. Yeh, S.-D., and Gonsalves, D. 1984. Evaluation of Induced Mutants of Papaya Ringspot Virus for Control by Cross Protection. Phytopathology, 74 (9) 1086-1091.

8. Gonsalves, D. 1986. Control of Papaya Ringspot Virus by Cross Protection. AIT Short Term Consultancy Report. 25pp.