

Goose grass (*Eleusine indica*) (Figure 1) is a noxious weed in oil palm plantation in Malaysia. The weed is listed as one of the 10 worst weeds of the world (Lim and Ngim, 2000). *E. indica* competes strongly with oil palm for nutrient, water, light and space (Mohamad *et al.*, 2010). Currently, application of herbicide is the most effective method to kill *E. indica* in plantation (Rusli *et al.*, 2014). A consequence of the extensive use of herbicides has been the emerging of herbicide resistance in weed species in oil palm plantations, orchards and vegetable farms. Therefore, an alternative method need to be sought, using microbes as biological control, which is more environmental-friendly. The fungus of the genus *Phoma* has the potential as a biological control agent of weeds, examples include *Phoma herbarum* Westendorp for *Taraxacum officinale* Weber in turf and *P. sorghina* on poke weed (Li *et al.*, 2011; Neumann and Boland, 2002; Venkatasubbaiah *et al.*, 1992). Powder formulation of *P. herbarum* has been developed and has the potential as a biological control agent of *E. indica* (Figure 2).



Figure 1. *Eleusine indica* (goose grass).



Figure 2. Powder formulation of *Phoma herbarum* G5S5.

NURSERY EFFICACY TEST

A nursery trial was conducted in MPOB, Bandar Baru Bangi. Two treatments (treated and untreated) were carried out, where each treatment consisted of 20 pots with three replicates using randomised complete block design (RCBD). The effects of powder formulation of *P. herbarum* was noticeable at 14 days after treatment and continued to increase at 21 days and 28 days after applications (Figure 3). At the end of the experiment (28 days), 90% of the *E. indica* treated with *P. herbarum* were killed whereas no mortality symptoms was observed for the control treatment (Table 1).

FIELD EFFICACY TEST

A field trial was conducted on young oil palm (12 months) in Bandar Baru Bangi, Selangor. The trial was set up in three quadrats (2 m x 5 m) where powder formulation of *P. herbarum* was treated and

TABLE 1. EFFECTS OF THE POWDER FORMULATION *P. herbarum* ON *Eleusine indica* IN A NURSERY TRIAL

Treatment	Mortality of <i>E. indica</i> (%)			
	7 days	14 days	21 days	28 days
T1 – <i>P. herbarum</i> at 10 ⁶ conidial ml ⁻¹	0	30a	80a	90a
T2 – Untreated (control)	0	0b	0b	0b

Note: Different letter within the same column denotes significant difference (p<0.05) by T-Test.



Figure 3. Effects of the powder formulation of *P. herbarum* on *Eleusine indica* at 28 days after treatment. a) Treated and b) untreated.

replicated three times in a completely randomised design (CRD). In each quadrat, there were approximately 20 *E. indica*. Mortality of *E. indica* increased significantly at 14 days after treatment and thereafter (Table 2; Figures 4a and 4b). The mortality rate of *E. indica* continued until 28 days and stabilised at 80%. The study also recorded that 10% of the untreated *E. indica* died due to ageing factor. It was also observed that the treatment did not control the weed's root system. *E. indica* regenerated 42 days after treatment in all treated quadrats. The same observation was made when conidial suspensions of two leaf-spotting pathogens, *Bipolaris setariae* (Saw.) and *Pyricularia grisea* (Cke.) Sacc. were applied on *E. indica* (Riding, 1988). In comparison, regeneration of *E. indica* was recorded at 21 days after treatment when conventional herbicides mixtures were used (Rusli *et al.*, 2014).



Figure 4a. *E. indica* treated with powder formulation of *P. herbarum* showing 80% mortality at 35 days after treatment.



Figure 4b. Untreated *E. indica* at 35 days after treatment.

CONCLUSION

A stable formulation of *P. herbarum* for the control of *E. indica* as a biocontrol agent has been developed. The formulation effectively controls up to 80% of this weed. The powder formulation of *P. herbarum* is relatively cheap to produce, viable and efficacious in controlling the target weed.

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TABLE 2. EFFECTS OF THE POWDER FORMULATION OF *Phoma herbarum* ON *Eleusine indica* IN A FIELD TRIAL

Treatment	Mortality of <i>E. indica</i> (%)				
	7 days	14 days	21 days	28 days	35 days
T1 – <i>P. herbarum</i> at 10^6 conidial ml^{-1}	0	30a	70a	80a	80a
T2 – Untreated <i>E. indica</i> (control)	0	0b	0b	0b	10b

Note: Different letter within the same column denotes significant difference ($p < 0.05$) by T-Test.

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