AN INNOVATIVE TECHNIQUE ON MANAGEMENT OF BIOMASS DURING OIL PALM REPLANTING

By: KHALID H, ARIFFIN D, ZIN Z Z and A TARMIZI M

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With the adoption of zero burning in replanting oil palm, large quantities of oil palm biomass from the previous stand become available and are usually left *in situ*. The trunks and fronds felled during clearing operations amount to 85 t dry matter ha^{-1}, with an additional 16 t ha^{-1} of below ground root biomass which contain a significant pool of nutrients equivalent to 642 kg N, 58 kg P, 1384 kg K and 156 kg Mg (*Table 1*). In terms of inorganic fertilizers, the nutrients are equivalent to approximately 3.06 t of sulphate of ammonia (A/S), 0.37 t of Christmas Island rock phosphate (CIRP), 2.77 t of muriate of potash (MOP) and 1.00 t of kieserite. With appropriate management technique, the recycling of oil palm biomass following felling may enable the carry over of this nutrient content to support the growth of young palms in the next planting. This will reduce the need for inorganic fertilizer input.

Under the conventional zero burning practices, young palms are normally planted on bare soil between widely spaced windrows of oil palm residues from the old planting. This practice places the palms away from the decomposing residues that release nutrients to the soil pool. Consequently, the roots of the young palms are unable to access and utilize the nutrients released from the decomposing residues.

An innovative technique of replanting oil palm has been developed where the young palms are planted directly onto the residue piles in order to improve the accessibility and efficiency of nutrient utilization (*Figure 1*). Proper location of the organic residues that release nutrients to the plant roots is critical and by adopting this technique, the roots of the young palms are in direct contact and easily accessible to the rapid release of nutrients from the residues. The technique also gives greater synchrony between nutrient release and plant uptake in terms of space and time compared with the standard replanting practice.

The results of our current research on nutrient cycling and residue management during replanting confirmed that there is a great potential for conservation of nutrients by managing oil palm biomass during replanting. The growth

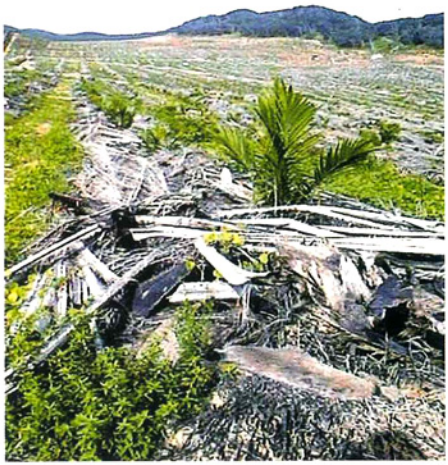

Figure 1. Young palms planted directly on residue piles under innovative technique of oil palm replanting.

and nutrient uptake of the succeeding palms transplanted directly onto the residue piles showed very impressive response in terms of palm growth performance and yield. This could be attributed to the excellent physical and chemical properties of the soil maintained by the organic matter input underneath the mulched areas. *Figure 2* shows the growth performance of 30-month-old palms planted onto the residue piles. The FFB yields and yield components of the succeeding palms that receive nutrients solely from recycling of residue inputs (without any input of inorganic fertilizers) gave significantly higher yield when compared with palms planted in the area which had no residue (complete removal of biomass) during

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Malaysian Palm Oil Board, Ministry of Primary Industries, Malaysia

P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-89259155, 89259775, Homepage: http: //mpob. gov. my Telefax: 03-89259446

Figure 2. Palms (30-month-old) adopting the innovative technique ready for first harvesting.

replanting on inland Rengam series soil (*Table 2*). The conventional or standard replanting is a similar situation in which the residues are placed some distance away from the newly planted palms.

TECHNIQUE OF REPLANTING

Felling of the old stand is first carried out using an excavator fitted with a chipping bucket. The palm trunks and fronds are chipped and shredded to pieces of about 5-10 cm thick across at 45° – 60° angle. During chipping and shredding, the operator is required to clear or vacate an area of about 1.5 m square in between the old stand for the new planting points. The chipped and shredded materials are spread evenly at about 3 m – 4 m width to avoid thick pile formation (*Figure 3*).

Legume cover seeds are sown after the felling of old palms has been completed. At the same time, base-lines or *rajah lines* for the new planting points are surveyed. The base line of old stands is used as a reference and the new planting points are marked in old planting rows between the old stands. Oil palm seedlings are field planted immediately after the lining survey has been completed. Each planting hole is applied with 250 g of phosphate rock at the time of field planting.

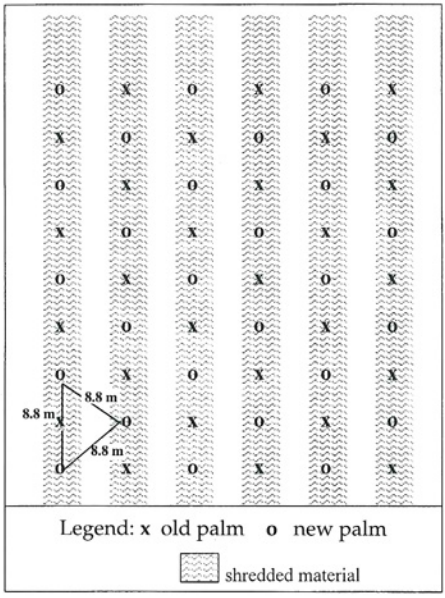

Figure 3. Stacking patterns of shredded palm debris and planting position of old palm stands and new palms.

FERTILIZER RECOMMENDATION

Even though significant amounts of nutrient reserves are contributed by the recycling of biomass during replanting, the nutrient release is not immediate and needs to go through the process of decomposition and mineralization. It is therefore recommended that the palms be given some initial inorganic fertilizer supplement as a starter in order to boost and optimize the growth of the immature palms. The additional fertilizer input will help replace the nutrients removed from the field in fruit bunches, pruned fronds and the nutrient reserve immobilized in the palms. The level of nutrients in the soil needs to be maintained to remain sustainable for plant growth and should not be depleted, as this will affect the subsequent yield.

The interim fertilizer recommendation for the first five years after field planting is given in *Table 3*.

PEST CONTROL

The rhinoceros beetle (*Oryctes rhinoceros*) has become a serious pest of oil palm in many areas practising zero burning during replanting. This is due to the abundance of oil palm residues that are left to rot *in situ*. Chipping the palm trunks into small pieces and avoiding a thick pile formation of the residues is recommended to reduce the breeding sites and outbreaks of *Oryctes*. In addition,

TABLE 1. AVAILABLE NUTRIENTS AND FERTILIZER EQUIVALENTS OF OIL PALM BIOMASS AT REPLANTING

Palm residues	Dry matter (t ha^{-1})	Nutrient (kg ha^{-1})			
		N	P	K	Mg
Above ground	85	577	50	1 255	141
Below ground	16	65	8	129	15
Total	101	642	58	1 384	156
		A/S	**CIRP**	**MOP**	**KIES**
Fertilizer equivalent		3 060	370	2 770	1 000

A/S = ammonium sulphate. CIRP = Christmas Island rock phosphate.
MOP = muriate of potash. KIES = kieserite.

TABLE 2. YIELD OF OIL PALM PLANTED ONTO THE RESIDUE ROW AS COMPARED TO PALMS PLANTED IN THE AREA WITHOUT OIL PALM BIOMASS RESIDUE

Treatment	Months after treatment	FFB yield (t ha^{-1} yr^{-1})	Bunch wt. (kg)	Bunch No. palm^{-1} yr^{-1}
With biomass	25-36	10.5 (1.5)	4.0 (0.3)	18.8 (2.2)
	37-48	15.2 (1.2)	6.5 (0.1)	17.2 (1.2)
	49-60	23.0 (2.8)	10.8 (0.5)	15.4 (1.4)
Without biomass	25-36	4.6 (0.7)	3.6 (0.3)	9.1 (1.1)
	37-48	11.1 (0.5)	5.1 (0.6)	16.7 (2.3)
	49-60	16.6 (1.9)	8.6 (0.7)	14.0 (1.0)

Note: figures in parenthesis are standard errors of means.

TABLE 3. FERTILIZER RECOMMENDATIONS* FOR UP TO FIVE YEARS AFTER FIELD PLANTING (kg palm^{-1} yr^{-1})

Year after planting	A/S	CIRP	MOP	KIES.
1	0.5 (0.11 kg N)	0.5 (0.18 kg P_2O_5)	0.25 (0.15 kg K_2O)	0.25 (0.07 kg MgO)
2	1.0 (0.21 kg N)	0.5 (0.18 kg P_2O_5)	0.75 (0.45 kg K_2O)	0.5 (0.13 kg MgO)
3	1.5 (0.32 kg N)	0.75 (0.27 kg P_2O_5)	1.0 (0.60kg K_2O)	0.5 (0.13 kg MgO)
4	2.0 (0.42 kg N)	0.75 (0.27 kg P_2O_5)	1.5 (0.9 kg K_2O)	0.75 (0.20 kg MgO)
5	2.5 (0.53 kg N)	0.75 (0.27kg P_2O_5)	1.5 (0.9kg K_2O)	0.75 (0.20 kg MgO)

Note: * General interim recommendation for inland soils.

spraying of synthetic pyrethroids such as cypermethrin, or application of carbofuran on the young palms, can help reduce the infestation. Pheromone trapping is another means to overcome the problem. Good establishment of leguminous cover crops during the early stage of replanting may also help to reduce rhinoceros beetle attacks. Rat baits also need to be applied immediately after planting the young palms as a preventive measure to control rats.

BENEFITS OF THE TECHNIQUE

- The new technique can reduce the input of inorganic fertilizers. There is also reduced weed control surrounding the palm circle during the first two years after field planting, thus reducing the production and maintenance costs;
- The young palms planted in the row with biomass placement showed very impressive growth performance and were brought into maturity much earlier than the palms planted following the normal practice in between residue rows; and
- By maintaining the old planting rows to plant the new palms, no extra cost is incurred on new infrastructure such as construction of field roads, field drains and terracing.

CONCLUSION

The recycling of biomass accruing from replanting activities, together with proper agronomic management based on scientific approach, without doubt provide significant pools of nutrients to the succeeding young palms. Such a practice will directly reduce the production cost and indirectly cut down on pollution that is caused by over dependence on fossil fuel required for the manufacture of inorganic fertilizers.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-89259155, 89259775,
Homepage: http: //mpob. gov. my
Telefax: 03-89259446