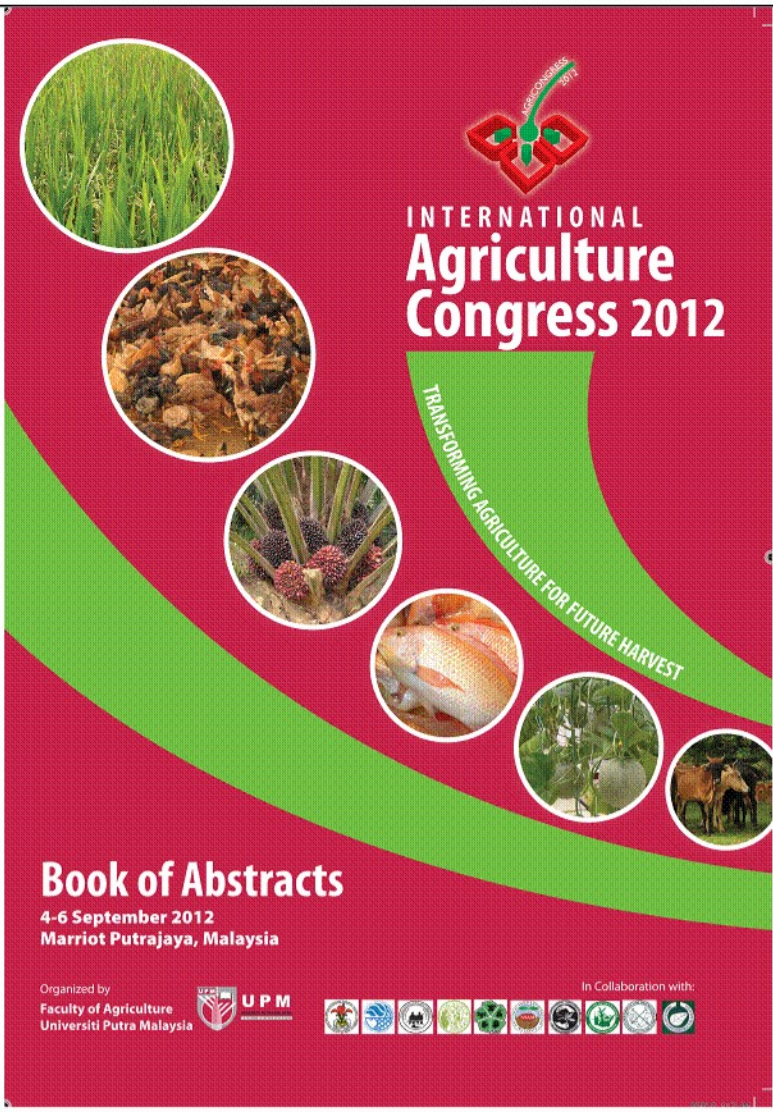

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SIMULATION BY HIDRUS 2D MODEL ON SILT PIT EFFICIENCY ON CONSERVING SOIL WATER

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INTRODUCTION

Silt pits are one of the recommended soil water conservation methods in Malaysia (Teh *et al.*, 2011). Silt pits are close-ended trenches dug into the ground to help to collect runoff during rainfall and later distribute the water back into the soil. Nevertheless, there have been surprisingly little study done on silt pit's effectiveness in conserving soil water. Goh *et al.* (1994) remarked that Malaysia optimum yield production can be increased by yield intensification through land management practices such as silt pits. The purpose of this study was simulate the effectiveness of various silt pit dimensions on the soil water content and how long the pits took to dry out.

METHODOLOGY

The HYDROS 2D model was used for simulating the effectiveness of silt pit on soil water content around the silt pits. Four treatments of silt pits with different dimensions were selected (Table 1). The data on soil hydraulic and physical properties collected from Tuan Mee oil palm plantation (03^o 16$'$ N and 101^o 28$'$ E) at Sg. Buloh. These data used in the model were bulk density (1.35 Mg m^{-3}); sandy clay loam texture (USDA) with 24.92, 7.34 and 67.74 % clay, silt and sand, respectively; and the soil water characteristics were: permanent wilting point (0.13 m^3 m^{-3}), saturated point (0.44 m^3 m^{-3}), parameter alpha in the soil water retention function (2.00 cm^{-1}), parameter *n* in the soil water function (1.30), saturated hydraulic conductivity (0.02 m day^{-1}) and tortuosity parameter in the conductivity function (0.50). In the model simulation, the soil geometrical and environmental conditions were set constant across all silt pit treatments (dimensions). The topography was flat. Simulations assumed no evaporation and plant water uptake and further assumed free drainage in order to make the simulation as simple as possible. A 0.50 m soil depth was selected for determination of soil water content because oil palm has a shallow active root system (Gray et al., 1968).

Table 1. Silt pit sizes used in the simulations

Treatment	Silt pit size (m) Width x Length x Depth	Volume (m^3)	Opening or floor Area (m^2)	Cross Section Area (m^2)	Water Head for 1 m^3 of water (m)
H1	1.0×1.0×1.0	1.0	1.0	1.0	1
H2	1.5×1.0×1.0	1.5	1.5	1.5	0.75
H3	2.0×1.0×0.5	1.0	2.0	1.0	0.5
H4	2.0×1.0×1.0	2.0	2.0	2.0	0.5

RESULTS AND DISCUSSION

The results show that the smaller the floor area (or opening area) of silt pits, the longer it took for the pits to dry out (Figure 1). H1, H2, H3 and H4 dried out (*i.e.*, lost their all water content) in 72, 57.6, 52.8 and 52.8 hours, respectively. Water can infiltrate vertically and laterally into a soil (Lal *et al.*, 2004). The vertical water percolation is faster than lateral water infiltration because vertical soil water movement is driven by both gravity and water potential differences compared with lateral water movement which is only driven by soil water potential differences. H1 has half the floor area compared with H4; therefore, there is less vertical water and the water remains longer time in the H1 silt pit.

On the other hand, the soil water content at the 50 cm soil depth (Figure 2) shows that H1 and H3 can affect the soil water content in a larger radius (80 cm) around the silt pits than H2 and H4 (70 and 60 cm, respectively). Consequently, the head of water in the silt pits should not be lower than the oil palms root zone, as the downward water flow under given water head pressure is more and easier than upward soil water movement.

CONCLUSION

The water conservation ability of silt pits depends on the opening area of the silt pits. The smallest opening area is able to keep the water head near to the top of the soil profile, which would then allow more water lateral water inflitration, rather than vertical percolation, to the plant root system.

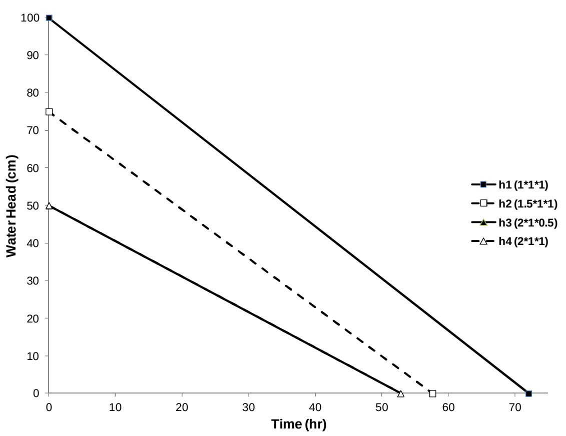

Figure 1. Changes of water head inside of the silt pit during of the time (H3 and H4 overlap).

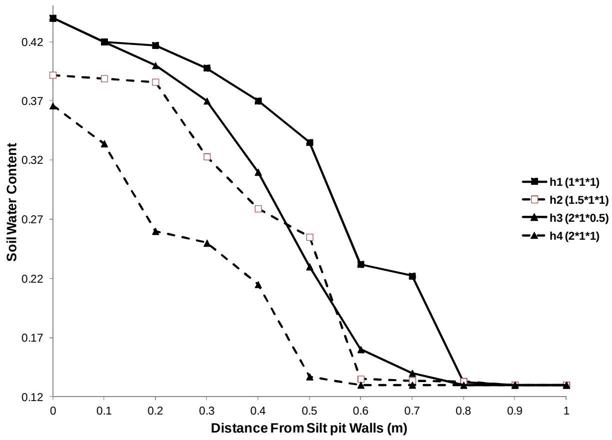

Figure 2. Soil water content changes horizontally from silt pit's side boundary.

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