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REVIEW MEETING AT THE INDONESIAN SUGAR RESEARCH INSTITUTE AND ASSOCIATED INDUSTRY INFORMATION MEETING 29 MARCH – 4 APRIL 2009

PROJECT: INTEGRATED PEST MANAGEMENT OF STEM BORERS AND INSECT VECTORS OF VIRAL DISEASES OF SUGARCANE (HORT/2006/147)

by

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SR09003

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BSES Limited Publication
Study Tour Report SR09003 **April 2009**

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1.0 BACKGROUND

This report provides detail on an ACIAR-funded project (HORT/2006/147) meeting between Australian and Indonesian staff to review project activities, and to plan further research, development and extension for the next 12 months. This is the second annual project meeting to be held at Pasuruan. Rob Magarey also visited Jakarta to speak with ACIAR staff to keep them informed of project developments and outputs.

The review meeting was held from 31 March-1 April at the Indonesian Sugar Research Institute (ISRI) at Pasuruan. On Thursday 2 April, 110 staff from over 30 Javan sugar factories congregated at ISRI facilities in Pasuruan to hear presentations from Australian and Indonesian scientists on project objectives and outputs. This was very well received. Inspection of the ISRI facilities and a visit to the facilities of Pesantren Baru sugar factory, Kediri, were undertaken during this trip.

The main objective of the project is to enhance sugarcane productivity in Java through improved implementation of IPM strategies for pest and disease control. Benefits to Indonesia will be improved productivity and profitability; for Australia the benefits are a better preparedness for borer and mosaic incursions into Australian cane crops.

2.0 PRE-INDONESIA MEETING, BRISBANE, 27 MARCH

A pre-project review meeting was held in Brisbane on Friday 27 March and involved the project entomologists (Drs Sallam, Samson and Goebel) plus the project pathologist (Dr Magarey). The meeting was useful for considering the Indonesian general survey analyses and for deciding the details related to the intense monthly crop surveys, specifically:

1. Pest data to be recorded
2. Parasitoid information required
3. Pest data recording sheets
4. Data storage issues
5. Reporting requirements
6. Visit schedules
7. Potential monitoring sites (taking into account comments from the Indonesian scientists).

The meeting saved considerable discussion time at the Pasuruan review meeting and meant that the Australian team was well prepared when we arrived in Indonesia.

3.0 MATERIALS AND METHODS

Participants (review and sugar factory meetings, 31 March-2 April 2009)

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Dr RC Magarey	Principal Plant Pathologist, BSES and Project Leader
Dr N Sallam	Entomologist, BSES
Dr PR Samson	Principal Entomologist, BSES
Mr PG McGuire	Senior Extension Officer, BSES
Dr R. Goebel	Visiting CIRAD Entomologist at BSES

Indonesian Sugar Research Institute (ISRI)

Ms Ari Kristini	Plant Pathologist (Indonesian project leader)
Ms Etik Achadian	Entomologist
Pk Lilik Putra	Pathologist
Pk Muhammad Mulyadi	GIS systems operator (and soil scientist)
Ms Trikuntari Dianpratiwi	Extension specialist

In addition, a brief meeting was held with Pak Mirzawan, the Acting Director of the Indonesian Sugar Research Institute on Tuesday 31 March.

4.0 TRAVEL

Drs Sallam, Samson, Goebel and Mr McGuire travelled via Brisbane, Singapore to Surabaya and were transported by car to Pasuruan. Dr Magarey travelled via Brisbane, Kuala Lumpur, Jakarta and Surabaya before car transport to Pasuruan. Travel to other centres in Java was via an ISRI vehicle. The itineraries for the trip are in Table 1.

Table 1 Itinerary for the Pasuruan visit in March-April 2009.

Date	Travel
29-30 March	Travel to Indonesia
30 March	Visit to ACIAR Jakarta (Dr Magarey) Visit to ISRI facilities (Drs Sallam, Samson and Goebel, and Mr McGuire)
31 March / 1 April	Project review meeting, Pasuruan (Indonesian Sugar Research Institute)
2 April	Factory staff information meeting, Pasuruan
3 April	Visit Pesantren Baru sugar factory, Kediri, East Java
3-4 April	Travel back to Australia

5.0 VISIT TO ACIAR JAKARTA OFFICES (DR MAGAREY)

Discussions were held with Mirah Nuryati and Maria Ludwina in the ACIAR Jakarta office during this visit; Julien de Meyer was unavailable as he was attending another meeting. Discussions centred on project objectives, progress and an update on the ACIAR regulations governing project administration. This face-to-face meeting was of very good value, and it was decided that project staff should visit the Jakarta office en-route to the next review meeting in Pasuruan in March-April 2010, to present a short seminar on project activities and outputs.

6.0 ISRI FACILITIES INSPECTION AND INFORMAL DISCUSSIONS

Informal discussions were held between the BSES staff (Drs Sallam, Samson and Goebel, and Mr McGuire) and ISRI staff on Monday 30 March (Figure 1); this enabled scientists to gain important information on extension activities and the work of ISRI. Mr McGuire, on his first visit to Indonesia, was able to speak with extension and research staff and gain significant insight into the Indonesian sugarcane industry, the farming community and Indonesian culture.

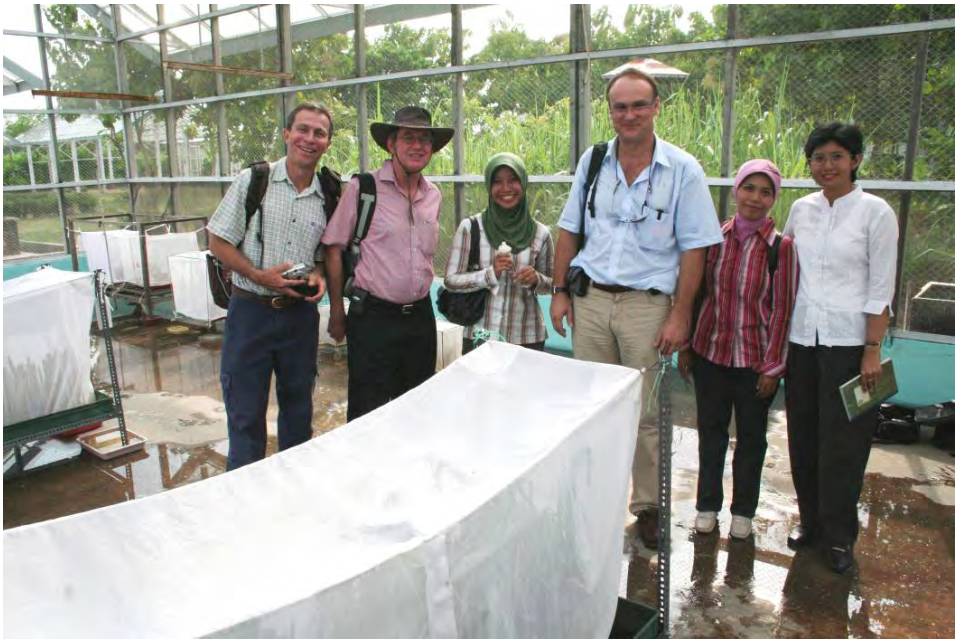


Figure 1 **Dr Peter Samson, Peter McGuire, Etik Achadian, Dr Regis Goebel, Ari Kristini and Trikuntari Dianpratiwi at the Indonesian Sugar Research Institute Facilities at Pasuruan, Indonesia.**

7.0 REVIEW MEETING, 30 MARCH – 1 APRIL

The review meeting agenda is given in Appendix 1. It focused on:

- Review of previous project activities and data (2008): specifically the general survey work undertaken in each of 30 sugar factories during the previous 12 months, as well as individual research projects involving mosaic, (elimination of mosaic through tissue culture and hot water treatments; yield loss research), and work with parasitoids of the stem borer (*Chilo*) species.

- Planning activities: the second part of the meeting addressed several planning issues including: -
    - plans for the monthly surveys, designed to provide a greater understanding of the biology of borers and their parasitoids,
    - further research into management of borers and canegrubs,
    - and the extension of IPM strategies, disease-free nurseries and other project outcomes,

7.1 Project review: 'general survey'

Over 930 individual crops (fields) were surveyed by ISRI project staff between March 2008 and March 2009 and this represents a huge commitment to data collection. Data on borer (and their parasitoids) incidence were recorded along with information on pest and disease incidence and severity. These data were summarised by both ISRI and BSES staff 'pre-review' and presented to the review meeting participants through PowerPoint presentations. Further analyses to extract all relevant information are still required. Some of the data summaries are presented below in either graph or map form (or both).

7.2 Stem borers

The incidence of stem borers (*Chilo auricilius* and *Chilo sacchariphagus*) and the top shoot borer (*Scirpophaga*) varied with location and crop site. Figures 2, 3 and 4, respectively, show the pests incidence (in 'low', 'medium' and 'high' relative terms) in each of West, Central and East Java.

Pest incidence data suggest there is a lower severity of stem borers (*Chilo* species) and the top shoot borer (*Scirpophaga*) than anticipated. The incidence of these borers was high in particular locations and these areas will be selected for further study. Not all crops could be inspected when borer infestations were peaking. However, data analyses showed crop age (in months) to be significantly correlated with damage by all borers. This indicates that infestation increases as the crop matures. There was also an interaction between the sugar factory and crop age, indicating that sampling time did have an influence on the results. The Indonesian research team confirmed that those sugar factories that had the highest damage during the general survey are known high borer infestation areas.

Points to note on *Chilo sacchariphagus* (Figure 2):

- It was the most common stem borer species in Java
- It causes dead heart in young shoots and tunnels extensively in more mature plants.
- It was found in high levels in Candi Baru, Jombang Baru and Sumberharjo sugar factories
- The pest was present at varying levels in most other sugar factories across Java.
- Damage levels ranged from 0-3.2 bored internodes per 10 m row, with the majority of sugar factories suffering from more than 0.2 bored internodes per 10 m.
- Data analyses indicated that this borer species is more common in irrigated fields in comparison to fields relying on rainfall.

Points to note on *Chilo auricilius* (Figure 3):

- It was found in high numbers only in Pesantren Baru sugar factory (3.3 bored internodes per 10 m), with the remaining sugar factories suffering far less damage levels (0-0.2 bored internodes per 10 m).
- This is likely to be due to the higher altitude of Pesantren Baru (>200 m). In addition, *C. auricilius* prefers wet areas, whilst *C. sacchariphagus* tolerates extended dry periods.
- In the past *C. auricilius* was more common than *C. sacchariphagus* in Java, but more recently water allocations have been devoted to rice rather than sugarcane, so the cane crops suffer additional water stress.
- This has caused a shift in pest status and *C. sacchariphagus* is now the dominant stem borer species. Data analyses showed infestation levels to be high.

Points to note on *Scirpophaga excerptalis* (Figure 4):

- It is the major sugarcane pest species in Java. It mainly causes dead heart in both young and mature crops.
- The pest was found in all surveyed regions across Java, with Jatituju, Gondang Baru, Subang and Sragi sugar factories recording the highest infestation levels.
- Monitoring showed damage levels ranging between 0.12-5.3 dead hearts per 10 m row, with 15 sugar factories recording more than 1.5 dead hearts per 10 m row.
- Top borer was more common in areas owned by sugar factories compared to grower-owned fields. This is due to the fact that individual farmers tend to diversify their crops and not rely solely on sugarcane.
- Individual growers also do not grow as many ratoons as is the case in areas owned by the sugar factory, hence the top borer life cycle can be interrupted resulting in less damage by this species.

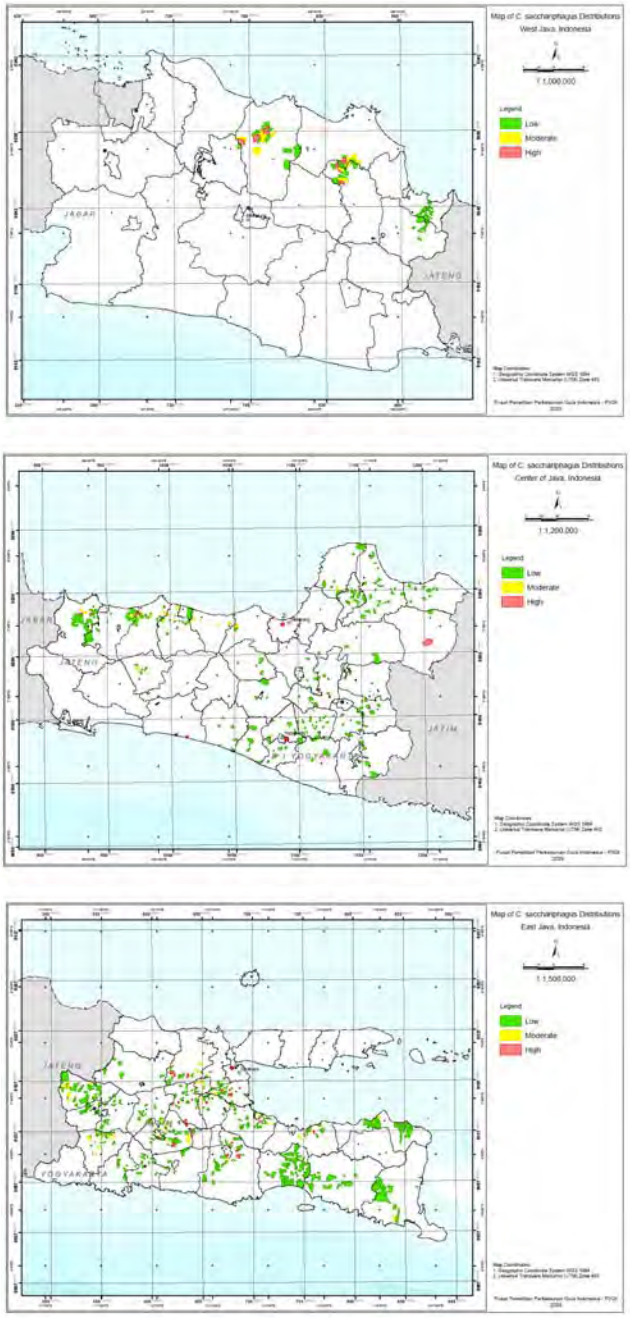


Figure 2 **Severity of *C. sacchariphagus* in West, Central and East Javan sugar factories.**

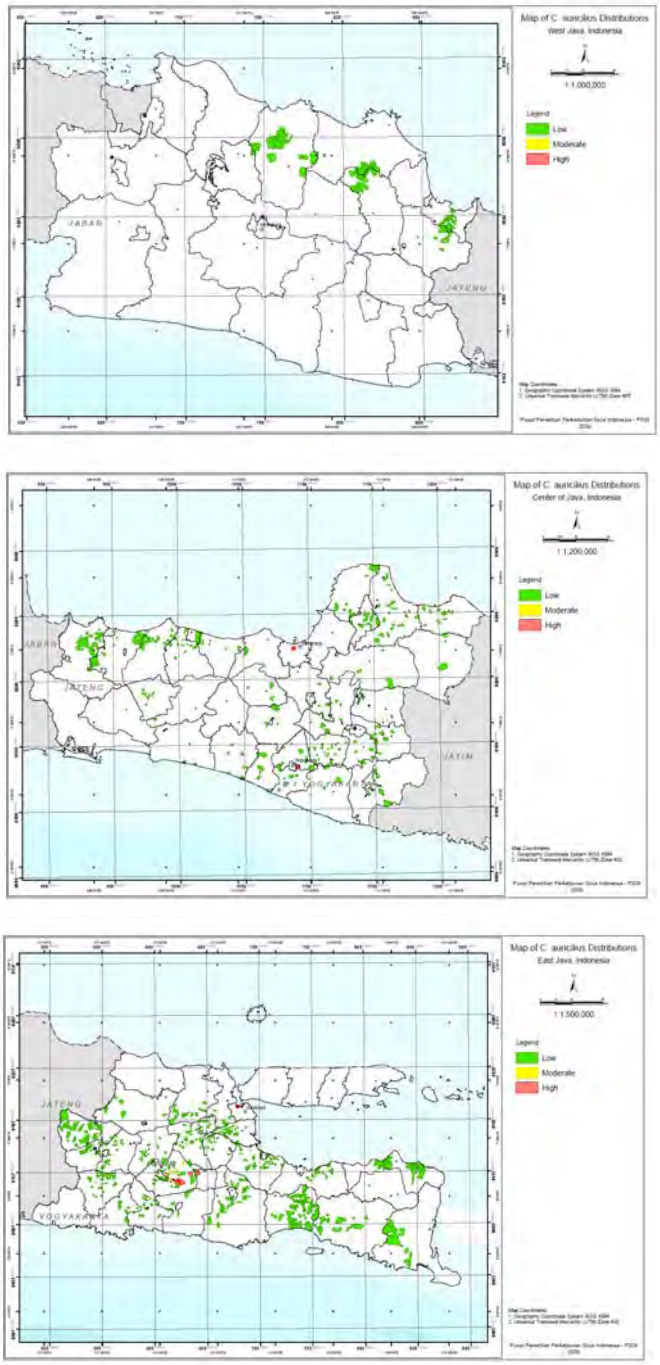


Figure 3 **Severity of *C. auricilius* in West, Central and East Javan sugar factories.**

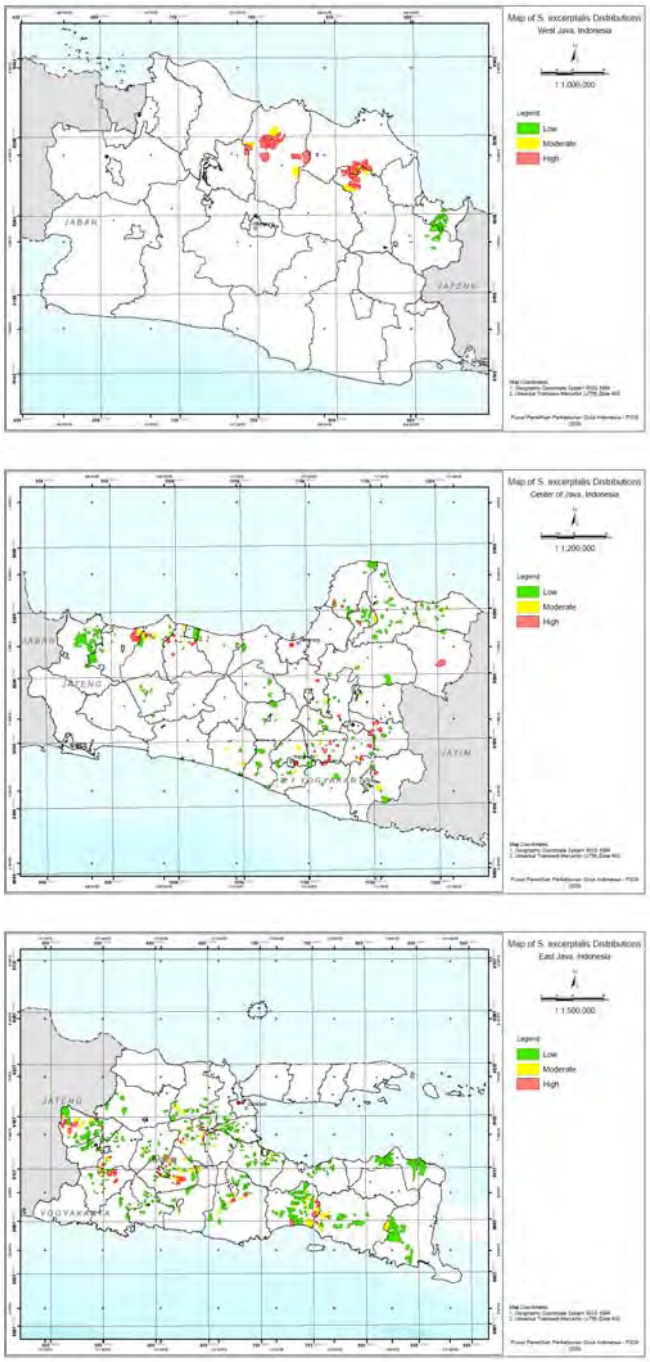


Figure 4 **Severity of *S. excerptalis* in West, Central and East Javan sugar factories.**

7.3 Diseases

Surveys for diseases were also conducted during the last 12 months. As borers are of higher priority (in general) in this project, some diseases assessment of disease severity was at an inappropriate time. This particularly applies to leaf diseases; when the crop is small, the conditions do not favour orange rust and yellow spot, so any assessment of their distribution and severity are under-estimates. One of the most important diseases in Java, and in S.E. Asia, is the various forms of sugarcane mosaic. Symptoms of this disease are evident through the season and survey results provide a reasonable prediction of the likely affected areas.

With diseases, results were partitioned by disease severity with the number of crops in each category represented in bar charts. This provides a strong impression of the occurrence of these diseases.

Points to note on mosaic (Figures 5-7):

- Mosaic is one of the most widely distributed diseases in Javan sugarcane fields
- There are several different pathogens causing mosaic (sugarcane streak mosaic virus; sugarcane mosaic virus and sorghum mosaic virus); assays for these pathogens in survey specimens are pending. The results will provide further insight on casual agents infecting Javan crops
- Mosaic severity varied widely (some crops had 90-100% diseased stools, though these were few in number).
- The sugar factories with the highest mosaic levels were Trangki, Sumberharjo and Karangsuwung
- Incidence maps of Javan production areas indicated where the more heavily diseased areas were located; the reasons for this distribution require further investigation. Varietal susceptibility will be one of the controlling factors.

Points to note on chlorotic streak (Figures 8-9):

- Chlorotic streak was found for the first time in parts of central Java.
- There were a number of crops (274) where chlorotic streak was recorded; the disease is obviously widely distributed and potentially causing significant yield losses.
- Further information is needed on the distribution and severity of chlorotic streak.

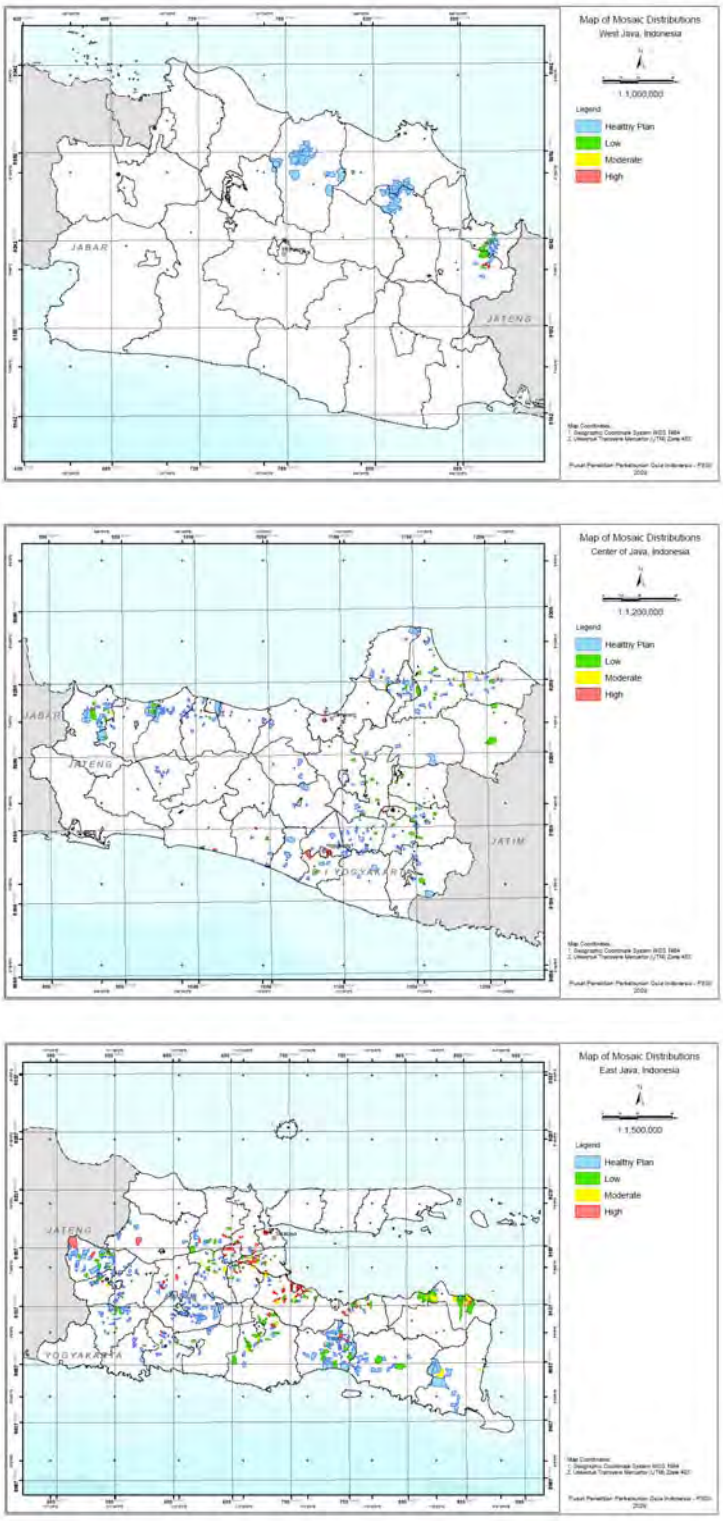


Figure 5 **Severity of mosaic in West, Central and East Javan sugar factories.**

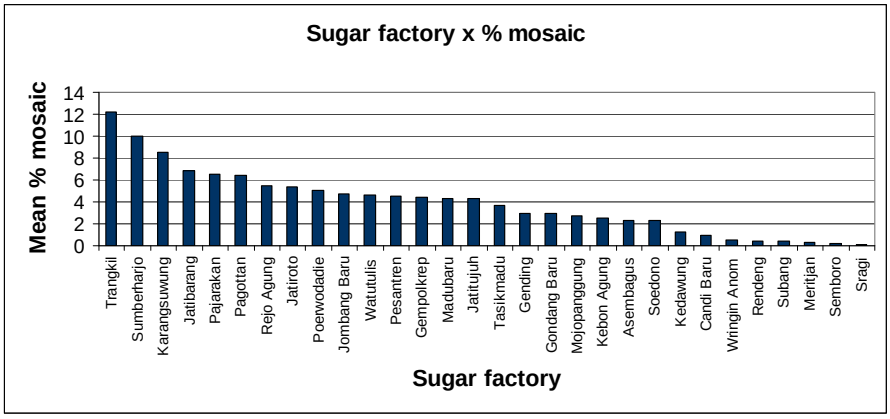


Figure 6 **Average % mosaic stools in crops in each surveyed sugar factory in Java.**

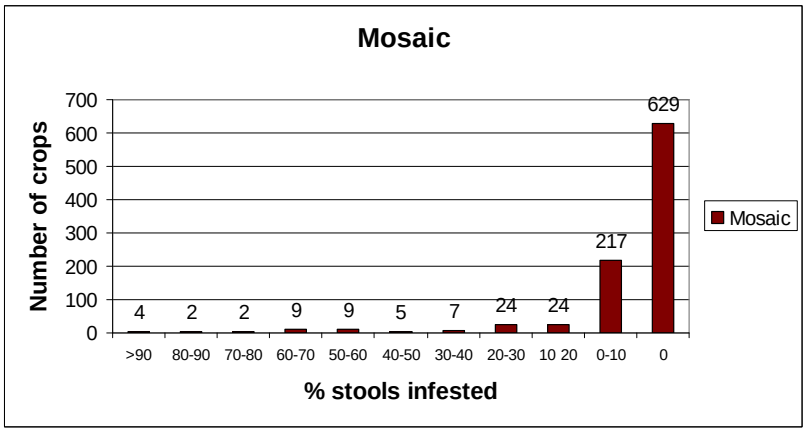


Figure 7 **Number of crops in each mosaic severity category in all crops surveyed in Java. The data suggest that there were a few highly diseased crops identified during the survey.**

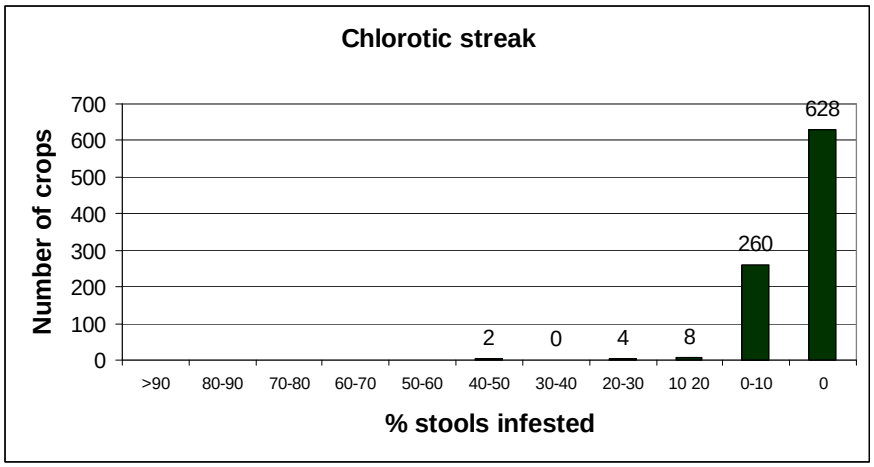


Figure 8 **Number of crops in each disease severity category for chlorotic streak in Javan sugarcane fields. There were very few severely affected crops.**

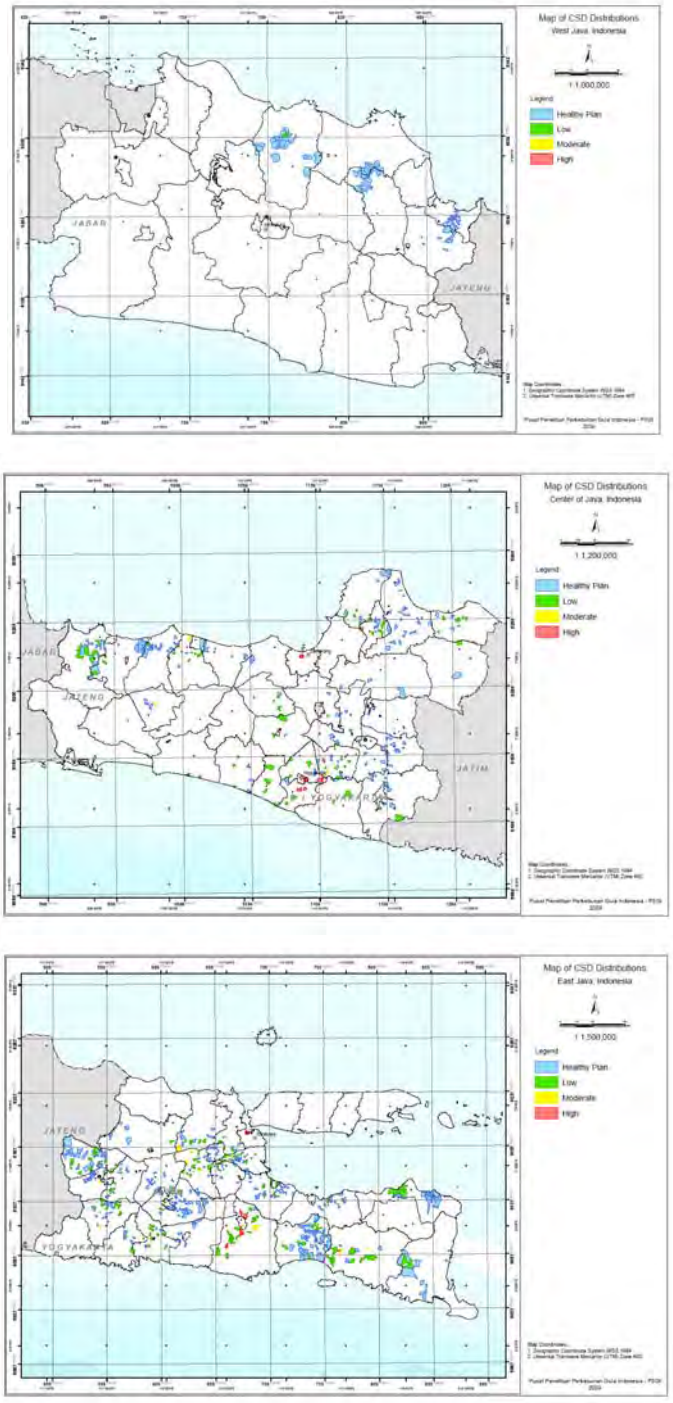


Figure 9 **Severity of chlorotic streak in West, Central and East Javan sugar factories.**

Points to note on yellow spot (Figures 10-11):

- Records for leaf diseases need to be treated with some caution as some data was collected at an inappropriate crop growth stage; yellow spot usually occurs in older crops during and just after the wet season. The data presented can therefore be assumed to be an under-estimate of the actual incidence of yellow spot in Java.
- Further analyses of disease incidence by crop age, and the use of climate data to ascertain the underlying factors (besides variety) that may be influencing disease severity, are required.

Figure 10 Severity of yellow spot in West, Central and East Javan sugar factories.

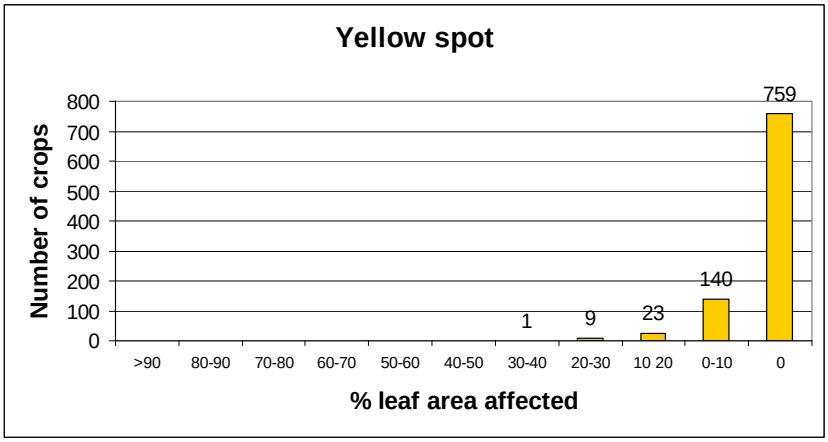


Figure 11 Number of crops in each disease severity category for yellow spot in Javan sugarcane fields. Yellow spot levels were generally low, partly because the disease was not at peak levels when the survey was undertaken.

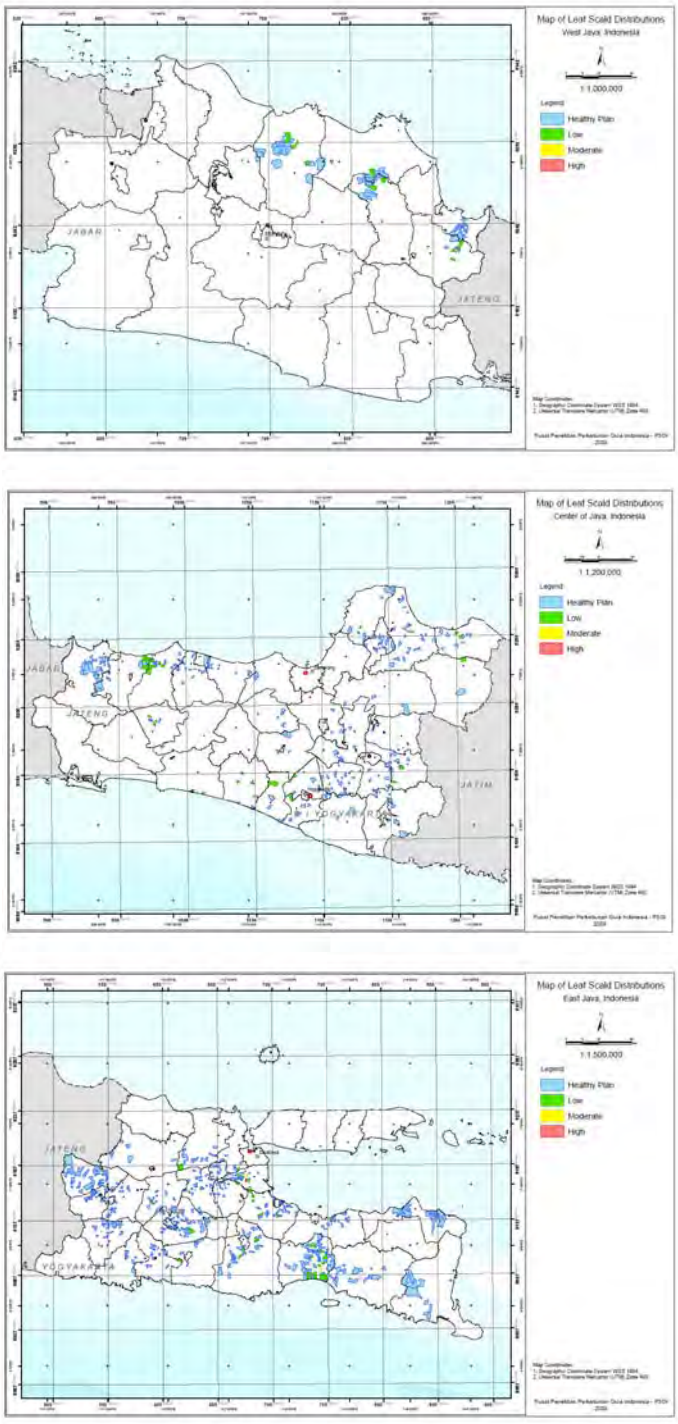


Figure 12 Severity of leaf scald in West, Central and East Javan sugar factories.

Points to note on leaf scald (Figures 12-13):

- Leaf scald is restricted in incidence and very few crops are infested. This is a good outcome, since leaf scald has the potential to kill crops of susceptible varieties.
- Further variety susceptibility by crop incidence analyses are required.

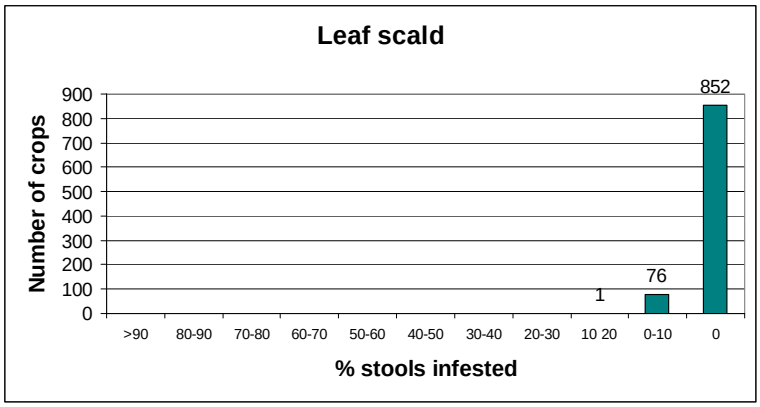


Figure 13 Number of crops in each disease severity category for leaf scald in Javan sugarcane fields. There were relatively few crops affected and these were at low disease severity. However, 10% diseased stools in some crops would be quite serious with this major disease.

Other diseases of note:

- Leaf scorch
  The previous Indonesian records of 'leaf scorch' have been in Sumatra. It is capable of defoliating the canopy and can significantly reduce the yield of susceptible varieties. The finding of this disease in central Java is of real significance to the Indonesian sugarcane industry and field crop staff and sugar factories should be made aware of the need to monitor for this disease.
- Target blotch
  The first record of target blotch in Java was also made during this survey. The disease is found in Papua New Guinea and is generally of minor concern, but individual susceptible varieties could be badly affected by the disease. Further surveys should inspect carefully for the presence of the disease.

7.4 Further analyses

There remains a real need to rigorously analyse the general survey data in order to extract several different types of information; this includes:

- Climatic factors affecting pest and disease severity and distribution: spatial data for both disease incidence and climate (rainfall, relative humidity and temperature (maximum and minimum)) could be analysed to determine the factors controlling incidence and severity. Multiple regression analysis would be appropriate.

- Varietal susceptibility influences: pest and disease severity and incidence will also be linked to varietal susceptibility; analyses have yet to take this into account.
- Mapping: GIS-type data on distribution (taking into account climatic and varietal influences) will allow 'thematic' risk maps to be produced outlining the risk of high pest or disease incidence in each major region. These will be useful in extending pest and disease incidence information to local industry.

The general survey was very useful in providing information on the distribution, severity and incidence of pests and diseases. Not only will these data assist with selecting sites for detailed monthly monitoring, but they will assist in determining the underlying influences affecting the distribution and severity of pests and diseases.

8.0 MONTHLY CROP MONITORING

The proposed monthly monitoring of a selected number of crop sites (7-8) across Java is most important for gaining information on the biology of sugarcane borers. The development of an IPM (Integrated Pest Management) strategy relies on possessing detailed information on pest species development, multiplication and aspects of natural control mechanisms, such as parasitoids. The monthly monitoring will provide this information and allow project scientists to devise the best IPM strategy.

8.1 Selection of factory areas for monitoring

Presentation of general survey results enabled tentative decisions to be made on the sugar factories where the monthly monitoring will occur. There was general agreement on the proposed sugar factory areas to undertake the detailed monthly monitoring; details are included in Table 3.

Monthly monitoring will begin in late-April or early May 2009 and occur for the current crop and proceeding crop. During this time there will be detailed sampling for all borers, including borer eggs, larvae and pupae plus the parasitoids infesting each species. The parasitoids will be identified by transporting samples back to the ISRI laboratory at Pasuruan to allow completion of both borer and parasitoid development. In this way, the species will be positively identified. Observations will also be made on the diseases present in these crops plus also potential mosaic vectors.

Table 3 Details of the village, sugar factory, region and variety to be included in the monthly monitoring program. These crops were selected after assessing pest and disease incidence in the general survey results conducted in 2008-2009.

No.	Village	Sugar Factory	Region	Variety
1.	Bago	Jatiroto	East Java	BL
2	Wonokasian	Candi Baru	East Java	BL
3.	Cerme	Jombang Baru	East Java	PS 864
4.	Ploso Kidul	Pesantren Baru	East Java	BL
5.	Karangkepoh	Tasikmadu	Central Java	PS 864
6.	Gayamemprit	Gondang Baru	Central Java	Mixed
7.	Bojongbata	Sumberharjo	Central Java	PS 951
8.	Rancabagong	Jatitujuh	West Java	Kidangkencana
9.	Koranji	Subang	West Java	PS 951

8.2 Monitoring parameters

Dr Sallam discussed the methods and recording sheets with Etik and this has now been finalised. The development of both borers and parasitoids in crops will be closely monitored using the agreed parameters and recording details.

9.0 PEST RESEARCH

There are a number of components to the pest research program, including:

- Crop loss from stem borers and the effectiveness of the *Trichogramma* parasitoid - There is a need to determine what effect each borer has on yield and how the different parasitoids reduce yield impacts.
- Efficacy of *Trichogramma* and *Cotesia* for *Chilo* species - Each parasitoid has a different life cycle; *Trichogramm*a is an egg parasite whilst *Cotesia* attacks the larval stage of the borers. Their effectiveness in controlling *Chilo* species will be examined in the proposed work.
- Efficacy of *Elasmus* for control of *Scirpophaga* - *Elasmus* is a potential parasitoid for the top borer, *Scirpophaga*, and this species will be tested for control of the borer.
- Soft pesticides for control of borers for use in an IPM strategy - Although it would be nice to use only parasitoids in an IPM strategy, it may be necessary to use a pesticide at certain stages in the borer development to achieve the best control options. For this reason, 'soft' pesticides will be tested to see how well they control the borer, and to see also ho they affect parasitoid populations. This will define whether such a pesticide could be used within an IPM strategy.
- Testing insecticides for control of canegrubs (*Lepidiota stigma*) in plant cane - In some factory areas, and on certain soils, whitegrubs create a problem for

sugarcane farmers. It is necessary therefore to test some options for cane grub control. The next two listed projects also seek to address this issue, with the use of imidacloprid in either plant or ratoon crops.

- Assessing the efficacy of imidacloprid for control of *Lepidiota stigma* in plant cane
- Assessing the efficacy of imidacloprid for control of *Lepidiota stigma* in ratoon cane

A summary of the pest research program for each of these topics is given in Appendix 4.

10.0 SUGARCANE MOSAIC RESEARCH

Sugarcane mosaic disease is caused by three different pathogens; sugarcane mosaic virus (SCMV), sugarcane streak mosaic virus (SCSMV) and sorghum mosaic virus (SrMV). The distribution of the three pathogens in Indonesia is not yet clear; this will become clearer when all the survey specimen assays have been assayed for each pathogen.

Research was conducted into three aspects of sugarcane mosaic during the last 12 months.

10.1 Yield loss research

A field yield loss experiment was planted during the period with the following trial design:

- Plot size: 4 rows by 20 m
- Replication: 10 reps
- Treatments:
  - No diseased planting material
  - 25% diseased setts planted with 75% healthy material
  - 50:50
  - 75:25
  - 100% diseased planting material

Harvest parameters were: -

- Stalk height
- Stalk population
- Stalk thickness
- Rendement (CCS) at harvest
- Total cane yield at harvest

The main outcomes were that sugarcane mosaic reduced total yield (but not rendement (CCS) by between 15-17% for all mosaic treatments. This confirms other data from overseas that the disease can significantly reduce crop yields.

There seemed to be no direct relationship between percent diseased planting material and any yield loss parameters.

10.2 Elimination from planting material (hot-water treatment)

The provision of clean planting material is very important for mosaic disease control. Experiments investigated whether different hot-water treatment time by temperature combinations could eliminate the virus. Combinations of temperature between 50 and 58°C were tested for periods ranging from 10-30 minutes. Some treatments were also applied to setts pre-hot water treatment to assess the potential for pre-disposing (protecting) the cane from the effects of hot water; pre-treatments were at 35°C. The data showed that:

- Cane germination was completely eliminated above 52°C, at all time exposures.
- Mosaic symptoms were recorded in all treatments (with 100% infection).

It is concluded, therefore, that the production of disease-free planting material by hot water treatment is not a commercially viable option.

10.3 Vector transmission

Research into the vectors that spread sugarcane mosaic viruses was initiated during the period. Three species were investigated:

- Brown aphid (species?): a species feeding on weeds in sugarcane production areas
- *Rhopalosiphum maidis* (corn aphid): a known vector of the disease
- The third insect is being identified.

The results show clearly that the brown aphid was a very effective vector of the disease; further studies are needed to confirm this initial result. No other vector led to plant infection. Crop observations are also needed to assess the presence of the brown aphid in mosaic-infected sugarcane crops in Java.

It is proposed to:

- Confirm the pathogen used in the experiment via molecular assay
- Confirm the vector species identification
- Monitor crops for the presence of the brown aphid. his will be done both in the monthly monitoring, and in other crops where sugarcane mosaic disease is common.

Mosaic session discussions centred on the proposed transmission research, and also on other methods for the production of disease-free planting material. These methods will not only be useful for mosaic control but also for the control of ratoon stunting disease (RSD), chlorotic streak and leaf scald.

11.0 SUGAR FACTORY STAFF MEETING, ISRI, THURSDAY 2 APRIL

A meeting of over 100 sugar factory staff from many of the 54 sugar factories in Java was organised to coincide with our visit and this focused on the ACIAR project. This allowed project staff to provide background information on pests and diseases in Indonesia, to outline the objectives of the project, and to answer queries on project objectives and outcomes. The Indonesian scientists summarised outputs from the general survey. There was very significant interest in the material presented from sugar factory participants and a strong emphasis on the need for further training – in both pest and disease recognition and also on management issues. This provides extra reason to strengthen the project emphasis on training and extension which arose from the project review meeting.

Figure 14 **Participants in the project meeting held at ISRI, Pasuruan on Thursday 2 April to inform them of the project objectives and outcomes to date. Over 100 people attended the workshop. Dr Peter Samson is presenting on grubs (top) while the attendees filled the meeting room (bottom).**

12.0 VISIT TO SUGAR FACTORY: PESANTREN BARU

We visited the Pesantren Baru sugar factory on Friday 3 April to examine the tissue culture and biological control laboratories, to visit a field crop to investigate potential grub control strategies, and to speak with factory staff about the need for further training

Pesantren Baru (Factory group PTPN 10) sugar factory is located in the westerly sector of East Java (about 3 hours drive west from Pasuruan) and harvests sugarcane on about 11,000 ha to produce > 1.0 Mt of sugarcane. Cane yields are around 90 t/ha with sugar content averaging between 8.0-9.0%. Yields on factory-owned land are around 85 t/ha and rendement (sugar content) is around 9.5%; yields on farmer-owned land are greater (around 95 t/ha) with rendement slightly lower (8.5%).

The sugar factory owns around 1,000 ha of land, whilst 11,000 individual farmers produce the rest of the crop; the average area on each cane farm is therefore around 1 ha. The sugar factory assists cane farmers with advice on their operations and there are several advisory personnel strata in the factory structure; general supervisors are responsible for overseeing production on 800-1500 ha of cultivated land (i.e. overseeing 800-1500 farmers). These are key extension targets since they have significant influence on the farmer adoption of IPM strategies; their limited number in each factory means project scientists could realistically train them with our given resources. Other factory staff operate on a closer basis with fewer farmers.

As in Australia, the factories have nursery plots for seed-cane and these are divided into mother plots with a series of secondary increase plots. The quality of this seed cane has not been adequately assessed by project staff nor the application of pest and disease control measures (hot-water treatment is not generally applied). There remains much scope for improving these systems and this will be the target of extension activities. An outline of the proposed extension program is included in Appendix 2.

Figure 14 Dr Goebel speaking to the staff at the biological control laboratory at Pesantren Baru sugar factory.

13.0 DISCUSSION

The trip to the Indonesian Sugar Research Institute (ISRI), the review of project activities, the meeting with over 100 staff from more than 30 sugar factories, and the visit to the Pesantren Baru sugar factory contributed to a very good visit. It enabled Australian staff to gain further information in relevant areas and enabled plans to be developed for the next 12 months. Again, the hospitality of the Indonesian project staff was outstanding and the outcomes of the meeting excellent.

The Indonesian project team has been working very hard over the last 12 months and have collected a large amount of crop data. Preliminary conclusions from the data have enabled further decisions to be made on monthly crop monitoring and the planning of many activities for the next 12 months. There remains a need for quite a large amount of data analysis; this will provide a greater understanding on the factors governing distribution and severity of the pests and diseases.

The presence of Peter McGuire in his extension role also was very appropriate for this stage of project development. There are very definite things that need progressing in this field at this time. Training by other project scientists is also planned and this will assist factory staff with biological control procedures and also grub control programs in the field.

14.0 CONCLUSIONS

1. The visit proved very fruitful in progressing a number of different project activities. The presence of Mr McGuire, our extension and business specialist, was important for progressing the planning of training, model farm, and other extension initiatives.

2. The review meeting ensured that all project staff were well informed of general survey data analysis, including viewing of GIS systems analyses. We also identified further analyses that are needed. This enabled the selection of suitable sites for the proposed detailed monthly monitoring.

3. The extension day held on Thursday 2 April was very well attended by sugar factory staff and generated a great deal of interest in the project and in further training. The proposed extension program will incorporate ideas and initiatives arising from this day.

4. Sugar Factory staff approached during the visit were also very keen to improve their skills and to cooperate with project staff. This augers well for project outputs and outcomes.

5. The project team identified that further visits from other project staff would be beneficial: these include: Kim Lonie (GIS and Desktop

publishing) – to finalise the Indonesian pests and diseases field guide (translations and final details) and to co-ordinate mapping of project data and results, and Danielle Skocaj (Extension) – to assist Peter McGuire with training and extension.

APPENDIX 1: REVIEW MEETING AGENDA

March 31 - April 1

1.0 Welcome and housekeeping (Ari)
2.0 Objectives of the meeting (RCM)
3.0 Project component review
    3.1 Surveys
        3.1.0 General surveys (Ari)
        - Summary of pest and disease incidence ok
        - Further data analysis (Etik, Ari, Sallam, Rob)
          We have done some analyses here and no doubt you have too. We suggest that each of us make our presentations and we see what comes out. To make time efficiency Etik and I want to prepare this before the meeting. What kind of analysis will be used for the survey data? Does the analysis include making graphs or changing the database form?
        - ok We think this priority will come out of the data analysis and so may not need to be an agenda item.
        - Molecular assays of collected specimens from general surveys
          We have collected some larvae of borers and mosaic samples.
        - Selection of survey sites for monthly monitoring
          We have summarized the data ourselves and have some ideas. We'll discuss site selection after seeing all the data. Etik and I tried to make top borer, stem borer and mosaic incidences in one graph. The graph can be used as consideration for selecting sites for monthly monitoring
        - Summary outcomes and publications/reporting

        3.1.1 Monthly surveys (Sallam to coordinate)
        - Site selection
        - Survey method
        - Data storage and reporting
        - Timing
        - Interaction with IPM development and extension
        - Molecular assays of collected specimens (borers/parasitoids/pathogens)
        - Photos

    3.2 Canegrubs (Peter Samson)
    3.3 Parasitoid research and outcomes (Sallam and Etik)
    3.4 Borer insecticides and IPM research (Regis)
    3.5 Mosaic research (Lilik) ok
    3.6 Disease-free propagation (Ari)

3.7 Mapping (Mulyadi)
3.8 IPM strategy development and extension (Ari/Dian/Peter McGuire)

- Champion farmers
- Model farms
- Other extension activities

3.9 Business considerations (Peter McGuire)
3.10 Field guide (RCM)
3.11 Budget considerations (RCM)

4.0 Discussion for Thursday activities
5.0 Review meeting summary (RCM)

APPENDIX 2: EXTENSION PLAN (APRIL 2009)

The following program was formulated after discussions with Dian, Ari and Lilik

1. Regional training
   - November 2009
   - 5 work shops (1 per region)
   - training at factories on pests & diseases
   - focus on disease free seed cane and best practice for seed nurseries
   - gather information from attendees on how they prefer to source disease free material eg tissue culture from ISRI
   - present information on yield loss data (good data from Lilik's work on mosaic; RSD- any Indonesian data available? If not use overseas data.
   - invite government seed cane certification (BP2MB) staff
   - Peter McGuire to help with preparing presentation and attend first 2 work shops.

2. Champion farmer
   - 1 champion farmer per region (5 regions)
     - Process to select:
       1. Sugar factories to identify say top 5 or 6 farmers based on productivity, use of good seed cane, adoption of new methods (socialisation) etc
       2. Top farmers interviewed by regional ISRI staff
       3. Farm visit of say top 2 farmers if needed
     - Will use the champion farmers to promote the project by:
       - Farm walk (mini field day) at Champion Farmer's farm (50 expected to attend each champion farm)
       - article and photo in agricultural newspaper
       - The farm walk and articles will highlight practices on the farm that are endorsed by the project eg use of disease free nursery cane, biological control of borers

3. Model farms
   - establish 4 model farms
   - Plant in May/June 2010 to use at workshop in 2010
   - Use best practice for variety selection, pest and disease control and agronomy
   - Etik is the coordinator

4. Demonstration plots
   - Separate demonstration plots to be used for each practice eg disease free seed, borer control, grub control
   - establish 3 to 5 plots with disease free planting material to demonstrate yield losses from mosaic and RSD.
   - use plots with Farmer Field Training

5. Field guide for pests and diseases
   - Should be available by mid 2010
   - Need a larger print run (1,000 to 2,000 copies) to assure all key people have a copy

- Include a section on seed cane and nursery management. Should have a pictorial showing progression from tissue culture → "mother plot" → larger nursery → farm nursery or commercial planting.
- Distribute copies to certification staff and quarantine staff

6. Training workshop
- Regis Goebel plans to provide training on biological control of borers using Trichogramma spp at Pesantren Baru in July 2009.
- Emphasis will be on quality control of Trichogramma production.
- Staff from other mills will be invited to attend.

APPENDIX 3: GENERAL SURVEY - ENTOMOLOGY NOTES

Summary:

- *Chilo sacchariphagus* infestation level seems low compared with other countries, but this is only a snapshot and the situation could be different in other years. Note also that damage may have increased in some fields after the survey was completed.
- *Scirpophaga* seems to be the most serious pest.
- Further analyses (Sallam to do) are needed to determine effects of:

    - variety
    - crop class
    - parasite release
    - ownership
    - irrigation

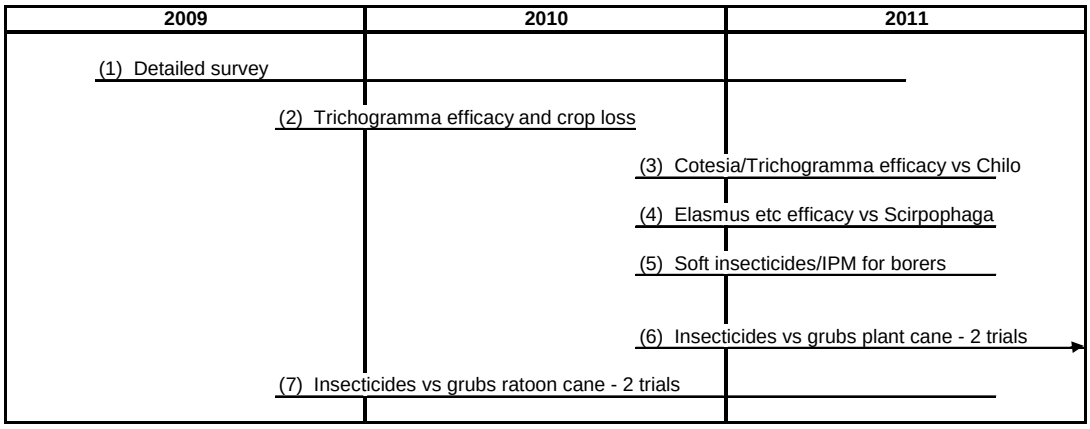
Crop age seems to be a major determinate of damage level and probably should be investigated as a covariate in all multivariate analyses.

- Additional data needed for each farm on altitude and crop yields (ISRI to obtain).
- Priorities for future research

    - measure crop loss caused by borers
    - assess efficacy of current biocontrol program with *Trichogramma*
    - implement and assess efficacy of improved biocontrol programs for the main borer species
    - study population dynamics of borers and determine regulating mechanisms

APPENDIX 4: PLANS FOR FIELD TRIALS

The anticipated time line for proposed trials is given in the table. This can be changed, especially if there is insufficient time to conduct all proposed activities. An outline of each proposed trial is given below the table.



ACTIONS

1. Detailed survey (beginning April 2009)

This will be conducted according to procedures agreed between Sallam and Etik. Regis will provide Etik with a protocol and data recording sheet for additional sampling of life stages (eggs, larvae, pupae) of *Chilo spp*. and *Scirpophaga*.

2. *Trichogramma* efficacy and crop loss (July 2009)

Aim
- Assess actual and potential efficacy of *Trichogramma* biocontrol program
- Measure crop loss caused by borers

Trial design

4 treatments:
- *Trichogramma* released according to factory procedure
- *Trichogramma* released according to recommended procedure (10-15 releases 1-4 mo)
- Insecticide (cypermethrin 12 g ai/ha every 2 wks from 1-8 mo)
- UTC (untreated control)
- 5 replicates

Plot size 500 m^2 with 20 m of cane buffer between them

Observations/assessments
- Damage at 6 months and just before harvest
- Crop yield and ccs at harvest

Preparations - ASAP
- Obtain suitable insecticide
- Obtain permission to use cypermethrin (12 g ai/ha approx 14 times)
- Regis to:
  - Send to Etik the protocol on crop loss trials (*Trichogramma* / insecticide plots)
  - Prepare the next trip with Etik (probably in July) on the quality control of *Trichogramma* production and field releases in the factory of Pesantren-Baru, near Kediri
  - Send to Etik the new identification/confirmation of *Trichogramma spp* collected from the lab production
  - Send to Etik a standardised protocol for quality control (*Trichogramma*)

3. *Trichogramma / Cotesia* efficacy vs *Chilo* spp. (2010)

Aim
- Assess the efficacy of a combined biocontrol program for *Chilo spp.*

Trial design
Large-scale trial because of high dispersal ability of *Cotesia.*

Tentatively 4 treatments:
- *Trichogramma* only (1-4 mo)
- *Cotesia* only (4-5 mo)
- *Trichogramma + Cotesia*
- UTC

x 2 reps

Plot size: whole fields separated by at least 1 km

Observations/assessments
- Monitor regularly to determine rates of parasitism over time
- Damage estimates
- Crop yield and ccs

Preparations during 2009-2010
- Select suitable sugar factory
- Develop final plan

4. *Elasmus* efficacy vs *Scirpophaga* (2010)

Aim
- Develop and assess the efficacy of a combined biocontrol program for *Scirpophaga*

Trial design
Not available.

Observations/assessments
Not available.

Preparations during 2009-2010
- Collaborate with suitable sugar factory (Subang, Jatitujuh?)
- Establish *Elasmus* culture during 2009
- Investigate other parasitoids that could be mass-reared and included in the trial
- Develop trial plan

5. Soft insecticides / IPM for borers (2010)

Aim
- Assess the efficacy of insecticides that could be combined with biocontrol in an IPM program for moth borers

Trial design
Not available.

Observations/assessments
Not available.

Preparations during 2009-2010
- Develop list of candidate suitable insecticides, especially insect growth regulators (IGRs)
- Source insecticides in Indonesia
- Obtain permission to use insecticides in trial

6. Insecticides vs canegrubs – plant cane (May 2010)

Aim
- Assess the efficacy of liquid imidacloprid against *Lepidiota stigma* when applied in plant crops

Trial design
Two trials.

8 treatments:
- Standard insecticide (diazinon/carbofuran/carbosulfan) at planting
- Liquid imidacloprid @ three rates, tentatively 250, 375, 500 g ai/ha, at planting
- Liquid imidacloprid @ three rates, tentatively 250, 375, 500 g ai/ha, at fill-in
- UTC

x 5 reps

Plots 4 rows x 15 m

Observations/assessments
- Count grubs in March 2011 and 2012
- Crop yield and ccs in 2011 and 2012

Preparations
- Obtain imidacloprid liquid
- Obtain permission for insecticide use
- Identify trial sites

7. Insecticides vs grubs – ratoon cane (November 2009)

Aim
- Establish a system for treating ratoon crops against canegrubs in Indonesia
- Assess the efficacy of liquid imidacloprid against *Lepidiota stigma* when applied in ratoon crops

Trial design
Two trials.

5-6 treatments with insecticides applied sub-surface:
- Standard insecticide if there is one (diazinon/carbofuran/carbosulfan)
- Liquid imidacloprid @ four rates, tentatively 250, 375, 500, 750 g ai/ha
- UTC

x 5 reps

Plots 4 rows x 15 m

Observations/assessments
- Count grubs in March 2010 and 2011
- Crop yield and CCS in 2010 and 2011

Preparations
- Obtain imidacloprid liquid
- Obtain permission for insecticide use
- Identify trial sites
- Determine availability of suitable equipment for sub-surface application; build if necessary

APPENDIX 5: BIOLOGICAL CONTROL NOTES - DR REGIS GOEBEL

1) **Biological control of stemborers with *Trichogramma chilonis*.**
Regis to:

- Send to Etik the protocol on crop loss trials (*Trichogramma* / insecticides plots)
- Prepare the next trip with Etik (probably in July) on the quality control of *Trichogramma* production and field releases in the factory of Pesantren-Baru, near Kediri.
- Send to Etik the new identification/confirmation of *Trichogramma* sp. collected from the lab production.
- Send to Etik a standardised protocol for quality control (*Trichogramma*).

2) **Visit to the factory in Pesantren Baru** (Friday morning 3 April).
Biological control: few points

- Release of 3 species of *Trichogramma* (*T. chilonis, T. minutum, T. japonicum*): the 2 first are for the control of *Chilo sacchariphagus* and *C. auricilius* (stemborers), the last one for *Scirpophaga excerptalis* (top borer);
- 50 cards brought to the fields per species (150 for 3 species) from 1, 5 months to 4 months (1 card = 2000 eggs), 100 000 individual per species per ha (300 000 *Trichogramma* in total).
- Schedule of release: 8 cards 1st week, and then 7 releases of 6 cards per week (per species).
- Areas covered/protected: 1900 ha out of 12000 in the region.

3) **Actions needed**:

- Identification of the species, quality of each *Trichogramma* used,
- timing of application,
- release doses,
- release points,
- efficacy in the fields.