

Potential of Oil Palm Empty Fruit Bunch (EFB) as Fertilizer in Oil Palm (*Elaeis guineensis* L Jacq.) Nurseries

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Abstract

Oil palm is one of the major oil crops in the world. Oil palm empty fruit bunch (EFB) could serve as an alternative and cheaper organic fertilizer in oil palm farms. This study investigated the value of composts of different forms of EFB for raising oil palm in the nursery. The experiment, which covered the pre-nursery (< 3 months) and nursery stages (3-13 months) used different EFB: cow dung ratios (100:0, 90:10, 80:20, 70:30 and 60:40) as compost as well as cow dung only and mineral fertilizer (NPKMg 12-12-17-2). The composts were added to the soil at the rate of 4.8 g N /plant. The experiment was laid out in a randomized complete block with three replicates. Data were collected on dry weight, nutrient concentrations, and soil pH changes. Oil palm seedlings under the application of unsoaked oil palm EFB and cow dung (60:40) were significantly ($p < 0.05$) higher in dry weight (18.0 g / plant) than those from the mineral fertilizer and control treatments (15.7 and 10.5 g / plant respectively) in the nursery stage. Composts of unsoaked EFB and cow dung (ratio 60:40) was more suitable for raising oil palm seedlings in the nursery than other treatments used.

Introduction

Development of organized organic agriculture system is still young in most developing countries. However, sourcing and adoption of sustainable organic inputs and resources by practitioners are essential for lasting development in this area. Application of mineral fertilizers is the most common means of improving soil fertility among farmers. However, the positive effects of mineral fertilizers on soil for crop production last only for a short time. In the long run, mineral forms of N fertilizers (urea and ammonium sulphate) can lead to decreasing base saturation, acidification, and a drop in soil pH (Phicot *et al.*, 1981). Ogedengbe (1991) observed a cationic imbalance in the soil of the Okomu oil palm plantation, Benin, Nigeria and linked this to the problem of intensive application of mineral fertilizer. Another complication is the fact that the commonly used mineral fertilizers are becoming scarce and not usually available to most farmers. This situation has triggered the problem of underfertilization on many farms. As a result, crop performance has been reduced. Organic fertilizers have the potential to correct almost all negative impacts of mineral fertilizers on soil. Efforts targeting increases in agricultural production should be backed up with environmentally friendly fertilizer application practices that should guarantee safety and sustainability of the soil natural resources.

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Oil palm (*Elaeis guineensis* L Jacq.) is a crop of national economic importance in Nigeria. Mineral fertilizers (urea and NPKMg 12-12-17-2) are the conventional fertilizers in raising oil palm. However, oil palm empty fruit bunch (EFB) and cow dung (from oil palm/ livestock integration), usually available year-round, seem to be underutilized. These materials, if composted and used as organic fertilizer in oil palm production, could increase yield and also eliminate problems associated with intensive mineral fertilizer application. Thus, this investigation focussed on determining effective combinations of oil palm EFB and cow dung in composting for raising oil palm in the nursery.

Materials and methods

Geminated oil palm (var. 'Tenera' was used. Pre-nursery stage (0 – 3 months after planting) took place in the greenhouse, whereas the plants were exposed to prevailing environmental conditions during the nursery period (3 –13 months after planting). The experiment was laid out in a randomised complete block design with three replicates. 2 kg of rain-washed river sand was used to raise the plants at the pre-nursery stage, while at the nursery, the soil was made up to 5 kg per bag. Treatments investigated were: (1) Control (no application), (2) Mineral fertilizer, (3) 100% Unsoaked Empty Fruit Bunch (UEFB), (4) 80 % (UEFB)+ 20 % cow dung, (5) 60 % (UEFB) + 40 % cow dung, (6) 100% Soaked Empty Fruit Bunch (SEFB), (7) 80 % (SEFB) + 20 % cow dung, (8) 60 % (SEFB) + 40 % cow dung and (9) Cow dung. Conventional mineral fertilizer was applied at 7 g urea / 5 L water per 100 seedlings (Hartley,1988) as fertigation in the pre-nursery as well as N-P-K-Mg (12-12-17-2 compound fertilizer, 14 g per plant [Onwubuya, 1982]) in the nursery. This was applied twice (2nd and 8th months) during the nursery period. The compost treatments were applied once at a rate equivalent to 4.8 g N /plant one week before planting. Dry matter yield was determined. The most recently matured leaf (Mengel and Kirkby, 2001) of the pre-nursery treatment plant was used for nutrient analysis in the pre-nursery stage, while at the nursery stage total plant shoot was used. Soil and plant material analyses were conducted using standard methods. Means of dry matter yield were compared using the treatment error ($p < 0.05$).

Results

The un-soaked EFB: cow dung – 60: 40% compost treatment performed significantly ($P < 0.05$) better than other treatments in total plant dry matter yield at 10 months in the nursery (Fig. 1). At the end of this period, no plant on the cow dung compost treated soil survived.

Manganese concentration in the oil palm plants at the end of the pre-nursery stage ranged from 52 – 1126 mgkg⁻¹ (least in control and 100% UEFB and highest in cow dung treatments). Iron concentration at this stage ranged 906 – 3332 mgkg⁻¹ (least in mineral and highest in cow dung treatments). At 10 months in the nursery, manganese concentration in the plants ranged from 196 - 1204 mgkg⁻¹ (least in soaked EFB: cow dung – 80: 20% and highest in mineral fertilizer treatments respectively). Also, iron ranged 1704 – 2418 mgkg⁻¹ (least in 100% soaked EFB and highest in mineral fertilizer treatments respectively). Soil pH at the end of the 10 months in nursery ranged 5.4 – 7.1 (least in mineral and highest in control treatments respectively). See Table 1.

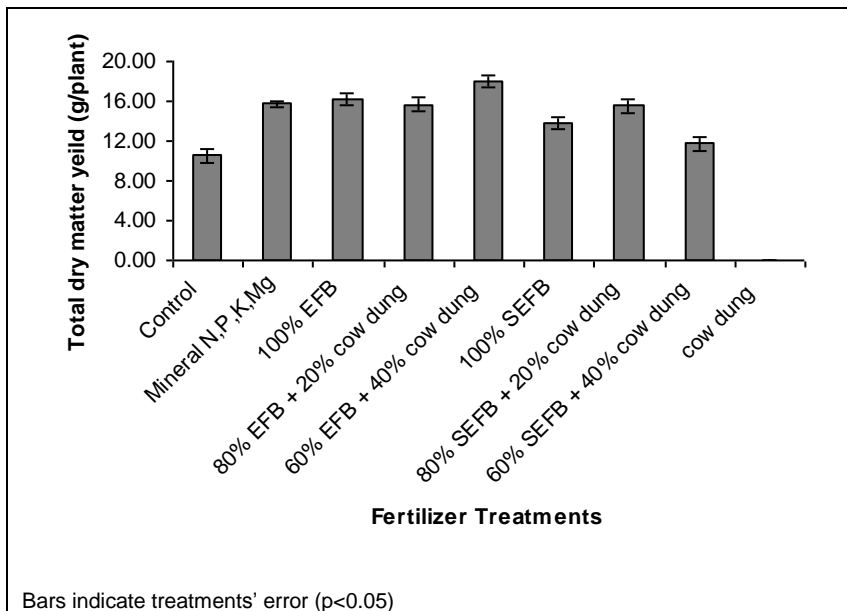


Figure 1: Effects of oil palm empty fruit bunch (EFB) compost on oil palm dry matter yield at 10 months in the nursery

Tab. 1: Effects of oil palm empty fruit bunch (EFB) compost treatments on nutrients concentration in leaves of oil palm seedlings and soil pH

| Stage | Pre-nursery | | Nursery | | |
|-------------------------|-------------|------|---------|------|---------|
| | Mn | Fe | Mn | Fe | Soil pH |
| Treatments | mg/kg | | | | |
| Control | 52 | 1219 | 382 | 1785 | 7.1 |
| Mineral fertilizer | 72 | 906 | 1204 | 2418 | 5.4 |
| 100% UEFB | 52 | 1848 | 252 | 2351 | 6.7 |
| 80% UEFB + 20% cow dung | 69 | 2257 | 215 | 1796 | 6.8 |
| 60% UEFB + 40% cow dung | 57 | 2282 | 233 | 1928 | 6.6 |
| 100% SEFB | 65 | 2530 | 211 | 1704 | 6.6 |
| 80% SEFB + 20% cow dung | 53 | 2683 | 196 | 2103 | 6.7 |
| 60% SEFB + 40% cow dung | 59 | 1891 | 214 | 1659 | 6.8 |
| Cow dung | 1126 | 3332 | - | - | 6.0 |

Discussion

Unsoaked oil palm EFB plus cow dung (60 : 40) resulted in significantly higher dry matter yield than the conventional mineral fertilizer and control (no fertilizer) treatments at the end of the nursery stage. Generally, nutrient concentrations in the leaves of the plants ranged from optimum to excessive as a result of the treatments

(von Uexkull, 1992; Hartley, 1988). The plants treated with cow dung compost died shortly after the 3rd month in the nursery. Manganese toxicity was suspected as the cause, arising from the high Mn concentration and the marginal leaf necrosis observed at the prenursery stage. Hochmuth *et al.* (2004) reported that Mn, which is an immobile nutrient in plants, could be toxic to plants when the concentration in the plants' tissue is very high (above 500 mg / kg). This means that the very high concentration of Mn in the plants treated only with cow dung compost could have resulted into the death of those plants. Thus, it seems inadvisable to use compost of only cow dung for raising oil palm seedlings in this type of soil.

Highest soil acidity caused by the mineral fertilizer treatment is a negative consequence in this tropical soil. Soil acidity is usually enhanced by rapid decline in soil organic carbon content (Bagayoko *et al.*, 2000). However, adequate compost application to soil could arrest this situation, as was observed in this investigation.

Conclusions

The overall results of this investigation indicated that composting a combination of oil palm empty fruit bunch with cow dung led to better performance of oil palm seedlings. Thus, this treatment could be used as an alternative to mineral fertilizer for raising oil palm seedlings. Soaked or unsoaked EFB and cow dung (60:40) composts seemed to enhance plants' performance better than other EFB composts. Composted soaked EFB and cow dung in the ratio 60:40 performed better in the oil palm pre-nursery, while unsoaked EFB and cow dung (60:40) compost performed better in the oil palm nursery than other EFB composts used in this investigation. However, sustainable integration of oil palm and livestock is essential for getting sufficient cow dung for this compost combination.

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