REPORT ON MPOB-SOPPOA RESEARCH COLLABORATION TRAINING ON STANDARD OPERATING PROCEDURE

9-12 MAY 2016 at SARATOK-SIBU &
24-25 MAY 2016 at MIRI SARAWAK

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1.0 BACKGROUND

Oil palm is a major crop commodity in Malaysia with the contribution of product export values up to RM60.17 billion in 2015. The oil palm was planted in almost 60% of the agricultural land in Malaysia or equivalent to 5.64 million hectares (MPOB, 2015). Out of this, 25.5% or 1.44 million hectares of oil palm was planted in Sarawak. Based on rate of new planted areas, the oil palm industry in Sarawak is growing at the annual rate of 1.8% since 2000, higher than those of Peninsular Malaysia and Sabah. However, since 2010, the healthy development of the industry was somewhat affected by the declining in production of fresh fruit bunches as well as the oil extraction rate. Sarawak Oil Palm Plantation Owners Ascosiation (SOPPOA) had said that these issues are seriously observed affecting plantations and mills in lower Baram and central coastal regions in Sarawak. Various factors associated with the issues are highlighted by SOPPOA and these included infestation of pests such as bunch moth, termite, rats and *Ganoderma*, poor fruit set, bunch failure, lower frond desiccation and acid sulphate soil.

To address issues faced by the Sarawak oil palm industry, the Malaysian Palm Oil Board (MPOB) and SOPPOA has jointly organized a workshop on 10 March 2016 in Sibu, Sarawak. The main aim is to enhance the productivity and improve overall performance in plantation management in the oil palm industry in Sarawak. In the workshop, members of SOPPOA are updated on current findings on fertilizer programme, major pests and *Ganoderma* disease, and possible factors affecting yield and OER in peat. The outcomes of the workshop have identified specific collaborative research projects to be implemented between MPOB researchers and interested SOPPOA members. The projects are covering various aspects from agronomic and fertilizer trials, poor fruit set and weevil populations to management of pests such as bunch moth, termites, rats, *Ganoderma* and other diseases.

To ensure research projects conducted by members of SOPPOA will use the same methods, training on Standard Operating Procedure was conducted covering i) Pests, fruit set and agronomy management issues and ii) Field clinic of *Ganoderma* and other diseases in oil palm. The training was aimed to update the standard operating procedure (SOP) of proposed research project to be implemented in collaboration with MPOB researcher and interested SOPPOA members.

2.0 TRAINING PROGRAM ON STANDARD OPERATING PROCEDURE

2.1 Objective

1. To ensure research projects conducted among the members of SOPPOA will be using the same standard operating procedures.
2. To train members of SOPPOA on related standard operating procedure and activities involved in the respective projects.
3. Enhance knowledge and understanding on possible factors associated with low production of yield and OER for oil palm planted in peat.

2.2 Training Program

The training program was divided into two sessions, Session 1 and Session 2 (Refer Appendix 1). The Session 1 was held on 9 - 12 May 2016 at the MPOB Research Station in Saratok and various estates of SOPPOA in Sibu Sarawak. The training aspects covering related SOP and research activities on counting of fruit set, census of pollinating weevil, determination of sex ratio, study on rats and pollen viability test. The Session 2 was held on 25 – 26 May 2016 at Sarawak Oil Palm Berhad (SOPB) in Miri Sarawak covering SOP and research activities on *Ganoderma* and other diseases of oil palm.

The training program had two parts, the first part was the technical presentations and the second part was the hand-on and field demonstration of related aspects or methods involved in each research activity. Field demonstration on related aspects were conducted in various plantations owned by members of SOPPOA. The determination of fruit sets in the unaffected areas and census for sex ratio was conducted at the MPOB Research Station Sessang. Demonstration for counting of fruit sets and census of weevil population in the affected areas was conducted at the Zumida Estate of Ta Ann Plantation in Sibu. The demonstration on methods related to study on termites, bunch moth and rats was also conducted in this locality. Activities related to study on frond desiccation, frond snapping and issues on acid sulphate soil were deliberated at the Ladang Pelitanah 1, Tradewind Plantation and Lepah Jaya Estate, Jayatiasa Plantation in Sibu. The field demonstration on methods related to study on *Ganoderma* and other diseases such as bunch rots and OS-CCCVd was done at the SOPB, Miri. The summary of each presentation and field visit related to *Ganoderma* and other diseases were elaborated in **ITEM 5.0.** The list of SOP and related research activities deliberated in both sessions are as in **Table 1** and the action plan and list of companies involved in each project are as in **Table 2.**

TABLE 1. LIST OF RELATED STANDARD OPERATING PROCEDURE AND RESEARCH ACTIVITY DELIBERATED IN THE MPOB-SOPPOA RESEARCH COLLABORATION TRAINING

No.	Aspects of training on related SOP	Presenter	Appendix
1.	Study of premature frond desiccation incidence	En Hasnol, En Dominic & En Latif	3
2.	Study on the incidence of oil palm frond snapping	En Hasnol & En Dominic	4
3.	Proposal and SOP on counting of fruit set and census to determine the population of pollinating weevil	Dr Ramle & En Saharul	5
4.	Proposal and presentation on poor fruit set formation of oil palm on peat	En Hasnol, En Mazli & Pn Nur Zuhaili	6
5.	Presentation on heavy liming application of oil palm on peat	En Hasnol	7
6.	Proposal and SOP on research to control termites	Dr Ramle & En Yaqin	8
7.	Proposal and SOP on research to control bunch moth	Dr Ramle & En Saharul	9
8.	Proposal and SOP on research on rats and its control	En Rizuan (FGV)	10
9.	Basidiospores studies on *Ganoderma* disease	Dr Idris & Dr Shamala	11
10.	Nursery and field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm	Dr Idris & Pn Nur Rashyeda	12
12.	Bunch rot disease in oil palm	Dr Idris	13
13.	Field demonstration on OS-CCCVd infection in oil palm	Dr Shamala & Dr Idris	14

3.0 LIST OF PARTICIPANT

Participants attending the training were officially invited by the SOPPOA and mostly are personnels or workers who are involved in the research activities. A total of 47 participants was attending the Session 1 and 41 participants was attending the Session 2. The list of participants was in the **Appendix 2**.

4.0 LIST OF ORGANIZING COMMITTEE

1.	Datuk Dr Choo Yuen May	- Advisor
2.	Dr Norman Kamarudin	- Chairman, Director of Biology, MPOB
3.	Mr Sylvester Fong	- Co-Chairman, CEO SOPPOA
4.	Dr Idris Abu Seman	- MPOB, Headquaters
5.	En Hasnol Othman	- MPOB, Teluk Intan
6.	Su Chong Ming	- SOPB, Sarawak
7.	Siaw Ting Chuan	- Ta Ann Plantation, Sarawak
8.	Dr Liew Voon Kheong	- Tradewinds Plantation, Sarawak
9.	Dr Shamala Sundram	- MPOB, Headquaters
10.	Mohamad Izzuddin Anuar	- MPOB, Headquaters
11.	Mohamad Rosman Sulaiman	- MPOB, Headquaters
12.	Saharul Abillah Bin Mohamad	- MPOB, Sessang, Sarawak
13.	Muhammad Nurul Yaqin Bin Syarif	- MPOB, Lahad Datu, Sabah
14.	Farawahida Mohd Darus	- MPOB Kluang, Johor
15.	Mohd Faizal Sedie	- MPOB, Sessang, Sarawak
16.	Latip Bundan	- MPOB, Sessang, Sarawak
17.	Dominic ak Pagang	- MPOB, Sessang, Sarawak
18.	Masitah Saperi	- MPOB, Sessang, Sarawak
19.	Sindy Maurice Goulip	- MPOB, Lahad Datu, Sabah
20.	Mazli Eswa	- MPOB, Teluk Intan
21.	Rosmidi Miswan	- MPOB, Headquaters
22.	Dr Ramle Moslim	- Secretariat
23.	Nur Zuhaili Harris Abidin Z Abidin	- Secretariat
24.	Nur Rashyeda Ramli	- Secretariat

5.0 SUMMARY OF PROPOSAL PRESENTATION AND FIELD VISIT

PAPER 1: Basidiospores studies on *Ganoderma* disease. Sub-project: Insect Vectors

The objective of this study is to identify insect vector carry basidiospores of *Ganoderma* and causing upper stem rot (USR) and basal stem rot (BSR) disease. Dr Idris Abu Seman highlighted two (2) companies will collaborate on this study which are SOPB and Ta Ann Plantation. He also offered to other interested companies to collaborate in this project. He emphasized that MPOB need more study site for this study thus collaboration from many parties is mostly welcomed. SPAD is interested to collaborate on this project and will be allocated study site in their plantation. Dr Idris also highlighted that basidiospores play a role in spreading the disease through insect as a vector. Tiger beetle, *Episcapha muculata* can carry basidiospores of *Ganoderma* and infect oil palm to cause USR and BSR. He concluded that for this study, identification of insect carrying spores associated with oil palm will be conducted once the plantation has identified the area with USR and BSR disease. The slide presentation as in **Appendix 11.**

As for immediate action for USR disease in Sarawak, Dr Idris suggested to do the fungicide treatment by using hexaconazole and tetraconazole to prolong the life span of infected palm. GanoDROP staff in MPOB Sessang with the SOPB will conduct the census in SOPB Sg Balim, Miri plantation to categorize the oil palm according to their severity. For this study, only infected palm with DSI 1 and 2 will be treated with hexaconazole and tetraconazole. The application of hexaconazole and tetraconazole will be conducted in August 2016 as the disease census was already carried out in 20-24 June 2016.

PAPER 2: Nursery and field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm.

The objective of this study is to test the efficacy of BCA products (in the market) for controlling *Ganoderma* disease in oil palm planted in nursery and field. Previously, this study has been conducted in SOPB and MPOB will discuss the results with SOPPOA members in the next meeting. SPAD requested to repeat the experiment in their plantation. Dr Idris highlighted that SPAD with the collaboration of GanoDROP staff in MPOB Sessang need to do the census and allocated the infected stump with DSI 3 and 4 for this study. He also suggested that this study must be conducted during the rainy season as to ensure the effectiveness of BCA product to control *Ganoderma* disease.

During the field visit, Dr Idris showed signs oil palm infected with *Ganoderma* disease, according to the disease severity index (DSI) which corresponding with levels of severity. He also explained that treatment with fungicides can only be conducted if the infected palm was categorized at DSI 1 and 2. For infected palm with DSI 3 and 4, it was suggested to control using the sanitation method by deboiling and removal of the infected palm. At the end of the visit, En Rosmidi Miswan explained and showed the pathological parameters and data assessment as well as data recording for this study. The slide presentation and the forms for data recording as in **Appendix 12.**

PAPER 3: Studies on bunch rot disease in oil palm

The main objective of this study is to identify the causal pathogen and predisposing factors of bunch rot in oil palm. The other objectives are to develop an early detection technique and control measures as well as the survey of the presence of bunch rot disease in oil palm in Sarawak. Three (3) companies will collaborate on this study which are Ta Ann Plantation, Woodman Plantation and Tabung Haji Plantation. Dr Idris highlighted that bunch rot is caused by *Schizophyllum* fungus in Sabah while according to PD Turner, this disease is caused by *Marasmius* fungus. Dr Idris emphasized that MPOB need help from DOA to collect the sample (bacteria and fungus) associated with bunch rot and MPOB will conduct the pathogenicity test to confirm the infection. The slide presentation as in **Appendix 13.**

PAPER 4: Effects of OS-CCCVd infection on oil palm yield in Sarawak.

The main objective of this study is to estimate the effects of OS-CCCVd infection on oil palm yield in Sarawak. Dr Shamala explained to date, no scientific paper recorded on the effects of OS-CCCVd in reducing the oil palm yield. Thus, she requested among plantations in Sarawak with OS-CCCVd palm to let MPOB conduct the experiment by sampling leaf tissue and record the yield for a duration of 3-4 years.

During the field visit, she showed and explained the symptoms of OS-CCCVd on oil palm to the participants. She also showed the method of leaf sampling process and explained the sampling must focus on frond 10 and 20 for the best RNA extraction. The slides presentation and sampling and screening procedures as in **Appendix 14.**

TABLE 2. ACTION PLAN AND LIST OF THE COMPANY INVOLVED IN RESEARCH PROJECT DELIBERATED IN THE MPOB-SOPPOA RESEARCH COLLABORATION TRAINING

No	Aspects of training on related SOP	Collaboration company	Project Timeframe	
			Start	End
1.	Study of premature frond desiccation incidence	Ta Ann, SOPB, Jaya Tiasa, Tradewinds	2016	2018
2.	Study on the incidence of oil palm frond snapping	Jaya Tiasa	2016	2017
3.	Proposal and SOP on counting of fruit set and census to determine the population of pollinating weevil	Ta Ann, SOPB, SALCRA	2016	2021
4.	Proposal and presentation on poor fruit set formation of oil palm on peat	Ta Ann, SOPB, Jaya Tiasa, Woodman, Golden Star Ace, Tabung Haji (TH)	2016	2018
5.	Presentation on heavy liming application of oil palm on peat	Woodman, Tradewinds	2016	2017
6.	Proposal and SOP on research to control termites	Ta Ann, SOPB	2016	2019
7.	Proposal and SOP on research to control bunch moth	SOPB, Ta Ann	2016	2019
8.	Proposal and SOP on research on rats and its control	SOPB, Ta Ann	-	-
9.	Basidiospores studies on *Ganoderma* disease	SOPB, Ta Ann, SPAD	2016	2018
10.	Nursery and field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm	SPAD, SOPB	2016	2019
12.	Bunch rot disease in oil palm	Ta Ann, Woodman, TH	2016	2019
13.	Field demonstration on OS-CCCVd infection in oil palm	SOPB	2016	2020

6.0 CONCLUSION

The MPOB-SOPPOA research collaboration training on standard operating procedure was successfully conducted on May 2016 in Sibu, Saratok and Miri Sarawak. A total of 11 standard operating procedures and related activities have been presented to members of SOPPOA that are interested to conduct research which is mainly to improve productivity of oil palm in Sarawak. The training program not just to give guidelines on SOP, but more importantly, it will enhance knowledge and understanding of possible factors associated with low production of yield and OER for oil palm planted in peat. Research findings generated from the collaborative study between MPOB and SOPPOA hopefully will beneficial not only to oil palm estates in Sarawak, but also to oil palm industry in Malaysia.

7.0 ACKNOWLEDGEMENT

The organizing committee would like to express sincere appreciation to committee, secretariat, speakers, participants and staffs or estates who are involved in making the training program a success.

APPENDIX 1

SESSION 1 :
PROGRAM MPOB-SOPPOA RESEARCH COLLABORATION TRAINING ON STANDARD OPERATING PROCEDURE
9-12 May 2016, Saratok-Sibu, Sarawak

9 May 2016 (Monday)			
Time	**Programme**	**PIC**	**Venue**
7.30 am	Registration	*Secretariat*	Complex MPOB Sessang Research Station
8.00 am	Discussion on the materials and methods on: • Premature frond desiccation (PFD) • Oil Palm frond snapping • Poor fruit set formation on peat and mineral soil • Liming study on peat	En Hasnol	
10.00 am	*Morning tea break*	*Secretariat*	
10.30 am	Discussion on materials and methods on study of weevil population and fruit set	Dr Ramle/ En Saharul	
11.30 am	Discussion on materials and methods for rat study	FGV/TaAnn	
12.30 pm	*Lunch*	*Secretariat*	
2.00 pm	Discussion on materials and methods for termite trials	Dr Ramle/En Yaqin	
3.30 pm	Discussion on materials and methods for bunch moth trial	Dr Ramle/En Saharul	
5.00 pm	*Afternoon tea break*	*Secretariat*	
End of Day 1			

10 May 2016 (Tuesday)			
Time	**Programme**	**PIC**	**Venue**
7.30 am	Depart to Ladang MPOB Sessang	-	Ladang MPOB Sessang
8.30 am	Field training on flower census for sex ratio determination	En Hasnol/En Mazli	
10.00 am	*Morning tea break*	*Secretariat*	
10.30 am	Field training on fruit set count for flower sex ratio determination	En Hasnol/En Mazli	
11.30 pm	*Lunch &* *Depart back to MPOB Sessang Research Station Complex*	*Secretariat*	-
2.00 pm	Pollen viability test	Pn Nur Zuhaili	MPOB Sessang Research Station
3.30 pm	Flower census (key-in data)	En Hasnol/En Mazli	
4.30 pm	*Afternoon tea break*	*Secretariat*	
	Depart to Tanah Mas Hotel, Sibu		
End of Day 2			

Discussion on materials and methods on study of weevil population and fruit set will include experimental site & layout, data recording of key parameters, data recording interval etc.
Discussion on materials and methods for bunch moth , termite and rat trial will include identification of experimental sites, pre-census requirements, experimental design, treatments, application of treatment, data recording, data analysis

11 May 2016 (Wednesday)			
Time	**Programme**	**PIC**	**Venue**
7.30 am	Depart to Tradewinds Plantation	-	Ladang Pelitanah II, Tradewinds Plantation, Sibu.
9.00 am	Visit to frond desiccation study site	En Hasnol/ En Dominic	
10.30 am	*Morning tea break*	*Secretariat*	
10.50 am	Discussion on frond desiccation issue	En Hasnol/En Dominic	
12 noon	*Lunch*	*Secretariat*	Sibu
1.00 pm	Depart to Jaya Tiasa	-	Lepah Jaya, Jaya Tiasa Plantation
2.30 pm	Visit to frond desiccation site	En Hasnol/En Latip	
4.30 pm	*Afternoon tea break*	*Secretariat*	
5.00 pm	Depart back to hotel		
End of Day 3			

12 May 2016 (Thursday)			
Time	**Programme**	**PIC**	**Venue**
7.00 am	Depart to Zumida Oil Palm Plantation, Ta Ann Sdn Bhd	-	
8.00 am	Briefing on materials and methods on study of weevil population and fruit set	En Saharul/ En Mohd Faizal	Block 107, Zumida Estate
10.00 am	*Morning Tea Breaks*	*Secretariat*	
10.30 am	Briefing on materials and methods on study of bunch moths	En Saharul/ En Yaqin	
11.30 am	Briefing on materials and methods on study of termite	En Saharul/ En Yaqin	To be determined
12.30 pm	*Lunch*	*Secretariat*	
2.00 pm	Briefing on materials and methods on study of rat	FGV	To be determined
4.00 pm	*Afternoon tea break*		
4.30 pm	Depart back to hotel	-	-
End of training			

Briefing on materials and methods on study of weevil population and fruit set will include census of weevils, male inflorescences, marking of palm trees for sampling, weevils sampling from male inflorescence, fruit set counting, collection of pollens, pollen preparation & preservation, puffing, assisted pollinating

Briefing on materials and methods on study of:

- **Bunch moth:** census of bunch moths, sampling of inflorescences, developmental stages of bunch moths, treatments, application of treatment, data recording etc.
- **Termite:** census of termite, species & colony detection, severity census, treatments, application of treatment, data recording etc.
- **Rat:** fundamental rat study, experimental sites, species identification, census of rats population & palm damages, baiting techniques, data recording etc.

SESSION 2 :
MPOB-SOPPOA RESEARCH COLLABORATION TRAINING ON FIELD CLINIC OF *Ganoderma* AND OTHER DISEASES IN OIL PALM
25-26 May 2016, SOPB, Miri, Sarawak

Date	Time	Activity/Programme	Venue
25/6/2016	2.30 pm	Briefing and discussion on Field clinic on *Ganoderma* and other diseases with SOPPOA members • Study on basidiospores of *Ganoderma* (USR and BSR) disease in oil palm • Field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm • Detection of *Ganoderma* disease in oil palm using Remote Sensing • Investigation on the primary pathogen causing the bunch rot in oil palm • Effects of OS-CCCVd infection on oil palm yield in Sarawak	Training room, SOPB, Miri
	5.00 pm	Refreshments and end of Day 1	
26/5/2016	9.00 am	Nursery dan field visit for data recording on *Ganoderma* and other diseases: • Study on basidiospores of *Ganoderma* (USR and BSR) disease in oil palm • Field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm • Detection of *Ganoderma* disease in oil palm using Remote Sensing • Investigation on the primary pathogen causing the bunch rot in oil palm • Effects of OS-CCCVd infection on oil palm yield in Sarawak	SOPB, Miri (Lambir Estate)
	12.30 pm	Lunch	
	2.30 pm	Continue on nursery and field visit for data recording on *Ganoderma* and other diseases	
	5.00 pm	Refreshments and end of programme	

A. LIST OF PARTICIPANTS ATTENDING SESSION 1

No.	Name of the participant	Organization
1.	Dr Ramle Moslim	MPOB HQ
2.	Hasnol Othman	MPOB Teluk Intan Research Station
3.	Nur Zuhaili Harris Abidin Z Abidin	MPOB HQ
4.	Saharul Abillah Bin Mohamad	MPOB Sessang Research Station
5.	Latip Bundan	MPOB Sessang Research Station
6.	Muhammad Nurul Yaqin Bin Syarif	MPOB Lahad Datu Research Station
7.	Mohd Faizal Sedie	MPOB Sessang Research Station
8.	Dominic ak Pagang	MPOB Sessang Research Station
9.	Nor Nasaruddin Paiman	MPOB HQ
10.	Muhamad Kamil Harun	MPOB Kluang Research Station
11.	Ena Uji	MPOB Sessang Research Station
12.	Jamaluddin Ini	MPOB Sessang Research Station
13.	Mohd Faizal Sedie	MPOB Sessang Research Station
14.	Mazli Eswa	MPOB Teluk Intan Research Station
15.	Mohd Younus Jerni	MPOB Sessang Research Station
16.	Mohamad Azhar Saleh Kamil	MPOB Sessang Research Station
17.	Cik Mohd Rizuan Zainal Abidin	FGV R&D
18.	Su Chong Ming	SOPB
19.	Chua Yong Kian	SOPB
20.	Leong Ting Hao	SOPB
21.	Wong Pak Soon	SOPB
22.	Chai We Jin	SOPB
23.	Siaw Ting Chuan	Ta Ann Plantation Sdn Bhd
24.	Wong Sei Toh	Ta Ann Plantation Sdn Bhd
25.	Chen Yik Ming	Ta Ann Plantation Sdn Bhd
26.	Reki Ak Ribot	Ta Ann Plantation Sdn Bhd
27.	Yunus Abun	Ta Ann Plantation Sdn Bhd
28.	Kon Thian Woei	Woodman Group of Companies
29.	Liew Li Yee	Woodman Group of Companies
30.	Ling Teck Huat	Jaya Tiasa Holdings Bhd
31.	Colin Tang	Jaya Tiasa Holdings Bhd
32.	Tang Kie Teck	Jaya Tiasa Holdings Bhd
33.	Abang Beniamin Bin Abang Aing	Jaya Tiasa Holdings Bhd
34.	Tiong Nieng Chiong	Jaya Tiasa Holdings Bhd
35.	Richard Rubun	Jaya Tiasa Holdings Bhd
36.	Kong Nieng Kie	Jaya Tiasa Holdings Bhd
37.	Abdullrahman	Jaya Tiasa Holdings Bhd
38.	Alex Ting Mui Kiong	Jaya Tiasa Holdings Bhd
39.	Maximus Shen	Jaya Tiasa Holdings Bhd
40.	Peter Hu Jartea	Jaya Tiasa Holdings Bhd
41.	Ikong Belikau	Jaya Tiasa Holdings Bhd
42.	Bong Kanela Wang	Jaya Tiasa Holdings Bhd
43.	Kevin Kens	Jaya Tiasa Holdings Bhd
44.	Asraf Adenan	Jaya Tiasa Holdings Bhd
45.	Hamzah Ali	Jaya Tiasa Holdings Bhd
46.	Nicholas Upa	Jaya Tiasa Holdings Bhd
47.	Mohd Luqman Al hakim	Jaya Tiasa Holdings Bhd

B. LIST OF PARTICIPANTS ATTENDING SESSION 2

No.	Name of the participant	Organization
1.	Dr Idris Abu Seman	MPOB HQ
2.	Dr Shamala Sundram	MPOB HQ
3.	Nur Rashyeda Ramli	MPOB HQ
4.	Nur Diyana Roslan	MPOB HQ
5.	Rosmidi Miswan	MPOB HQ
6.	Zulfaika Mohamad@Mahmud	MPOB Sessang Research Station
7.	Mohamad Zuhasli Botan	MPOB Sessang Research Station
8.	Awang Mohd Ridzwan Awang Bujang	MPOB Sessang Research Station
9.	Jumain Sinring	MPOB Lahad Datu Research Station
10.	Ms.Liew Li Yee	Woodman Group of Companies
11.	En. Mohd Farith Bin Kota	Woodman Group of Companies
12.	Ms. Siaw Ting Chuan	Ta Ann Plantation Sdn Bhd
13.	En Mohd Azim Hazny	Tabung Haji Plantation
14.	En.Zulkhairi Zainuddin	Tabung Haji Plantation
15.	Sireh linggang	DOA Sarawak
16.	Lai Lee San	DOA Sarawak
17.	En.Shaiful Hambali	Sarawak Plantation Agriculture Development Sdn Bhd
18.	Pn.Rofidza Sendi	Sarawak Plantation Agriculture Development Sdn Bhd
19.	Agnetha Sherod Ismail	Sarawak Plantation Agriculture Development Sdn Bhd
20.	Joqiues Galip	Sarawak Plantation Agriculture Development Sdn Bhd
21.	Chua Kian Hong	Sarawak Oil Palms Berhad (SOPB)
22.	Chua Yong Kian	Sarawak Oil Palms Berhad (SOPB)
23.	Leong Ting Hao	Sarawak Oil Palms Berhad (SOPB)
24.	Ong Kim Pin	Sarawak Oil Palms Berhad (SOPB)
25.	Peter Ko	Sarawak Oil Palms Berhad (SOPB)
26.	Chai We Jin	Sarawak Oil Palms Berhad (SOPB)
27.	Nuerella Bunniza	Sarawak Oil Palms Berhad (SOPB)
28.	Zamawi Ena	Sarawak Oil Palms Berhad (SOPB)
29.	Kamarozzaman	Sarawak Oil Palms Berhad (SOPB)
30.	Su Chong Ming	Sarawak Oil Palms Berhad (SOPB)
31.	Wong Pak Soon	Sarawak Oil Palms Berhad (SOPB)
32.	Nicholas Lipa	Jaya Tiasa Holdings Bhd
33.	Asrani Adnan	Jaya Tiasa Holdings Bhd
34.	Dennis Pungah	Jaya Tiasa Holdings Bhd
35.	Abang Beniamin Bin Abang Aing	Jaya Tiasa Holdings Bhd
36.	Hakizah Ali	Jaya Tiasa Holdings Bhd
37.	Mohd. Luqman Alhakim	Jaya Tiasa Holdings Bhd
38.	Yusof Ahmat	Jaya Tiasa Holdings Bhd
39.	Liik Chek Sheng	Jaya Tiasa Holdings Bhd
40.	Hazian B. Mohd Bee	Jaya Tiasa Holdings Bhd
41.	Jahidi Hj Upay	Jaya Tiasa Holdings Bhd

STUDY OF PREMATURE FROND DESSICATION INCIDENCE

1. Proposal
2. Slide presentation

PROPOSAL

Project Title:

Investigations on premature frond desiccation (PFD) incidence of oil palm planted on peat soil in Sarawak.

Collaborator:

1. Ta Ann Plantation.
2. Sarawak Oil Palm Bhd (SOPB).
3. Jaya Tiasa.
4. Tradewinds Plantation - on-going project.

Research Approach:

1. Carry out census on PFD incidence status (severity) of the estate.
2. Carry out sampling and analysis on leaf nutrients status, soil fertility status, soil moisture regime and ground water quality in the PFD affected area and unaffected area - to determine potential factors that caused PDF incidence in relation to oil palm nutrition status (deficiency/ toxicity) and moisture stress.
3. Carry out water management treatment – to determine effect of water management on the incidence of PFD.
   - T1: Ground water table under stagnant condition (40-50cm below ground surface)
   - T2: Ground water table under fluctuated condition by flushing the field water.
4. Carry out fertilizer treatment that can overcome the incidence of PFD – type of fertilizer treatment will be determine based on results leaf nutrients status, soil fertility, ground water quality sampling.

Expected Outcome:

1. Identify factors that caused the PFD incidence of oil palm on peat.
2. Recommendation on GAP (fertilizer and water management) of oil palm peat in relation to minimize PFD incidences.

Project Timeframe: 2016 – 2018 (3 years)

Year	Period	Activity
2016	Jan-Mac	Literature review and research proposal.
	Apr-Jun	• Site selection and plotting. • Census on PFD incidence of the estate. • Pre-treatment sampling of leaf tissue, soil and ground water.
	Jul-Sep	Commence water management treatment.
	Oct-Dec	Census on PFD incidence of the study block.
2017	Jan-Mac	• Sampling of leaf tissue, soil and ground water (6 months after treatment). • Commence fertilizer treatment.
	Apr-Jun	Census on PFD incidence of the study block.
	Jul-Sep	Sampling of leaf tissue, soil and ground water (12 months after treatment).
	Oct-Dec	Census on PFD incidence of the study block.
2018	Jan-Mac	Sampling of leaf tissue, soil and ground water (18 months after treatment).
	Apr-Jun	Census on PFD incidence of the study block.
	Jul-Sep	Sampling of leaf tissue, soil and ground water (24 months after treatment).
	Oct-Dec	Data analysis and writing final report.

Project

Investigations on premature frond desiccation (PFD) incidence of oil palm planted on peat soil.

Collaborator:

1. Ta Ann Plantation.
2. Sarawak Oil Palm Bhd (SOPB).
3. Jaya Tiasa.
4. Tradewinds Plantation - on-going project.

STANDARD OPERATING PROCEDURE (SOP)

Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

INTRODUCTION

- Reported in mature palms after 8 to 10 years oil palm planting.
- Water table, peat depth and peat maturity were not significant in the incidence of PDF (Joshua, 2004 and Totok *et al*, 2011).
- Further findings are likely caused by high acidity and excessive P concentration (Totok *et al*, 2011).
- Application of rock phosphate increased the number of desiccated fronds (Totok *et al*, 2011).
- Poor root development of the desiccated palms was visually found lower than the normal healthy palms (Achmad, 2001; Joshua, 2004).

Study on premature frond desiccation (PFD) incidence of oil palm planted on peat soil.

Scope of Work

1. Carry out census on PFD incidence status (severity) of the estate.
2. Carry out sampling (foliar, soil and ground water) in the PFD affected area and unaffected area.
3. Carry out water management treatment – to determine effect of water management on the PFD incidence.
4. Carry out fertilizer treatment that can overcome the PFD incidence.

Research Approach

- Carry out census on PFD incidence status (severity) of the estate.
- Determine potential factors that caused PDF incidence in relation to oil palm nutrition status (deficiency/ toxicity) and moisture stress - carry out sampling in the PFD affected area and unaffected area.
  1. Leaf and rachis nutrients status.
  2. Soil fertility status.
  3. Soil moisture regime.
  4. Ground water quality.

Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

Symptom of Incidence

- Visible first at the oldest frond (fronds 25-40)
- Showed a burnt or necrotic at the tips and margin of the leaf of older fronds
- Leaf drying starting from tip and extended towards rachis
- The rachis and petiole - yellow or chlorosis with brown necrotic patches
- Drying fronds break up about 1 feet from petiole base
- Severe cases- spread to frond 17

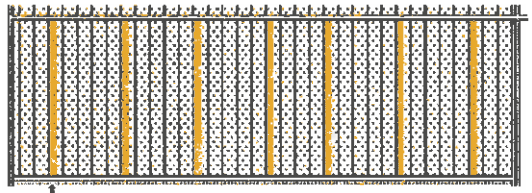
Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

Census of PFD Incidence

- Study area:
  - 1 harvesting block
  - 10 – 15 ha @ 1600 – 2400 palms
- Recording palm:
  - 160 – 240 palms (10% of total palms).
  - Every 10 harvesting path.
- Census:
  - Frequency: 4 months interval.
  - Parameter: total number of green frond.
  - Indentify position (parastichy) the lowest green frond of frond spiral no. 1.

Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

Study Block and Recording Palm



Recording palm (RP) @ all palms in selected harvesting path.

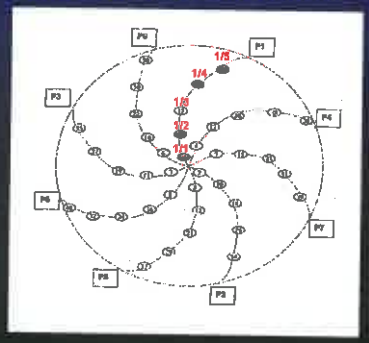
Research Design

Hectareage: 10- 15 ha @ 1600 - 2400 palms

Total RP: 160 – 240 palms (10% of planted palms)

Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

Frond Parastichy @ Phyllotaxis



Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

Estimation of Total Green Frond

Parastichy @ phyllotaxis *		Estimate of total green frond per palm
Spiral	Frond no.	
1	1	5
	2	13
	3	21
	4	29
	5	37
	6	45
	7	53

* Position (parastichy) of the lowest green frond

Census on Oil Palm Premature Frond Desiccation (PFD) Incidence Severity

PFD Severity Classes

Estimate of total green frond per palm	Severity classes
5	Severe
13	
21	Moderate
29	
37	Mild
45	Normal
53	

- PFD Severity Classes of study block based on an average of estimated total green frond of recording palm.

Project 3: Investigations on premature frond desiccation (PFD) incidence of oil palm planted on peat soil.

Research Approach

Expected Outcome:

1. Identify factors that caused the PFD incidence of oil palm on peat.
2. Recommendation on GAP (fertilizer and water management) of oil palm peat in relation to minimize PFD incidences.

STUDY ON THE INCIDENCE OF OIL PALM FROND SNAPPING

1. Proposal
2. Slide presentation

PROPOSAL

Project Title:

Investigations on the incidence of oil palm frond snapping (PS).

Collaborator:

1. Jaya Tiasa.
2. MPOB Lahad Datu, Sessang, Teluk Intan, Keratong, Kluang and Ulu Paka - on-going project.

Research Approach:

1. Carry out census on PS incidence status (severity) of the study area.
2. Carry out sampling and analysis on

i. **Rainfall data:**

a. To collect monthly (April, May, June, July) from each station.

ii. **Rainwater sample**

a. To collect sample during (in April or May) and after El Niño phenomenon (in June or July). (The purpose is to analyse the rainwater element, not to collect the quantity.)

b. To collect once there is rainfall in the mentioned month. Only one sample each for during and after El Niño.

c. Approximate amount of sample is 150 – 250 ml.

d. To analyse all elements and water pH.

iii. **Soil physical properties**

a. To collect sample once, which is during (in April or May) El Niño phenomenon only.

b. To collect one sample / rep at one point (inter-palm).

c. List of properties are :

- Bulk density
- Porosity
- Soil moisture characteristics (Field capacity, wilting point and available water).

iv. **Soil moisture content**

a. To collect during (in April or May) and after El Niño phenomenon (in June or July).

b. To collect one sample / rep at one point (inter-palm).

c. 3 soil depths: 0-20 cm, 20-40 cm and 40-60 cm.

v. **Foliar and rachis sampling**

a. To collect during (in April or May) and after El Niño phenomenon (in June or July).

b. Each station to send sample to HQ (to analyse nutrient using ICP).

c. To mark the recording palms and select frond 17.

d. Foliar : To select 7 – 9 palms / composite sample / rep

e. Rachis : To select 3 palms / composite samples / rep at Part b (See figure below).

vi. **Frond characteristics**

a. To collect during (in April or May) and after El Niño phenomenon (in June or July).

b. To mark the recording palms and select frond 33 (if not available, select nearby frond).

c. To select 7 – 9 palms / composite samples / rep

i) **Vegetative measurement**

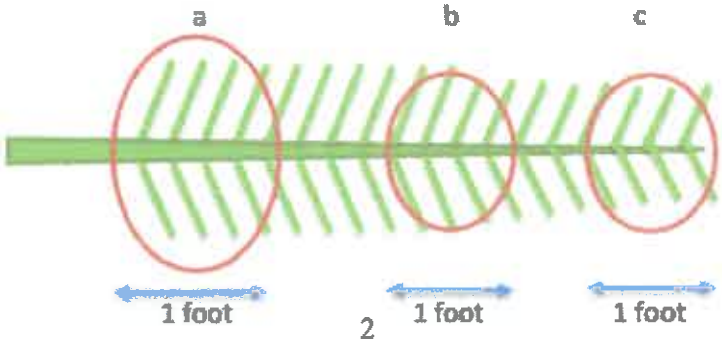
- To conduct VM on frond 33

ii) **Frond fresh weight**

- To weight frond 33's fresh weight

iii) **Frond moisture content (%)**

- To select 1 palm / composite sample / rep
- To include frond and rachis as one sample.
- To composite sample from 3 parts of frond (a + b + c), e.g.:-



Expected Outcome:

1. Identify factors that caused the PS incidence of oil palm.
2. Recommendation on GAP (fertilizer and water management) of oil palm in relation to overcome the PS incidences.

Project Timeframe: 2016 – 2017 (2 years)

Year	Period	Activity
2016	Jan-Mac	Literature review and research proposal.
	Apr-Jun	• Site selection and plotting. • Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic. • Sampling of soil fertility and soil moisture regime.
	Jul-Sep	• Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic.
	Oct-Dec	• Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic.
2017	Jan-Mac	• Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic.
	Apr-Jun	• Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic.
	Jul-Sep	• Census on PS incidence of the study area. • Sampling of leaf nutrient status and frond physical characteristic.
	Oct-Dec	Data analysis and writing final report.

Project

Investigations on the incidence of oil palm frond snapping (PS).

Collaborator:

1. Jaya Tiasa.

On-going Project

1. MPOB (Sessang, Sarawak; Lahad Datu, Sabah; Teluk Intan, Perak; Keratong, Pahang, Kluang, Johor and Ulu Paka, Terengganu.

Previous Study

- Reported serious incidences of PF in 1997/98 (after El Nino event).
- 2008, Ladang Dovenby (Sg. Siput, Perak) – 50% palms effect by PS with 2% crown collapsed. Foliar and rachis tissue analysis showed no strong evidence on palms nutrition factor.
- UP Bhd reported high PS incidences occurred in high N and low K plot (NK imbalance).

Ladang Dovenby, Sg. Siput, Perak - 2008

Research Approach

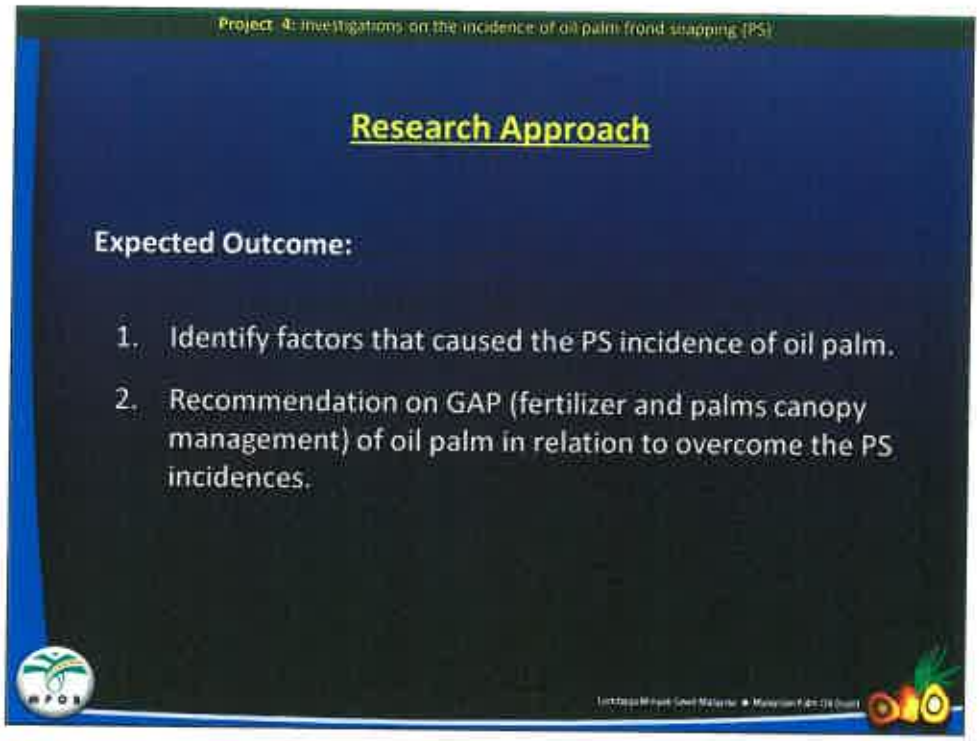
- **Strategy 1:**
  - Carry out census on PS incidences at the study area.
  - Carry out sampling on foliar and rachis of the healthy and PS effected palms.
- **Strategy 2:**
  - Carry out census on PS incidence status during and after El Nino event at the study area.
  - Carry out sampling on leaf, rachis and soil during and after El Nino event.

Project 4: Investigations on the incidence of oil palm frond snapping (PS)

Research Approach

Parameter Measurement:

1. Rainfall data and rainwater sample
2. Leaf and rachis nutrients concentration status - N, P, K, Mg, Ca, Si, Zn, Cu, B, Fe and Mn.
3. Frond characteristics – length, weight, moisture and petiole size.
4. Soil (physical, fertility and moisture).
5. Census on PS incidences.


Project 4: Investigations on the incidence of oil palm frond snapping (PS)
Research Approach
Expected Outcome:
1. Identify factors that caused the PS incidence of oil palm.
2. Recommendation on GAP (fertilizer and palms canopy management) of oil palm in relation to overcome the PS incidences.

APPENDIX 5

PROPOSAL AND SOP ON COUNTING OF FRUIT SETS AND CENSUS TO DETERMINE THE POPULATION OF POLLINATING WEEVIL

RESEARCH PROPOSAL

1. PROGRAM	:	**Understanding population dynamic and factors affecting performance and genetic viariation of pollinating weevil *Elaeidobius kamerunicus* in Malaysia**
2. LEADER	:	MPOB
3. COLABORATORS	:	Members of SOPPOA Members of MEOA Members of SOPB Members of MPOA Universities (UKM, UNIMAS) Other related agencies
4. DURATION	:	5 years (June 2016 to June 2021)

5. INTRODUCTION

The production of fruit bunches in the oil palm is influenced by several factors, and one of the main factor was caused by the activity of pollinating insects. Pollination by two indigenous pollinating insects found in Malaysia, the *Thrips hawaiiensis* and *Pyroderces sp.* is found not sufficient to increase yield. Even by the introduction of hand assitsed pollination, which is labour-intensive and costly, the production of fruit bunches is still substaintialy improved. To overcome this problem, an Afican pollinating weevil, the *Elaeidobius kamerunicus* was then imported from Cameroon into Malaysia in 1981. Two years after the introduction, the levels of fruit set were improved to about 20%-30% in Peninsular Malaysia and 53% in Sabah, thus contributing to high production of fresh fruit bunches in nationwide.

After years of high yield, there have been reports on poor fruit set, low population of weevil, and low OER in 1996, and recurrence of poor fruit set was again reports in 2015, especially in Sarawak. Factors affecting fruit set or pollinating weevil included climate (high rainfall, natural enemies such as pathogen (nematodes), infectation of pests such as rats and bunch moths, over usage of chemical insecticides, pollen viability due to boron deficiency, planting of high yielding planting materials with high sex ratio and less attractive new planting materials. These factors need to be properly quantified by multivariate analysis to determine the correlation between these factors with the fruit sets. Study should be carried out in various sites in Peninsular Malaysia, Sabah and Sarawak.

Other factors that possibly affecting the weevil population is the level of estragole, a natural volatile organic compound emited by the female inflorescences. Palm planted in different soil types might produce different level of estragole in which will affecting the

behaviour of the weevil. The agrasiveness of the pollinating weevil can be determined by conducting at the life table study. The study should be conducted in different planting material, fertilizer application, climate condition and management practices. After 35 years in Malaysia, the possibility changes on morphological and behavioural traits of *E. kamerunicus* need also to be studied. Therefore, with the available of advanced molecular techniques, the genetic variation among weevil population in Malaysia can be investigated.

6. OBJECTIVE

1. To update on the effective role of pollinating weevil, *E. kamerunicus* in oil palm pollination based on database of key parameters to measure their performance.

2. To ascertain factors affecting low weevil population and poor fruit set and find effective solutions to resolve the problems.

3. To develop database on association of genetic variation and behavior of pollinating weevil in various plantations.

6. EXPECTED BENEFIT

Comprehensive understanding on effective role of pollinating weevil, factors affecting the population, and on variation of genetic and behavior of *E. kamerunicus*, thus helping industry for better management of oil palm plantation in various sites in Malaysia

7. METHODOLOGY

7.1 Project 1 - Study on correlation between factors affecting fruit set and weevil population

Project leader	:	MPOB
Collaborators	:	Members of SOPPOA
		Members of SOPB
		Members of MPOA
		Members of MEOA
Project Duration	:	5 Years (Jun 2016 to Jun 2021)

Site selection

The study is preferably will be conducted in young palms at age below than 5 years old with low and high fruit set and having the following cases.

1. High and low rainfall
2. High malformed bunches due to poor pollination
3. High infestation of bunch moth and rats
4. Planting density – Standard DxP, high yielding planting materials and clones

5. Mineral or peat soil in the coastal or inland regions
6. High and low boron deficiency areas
7. Planting density - standard 150 palms/ha, high density >160 palms/ha

Size of experimental block of field

Preferable size of the experimental block or field is more than 10 hectares. The total numbers of palms required in sampling for measurement of key parameters are at least 150 palms in each experimental block.

Key parameters and frequency of recording

The key parameters will be recorded at least a week before commencement of experiment. The post data recording will me measure based on individual parameters as follows.

1. Volume of rainfall (monthly)
   Note : The automated rain gauge should be placed in the selected experimental site in the plantation, not at the management office.
2. Weevil population - numbers of weevil/male spikelet (monthly)
3. Numbers of male and female inflorescences to get sex ratio (monthly)
4. Pollen viability (monthly)
5. Infestation of nematodes on adults (monthly)
6. Infestation or population of insect pests and rats (every 3 months)
7. Bunch component analysis including fruit set count (every 3-4 months)
8. Numbers of malformed bunches (every 3 months)
9. Numbers of newly emerged weevil/male spikelet (every 3 months)
10. Samples of pupae (for genetic variation study)

7.2 Project 2 - Life table of pollinating weevil, *E. kamerunicus*

Project leader	:	MPOB & UKM / UNIMAS
Collaborators	:	Members of SOPPOA
		Members of SOPB
		Members of MPOA
		Members of MEOA
Project Duration	:	2 Years (Jun 2016 to Jun 2018)

Site selection

The study is preferably will be conducted in young palms at age below than 5 years old in various plantation in Peninsular Malaysia, Sabah and Sarawak. The study sites with following cases will be selected.

1. Low and high fruit set.
2. Different climate condtion (low & high rainfall, dry areas)
3. Planting materials – DxP, High yielding planting materials or clones
4. Different soil types & management practices.

Key parameters and frequency of recording

1. Meteorological data such as rainfall, temperature and humidity (annual)

2. The life-cycle analysis parameters as method of Tuo *et al.*, 2011.
   Collection of eggs
   Eggs will be sampled from florets of spikelets of post-anthesised male inflorescences collected from the experimental plots. The placement of eggs in florets is characterized by traces of tissues made by the female to cover the eggs. The eggs with the florets will then be–transferred into a breeding tube and observed under a dissecting microscope till hatching.
   Hatched larvae
   The number of hatched larvae will be counted using a dissection microscope. The hatching rate (Te) will be estimated by the formula Te=100× (number of larva/ number of eggs)
   Developmental cycle
   The development cycle of each stages will be obtained by determining the duration of different stages of the insect development. The duration of each developmental stage will be monitored at least from 150 eggs.

   Egg stage to larva LI
   Larva L1 to larva L2
   Larvae L2 to larva stage 2
   Larvae L3 - larva nymph
   Nymph to adult

   Lifespan of adult
   The lifespan of adult *E. kamerunicus* will be evaluated in the laboratory environment at 27° C and 75 RH. The pollinators will be introduced into a tube of breeding with an anthesis spikelet which is used as food. The spikelets will be replaced by new ones every alternate day until the death of insects. The average life span was then determined.

7.3 Project 3 - Genetic variation of pollinating weevil in Malaysia

Project leader	:	MPOB & UKM / UNIMAS
Collaborators	:	Members of SOPPOA
		Members of SOPB
		Members of MPOA
		Members of MEOA
Project Duration	:	2 Years (Jun 2016 to Jun 2018)

Sampling of pupae of *E. Kamerunicus*

Samples of pupae of pollinating weevil will be collected from the experimental sites that involved in the Project 1 and Project 2. Pupae were samples (20-30 pupae) from post anthesised male inflorescences and placed inside an 1.5ml microtube containing fixative. The samples were then bring to laboratory for genomic DNA extraction and analysis of DNA using currect methods

Extraction of genomic DNA

The DNA of pollinating weevil will be individually extracted from the pupae of the *E. kamerunicus*. The DNA will be then diluted in TE buffer and analysed using RAPD-PCR or sequencing of ITS regions

Analysis of DNA

The DNA will be then analysed using RAPD performed using ten primers (Operon Technologies, Alameda, CA, USA) primers: A01 (CAGGCCCTTC), A09 (GGGTAACGCC), A16 (AGCCAGCGAA), A17 (GACCGCTTGT), B01 (GTTTCGCTCC), B05 (TGCGCCCTTC), C09 (CTCACCGTCC), C15(GACGGATCAG), F03 (CCTGATCACC) and G13 (CTCTCCGCCA) following method of Sosa-Gómez et al., (2008). The DNA amplification will be performed at 45 cycles of 94^{0}C for 15 s, 39^{0}C for 30 s and 72^{0}C for 1 min with a final extension of 72^{0}C for 7 min. The PCR amplification products were electrophoresed in 1.3% agarose gel with ethidium bromide, at 120 V, for 2.5 h in TBE buffer.

8. TIMEFRAME

Table 1: Timeframe of the project involved in the research program

Year / Quarter	2016				2017				2018				2019				2020				2021			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project 1 - Study on correlation between factors affecting fruit set and weevil population					→																			
Project 2 - Life table of pollinating weevil, *E. kamerunicus*									→															
Project 3 - Genetic variation of pollinating weevil in Malaysia									→															

9. EXPECTED EXPENDITURE

Table 2: Expected expenditure for the program Understanding population dynamic and factors affecting performance and genetic viariation of pollinating weevil *E. kamerunicus* in Malaysia

Item	Year 1 (RM)	Year 2 (RM)	Year 3 (RM)	Year 4 (RM)	Year 5 (RM)	Total (RM)
Assest *	70,000	0	0	0	0	70,000
Service & Supply	50,000	110,000	30,000	30,000	30,000	250,000
Total	120,000	110,000	30,000	30,000	30,000	320,000

*Assets

Automatic rain gauge (10 units x 5k), microscope (2 units x 20k), Desktop Computer (1 unit x 4k), electrophoresis set (1-10k)

STANDARD OPERATING PROCEDURE (SOP) FOR COUNTING OF FRUIT SET

INTRODUCTION

The efficiency of pollination can be determined based on fruit set and it affect the production bunches and weight of bunches. There are significant correlations between bunch weight with fruit set and fruit to bunch ratio (Wong and Hardon, 1971; Mohd Haniff and Mohd Roslan, 2002). Fruit set should be determined on bunches at age between 5 to 6 months old. Prasetyo (2012) reported that the reduction of oil palm productivity are closely related to poor fruit set. Development of malformed and 'thorny' bunches led to decreasing number of fertile fruitlets. These problems are usually experienced in a newly opened oil palm plantation. It was also reported that new generation palms with high sex ratio also contributes toward poor fruit set, where the availability of male inflorescence and pollen was greatly reduced.

Fruit set count and other bunch components analysis serves as great tool for the estate and agronomists to generally measure the yield performance of their palms. By knowing these valuable information, decision on several important matters such as necessity for assisted.

By conducting fruit set count and bunch components analysis, estate will be able to measure the relationship between sex ratio and pollinating weevil population on yield performance of the palm. When poor fruit set and malformed bunches problem is experienced by the estate, the management can utilize the knowledge to facilitate in decision making related to relevant corrective actions.

METHODOLOGY

Fruit set counting

1. Fruit set count should be preferably conducted on monthly basis, or once in every three months.
2. Select and harvest 15 bunches from marked palms, which were used as in the weevil population census and flower census. Avoid harvesting the rotten bunches due to pests (bunch moth or rat) or disease infestation.
3. Bunches selected for fruit set count should be full ripening.
4. Weigh the harvested fruit bunches. Bunches more than 3kg will divided into two parts; Part 1 is for fruit set counting and Part 2 will be discarded. Bunches less than 3kg, all fruits will be used for fruit set counts.
5. The bunch will be then chopped to facilitate counting.
6. Weigh the bunch stalk.
7. Randomly divided the spikelets into two similar portions. The numbers of unused fruit spikelet should also be recorded in the form.
8. Count and record the numbers of fertile and parthenocarpic fruits into the form as in the appendix.

Appendix

Table 1. Example form used for fruit set counting

State	: Ladang Hgan (block 501)	Date Sampling	:
D.Haversting	10/09/2014	S.Anthesis	:
Palm no	:	Serial No.	:

Fertile Fruit					Parthernocarpic Fruit				
3	3	0	0	0	4	1	10	9	12
7	0	0	0	1	6	9	3	8	4
0	1	0	0	0	9	7	4	8	7
4	1	0	0		2	6	8	7	
0	0	0	0		9	8	9	9	
3	0	1	2		5	9	5	1	
3	1	0	0		4	5	8	7	
0	0	2	0		8	10	1	9	
1	0	0	1		4	11	8	6	
2	0	0	0		1	8	5	7	
0	0	0	0		10	7	6	4	
0	0	0	0		5	9	9	7	
1	3	0	0		2	0	6	6	
1	0	0	0		7	11	7	9	
0	1	0	0		3	8	3	5	
0	0	0	0		8	6	7	4	
6	3	0	0		0	0	8	9	
0	3	0	0		7	4	9	7	
4	2	0	0		2	5	3	7	
0	0	0	0		8	8	3	7	
1	2	1	0		7	8	4	9	
0	0	0	2		7	2	7	3	
3	0	0	0		5	7	9	8	
0	0	0	0		8	3	9	7	
2	0	0	0		4	7	8	9	

a b C **0.00** Kg

Weight of stalk : Weight of bunch :

Total Fertile Fruit: 347
Total Parthenocarpic Fruit: 686
Total Fruit: 1033
Fruit set: (347/1033) x 100%: 33.59%

Figure 1. Estimation of fruit set in the field

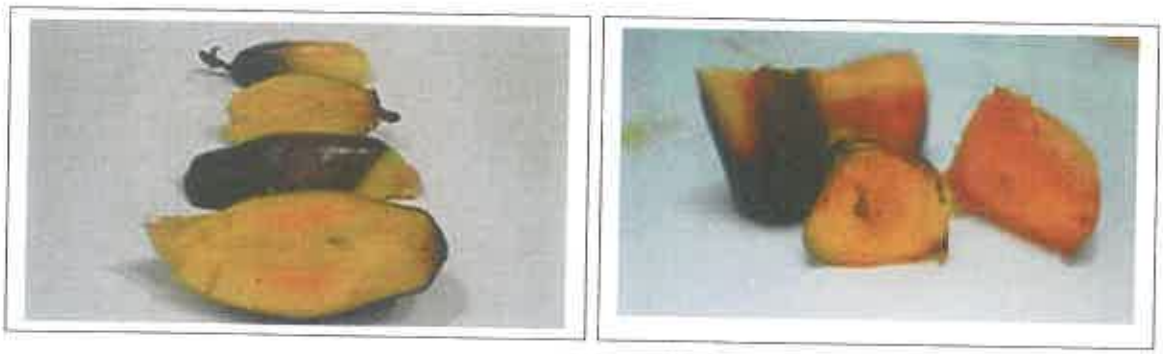


Figure 2. Parthenocarpic fruits (formation of fruit without shell)

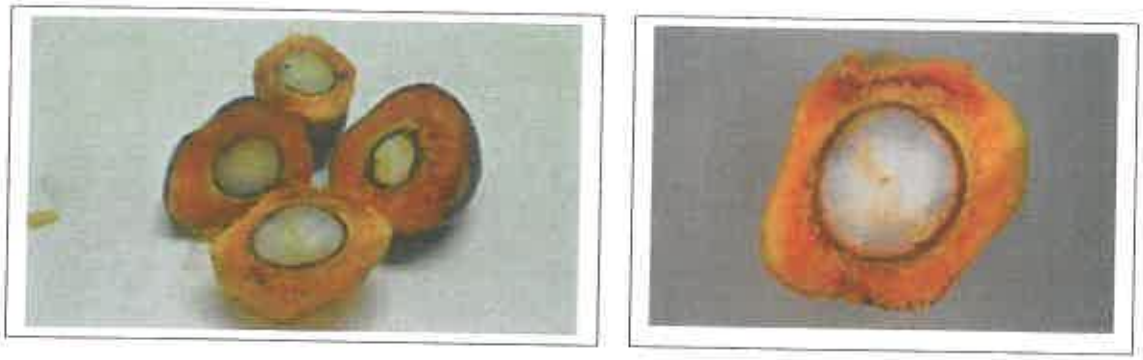


Figure 3. Fertile fruits (formation of fruit with shell)

STANDARD OPERATING PROCEDURE (SOP) FOR CENSUS OF POLLINATING WEEVIL *Elaeidobius kamerunicus*

INTRODUCTION

Prior the introduction of pollinating weevil, *Elaeidobius kamerunicus* in oil palm estates in Malaysia in 1981 (Syed et al.,1982), pollination were mainly by *Thrips hawaiiensis* (Syed, 1979). However, the population of this insect species was low in young planting areas, thus required assisted pollination to get satisfactory yield production. However, the this method is costly and labour-intensive. To overcome the problem, the African pollinating weevil *E. kamerunicus* was imported from Cameroon and introduced in Malaysia. The introduction of pollinating weevil leads to increase on fruit set, mean bunch weight and later yields.

It was shown that the oil palm yield increased immediately after the introduction of the pollinating weevil (Khalid Ibrahim, 1996). Declining in yield performance especially in central Sarawak has raised concerns about the pollinating ability of this beneficial insect. It was even worse by the increasing usage of chemical insecticides such as cypermethrin to control pest such as oil palm bunch moth. The excessive usage of such chemicals adversely affecting the population of pollinating weevil. Hence, it is very important to monitor the population of pollinating weevil especially in estates with low fruit set.

Donough et al (1996a) estimated that 20,000 weevils/ha was sufficient to ensure reasonable fruit set. Some studies used population available per female inflorescence to estimate weevil population. Syed and Saleh (1988) considered that if the weevil population was less than 700 per female inflorescence, fruit set might be inadequate.

Monitoring the population of pollinating weevil in the oil palm estates is important for management to determine the possible factors that cause poor fruit set in their respective estates.

METHODOLOGY

The common method to estimate the weevil population is by collecting samples of spikelets from male inflorescence in early morning whiles the weevils still inactive. The population per hectare can be estimated from the number of weevils per spikelet, number of spikelet per inflorescence and number of inflorescence per hectare.

Site selection

The experimental sites are preferably selected in areas with poor fruit set and large cases on malformed bunches due to poorly pollinated female inflorescence.

Frequency of population census

Varies from monthly basis to once in three months.

Number of palms covered in the experimental areas

150 palms per 10 hectare of experimental site (varies according to individual planting density)

Census of Inflorescences

1. A total of 150 palms were selected from an area of 10 hectare.
2. The selected palms were marked and numbered using waterproof label or paint.
3. One (1) palm was marked for every 10 palms. Selected palms must be producing both types of inflorescences and are also well-maintained.
4. Each selected palms were checked for the following:
   a. Stages of male inflorescence (refer to the accompanying diagram)
      i. ¼ of the spikelet anthesising
      ii. ½ of the spikelet anthesising
      iii. ¾ of the spikelet anthesising
      iv. FULL anthesising stage, emitting unique smell

   b. Stages of female inflorescence (refer to the accompanying diagram)
      i. Pre-anthesis - white buds visible on the tips of individual female inflorescence spikelets
      ii. At-anthesis- white small flower blossoming at the tips of individual female inflorescence, emitting unique smell
      iii. Post-anthesis – the white flowers turn purplish/brown in colour, indicating pollinated inflorescence

   The numbers of each stages of inflorescence were recorded into a specifically formatted census form. Refer to detailed examples given.

Figure 1: Male inflorescence with ¼ anthesising

Figure 2: Male inflorescence with ½ anthesising

Figure 3: Male inflorescence with full anthesising

Figure 4: Female inflorescence at pre- anthesis

Figure 5: Female inflorescence at anthesis

Figure 6: Female inflorescence at post anthesis

Male inflorescence spikelet and pollinating weevil sampling

1. Preferably, the pollinating weevils should be sampled from full anthesising male inflorescences. This to ensure more accurate estimation on population.
2. For every sampling date, male inflorescence spikelet should be sampled from at least 10 anthesising inflorescences (for 10 ha of study location).
3. The male inflorescences should be sampled from marked palms that were also used for flower census. However, in case of no anthesising inflorescence on marked palms, sample of inflorescences can be collected from the nearby marked palms.
4. Collect 9 spikelets (3 spikelet each from top, middle and bottom region of the inflorescence) from each anthesising male inflorescences. Spikelets should be kept in airtight plastic such as plastic bags for ice-popsicles. Spikelet should carefully cut to reduce the number of weevils escaping during the sampling.
5. Count the total number of spikelet in each sampled inflorescences.
6. The spikelet were left over for at least 12 hours until all the weevils dead to facilitate counting process.
7. Measure the length of sampled spikelet during the weevil counting process.

Emergence of pollinating from the spikelets

1. Collect 10 post-anthesising male inflorescences, preferably from marked palms. From each inflorescence, cut 9 spikelets (3 spikelet each from top, middle and bottom region of the inflorescence).
2. Record the sampling date, trial number and any related information and label the samples properly (i.e. Location of sampling, spikelet position).
3. Place the spikelet individually in a conical flask (or any closed container). Use muslin to cover the top of the flask.
4. Record the numbers of emerged adult on daily basis. If possible, the numbers of emerged adult weevils were sorted according to sex.
5. The observation and recording should be continued until no emergence of adult from the samples was found. Time taken for adult weevil to emerge from the spikelets are depending on the number of larvae per spikelet.

Table 1: Form for flower census

Borang: SE-01

STESEN PENYELIDIKAN MPOB SESSANG, SARAWAK

TRIAL: Weevil Population Study In Sabah And Sarawak (Ladang Kenyalang Blok 40)

FLOWER CENSUS

ESTATE : **DATE :**

Palm No.	Stage of Anthesis Inforescence							Palm No.	Stage of Anthesis Inforescence						
	MALE				FEMALE				MALE				FEMALE		
	1/4	1/2	3/4	FULL	PRE	AT	POST		1/4	1/2	3/4	FULL	PRE	AT	POST
1								76							
2								77							
3								78							
4								79							
5								80							
6								81							
7								82							
8								83							
9								84							
10								85							
11								86							
12								87							
13								88							
14								89							
15								90							
16								91							
17								92							
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20								95							
21								96							
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24								99							
25								100							
26								101							
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42								117							
43								118							
44								119							
45								120							

46								121									
47								122									
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53								128									
54								129									
55								130									
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60								135									
61								136									
62								137									
63								138									
64								139									
65								140									
66								141									
67								142									
68								143									
69								144									
70								145									
71								146									
72								147									
73								148									
74								149									
75								150									

Table 2. The example of recording population of weevil

TRIAL: Weevil Population Study in Sabah And Sarawak (Ladang Kenyalang)
WEEVIL POPULATION CENSUS AT MALE INFLORESCENE

MONTH :

Palm No.	Total No. Of Spikelet	Length Of Spikelet			Stage Of Anthesis				No. Of Weevil
		Position	No.	cm	1/4	1/2	3/4	FULL	
116	77	TOP	1	8.5		✓			10
			2	8.5		✓			15
			3	9.4		✓			17
		MIDDLE	1	14.7		✓			12
			2	12.9		✓			15
			3	14.6		✓			13
		BOTTOM	1	13.1		✓			11
			2	13.6		✓			15
			3	14.0		✓			15
119	128	TOP	1	17.2				✓	63
			2	14.5				✓	80
			3	17.5				✓	90
		MIDDLE	1	17.7				✓	45
			2	17.0				✓	43
			3	16.6				✓	37
		BOTTOM	1	17.7				✓	29
			2	16.0				✓	35
			3	19.5				✓	40
			1	15.6	✓				3

Figure 7: Post-anthesised inflorescence for weevil emergence count

Table 3. The example of recording the emergence of adults from spikelet

ADULT EMERGENCE (LADANG MPOB FASA 6)

Tarikh diambil	Info no.	Tarikh keluar	SPK.	Male	Female
07.03.2013	Pokok 1	13.03.2013	T1	1	18
			T2	2	13
			T3	1	26
			M1	6	21
			M2	5	18
			M3	3	13
			B1	2	26
			B2	1	18
			B3	1	13
			JUMLAH	22	166
07.03.2013	Pokok 1	14.03.2013	T1	8	41
			T2	4	29
			T3	3	31
			M1	5	28
			M2	3	26
			M3	3	27
			B1	5	33
			B2	2	25
			B3	1	45
			JUMLAH	34	290

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STANDARD OPERATING PROCEDURE FOR ASSISTED POLLINATION
(Manual/Hatch & Carry)

INTRODUCTION

Manual assisted pollination has been used as a main pollinating method prior importation of pollinating weevil, *Elaeidobius kamerunicus* from Cameroon in 1981 (Syed et al.,1982). It was reported that oil palm yield increased immediately after the introduction of *E. kamerunicus* (Khalid Ibrahim, 1996). However, recently report by the industries on low fruit set and high number of malformed bunches have increased, thus rising of concerns on the role and ability of pollinating weevil of *E. kamerunicus* in oil palm.

There are two methods of assisted pollination can be practiced in the badly affected areas. The manual and hatch and carry methods. Prasetyo & Susanto (2012) suggested that assisted pollination should be done in area where the fruit set is low, less than 25%, low availability of anthesising male inflorescence available in the area (less than 2 flower/ha) and low population of pollinating weevil (less than 10,000/ha). Manual assisted pollination required each anthesising female inflorescence to be puffed with pollens collected from anthesising male inflorescence, preferably with high viability of above 60%. This method need to ensure that the pollens reached every parts of the anthesising female flower. This method, however, is labour-intensive and only practical in the young palm areas. Mohd Haniff & Mohd Roslan (2002) also reported difficulties in hand-applied pollens to reach the inner parts of the female flower.

Hatch and carry techniques were reported could increase the population of pollinating weevil, especially in newly developed plantations. It was also recommended that these methods can be practiced in areas with low fruit set and high sex ratio. This technique have proven effective to increase the fruit set level up to 30% in several estates in Indonesia (Prasetyo et al., 2012b). Both of assisted pollination techniques were highly recommended for areas experiencing low fruit set and low population of pollinating weevil. Improved pollination can ensure proper fruitlet development, increasing the number of fertile fruitlets and thus increasing fruit set.

METHODOLOGY

Manual assisted pollination

Materials & apparatus required

1. Pollen (viability more than 60%)
2. Talcum (Preferably Baby Johnson-white)
3. Oven/Hot Room
4. Sieve (180µm)

5. Puffing bottle/empty distilled water bottle
6. Scateurs

Preparation of Pollen & Puffing Methods

1. Collect pollen from anthesising male inflorescence. The collection of pollen can be done by wrapping up the anthesising inflorescence with plastic bag and thoroughly shaken to extract the pollen.
2. Dry the pollen in the oven at 35-40°C for a period of 24 hours. The pollen can also be dried in a hot room at temperature 38-40°C for 24 hours.
3. Sieve the dried pollen through a sieve with pore size of 180µm to separate the pollen from the debris.
4. Conduct pollen viability test to ensure that the viability is more than 60%. If less, discard the existing pollen and conduct resampling of pollen again.
5. Mix 0.1g pollen with 2g of talcum and mix thoroughly.
6. Insert the pollen mixture into puffing bottle.
7. Identify receptive female inflorescences and remove thorns using scateurs/machete.
8. Puff the pollen mixture on anthesising female inflorescences
9. Mark the puffed inflorescences with waterproof label and observe the results in 4-6 months' time.

Hatch and Carry (semi-assisted pollination)

1. Collect post anthesis male inflorescences, preferably 4-5 days after anthesised.
2. The collected inflorescences should be laid on the floor for at least 1 day to remove other insects e.g. ants.
3. Place the post anthesised male inflorescence in a wooden box (measurement: 60cm H x 60cm W x 120cm L) covered with white muslin. The box should be located at least 40cm from the ground surface. The recommended density of the hatch & carry box is 1-3 box for every 25 hectares. However, this largely depends on the fruit set of the estate. Place 6-8 post anthesised male inflorescences in each box (one large compartment). For two compartment system, place 3-4 post anthesised male inflorescence for each compartment.
4. At 2 days after placement, adult weevils will emerge from the inflorescence. Once the adult weevil emerged, spray them with pollen (viability of >60%), specifically targeting the adult weevils.
5. Pollen spraying should be done early in the morning, preferably at 7am. Spray 1g of pollen for each box.
6. Release the sprayed adult pollinating weevils by opening the cover of the box. The box should be closed after 1-2 hours (estimated at 9 am). Repeat on daily basis.

Appendix

Figure 1. A sieve 180 um mesh for preparation of pollen

Figure 2. The receptive female inflorescence

Figure 3. Remove thorns using secateurs to facilitate puffing of pollen

Figure 4. Puffing of pollen onto the receptive female inflorescences

Figure 5. Assisted pollinated fresh fruit bunch at 5-6 months after puffing

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APPENDIX 6

PROPOSAL AND PRESENTATION ON POOR FRUIT SET FORMATION

1. SOP on Counting Of Fruit Set And Flower Census To Determine Sex Ratio
2. Method on Determination Of Pollen Viability

Project Title:

Study on the poor fruit set formation of oil palm planted on peat soil in Sarawak.

Collaborator:

1. Ta Ann Plantation.
2. Sarawak Oil Palm Bhd (SOPB).
3. Jaya Tiasa.
4. Woodman Plantation.
5. Golden Star Ace.
6. Tabung Haji (TH) Plantation - on-going project.

Research Approach:

1. Carry out monthly fruit set count of the study block.
2. Carry out sampling and analysis on leaf nutrients concentration and soil fertility status of the study block.
3. Carry out flower census to determine the sex ratio of the study block.
4. Carry out monthly pollen viability test of the study block.
5. Recording rainfall data and ground water table.

Expected Outcome:

1. Evaluation of poor fruit set formation status of oil palm planted on peat soil in Sarawak.
2. Identify factors that caused the poor fruit set formation of oil palm planted on peat soil in Sarawak.
3. Recommendation on GAP (fertilizer and water management) of oil palm planted on peat soil in relation to minimize poor fruit set formation incidence.

Project Timeframe: 2016 – 2018 (3 years)

Year	Period	Activity
2016	Jan-Mac	Literature review and research proposal.
	Apr-Jun	• Site selection and plotting. • Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling of leaf nutrient status and soil fertility. • Measurement of ground water table (monthly).
	Jul-Sep	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Measurement of ground water table (monthly).
	Oct-Dec	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status. • Measurement of ground water table (monthly).
2017	Jan-Mac	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Measurement of ground water table (monthly).
	Apr-Jun	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status. • Measurement of ground water table (monthly).
	Jul-Sep	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Measurement of ground water table (monthly).
	Oct-Dec	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status. • Measurement of ground water table (monthly).
2018	Jan-Mac	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Measurement of ground water table (monthly).
	Apr-Jun	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status. • Measurement of ground water table (monthly).
	Jul-Sep	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Measurement of ground water table (monthly).
	Oct-Dec	Data analysis and writing final report.

Project Title:

Study on the poor fruit set formation of oil palm planted on mineral soil in Sarawak.

Collaborator:

1. SALCRA.

Research Approach:

1. Carry out monthly fruit set count of the study block.
2. Carry out sampling and analysis on leaf nutrients concentration and soil fertility status of the study block.
3. Carry out flower census to determine the sex ratio of the study block.
4. Carry out monthly pollen viability test of the study block.
5. Recording rainfall.

Expected Outcome:

1. Evaluation of poor fruit set formation status of oil palm planted on mineral soil in Sarawak.
2. Identify factors that caused the poor fruit set formation of oil palm planted on mineral soil in Sarawak.
3. Recommendation on GAP (fertilizer and water management) of oil palm planted on mineral soil in relation to minimize poor fruit set formation incidence.

Project Timeframe: 2016 – 2018 (3 years)

Year	Period	Activity
2016	Jan-Mac	Literature review and research proposal.
	Apr-Jun	• Site selection and plotting. • Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling of leaf nutrient status and soil fertility.
	Jul-Sep	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month).
	Oct-Dec	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status.
2017	Jan-Mac	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month).
	Apr-Jun	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status.
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	Oct-Dec	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status.
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	Apr-Jun	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month). • Sampling and analysis of leaf nutrient status.
	Jul-Sep	• Census/count of fruit set (100 bunches/month). • Flower census (3 month interval). • Pollen viability count (>20 male flowers/month).
	Oct-Dec	Data analysis and writing final report.

OIL PALM FRUIT SET COUNT

KAEDAH PENGAMBILAN SAMPEL TANDAN SAWIT SISTEM ' S '

PERALATAN YANG DIPERLUKAN

1. Timbang
2. Cat Putih
3. Berus cat 2 ½ inci
4. Sarung tangan
5. Kapak untuk chopping (nipis)
6. Marker pen
7. Plastik bag (Warna kuning)
8. Kertas lebal
9. Pisau atau gunting
10. Tray untuk menyimpan spikelet

KAEDAH MENGAMBIL SAMPEL

1. Timbang tandan yang masak

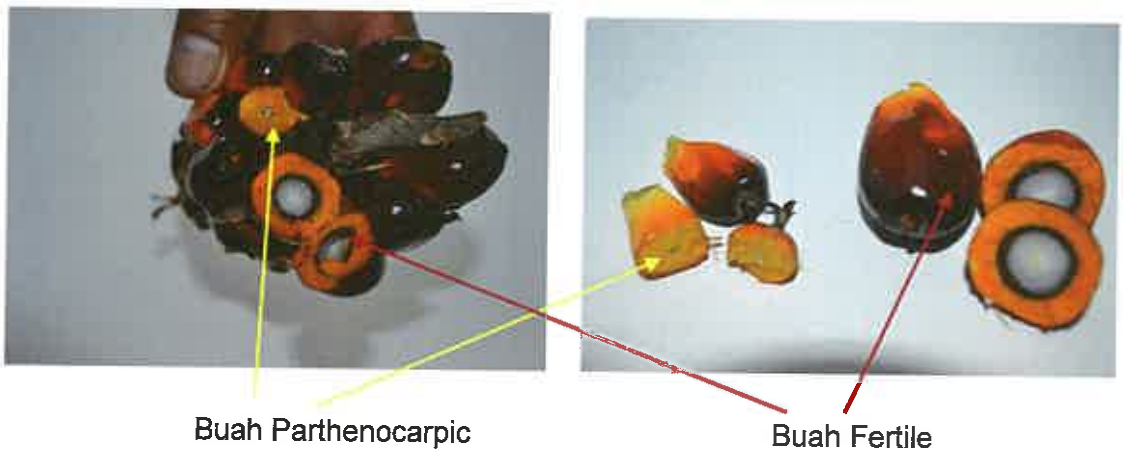
2. Cat pada duri spikelet dan biji bahagian atas tandan dengan sudut 60^0 dalam bentuk 's'. Tujuannya ialah untuk mendapatkan sampel spikelet bagi mewakili semua bahagian tandan.

3. Chopping tandan tersebut dengan menggunakan kapak untuk mengasingkan spikelet dengan tangkai tandan. Pastikan kerja melerai spikelet rapat pada tangkai tandan bagi mengurangkan kerosakan pada biji dan spikelet.

4. Timbang tangkai tandan yang telah dileraikan

5. Pilih spikelet yang terkena cat putih anggaran 30 spikelet kedalam plastik bag dan ditimbang serta di bawa ke makmal untuk proses seterusnya.

6. Di makmal, biji pada spikelet diasingkan antara biji fertile (ada isirong) dan biji parthenocarpic. Kemudian kira bilangan biji tersebut untuk mendapatkan peratus biji fertile dan parthenocarpic.



7. Kaedah ini boleh digunakan untuk proses analisa tandan seterusnya jika perlu.

BORANG ANALISA BILANGAN BIJI FERTILE & PARTHENOCARPI

BIL	TARIKH	NO POKOK	BERAT TANDAN (Kg)	BERAT TANGKAI (Kg)	BERAT SPIKELET (Kg)	BERAT FERTILE (Kg)	BERAT PARTHENO. (g)	BIL. BIJI FERTILE	P
1									
2									
3									
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20									

FLOWER CENSUS TO DETERMINE FRUIT SEX RATIO
KAEDAH MEMBUAT BANCIAN BUNGA SAWIT

Oleh : Mazli b. Eswa

1. Pengenalan

Pokok sawit adalah jenis tumbuhan *monoecious* dimana bunga jantan dan bunga betina pada pokok yang sama tetapi pada mayang (jambak bunga) dan pelepah berasingan. Terdapat juga mayang yang mempunyai dwijantina (*hermaphrodite)* dan ini biasa berlaku sewaktu perubahan kitaran jantina atau peringkat pokok muda. Mayang (jambak bunga) boleh didapati pada celah setiap pelepah kecuali jika mayang telah gugur.

Pokok dewasa (6 – 7 tahun ke atas) biasanya akan mengeluarkan sebanyak 2 pelepah sebulan dan pokok muda (kurang dari 6 tahun) sebanyak 3 pelepah sebulan.

2. Tujuan Bancian Bunga

- Untuk mengetahui nisbah bunga (*sex ratio)* dengan mengetahui jumlah pengeluaran bunga jantan (M), bunga betina (F), hermaphrodite dan bunga yang mengalami keguguran (arbotion) setahun.
- Untuk mengetahui jumlah pengeluaran pelepah baru setahun dan jumlah pelepah keseluruhan.
- Untuk membuat anggaran pengeluaran hasil tahunan dengan mengetahui jumlah bunga betina(F) atau tandan yang telah dituai (FC).

3. Kekerapan Bancian

- Bancian bunga dilakukan empat (4) kali setahun iaitu 3 bulan sekali setiap percubaan. Sebaiknya dilakukan selepas penuaian terakhir tiap bulan dan sebelum pusingan pertama bagi bulan berikutnya.

4. Keperluan Peralatan

- Peralatan untuk mengecat (Cat, Galah dan Berus)
- Klip Board
- Pen, pensil dan pemadam

- Borang bancian bunga diladang
- Borang bancian bunga utama (dipejabat)

5. Proses kerja

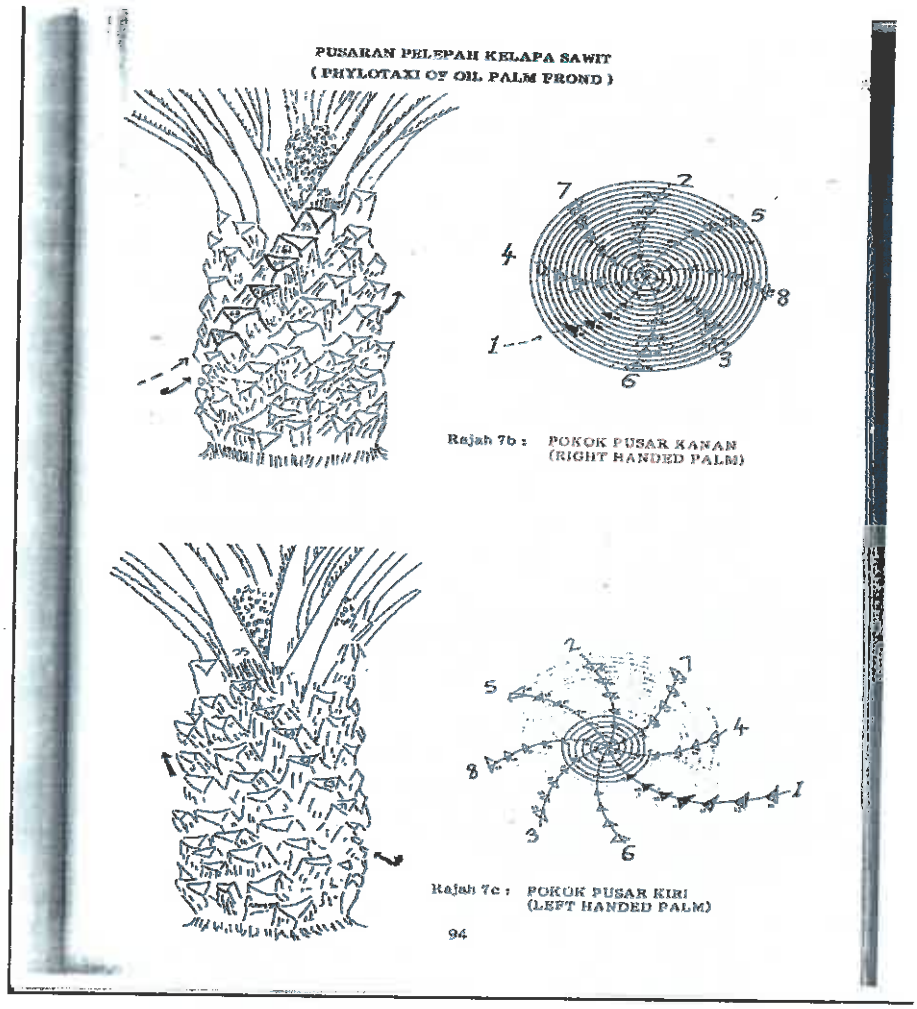
- Bancian hanya dilakukan pada pokok percubaan yang berekod sahaja
- Tentukan pelepah nombor 1 iaitu pelepah yang paling muda tapi telah jelas terbuka dimana hujung anak daun sudah tidak bercantum. (telah berkembang sepenuhnya)
- Cat pelepah tersebut, sebaiknya setiap kali bancian berlainan warna bagi memudahkan untuk mengetahuai bilangan pelepah baru dalam masa 3 bulan.
- Tentukan pusaran pelepah sawit terlebih dahulu samada pokok pusaran kanan atau pokok pusaran kiri untuk mengetahui arah pergerakan bancian. Sebagai contoh jika pokok pusaran kanan arah untuk membanci ialah ke kiri pokok dan begitulah sebaliknya.

Pokok Pusaran Kanan

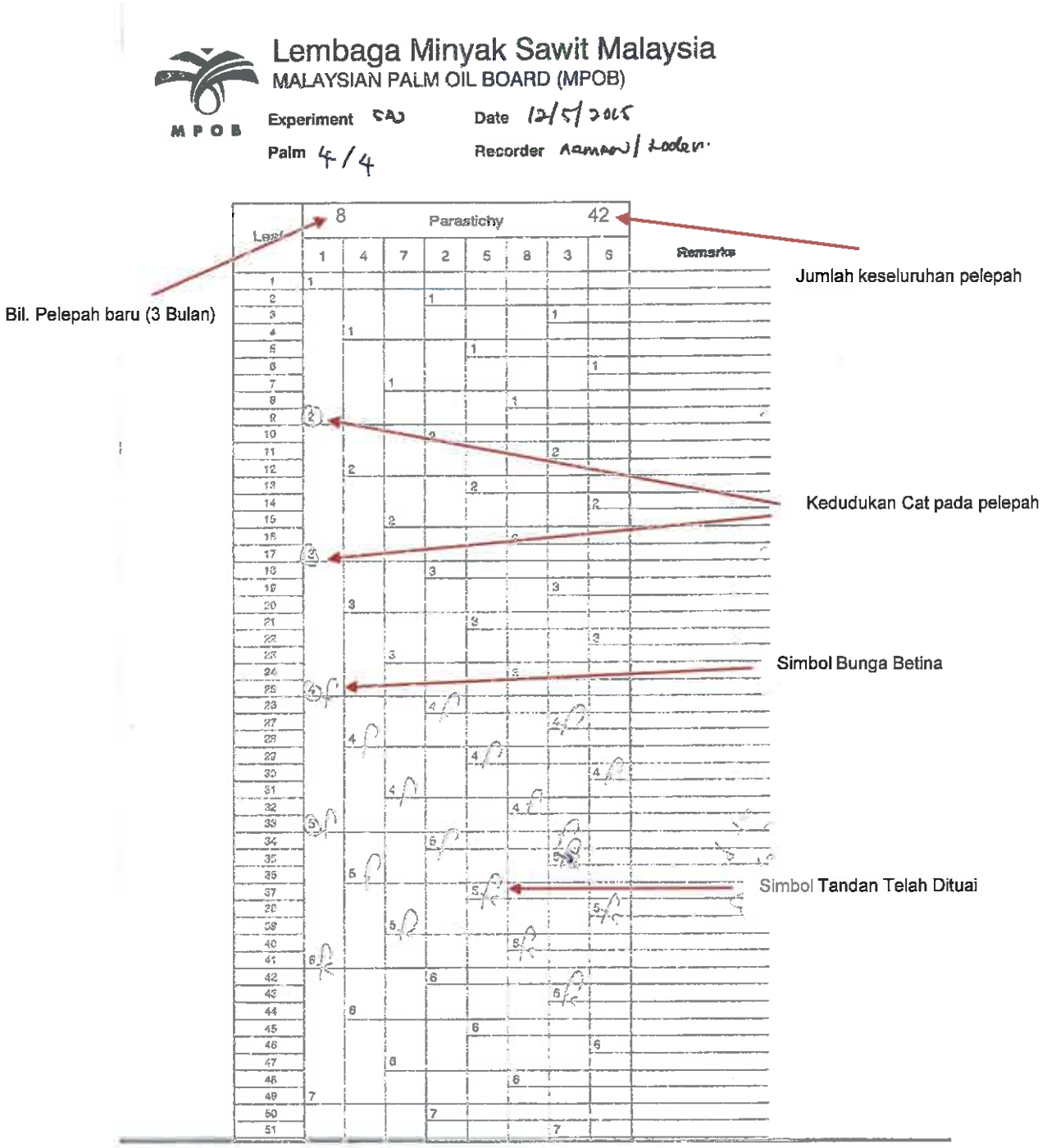
Pokok Pusaran Kiri

Kedudukan tandan menentukan pusaran pokok

PUSARAN PELEPAH DAN NOMBOR PELEPAH



- Catat maklumat penting dalam borang bancian iaitu percubaan, tarikh bancian, plot dan nombor serta nama pembanci
- Daripada pelepah pusaran pertama hingga pusaran ke lapan (setiap pokok ada lapan pusaran) tandakan semua jambak bunga yang ada pada pelepah dan pastikan di kedudukan yang betul dengan menggunakan simbol yang telah ditetapkan kedalam borang bancian.
- Tandakan kedudukan pelepah yang bercat dengan menggunakan simbol yang tetapkan (1 tahun sepatutnya ada 4 pelepah yang bercat)



- Selepas kerja bancian borang hendaklah disusun mengikut plot dan nombor pokok seterusnya dibawa kepejabat untuk kemasukan data ke dalam borang khas.
- Setiap set borang bancian yang telah dibuat kemasukan data hendaklah disatukan dan ditanda pusingan dan tarikh bancian untuk rujukan jika ada masalah akan datang.

- Keperluan tenaga kerja ialah 1 orang untuk mengecat pelepah nombor 1 (mahir) dan 2 orang satu kumpulan bancian (seorang membanci dan seorang mencatat pada borang bancian)

6. Simbol atau Kod Bancian pada Borang

INF	:	Jambak bunga yang belum dikenali jantina (dalam seludang)
FA	:	Bunga betina diperingkat mengorak
MA	:	Bunga jantan diperingkat mengorak
HA	:	Bunga Hermaphrodite diperingkat mengorak
F	:	Bunga betina selepas mengorak
M	:	Bunga jantan selepas mengorak
HA	:	Bunga Hermaphrodite selepas mengorak
FC	:	Buah yang telah dituai
FR	:	Buah yang telah busuk (tidak dituai)
I	:	Tiada jambak bunga (arbotion)
O	:	Tanda pelepah yang ada cat

INF- Jambak bunga belum diketahui jantina

Bunga jantan (M)

Bunga betina mengorak (FA)

Hermaphrodite

Bunga jantan mengorak (MA)

Bunga betina

Tandan Hermaphrodite

Bunga Jantan telah layu

Tandan hitam (F)

Bunga jantan telah gugur

Bekas tandan telah dituai

MPOB-SOPPOA RESEARCH COLLABORATION TRAINING ON STANDARD OPERATING PROCEDURE
9-12 May 2016
Saratok-Sibu, Sarawak

Study on the poor fruit set formation of oil palm

Pollen Viability Test

Nur Zuhaili Harris Abidin Zainal Abidin

Lembaga Minyak Sawit Malaysia • Malaysian Palm Oil Board

METHODS

- Pollen Viability (%)
- Pollen viability test
- Stock solution preparation
- Pollen processing in laboratory
- Pollen collection in field

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POLLEN COLLECTION IN FIELD

Research type	No of inflorescence	Replicates
Monitoring	10 - 20 male inf./ month / monitor plot (Approximately 10 – 15 ha/ monitor plot)	5 – 7 reps/plot
Special treatment*	Sample from each recording palm	Min 5 reps

* Special treatment such as fertilizer treatment, planting material etc.

Most pollen grains shed in first 2 days after anthesis & ceases within 5 days.

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POLLEN COLLECTION IN FIELD

Step 1: Harvest pollen from anthesised male inflorescence

9 Spikelets were cut and place in an envelope/bag *(as 1 composite sample)*

Upper part: 3 Spikelets

Centre part: 3 Spikelets

Lower part: 3 Spikelets

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POLLEN PROCESSING IN LABORATORY

Step 2: Pollen drying process

- Drying process: Pollen is kept in oven at 40˚C for 24 to 36 hours : *to reduce the moisture content down to 5 – 6%.*

Step 3: Pollen segregation process

i) Gently tapped or shake the spikelets in the envelope/bag : *to release pollen from the spikelet.*

POLLEN PROCESSING IN LABORATORY

ii. Pour the pollen grains into the sieve (150 µm): *to segregate impurities and insects.*

POLLEN PROCESSING IN LABORATORY

Step 4: Pollen storage

- Pollen grains were placed in air-tight screw cap glass vials.
- The pollen grains were kept in freezer (-5˚C) for prolonged preservation up to 1 year.

POLLEN VIABILITY TEST

Step 1: Prepare stock solution

Step 2: Prepare the equipment

POLLEN VIABILITY TEST

Step 3: Shake the vial that contains pollen.

Step 4: By using pipette, drop the sucrose solution into the petri dish until fully covered the base of the dish

Step 5: By using spatula, take very small amount of pollen from the vial and place into the petri dish containing solution.

Step 6: The sample was leave under ambient temperature for about 2 – 3 hours.

POLLEN VIABILITY TEST

Step 7: By using pipette, drop 4 drops of the solution (*as replicates*) contains pollen samples on the glass slide and cover with glass cover slip

Step 8: By using microscope, count the number of active and dead pollen.

Step 9: Record the counted pollen in the pollen score paper

POLLEN VIABILITY TEST

Method to count pollen

POLLEN VIABILITY TEST

Pollen score card

APPENDIX 7

PRESENTATION ON HEAVY LIMING APPLICATION OF OIL PALM ON PEAT

Project Title:

Observation on the heavy liming (60 t/ha limestone chip) application of oil palm on peat.

Collaborator:

1. Woodman Plantation.
2. Tradewinds Plantation – on-going project

Research Approach:

1. Carry out monthly soil pH monitoring.
2. Carry out sampling and analysis on leaf nutrients concentration and soil fertility status of the study block.

Expected Outcome:

1. Evaluation of the heavy liming practice on improving soil pH.
2. Evaluation of the heavy liming practice on soil nutrients uptake efficiency (especially K and Mg) of oil palm on peat.
3. Evaluation of the heavy liming practice on minimise premature frond desiccation incidence.
4. Recommendation on GAP (liming practice) of oil palm planted on peat soil.

Project Timeframe: 2016 – 2017 (2 years)

Year	Period	Activity
2016	Jan-Mac	Literature review and research proposal.
	Apr-Jun	• Site selection and plotting. • Sampling of leaf nutrient status and soil fertility. • Census on premature frond desiccation incidence.
	Jul-Sep	• Sampling of leaf nutrient status (3 month interval). • Soil pH measurement (monthly). • Census on premature frond desiccation incidence.
	Oct-Dec	• Sampling of leaf nutrient status (3 month interval). • Soil pH measurement (monthly). • Census on premature frond desiccation incidence.
2017	Jan-Mac	• Sampling of leaf nutrient status (3 month interval). • Soil pH measurement (monthly). • Census on premature frond desiccation incidence.
	Apr-Jun	• Sampling of leaf nutrient status (3 month interval). • Soil pH measurement (monthly). • Census on premature frond desiccation incidence.
	Jul-Sep	• Sampling of leaf nutrient status (3 month interval). • Soil pH measurement (monthly). • Census on premature frond desiccation incidence.
	Oct-Dec	• Data analysis and writing final report.

Project

Observation on the heavy liming (60 t/ha limestone chip) application of oil palm on peat

Collaborator:

1. Woodman Plantation
2. Tradewinds Plantation – on-going project

Previous Study

Effect of Liming on FFB Yield, Leaf Nutrient levels and Soil pH of Oil Plan on Peat (MPOB Research Station Sessang, Sarawak)

Liming Rate	FFB Yield (kg palm^{-1} year^{-1})	Leaf K (%)	Leaf Ca (%)	Soil pH
L0	144.9	0.876	0.561	3.84
L1	148.9	0.951	0.548	3.99
L2	142.1	0.899	0.500	3.95
Mean	145.3	0.942	0.570	8.23
LSD 0.05	9.67	0.051	0.054	0.23

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

FFB yield: 7-year mean Leaf & soil analysis: 10 years after treatment

L0: Without liming
L1: 2.5 kg LSD/palm (only during planting)
L2: 4.5 kg LSD/palm (during planting + 2.0 kg LSD/palm/year

Research Approach

- Carry out monthly soil pH monitoring at study block.
- Carry out sampling and analysis on leaf nutrients concentration and soil fertility status of the study block.
- Census on oil palm nutrient deficiency symptoms.

Research Approach

Expected Outcome:

1. Evaluation of the heavy liming practice on improving soil pH.
2. Evaluation of the heavy liming practice on soil nutrients uptake efficiency (especially K and Mg) of oil palm on peat.
3. Evaluation of the heavy liming practice on minimize premature frond desiccation incidence.
4. Recommendation on GAP (liming practice) of oil palm planted on peat soil.

APPENDIX 8

PROPOSAL AND SOP ON RESEARCH TO CONTROL TERMITE

1. Project	:	**Management of termites *Coptotermes curvignathus* in peat using biological control agents and chemical insecticides**
2. LEADER	:	MPOB
3. COLABORATORS	:	Members of SOPPOA Members of MEOA Members of SOPB
4. DURATION	:	3 years (June 2016 to June 2019)

5.0 INTRODUCTION

Termite is one of the major insect pests of oil palm especially in peat. Termite infestation is rare on palm trees planted in mineral soil. The abundance of organic matter, such as timber residue is highly contributed to population of termite in peat. Two species of termite are reported attacking oil palm, there are *Coptotermes curvignathus* and *Macrotermes gilvus*. The *C. curvignathus* is a subterranean termite which developed the colony inside the soil without building termite's mound. This species feeds on oil palm apical meristem whereas the *M. gilvus* only caused damage on the oil palm roots. The *C. curvignathus* builds mudwork around the trunk, frond base, and spear. Attack of termite on young palms is through spear region then moved to meristem tissues. In mature palms, the *C. curvignathus* feeds on palm tissues and nesting inside the trunk. This species could feeds on living trees which makes it a serious threat of oil palm plantation in Sarawak. As termite live inside the peat, detection of colony activities throughout the planting areas is difficult.

The termite infestations vary from location to location and generally increase with age of the palms. Infestation in three years old palms showed that the attack could reach 9% with 3% dead palms. The *C. curvignahtus* is the only species capable of killing young and mature living oil palm trees. Control methods for termites are mostly relying on applying poisonous organophosphates insecticides such as chlorpyrifos or fipronil. Currently, the focus in termite management has shifted increasingly to alternative methods such as the use of entomopathogenic fungi. This is because the fungi are easy and cheaper to produce, safe to non-target organisms, stable formulation and longer life span in the field. Generally, studies focus on three fungal

species, *Beauveria bassiana*, *Metarhizium anisopliae* and *Paecilomyces fumosoroseus*.

6. OBJECTIVE

1. To determine the effectiveness of biological control agents and chemical insecticide to control termite *C. curvignathus* infesting oil palm.

2. To develop effective delivery methods of biological control agents to control termite on infested mature and young palms, and to reduce population of termite in the soil.

6. EXPECTED BENEFIT

Effective delivery methods of environmentally friendly products to control and prevent the infestation of termite on oil palms planted in peat.

7. METHODOLOGY

Selection of experimental block

The study will be conducted at block or field with DXP planting materials planted on peat. Census will be conducted to determine the severity of termite infestation in the block.

Census of termite infestation

Census will be conducted both prior and after treatment. A week before treatment, the infested palms will be marked. Determination of infested palms will be conducted based on observation of fresh damage and fresh mud-works on palm trunks. In some cases, termite baiting traps will be also installed either in soil or on palm trunk that exhibit signs of termite infestation. There are two different types of baiting traps, namely termite detector station made from a feet long PVC tube with perforated part at the bottom of the station. The station was filled with wet corrugated cardboard and buried in soil around the palm base. The second trap was a soap box termite trap, which was also filled with wet corrugated cardboard and tied onto the palm trunk.

Number of tested palms

The numbers of treated palms should be equal for each treatment. It was preferably more than 10 palms per treatment. No untreated control palm will be used in this experiment.

Proposed Treatment

A - Treatment by direct spraying of product

There are 3 treatments will be tested in this experiment as following.

1. Fungal pathogen *Metarhizium anisopliae*
2. Fungal pathogen *Beauveria bassiana*
3. Chemical insecticide fipronil.

Application of treatments and application rate

Treatments will be applied by two techniques as following

1. Spraying of the whole trunk of infested palms
2. Soil injection around the base of infested palms

Spraying of trunk is mainly targeted to control *C. curvignathus* colonies infesting the palm's trunk. While soil injection is used to control *C. curvignathus* in the soil and also to prevent new termite infestation. This method was commonly practiced to control termite in urban areas, but not yet fully exploited in agricultural sector, especially to control infested oil palms.

For mature palm, the whole palm trunk will be treated by spraying at rate of 8 litres product solution using a knapsack sprayer. The palm will be then further treated by soil injection of product solution at 10 holes around the palm base at rate of 1 L per hole. The distance of the holes from the palm base and between holes is one feet long.

For supply seedling, the palm will be only treated by soil injection at 5 holes around palm base. Soil injection will be conducted using a motorised soil injector equipped with a nozzle attached to bottom part of 4 feet long stainless rod with handle.

Data recording and frequency

The presence of termite activities on each the treated palms will be recorded every 3 months. Successful control was number of treated palm without termite activities.

A - Treatment by direct baiting technique

Site detection and monitoring

In this study, population of termite in the soil will be detected at least 15 days earlier before placing the baiting formulation with the treatment products. The

termite bait stations will be placed surrounding the infested palms to detect activities of termite colonies. The termite baiting station will be using pine (*Pinus caribaea*) wood blocks or rubber wood stake (Zulkefly et al., 2006). The station will be placed in 5-litres plastic container and buried approximately 0.2m from the infested tree. Termites will be separated from the debris based on Tamashiro's technique (Tamashiro *et al.*, 1973). These stations will be routinely monitored for termite activity by weekly.

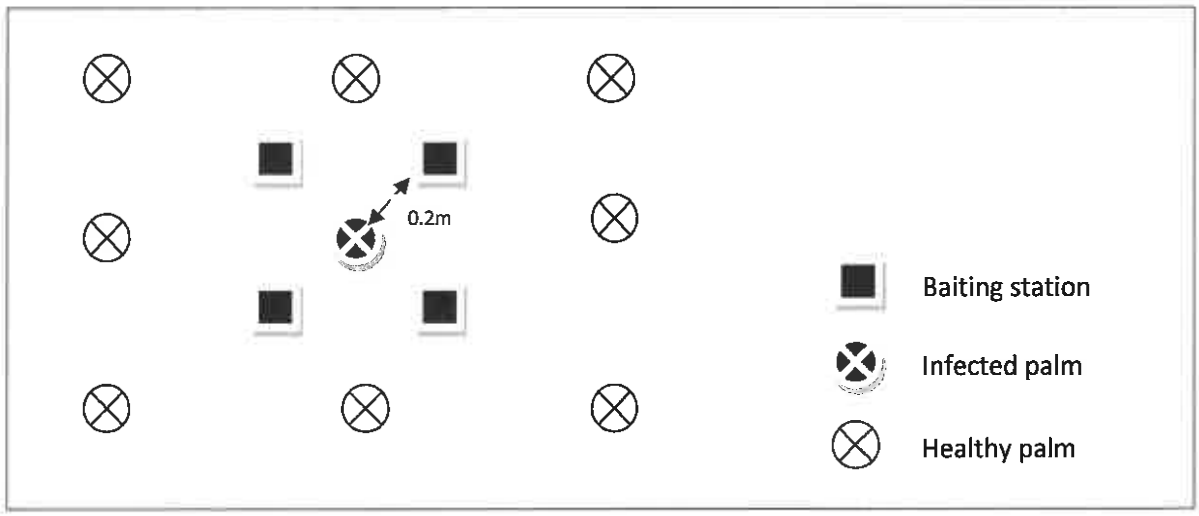

Figure 1. Example of placement of termite baiting station in the field

Placement of treated bait

Placing the "treatment products" at pre-baiting stage would kill the termite workers thus inhibit the establishment the termite colonies. Therefore, introduction of the treatment will be only conducted after the termites has attracted to baiting stations and start feeding on baiting wood. Baiting formulation will be using oil palm parenchyma mixed with cellulose and treatment products. The density of baiting station in the experimental blocks will be identified.

Treatments use in baiting

1. Fipronil
2. Hexaflumuron
3. Entomopathogenic fungi *Metarhizium anisopliae*
4. Entomopathogenic fungi *Beauveria bassiana*

Post Baiting Activity

The debris of baiting wood will be weighed in every visit to check for reduction in foraging activity. Once the termites stop feeding on baiting wood block, the termite colony was considered has been successfully controlled.

References

Sajap, A. S., & Kaur, K. (1990). Histopathology of Metarhizium *anisopliae*, an Entomopathogenic Fungus, Infection in-the Termite, *Coptotermes curvignathus. Pertanika*, *13*(3), 331-334.

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STANDARD OPERATING PROCEDURE FOR STUDY ON TERMITE AND ITS CONTROL

INTRODUCTION

Termites could be regarded as one of the major pest in oil palm especially planted in peat areas. Termites are rarely attack the palm trees in the mineral soil. The abundance of organic matter, such as timber residues were highly contributed to high population of termites in peat. Two species of termites were reported attacking oil palm trees. The species were known as *Coptotermes curvignatus* and *Macrotermes gilvus*. The *C. curvignathus* is a subterranean termite which developed its colony inside the soil without building termite's mound. The *C. curvignathus* feeds on oil palm apical meristem whereas *M. gilvus* only caused damage on palm roots. Signs of *C.curvignathus* infesting palm were observed from wet mudwork around the trunk, frond base, and spear. Young palms are attacked through spear region before targeting the meristem tissues. In mature palm, *C. curvignathus* feeds on palms tissue and then nesting inside the trunk. This species feeds on living tissues of palm trees which makes them a serious threat to oil palm plantation in Sarawak. As termites living inside the soil, the early detection of the colony throughout the planting area are difficult.

METHODOLOGY

Selection of experimental site

1. Study is preferably conducted in field with termite infestation and planted with D x P palms at age less than 10 years old after planting.
2. Make sure that palm was infested by termite species, *Coptotermes curvignathus.*
3. Pre-census need to be conducted on all palms in the experimental block to estimate the severity of termite infestations in the area.
   Determination of infested palms was conducted based on observation of fresh damages and fresh mud-work on palm. In some cases, a termite baiting trap was also installed either in soil or on palm trunk that exhibit infestation symptoms.
4. Record and marked palms with fresh sign of termite infestation.
5. Record also the vacant planting point, rotten stumps and supply seedling.

Monitoring of termite activity in soil

1. Long term monitoring of termite using baiting method with pine wooden blocks or rubber wood blocks (Zulkefli et al., 2006).
2. Placed the rubber stake in the experimental sites by inserting the stake in the soil approximately 0.2m from the infested tree.

3. The population of termites were separated from the debris based on Tamashiro's technique (Tamashiro *et al.*, 1973).
4. The wooden bait stake has to routinely monitor weekly or monthly.

A - Treatment by spraying and soil injection

1. Types of treatments are depends on each agency that participated in the project.
2. Treatment can consist of biological agents such the pathogenic fungi *Metarhizium anisopliae* and *Beauveria bassiana* and also chemical fipronil.

Preparation of *M. anisopliae* and *B. bassiana*

1. The source of *M. anisopliae* used in the study can be obtained from a commercial product such as Ory-X. Spore solutions should be prepared by mixing the product with water plus 0.02% wetting agent Tween 80 (or any commercially available) and the concentrations of spore solution was adjusted, preferably to 10^7 spores/ml.
2. For *B. bassiana*, the fungus was mass produced on autoclaved rice for 2 weeks. Harvesting of spores can be done on site by adding appropriate volume of water plus wetting agent. The spore mixture were poured via a 200µm mesh sieve. The spore concentration was determined and adjusted to 10^7 spores/ml.

Preparation of fipronil

1. Any product with fipronil as an active ingredient can be used in the study. Preferably used a commercial product Chalcid 5SC at fipronil 5% (w/w).
2. The product was diluted by mixing of 1ml product with 10 ml water.

Number of tested palms and application rate

1. Two categories of palm, mature palm and supply young palm.
2. The numbers of treated palms used in each treatment should be equal.

Application of treatment

Treatments were applied as follows

1. Spraying of palm trunk .
2. Soil injection around the palm base.

Spraying of trunk is mainly targeted to control *C. curvignathus* colonies infesting the palm's trunk. While soil injection is used to control *C. curvignathus* in the soil and also to prevent new termite infestation. This method have been commonly practiced to control termite in urban areas, but yet to be fully applied in agricultural sector, especially in oil palm plantations.

Two type of apparatus will be used, the 16 L knapsack sprayer and motorized soil injector. Prior to treatment, the knapsack sprayers and motorized soil injector need to be calibrated to ensure uniform and accurate application of each treatment to every treated palm.

Calibration of sprayer and motorized injector

1. A 16L knapsack sprayer used in this study should be equipped with lance and an adjustable cone-shaped nozzle. Record the volume of water and time required to spray the whole palm trunk until satisfactory coverage on trunk surface was achieved.
2. A 20L motorized soil injector filled with water solution mixed with white water-based dye. The solution was then injected into soil at the depth of 6 inches, where the dispersion and penetrability of the dye solution is observed and noted. The calibration found the flow rate of the injector was at 10 seconds to inject 1 litre of dye solution.

Rate of application

1. For mature palm, spray the whole palm trunk at rate of 8 litres product solution using a knapsack sprayer.
2. Further treat the palm by soil injection of product solution at 10 holes around the palm base at rate of 1 L per hole. The distance of the holes from the palm base and between holes is one feet long.
3. For supply seedling, treat the palm by soil injection at 5 holes around palm base.

Post data recording

Record the presence of termite activity on treated palms at 3 month after treatment (MAT), 6 MAT and 9 MAT.

B – Treatment by baiting technique

Monitoring could be also called pre-baiting which established to create a solid feeding cycle between the bait stations and the termite colony. Monitoring stations include a wood monitor or inspection cartridges in the soil allowing termites foraging the wood, "sourcing out" the feeding source.

1. Population of termite in the soil will be detected at least 15 days earlier before placing the baiting formulation with the treatment products.
2. The termite bait stations will be placed surrounding the infested palms to detect activities of termite colonies. The termite baiting station will be using pine (*Pinus caribaea*) wood blocks or rubber wood stake (Zulkefly et al., 2006).
3. The station will be placed in 5-litres plastic container and buried approximately 0.2m from the infested tree.

4. Termites will be separated from the debris based on Tamashiro's technique (Tamashiro *et al.*, 1973).
5. These stations will be routinely monitored for termite activity by weekly.

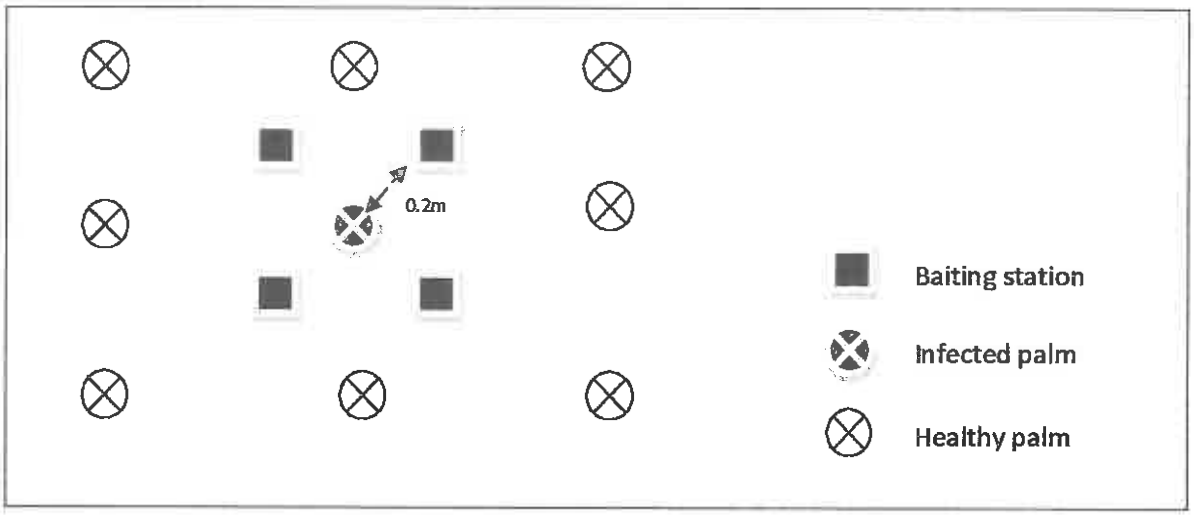

Figure 1. Example of the placement of termite baiting station in the field

Placement of treated bait

1. Introduction of the treatment will be only conducted after the termites has attracted to baiting stations and start feeding on baiting wood.
2. Baiting formulation will be using oil palm parenchyma mixed with cellulose and treatment products.
3. The rate of each product will be identified later.
4. The density of baiting station in the experimental blocks will be identified.

Treatments use in baiting

1. Fipronil
2. Hexaflumuron
3. Entomopathogenic fungi *Metarhizium anisopliae*
4. Entomopathogenic fungi *Beauveria bassiana*

Post baiting activity

1. The debris of baiting wood will be weighed in every visit to check for reduction in foraging activity.
2. Once the termites stop feeding on baiting wood block, the termite colony was considered has been successfully controlled.

Appendix

Figure 2. Treatments applied by direct spraying on mature infected palms using a manual knapsack sprayer.

Figure 3. Soil injection of product solution on infected mature palms using motorized knapsack sprayer.

Figure 4. Rubber wood stake for long term monitoring of termite population in soil treated by baiting method

Referenc

Sajap, A. S., & Kaur, K. (1990). Histopathology of *Metarhizium anisopliae*, an entomopathogenic fungus, infection in the termite, *Coptotermes curvignathus*. *Pertanika*, *13*(3), 331-334.

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APPENDIX 9

PROPOSAL AND SOP ON RESEARCH TO CONTROL BUNCH MOTH

1. PROJECT	:	**Field evaluation of biological control agent and chemical insecticides to control bunch moth, *Tirathaba rufivena.***
2. LEADER	:	MPOB
3. COLABORATORS	:	Members of SOPPOA Members of MEOA Members of SOPB
4. DURATION	:	3 years (June 2016 to June 2020)

5. BACKGROUND

The bunch moth. *Tiratabha rufivena* is known to be one of major insect pests of oil palm planted in peat and its do not follow predictable pattern. High infestation of bunch moth was usually reported during rainy season. Currently, outbreaks of this pest were reported in various plantations in Mukah, Sibu and Miri, Sarawak. Once the caterpillars had infested palms, the female inflorescences and bunches at various stages of development are attacked. Various insecticides being implemented to control the infestation, but the adverse effects towards beneficial insects such as pollinating weevil, parasitoids and predators should also be considered. Therefor further study of field evaluation of insecticides and biological agents to control oil palm bunch moth, *T. rufivena* was needed. Better understanding of the ecological aspect of *T. rufivena* is also needed in order for better management of the pest. Understanding on ecological study included identification of natural enemies, life cycle, alternate hosts and trapping methods to reduce population.

6. OBJECTIVE

1. To evaluate the effectiveness biological control agents, chemical insecticides and trapping method in controlling the oil palm bunch moth.
2. To understand the ecological aspects of *T. rufivena* for better management of the pest.
3. To develop sustainable methods for better control of *T. rufivena* in the field.

6. EXPECTED BENEFIT

Development of sustainable methods to control the infestation of bunch moth on oil palms planted in peat.

7. METHODOLOGY

Selection of experimental Site

The study will be conducted in areas planted with oil palm below than 10 year old having high infestation of bunch moth. Pre-census will be conducted to determine the severity of infestation in the entire areas of the experimental blocks.

Treatment

A - Direct spraying of product

Types of treatments and active ingredients used in this study are as follows. Palms in control plot were untreated.

Table 1. Proposed treatments used in the study.

No	Active ingredient (Trade name)
1.	Cypermethrin
2.	Chlorantraniliprole
3.	*Bacillus thuringiensis*
4.	*Metarizium anisopliae*
5	*Beauveria bassiana*
6.	Sanitation method + Cypermethrin
7.	Sanitation method + Biological agents
8.	Sanitation method

Application of treatment

The products were applied by spraying method using a 16 Liter knapsack sprayer equipped with 4ft long lance and an adjustable cone shaped nozzle. Based on calibration to get satisfactory penetration of solution within the crown region, 1 litre solution was required to treat one palm. To improve adherent and deposition of droplets, 10ml of sticking agent Nufarm Bond® was added into the solution. Application of products were directed to every stages of bunches, male and female inflorescences in the crown region of each treated palm.

Frequency of application

Treatments were applied at least 4 rounds with the interval of more than 21 days.

Data Recording

Data on population of all stages of bunch moth was recorded from post anthesised male and female inflorescences and developing bunches. Five samples were collected in each experimental plot, consisting of one male inflorescence, two female inflorescences and two developing bunches. For female inflorescences and developing bunches, spikelets were separated from the bunch by chopping to manageable sizes. The same method was also used to treat samples of male inflorescences. The numbers of larvae, pupae and adults found on each sample were then counted and recorded.

B – Mass trapping

Type of trapping

The mass trapping will be using two types of light source, the normal fluorescent light and ultra violet light. A total of twenty units both types of trap will be placed in the identified experimental blocks. The trap placed at the density of 2 traps per hectare.

Post Data Recording

Data on capture of adult bunch moth in each trap will be collected daily for the first month, then increased to weekly. The population of bunch moth on male and female inflorescence will be also monitored at monthly basis. From this study, the most attracted source of light will be determined and will be used for further commercial testing.

STANDARD OPERATING PROCEDURE FOR STUDY ON BUNCH MOTH AND THEIR CONTROL

INTRODUCTION

The bunch moth, *Tirathaba rufivena* is a major insect pest of oil palm planted in peat in Sarawak. High numbers of larvae found infesting the post anthesised male inflorescences as compared to female inflorescences and fruit bunches. The pest was commonly control by the use of biological control agents and chemical products. Better understanding of the ecological *T. rufivena* needed in order for better management. These include the understanding ecological behavioural such as the natural enemies, life cycle and alternate host so that less chemical product used and thus reduce the maintenance pest cost.

METHODOLOGY

Selection of experimental Site

The study will be conducted in areas planted with oil palm below than 10 year old that having of high infestation of bunch moth. Pre-census will be conducted to determine the severity of infestation in the entire areas of the experimental blocks.

A - Direct spraying of product

Types of treatments and active ingredients used in this study are as follows. Palms in control plot were untreated.

Table 1. Proposed treatments used in the study.

No	Active ingredient (Trade name)	Rate
1.	Cypermethrin	
2.	Chlorantraniliprole	
3.	*Bacillus thuringiensis*	
4.	*Metarizium anisopliae*	
5	*Beauveria bassiana*	
6.	Sanitation method + Cypermethrin	
7.	Sanitation method + Biological agents	
8.	Sanitation method	

Application of treatment

1. Treatment were applied by spraying method using a 16 Liter knapsack sprayer equipped with 4ft long lance and an adjustable cone shaped nozzle.

2. Volume of solution spray on the crown region was 1 litre solution. To improve adherent and deposition of droplets, 10ml of sticking agent Nufarm Bond® was added into the solution.
3. Spraying should be directed to every stages of bunches, male and female inflorescences in the crown region of each treated palm.

Frequency of application

Treatments were applied at least 4 rounds with the interval of more than 21 days.

Data Recording

1. Data on population of all stages of bunch moth was recorded from post anthesised male and female inflorescences and developing bunches.
2. Five samples were collected in each experimental plot, consisting of one male inflorescence, two female inflorescences and two developing bunches. These samples should be collected systematically to represent the actual population in each block.
3. For female inflorescences and developing bunches, spikelets were separated from the bunch by chopping to manageable sizes.
4. The same method was also used to treat samples of male inflorescences.
5. The numbers of larvae, pupae and adults found on each sample were then counted and recorded.

A - Mass Trapping

The mass trapping used UV light and normal white light traps. The design was proposed by MPOB and fabricated to suite the field conditions. The trap will be 4 feet high from the ground and equip with battery operated to power the light. There will be a pole supported the trap housing. The trap housing consists of the roof attached with lamp underneath the roof and 1 feet square of rectangular collection chamber. Beneath the rectangular chamber there will be collection part for moth that will added with sticky gum to prevent the moth flying back from the trap.

Selection of experimental Site

The study will be conducted in areas planted with oil palm below than 10 year old that having of high infestation of bunch moth. Pre-census will be conducted to determine the severity of infestation in the entire areas of the experimental blocks.

Methods

1. Place trap, at appropriate density, preferably 2 traps per 1 hectare plot.
2. The traps will be placed in between palm at a distance of 15-20 m to one another.

The attraction of light traps decreases with distance, and is low at distances exceeding 20 m as cited by (Truxa C & Fiedler K (2012), Merckx T & Slade EM (2014). To avoid possible influence of the local site on trap performance, the traps were rotated between the two positions three times within the sampling period.

3. Switch on the trap after 7 pm and let in on for overnight or until 7 am.
4. Record the number all captured insects and sort according to types and if possible up to genus level.
5. Count the adult of bunch moth daily, up to appropriate period and stop trapping when the capture were reduce to very low level.

Post data recording

1. Data on capture of adult bunch moth in each trap will be collected daily for the first month, then increased to weekly.
2. The population of bunch moth on male and female inflorescence will be also monitored at monthly basis.
3. From this study, the most attracted source of light will be determined and will be used for further commercial testing.

Appendix

Figure 1. Sign of bunch infected by bunch moth showing the presence of fresh feces

Figure 2. Fruit Bunches infested by bunch moth

References

1. Jonason, D., Franzén, M., & Ranius, T. (2014). Surveying Moths Using Light Traps: Effects of Weather and Time of Year. *PLoS ONE*, *9*(3), e92453. http://doi.org/10.1371/journal.pone.0092453
2. Merckx T, Slade EM (2014). Macro-moth families differ in their attraction to light: implications for light-trap monitoring programmes. Insect Conserv Div: in press. doi:10.1111/icad.12068
3. Truxa C, Fiedler K (2012). Down in the flood? How moth communities are shaped in temperate floodplain forests. Insect Conserv Div 5: 389–397

APPENDIX 10

PROPOSAL AND SOP ON RESEARCH ON RATS AND ITS CONTROL

KAJIAN ASAS TIKUS DAN KAWALANNYA

Oleh:

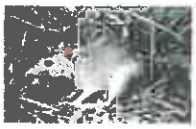
CIK MOHD RIZUAN ZAINAL ABIDIN
AHLI KAWALAN TANAMAN
FELDA GLOBAL VENTURES RESEARCH & DEVELOPMENT (FGV R&D)

Research Collaboration Training on SOP, 9-12 Mei 2016, Sibu

FGV R&D Z

Small Rodents in Sabah/Sarawak:

1. *Rattus rattus diardii*	90-250 gm
2. *Rattus tiomanicus*	100-130 gm
3. *Sundamys muelleri*	160- 350 gm
4. *Rattus argentiventer*	200-270 gm
5. *Maxomys whiteheadi*	30-70 gm
6. *Rattus exulans*	40-50 gm
7. *Callosciurus notatus*	ave. 250 gm



DAMAGED BY RATS

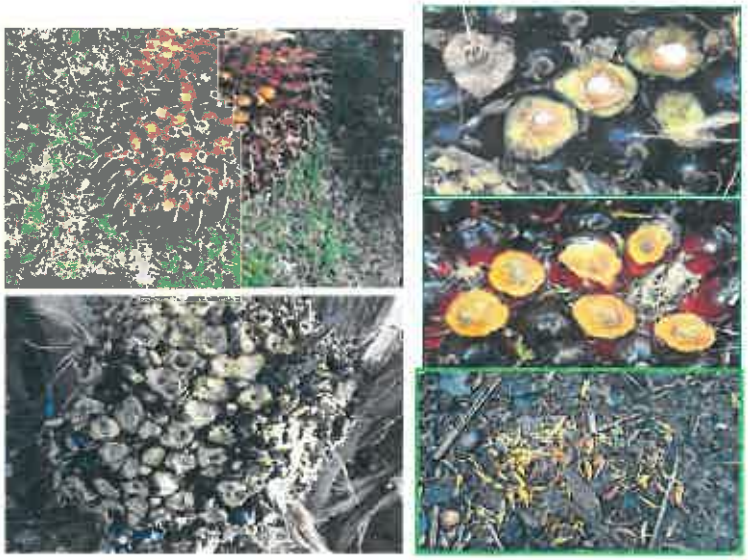
Immature stage

Baru

Iama

Pre- mature stage

Baru



Iama

DAMAGE SYMPTOMS & ACTIVITY SIGNS

- Seedling in polybags
- Cabbage- immature palms
- Ripe and Unripe
- Loose Fruit lets
- Fruit bunch
- Unopened male/female inflorescence

PAMI

Borang Bancian Serangan Tikus

Nama Ladang :										No. Pusingan :
Peringkat :										Tarikh Mengumpan Tikus :
Blok :										Tarikh Banci :
No. Baris	No. Pokok									
	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Petunjuk :

- Paras kehilangan ekonomik = 5% kerosakan baru BTS
- Sesuai untuk pokok muda atau pra matang.
- 1 plot (100 pokok) = 20-50 ha

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PENGAWALAN TIKUS SECARA BERSEPADU

Economic injured level (EIL) – Initiate of control program

Rat Damage and The Status

Peratus Kerosakan	Status serangan	Tindakan
0.1-2.9	Rendah	Pemerhatian diteruskan
3.0-4.9	Sederhana	Paras berjaga-jaga
≥ 5.0	Serius	Perlu mengumpan segera

% Fresh Damage	Estimated Rat Population/ha
Below 5%	< 100
5 – 20 %	100 – 250
21 – 50 %	250 – 500
Above 50 %	> 500

Diet of Rats

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Species (n= 13) 8♂ 5♀	Stomach contents	%, Contents
R. tiomanicus	• Kernel	46
	• Kernel-Shell	76
	• Weaver ants (*Oecophylla smaragdina*)	15
	• Beetle (immature stage) • Catterpillar	38
	• Cricket (Immature stage)	23

EFFECT of CROPS LOSS

Amount eaten by Rat Species

Rat Species	Mean consumption (gm/rat/day)	Source
Rattus tiomanicus	4.29	Wood, 1976, Wood and Liau 1984)
Rattus argentiventer	8.60 (unripe+ ripe fruits)	Liau, 1990
Rattus rattus diardii	9.0 (ripe fruits)	Wood *et al.* 1988
Rattus rattus muelleri	10.80 (oil palms fruit)	Hoong and Hoh, 1992
Bandicota Indica	±80.0 (unripe fruits)	Sukri *et al.* 2015

- **96% of their stomach contents** was made up of oil palm fruit (Wood and Liau, 1984)

**after Chung, 2012

Kenalpasti Species

Skull measurement:

Species	gl/cbl	mt/ut
R. r. diardii	33-43	6.2-7.0
R. exulans	27-30	4.5-6.0
M. whiteheadi	29-34	5.1-6.2
Shrews	9.2-11	21.5-25
S. muelleri	53-62	9.4-11.5

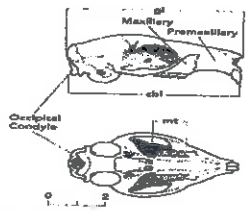


Fig. 5 Skull measurements of a rodent

from the front of the head to the notch in the tail flukes.

Shoulder height (SH) Height from the ground to the top of the shoulder when animal is standing.

SKULL MEASUREMENTS (Figs 5–7)

Greatest length (gl) The longest distance from the back of the skull to the front of the skull.

Condylobasal length (cbl) From the back of the occipital condyles to the front of the premaxillae.

Condylocanine length (ccl) From the back of the occipital condyles to the front of the canines.

Maxillary toothrow (mt) The length of the upper toothrow from the back of the molars to the front of the canines (excluding the incisors); usually this is measured to the base of the canine, but for bats this extends to the front of the curve of the canine; for rodents, which have no canines, this includes only the molars and premolars (3 teeth in rats, 4 in squirrels – the tiny premolar at the front is excluded).

Upper toothrow (ut) For shrews the relationships of the teeth are unclear, and the whole toothrow is measured.

Molar width (m–m) The width across the outside of the widest upper molars (or the bases)

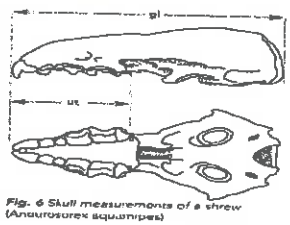


Fig. 6 Skull measurements of a shrew (Anourosorex squamipes)

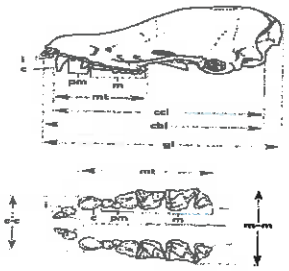


Fig. 7 Skull measurements and dentition of a bat (Myotis horsfieldi).

Francis, C. M. 2008. *A Field Guide To the Mammals of South-East Asia*. New Holland Publishers (UK) Ltd. 392 pp.

Rat's Mammae

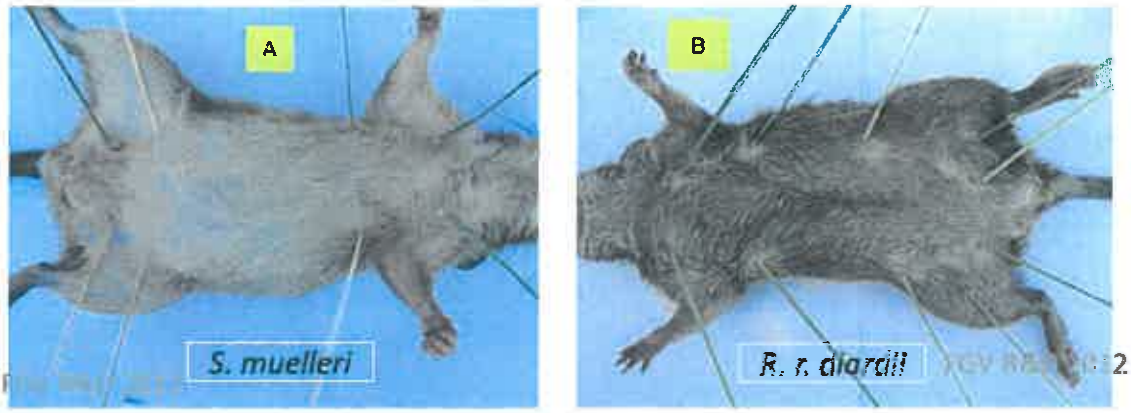
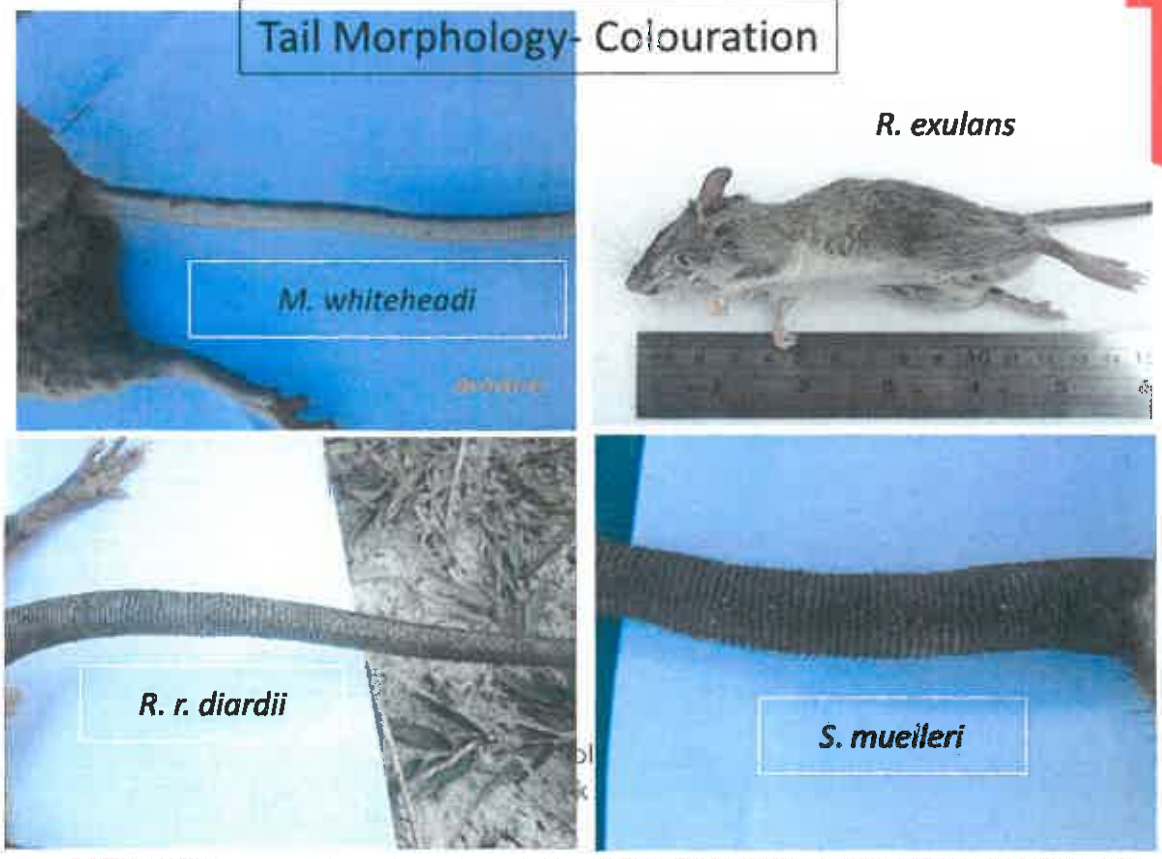


Fig. 3 Under parts of matured adult female rat showing some of the different patterns of axillary and inguinal mammae: A; *S. muelleri:* 2+2 and B; *R. r. diardii*: 2+3.

Tail Morphology- Colouration



Matured or juvenile

Rat composition - 1

* Rat species	*Sundamys muelleri*	*Rattus tiomanicus*	*Rattus rattus diardii*
Sample	(N=20)	(N= 12)	(N=10)
Head + Body (HB) (mm)	155 - 235	157-174	125 - 200
Tail length (mm) & % of HB	189 - 255 & 110 - 120%	144-171 & 86 - 120%	145-199 & 92 – 116%
Hind foot (mm)	42 - 49	29-38	30- 40
Skull (mm)	50 - 65	39 - 48	36 - 54
Weight	160 - 350	100-130	90 - 250
Back colour	Brown (sometime with soft fur)	Greyish brown	Brown
Belly colour	Pale greyish, brown, dull buffy-white	White and pale yellow	Grey and Pale brown
Tail colour (upper and lower)	Entirely dark and scale both sides	Entirely brown both sides	Entirely dark brown and scale both sides
No. of mammae	(2+2) = 8	(2+3) = 10	(2+3) = 10

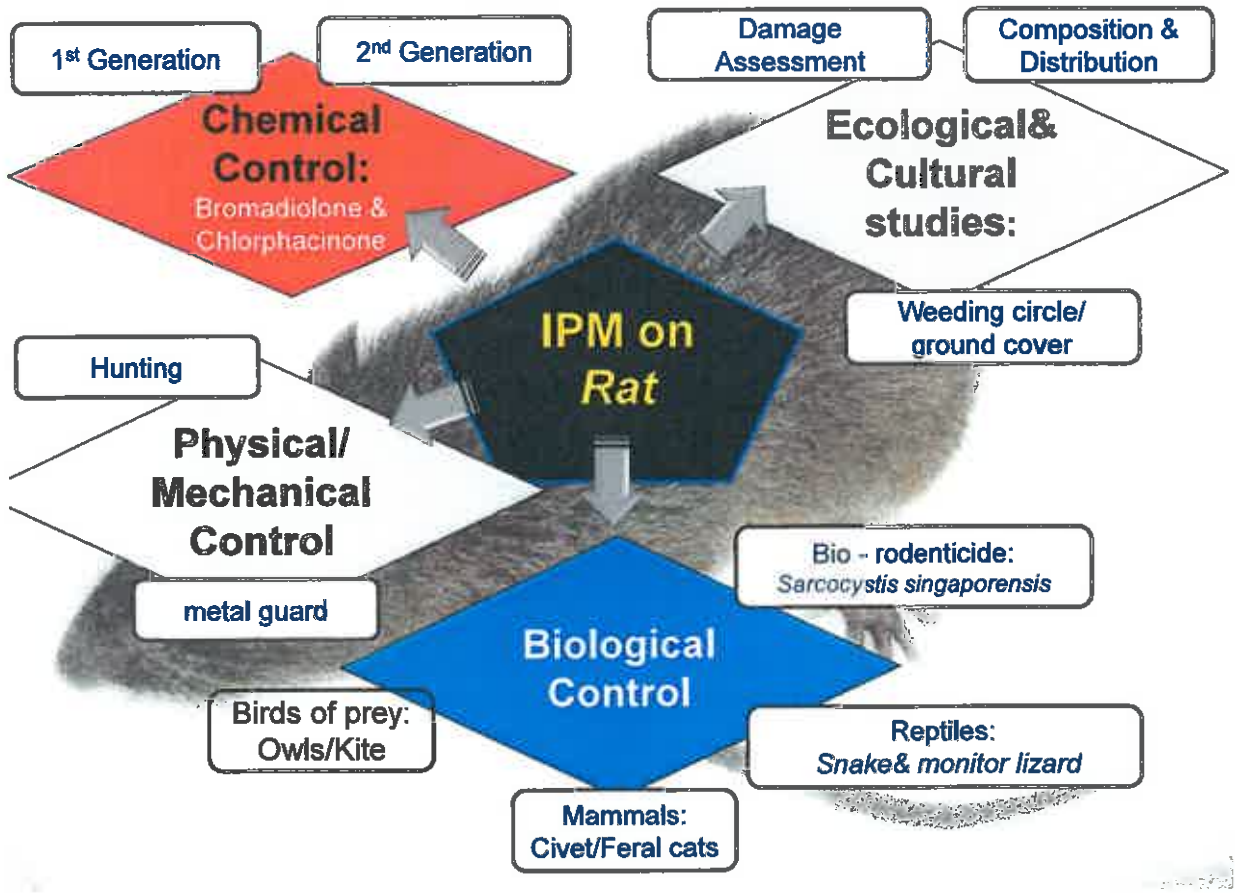
Estimation of Rat Population

1. CMR = catch marked and release
   @ MRR = mark release and recapture
2. Trap success = adjusted sprung trap or non target
3. Hunting
4. Activity signs = Damage. Nests, burrows

Kaedah 1

Hari	Activiti	Bil. tikus	Formula
0	Persediaan perangkap		
1	Malam 1 – mark & release	Jumlah tikus, A	Rat population = A x (B+1)/ (C+1) (Bailey Corrected)
2	Malam 2 – mark & release		
3	Malam 3 – mark & release		
4	Malam 4 – Recaptured	Jumlah tikus, B Tikus bertanda, C	

* 50 palms/ 100 traps
** Stand/ ha = 136 (A= 30, B= 40, C= 20) = 158 rats / ha



BIOLOGICAL CONTROL

Why Barn owl?

FGV

Snakes (Common Cobra, *Naja* spp.)	• Eat 12-25 rats/year (Harrison, 1956; Duckett,2013) • 2 weeks to digest the rat • Worker resistances – killed on sight
Eagle (white eagle/kites	• Replanting area; • 75% diet was rat • Have wide diet
Domestic cat, Leopard cat	• Failed – eat poison baits (primary user) • Diet on Rats?? Unknown
Monitor lizard	• Mostly eat Carcasses
Tyto alba javanica	• Nocturnal – Efficient hunter in darkness • Per owl pair + off-breeding= 2000 rats per year • Per owl pair + 5 young birds = 4000 rat per year • 98-99.98% diet was rat • High reproductive systems (triple a year) [2 to 13 clutch size)

Kawalan Fizikal & Kultural

Collar Zink- guard

Well-keep Weeding circle

Chemical poison Baiting

- **Acute rodenticides** – Zinc phospide (highly toxic to human, no antidote, need prebaiting)
- **Anticoagulant** – 1st generation & 2nd generation(Slow acting)

- *Table: Concentration of first and second generation anticoagulant poisons in rat baits.*

1st generation rat poison	2nd generation rat poison
Chlorophacinone, 0.005%	Bromadiolone, 0.005%
Warfarin, 0.05%	Brodifacoum, 0.003% - 0.005%
Coumatetralyl	Flocoumafen, 0.005%

BUTIK S

ai : 0.005%
CHLOROPHACINONE,12.5 g

BUTIK G2

ai : 0.005%
BROMADIOLONE, 10 g

Replacement at 4 or 7 days interval depending on baiting recommendation.

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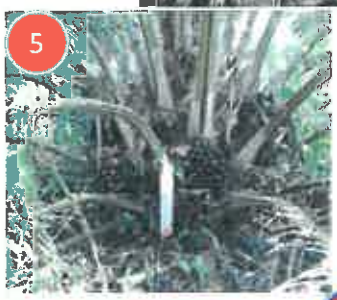
Poison	Active ingredient	ppm	Bait size	Baiting density	Checking / Replacement	Crop
First generation	warfarin	500	15 g	100 %	4 days	Immature & mature
	chlorphacinone	50	12.5	100 %	7 days	Immature & mature
Second generation	bromadiolone	50	10 g	100 %	5 days	Immature & mature
	flocoumafen	50	4 g	100%	7 days	Immature & mature
	brodifacoum	30	4 g	100 %	7 – 8 days	Immature & mature

Baits placement? Pro and Cont?

1. Weeding circle – FGV/FELDA/Sime Darby etc.
2. Frond heaps –FGV/FELDA/ Sime Darby etc.
3. Frond bud - SOPB, PPB Wilmar
4. Marking stick – FGV
5. Baits Dispenser (Ecorat®) – FGV....



What do we understand about ONE CAMPAIGN of rat baiting in mature palm?

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STANDARD BAITING

- **One round 100% density application at one bait per palm and follow up with several selective application rounds TILL 20% baits acceptance (LOW RAT NO.).**

PULSE BAITING

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POKOK Pra matang dan matang:

Sekurang-kurangnya 2 kempen (2-3 pusingan per kempen) mengumpan setahun perlu dijalankan oleh setiap ladang

HOW TO EVALUATE BAITS REPLACEMENT AND ITS EFFICACY

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1. Acceptance Level Is Below Than 20% (Baits)
2. Fresh Damage over palm Is below Than 5%
3. Fresh damage over FFB at platform below than 20%
4. Trapping, Hunting and Carcasses collecting
5. Baits effective? 4-7 days later after consumed correct lethal dosage

LAMPIRAN 2 : BORANG BANCIAN UMPAN TIKUS

Nama Ladang	:	FASSB Sahabat	No. Plot Bancian	:	1
Nama Pengurus	:	Jalil b Rami	Pusingan Mengumpan	:	1
Peringkat	:	3	Tarikh Mengumpan	:	10.02.2012
Keluasan ladang		1700.50 ha	Jenis Umpan Tikus	:	BUTIK S
Blok	:	2	Tarikh Bancl Umpan	:	17.02.2012
Thn. Pembangunan	:	2008	Nama Pembancl	:	Ahmad b Baba

No Baris	No. Point/Umpan									
	1	2	3	4	5	6	7	8	9	10
1	√	√	√	√	√	√	√	√	√	√
2	√	√	√	√	√	√	√	√	√	√
3	√	√	√	√	√	√	√	√	√	√
4	√	√	√	√	√	√	√	√	√	√
5	0	√	0	0	√	0	√	0	√	√
6	X	√	X	X	√	X	√	X	√	√
7	√	√	√	√	√	√	√	√	√	√
8	0	√	0	0	√	0	√	0	√	√
9	0	0	0	0	0	0	√	0	√	√
10	X	0	X	X	H	X	√	X	√	√
X	2	0	2	2	0	2	0	2	0	0
0	3	2	3	3	0	3	0	3	0	0
√	5	8	5	5	8	5	10	5	10	10
Jum	10	10	10	10	10	10	10	10	10	10

SIMBOL	ULASAN	BILANGAN
X	Umpan dimakan oleh tikus (masih berbaki)	10
0	Umpan lalang oleh tikus (tidak berbaki)	19
√	Umpan masih kekal (berada ditempat asal)	71
	Jumlah X + 0 + √	100
	% Penerimaan (X + 0)	29

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* 1 round Ecorat™ = 10 days interval
* 1 round conventional = 5 days

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Results at 25 DAT: Bait acceptance,%

400 palms

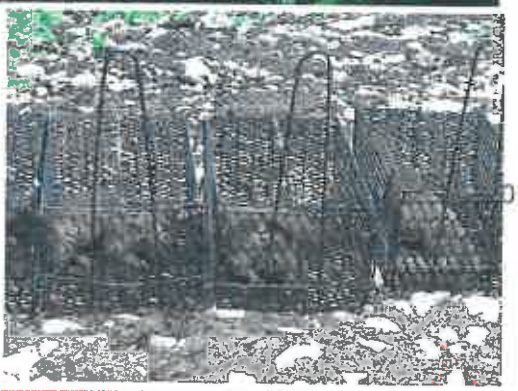
Round	1	2	3	4
Treatment	Bait acceptance, %			
Ecorat ™	76.67	21.67	-	-
Conventional	100	97.00	79.00	63.00

Results at 25 DAT; Fresh Damage,%

Treatment / ROUND	Pre-treament	1	2	3	4	Pre-treament	1	2	3	4
	FFB Damage score, %					Fruitlets Damage Score, %				
Ecorat™	0.00	1.00	1.00	-	-	12.44	8.27	2.15	-	-
Conventional	2.00	2.00	1.00	0.00	0.00	17.09	12.5	10.3	7.88	2.46
Control	4.00	8.00	3.00	4.00	4.00	30.85	23.29	23.29	25.42	25.83

Plantain squirrel – *Callosciurus notatus*

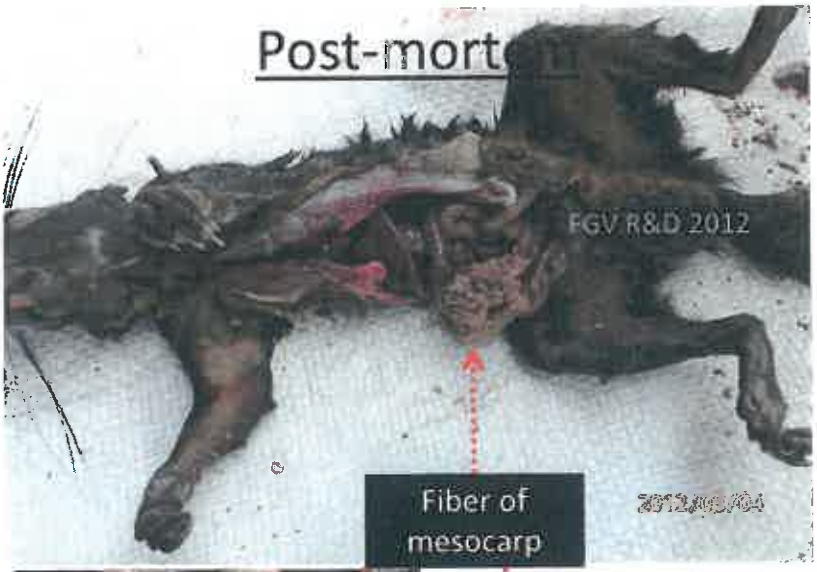
Trapping squirrel

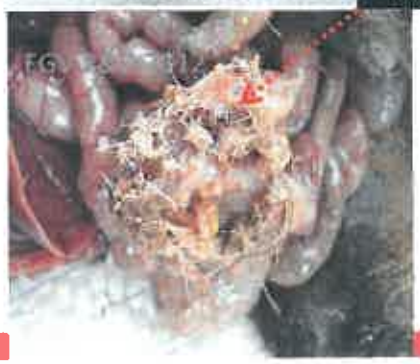


Post-trapping

Duration	No. of Trap set up	Baits	% caught	Squirrel	Rat	Total
01- 30 Sept	3889	Banana, OP fruitlets, Ubi kayu	34.97	1225	135	1360
01 Oct-10 Nov	4994	Banana, OP fruitlets, Ubi kayu	23.21	1021	138	1159
Total	8883		**28.35%**	**89.16%**	**10.84%**	**2519**

Post-mort





Damaged oN unripe fruit

Squirrel diet – indirect affect to decrease the weevil population

Damaged symptoms of fruitlets:

C. notatus

Bil. Sampel: 15-20 biji
Hari ke - 15
Bilangan Tupai = 10 ekor
Bilangan Tikus = 16 ekor

S. muelleri

Research Collaboration Training on SOP, 9-12 Mei 2016, Sibu

RUMUSAN

PERKARA	ISU
1. Persampelan kerosakan baru (BTB):	- Kurang tepat (pokok tinggi) - Subjektif melibat kesan serangan baru @ lama - Penglihatan tidak jelas (Silau matahari/bayangan)
2. Kajian Populasi tikus:	- Trap shyness - Marked issue - Labour issue/ kepakaran
3. Kajian Species Tikus	- Tahap kerosakan berbeza mengikut spesies (diet?) - Menentukan kejayaan program penaburan umpan
4. Bait /baiting	- Bait shy - Fresh bait - Palatability test - ↑ Bait acceptance ↓ Rat Damage
5. Holistic IPM	- Ekologi, Kultural, Fizikal, biologi, kimia

OUR TEAM/CONSULTANT

THANK YOU

APPENDIX 11

BASIDIOSPORES STUDIES ON *Ganoderma* DISEASE

1. Proposal
2. Slide presentation

GanoDROP Unit

PROJECT 1:

Project Title:

Basidiospores studies on *Ganoderma* disease

Sub-project: Insect vectos

MPOB Team:

1. Dr Shamala Sundram (Project Leader)
2. Dr Idris Abu Seman

Collaborator:

1. Sarawak Oil Palm Bhd (SOPB).
2. Ta Ann Plantation

Objectives:

To identify insect vector carry basidiospore of Ganoderma causing USR and BSR disease

Research Approach:

1. Conduct one-day course on *Ganoderma* SOP. SOPB will be selected to facilitate the training organized by GanoDROP Unit.
2. Conduct a BSR census
3. Collecting fruiting body of *Ganoderma* with insect vector
4. Identify insect vector

Expected Outcome:

Mode of spread of *Ganoderma* disease through insect vector will be identified

Project Timeframe: Jun 2016 – Jun 2018 (3 years)

Years		2016				2017				2018			
Phase	**Activity**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
1	Conduct a BSR census												
2	Collecting fruiting body of Ganoderma with insect vector												
3	Identify insect vector												
4	Data analysis, report writing												

PROJECT 1-
BASIDIOSPORES STUDIES ON *Ganoderma* DISEASE

BIOLOGY DIVISON, MALAYSIAN PALM OIL BOARD (MPOB), MALAYSIA

Presented at the MPOB-SOPPOA COLLABORATION TRAINING ON FIELD CLINIC *Ganoderma* & OTHER DISEASES IN OIL PALM
SOPB, Miri, Sarawak; 25-26 May 2016

MPOB TEAM

1. DR SHAMALA SUNDRAM (PROJECT LEADER)
2. DR IDRIS ABU SEMAN

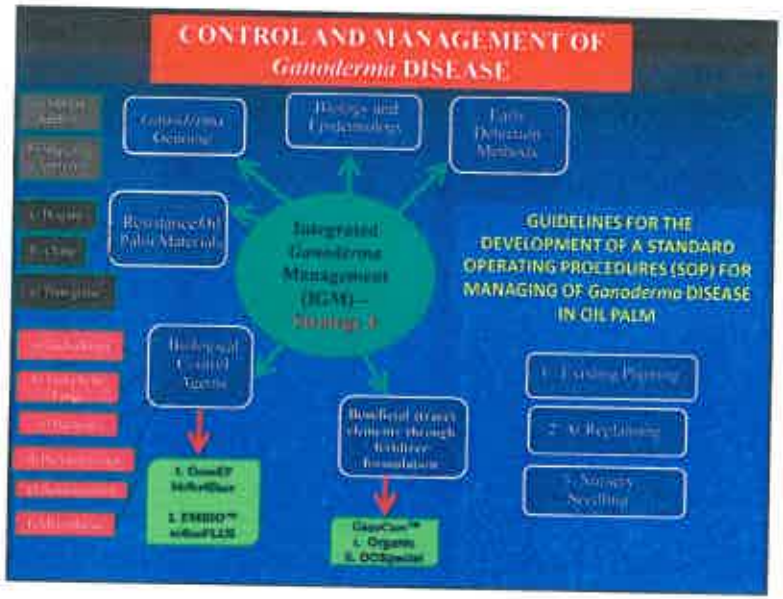
COLLABORATOR

1. Sarawak Oil Palm Bhd (SOPB)
2. Ta Ann Plantation

OBJECTIVES:

To identify the insect vector carry basidiospore of *Ganoderma* causing upper stem rot (USR) and basal stem rot (BSR) disease in oil palm

CONTROL AND MANAGEMENT OF *Ganoderma* DISEASE



The Species of Ganoderma Fungus (Idris, 1999)

Species of *Ganoderma*	Pathogenicity test (infection in roots)
G. boninense	Pathogenic (most aggressive – 2.5 cm/month)
G. zonatum	Pathogenic (moderately – 1.9 cm/month)
G. miniatocinctum	Pathogenic (least aggressive – 1.5 cm/month)
G. tornatum	Non-pathogenic (saprophytic)

Penyebab Penyakit: Kulat *Ganoderma* spp.

G. boninense

G. zonatum

Reput Pangkal Batang Reput Batang Atas

Penyakit Ganoderma

Fruiting body

Epidemiology (disease spread)

1. Mycelium contact - Contact between healthy roots with diseased tissues left buried in soil (Flood et al., 2000; Idris, 2011)

2. Basidiospores – play a role in spreading the disease through insects vector (Idris, 2011).

***Episcapha 4-maculata* (Tiger beetle) - can carry basidiospores of *Ganoderma* and infect oil palm**

RESEARCH APPROACH

1. Conduct one-day course on *Ganoderma* SOP. SOPB will be selected to facilitate the training organized by GanoDROP Unit.
2. Conduct a BSR census
3. Collecting fruiting body of *Ganoderma* with insect vector
4. Identify insect vector

BSR CENSUS
Disease Severity Index (DSI) - For Mature Palms

DSI	Description	
0	Uninfected palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma	
1	Mild infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm not showing foliar symptoms and slightly stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
2	Moderate infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm showing foliar symptoms (<50%) and slightly stem rotting (<30%) at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
3	Severe infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm not showing or showing foliar symptoms (>50%) and stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
4	Very severe (dead) infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm dead/collapsed showing severe foliar symptoms and stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	

BSR CENSUS
Disease Severity Index (DSI) - For Immature Palms

DSI	Description	Symptoms
0	Uninfected immature palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma.	
1	Infected immature palm. One sided yellowing leaves with the bole or stem slightly rotting at the base. In severe infection, palm dead with the bole or stem completely rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	 

BSR CENSUS
Disease Severity Index (DSI)

DSI – 0 (uninfected)
DSI – 1 (infected)

PROJECT TIME FRAME

Phase	Activity	2016 Q1	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1	2018 Q2	2018 Q3	2018 Q4
1	Conduct a BSR census		■										
2	Collecting fruiting body of Ganoderma with insect vector			■				■				■	
3	Identify insect vector			■				■				■	
4	Data analysis, report writing				■				■				■

EXPECTED OUTCOME

Mode of spread of *Ganoderma* disease through insect vector will be identified

APPENDIX 12

NURSERY AND FIELD EVALUATION OF BIOLOGICAL CONTROL AGENT (BCA) PRODUCTS FOR CONTROLLING *Ganoderma* DISEASE IN OIL PALM

1. Proposal
2. Slide presentation
3. Evaluation forms

PROJECT 2:

Project Title:

Nursery and field evaluation of biological control agent (BCA) products for controlling *Ganoderma* disease in oil palm

MPOB Team:

1. Dr Idris Abu Seman (Project Leader)
2. Nur Rashyeda Ramli

Collaborator:

1. Sarawak Oil Palm Bhd (SOPB) - ongoing
2. Sarawak Plantation Agiculture Development (SPAD)/Sarawak Plantation Berhad (SPB)

Objectives:

1. To test the efficacy of biological control products (in the market) in controlling Ganoderma disease in oil palm (nursery and field testing)
2. To test the efficacy of biological control products (in the market) for vegetative growth of oil palm seedlings (nursery testing)

Research Approach:

1. To conduct one-day course on *Ganoderma* SOP. SOPB will selected to facilitate the training organized by GanoDROP Unit.
2. To conduct nursery evaluation of BCA products against *Ganoderma boninense*. Application of BCA products in the nursery (follow the application as recommended in product packaging). Data recording at monthly interval
3. To conduct a BSR census on the selected field. Planting of treated seedlings in the planting hole. Method use to test the product is through seedling baiting technique. Data collection at three months interval for a period of 36 months

Expected Outcome:

1. Identification of potential of BCA product to control *Ganoderma* disease.
2. Recommendation on the use of BCA product in oil palm planted in peat in order to control BSR incidences.

Project Timeframe: Jun 2016 – Dec 2019 (3 ½ years)

Years		2016				2017				2018				2019			
Phase	**Activity**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
1	i. Training on the application of BCA product ii. BSR census																
2	Application of BCA products in the nursery																
3	Data collection monthly																
3	Planting of the treated oil palm seedlings in the planting hole																
4	Data collection at 3-months interval																
5	Data analysis and report writing																

PROJECT 2-
NURSERY AND FIELD EVALUATION OF BIOLOGICAL CONTROL AGENT (BCA) PRODUCTS FOR *Ganoderma* CONTROL

BIOLOGY DIVISON, MALAYSIAN PALM OIL BOARD (MPOB), MALAYSIA

Presented at the MPOB-SOPPOA COLLABORATION TRAINING ON FIELD CLINIC *Ganoderma* & OTHER DISEASES IN OIL PALM

SOPB, Miri, Sarawak; 25-26 May 2016

MPOB TEAM

1. DR IDRIS ABU SEMAN (PROJECT LEADER)
2. NUR RASHYEDA RAMLI

COLLABORATOR

1. Sarawak Oil Palm Bhd (SOPB) – ongoing
2. Sarawak Plantation Agriculture Development (SPAD)

OBJECTIVES:

1. To test the efficacy of biological control products (in the market) in controlling *Ganoderma* disease in oil palm (nursery and field testing)
2. To test the efficacy of biological control products (in the market) for vegetative growth of oil palm seedlings (nursery testing)

RESEARCH APPROACH

1. To conduct one-day course on *Ganoderma* SOP. SOPB will selected to facilitate the training organized by GanoDROP Unit.
2. To conduct nursery evaluation of BCA products against *Ganoderma boninense*. Application of BCA products in the nursery (follow the application as recommended in product packaging). Data recording at monthly interval
3. To conduct a BSR census on the selected field. Planting of treated seedlings in the planting hole. Method use to test the product is through seedling baiting technique. Data collection at three months interval for a period of 36 months

BSR CENSUS
Disease Severity Index (DSI) - For Mature Palms

DSI	Description	
0	Uninfected palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma.	
1	Mild infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm not showing foliar symptoms and slightly stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
2	Moderate infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm showing foliar symptoms (<50%) and slightly stem rotting (<30%) at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
3	Severe infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm not showing or showing foliar symptoms (>50%) and stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	
4	Very severe (dead) infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm dead/collapsed showing severe foliar symptoms and stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).	

BSR CENSUS
Disease Severity Index (DSI) - For Immature Palms

DSI	Description	Symptoms
0	Uninfected immature palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma	
1	Infected immature palm. One sided yellowing leaves with the bole or stem slightly rotting at the base. In severe infection, palm dead with the bole or stem completely rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g GSM or PCR-DNA).	 

BSR CENSUS
Disease Severity Index (DSI)

DSI - 0 (uninfected)
DSI - 1 (infected)

PRODUCT EVALUATION

- Will be identify

APPLICATION METHOD

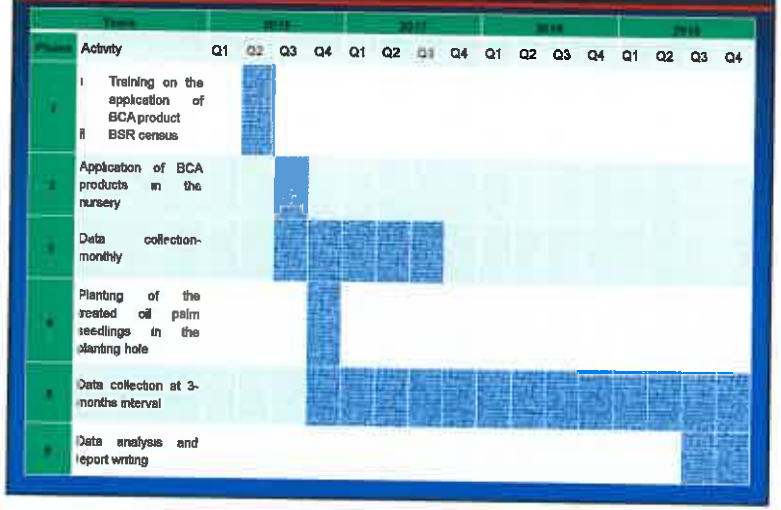
2. Nursery testing – effects BCA products in controlling *Ganoderma* disease in oil palm seedlings

- **Seedling treated with BCA products. Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.**
- **After inoculation, seedlings will be evaluated for pathological parameters.**

3. Field testing – effects BCA products in controlling *Ganoderma* disease in field planted oil palm.

- **60 seedlings per treatment.**
- **Seedling treated with BCA products in nursery; planting hole; and after planting. Twelve-month old seedlings were planted 35-45 cm away from *Ganoderma*-infected stump (using seedling baiting technique).**
- **After planting, pathological parameters will be recorded.**

PROJECT TIME FRAME



EXPECTED OUTCOME

1. Identification of potential of BCA product to control *Ganoderma* disease.
2. Recommendation on the use of BCA product in oil palm planted in peat in order to control BSR disease.

Thank You

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EVALUATION FORMS

LEMBAGA MINYAK SAWIT MALAYSIA (MPOB)

Project : Biology Control - Nursery Testing
Title :
Location :

Date :
Treatment :
Unit :

Code	Severity Foliage Symptoms				DI	DSIF	GSM	Dead	Internal Symptoms		Remarks
	Foliar symptoms			Total	FB/My	*(0-4)*	Test	Seedling			
	G	Y	D	frond	*(0/1)*		*(0/1)*	*(0/1)*	DSIR	DSIS	
Total :											
Avg/ %											

LEMBAGA MINYAK SAWIT MALAYSIA (MPOB)

Project : Biology Control-Seedling Baiting **Date :**
Title : **Treatment :**
Location : **Unit :**

Code	Severity foliage symptoms				DI	DSIF	GSM	Dead	Internal Symptoms		Remarks
	Foliar symptoms			Total	FB/My	*(0-4)*	Test	Palm			
	G	Y	D	frond	*(0/1)*		*(0/1)*	*(0/1)*	DSIR	DSIS	
Total :											
Avg/ %											

LEMBAGA MINYAK SAWIT MALAYSIA (MPOB)-Project MPOB-SAPPOA

Project : Chemical Control
Title :
Location :

Date :
Treatment :
Unit :

Code	Severity Foliage Symptoms				Flower Census		DI		DSIF	GSM	Dead	Remarks
	Foliar symptoms			Total			FB/My					
	G	Y	D	Frond	F	M	FB (+)	FB (-)	*(0-4)*	Test *(0/1)*	Palm *(0/1)*	
Total												
Avg / %												

LEMBAGA MINYAK SAWIT MALAYSIA (MPOB)

Project : Biology Control-Vegetative Growth/Physiology Growth

Location :

Date :
Treatment :
Unit :

No.	Foliage symptom				Rachis Length *(cm)*	No. of Leaflets	Girth *(mm)*	Height *(cm)*	Chlorophyll (SPAD)				Dry weight		Remarks
	G	Y	D	Frond prod.					L1	L2	L3	Avg.	Wet(gm.)	Dry(gm.)	
Total :															
Avg :															

APPENDIX 13

BUNCH ROT DISEASE IN OIL PALM

1. Proposal
2. Slide presentation

PROJECT 4:

Project Title:

Studies on bunch rot disease in oil palm

MPOB Team:

1. Dr Idris Abu Seman (Project Leader)
2. Maizatul Suriza Mohamed
3. Dr Shamala Sundram

Collaborator:

1. Ta Ann Plantation (TA)
2. Woodman Plantation (WM)
3. Tabung Haji Plantation (TH)

Objectives:

1. To identify causal pathogen of bunch rot in oil palm
2. To identify the predisposing factors of bunch rot
3. To develop an early detection technique for bunch rot disease
4. To survey the presence of bunch rot disease in oil palm in Sarawak
5. To develop control measures of the bunch rot disease

Research Approach:

1. Investigation on the causal agent of bunch rot and carry out bunch rot survey in Sarawak
2. Developing of early detection technique for bunch rot disease.
3. Developing of control measures of the disease.

Expected Outcome:

1. Identifying the causal pathogen and predisposing factors that leads to the bunch rot disease in oil palm planted on peat soil in Sarawak.
2. Detection method of the bunch rot disease
3. Recommendation on effective control measures of oil palm planted on peat soil in order to control the bunch rot disease in oil palm.

Project Timeframe: Jun 2016 – Jun 2019 (3 years)

Years		2016		2017		2018		2019	
Phase	**Activity**	**Q1**	**Q2**	**Q1**	**Q2**	**Q1**	**Q2**	**Q1**	**Q2**
1	Preparation, training and literature review								
2	Identification of bunch rot pathogen - Sampling and other plant pathology assays								
3	Developing of early detection technique for bunch rot								
4	Disease survey and assessment in oil palm								
5	Developing of control measures								
6	Data analysis, finalisation, patenting and report writing								

PROJECT 4 – STUDIES ON BUNCH ROT DISEASE IN OIL PALM

BIOLOGY DIVISON, MALAYSIAN PALM OIL BOARD (MPOB), MALAYSIA

Presented at the MPOB-SOPPOA COLLABORATION TRAINING ON FIELD CLINIC *Ganoderma* & OTHER DISEASES IN OIL PALM
SOPB, Miri, Sarawak: 25-26 May 2016

MPOB TEAM

1. DR IDRIS ABU SEMAN (PROJECT LEADER)
2. MAIZATUL SURIZA MOHAMED
3. DR SHAMALA SUNDRAM

COLLABORATOR

1. Ta Ann Plantation
2. Woodman Plantation
3. Tabung Haji Plantation

1.1 FIELD DISEASES

1. 'Crown disease'
2. Stem wet rot
3. Charcoal base rot
4. Marasmius bunch rot
5. Sooty mould
6. Algae leaf spot
7. Fruit bunch stalk rot
8. Fruit rot
9. Fan blight
10. Wither tip disease
12. Pestalotiopsis leaf spot
13. Orange spotting-CCCVd

Root and Stem Diseases:

1. Basal stem rot
2. Upper stem rot
3. Stem wet rot
4. Charcoal base rot

OBJECTIVES:

1. To identify causal pathogen of bunch rot in oil palm
2. To identify the predisposing factors of bunch rot
3. To develop an early detection technique for bunch rot disease
4. To survey the presence of bunch rot disease in oil palm in Sarawak
5. To develop control measures of the bunch rot disease

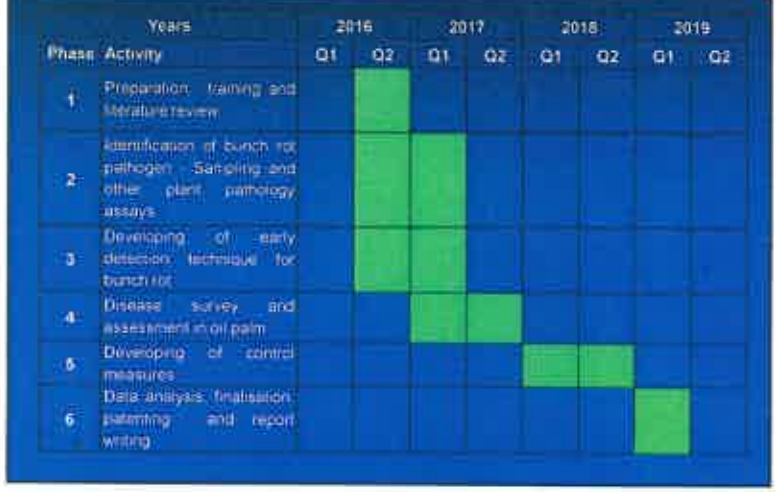
RESEARCH APPROACH

1. Investigation on the causal agent of bunch rot and carry out bunch rot survey in oil palm
2. Developing of early detection technique for bunch rot disease.
3. Developing of control measures of the disease.

EXPECTED OUTCOME

1. Identifying the causal pathogen and predisposing factors that leads to the bunch rot disease in oil palm
2. Detection method of the bunch rot disease.
3. Recommendation on effective control bunch rot disease in oil palm.

PROJECT TIME FRAME



Thank You

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APPENDIX 14

FIELD DEMONSTRATION ON OS-CCCVD INFECTION ON OIL PALM

1. Proposal
2. Slide presentation
3. SOP – Sampling, screening for CCCVd-like Viroids

PROJECT 5:

Project Title:

Effects of OS-CCCVd infection on oil palm yield in Sarawak

MPOB Team:

1. Dr Shamala Sundram (Project Leader)
2. Dr Idris Abu Seman

Collaborator:

1. Sarawak Oil Palm Berhad (SOPB)
2. DOA Sarawak

Objectives:

1. To develop a yield loss model of oil palm due to OS-CCCVd variant infection
2. To estimate the economic loss due to OS-CCCVd variant infection in oil palm

Research Approach:

1. To conduct disease survey
2. To sampling tissues for CCCVd from infected palm
3. To access yield record for CCCVd infected palm
4. Data analysis and report writing

Expected Outcome:

1. Identify the relationship between disease and yield loss before any actions or disease management can be implemented.
2. Determine the effectiveness of the practical disease management to minimize the OS-CCCVd infection in oil palm.

Project Timeframe: Jun 2016 – Jun 2020 (4 years)

Years		2016		2017		2018		2019		2020	
Phase	**Activity**	**Q1**	**Q2**	**Q1**	**Q2**	**Q1**	**Q2**	**Q1**	**Q2**	**Q1**	**Q2**
1	Disease survey										
2	Sampling tissues for CCCVd presence										
3	Yield recording										
4	Analysis of data and report writing										

PROJECT 5-
EFFECTS OF OS-CCCVD INFECTION ON OIL PALM YIELD

BIOLOGY DIVISON, MALAYSIAN PALM OIL BOARD (MPOB), MALAYSIA

Presented at the MPOB-SOPPOA COLLABORATION TRAINING ON FIELD CLINIC *Ganoderma* & OTHER DISEASES IN OIL PALM

SOPB, Miri, Sarawak; 25-26 May 2016

MPOB TEAM:

1. DR SHAMALA SUNDRAM (PROJECT LEADER)
2. DR IDRIS ABU SEMAN

COLLABORATOR:

1. SARAWAK OIL PALM BERHAD (SOPB)
2. DOA SARAWAK

OBJECTIVES:

1. To develop a yield loss model of oil palm due to OS-CCCVd variant infection
2. To estimate the economic loss due to OS-CCCVd variant infection in oil palm

RESEARCH APPROACH:

1. To conduct disease survey
2. To sample tissues for CCCVd from infected palm
3. To access yield record for CCCVd infected palm
4. Data analysis and report writing

Orange Spotting of Oil Palm
Cocanut cadang-cadang viroid
(CCCVd)

INTRODUCTION

- Recognized disorder
  - In early 19th century, West Africa (Forde & Leyritz, 1968)
- Found in commercial plantation in
  - South East Asia, South Pacific, Central and South America (Forde & Leyritz, 1968 ; Hanold & Randles, 1991)
  - 1-10 % incidence rate
- Originally associated with potassium deficiency
- Biological agent???

SYMPTOMS AND EFFECTS

- Single standing OS palm with Orange/ yellowish/ bronze crown appearance in a plot
- Stunting
- Smaller fruit bunches or no fruit bunch
- Associated with losses in oil palm production
  - Yield reduction up to 50% in a single palm compared to healthy adjacent palm

(Fondi & Leyritz, 1968 ; Harold & Randles, 1991; Randles, 1998)

STUDIES ON THE BIOLOGY, EPIDEMIOLOGY AND ECONOMIC IMPACT OF ORANGE SPOTTING DISEASE OF OIL PALM

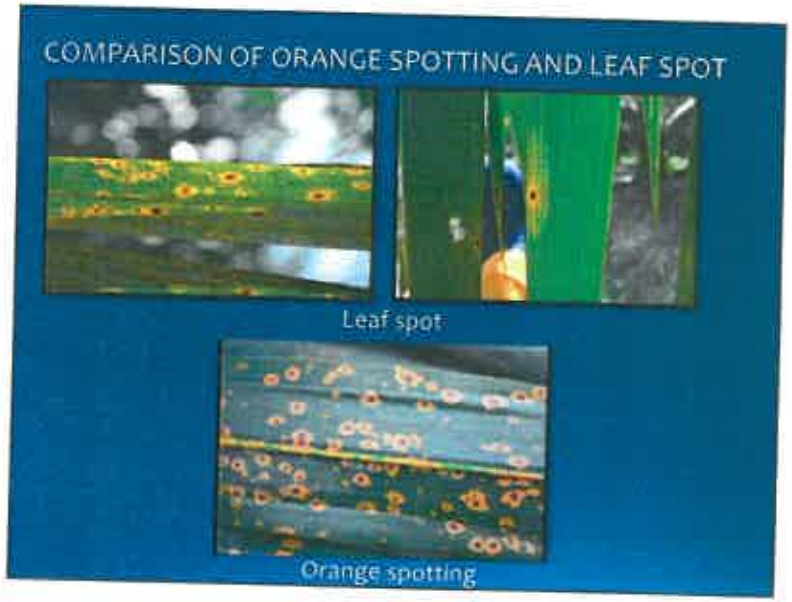
- 99 estates shortlisted, 52 estate visited
- 17 estates confirmed –ve OS symptoms
- 47 estates were not visited due to the following reasons:

(contact not valid, no consent, palm replanted, palm recovered, unsure of palm location due to management change)

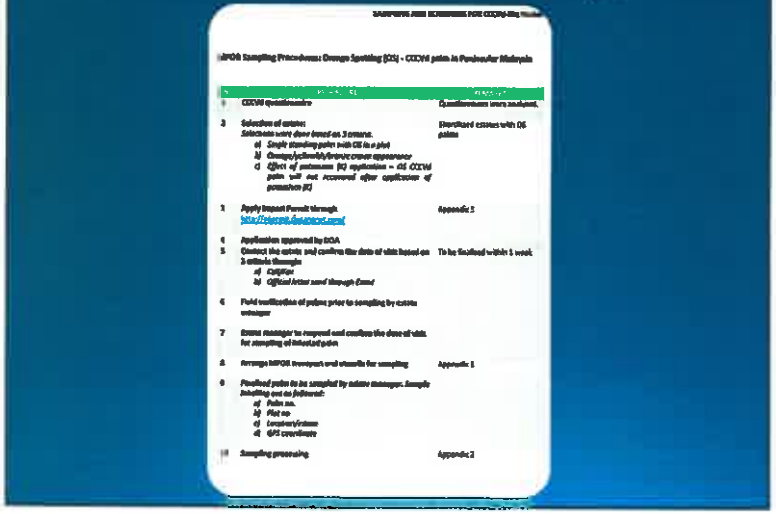
- RT-PCR
- RT-LAMP (Loop-mediated Isothermal Amplification)
- NGS (Next generation sequencing)

ORANGE SPOTTING PALM

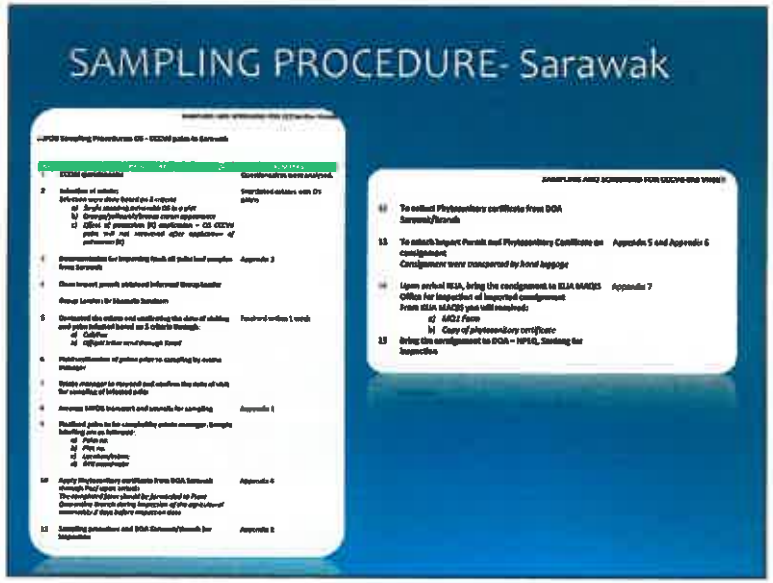

SYMPTOMS ON ORANGE SPOTTING LEAVES


COMPARISON OF ORANGE SPOTTING AND LEAF SPOT
Leaf spot
Orange spotting

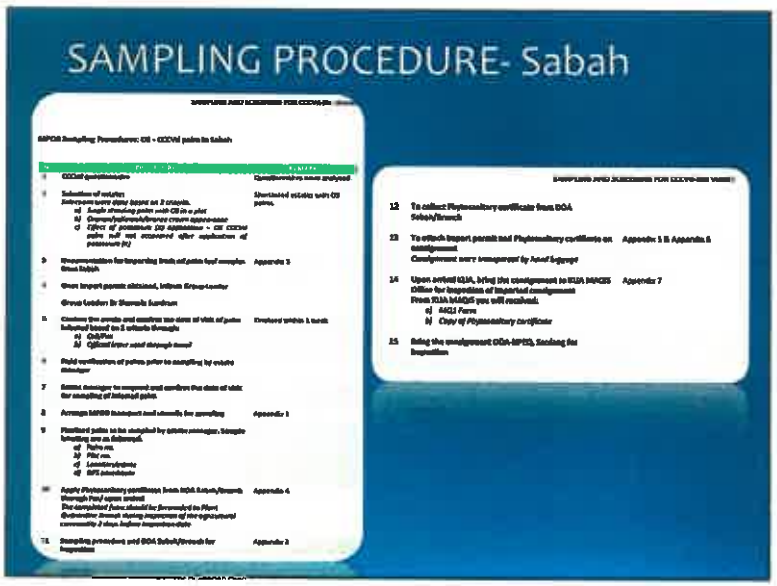
SAMPLING PROCEDURE- Peninsular Malaysia



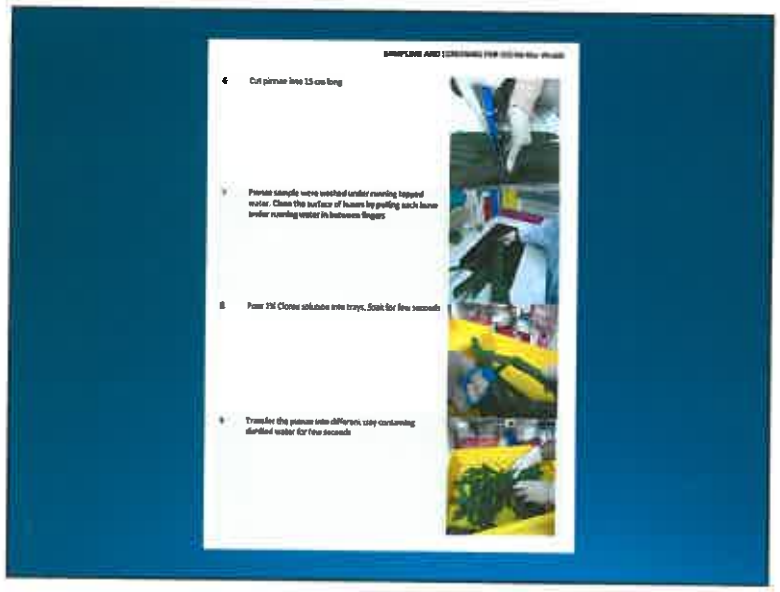
SAMPLING PROCEDURE- Sarawak

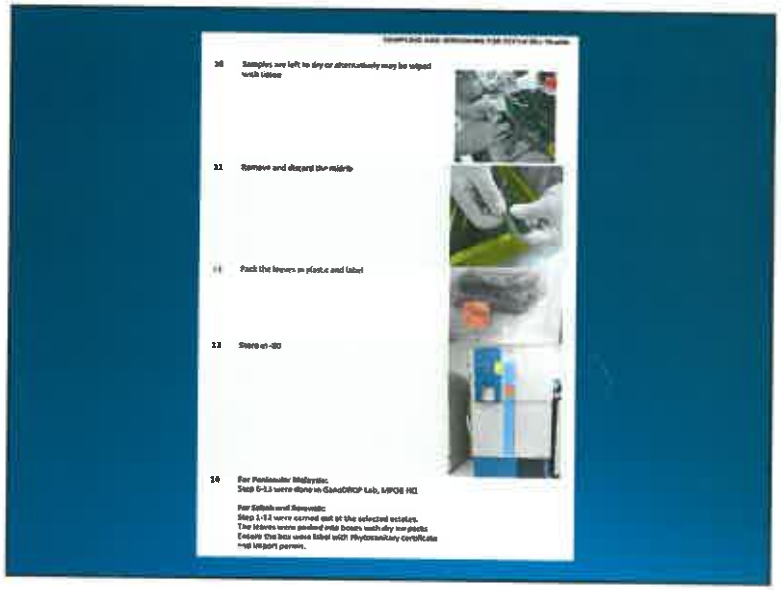


SAMPLING PROCEDURE- Sabah



PROCEDURE FOR PROCESSING FRESH OIL PALM LEAVES





THANK YOU...

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SAMPLING AND SCREENING FOR CCCVd-like Viroids:

MPOB Sampling Procedures and Import Requirements

By

Dr Shamala Sundram & Nur Diyana Roslan

M P O B

MPOB Sampling Procedures: Orange Spotting (OS) - CCCVd palm in Peninsular Malaysia

NO	PROCEDURE	REMARKS
1	**CCCVd questionnaire**	Questionnaires were analysed.
2	**Selection of estate:** *Selections were done based on 3 criteria:* *a) Single standing palm with OS in a plot* *b) Orange/yellowish/bronze crown appearance* *c) Effect of potassium (K) application – OS CCCVd palm will not recovered after application of potassium (K)*	Shortlisted estates with OS palms
3	**Apply Import Permit through** http://epermit.dagangnet.com/	Appendix 5
4	**Application approved by DOA**	
5	**Contact the estate and confirm the date of visit based on 3 criteria through:** *a) Call/Fax* *b) Official letter send through Email*	To be finalised within 1 week
6	**Field verification of palms prior to sampling by estate manager**	
7	**Estate manager to respond and confirm the date of visit for sampling of infected palm**	
8	**Arrange MPOB transport and utensils for sampling**	Appendix 1
9	***Finalised palm to be sampled by estate manager. Sample labelling are as followed:*** *a) Palm no.* *b) Plot no.* *c) Location/estate* *d) GPS coordinate*	
10	**Sampling processing**	Appendix 2

MPOB Sampling Procedures: OS - CCCVd palm in Sabah

NO	PROCEDURE	REMARKS
1	**CCCVd questionnaire**	Questionnaires were analysed.
2	**Selection of estate:** *Selections were done based on 3 criteria:* *a) Single standing palm with OS in a plot* *b) Orange/yellowish/bronze crown appearance* *c) Effect of potassium (K) application – OS CCCVd palm will not recovered after application of potassium (K)*	Shortlisted estates with OS palms
3	**Documentation for importing fresh oil palm leaf samples from Sabah**	Appendix 3
4	**Once import permit obtained, inform Group Leader** **Group Leader: Dr Shamala Sundram**	
5	**Contact the estate and confirm the date of visit of palm infected based on 3 criteria through:** *a) Call/Fax* *b) Official letter send through Email*	Finalised within 1 week
6	**Field verification of palms prior to sampling by estate manager**	
7	**Estate manager to respond and confirm the date of visit for sampling of infected palm**	
8	**Arrange MPOB transport and utensils for sampling**	Appendix 1
9	**Finalized palm to be sampled by estate manager. Sample labelling are as followed:** *a) Palm no.* *b) Plot no.* *c) Location/estate* *d) GPS coordinate*	
10	**Apply Phytosanitary certificate from DOA Sabah/Branch through Fax/ upon arrival** *The completed form should be forwarded to Plant Quarantine Branch during inspection of the agricultural commodity 2 days before inspection date*	Appendix 4
11	**Sampling procedure and DOA Sabah/Branch for inspection**	Appendix 2

12	**To collect Phytosanitary certificate from DOA Sabah/Branch**	
13	**To attach Import permit and Phytosanitary certificate on consignment** *Consignment are transported by hand luggage*	Appendix 5 & Appendix 6
14	**Upon arrival KLIA, bring the consignment to KLIA MAQIS Office for inspection of imported consignment** **From KLIA MAQIS you will received:** *a) MQ1 Form* *b) Copy of Phytosanitary certificate*	Appendix 7
15	**Produce the consignment DOA-NPEQ, Serdang for inspection**	

MPOB Sampling Procedures: OS - CCCVd palm in Sarawak

NO	PROCEDURE	REMARKS
1	**CCCVd questionnaire**	Questionnaires were analysed.
2	**Selection of estate:** *Selection were done based on 3 criteria:* *a) Single standing palm with OS in a plot* *b) Orange/yellowish/bronze crown appearance* *c) Effect of potassium (K) application – OS CCCVd palm will not recovered after application of potassium (K)*	Shortlisted estates with OS palms
3	**Documentation for importing fresh oil palm leaf samples from Sarawak**	Appendix 3
4	**Once Import permit obtained informed Group Leader** **Group Leader: Dr Shamala Sundram**	
5	**Contacted the estate and confirming the date of visiting and palm infected based on 3 criteria through:** *a) Call/Fax* *b) Official letter send through Email*	Finalised within 1 week
6	**Field verification of palms prior to sampling by estate manager**	
7	**Estate manager to respond and confirm the date of visit for sampling of infected palm**	
8	**Arrange MPOB transport and utensils for sampling**	Appendix 1
9	**Finalised palm to be sampled by estate manager. Sample labelling are as followed:** *a) Palm no.* *b) Plot no.* *c) Location/estate* *d) GPS coordinate*	
10	**Apply Phytosanitary certificate from DOA Sarawak through Fax/ upon arrival:** *The completed form should be forwarded to Plant Quarantine Branch during inspection of the agricultural commodity 2 days before inspection date*	Appendix 4
11	**Sampling procedure and DOA Sarawak/Branch for inspection**	Appendix 2

12	**To collect Phytosanitary certificate from DOA Sarawak/Branch**	
13	**To attach Import Permit and Phytosanitary Certificate on consignment** *Consignment are transported by hand luggage*	Appendix 5 and Appendix 6
14	**Upon arrival KLIA, bring the consignment to KLIA MAQIS Office for inspection of imported consignment** **From KLIA MAQIS you will received:** a) *MQ1 Form* b) *Copy of phytosanitary certificate*	Appendix 7
15	**Produce the consignment to DOA – NPEQ, Serdang for inspection**	

Appendix 1

For sample collection:

ITEM	NO OF ITEM
Transport 4WD	1
RA	3
Harvesting knife	1
Parang	1
Tape for labelling	1
Marker pens	1

For sample processing:

ITEM	NO OF ITEM	REMARKS
RA	3	
Parang	1	
Weighing scale	1	
Disposable gloves	1 box	
Tape for labelling	1	
1 % Clorox	1.5 L per sample	
Distilled water	1.5 L per sample	For Sabah and Sarawak only. Distilled water were changed to mineral water
Plastic tray	2	1 tray for Clorox and 1 tray for distilled water
Scattier	2	
Plastic bag	2 bags per sample	
Stapler	1	
Tissue	Several rolls	
Old news paper	Several piece	
Dry ice	Several block	
Box	1	
Fridge	1	For Sabah and Sarawak only. Store sample in fridge or cool room. Samples to be stored upright and inverted to ensure any moisture escapes plastic bag

Appendix 2: Flowchart of sample processing procedure

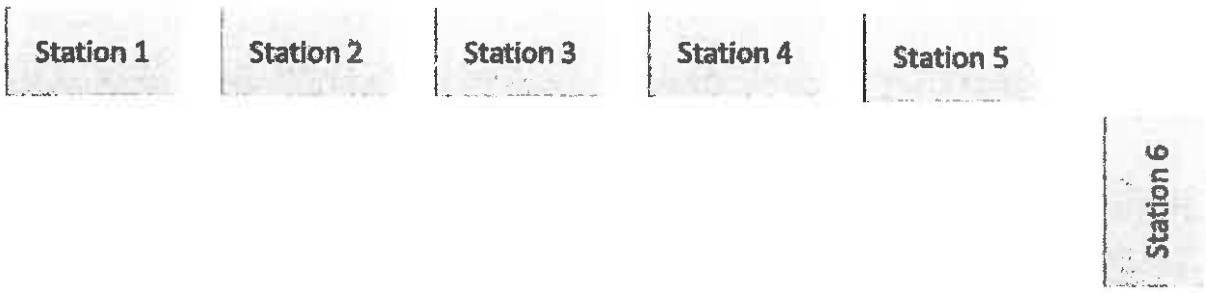
- The overall process described in Appendix 2 may take up to 30-45 minutes per sample

- There are several steps involved and each team can be divided into 6 stations:
  Station 1: Cut the frond into 15 cm long
  Station 2: Washing frond under tapped water
  Station 3: Soak into 1% Clorox
  Station 4: Soak into distilled water
  Station 5: Wipe with tissue
  Station 6: Remove midrib and packaging

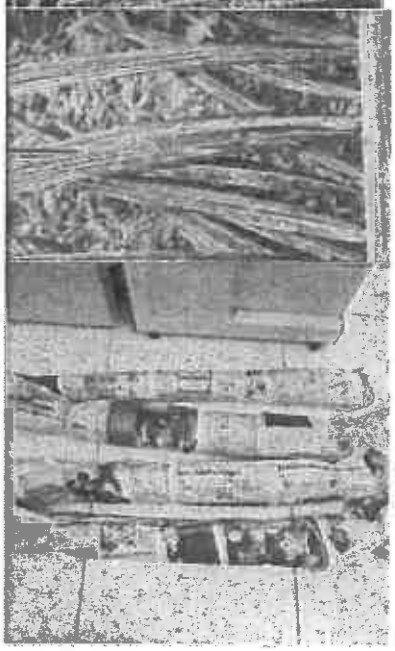
- Ensure that healthy samples are processed first

- Each team to handle 1 sample at a time

- Gloves need to be changed for each sample



Appendix 2: Procedure for sampling and processing of fresh oil palm leaf sample

STEP	PROCEDURE	REFERENCE
1	Verify palms prior sampling	
2	Record palm location with GPS equipment	
3	Select frond for sampling followed by cutting using a sickle	
4	Sample 500g of pinnae (leaflets) from the middle of the cut frond	
5	Wrap the samples with old newspaper and label it accordingly	

6 Once in the lab, cut the pinnae into 15 cm long

7 Pinnae samples are washed under running tap water. Clean the surface of leaves by pulling each leaf under running water in between fingers. This is to remove surface debris/dirt

8 Prepare 1% Clorox solution in trays. Soak the leaves for 10 - 15 seconds

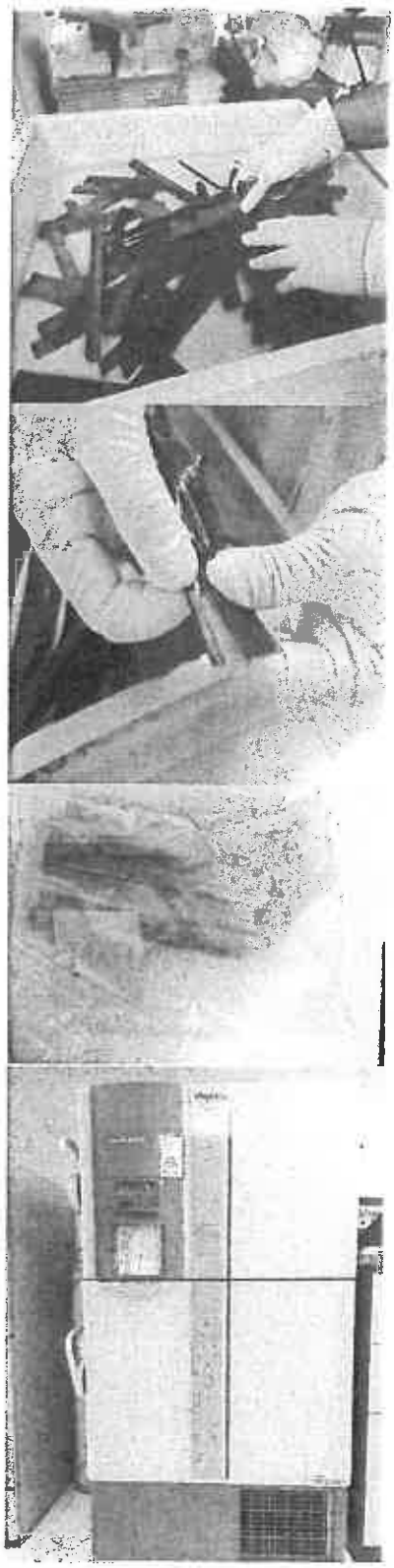
9 Transfer the pinnae into different tray containing distilled water for a few seconds for rinsing

10 Samples are left to dry or alternatively may be wiped with tissue

11 Remove and discard the midrib

12 Pack the leaves in plastic and label

13 Store in -80



14 **For Peninsular Malaysia:**
Step 6-13 were done in GanoDROP Lab, MPOB HQ

For Sabah and Sarawak:
Step 1-12 were carried out at the selected estates.
The leaves were packed into boxes with dry ice packs

Ensure the box were label with Phytosanitary certificate and Import permit.

Appendix 3: Documentation & Procedure for importing fresh oil palm pinnae samples from Sabah/Sarawak into peninsular Malaysia for CCCVd testing

NO	DETAILS	Remarks/Person In Charge
1	**Apply Import Permit through online website** http://epermit.dagangnet.com/ *Consignee: MPOB HQ Bangi* *Consignor: MPOB (Branch)*	Puan Nur Diyana
2	**Received Import Permit (PQ18) and print out**	Several copies are required for the Import permit
3	**Booking Flight**	*MPOB to book the flight*
4	**MPOB (Branch) to prepare utensil for sampling process**	
4	**To inform Plant Quarantine Officer(s), DOA Peninsular Malaysia (National Post Entry Quarantine-NPEQ Serdang) the exact date of arrival of the consignment Tel: 03-89484675/03-89480995** *NOTE: At least 1 week before the importation*	Puan Normawati (DOA-NPEQ Serdang)
5	**Apply Phytosanitary Certificate Form to Plant Quarantine Branch** *Attach Import Permit (PQ18) copy at least 2 days before inspection date*	
6	**Inspection day** *Bring sample to Plant Quarantine Branch. Collect Phytosanitary certificate*	
7	**Delivery** *a) Plant Quarantine Notice **Daun Kelapa Sawit Segar** written on the consignment* *b) Import permit copy* *c) Phytosanitary certificate* *d) Consignee address*	
8	**The consignment must be sent directly to DOA-NPEQ, Serdang for sampling and screening**	
9	**Apply PQ12 to destroy the consignment once laboratory analysis completed**	

Appendix 4: Phytosanitary Certificate Form

JABATAN PERTANIAN SABAH

No. Ruj.:

MALAYSIAN PALM OIL BOARD (MPOB)
NO 6 PERSIARAN INSTITUSI
BANDAR BARU BANGI 43000 KAJANG, SELANGOR

Tarikh: 28 JANUARI 2014

BORANG PERMOHONAN UNTUK SIJIL FITOSANITASI

JABATAN PERTANIAN SABAH
BAHAGIAN KUARANTIN TUMBUHAN
SANDAKAN

Tuan,

Saya/kami SHAHIALA SUNDRAM , MALAYSIAN PALM OIL BOARD (MPOB)
(Nama dan Alamat)

012 - 7078747 memohon untuk
(No. Tel jika ada)

pemeriksaan/rawatan dan perakuan untuk bahan-bahan tumbuhan yang hendak dieksport/diimport seperti berikut :

a) Nama Biasa : KELAPA SAWIT (DAUN)
b) Nama Saintifik/Botanikal : ELAEIS GUINEENSIS
c) Kuantiti (Unit tertentu) : 4 KG
d) Kegunaan Bahan-Bahan: Ditanam/Hiasan/Makanan/Tujuan Sanitifik/Tujuan Perdagangan/Tujuan Lain (Sila nyatakan) UNTUK PENYELIDIKAN BAGI PENYAKIT DAUN BINTIK COREN
e) Diskripsi & Bilangan Bungkusan : 5
f) Tanda-tanda Pengenalan (jika ada) : BINTIK COREN
g) Tempat Asal : SANDAKAN
h) Nama & Alamat penerima/Pengirim : ANDAMY PROPERTIES SDN BHD
LEVEL 2 DAN 3 MENARA ANDAMY, BANDAR RAHAI RAHAI POBOX 1471 90
SANDAKAN, SABAH
i) Tarikh dan Tempat Pemeriksaan/Rawatan* Dikehendaki : 6 FEBRUARI 2014
JABATAN PERTANIAN SANDAKAN
j) Tempat Masuk : KLIA, SEPANG
k) Cara Pengangkutan :..... HAND LUGGAGE
l) Tarikh Keberangkatan : 6 FEBRUARI 2014
m) No. Permit/Rawatan yang dikenakan (jika ada) : * JPK 141 101 0171 02014
n) Kenyataan Tambahan :.....

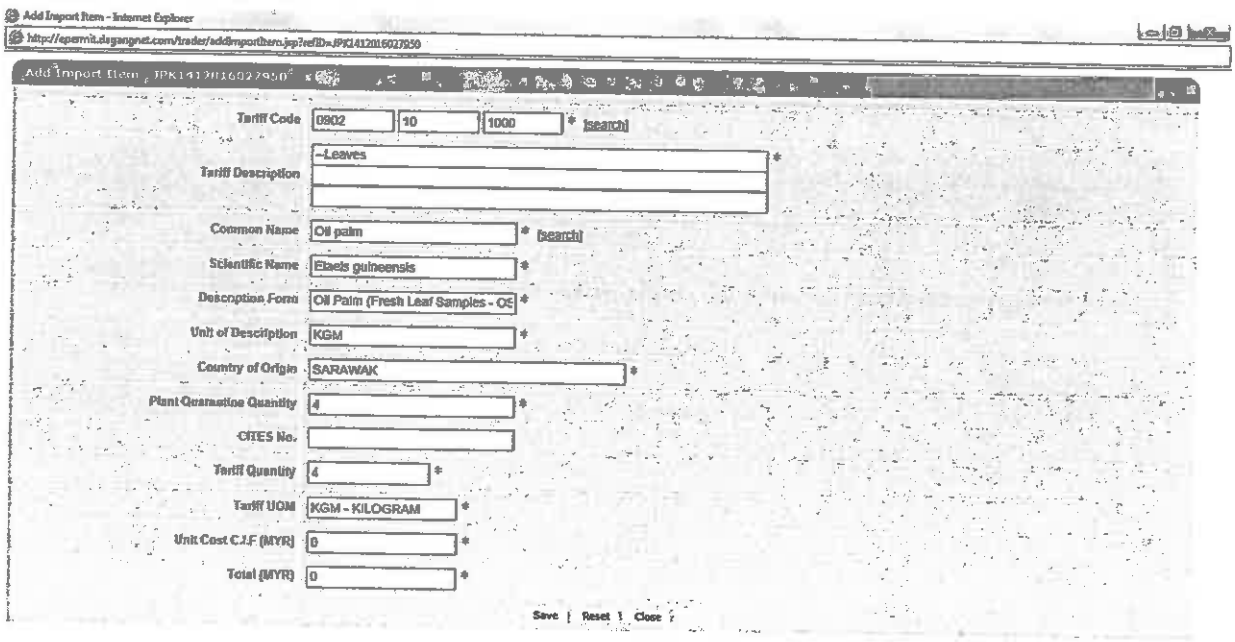
(Tandatangan Pemohon atau Wakil Yang Diberi Kuasa/Cop)

Group Leader
Emerging and Exotic Diseases
Ganoderma Diseases Research for Oil Palm (GANOD
Malaysian Palm Oil Board (MPOB)

Appendix 5: Application of Import Permit

Details:

a) Consignor : Malaysian Palm Oil Board Lahad Datu, Sabah
b) Consignee : Malaysian Palm Oil Board Kajang, sleangor
c) Purpose : Research
d) Country of Origin : Malaysia –MY
e) Place of Origin : Lahad Datu-MYLDU
f) Mode of Transport : Air
g) Consigned from : Malaysia-MY
h) Mode of delivery : Hand luggage
i) Entry Point : KLIA Sepang
j) Mode of Packaging : Box
k) Common name : Oil Palm
l) Scientific name : *Elaeis guineensis*
m) Description Form : Oil Palm (Fresh leaf sample)
n) Plant quarantine : 4 KG



Appendix 5: Import Permit

PQ 18

Application ID : JPK1412016019293

DEPARTMENT OF AGRICULTURE, MALAYSIA

PERMIT TO IMPORT PLANTS/SOIL/ROOTING COMPOST/ GROWING MEDIA/BENEFICIAL ORGANISMS/ORGANIC FERTILIZER

(Plant Quarantine Regulations 1981)

Permit No : **JPK141104007892016**

Name and address of consignee: MALAYSIAN PALM OIL BOARD
NO. 6, PERSIARAN INSTITUSI , 43000 KAJANG
SELANGOR

Name and address of consignor: MALAYSIAN PALM OIL BOARD
LOT 1262 1ST FLOOR , MIRI CENTRE POINT JALAN MIRI
98000 MIRI SARAWAK

Permission is hereby granted to the consignee to import the plants/plant products/soil/rooting compost/growing media/beneficial organisms/organic fertilizer contained in the Schedule hereto through

KLIA, Sepang
(Appointed entry check-point)

This Import Permit is valid for one consigment only until (date)
Further conditions:

Import Conditions, Additional Declarations, Other Requirements, Treatment, Post-Entry Requirements (For consignee only). }**See List Attached**

Schedule:

Descriptions	Quantity	Country of Origin
Elaeis guineensis Oil Palm (Fresh Leaf Samples - OS and CCCVd Analysis) For Malaysian Palm Oil Board (MPOB) Research Purpose Only	4 KG	SARAWAK

Date of Issue 07/04/2016

MALIZA HAZIN@AB RAHMAN

C/o: Director General of Agiculture
Peninsular Malaysia

DEPARTMENT OF AGRICULTURE
CROP PROTECTION & PLANT QUARANTINE SERVICES
PENINSULAR MALAYSIA

*This is a computer generated form and no signature required

DEPARTMENT OF AGRICULTURE, MALAYSIA

PERMIT TO IMPORT PLANTS/SOIL/ROOTING COMPOST/ GROWING MEDIA/BENEFICIAL ORGANISMS/ORGANIC FERTILIZER

(Plant Quarantine Regulations 1981)

Attachment To Import Permit

Permit No : **JPK141104007892016**

Scientific Name : **Elaeis guineensis**

Import Conditions :

1. Import Licence is to be sought from the relevant Ministry.
2. A copy of this Import Permit (IP) must be sent to the consignor.
3. Consignment must be accompanied with:

i. Import Permit (IP)

ii. Phytosanitary Certificate (PC) which has the Peninsular Malaysian Import Permit (IP) reference number printed at the additional declaration column.

4. Consignment must be exported within fourteen (14) days from the date of PC issued.
5. Consignment must be inspected and tested according to appropriate official procedures and are considered to be free from soil, pests, diseases, weed seeds contaminants and regulated articles by Department of Agriculture (DOA) Sarawak.
6. Consignment is allowed to enter at KLIA International Airport only.
7. Consignment is subjected to visual inspection, examination or analysis prior to clearance by MAQIS officer upon arrival at the point of entry into Peninsular Malaysia.

Treatment :

Nil

Additional Declarations :

DOA Sarawak must include this Additional Declaration in the PC:

1.The issuance of this PC is based on the Peninsular Malaysia IP reference number : JPKxxxxxxxxxxxx

Other Requirements :

1. PACKAGING:

The sample's packing must use sturdy material such as durable plastic and doubled-packed. The first packing is to ensure the safety of the sample as to avoid the loss of sample or cross-contamination and to prevent the escape of micro-organism. The second packing must be durable to ensure the safety of the sample during shipment or transportation.

2. LABEL:

Consignment shall be labelled and contained the following information:

a. The consignee name and address:

c/o Director of Plant Biosecurity Division
Department of Agriculture Peninsular Malaysia
National Post Entry Quarantine, 43409 Serdang, Selangor

b. The telephone number of the importer.

DEPARTMENT OF AGRICULTURE
PENINSULAR MALAYSIA
CROP PROTECTION & PLANT QUARANTINE SERVICES

*This is a computer generated form and no signature required

DEPARTMENT OF AGRICULTURE, MALAYSIA

PERMIT TO IMPORT PLANTS/SOIL/ROOTING COMPOST/ GROWING MEDIA/BENEFICIAL ORGANISMS/ORGANIC FERTILIZER

(Plant Quarantine Regulations 1981)

Attachment To Import Permit

Permit No : **JPK141104007892016**

Scientific Name : **Elaeis guineensis**

c. Plant Quarantine warning written on the container/ package as follow:
AMARAN KUARANTIN TUMBUHAN
PLANT QUARANTINE WARNING
DAUN SEGAR KELAPA SAWIT

Post-Entry Requirements :

1. The importer must inform the Plant Quarantine Officer(s), DOA Peninsular Malaysia (National Post Entry Quarantine - NPEQ Serdang. Sela Tel: 03-89484675 / 0389480995) the exact date of arrival of the consignment at least 1 week before the importation, failing which will affect future importation.
2. Upon arrival at the entry point, the consignment must be sent directly to NPEQ Serdang by the importer accompanied by MAQIS Officer(s) fo sampling and screening. The remaining consignment will be released to the importer.
3. The imported samples are used only for analysis purposes at Makmal GanoDROP 2, Bahagian Penyelidikan Biologi, No. 6, Persiaran Institut. Bandar Baru Bangi 4300 Kajang, Selangor.
4. All packing material are required to be autoclaved or incinerated immediately once the package is unpacked at the importer's premise with the presence of DOA Inspecting Officer(s) and recorded in the PQ 12 Form.
5. Upon completion of the laboratory analysis, all consignment must be destroyed. The importer must notify the Department of Agriculture (Enforcement Section, Plant Biosecurity Division, Tel: 03-2030 1411) prior to disposal. Disposal need to be recorded in PQ 12 form with the presence of DOA Inspecting Officer(s).
6. All cost incurred during post entry quarantine will be borne by the importer.

DEPARTMENT OF AGRICULTURE
PENINSULAR MALAYSIA
CROP PROTECTION & PLANT QUARANTINE SERVICES

*This is a computer generated form and no signature required

Appendix 6: Phytosanitary Certificate

PQ 16

	GOVERNMENT OF MALAYSIA **PHYTOSANITARY CERTIFICATE** FAO International Plant Protection Convention	**CUSTOMER COPY** Siri SB 054897 Certificate Number

To: The Plant Protection Organization(s) of	Place of Issue

DESCRIPTION OF CONSIGNMENT

1. Name and address of exporter	2. Declared name and address of consignee
3. Number and description of packages	4. Distinguishing marks
5. Place of origin	6. Declared means of conveyance
7. Declared point of entry	

8. Name of produce and quantity declared

No.	Name of produce	Botanical Name	Quantity	Unit

This is to certify that the plants, plant products or other regulated articles described herein have been inspected and/or tested according to appropriate official procedures and are considered to be free from the quarantine pests specified by the importing contracting party and to conform with the current phytosanitary requirements of the importing contracting party, including those for regulated non-quarantine pests.

DISINFESTATION AND / OR DISINFECTION TREATMENT

9. Date	10. Treatment
11. Chemical (Active ingredient)	12. Duration and temperature
13. Concentration	14. Additional information
15. Additional declaration	
Stamp of Organization 16. Date	18. Name of authorized officer

Appendix 7: MQ1

Borang MQ
Salinan Pengimpor

PERKHIDMATAN KUARANTIN DAN PEMERIKSAAN MALAYSIA (MAQIS) No. 026669
MALAYSIAN QUARANTINE AND INSPECTION SERVICES (MAQIS)
KEMENTERIAN PERTANIAN DAN INDUSTRI ASAS TANI
MINISTRY OF AGRICULTURE AND AGRO BASED INDUSTRY

Pemeriksaan Konsainan Yang Diimport
Inspection of Imported Consignments

No. Rujukan/*Reference No.*: D / 02.14 / A (02)

1 Nama dan Alamat Pengimport/Penumpang
Name and Address of Importer/Passenger
MALAYSIAN PALM OIL BOARD
No.6, PERSIARAN INSTITUSI, 43000
KAJANG SELANGOR

1.1 No. Telefon/Faks *Tel. No. Fax*: –

1.2 No. K.P./Pasport *I.C No./Passport*: –

2 Nama dan Alamat Ejen Penghantaran
Name and Address of Forwarding Agent
ANDAMY PROPERTIES SDN BHD
LEVEL 2 DAN 3 MENARA ANDAMY
BDR RAMAI-RAMAI PO BOX 142990 7/S
SOKN, SABAH.

2.1 No. Telefon/Faks *Tel. No. Fax*: –

2.2 No. K.P./Pasport *I.C No./Passport*: –

3 No. Bil Muatan/Airwaybil *Bill of Lading/Airwaybill No.*: –

4 No. Kapal/Penerbangan/Kenderaan *Vessel/Flight/Vehicle No.*: MH2711

5 Negara Asal/*Country of Origin*: SABAH

6 No. Daftar Kastam/*Customs Registration No.*: –

7 No. Manifes/Inbois *Manifest No./Invoice*: –

8 No. Lesen/Permit/*Licence/Permit No.*: JPK 1411010171020/14

9 No. Sijil/*Certificate No.*: PC(S) 14/98

10 No. Permit CITES/*CITES Permit No.*: –

11 Tarikh Import/*Date of Import*: 6/2/14

12 Tarikh Pemeriksaan/*Date of Inspection*: 6/2/14

13 Masa Pemeriksaan/*Time of Inspection*: 1740 HRS

14 Tempat Pemeriksaan/*Place of Inspection*: MTB (DOM)

15 Pegawai yang Memeriksa (Nama)/*Inspection by (Name)*: HEDRAWATI / KHAIRUL KORPHANY

16 Butiran Komoditi/*Commodity Details*

Bil.	Nama Komoditi/*Name of Commodity*	No. Kontena/*Container No.*	Kuantiti/*Quantity*	Nilai/*Value* (RM)
1	OIL PALM LEAVES	2 KGT		–
2	(MPOB - Research Only) 2013			
3				

17 **Keputusan Pemeriksaan/*Inspection decision***

☑ Dilepaskan/*Released*

☐ Dikuarantinkan/*Quarantined*

☐ Ditahan untuk tindakan lanjut kerana/*Detained for further action because*:

- ☐ Disyaki berperosak berpenyakit / *Suspected of being infested with pest/disease*
- ☐ Tiada Lesen/Permit / *Without valid Permit*
- ☐ Tiada Sijil Fitosanitasi / *Without Phytosanitary Certificate*
- ☐ Tiada Sijil Kesihatan / *Without Health Certificate*
- ☐ Diseman/berserta tanah / *Infested with soil*
- ☐ Tidak mematuhi syarat-syarat Permit Import / *Does not comply with Import Permit conditions*
- ☐ Tidak mematuhi 3P / *Does not comply with 3P*
- Lain-lain: Nyatakan/*Others, specify*: PERMIT & PC LENGKAP

18 Pengimport/Ejen Penghantaran/Penumpang
Importer/Forwarding Agent/Passenger

Tandatangan/*Signature*

No. Telefon/*Telephone No.*:

Tarikh/*Date*:

19 Penguat kuasa MAQIS
MAQIS Enforcement Officer

Tandatangan/*Signature*

No. Telefon/*Telephone No.*: 034 76 76 76

Tarikh/*Date*: 6/2/14