VERMICOMPOST FOR ENHANCED VEGETATIVE GROWTH OF OIL PALM SEEDLINGS

NAHRUL HAYAWIN ZAINAL; ASTIMAR ABDUL AZIZ; KHALID HARON and ZULKIFLI HASHIM

629

MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2013 MPOB TT No. 531

Composts are produced in some palm oil mills as a waste management method to mitigate greenhouse gas (GHG) emissions from empty fruit bunches (EFB) and palm oil mill effluent (POME). Vermicomposting has been considered as a method of achieving stabilised compost products (Elvira *et al.*, 1998; Gupta and Garg, 2008; Suthar, 2006). Vermicomposting of EFB and POME has been identified as one of the sustainable options in managing the wastes (Singh *et al.*, 2011; Nahrul Hayawin *et al.*, 2010; 2011a). A technology for vermicomposting the oil palm biomass at a small industrial scale has been introduced (Nahrul Hayawin *et al.*, 2011b). The composting enables sanitisation of the waste and elimination of toxic compounds, while the subsequent vermicomposting reduces particle size and increases nutrient availability. In addition, the inoculation of the oil palm wastes resulting from the thermophilic phase of composting with earthworms reduces the expense and duration of the treatment process. The potential of vermicompost as a plant growth media and soil amendments has been tested and proven to increase vegetative growth. The addition of zeolite (clinoptilolite) substrates may provide several benefits during the vermicomposting process. Studies have shown that the addition of natural zeolites to compost leads to a significant increase in vegetative growth of oil palms (Kosobucki *et al.*, 2008; Sprynskyy, 2009; Turan, 2008).

OBJECTIVE

To evaluate the effect of the vermicompost with POME in the high potential organic fertilisers towards the growth of oil palm.

METHODOLOGY

The composts were prepared using EFB amended with POME in different ratios. Composting was carried out by mixing the substrates with selective effective microbes for 20 days to soften and reduce the time required for composting to less than three months. Vermicomposting was carried out in 1 m^3 vermireactor racks by adding 50% of worms and allowed it to be further composted for 30 days. Moisture content of the feed mixture was maintained at 75%-80% by watering twice a week. The pH was maintained between 6-8. Vermicompost for the study was collected from the top layer of the vermireactor rack after 30 days of vermicomposting. A 10% zeolite was mixed with vermicompost and applied to three-month-old oil palm seedlings at the nursery with 10 seedlings per treatment at intervals sampling. The treatments and parameters for this study are shown in *Table 1*.

TABLE 1. TREATMENTS AND PARAMETERS OF VERMICOMPOSTING ON THREE- MONTH-OLD OIL PALM

Treatment	Parameter seedlings
Control (chemical 12:12:17:2)	a) Foliar and soil analyses
Vermicompost (100%)	
Vermicompost (90%) + zeolite (10%)	
Vermicompost (70%) + chemical (30%)	

ISSN 1511-7871
9 771511 787001

Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-8769 4400 Fax: 03-8925 9446 Website: www.mpob.gov.my

MPOB

RESULTS

The initial nutrient compositions of the compost and vermicompost are summarised in *Table 2*. The initial C/N ratio for compost was higher than that of the vermicompost indicating that vermicomposting accelerated the degradation of the subtrates. The initial total nitrogen (TN) and total phosphorus (TP) of feed mixture in vermicomposter were 1.77% and 0.25% respectively, showing higher nutrient levels than in compost. The total potassium (TK) content in compost was higher than in vermicompost, which may be due to the leaching of soluble potassium by excess water.

The addition of vermicompost to soil improved the soil environment and encouraged the proliferation of roots. The treatment had a significant effect on oil palm seedling heights after four months, especially those which were added with zeolite and chemical fertiliser (*Table 3* and *Figure 1*). Plant height and number of fronds of the oil palm seedling were enhanced by the application of vermicompost (*Table 3*). The numbers of fronds were also improved with the application of vermicompost (*Table 3* and *Figure 2*). From the number of functional fronds at various rates and types of fertiliser, the positive role of vermicompost + chemical at ratio 70:30 in the % increment in number of frond was established, which is 75% followed by 50% increment of vermicompost + zeolite. This study shows that vermicompost plus the additional chemical had the largest increase in palm height and number of fronds (*Table 3, Figures 1* and 2).

ECONOMIC ANALYSIS

The estimated fixed cost for the production vermicompost from EFB and POME is RM 20 950. The payback period is three years with an Internal Rate of Return (IRR) of 65%. The Net Present Value (NPV) at 10% discount rate is RM 8104, with a benefit: cost ratio (B:C) of 1.18. Since the B:C is > 1, NPV is positive and IRR is greater than the opportunity cost of capital, the investment is expected to be financially feasible.

CONCLUSION

This study indicates that oil palm biomass-based vermicompost could be utilised as an efficient soil conditioner for the better growth of oil palm seedlings, and adding an adsorbent material like zeolite has provided additional benefits for vegetative growth.

TABLE 2. INITIAL NUTRIENT COMPOSITION OF COMPOST AND VERMICOMPOST FROM EMPTY FRUIT BUNCH (EFB) MIXED WITH PALM OIL MILL EFFLUENT SLUDGE IN 1:1 RATIO

Type of compost	C/N	TN (%)	TP (%)	TK (%)
Compost	36.23 ± 1.5	1.31 ± 0.2	0.15 ± 0.01	0.57 ± 0.01
Vermicompost	21.79 ± 1.3	1.77 ± 0.3	0.25 ± 0.1	0.33 ± 0.01

TABLE 3. VEGETATIVE GROWTH OF OIL PALM SEEDLINGS OF DIFFERENT FERTILISER TREATMENTS*

Treatment	No. of frond	Palm height (cm)
Control (chemical 12:12:17:2)	7.90 ± 2.2	87.00 ± 13.6
Vermicompost (100%)	8.21 ± 2.3	98.14 ± 17.7
Vermicompost (90%) + zeolite (10%)	8.63 ± 2.5	99.08 ± 15.8
Vermicompost (70%) + chemical (30%)	9.35 ± 2.4	102.25 ± 12.8

Note: *Mean of 10 seedlings per treatment.

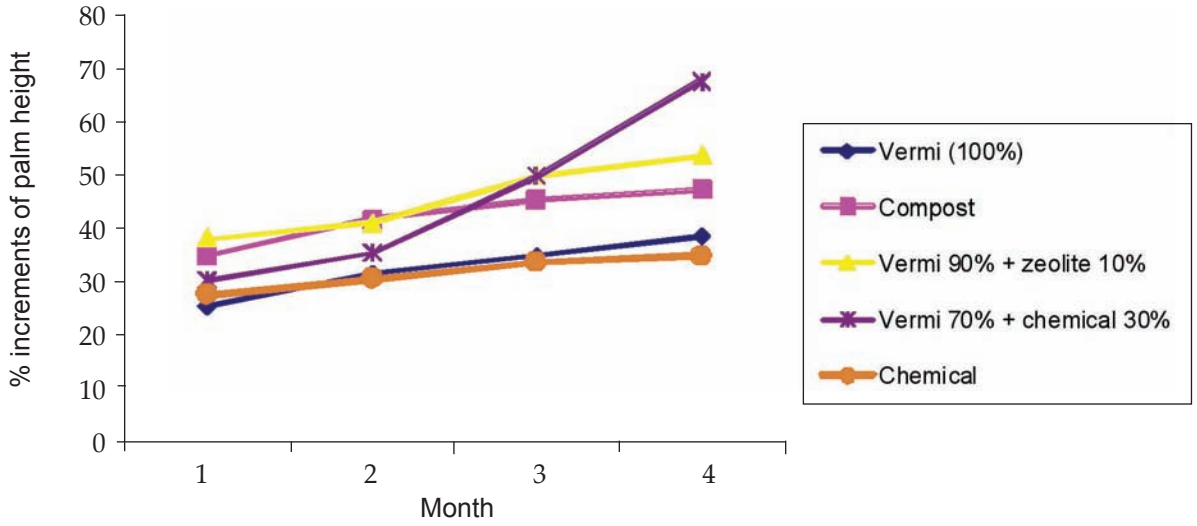

Figure 1. Percentage increment in palm height of three-month old oil palms at different rates of fertiliser.

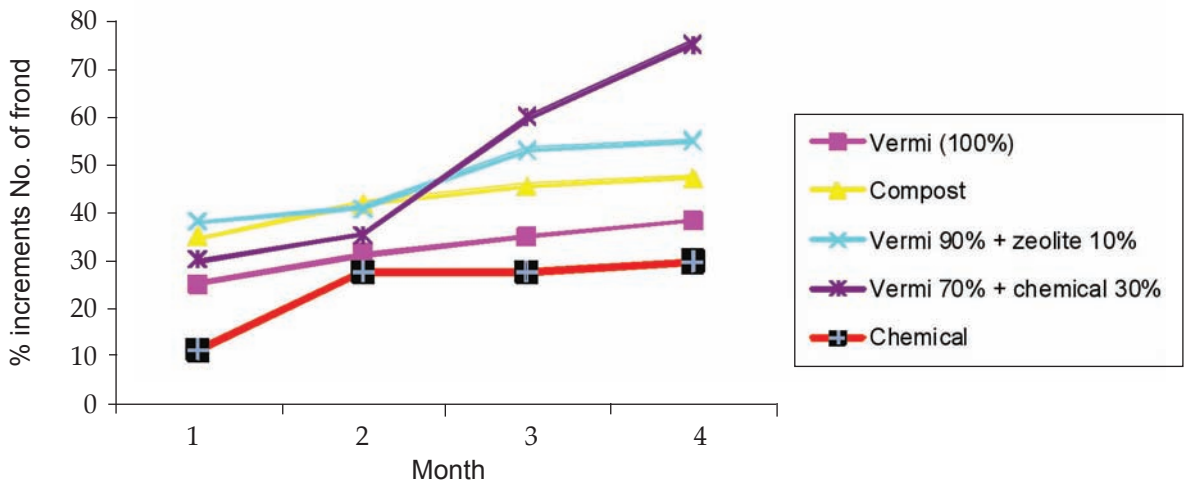

Figure 2. Percentage increment in number of fronds of three-month old oil palms at different rates of fertiliser.

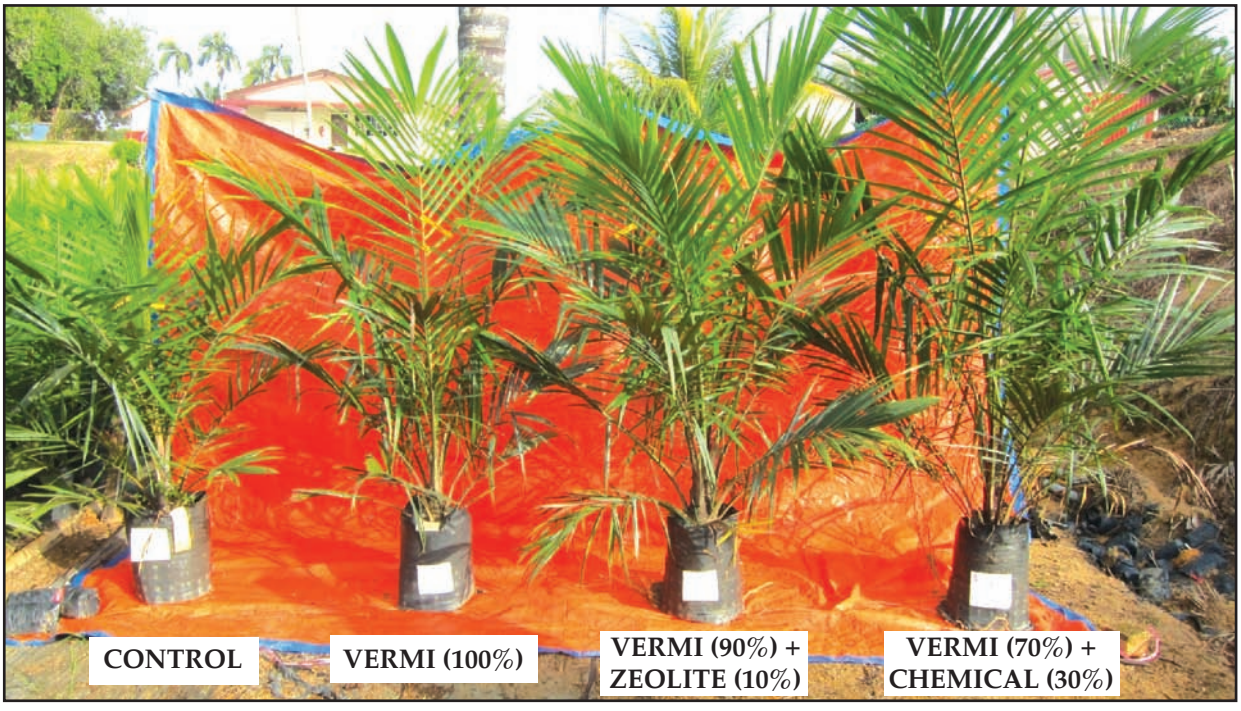

Figure 3. Different heights of 12-month-old oil palm seedlings treated with different ratios of vermicompost.

REFERENCES

ELVIRA, C; SAMPEDRO, L; BENITEZ, E and NOGALES, R (1998). Vermicomposting of sludges from paper mill and dairy industries with Eisenia andrei: a pilot scale study. *Bioresour. Technol., 63*: 205-211.

GUPTA, R and GARG, V K (2008). Stabilisation of primary sewage sludge during vermicomposting. *J. Hazard. Mater., 153*: 1023-1030.

KOSOBUCKI, P; KRUK, M and BUSZEWSKI, B (2008). Immobilization of selected heavy metals in sewage sludge by natural zeolites. *Bioresour. Technol., 99*: 5972–5976.

NAHRUL HAYAWIN, Z; ABDUL KHALIL, H P S; JAWAID, M; HAKIMI IBRAHIM, M and ASTIMAR, A A (2010). Exploring chemical analysis of vermicompost of various oil palm fibre wastes. *The Environmentalist, 30(3)*: 273-278.

NAHRUL HAYAWIN, Z; ASTIMAR, A A; HAKIMI IBRAHIM, M; WAN HASAMUDIN, W H and ABDUL KHALIL, H P S (2011a). Vermicomposting of different types of oil palm fibre waste using Eudrilus eugeniae: a comparative study. *J. Oil Palm Research Vol. 23*: 979-989.

NAHRUL HAYAWIN, Z and ASTIMAR, A A (2011b). Small scale production of palm-based vermicompost. *MPOB Inforrmation Series No. 477*.

SINGH, R P; EMBRANDIRI, A; IBRAHIM, M H and ESA, N (2011). Management of biomass residues generated from palm oil mill: Vermicomposting a sustainable option. *Resources, Conservation and Recycling, 55(4)*: 423-434.

SUTHAR, S (2006). Potential utilisation of guar gum industrial waste in vermicompost production. *Bioresour. Technol., 97*: 2474-2477.

SPRYNSKYY, M (2009). Solid-liquid-solid extraction of heavy metals (Cr, Cu, Cd, Ni and Pb) in aqueous systems of zeolite-sewage sludge. *J. Hazard. Mater., 161*: 1377–1383.

TURAN, N G (2008). The effects of natural zeolite on salinity level of poultry litter compost. *Bioresour. Technol., 99*: 2097–2101.

For more information, kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-8769 4400
Fax: 03-8925 9446
www.mpob.gov.my