BEST MANAGEMENT PRACTICES FOR OIL PALM CULTIVATION ON PEAT: USING ZEOLITE AS SOIL CONDITIONER

HASNOL OTHMAN; ZULKIFLI HASHIM and FARAWAHIDA MOHAMAD DARUS

626

MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2013 MPOB TT No. 528

Oil palm cultivation on peat in Malaysia was estimated at 0.67 million hectares (Wahid *et al.*, 2010). The poor physical and chemical properties of peat need amelioration for successful cultivation of oil palm. Several recommendations for oil palm cultivation on peat such as land preparation, planting technique, water management, fertiliser requirements and mechanisation have been documented (Gurmit *et al.*, 1987; Hasnol *et al.*, 2007; 2010; Mohd Tayeb, 2005).

Fertilisers account for about 40% to 50% of production cost. With increasing fertiliser cost, precision in management is essential for high productivity and profits. Peat is highly deficient in potassium (K) and oil palm requires high amount of this nutrient. Experiments carried out at the MPOB Peat Station in Teluk Intan, Perak showed that oil palm responded to K fertiliser application of up to 6.0 kg muriate of potash (MOP) per palm per year consistently (Mohd Tayeb *et al.*, 1996). Another study on peat at the MPOB Research Station in Sessang, Sarawak recorded a low response to inorganic K fertiliser for bunch yield, suggesting that the efficiency of inorganic K fertiliser recovery was low, due likely to leaching (Hasnol *et al.*, 2005).

Natural zeolite (Z) has special physical and chemical characteristics that could improve soil properties. In agriculture, Z is used for soil treatment and provides a source of slow release K. Z can also be used for soil moisture conservation, in which they absorb water for later release according to the environmental moisture balance.

METHODOLOGY

The possibility of using Z as a soil conditioner for oil palm cultivation on peat was investigated at the MPOB Research Station in Teluk Intan, Perak. The area was previously a secondary forest of lowland peat swamp with peat depths ranging from 300 to 320 cm. The standard land clearing method of underbrushing and felling, stacking and restacking was adopted. The mechanical compaction of harvesting paths and planting rows were carried out during land preparation. Oil palm seedlings were planted using the hole-in-hole planting technique (Mohd Tayeb, 2005). Fertiliser applications and field management followed standard estate practices.

The trial was laid in a randomised complete block design (RCBD) with six replications. The treatments were different rates of Z and K in 2^2 ZK factorial layouts. The chemical properties of Z used in this study are indicated in *Table 1*. Z and K fertiliser treatments were applied in a single and two split applications, respectively (*Table 2*). The fertilisers were broadcasted within the weeded

TABLE 1. SELECTED CHEMICAL PROPERTIES OF NATURAL ZEOLITE USED IN THE STUDY

Property	Quantity	Property	Quantity
CEC cmol kg^{-1}	76.0 ± 8.4	Si (%)	24.5 ± 0.3
P (%)	0.0056 ± 0.0002	Cu (mg kg^{-1})	1.41 ± 0.47
K (%)	1.93 ±0.01	Zn (mg kg^{-1})	6.13 ± 0.39
Mg (%)	0.18 ± 0.01	Mn (mg kg^{-1})	47.8 ± 6.7
Ca (%)	0.91 ± 0.08	Fe (mg kg^{-1})	885.6 ± 228.7

Natural zeolite in powder form

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

circle. The treatments were applied eight years after field planting. The six-year fresh fruit bunch (FFB) yields were obtained by carrying out palm-to-palm recording of bunch number and weight.

tion, the optimum K requirement using MOP was 3.5 kg palm^{-1} yr^{-1}. On the other hand, without Z, the optimum MOP rate would be 5.0 kg palm^{-1} yr^{-1}.

TABLE 2. TREATMENT DETAILS

Zeolite treatment		K treatment (MOP equivalent)	
Rate	kg palm^{-1} yr^{-1}	Rate	kg palm^{-1} yr^{-1}
Z1	0	K1	3.5
Z2	3.0	K2	5.0

BUNCH YIELDS RESPONSE

The application of natural Z increased the FFB yields where significant differences were detected in the third, fourth, sixth years and the six-year mean (*Table 3*). The six-year mean FFB yield from plots treated with Z (Z1) was 27.03 t ha^{-1} yr^{-1}, significantly higher than that without Z (Z0) at 25.23 t ha^{-1} yr^{-1}. The yield increment from Z0 to Z1 was 7%. The FFB yield performances based on Z and K factorial analysis are summarised in *Table 4*. In the plots without Z (Z0), the six-year mean FFB yield significantly improved with increased K fertiliser rates. No significant difference for mean yield was recorded between two K fertiliser treatments in Z plots (Z1). These indicated that, with Z applica-

ECONOMIC ANALYSIS

The cost of FFB production for different combinations of K fertiliser (MOP) and Z is presented in *Table 5*. Based on production cost per tonne FFB, Z1K1 treatment recorded the lowest cost of RM 160 t^{-1} compared to Z0K1 (RM 162 t^{-1}), Z0K2 (RM 167 t^{-1}) and Z1K2 (RM 173 t^{-1}). Based on the benefit to cost ratio (B:C) and net revenue (*Table 6*), Z1K1 was the best combination.

CONCLUSION

The findings indicated that the Z1K1 combination, namely 3.0 kg palm^{-1} yr^{-1} of Z and 3.5 kg palm^{-1} yr^{-1} of MOP is the agronomically and economically optimum input for oil palm on peat.

TABLE 3. EFFECT OF ZEOLITE ON FRESH FRUIT BUNCH (FFB) YIELD PERFORMANCE

Zeolite rate	FFB Yield (t ha^{-1})						
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Mean
0	28.27a	27.09a	24.90b	23.98b	23.19a	23.94b	25.23b
1	28.20a	27.29a	27.46a	27.08a	24.48a	27.69a	27.03a
Mean	28.24	27.19	26.18	25.53	23.83	25.81	26.13
$LSD_{0.05}$	1.45	1.92	1.26	2.33	2.15	1.72	0.86

Note: Means within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test).

TABLE 4. EFFECT OF DIFFERENT ZEOLITE (Z) AND K FERTILISER RATE COMBINATIONS ON FRESH FRUIT BUNCH (FFB) YIELD

Treatment		FFB yield (t ha^{-1})						
Z	K	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Mean
0	1	27.37a	25.40b	24.27c	22.03b	22.43b	22.80b	24.05b
0	2	29.17a	28.78a	25.54bc	25.93a	23.95ab	25.07b	26.41a
1	1	28.35a	29.02a	27.88a	26.14a	24.05ab	25.66a	26.85a
1	2	28.05a	25.55b	27.03ab	28.02a	24.90a	29.71a	27.21a
Mean		28.24	27.19	26.18	25.53	23.83	25.81	26.13
$LSD_{0.05}$		2.01	2.31	1.92	3.16	2.31	2.71	1.32

Note: Means within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test).

TABLE 5. COST OF FRESH FRUIT BUNCH (FFB) YIELD PRODUCTION FOR DIFFERENT COMBINATIONS OF ZEOLITE (Z) AND POTASSIUM (K) FERTILISER RATES ON OIL PALM CULTIVATED ON PEAT

Treatment rate		Mean FFB yield[a] (t ha^{-1})	Amortised cost[b] (RM ha^{-1})	Variable cost[c] (RM ha^{-1})						Treatment cost[d] (RM ha^{-1})		Total cost	
Z	K			Weeding	Manuring	Pest & disease	Road & drain maintenances	Harvesting	Pruning	Z	K Fertiliser	RM ha^{-1}	RM t^{-1} FFB
0	1	24.05	720	200	410	50	350	1 203	40	0	936	3 908	162
0	2	26.41	720	200	410	50	350	1 321	40	0	1 320	4 410	167
1	1	26.85	720	200	410	50	350	1 343	40	260	936	4 308	160
1	2	27.21	720	200	410	50	350	1 361	40	260	1 320	4 710	173

Note:
[a] Six-year mean.
[b] Based on cost to maturity of RM 18 000 ha^{-1}.
[c] Based on average cost of upkeep of mature areas at MPOB Research Station Teluk Intan, Perak.
[d] Based on Z price of RM 500 t^{-1}; MOP price of RM 1600 t^{-1}.

TABLE 6. ECONOMIC ANALYSIS OF DIFFERENT RATES OF ZEOLITE (Z) AND K FERTILISER ON OIL PALM CULTIVATED ON PEAT

Treatment rate		Mean FFB yield[a] (t ha^{-1})	Total cost		Total revenue[b] (RM ha^{-1})			Net revenue[b] (RM ha^{-1})			B:C ratio[b]		
Z	K		RM ha^{-1}	RM t^{-1}	RM 400 t^{-1}	RM 450 t^{-1}	RM 500 t^{-1}	RM 400 t^{-1}	RM 450 t^{-1}	RM 500 t^{-1}	RM 400 t^{-1}	RM 450 t^{-1}	RM 500 t^{-1}
0	1	24.05	3 908	162	9 620	10 823	12 025	5 712	6 914	8 117	2.46	2.77	3.08
0	2	26.41	4 410	167	10 564	11 885	13 205	6 154	7 474	8 795	2.40	2.69	2.99
1	1	26.85	4 308	160	10 740	12 083	13 425	6 432	7 774	9 117	2.49	2.80	3.12
1	2	27.21	4 710	173	10 884	12 245	13 605	6 174	7 534	8 895	2.31	2.60	2.89

Note:
[a] Six-year mean.
[b] Based on three price levels of FFB yields.

REFERENCES

GURMIT, S; TAN, Y P; RAJAH PADMAN, C V and LEE, F W (1987). Experiences on the cultivation and management of oil palms on deep peat in United Plantations Berhad. *The Planter Vol., 63*(733):143-157.

HASNOL, O; TARMIZI, A M and MOHD TAYEB, D (2005). Effects of various sources of potassium fertilizer application on oil palm planted on peat in Sarawak. *Proc. of the PIPOC 2005 International Palm Oil Congress.* p. 864-875.

HASNOL, O; TARMIZI, A M and KHAIRUMAN, H (2007). Performance of oil palm on deep peat in relation to soil compaction and planting technique. *Proc. of the Malaysian Soil Science Conference (SOILS 2007)*. p. 182-201.

HASNOL, O; TARMIZI, A M; HANIF, M H; FARAWAHIDA, M D and HASIMAH, M (2010). Best management practices for oil palm planting on peat: optimum groundwater table. *MPOB Information Series No. 528*: 7 pp.

MOHD TAYEB, D; HAMDAN, A B; TARMIZI, A M and ROSLAN, A (1996). Recent progress on research and development on peat for oil palm. *Proc. of the 1996 Seminar on Prospect of Oil Palm Planting on Peat in Sarawak: The Golden Opportunity* (Mohd Tayeb, D ed). PORIM, Bangi. p. 89-111.

MOHD TAYEB, D (2005). *Technologies for Planting Oil Palm on Peat*. MPOB, Bangi. 83 pp.

WAHID, O; NORDIANA, A Z; TARMIZI, A M; HANIF, M H and KUSHAIRI, A D (2010). Mapping of oil palm cultivation on peatland in Malaysia. *MPOB Information Series No. 529*: 4 pp.

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