

*Ecological Engineering to Reduce Rice Crop
Vulnerability to Planthopper Outbreaks*

**Interim Technical Report II: Visit to Chinese
ecological engineering research sites at Lingui
(Guangxi Province) and Jinhua (Zhejiang
Province), September 2009.**

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Introduction

As detailed in Interim Technical Report I, rice production in the tropics of Asia is under threat from insect pests, particularly planthoppers. Insecticide- and host plant resistance-based control is faltering. There is a need to restore ecosystem resilience to make biological control better able to contribute to IPM. Ecological engineering (Gurr et al. 2004) approach provides a framework to strengthen essential pest management ecosystem services that will improve crop health, thus preventing secondary pest outbreaks, like planthoppers.

The utilization of these principles for rice pests is now being explored with the assistance of Professor Geoff Gurr of Charles Sturt University (CSU). Prof Gurr is collaborating with the International Rice Research Institute (IRRI), initially undertaking *ad hoc* trips to the Philippines and China and now under the terms of a Letter of Agreement for the project entitled *Ecological Engineering to Reduce Rice Crop Vulnerability to Planthopper Outbreaks*.

This interim technical report concerns the second trip undertaken by Prof Gurr under the terms of the Letter of Agreement. This visit was to the ecological engineering research sites established at Lingui (Guangxi Province) and Jinhua (Zhejiang Province) in September 2009. Funding had also been secured by Professor Gurr from Charles Sturt University to conduct a pilot study into the feasibility of using molecular taxonomy to identify arthropods sampled for the research sites. This trip afforded the opportunity to collect hymenopteran parasitoids. This taxon was selected for the pilot work because of its obvious relevance to rice pest management. A compilation of information on parasitoids of key rice pests is being compiled in support of this initiative (Appendix 1). The trip was timed to coincide with the *International Workshop on Insect Pheromones for Monitoring and Controlling Key Agricultural Insect Pests* allowing Professor Gurr optimal opportunity to meet with collaborating scientists as well as to make a presentation on ecological pest management.

Activities and Recommendations

Guilin, Guangxi Province

Prof Gurr travelled to the ecological engineering research site located at Lingui near Guilin, Guangxi Province, China on 8th September 2009 accompanied by Prof Cheng (Zhejiang University) and staff of the Guangxi Provincial Station of Plant Protection. Ecological engineering had been established on a relatively small area of approximately 6.5ha with an additional ca. 3.5ha nearby identified as a control area. Approximately 25 farmer families were participating. Rice was in an early-medium stage of vegetative growth (Figure 1).



Figure 1. Ecological engineering research site located at Lingui near Guilin, Guangxi Province, China (GM Gurr, 8th September 2009).

The area had relatively rich non-crop habitat nearby occupying the steep rocky outcrops. Areas of vegetables and perennial fruit production were also present and constituted other potential sources of natural enemies for rice.

The major ecological engineering approach being trialed on this site was nectar plants added to the bunds. Some dicotyledonous weeds were present in small areas but most bunds had been planted to soybeans that had been sown in June (Figure 2). Sesame had

also been sown in some areas but rather too late (August) to establish. Lucerne had also been attempted but this failed. Wet conditions were suspected as the cause.

Sampling had been implanted. Water pan trapping, sweep netting and pitfall trapping was reportedly conducted on 18 August and sticky boards were placed out on 1 September. Hills were also being monitored for pests and light traps were also in place.



Figure 2. Bund with self-sown dicotyledonous weeds (foreground) and soybean (background) on ecological engineering research site located at Lingui near Guilin, Guangxi Province, China (GM Gurr, 8th September 2009).

Brown plant hopper was reported to have been present but only low numbers were evident to casual observation. Vacuum sampling was conducted by local staff and Prof Cheng on 8-9 September. One practical refinement that was discussed in relation to vacuum sampling related to the risk of disturbing an area about to be sampled during sampling of nearby points on the transect. This was likely to occur because sampling intervals were as small as 1m in the field margin. The solution agreed upon was to stagger in a lateral manner the sampling points such that they were the desired distance from the field margin but not in a straight line (Appendix 1).

Insecticide applications were apparently discouraged in the ecological engineering area by rewarding compliant individuals with free fungicides. Despite this some empty insecticide packs had been discarded there. Some may have been from earlier seasons but there appears to be a need to check and carefully monitor insecticide use patterns to ensure that natural enemies are not killed by insecticides.

Practical issues raised by local staff were that they did not have regular access to a vehicle to access the field site from Guilin so had to use public transport. Difficulty was also reported in identifying a suitable plant for growing on bunds that would flower and provide nectar in March-April. Farmers had been asked to make future bunds approximately 15 cm wider in order to provide more space for bund flowers to be established.

Sweep net sampling of rice and the various plant species growing on bunds yielded very few parasitoids. Only two were captured in ca 40mins (see detailed collection notes in Appendix 3). This may have been a reflection of previous pesticide applications. Yellow and white water pan traps were set out on various parts of the bunds (Figure 3) and in the margin of rice crops. A return visit was made to the site the following day, this time accompanied also by Dr KL Heong (International Rice Research Institute). Water pan traps were inspected and a further seven parasitoids obtained. Because numbers of parasitoids collected were so low the local collaborators provided several yellow sticky traps that had been in the field for 9 days. Though the quality of their DNA was likely to be very poor after this length of time another 9 parasitoids were added to the collection.



Figure 3. Yellow and white water pan traps for parasitoid trapping on bund at ecological engineering research site located at Lingui near Guilin, Guangxi Province, China (GM Gurr, 8th September 2009).

On 10-11 September Professor Gurr attended the *International Workshop on Insect Pheromones for Monitoring and Controlling Key Agricultural Insect Pests*. On the first day he delivered an overview of recent work on chemical ecology-based approaches for

pest management and was able to speak with a range of Chinese colleagues about wider topics including ecological engineering for rice.

Jinhua, China

Prof Gurr travelled to the ecological engineering research site located near Jinhua, Zhejiang Province, China on 13 September 2009 accompanied by Prof Lv Zhongxian from the Zhejiang Academy of Agricultural Sciences, Prof Cheng Jia An and Dr Zhu Zhen Rong of Zhejiang University.



Figure 4. Sesame planted on bunds surrounding rice fields on research site near Jinhua, Zhejiang Province, China (13 September 2009, GM Gurr).

Details of the site and ecological engineering strategies implemented were set out in Interim Report I. Significant changes from the visit made in July were that the sesame planted on bunds was now largely seeding (Figure 4) and the erection of two large information boards, one in Chinese and one in English (Figure 5). An MSc graduate (Mr Yow) was now based on site and leading sampling efforts.

Parasitoid sampling was undertaken by Professor Gurr on 13-14 September using sweep netting and water pan traps as used at Lingui. Local staff also assisted by placing out additional yellow water pan traps (Figure 6). Parasitoids were approximately 100 times

more numerous than at the Lingui site and over two hundred individuals (Appendix 1) were captured and paced in 100% ethanol for later DNA taxonomy. Reasons for the discrepancy in parasitoid abundance across the two sites are not clear. It is likely that pesticide use at Lingui is partly the cause. An additional factor is that ecological engineering strategies were implemented at Lingui only over recent months after a history of conventional pesticide regimes. In contrast, ecological engineering methods had been trialed at the site at Jinhua for several years.

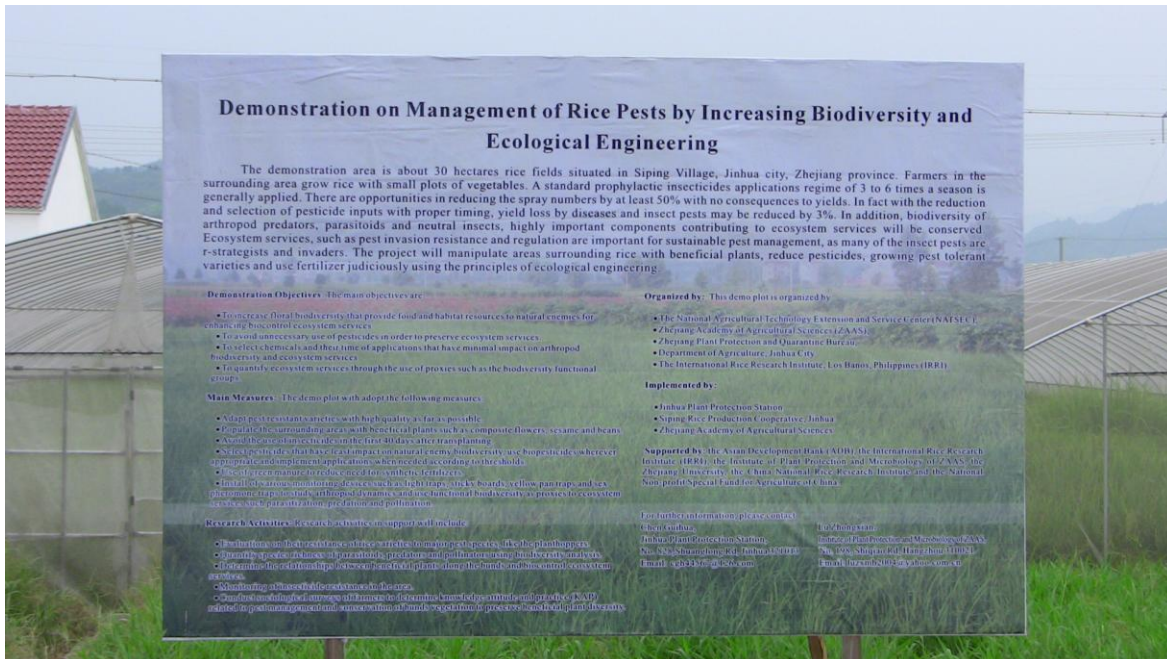


Figure 5. Information board at research site near Jinhua, Zhejiang Province, China (13 September 2009, GM Gurr).

During field work a potential problem was identified with the yellow pan traps in use. These were proprietary food bowls that were fading in colour as a result of weathering (most likely UV exposure). That had resulted in bowls of differing degrees of bright yellow to pale yellow being in use. This is likely to affect the attractiveness to parasitoids and other aerial natural enemies. This was discussed with local staff.

A lesser issue identified was the use of detergent in water pan traps. It was pointed out that the rather generous amounts of soap powder being used interfered with clarity of the water and later recovery of captured arthropods. Only a minute amount of liquid based detergent is necessary to reduce surface tension of the collecting water. This constitutes another example of the need for careful definition of methods and subsequent adherence.

Further discussion will need to take place at the review meeting in Vietnam in December 2009 to refine the fine detail of methods. This should extend over issues such as the mesh size of sweep net fabric and specifications of the vacuum sampler. The Sampling Protocol Document (<http://ricehopper.files.wordpress.com/2009/07/sampling-protocol-27-july-2009.pdf>) will then need to be updated with appropriate detail.



Figure 6. Yellow water pan traps for parasitoid sampling from rice at research site near Jinhua, Zhejiang Province, China (13 September 2009, GM Gurr).

Conclusions

Good progress had been made in establishment of the research site at Lingui in Guangxi Province though several logistical issues need to be resolved by negotiation. The most

fundamental of these is the withholding of insecticide use in the ecological engineering (not control) area.

Work at the Jinhua site appears to have gone smoothly over the course of the two months since the last visit by Prof Gurr. As noted above there is a need to review the detail of sampling methods to resolve minor problems and ensure that consistent methods are being employed across all four sites.

Parasitoid collections were made successfully from both Chinese sites though wasp densities were conspicuously lower at the Lingui site. Specimens will be the subject of DNA studies in Australia via a collaboration with Dr Andrew Mitchell of the EH Graham Centre for Agricultural Innovation. If DNA-based taxonomy appears workable from this pilot study with wasps, additional funds will be sought to expand its use in the overall project.

References

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Acknowledgements

Donna Read (Charles Sturt University), Heng Jia An (Zhejiang University) and Josie Catindig (International Rice Research Institute) are thanked for compiling parasitoid data for Appendix 1.

Appendix 1: Summary data of literature on parasitoids of key rice pests
(Donna Read (Charles Sturt University), Heng Jia An (Zhejiang University) and
Josie Catindig (International Rice Research Institute)).

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Appendix 2. Schematic diagram of revised transect layout; blue denotes sampling point within transect (Not to scale).

Appendix 3. Parasitoid collection data

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