International Planthopper Conference

June 23 – 25, 2008
Venue: IRRI

Theme: *Planthoppers – New threats to the sustainability of intensive rice production systems in Asia*

Conference Synopsis

The rice planthoppers, brown and white back planthoppers (BPH and WBPH) are pests which are normally kept in check by naturally-occurring biological control services. In large populations, the planthoppers can completely destroy crops, a symptom called “hopper burn”. In addition, the BPH is a known vector of two persistent virus diseases, the grassy stunt and the ragged stunt. Plants infected by these viruses are stunted and have no yields.

In the 1970s, BPH became a threat to rice intensification programs in Indonesia, Thailand, India, Solomon Islands and the Philippines. IRRI organized the first BPH international conference in 1977 which brought together scientists from all rice producing countries to tackle the problem. Activities triggered by this conference that followed, including IPM, reducing unnecessary insecticide use and breeding resistant varieties that contributed to improved management of the pest that kept it under control for the next 20 years. However in the last 5 years, planthopper problems have intensified in several countries, like China and Vietnam. This might be due of factors such increased fertilizer and pesticide intensities, climate, changes in rice varieties (hybrid rice) and cropping patterns. Growing insecticide resistance especially to imidacloprid, BPMC, fipronil and buprofuzin is also a concern.

The International Conference on Rice Planthoppers brought together 88 scientists, agricultural directors and pesticide company representatives from Australia (1), Bangladesh (2), Cambodia (3), China (4), FAO (3), India (5), Indonesia (2), Japan (7), Korea (3), Laos (2), Malaysia (3), Philippines (13), Singapore (1), Taiwan (1), Thailand (6), USA (2), Vietnam (5) and IRRI (25). Two keynote addresses and 17 scientific papers were presented. On the third day, a panel discussion and a facilitated workshop to brainstorm for solutions was conducted. The Conference program is in Appendix 1.

Opening and keynote addresses

The Conference was opened with a welcome address from the acting director general, Dr William Padolina and a video of the DG Dr Robert Zeigler’s welcome speech. In the DG’s welcome he challenged the Conference to developed sustainable solutions to the planthopper problems to tackle rice price increases and climate change. The first keynote address was presented by Dr Peter Kenmore, Chief of Plant Protections Services, FAO, Rome. He stressed that planthopper problems are induced by insecticides. Farmers generally respond to cues from the public and private sector that instill their fear of losing their production. In the 1970s and 80s, the BPH was a huge problem in the rice intensification
programs of the Philippines and Indonesia as a result of packaged fertilizers and insecticides and in these two countries. The BPH problem in Indonesia has remained minor after significant policy interventions to remove insecticide subsidies and the implementation of IPM. Professor Geoff Gurr, professor of applied ecology in Charles Sturt University, Australia, in his keynote emphasized the role of habitat manipulation and design in agricultural systems in bringing about sustainable pest management and introduced the concepts of ecological engineering. He described the use of shelters, border rows and corridors in enhancing biological control in Australian agriculture and the prospects of using such approaches in rice production.

The scientific papers were presented in three sessions:

**Planthopper Problems**

Dr Kajisa provided the economic setting for the Conference discussing the current situation in rice market and the lessons we can draw from the past. A similar rice price surge happened in the 1960s and it prompted the Green Revolution. At the same time it also prompted heavy chemical usage and the first threat of the BPH occurred in several Asian countries. Professor Jiaan Cheng discussed about the increasing BPH problems in China and attributed these occurrences to increase in population growth rates, brought about by increases in summer temperatures, cropping intensities, hybrid rice and heavy pesticide use. In 2005, the BPH, which had remained in low densities since the 1980s, caused a series of outbreaks in Vietnam, China, Korea and Japan. The biggest damages were from China, where 7.5 million ha in several provinces were infested resulting in a loss of 2.8 million t of paddy. In Vietnam in addition to BPH damages, crops were severely damaged by viral infections transmitted by BPH. In 2006, the ministry reported a loss of 400,000 t rice, which prompted the government to restrict exports in fear of domestic shortages.

Watanabe et al discussed about the wind borne immigrants from China are the main source of BPH immigrants to Japan, as BPH is unable to over-winter there. Thus all BPH populations are exogenous from Southern China. Development of insecticide resistance by BPH is at an alarming rate and Matsumura et al presented data from Vietnam, China and Japan showing > 800 fold resistance to imidacloprid which was introduced about 10 years ago. One factor they attributed to was the use of imidacloprid seed dressing as a prophylactic which contributed significantly to selection pressure for the BPH to evolve. Since planthoppers cannot over-winter in Japan thus all insecticide resistant BPH are immigrants from China. The main reason for the quick development of insecticide resistance may be due to the heavy use of compounds with similar chemistry over Vietnam, China and Japan. Dr Cabauatan et al presented a whole spectrum of symptoms the two viruses carried by BPH exhibit and called this “yellowing syndrome”. The range of symptoms depends on the relative timing of infections by the rice grassy stunt (RGSV) and the rice ragged stunt (RRSV). Otuka et al developed a model to predict the potential of BPH migration based on weather data. The model available in the web presents the areas in China, Japan and Korea that BPH can potentially move to. Sogawa et al introduced their work on WBPH in Chinese hybrid rice. They found that hybrid rice CMS lines are extremely susceptible to WBPH thus favoring their development. The situation of planthopper problems and current research in
several Asian countries were summarized by Catindig et al. The survey showed that the countries where planthoppers are seriously infesting rice are China and Vietnam, where pesticide use is high. Planthopper research in many countries is mainly dominated by screening of varieties, chemical evaluation, laboratory studies and lack of field research. Limited research is done on developing field resistance and ecology. Zhu et al discussed the management of the smaller brown planthopper, another species of planthoppers that occur in temperate rice. This species transmits the black streak virus disease and is beginning to cause production losses in central and northern China.

**Host plant resistance (HPR) breeding**

In the last 30 years since the first BPH conference in 1977, scientific approaches in genetics, ecology and pest management have advanced considerably. Classical host plant resistance had been IRRI’s main approach to BPH management but this may not suffice, as the pest population structures constantly evolve. Meanwhile about 21 BPH resistance genes and several QTLs have been identified by researchers. However all these genes have been screened using the same phenotypic bioassay, the seedbox test. This test seem to have only screened for anti feedant effects that seedling rice have on BPH and that field populations can easily adapt to. Thus varieties carrying genes screened by the seedbox technique might confer resistance at the young crop stages, but this resistance may not hold when the crop is in the field as BPH populations can easily find a small niche to continue feeding to survive. In debating this point there was consensus in the Conference that there is need to develop another phenotypic bioassay that is identifying plant characteristics that affect the insect’s ecological fitness. Work by Dr Seo et al in Korea also showed that BPH populations migrating from China have strong resistance breaking abilities using the seedbox test as well as other fitness characters. Chen et al discussed the variability of BPH populations using micro satellite markers and found that there are little differences probably because of the constant insect movements. She also discussed the role symbionts might play in the observed variability and adaptability in planthoppers’ host plant-insect relationships. Noda et at described recent developments in insect genomics had facilitated new approaches to elucidate planthopper virulence against resistant rice varieties, pesticide resistance mechanisms, and virus transmission abilities. From expressed sequence tag (EST) analysis in BPH a micro-array can be fabricated.

**Management of rice planthoppers**

Ecological research showed that BPH is a secondary pest induced by ecological perturbations, particularly insecticides. Heong discussed evidences to show that BPH outbreaks are due to breakdown in ecosystem services, particularly biological control and invasion resistance, thus compromising rice system health and make them vulnerable to pest attacks. If the perturbations are removed, rice ecosystems have the resilience to bounce back. Species richness of predators, parasitoids and detritivores increased significantly in IRRI farm after insecticide use was reduced by > 95% and BPH populations are now extremely low. Another symptom of ecosystem breakdown is the rapid development of insecticide resistance similar to the “crisis and disaster phases” described by Huffacker and DeBach in 1971. Lu et al discussed the role excessive fertilizer will play in affecting ecological fitness
of planthoppers. An increase of nitrogen rate from 100 kg N to 400 kg N can increase BPH populations by 40 folds. A rate of 100 kg N is optimum in most cases. To build sustainable systems that will keep BPH in low densities, a broader perspective incorporating landscape ecology, ecological engineering and population ecology to manage “system resistance” (which includes host plant resistance) will be needed. To achieve this over a large scale will require developing communication strategies with multi stakeholder participation to implement ecological engineering practices. Such approaches will also be needed to build system resilience in order to enhance adaptation strategies and local capacities to reduce local vulnerability and combat climate change. BPH outbreaks have been attributed to the lack of “system resistance” and thus making the crop vulnerable to slight changes in climate and cropping shifts. Rice ecosystems have rich habitat biodiversity that can conserve natural biological control services. From the early 1990s rice farmer’s insecticide use in many countries (except China, Korea and Japan) has steadily reduced as a result of intensive media campaigns, radio and training programs implemented by government. However in the last 5 years, farmers’ insecticide use intensity is gradually increasing. The meta-analysis of farmer surveys conducted from 1992 to 2007 in the Mekong Delta showed that farmers’ insecticide are often prone to external cues. After a campaign or training their insecticide use tended to reduce, but would gradually creep back up subsequently. They attributed this to government pesticide distributions and private sector advertising.

Panel Discussion and Brain storming for solutions

KL Heong introduced a framework of three facets in achieving sustainable management of planthoppers – Ecological management techniques, Ecosystem deteriorating forces and Management and policy facilitation (figure 1). Ecological management techniques to favor ecosystem services, such as IPM, habitat manipulations, use of resistant varieties and ecological engineering are often masked or subdued by Ecosystem deteriorating forces, such as unnecessary prophylactic use of insecticides, cheap pesticides, advertising and promotion motivating insecticide use. In many rice intensification programs, the Management and policy facilitation facet tends to favor the deteriorating forces, such as subsidized pesticides, extension promoting and selling pesticides, lack of pro green policies, lack of incentives to provide environmental services for global benefits. Planthopper outbreaks are signs of ecosystem deterioration and in order to implement sustainable management strategies, there is need to adjust the Management and policy facilitation facet to favor Ecological management techniques. These adjustments might be in pesticide use policies, extension policies, initiating pro green and payment for environmental services (PES) policies. The five panel speakers and the topics they introduced were as follows:

A. Santi Obien – Research needs and considerations
B. Geoff Gurr - Ecological engineering ideas for planthopper management
C. J. Xia - Extension adjustments to promote sustainable management
D. S. Mohanty - Social and economic considerations
E. Peter Kenmore - Policy adjustments

The Conference participants, facilitated by two external facilitators, were divided into three discussion groups (research, extension and policy) to brainstorm using the framework
questions “What to continue, what to stop, what to start and how to start”. The theme question was

“What structural, policy and research adjustments will be required for sustainable management of rice planthopper problems?”

A summary of the brain storming suggestions is shown in Appendix 2.
Appendix 1. Program

23 to 25 June 2008
Seminar Rooms A, B and C
D.L. Umali Laboratory Bldg.
In the 1970s, the brown planthopper (BPH) became a threat to rice intensification programs in Indonesia, Thailand, India, Solomon Islands and the Philippines. IRRI organized the first BPH international conference in 1977 which brought together scientists from all rice producing countries to tackle the problem. Activities triggered by this conference, including IPM, reducing unnecessary insecticide use and breeding tolerant varieties, that contributed to improved management and kept the pest under control for the next 20 years. However in the last 5 years, planthopper problems have intensified in several countries, like China and Vietnam. This might be due of factors such increased fertilizer and pesticide intensities, climate, changes in rice varieties (hybrid rice) and cropping patterns. Growing insecticide resistance especially to imidacloprid, BPMC, fipronil and buprofezin is also a concern. Over the years possibly because of complacency, changes in emphases and shortage of resources there is lack of research, monitoring and comprehensive analyses to understand, model and predict the potential pest developments, leaving a gap in knowledge.

In the last 30 years since the first BPH conference in 1977, scientific approaches in genetics, ecology and pest management have advanced considerably. Classical host plant resistance had been IRRI’s main approach to BPH management but this may not suffice, as the pest population structures constantly evolve. Meanwhile several BPH resistance genes (bph 1, 2, 3, 10, 18, 25 etc) and QTLs have been identified by breeders. Ecological research showed that BPH is a secondary pest induced by ecological perturbations. To build sustainable systems that will keep BPH in low densities, a broader perspective incorporating landscape ecology, ecological engineering and population ecology to manage “system resistance” (which includes plant resistance) will be needed. To achieve this over a large scale will require developing communication strategies with multi stakeholder participation. Such approaches will also be needed to build system resilience in order to enhance adaptation strategies and local capacities to combat climate change. BPH outbreaks have been attributed to the lack of “system resistance” and thus making the crop vulnerable to slight changes in climate and cropping shifts. The outbreaks in northern China were partly due to the slight increase in summer temperatures of 2°C in 2005 and abnormal numbers of south-west typhoons. Similar post-ante analyses of Vietnam’s BPH/virus problem may provide important information for developing management options.

Recent research by Japanese entomologists showed that Chinese hybrid rice varieties seem to favor a new problem, the white backed planthopper (WBPH). While hybrid rice adoption is spreading in many Asian countries, research, information and management strategy on this new problem is still lacking. Japanese scientists have also identified sources of induced resistance from WBPH feeding in Japonica varieties.

Rice ecosystems have rich habitat biodiversity that can conserve natural biological control services. From the early 1990s rice farmer’s insecticide use in many countries (except China, Korea and Japan) has steadily reduced as a result of intensive media campaigns, radio and training programs implemented by government. However in the last 5 years, farmers’ insecticide use intensity is gradually increasing.

The Conference will address the threat of planthopper pests in intensive systems, review ecological concepts bearing on management strategies, progress in developing insect resistance for planthoppers, management of virus diseases transmitted by planthoppers and brainstorm for solutions in adjustments to policy and structures that will favor sustainable management.
INTERNATIONAL CONFERENCE ON BROWN PLANTHOPPER

Programme

22 June 2008 (Sunday) Arrival of participants

23 June 2008 (Monday) - Day 1

0800 Registration
0830 Opening Session
     Welcome remarks
     Dr. William Padolina
     Acting Director
     General

0900 Keynote Address: Science and politics in rice planthopper management in Asia: Prospects for a common language in the future
     Chairperson: Dr. Santiago Obien
     Dr. Peter Kenmore

1000 Group photo and coffee/tea break
1030-1200 Session 1: Planthopper problems in rice production
     Chairperson: Professor Jingyuan Xia

1030 Global rice market: current situation and lessons from the past
     K. Kajisa

1100 Planthopper outbreaks in China
     J.A. Cheng

1130 Recent occurrences of long-distance migratory planthoppers and factors causing the outbreaks in Japan.
     M. Matsumura
     A. Otuka

1200 Discussions
1230 Lunch

1330-1730 Session 1: Planthopper problems in rice production (continued)
     Chairperson: Professor Candida Adalla

1330 Current status of insecticide resistance in rice planthoppers in Asia.
     M. Matsumura
     H. Takeuchi
     M. Satoh
     S. Sanada-Morimura
     A. Otuka
     T. Watanabe
     D. V. Thanh

1400 Rice viruses transmitted by brown planthoppers.
     P. Cabauatan
     R. Cabunagan
     I. R. Choi
1430  Search for cross-boundary migrations between the Southeast Asian population and the East Asian population of rice planthoppers

A. Otuka
S.H. Huang
M. Matsumura
T. Watanabe

1500  Prevalence of the whitebacked planthoppers in Chinese hybrid rice and resistance in Chinese japonica rice.

K. Sogawa
G. Liu, Q. Qian

1530  Coffee

1600  Situation of rice planthoppers in Asia

J. Catindig
G. Arida
S.E. Baehaki
J.S. Bentur
L. Q. Cuong
M. Norowi
W. Rattanakarn
W. Sriratanasak
J. Xia, Z. Lu

1630  Management of the small brown planthopper Laodelphax striatellus and its transmitted rice viral diseases through cultural and chemical approaches.

Z-R. Zhu
Y. Zhou, X. Lin
J. Zhu, H. Wang
J.A. Cheng
B.H. Lee

1700  Discussions

1730  End of session

1900  Welcome Dinner at the IRRI Guest House

24 June 2008, Tuesday

0900  Keynote Address 2: Prospects for ecological engineering for planthoppers and other arthropod pests in rice

Chairperson: Dr K.L. Heong

Professor Geoff Gurr
Charles Sturt

1000  Coffee/tea break

1030-1200  Session 2: Genetics and plant breeding

Chairperson: Dr. Hei Leung

0900  Breeding for planthopper resistance

D. Brar
P. Virk, K.K. Jena

1100  The genetics of host plant resistance to rice planthoppers

D. Fujita
H. Yasui

1130  Variability in planthopper-rice interactions: exploration of three-trophic levels.

Y.H. Chen
J. Ferrater
C. Bernal
J. Sangha
A. Romena
1200  Discussion
1230  Lunch
1330-1500  Session 2: Genetics and plant breeding (continued)
             Chair: Dr Darshan Brar
1330  Planthopper genomics: How it can be useful for planthopper management?  H. Noda
1400  Resistance-breaking ability and feeding behavior of the brown planthopper, *Nilaparvata lugens*, recently collected in Korea. B. Y. Seo  J. K. Jung  B. R. Choi  H. M. Park
1430  Discussion
1500  Coffee
1530-1700  Session 3: Management of rice planthoppers
             Chairperson: Professor Jiaan Cheng
1530  Are planthopper problems due to breakdown in ecosystem services?  K.L. Heong
1600  Effects of nitrogen on ecological fitness of planthoppers  Z. Lu  X. Yu, K.L. Heong
1700  Discussion
25 June 2008 Wednesday

PANEL DISCUSSION AND BRAIN STORMING FOR SOLUTIONS

0830 Panel Discussion

Introduction

K.L. Heong

What structural, policy and research adjustments will be required for sustainable management of rice planthopper problems?

Panelists

P.E. Kenmore

J. Xia

S. Obien

G. Gurr

S. Mohanty

1000 Coffee/tea break

1030 - 1500 Break out groups to brain storm for solutions

Groups will be formed during the conference

1230 Lunch

1500 Plenary Group reporting

Group representatives

1600 Closing Remarks

J.A. Cheng
List of Participants

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**RESEARCH**

<table>
<thead>
<tr>
<th>What to continue</th>
<th>What to stop/re evaluate</th>
<th>What to start</th>
<th>How to start</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring planthopper abundances</td>
<td>Re-evaluate planthopper resistance screening method eg. Seedbox</td>
<td>Research on how to enhance ecosystem services viz. habitat manipulation, landscape ecology</td>
<td>Develop proposals for fund raising</td>
<td>Need to quantify not just ecosystem services but their economic impact as well.</td>
</tr>
<tr>
<td>Monitoring viruses, insecticide resistance</td>
<td>Stop selection of HPR based on plant traits that only confer anti feeding effects</td>
<td>Start research in search of “green” or biologically based for pest management</td>
<td>Develop human capacity in new research approaches</td>
<td>Policy research not presented.</td>
</tr>
<tr>
<td>Understand basis of HPR/Improve screening method</td>
<td>Stop routine evaluations of insecticides</td>
<td>Start research on adaptive management responses for pest outbreak management</td>
<td>Review literature and history of planthopper problems</td>
<td>Need to convince government about ecosystem services as alternate items for resource allocation, rather than just pesticides</td>
</tr>
<tr>
<td>Understand and apply conservation biological control</td>
<td>Stop developing insecticide mixtures to develop broader spectrum</td>
<td>Start research to develop adaptation strategies to climate change effects</td>
<td>Develop landscape level objectives</td>
<td>An awareness campaign for policy makers will be a good place to start.</td>
</tr>
<tr>
<td>Understand planthopper evolution</td>
<td>Stop research on use of transgenics for planthopper management</td>
<td>Develop new protocols to discover new phenotypic materials for HPR</td>
<td></td>
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</tr>
<tr>
<td>Quantify impact of good agricultural practices (GAP) on planthoppers</td>
<td>Stop just selection of varieties based only on high yields.</td>
<td>Develop measures to quantify ecosystem services.</td>
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<tr>
<td></td>
<td>Stop mixing insecticide promotional activities into research</td>
<td>Develop sustainable management strategies by understanding mechanisms of HPR, identify new genes and best timing of each measure</td>
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<tr>
<td></td>
<td></td>
<td>Understand ecology and epidemiology of planthoppers and viruses</td>
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<tr>
<td></td>
<td></td>
<td>Monitoring of planthoppers, insecticide resistance, virulence</td>
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<tr>
<td></td>
<td></td>
<td>Study cost benefits, impact of BPH infestations and farmer practices for BPH management.</td>
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</tbody>
</table>

Need to do the research on the negative consequences, like causing secondary pests, like BPH in respective countries. IRRI scientists have done these, but similar experiments are needed in respective countries to convince governments.
<table>
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</thead>
<tbody>
<tr>
<td>Information flow to farmers, field schools, mass media</td>
<td>Stop providing subsidies to hazardous chemicals</td>
<td>Multi lateral collaborations (eg in exchange of pest data, germplasm)</td>
<td>A resolution to start multi lateral collaborative programs</td>
<td>Levy on rice production may be difficult.</td>
</tr>
<tr>
<td>Restrictions on sale, production and use of banned pesticides</td>
<td>Stop excessive fertilizer use</td>
<td>Awareness for policy makers in support of IPM research</td>
<td>Policy maker awareness activities, like conferences, policy dialogues,</td>
<td>Although this can work in developed nations, not sure about in DCs.</td>
</tr>
<tr>
<td>Rigorous process for pesticide registration</td>
<td>Stop corruption</td>
<td>Start ecological engineering approaches to pest management</td>
<td>demonstrations, exhibitions.</td>
<td>May be possible to place levies on specific inputs that harm environment, like pesticides.</td>
</tr>
<tr>
<td>Support for research and extension</td>
<td>Stop heavy pesticide advertising and promotional activities</td>
<td>Start a mechanism to review policies and make adjustments</td>
<td>Establish ecological engineering research and demo plots</td>
<td></td>
</tr>
<tr>
<td>Conferences and international networking</td>
<td>Stop short term decision making</td>
<td>Start a levy on rice production to support research</td>
<td>Start process of developing levy</td>
<td></td>
</tr>
<tr>
<td>International and national forecasting pest warning system</td>
<td></td>
<td>International collaborations in planthopper ecology, virus epidemiology and</td>
<td>Initiate committees to review policies and mechanisms for policy dialogues</td>
<td>Concerned about using levies to raise funds for research and extension</td>
</tr>
<tr>
<td>IPM implementation, use of resistant varieties (field resistance), GAP and biological control</td>
<td>Government subsidies for pesticides</td>
<td>ecological engineering to develop sustainable management strategies</td>
<td>Set up an international working group on planthoppers</td>
<td>especially in the Philippines where rice is not exported.</td>
</tr>
<tr>
<td>Import and export of highly toxic pesticides</td>
<td>Advertising and mass information to farmers about outbreaks</td>
<td>Re establish Rice IPM Network coordinated by IRRI.</td>
<td>Establish national policies on pesticide subsidies.</td>
<td>Raising tax on pesticides may be a good idea, but how can this be implemented?</td>
</tr>
<tr>
<td></td>
<td>Implement strict control and regulation of pesticide in imports, advertising and applications</td>
<td>Organize international workshops, conferences and establish real time information on planthoppers and leaffolders</td>
<td>Taxing pesticides Reward farmers for ecological innovations</td>
<td></td>
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<tr>
<td></td>
<td>Increase funds for research and extension</td>
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<tr>
<td></td>
<td>Identify and acknowledge innovative farmers for their efforts in managing planthoppers</td>
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</table>

HPR is an important component but it must be durable.
## EXTENSION

<table>
<thead>
<tr>
<th>What to continue</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Farmer participatory research</td>
<td>Stop sales of banned pesticides</td>
<td>Raising awareness of IPM</td>
<td>Re vitalize IPM</td>
<td>IPM has been hijacked in many cases. Reviewing might be useful but it might get into a battle of semantics</td>
</tr>
<tr>
<td>Farmer monitoring of pests and natural enemies</td>
<td>Stop misleading pesticide advertisements</td>
<td>Building core groups in communities on critical issues, like climate change and its effects on pests</td>
<td>Explore the use ASEAN network</td>
<td>Important not to dwell in semantics. Get the principles right and go on with them</td>
</tr>
<tr>
<td>Post FFS training activities</td>
<td>Stop using farm training schools as channels for pesticide marketing</td>
<td>Teaching farmers to do economic analysis</td>
<td>Have discussions in the ASEAN ministers’ agenda</td>
<td></td>
</tr>
<tr>
<td>Use of mass media such as soap operas</td>
<td></td>
<td>Teaching farmers about ecological engineering</td>
<td>Use CORRA for discussion</td>
<td></td>
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<tr>
<td>Strengthening of corporate responsibilities</td>
<td>Over dependence on pesticides</td>
<td>Initiate new mechanisms for policy dialogue to adjust policies</td>
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<tr>
<td>Influencing policies</td>
<td>Stop subsidies</td>
<td></td>
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<tr>
<td>Improving extension policies</td>
<td>Stop overuse of chemical fertilizers</td>
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<tr>
<td>Strengthening of extension capacities</td>
<td>Stop wide scale planting of varieties with narrow genetic base i.e reduced genetic biodiversity</td>
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<td>Continue training programs</td>
<td>Stop asynchronous planting</td>
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<tr>
<td>Continue seeking financial support.</td>
<td>Stop ignoring farmers’ needs.</td>
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