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Research Article
Knowledge Assessment of Basal Stem Rot Disease of Oil Palm and its Control Practices among Recipients of Replanting Assistance Scheme in Malaysia

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Abstract

Background and Objective: There are considerable variability among smallholders pertaining to their level of knowledge on oil palm management especially concerning pests and diseases. One of the important disease threatening oil palm areas are Basal Stem Rot (BSR), a disease that is commonly associated with fungus of the *Ganoderma* species. This study aimed to determine the level of knowledge regarding BSR disease of oil palm and its control practices among recipients of replanting assistance scheme (TSSPK) in Selangor, Negeri Sembilan and Perak and to identify the relationship between respondent's backgrounds with their level of knowledge. **Methodology:** A total of 310 respondents were selected based on proportionate and simple random sampling. Interview administrated questionnaires were employed to obtain the relevant data. **Results:** The study revealed majority of the respondents had low level of knowledge regarding BSR disease. Few variables have been found to have significant relationship with the level of knowledge on BSR among the respondents. Results highlighted the level of knowledge on BSR disease and its control practices among oil palm smallholders. **Conclusion:** This study proposed the way to determine the level of knowledge among small farmers. Larger sample would provide a general guideline in plan training and courses according to knowledge level of smallholders.

Key words: Extension services, basal stem rot disease, oil palm smallholder, *Ganoderma*, knowledge level, MPOB, oil palm

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Malaysia is one of the bigger players in oil palm industry. Currently, there are 5.64 million hectares oil palm in Malaysia which included of plantation companies, organized smallholders and independent smallholders. Smallholder sector plays a significant part in the Malaysian oil palm industry as there are accounting for 16% of the country's total oil palm planted area with 902,870 ha of oil palm[1]. According to Malaysian Palm Oil Board Licensing Regulations[2], oil palm smallholding in Malaysia are those who own oil palm land <40.46 ha or in aggregate amount <40.46 ha.

Replanting of oil palm has been found to be one of the strategies to improve oil palm productivity which are normally carried out when palms were between 25-30 years old[3-5]. In the year 2012 and 2013, the government through Malaysian Palm Oil Board (MPOB) has introduced replanting assistance scheme known as Tanam Semula Sawit Pekebun Kecil (TSSPK) under the National Key Economic Areas to help smallholders to replant their oil palms of >25 years old. Under the scheme, an assistance of RM 7,500 ha^{-1} was allocated to oil palm smallholders in Peninsular of Malaysia. In 2013, approximately, 19,062 oil palm smallholders with an area of 42,097 ha in Selangor, 4,325 smallholders with 21,361 ha in Negeri Sembilan and 34,194 smallholders with 99,789 ha in Perak have been registered by MPOB licensing department. Based on this, 364 smallholders with 456.64 ha in Selangor, 135 smallholders with 373 ha in Negeri Sembilan and 1090 smallholders with 2492.9 ha in Perak have received MPOB's replanting assistance scheme in the year 2012 and 2013. Among these smallholders, 17.58% of recipients in Selangor (64 recipients with 82.60 ha), 2.22% of recipients in Negeri Sembilan (3 recipients with 19.14 ha) and 15.23% of recipients in Perak (166 recipients with 331.61 ha) has been reported to be affected by BSR disease by extension agents during field visit.

Oil palms areas are under threat by Basal Stem Rot (BSR) disease, a disease that is commonly associated with fungus of the *Ganoderma* species. The *G. boninense*, *G. zonatum*, *G. miniatocinctum* and *G. tornatum* are the four species of *Ganoderma* that has been identified to be associated with oil palm in Malaysia. Based on this, *G. boninense*, *G. zonatum* and *G. miniatocinctum* were found to be pathogenic to oil palm, while *G. tornatum* were not pathogenic[6,7]. It has been estimated total affected area due to *Ganoderma* in Malaysia was about 151,208 ha in 2009 with an estimated loss of RM 1.3 billion. In 2020, it is estimated a total of 400,000 ha could be affected by *Ganoderma* disease in Malaysia[8,9]. Financial losses normally happen when >10% of the oil palm stands were affected by the disease. Young oil palms infected by the disease normally will die within 6-24 months, while mature palms will die in 2-3 years[10]. Previously the disease was reported to attack on palms of >30 years. Later in 1957, more cases of disease were reported on palms of 10-15 years old followed by younger palms of 1-2 years since the year 1990[11-13]. Field observation in Perak showed in replanting from jungle or rubber, BSR only appeared when the palms were about 10-12 years old. However, in replanting from coconut or oil palm, the disease appeared much earlier between 12-24 months after planting but more usually when palms were 4-5 years old. Thereafter, the incidence could increase up to 40-50% by the time palms were 15 years old[12]. Mapping of BSR disease in Selangor revealed the most of the incidences were confined along the coastal area suggesting that it might be due to planting of oil palm on previous coconut stands[14]. A study conducted among smallholders in West Johor has found the symptoms of *Ganoderma* disease appeared at a much earlier age when oil palms were replanted on land previously affected by *Ganoderma*[15]. A study conducted in an area affected by *Ganoderma* in Indonesia has found yearly production of FFB per hectare have dropped much higher in plantation growing oil palm after oil palm compare to oil palm after rubber[16]. Underplanting technique practiced in oil palm plantation also has been found to increase the incidence of *Ganoderma*[17]. Study also suggested *Ganoderma* can infect leguminous cover crop and possibly act as an alternative host for *Ganoderma*[7]. Soepena *et al.*[18] suggested to treat oil palm seedlings with biofungicide and also to use disease free soil in the oil palm nursery to prevent infection of *Ganoderma* to the oil palm seedlings.

There are few numbers of disease control and management techniques that can be applied to reduce long term losses due to *Ganoderma* disease. Preventive control such as sanitation by removal of diseased palms, usage of GanoEF biofertilizer and stump treatment with fumigant dazomet. The curative control methods to prolong the productive life of *Ganoderma* infected palms include the use of fungicide hexaconazole via trunk injection and soil mounding[19-21]. One of the alternative solutions to control *Ganoderma* attack, to address concern over accumulating *Ganoderma* inocula and to avoid further losses is through early replanting program[16]. The BSR infected palm showed several sign of external symptoms such as the decay of the palm bole, multiple unopened spear leaves and production of fruiting bodies on the trunk base. In severe cases, the palm usually dies or falls over. Fresh Fruit Bunch (FFB) is adversely affected by the disease incidence, not only through yield loss from dead palms but also through yield reduction from living diseased palms which produce less number of FFB and with reduced bunch weight.

Viability of oil palm smallholders have been threatened over the years by multiplicity of factors such as high costs of fertilizers, incidence of pests and diseases, unstable global crude palm oil price, environmental change and others. Farm management levels vary considerably within the smallholders pertaining to their productivity, yields and pests and diseases management. Much of this variability has been attributed to their own level of knowledge regarding oil palm management especially concerning pests and diseases. The challenge now is to deliver the correct transfer of technology pertaining to the knowledge level of smallholders on *Ganoderma* disease. This transfer of technology has already started with the Pusat Tunjuk Ajar dan Nasihat Sawit (TUNAS) from Malaysian Palm Oil Board (MPOB) with a dedicated smallholder task force to extensively deliver the extension services. Rogers[22] stated that awareness and knowledge of a new technology was the 1st step in the adoption process. Through lack of knowledge or through inaccurate perceptions, the individual's evaluation of an innovation may not agree with an expert's. Several reports have found that higher knowledge of smallholders will translate into better adoption and control practice of pests and diseases of plant. David and Asamoah[23] reported that higher knowledge about black pod disease of cocoa was significantly translated into adoption of the proper way of disposing the diseased pods compared with farmers with lower knowledge. Lack of knowledge on disease recognition and management of Cassava Brown Streak Disease (CBSD) among smallholders in Northern Uganda has contributed significantly to rapid spread of the disease[24]. A survey conducted in the Philippines, found that most rice farmers were able to describe tungro disease symptoms of rice but gaps existed in their understanding of the causes and modes of spread. Most of them also were unaware of the risk of leaving infected plants, which can act as a source of disease inoculums, which in turn can be a threat to new planting[25]. Several studies reported on the relationship between socioeconomic backgrounds of farmers with their knowledge level. Farming experience was found to significantly contribute to farmer's knowledge on safe pesticide use while education, income and age have been shown to have no relationship with the knowledge level on pest[26]. Participation in training programs and extension activities had been shown to have a significant relationship with the knowledge level among sugarcane growers[27].

Most of the impact studies on new technology adopted by farmers are predominantly focusing on their yield and productivity with less attention paid to changes in farmer's knowledge pertaining to the adoption of related technology. It is important to assess smallholders knowledge level on *Ganoderma* disease as a prelude to design effective extension services. Therefore, improvement of smallholder's knowledge level of *Ganoderma* disease would help them to further manage this disease effectively especially during the replanting stage. Thus, this study was conducted to determine the level of knowledge regarding BSR disease of oil palm and its control practices among recipients of replanting assistance scheme (TSSPK) in Selangor, Negeri Sembilan and Perak and to identify the relationship between respondent's backgrounds with their knowledge level.

MATERIALS AND METHODS

The study was carried out among recipients of MPOB's replanting assistance scheme in Selangor, Negeri Sembilan and Perak in the year 2012 and 2013. The list of recipients of replanting assistance scheme were obtained from Malaysian Palm Oil Board (MPOB). The population of study consisted of 364 smallholders with 456.64 ha in Selangor, 135 smallholders with 373 ha in Negeri Sembilan and 1090 smallholders with 2492.9 ha in Perak. Proportionate and simple random sampling was employed in this study. Based on Krejcie and Morgan[28], the total sample size for the study was 310. Based on proportionate sampling, sample size of 71 respondents were randomly selected from Selangor, 26 respondents from Negeri Sembilan and 213 respondents from Perak. The study employed a survey research methodology using interview administrated questionnaire to gather information pertaining to knowledge of oil palm smallholders about BSR disease of oil palm and its control practices. Questionnaire and survey is an important data gathering process to determine knowledge level of a plant disease and its control practices. Farmer's surveys can identify gaps in knowledge, misconceptions or inappropriate practices that need to be addressed by Bentley and Andrews[29]. The interview was conducted by field extension agents from MPOB. A total of 21 questions about *Ganoderma* disease were developed covering aspects such as the method of infection, causes, identification of *Ganoderma* fungus, symptoms and their control methods. Quantification on the level of knowledge was made by giving one score and zero score for correct and incorrect answers, respectively. The score of all the individual items was summed to get the final knowledge score of respondents. Based on the total score obtained, respondents were categorized into three category of low, medium and high level of knowledge. Both descriptive and inferential statistics were used to describe the data and also to determine any relationship between the selected respondent's backgrounds with the level of knowledge.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents: Based on data in Table 1, a total of 25.8% of respondents were between the age of 51-60 years and followed by 24.5% between the age of 61-70 years. Only 4.2% of respondents were in the young category age of <30 years. The mean age of the respondents were 54.7 years old. This data implied that most of the oil palm smallholders were older farmers with less involvement of younger generation in the oil palm sector.

Table 1: Socio-demographic profile of respondents

Categories	Frequency (n)	Percentage	Average
Age (years)			
≤30	13	4.2	54.7
31-40	38	12.3	
41-50	65	21.0	
51-60	80	25.8	
61-70	76	24.5	
>70	38	12.3	
Gender			
Male	237	76.5	
Female	73	23.5	
Education level			
No formal education	15	4.8	
Primary school	78	25.2	
Secondary school	161	51.9	
College/university	56	18.1	
Full time oil palm smallholders			
Yes	138	44.5	
No	172	55.5	
Years of experience (years)			
≤10	206	66.5	8.9
11-20	62	20.0	
21-30	33	10.6	
31-40	3	1.0	
>41	6	1.9	
Time spent at farm in a week (h)			
<1	65	21.0	
1-2	69	22.3	
3-4	87	28.1	
5-6	31	10.0	
>6	58	18.7	
Land holding (ha)			
≤1.0	85	27.4	2.3
1.1-2.0	132	42.6	
2.1-3.0	36	11.6	
3.1-4.0	16	5.2	
>4.0	41	13.2	
Hire labour to conduct farm work			
Yes	250	80.6	
No	60	19.4	
Attended training on oil palm			
Yes	94	30.3	
No	216	69.7	
Adopted any new technology at farm in the last 5 years			
Yes	61	19.7	
No	249	80.3	
No of training attended			
1	23	7.4	
2	18	5.8	
3	10	3.2	
4	4	1.3	
5	39	12.6	
None	216	69.7	

Table 1: Continue

Categories	Frequency (n)	Percentage	Average
No of Sources of information			
1	173	55.8	
2	67	21.6	
3	43	13.9	
4	20	6.5	
5	7	2.3	
No of new technology adopted in the last 5 years			
1	18	5.8	
2	9	2.9	
3	34	11.0	
None	249	80.3	
Farm previously reported of having BSR by extension agents			
Yes	54	17.4	
No	256	82.6	
Nearby farm reported of having BSR by extension agents			
Yes	80	25.8	
No	230	74.2	

BSR: Basel stem rot

This data are consistent with most of the local studies on agriculture conducted in Malaysia[30,31].

Most of the respondents were males as they represent 76.5% compare to only 23.5% of females. Table 1 further shows 51.9% of respondents possessed secondary school qualification followed by 25.2% who had primary school qualification. Only a small number of respondents (4.8%) did not had any formal education, while 18.1% had higher education qualification of college or university. More than half of the respondents (55.5%) were not full time oil palm smallholders as most of them were self-employed and working on other business.

In terms of years of experience, most of the respondents (66.5%) have <10 years of experience in managing oil palm. The mean score for year of experience was 8.9 years. Majority of the respondents (28.1%) were spending between 3-4 h at farm in a week, while only 18.7% were spending >6 h at farm. This is not surprising as 80.6% of respondents were hiring external labour to conduct most of their farm works such as harvesting, fertilizer application and weeding.

The mean land holding of respondents was 2.3 ha as 42.6% of respondents were having land size of 1.1-2.0 ha. Majority of the respondents (69.7%) did not attended any training related to oil palm. Among the respondents who attended training, majority of them (12.6%) have attended at least five trainings with most of them have attended training on fertilizer application. This is not surprising as all the recipients of replanting assistance scheme will be given training on fertilizer application by extension agent during distribution of fertilizer under the scheme. Majority of the respondents (80.3%) did not adopt any new technology at their farm in the last 5 years compare to only 19.7% who adopted the technology. Among the respondents who adopted new technologies, most of them (11%) have adopted at least three new technologies with most of them adopting the correct technique of fertilizer application at their farm. These findings suggested that respondents who have attended training or adopted new technology are really committed by continuously attending more training and adopting more technology at their farm.

Slightly more than half of the respondents (55.8%) use only one type of source for information on oil palm followed by 21.6% who use two types of sources for information. Only a small fraction of respondents (2.3%) use five types of sources for information. Among this, most of the respondents answered that they are referring to their friends as one of the source of information. Hassan *et al.* [32] reported that friends and village leaders were among the most preferred and trusted source of agricultural information among rural community as it is easily and frequently available. Farmers extensively rely on other farmers and face-to-face interactions as their sources of information[33].

Based on feedback from extension agents, only 17.4% of the total respondents were reported of having Basal Stem Rot (BSR) at their farm based on previous visit by extension agents prior to applying for replanting assistance scheme under MPOB. Among these respondents, majority of them (81.5%) answered that they knew about BSR disease as extension agents had earlier mentioned about the disease during their previous visit. These findings suggested that extension agents play an important role in disseminating information to smallholders.

Further feedback from extension agents revealed that, 25.8% of respondent's farms were situated near to other farms which were reported of having BSR. Among these respondents, most of them (67.8%) answered that they knew about BSR disease. Possibly, these respondents might

Table 2: Level of knowledge on basal stem rot disease of oil palm among respondents

	Knowledge level of smallholders			
	Correct answer		Incorrect answer	
Questions/statements	n	%	n	%
Causes of *Ganoderma* disease	94	30.3	216	69.7
Physical appearance of *Ganoderma* fungus	106	34.2	204	65.8
Identification of pathogenic *Ganoderma* fungus	94	30.3	216	69.7
Method of infection of G*anoderma*	68	21.9	242	78.1
Spreading of BSR due to diseased old tree that are left in the field without treatment	81	26.1	229	73.9
Spreading of BSR when planted on former BSR infected land of rubber or coconut	74	23.9	236	76.1
Increase in BSR spreading due to under-planting technique	80	25.8	230	74.2
Age of oil palm tree affected by BSR	59	19.0	251	81.0
Infection of BSR on oil palm seedlings at nursery stage	11	3.5	299	96.5
Spreading of BSR other than oil palm	51	16.5	259	83.5
Identification of alternative crop affected by BSR other than oil palm	50	16.1	260	83.9
Spreading of BSR to cover crop	5	1.6	305	98.4
Reduction of yield due to BSR infection	103	33.2	207	66.8
Percentage of BSR infection resulted in economic loss	63	20.3	247	79.7
Symptoms of BSR on oil palm	119	38.4	191	61.6
Type of control practices of BSR	79	25.5	231	74.5
Sanitation practices of BSR	52	16.8	258	83.2
Trunk injection of BSR	62	20.0	248	80.0
Chemical used for trunk injection	43	13.9	267	86.1
Criteria to apply trunk injection	52	16.8	258	83.2
Soil mounding practices of BSR	48	15.5	262	84.5

BSR: Basal stem rot

Table 3: Categorization of respondents based on their level of knowledge regarding BSR disease

Knowledge level	Frequency (n)	Percentage
Low (0-7)	225	72.6
Moderate (8-13)	36	11.6
High (14-21)	49	15.8

Mean: 4.52, SD: 6.46, n: 310, n= Number of respondents

know about BSR disease through their friends nearby who's farms were affected by BSR. This report is consistent with the earlier data suggesting that most of the respondents were referring to their friends as one of the source of information.

Level of knowledge on basal stem rot disease of oil palm: Table 2 shows the correct and incorrect answers by respondents based on a total of 21 questions related to BSR disease. Almost all the respondents, 98.4% did not know that BSR can spread to the cover crop that are planted in oil palm plantation. Similarly, 96.5% respondents did not have the knowledge that oil palm seedlings at the nursery stage are capable of getting infected by *Ganoderma*. Based on the percentage of correct answers, most of respondents (38.4%) were able to identify the symptoms of BSR at field followed by 34.2% who were able to physically describe the *Ganoderma* fungus. Based on the answers, it was noted that most of the respondents have a basic understanding on BSR rather than in-depth knowledge. This might be due to the fact that most of the respondents were referring to their friends as one of the source of information who themselves might have a limited knowledge on BSR. Therefore, extension services needed to be easily and frequently available to smallholders as a way to encourage them to sought information from extension agents.

Table 3 revealed that the majority of respondents (72.6%) have low level of knowledge regarding BSR disease. It can be noted that 15.8% of respondents have high level of knowledge followed by 11.6% that belong to moderate level of knowledge about BSR disease.

Relationship between selected variables with the level of knowledge on basal stem rot disease: Pearson product-moment correlation analysis was conducted to identify the relationship between selected variables with the level of knowledge on BSR. Results in Table 4 show the full time oil palm smallholders, experience on oil palm, time spent at farm, ever attended training, adoption of new technology, number of training attended, number of sources of information, number of new technology adopted, farm previously reported of having BSR and nearby farm reported of having BSR have significant relationship with the level of knowledge on BSR among the respondents. Factors such as age, size of landholding and education were identified to be non-significant with the level of knowledge on BSR.

Table 4: Relationship between selected variables with the level of knowledge on basal stem rot disease using pearson product moment correlation

Variables	Correlation coefficient (r)
Age	-0.024
Education	-0.082
Full time oil palm smallholders	0.264**
Experience on oil palm	0.384**
Time spent at farm	0.228**
Size of landholding	-0.093
Ever attended training	0.574**
Adoption of new technology	0.586**
Number of training attended	0.620**
Number of sources of information	0.118*
Number of new technology adopted	0.599**
Farm previously reported of having BSR	0.295**
Nearby farm reported of having BSR	0.349**

**Correlation is significant at 1% level (2-tailed)
*Correlation is significant at 5% level (2-tailed)

Respondents who work full time as oil palm smallholders on their farm tended to have higher knowledge on BSR as they are more committed in seeking knowledge compare to non-full time smallholders. One of the way to gain their attention and increase their commitment level is by emphasizing more on the economic impact due to BSR disease and its severity to smallholders. Similarly, smallholders who are spending more time at farm tended to have better knowledge on BSR as they are able to identify any unusual problems at their farm and seek appropriate solution. Experienced people tended to have better knowledge on BSR as indicated by the significant relationship of correlation analysis as they accumulate knowledge based on their long years of experience. These results coincide with those reported by Midega *et al*.[34]. Extensive training need to be given to smallholders on BSR as a way to increase their experience which will eventually resulted in higher level of knowledge. It is clearly shown that, respondents who attended training on oil palm had better level of knowledge on BSR as compare to respondents who did not attended any training. Similarly, higher number of training attended by respondents significantly correlated to higher level of knowledge on BSR. Therefore, extension agents should introduce and increase the number of trainings to smallholders. Adoption of new technology contribute significantly towards the level of knowledge on BSR indicating that smallholders who are adopting new technology are always seeking the latest information thus increasing their knowledge. Similarly, higher number of technology adopted by smallholders resulted in higher level of knowledge. Better transfer of technology need to be introduced to smallholders to increase their participation thus increasing their knowledge. Respondent's farm which were previously reported of having BSR by extension agents had resulted in significant correlation on their level of knowledge about BSR. These results suggested that, smallholders who have contacted with extension agents and had received information about BSR during the replanting scheme application were able to demonstrate an increase in their level of knowledge. Therefore, extension agents need to further increase their level and frequency of engagement with smallholders in disseminating information on BSR. Extension services on BSR need to be increased to the area mainly affected by BSR as it will be resulted in increase of knowledge among the surrounding smallholders through sharing of knowledge. These findings were based on significant correlation reported between nearby farm that were reported of having BSR with the respondent's level of knowledge.

CONCLUSION AND RECOMMENDATION

The current study revealed that most of the recipients of replanting assistance scheme have a low level of knowledge regarding BSR disease. Several factors have been found to have significant relationship with the level of knowledge on BSR such as full time oil palm smallholders, experience on oil palm, time spent at farm, ever attended training, adoption of new technology, number of training attended, number of sources of information, number of new technology adopted, farm previously reported of having BSR and nearby farm reported of having BSR. Therefore, extension services need to be more focused on these factors as a way to increase the level of knowledge on BSR among the recipients of replanting assistance scheme. It is recommended that extension services need to be easily and frequently available to smallholders as a way to increase their participation in extension activities. On top of it, comprehensive training module on BSR need to be introduced to recipients of replanting assistance scheme especially those who are affected by BSR as way to increase their knowledge as well as to reduce the spreading of BSR.

One of the limitation of this study is that it only involved respondents from three states of Malaysia rather than respondents from all states of Malaysia. While the study greatly helped in identifying level of knowledge on BSR in three states, it is difficult to generalize the results to the entire oil palm smallholders in Malaysia. Therefore, further study should be conducted comprising respondents representing smallholders from all states in Malaysia as well as comparison study between smallholder's area affected by G*anoderma* and without G*anoderma*. Apart from that, further study should focus on identifying other constraints faced by smallholders in managing BSR disease such cost of application, availability of technology, availability of resources and many others.

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