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Evaluation on Cost and Efficacy of Herbicides to Eradicate *Merremia peltata* in Immature Oil Palm at Kinabatangan Region

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Merremia peltata *is a perennial vine with large underground tuber. The smooth stem can climb to more than 20 m long and twine at the tips. A humid tropic up to 700 m sea level provides suitable habitat to the* Merremia peltata *seeds to sprout with fast growth rates. In Sabah, it is commonly found in the immature oil palm field and has become a type of endemic weed competing with the leguminous cover crops. Removal and eradication of these weeds are observed to be labour intensive, costly due to multiple rounds of herbicide treatment needed and most importantly, may impede oil palm growth if it is not adequately controlled.* Merremia peltata *is found to grow in Genting Plantations Berhad (GENP) estates in Kinabatangan region. A trial was conducted on hilly terrain planted with immature oil palm of 2 years old with the objective to evaluate the various types of herbicides (systemic and contact) to control* Merremia peltata *up to the extent of when the subsequent spraying is necessary. The annual rainfall recorded was around 3 000 mm. Equipment used in the trial was the Conventional Knapsack Sprayer (CKS), 16 L sprayer calibrated to 450 L for blanket spraying fitted with LSA/4 (green) nozzle. A range of single herbicides was evaluated and ranked accordingly to the results based on the product efficacy as well as cost-effectiveness. The herbicide treatments were MSMA+ diuron (2.3 and 3.0 L/ha), glufosinate-ammonium (3.3 L/ha), MSMA (2.8 and 3.9 L/ha), metsulfuron-methyl (250 and 350 g/ha) and triclopyr (1.5 and 2.0 L/ha). The post-treatment analysis was carried out based on visual observation at 1, 2, 4, 8, 12 and 16 weeks after treatment (WAT) on the percentage of* Merremia *killed and incidence of regeneration or no effect (0% = no effect / full regeneration, 100% = complete kill). Seven out of ten treatments recorded 100 per cent kill at 4 weeks after treatment. Triclopyr being the best treatment, giving more than 90 per cent kill as early as 2 WAT up to 8 WAT with more effective control contributing to the lowest regeneration stage at 5 per cent. Triclopyr was also the most cost-effective treatment estimated at RM13.95 per treated hectare (50 ml/16 L water) compared with other type of herbicides. MSMA+ diuron and glufosinate-ammonium were ranked the second and third herbicides whose results were similar to triclopyr but with higher cost per treated hectare ranging from RM25 – RM45. Overall, subsequent round of herbicides treatment would be required every 3 months to control* Merremia peltata.

Keynote: Merremia peltata, *immature oil palm, herbicide evaluation.*

Merremia peltata is one of the plants with over 50 species available from Convolvulaceae family. It is widely distributed from East Africa through Indian Ocean Islands, Malesia and eastwards into Polynesia to many islands of the Pacific. This plant has smooth stems and climbing vines up to 20 m with a large underground tuber (Paynter *et al*., 2006).

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Often, *M. peltata* likes humid tropic favouring the edges of primary and secondary lowland forest and also plantations. Due to its natural attributes as a twinning plant, it is seen to smother and strangle other vegetations and become thickets forming a ground cover or canopy. According to Nazif and Pratiwi (1991), *M. peltata* is observed to be a dominant species in the forest plantations in western Polynesia, the Solomon Islands and Indonesia. As reported by Dovey *et al.* (2004 as cited in Paynter *et al.,* 2016), *M. peltata* was considered one of 24 serious weed targets to be explored for biological control in the Pacific island countries and territories. It frequently grows in the open area very quickly (Kirkham, 2004 as cited in Yansen *et al.,* 2014). Contrary to some local communities in Indonesia, *M. peltata* is considered as a perennial herbaceous plant due to its functionality as a traditional medicine for anti-cancer, diarrhea, abdominal pain, cough, sore eyes, wound, inflammation and wound compress (Alen *et al.,* 2016).

In Sabah, *M. peltata* is commonly seen in the immature oil palm areas. It becomes serious when this invasive large-leaved creeping weed dominates the field and competes with leguminous cover crops such as *Pueraria javanica* and *Calopogonium caeruleum.* Similar to other types of weeds, the uncontrolled infestation may lead to yield reduction and poor oil palm growth caused by water, nutrient, moisture, light and carbon dioxide competition. In the immature oil palm area (*Figure 1*), the impact of this competition is higher than the mature oil palm areas as spaces between the immature palms provide gaps and more light thus offering greater opportunity for such weeds to grow everywhere. With such field condition, it causes difficulty to oil palm management such as manuring operation and frond placement tend to be difficult. The use of herbicides to control *M. peltata* was reported by Balasubramaniam and Wijayanto (2015). The trials were conducted in Indonesia in immature oil palm plantings. Balasubramaniam and Wijayanto (2015) concluded that both glyphosate (2.0 L/ha) and triclopyr (1.5 L/ha) provided more than 90 per cent kill over 12 weeks after treatment with excellent control of *M. peltata* by triclopyr

(a) **(b)**

Figure 1 Merremia peltata *a)* M. peltata *creeps in an open area, dominating and competing with leguminous cover crops. b)* M. peltata *strangles immature oil palm and may become thickets if left uncontrolled*

at 100 per cent kill.

This paper reports the results of a trial that was conducted in Genting Plantations Research Centre Sabah in 2018 which is located in the area of Kinabatangan region. The bio-efficacy and cost-effectiveness of several herbicides in order to control *M. peltata*, was assessed and will be further discussed in this paper.

MATERIALS AND METHOD

The trial was conducted with 2-year-old palms (2017 planting) on a hilly area with sandy clay loam soil of Kumansi series derived from the sandstone and mudstone soil parent material. The annual rainfall recorded in the area was approximately 3 000 mm. There are ten treatments evaluated from five different herbicides at two different dosages each. The targeted weed was treated with single herbicide application without any mixture or adjuvant added solution. The sources of herbicides used were from generic to original brand-name herbicides. Generic products often have the same active ingredients but not required to have the same inactive ingredients as compared to the original brand-name herbicides. Hence, a similar effect of the active ingredient to the targeted weeds are expected, however, not evaluated in this observation.

Calibration of spray pump was carried out based on the conventional knapsack sprayer (CKS - 16 litre) fitted with LSA/4 (green) nozzle which is able to deliver 450 L per hectare of blanket spraying. A plot size of 4 ft x 5 ft was marked and all treatments were replicated three times randomly in between palms. It was ensured that spraying of herbicides was carried out only in the treatment plots to avoid any spray drift and contact with the other oil palm. The application of treatment to all plots was completed within a day and fully supervised until the end of the treatment application.

The data collection is based on visual observation on the percentage of *M. peltata* that is killed, no effect and incidence of regeneration (0% = no effect / full regeneration, 100% = complete kill). Regeneration of *M. peltata* after treatment was further evaluated to define the term of the impact of the treatment at 50 per cent regeneration of weed prior to subsequent herbicides application needed. More information on the treatments can be seen in *Table 1*.

TABLE 1
LIST OF TREATMENTS ON *M.PELTATA*

Treatment	*Active ingredient*	*Rate/ha*
T1	MSMA 39.5% + Diuron 7.8% w/w	3.00 L
T2	MSMA 39.5% + Diuron 7.8% w/w	2.30 L
T3	Glufosinate–ammonium 13.8% w/w	3.30 L
T4	Glufosinate–ammonium 13.8% w/w	2.80 L
T5	MSMA 47% w/w	3.90 L
T6	MSMA 47% w/w	2.80 L
T7	Metsulfuron-methyl 20% w/w	350 g
T8	Metsulfuron-methyl 20% w/w	250 g
T9	Triclopyr–butotyl 32.1% w/w	2.00 L
T10	Triclopyr–butotyl 32.1% w/w	1.50 L

RESULT AND DISCUSSION

Based on *Table 2*, the percentage of *M. peltata* killed will determine the efficacy of the herbicide applied. Application of metsulfuron-methyl at 0.012 kg and 0.008 kg per 16 L of water (0.35 kg and 0.25 kg per ha) were not effective in controlling *M. peltata* at 2 and 4 WAT. The efficacy of herbicide recorded for metsulfuron-methyl single application at different rates was much slower at 4 WAT ranging from 20 to 50 per cent with the maximum percentage of weed killed being 70 to 80 per cent at 8 WAT. Hence, these treatments trigger the least effect on all the herbicides tested in providing short to long-term control of *M. peltata.*

Application of MSMA + diuron at 2.30 L and 3.00 L per hectare, glufosinate-ammonium at 2.80 L and 3.30 L per hectare, triclopyr–butotyl at 1.50 L and 2.00 L per hectare effectively control *M. peltata* with 100 per cent kill at 4 WAT. Plots treated with MSMA + diuron at 3.00 L per hectare provided quicker control at more than 90 per cent as early as 1 WAT (*Figure 2*). Weed regeneration started at 8 WAT and gradually increased from 20 per cent to 95 per cent at 16 WAT. A single application of MSMA herbicide at 3.90 L per hectare and 2.80 L per hectare also gave 100 per cent kill at 4 WAT, however, the early symptom of desiccation of treated plots were slightly slower than the application of MSMA + diuron while more than 90 per cent of the weed reinfestation occurred at 16 WAT.

Glufosinate-ammonium at 2.80 L per hectare gave similar results to MSMA + diuron although the early kill was slightly slower at 50-60 per cent during 1 WAT (*Figure 3*). However, reinfestation of *M. peltata* occurred more rapidly than MSMA + diuron treated area. Collins (1991) as cited in Wibawa (2009) reported that contact herbicides such as paraquat and glufosinate-ammonium have limited efficacy over perennial weeds but is more effective on early established or

TABLE 2
EFFECT OF HERBICIDES ON *M.PELTATA*

Treatment	*Active ingredient*	*Rate/ha*	*Percentage (%) of* Merremia peltata *killed [mean of 3 replicates - assessed over week after treatment (WAT)]*					
			1	*2*	*4*	*8*	*12*	*16*
T1	MSMA 39.5% + Diuron 7.8% w/w	3.00 L	90	100	100	80	30	5
T2	MSMA 39.5% + Diuron 7.8% w/w	2.30 L	80	100	100	80	20	10
T3	Glufosinate–ammonium 13.5% w/w	3.30 L	60	100	100	70	0	0
T4	Glufosinate–ammonium 13.5% w/w	2.80 L	50	100	100	85	20	5
T5	MSMA 47% w/w	3.90 L	70	90	100	80	30	10
T6	MSMA 47% w/w	2.80 L	50	70	100	75	15	0
T7	Metsulfuron-methyl 20% w/w	350 g	0	0	50	80	20	5
T8	Metsulfuron-methyl 20% w/w	250 g	0	0	20	70	10	0
T9	Triclopyr–butotyl 32.1% w/w	2.00 L	30	90	100	95	30	5
T10	Triclopyr–butotyl 32.1% w/w	1.50 L	30	90	100	95	40	30

Note: 0 = no effect / full generation
100 = *M. peltata* completely killed

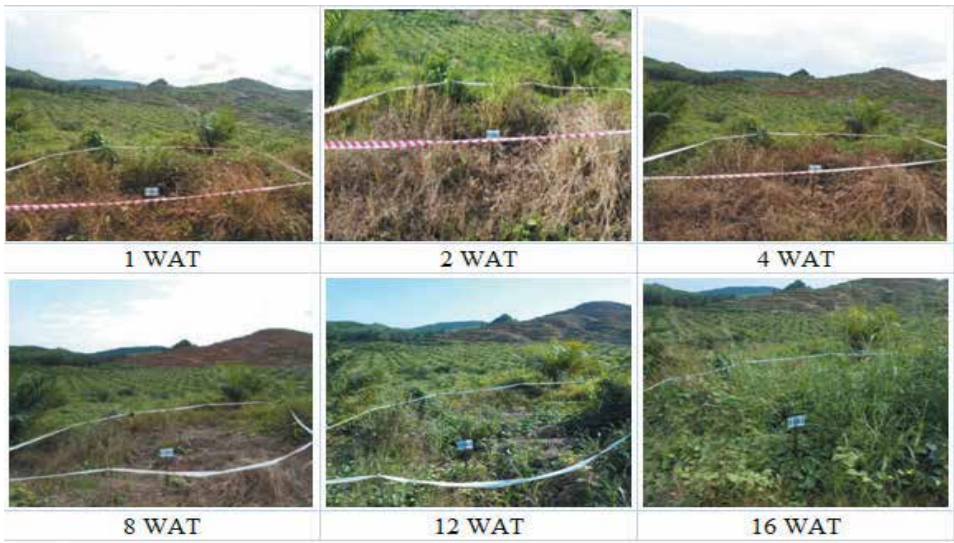

Figure 2 Effects of MSMA + diuron at 3 L per hectare on M.peltata *from 1 - 16 WAT*

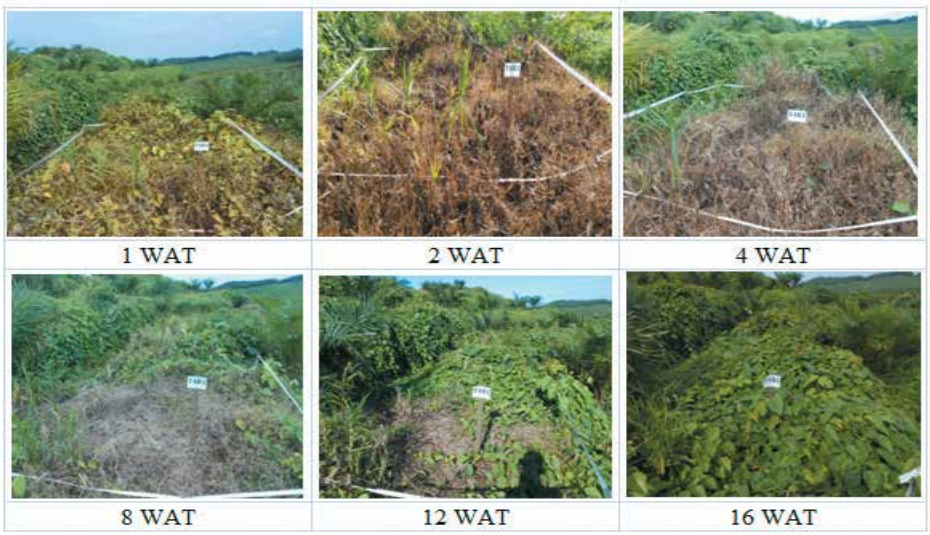

Figure 3 Effects of glufosinate-ammonium at 2.80 L per hectare on M. peltata *from 1 - 16 WAT*

vegetative phase of growth. This statement may further suggest that the reason for more rapid regeneration of *M. peltata* as a perennial weed with large leaves is due to the thick foliage which shielded the basal stem from the herbicide spray making contact with the storage capacity of underground tuber.

Triclopyr-butotyl at 1.50 L per hectare performed its best from 2 to 4 WAT with more than 90 per cent kill. Although the percentage of *M. peltata* killed was only 30 per cent during the earlier stage (1 WAT), because of the

systemic effect, the absorption and translocation of the herbicide to the point of damaging or killing the plant was slightly slower. However, treatment with triclopyr-butotyl gave longer duration of effective control compared with MSMA + diuron and glufosinate-ammonium with up to 95 per cent at 8 WAT and 60 per cent at 12 WAT regeneration of *M. peltata* respectively (*Figure 4*).

Recolonisation of *M. peltata* was observed to be extensive during 12 WAT with rapid regeneration of new vegetative shoots and extension of this weed from the untreated area creeping and occupying the treated plots. To avoid such incidence, re-application of herbicides at 3 months interval (12 weeks) is suggested to maintain weed suppression.

Three treatments in this evaluation that gave adequate control over *M. peltata* are: triclopyr-butotyl, MSMA + diuron and glufosinate-ammonium. The total cost for using triclopyr is estimated at RM13.95 per treated hectare and it is the lowest cost of treatment in the trial. MSMA + diuron and glufosinate–ammonium treatments gave relatively higher cost estimated at RM32.67 and RM35.95 per treated hectare respectively (*Table 3*). Even though these treatments showed satisfactory control up to 8 WAT, triclopyr-butotyl still was the most cost-effective treatment used requiring three to four rounds of application in a year.

CONCLUSION

Three treatments gave effective control of *M. peltata* in the immature oil palm namely triclopyr-butotyl at 1.50 L per treated hectare, MSMA+diuron at 3 L per treated hectare and glufosinate-ammonium with 2.80 L per treated hectare. The good kill at 100 per cent of weed was achieved at 4 WAT. Rapid regeneration of new vegetative shoots observed at 12 WAT suggest re-application of herbicides at 3 months interval is necessary to maintain weed suppression. As a precautionary action, application of treatments should be fully supervised to avoid spray drift and contact to the immature palms.

Cost comparison between treatments

Figure 4 Effects of triclopyr-butotyl at 1.50 L per hectare on M. peltata *from 1 – 16 WAT*

TABLE 3
ESTIMATED COST OF THREE EFFECTIVE TREATMENTS TO CONTROL *M.PELTATA*

Treatment	*Active ingredient*	*Rate/ha*	*Estimated cost per treated hectare (RM)*
10	Triclopyr–butotyl 32.1% w/w	1.50 L	13.95
1	MSMA 39.5% + diuron 7.8% w/w	3.00 L	32.67
4	Glufosinate–ammonium 13.8% w/w	2.80 L	35.95

Note: Sprayer equipment used – CKS, 16 L
Nozzle used – LSA / 4 @ 450 L water

depicted that triclopyr-butotyl at 1.50 L per hectare performed the most economical treatment which cost RM13.95 per treated hectare per application.

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