

Screening Herbicides for the Control of *Davallia denticulata*

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A weed control trial was carried out in an oil palm planting on peat soil to evaluate the efficacy of several herbicides against *Davallia denticulata*. Results from 13 weeks' evaluation showed that tank-mix of 75 ml glufosinate ammonium 15% w/v plus 2.22 g saflufenacil 70% w/w in 10 L water, tank-mix of 50 ml triclopyr BEE 67.0% w/v plus 3 g saflufenacil 70% w/w in 10 L water and tank-mix 15 g metsulfuron-methyl 20% w/w plus 4 g saflufenacil 70% w/w in 10 L water were effective against the weed with more than 90 per cent control when the trial was terminated at the thirteenth week after treatment.

Keywords: *Davallia denticulata*, weed management, saflufenacil.

Davallia denticulata (Burm. f.) Mett. ex Kuhn, also known as Rabbit's foot fern or *Paku tertutup* in Malay language (Chung *et al.*, 2013). It is a native fern in Africa, China, Sri Lanka, India (Assam), Myanmar, Thailand, Laos, Cambodia, Vietnam, throughout Malesia to Australia and the Pacific Island (Parris *et al.*, 2013).

In Latin, *denticulatus* means "with teeth", referring to the frond segments above the indusium of the plant. It is a very common epiphyte in different forest types including mangrove and coastal forest, sometimes just above high tide, on a wide variety of trees including in the old leaf bases of oil palm (*Elaeis guineensis* Jacq.), and rooted in other epiphytes like the bird's nest fern (*Asplenium nidus* L.), also as lithophytes on various substrates, especially on limestone and quartz or terrestrial, from sea level to 600 m altitude (Parris *et al.*, 2013).

The morphology of *D. denticulata* was

clearly described by Parris *et al.* (2013). The rhizome is 3-15 mm diameter without the scales, not white waxy, scales red-brown or nearly black, with pale border from the base to apex or without a pale border, narrowed evenly towards the apex or flat and nearly acicular, narrow abruptly from a broad based, often curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part or toothed, smooth on the adaxial surface, peltate, 4-8 mm long. The fronds is stipes pale, adaxially grooved, 4-50 cm long, glabrous or with few scale, lamina compound, bipinnate or tripinnate or quadripinnate towards base and in the middle part, deltoid and broadest towards base, glabrous, 16-90 x 13-50 cm, not or slightly dimorphic; longest petiolules 4-35 mm long, pinnae deltoid, longest pinnae 8-45 x 5-30 cm; pinnules or pinnalobes deltoid or narrowly ovate or ovate, longest pinnules 3.4-20 x 1.3-11 cm, ultimate pinnae lobed almost to the midrib or only shallowly lobed, linear oblong or narrowly

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ovate, ultimate segments 5-27 x 2-6 mm, acute and usually ending in a tooth; veins in sterile ultimate lobes pinnate (or forked in very narrow lobes) reaching the margin, false veins present. There is several sori on a segment, at the forking point of veins (*Figure 1a*); indusia attached along the sides, pouch-shaped, oblong, longer than wide or about as wide as long, 1-1.3 x 0.5-1 mm, lips or upper margin not elongated, truncate or slightly rounded, separated from or even with lamina margin, lamina generally extending into a tooth at both sides of a sorus or only at the outside of a sorus.

Davallia denticulata is a very common fern in oil palm plantations and rarely hindering estate's operation. However, this particular fern is able to grow vigorously and rapidly in both open and shaded areas with oil palm planted on peat soil (*Figure 1b*), and has become one

of the most troublesome weed species in oil palm plantations, dominating the ground surface at some of the area on the peat soil and hindering harvesting operation. It cannot be controlled with the usual weeding programme in oil palm plantations such as 35 ml glyphosate isopropylamine 48.6% w/v plus 1.5 g metsulfuron-methyl 20.0% w/w in 10 L water or 75 ml glufosinate ammonium 15% w/v in 10 L water, as the weed regrowth was reported starting from 6 weeks after the treatment and it is able to re-dominate the ground surface rapidly.

Due to lack of information on the control of this weed, a trial was carried out to screen various types of herbicides and their combinations (*Table 1*). Several combinations of saflufenacil with other herbicides were effective in controlling this weed.



Figure 1 (a) Pinnae with sori on the segment edge. (b) Davallia denticulata dominating the ground surface with oil palm planted on peat soil

MATERIAL AND METHODS

The trial was carried out in an oil palm estate in Riau Province, Sumatra. A total of 13 treatments including an untreated control were evaluated in randomised complete block design (RCBD). The experiment was conducted using four quadrats (1m x 1m) of *D. denticulata* per treatment and replicated four times. Details of the treatments are as below and tabulated in Table 1.

- T₁ - Glufosinate ammonium 15% w/v + saflufenacil 70% w/w (0.375 kg + 70 g/ha),
- T₂ - Glyphosate isopropylamine 48.6% w/v + triclopyr BEE 67% w/v (0.360 kg + 1.08 kg/ha),
- T₃ - Glyphosate isopropylamine 48.6% w/v (1.62 kg/ha),
- T₄ - Glyphosate isopropylamine 48.6% w/v + saflufenacil 70% w/w (1.62 kg + 94.5 g/ha),
- T₅ - Saflufenacil 70% w/w (94.5 g/ha),
- T₆ - Saflufenacil 70% w/w (126 g/ha),
- T₇ - Triclopyr BEE 67% w/v (1.08 kg/ha),
- T₈ - Triclopyr BEE 67% w/v + saflufenacil 70% w/w (1.08 kg + 94.5 g/ha),
- T₉ - Triclopyr BEE 67% w/v + saflufenacil 70% w/w (1.08 kg + 126 g/ha),
- T₁₀ - Metsulfuron-methyl 20% w/w (135 g/ha),
- T₁₁ - Metsulfuron-methyl 20% w/w + saflufenacil 70% w/w (135 g + 94.5 g/ha),
- T₁₂ - Metsulfuron-methyl 20% w/w + saflufenacil 70% w/w (135 g + 126 g/ha), and
- T₁₃ - Control – Untreated.

Treatments were applied once using a conventional knapsack sprayer fitted with a solid cone nozzle. The plants were sprayed to completely wet. Post treatment assessments on percentage weed control based on visual assessment (0% = no effect or full regeneration; 100% = complete control) were recorded at weekly intervals for a duration of 13 weeks.

RESULTS AND DISCUSSION

Details of the results are tabulated in Table 2. There was significant difference among the treatments from 1 week-after-treatment (WAT) to 13 WAT. Four of the treatments, T₁, T₂, T₉ and T₁₂ recorded more than 90 per cent weed control at 13 WAT on the test plants (Figures 2 to 5).

T₁ recorded more than 80 per cent weed control starting from 2 WAT, but regrowth of the test plants was observed starting from 12 WAT. This treatment recorded 99 per cent weed control at 13 WAT, with no significant difference compared to T₈ and T₉. There was no significant difference between T₁₂ and T₈.

Saflufenacil plays an important role in improving the effectiveness on weed control in this study. Tank-mix of saflufenacil with triclopyr or metsulfuron-methyl showed significantly higher weed control compared to treatments with the same active ingredient without adding saflufenacil.

CONCLUSION AND RECOMMENDATION

Our study indicated T₁, T₈ and T₁₂ were able to control *D. denticulata*. For effective control of *D. denticulata*, a follow-up spraying must be done before the regenerating weed become dominant weed species.

TABLE 1
LIST OF TREATMENTS AGAINST *DAVALLIA DENTICULATA*

Treatments	Chemical	Rate (acid equivalent, active ingredient)/ha	Rate product/ha (in 450 L water)	Dilution rate
T ₁	Glufosinate ammonium 15% w/v + saflufenacil 70% w/w	0.375 kg + 70 g	3.375 L + 100 g	75 ml + 2.22 g/10 L
T ₂	Glyphosate isopropylamine 48.6% w/v + triclopyr BEE 67% w/v	0.360 kg + 1.08 kg	1.00 L + 2.25 L	23 ml + 50 ml/10 L
T ₃	Glyphosate isopropylamine 48.6% w/v	1.62 kg	4.5 L	100 ml/10 L
T ₄	Glyphosate isopropylamine 48.6% w/v + saflufenacil 70% w/w	1.62 kg + 94.5 g	4.5 L + 135 g	100 ml + 3 g/10 L
T ₅	Saflufenacil 70% w/w	94.5 g	135 g	3 g/10 L
T ₆	Saflufenacil 70% w/w	126 g	180 g	4 g/10 L
T ₇	Triclopyr BEE 67% w/v	1.08 kg	2.25 L	50 ml/10 L
T ₈	Triclopyr BEE 67% w/v + saflufenacil 70% w/w	1.08 kg + 94.5 g	2.25 L + 135 g	50 ml + 3 g/10 L
T ₉	Triclopyr BEE 67% w/v + saflufenacil 70% w/w	1.08 kg + 126 g	2.25 L + 180 g	50 ml + 4 g/10 L
T ₁₀	Metsulfuron-methyl 20% w/w	135 g	675 g	15 g/10 L
T ₁₁	Metsulfuron-methyl 20% w/w + saflufenacil 70% w/w	135 g + 94.5 g	675 g + 135 g	15 g + 3 g/10 L
T ₁₂	Metsulfuron-methyl 20% w/w + saflufenacil 70% w/w	135 g + 126 g	675 g + 180 g	15 g + 4 g/10 L
T ₁₃	Control – Untreated	NIL	NIL	NIL

Note: triclopyr BEE - triclopyr butoxy ethyl ester

TABLE 2
MEAN PERCENTAGE (%) WEED CONTROL ON *DAVALLIA DENTICULATA*, COMPARED BETWEEN TREATMENTS FROM
1 WEEK AFTER TREATMENT (WAT) TO 13 WAT

Treatment*	Rate (acid equivalent active ingredient)/ha	% Weed control at weeks after treatment (WAT)												
		1	2	3	4	5	6	7	8	9	10	11	12	13
T ₁	0.375 kg + 70 g	28.19 ^a	80.31 ^a	96.81 ^a	98.81 ^a	98.94 ^a	99.06 ^a	99.19 ^a	99.19 ^a	99.31 ^a	99.38 ^a	99.38 ^a	#99.13 ^a	#99.00 ^a
T ₂	0.360 kg + 1.08 kg	11.56 ^b	14.44 ^{cd}	16.75 ^{de}	22.63 ^d	26.50 ^d	27.19 ^e	30.56 ^e	32.19 ^e	34.50 ^g	35.88 ^d	36.69 ^e	#36.25 ^e	#32.75 ^f
T ₃	1.62 kg	9.31 ^b	10.69 ^{cd}	11.81 ^e	13.00 ^e	14.13 ^e	14.63 ^f	#10.06 ^f	#7.00 ^f	#5.06 ^h	#4.63 ^e	#3.81 ^f	#3.13 ^f	#3.00 ^g
T ₄	1.62 kg + 94.5 g	11.63 ^b	16.44 ^{bcd}	19.31 ^{cde}	23.94 ^d	23.94 ^d	31.25 ^{de}	33.25 ^{de}	34.75 ^{de}	51.25 ^f	63.38 ^c	68.75 ^{cd}	77.06 ^{cd}	79.50 ^{de}
T ₅	94.5 g	10.18 ^b	13.00 ^{cd}	15.25 ^e	24.44 ^d	28.63 ^d	30.5 ^{de}	32.88 ^{de}	34.50 ^{de}	60.44 ^e	63.56 ^c	66.19 ^d	72.94 ^d	#72.50 ^e
T ₆	126 g	12.63 ^b	16.25 ^{bcd}	19.00 ^{cde}	25.81 ^{cd}	30.31 ^d	33.63 ^d	37.38 ^d	39.69 ^d	67.44 ^{de}	72.63 ^b	76.00 ^{bc}	83.19 ^{bc}	85.75 ^{cd}
T ₇	1.08 kg	7.56 ^b	9.63 ^d	11.44 ^e	13.13 ^e	14.38 ^e	14.69 ^f	#11.25 ^f	#7.75 ^f	#5.19 ^h	#4.56 ^e	#3.94 ^f	#3.06 ^f	#2.38 ^g
T ₈	1.08 kg + 94.5 g	13.00 ^b	22.81 ^b	30.38 ^b	39.19 ^b	63.25 ^b	73.25 ^b	82.69 ^b	85.69 ^b	90.44 ^b	93.00 ^a	94.13 ^a	96.31 ^a	97.31 ^{ab}
T ₉	1.08 kg + 126 g	11.38 ^b	17.00 ^{bcd}	25.63 ^{bc}	40.06 ^b	59.88 ^b	74.06 ^b	85.63 ^b	87.94 ^b	92.31 ^b	94.50 ^a	96.75 ^a	98.00 ^a	98.88 ^a
T ₁₀	135 g	6.81 ^{bc}	9.00 ^d	10.81 ^e	12.44 ^e	13.63 ^e	13.88 ^f	#12.06 ^f	#7.56 ^f	#5.44 ^h	#5.13 ^e	#4.19 ^f	#3.44 ^f	#2.88 ^g
T ₁₁	135 g + 94.5 g	9.75 ^b	14.69 ^{bcd}	17.94 ^{cde}	25.44 ^d	30.06 ^d	31.6 ^{de}	34.25 ^{de}	36.31 ^{de}	67.63 ^d	72.06 ^b	74.98 ^{bc}	78.44 ^{cd}	81.88 ^d
T ₁₂	135 g + 126 g	11.63 ^b	18.06 ^{bc}	24.94 ^{bcd}	31.63 ^c	40.63 ^c	43.86 ^c	51.06 ^c	53.94 ^c	75.13 ^c	79.25 ^b	81.81 ^b	88.25 ^b	90.36 ^{bc}
T ₁₃	NIL	0 ^c	0 ^e	0 ^f	0 ^f	0 ^f	0 ^g	0 ^g	0 ^g	0 ^h	0 ^e	0 ^f	0 ^f	0 ^g

Notes:

* For details refer to Table 1.

Regrowth

Means followed by the same letter within each column are not significantly different at $\alpha=0.05$ by Tukey's Test



Figure 2 *Davallia denticulata* treated with 75 ml glufosinate ammonium 15% w/v plus 2.22 g saflufenacil 70% w/w in 10 L water at 1 WBT (week before treatment), 8 WAT and 13 WAT, example of one test plant from each of the four replicates. Yellow circle shows the regrowth of the test plants



Figure 3 *Davallia denticulata* treated with 50 ml triclopyr BEE 67.0% w/v plus 3 g saflufenacil 70% w/w in 10 L water at 1 WBT, 8 WAT and 13 WAT, example of one test plant from each of the four replicates



Figure 4 *Davallia denticulata* treated with 50 ml triclopyr BEE 67.0% w/v plus 4 g saflufenacil 70% w/w in 10 L water at 1 WBT, 8 WAT and 13 WAT, example of one test plant from each of the four replicates



Figure 5 *Davallia denticulata* treated with 15 g metsulfuron-methyl 20% w/w plus 4 g saflufenacil 70% w/w in 10 L water at 1 WBT, 8 WAT and 13 WAT, example of one test plant from each of the four replicates

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REFERENCES

CHUNG, G. F., LEE, C. T., CHIU, S. B. and CHEE, K.

H. 2013. *Pictorial Guide to Common Weeds of Plantation and Their Control*. Agricultural Crop Trust, Selangor, Malaysia, 354pp.

PARRIS, B. S., KIEW, R., CHUNG, R. C. K. and SAW, L. G. 2013. *Flora of Peninsular Malaysia*. Malayan Forest Records no. 48. Series 1: Fern and Lycophytes, vol. 2. Forest Research Institute Malaysia and Ministry of Natural Resources and the Environment. Selangor, Malaysia. 243pp.

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