Effectiveness of Oil Palm Wastes as Organic Fertilizers
Khin Lat Lat Mon

Abstract
Oil palm wastes were recycled to be used as organic fertilizers for community uses. Their effectiveness and response were studied on the growth and yield of okra. The experiment was carried out in the open field of Thingangyun Township, Waizayandar Road, Yangon Division from May to November, 2010. Four treatments (Organic wastes, Fuller Earth or Bleaching Earth, Cow dung, and Soil) were applied in this experiment. The physical and chemical properties of soil and applied organic waste fertilizers, and cow dung were analyzed before growing okra. The experiment was laid out in Completely Randomized Design (CRD) using four treatments with three replicates. The results of analyzed soil using in cultivation of okra showed that the soil is sandy loam including 97.75% of sand, silt, and clay; very low organic carbon content (0.862%); humus (1.486%); low nitrogen content (0.18%); high phosphorous content (126ppm); and high potassium content (21.64 mg/100g). The pH of soil is 6.8 hence it is nearly neutral. The moisture content of soil is 2.88%. The analyzed results of fertilizer showed that the organic waste fertilizer from crude palm oil mill had higher CN ratio (13.13:1) than bleaching earth from refine mill (10.35:1) and cow dung (9.61:1). But CN ratio of both fertilizers were higher than that of control. The results demonstrated that the organic waste fertilizer has vegetative plant growth (48.2 cm in height, 43.53cm of leaf length, 23.45 cm leaf width, 14.61cm petiole length, and 379.53 cm² leaf area. The results of reproductive growth showed that the first and 50% flowering days of 26.2 and 27.4; first and 50% fruit setting days of 30.2 and 31.0), yield of 0.87617 kg treatment⁻¹ and 1.16 t ha⁻¹ respectively. The results of pod (fruit) characters showed that organic waste fertilizer had maximum pod length, width, and pod weight 20.38cm, 10.25cm and 35.77g. The organic waste fertilizer had maximum fresh weight 265.23 g but minimum dry weight 22.47g. However, the waste from refined palm oil mill had lower yield (0.62 kg treatment⁻¹ and 0.82 t ha⁻¹) than cow dung but it had influence effects than control. In the treatment of fuller earth or bleaching earth which is waste from the Refined palm oil mill, contained residues of oil, the results were poorer than those of organic fertilizer.

Key words: Oil palm wastes, community, CRD
Introduction

Myanmar is blessed with abundant natural recourses and bears a favourable climate for cultivation of commercial crops including oil palm. Oil palm is widely cultivated in Tanintharyi Region. Among these cultivation areas, Yuzana oil palm plantation and crude palm oil mill are located at 38 miles, Khamaukgyi Township, Kawthaung District, Tanintharyi Region. Vast amount of fresh fruit bunches are annually produced from this plantation. Wastes from the palm oil mill process include Palm Oil Mill Effluent (POME) generated mainly from oil extraction, washing and cleaning up processes. Discharging untreated effluent into water streams may cause considerable environmental problems. However, the solid wastes generated are mainly decanter cake, empty fruit bunches, seed shells, and fibre from the mesocarp. POME as well as solid wastes may rapidly deteriorate the surrounding environment. Hence there is an urgent need for a sustainable waste management system to tackle these wastes.

As these wastes are organic in origin, they are rich in plant nutrients. Composting of wastes generated from palm oil mill is a good practice as it is helpful in recycling useful plant nutrients. This experiment deals with various aspects of wastes management practices in palm oil mill and possibility of composting the wastes. Organic agriculture includes all agricultural systems that promote environmentally, socially and economically sound production of foods. Organic farming dramatically reduces external inputs by avoiding the use of chemosynthetic fertilizer and pesticides (Safwat, 2007).

Recycling organic materials much of which is harvested from the palm are the organic wastes. Most of tropical soils are low in organic content; hence recycling of wastes is a current concern (Wood, 1986). Empty oil palm bunches were used as a source of organic fertilizer which contains nutrients needed by the soil and plants. The empty bunches of oil palm reach 23% of the total utilization of oil palm waste as an alternative organic fertilizer will also provide other benefits from the economic view.

Most vegetable farmers in tropical countries such as India, Malaysia, Indonesia, Philippines, South Pacific and Tropical Africa are small holders who cannot afford cost of inorganic fertilizers, although soil fertility limits yields of vegetables especially in urban and periurban centres. Hence farmers depend largely on locally available organic fertilizers. Organic
fertilizers are being developed from farm and city wastes. Different organic wastes influence nutritional quality of crops. Evaluating of different brands depends on composition of organic and organo-mineral fertilizers.

Organic and organo-mineral fertilizers were found to increase the yield of maize and vegetables such as pepper, tomato, okra, melon and amaranthus significantly (Ipinmoroti, 2003; Fagbola and Dare, 2003; Olowokere, 2004; Adeoye et al., 2008, Ojeniyi and Adejobi, 2002; Ojeniyi et al., 2009; Akanni and Ojeniyi, 2008; Makinde, 2007). Hence this research has been carried out to record the value of oil palm waste on okra. This study was aimed to use the recycled oil palm wastes as organic fertilizer, to analyze the effectiveness of recycled oil palm wastes in cultivation of okra, to approve the recycled oil palm wastes as useful materials for agricultural aspect.

**Materials and Methods**

This experiment was carried out in the open field of Thingangyun Township, Waizayandar Road, Yangon Region from May to November 2010. The oil palm wastes fertilizer was collected from Yuzana Crude Palm Oil Mill, 38 miles, Kha-mauk-gyi Township, Kawthaung District, Tanintharyi Region. Bleaching earth were collected from Yuzana Refined Palm Oil Mill, Tharkayta Township, Yangon Region.

**Experimental layout and growing of okra**

The experimental lay out was Completely Randomized Design (CRD). Four treatments with 9 replicates were assigned in the block. The size of each plot was 150cm × 60cm. The spacing between plants and row were 30cm each and between plots were 30 x 60cm. The total cultivation area was 630 x 210 cm.

Before preparation of seed beds, the soil sample from the cultivation area was taken according to the method mentioned in the (Dierolf et al., 2001). The soil sample was put into the plastic bag and its physical and chemical properties were analyzed in the soil laboratory, Land Use Department, Myanmar Agriculture Service (MAS). Similarly, the physical and chemical properties of applied fertilizers were analyzed in this lab. Then 6.7 kg each of oil palm wastes fertilizer, Fuller Earth, and cow dung were mixed in a respective soil bed. Before growing okra, the assigned fertilizer and soil were thoroughly mixed. Then the soil mix was saturated
with water and allowed to keep for 14 days for the well decomposition of the organic fertilizers (Fig. 1). Fourteen days after decomposition, nine okra seedlings were planted in each plot. Irrigation and other intercultural operations were done whenever it was necessary. The four treatments are T1 (control), T2 (Cow dung), T3 (Organic fertilizer from oil palm wastes) and T4 (Fuller Earth from Refined palm oil mill).

**Preparation of organic fertilizer for agricultural uses**

The waste from the crude palm oil mill was prepared as organic fertilizer by mixing with 40 tons of wood chips, 3 tons of ash from oil cake, 5 tons of kernel cake, 10 tons of ground magnesium lime stone, 3 tons of rock phosphate, 36 tons of decanter cake, 3 tons of bleaching earth. These components are thoroughly mixed and left for 90 days to obtain the well decayed organic fertilizer.

![Fig. 1. Growing of okra in completely randomized design (CRD)](image)

**Data collection and statistical analysis**

Data were collected on plant height, number of leaves, length and width of leaves, length of petiole, leaf area, first and 50% flowering days, first and 50% fruit setting days, pod length, pod width, weight of individual pod, number of seed, seed and pulp weights per pod, yield, and total biomass weight. The Mean separation was done by Least Significant Different Test (LSD) (Gomez and Gomez, 1984). The data were analyzed...
using the IRRISTAT software package, version 4, developed by International Rice Research Institute (IRRI), Los Baños, the Philippines.

Fig. 2. Measuring of plant height, leaf length, leaf width and petiole length

Results

The results of analyzed soil using in cultivation of okra showed that the soil is sandy loam including 97.75% of sand, silt, and clay; very low organic carbon content (0.862%); humus (1.486%); low nitrogen content (0.18%); high phosphorous content (126ppm); and high potassium content (21.64 mg/100g). The pH of soil is 6.8 hence it is nearly neutral. The moisture content of soil is 2.88%.

The results of analyzed cow dung using in cultivation of okra are moisture (40.19%), total nitrogen (1.73%), total P₂O₅ (1.06%), total K₂O (1.11%), total Ca (2.4%), total Mg (0.12%), total sulphur (not detected), total organic matter (33.20%) and C:N (9.61:1). In organic fertilizer from crude palm oil mill, moisture (19.28%), total nitrogen (1.54%), total P₂O₅ (1.35%), total K₂O (1.12%), total Ca (4.8%), total Mg (0.24%), total sulphur (0.83%), total organic matter (40.53%) and C:N (13.13:1). In bleaching earth from refined palm oil mill, moisture (7.07%), total nitrogen (1.19%), total P₂O₅ (2.73%), total K₂O (0.13%), total Ca (4.8%), total Mg
(0.24%), total sulphur (0.99%), total organic matter (24.54%) and C:N (10.35:1).

Effects of different organic fertilizers from oil palm wastes on yield and yield contributing characters of okra have been given below:

**Vegetative growth**

**Plant height**

It is revealed from the results that organic wastes fertilizer significantly influenced the plant height of okra (Table 1, Fig. 3). The tallest plant (48.2cm) were found from the application of oil palm waste, which is followed by cow dung (44.3cm), and then bleaching earth (41.8cm), whereas the shortest was found from control (39.8cm).

**Table 1. Plant height from different fertilizer treatments**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 DAP</td>
</tr>
<tr>
<td>T1(Soil)</td>
<td>14.0</td>
</tr>
<tr>
<td>T2 (Cow dung)</td>
<td>16.3</td>
</tr>
<tr>
<td>T3 (Organic waste)</td>
<td>17.4</td>
</tr>
<tr>
<td>T4 (Bleaching earth)</td>
<td>15.6</td>
</tr>
</tbody>
</table>

F-test: ** = highly significant

5% LSD:

<table>
<thead>
<tr>
<th>F-test</th>
<th>**</th>
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<th>**</th>
<th>**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.88693</td>
<td>0.82729</td>
<td>1.13739</td>
<td>2.50882</td>
<td></td>
</tr>
<tr>
<td>cv%</td>
<td>8.7</td>
<td>2</td>
<td>2.5</td>
<td>4.2</td>
</tr>
</tbody>
</table>

DAP = days after planting ** = highly significant
Results showed that the leaf length and leaf width were also differed significantly by the application of different organic fertilizers (Table 2, Fig. 4). The maximum leaf length (43.53cm) and leaf width (23.45cm) were obtained from organic fertilizer of crude palm oil mill. The second was given by cow dung 40.43 cm in leaf length and 21.53cm in leaf width and followed by bleaching earth from the refined palm oil mill 37.68cm in leaf length and 20.23 cm in leaf width. The minimum results 34.63cm in leaf length and 18.30cm in leaf width was observed in control.

**Leaf length and leaf width**

The maximum petiole length 14.61cm was found in organic fertilizer from crude palm oil mill and followed by cow dung 13.26cm and
then bleaching earth from refined palm oil mill 12.11cm. Control showed minimum result 10.24cm (Table 3, Fig. 5).

Table 2. Leaf length, width and petiole length of okra resulted from different fertilizer treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaf Length (cm)</th>
<th>Leaf Width (cm)</th>
<th>Petiole Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Soil)</td>
<td>34.63</td>
<td>18.3</td>
<td>10.24</td>
</tr>
<tr>
<td>T2 (Cow dung)</td>
<td>40.43</td>
<td>21.53</td>
<td>13.26</td>
</tr>
<tr>
<td>T3 (Organic waste)</td>
<td>43.53</td>
<td>23.45</td>
<td>14.61</td>
</tr>
<tr>
<td>T4 (Bleaching earth)</td>
<td>37.68</td>
<td>20.23</td>
<td>12.11</td>
</tr>
</tbody>
</table>

F-test **   **   **

5%LSD  1.2916    0.543289    0.979893

cv%  2.4      1.9      5.7

** = highly significant

Fig. 4. Leaf length, width and petiole length of okra resulted from different fertilizer treatments
**Leaf area**

The organic fertilizer from crude palm oil mill gave the largest leaf area 360.60cm². The second largest area 307.59cm² was attained by cow dung and then followed by bleaching earth 269.09cm² and control 224.18cm².

The results of reproductive growth such as the first and 50% flowering days showed that 26.2 days and 27.4 days in organic fertilizer from crude palm oil mill, 31.4 days and 32.6 days in cow dung, 30.00 days and 31.80 days in bleaching earth and 39.80 days and 45.20 days in control. The first and 50% fruit setting days showed that 30.20 days and 31.00 days in organic fertilizer from crude palm oil mill, 36.2 days and 38.2 days in cow dung, 42.2 days and 45.6 days in bleaching earth and control as 51.6 days and 57.00 days.

 Marketable yield of okra resulted from different treatments showed that maximum yield 0.87617kg per treatment and 1.16 tons per hectare from organic fertilizer from crude palm oil mill and followed by 0.75405kg per treatment and 1.00 ton per hectare in cow dung, 0.62409kg per treatment and 0.82 ton per hectare from bleaching earth and the lowest yield 0.34815kg per treatment and 0.46 ton per hectare was found in control.

![Fig. 6. Marketable yield of okra from organic fertilizer treatments](image)

Organic fertilizer from crude palm oil mill gave maximum pod length, width and weight (20.38cm, 10.25cm and 35.77g) respectively. Followed by cow dung (16.39cm in pod length, 8.97cm in pod width and 27.11g in pod weight); bleaching earth (14.56cm in pod length, 6.63cm in
pod width and 24.45g in pod weight). The minimum value was achieved by control (11.54cm in pod length, 5.85cm in pod width and 20.19g in pod weight.

The maximum results of seed number, seed weight and seed pulp per pod of okra were found in organic fertilizer from crude palm oil mill had 57.40 in seed number, 4.66g in seed weight and 31.10g in pulp weight. Cow dung could attain by 52.33 in seed number, 3.19g per pod in seed weight and 23.91g in pulp weight and then followed by bleaching earth 47.73 seed number per pod, 2.88g seed weight per pod and 21.56g pulp weight per pod. Control gave the minimum results 39.67 seed number per pod, 2.26g seed weight per pod and 17.83g pulp weight per pod.

The organic fertilizer from crude palm oil mill gave the maximum fresh weight 265.22g followed by cow dung 247.45g, then bleaching earth 241.00g and control gave minimum fresh weight 208.33g. Among vegetative parts, the stem from organic waste fertilizer gave the highest fresh weight, 527.67 g.

In the dry weight, the maximum dry weight (265.22 g) was obtained from organic waste fertilizer whereas the minimum dry weight (203.33 g) was resulted from control.

**Discussion and Conclusion**

Agricultural wastes such as organic wastes from crude palm oil mill and bleaching earth from refined mill are effective sources of nutrients because of their addition to the soil which enhanced the leaf and plant height of okra. The results of analyzed soil using in cultivation of okra showed that the soil is sandy loam including 97.75 % of sand, silt, and clay; very low organic carbon content (0.862 %); humus (1.486 %); low nitrogen content (0.18 %); high phosphorous content (126 ppm); and high potassium content (21.64 mg/100 g). The pH of soil is 6.8 hence it is nearly neutral. The moisture content of soil is 2.88 %.

The application of organic materials increased soil pH. This confirms the findings of Akande et al. (2003) who reported that the application of organic materials could improve slightly acidic tropical soil for increase crop production. The waste of crude palm oil mill (organic waste fertilizer) and bleaching earth from refined palm oil mill is prepared as an organic fertilizer and these fertilizers were used in cultivation of okra.
Approving the effect of organic wastes in agricultural sector, application of organic wastes together with cow dung is established in this experiment.

The results showed that waste from the crude palm oil mill had maximum effects on vegetative plant growth (48.2 cm in height, 43.53 cm of leaf length, 23.45 cm leaf width, 14.61 cm petiole length, and 360.60 cm² leaf areas). The results of reproductive growth showed that the first and 50% flowering days of 26.2 and 27.4; first and 50% fruit setting days of 30.2 and 31.0; yield of 0.87617 kg treatment⁻¹ and 1.16 t ha⁻¹ respectively. The results of pod (fruit) characters showed that organic waste fertilizer gave maximum pod length, pod width, and pod weight 20.38 cm, 10.25 cm and 35.77 g. The organic waste fertilizer gave the maximum fresh weight 265.22 g but minimum dry weight 22.45 g.

Provision of a sustainable environment in the soil by amending with good quality organic additives that enhances water holding capacity and nutrient supplying capacity of soil and also the development of resistance in plants to pest and diseases and increases the yield. However, the waste from refined palm oil mill had lower yield (0.62 kg treatment⁻¹ and 0.82 t ha⁻¹) than cow dung but it had effects than control. Regarding to this, the organic fertilizers was utilized to sustain soil fertility for vegetables production. The people of Myanmar should practice the useful organic fertilizers enhance the balance between the soil nutrition and soil health. Bayu et al (2006) mentioned that the application of organic waste economically reduces the farmer’s expenditure spending on crop fertilization. Besides, the inclusion of organic fertilizer could reduce environmental pollution and improve the environment as well as reduce the cost of fertilizing crops.

Using organic fertilizers also reduces the harmful impact on the environment, which is teetering on the brink of a major ecological catastrophe. These types of fertilizers also strengthen the plants toward off many pests and diseases, and even in the long run they do not lose their effectiveness. However, they do have a few drawbacks but these are of minimal consequence (Safwat, 2007). He also reported that the organic matters in such fertilizers are essential for microorganisms, which build up the soil rich in humus. Besides, the organic fertilizers release the nutrients in a slow and consistent rate that the plants can utilize it. Organic fertilizer provided balanced nutrition to the plants due to the presence of a broad range of trace elements and it is safe for all types of plants and no danger of burning due to salt concentration. Organic matter binds to the soil where the
roots can access it. So, it is long lasting as the organic fertilizers do not leach out. Organic fertilizers also make the plants stronger to resist space disease and pest attacks. Plants that fed on organic fertilizers are also able to resist the advance of weeds and other parasitic plants. The results of analyzed soil expressed that the soil of the cultivation area was sandy loam, low organic matter content, low nitrogen but high phosphorous and potassium. The pH of this soil is 6.8.

The researchers mentioned that Okra prefers to grow in soil that is neutral or slightly sour, meaning a soil that has a pH lower than 6.0. Preferred pH levels for okra are 5.8 to 6.5 and thus the proper fertilization can adjust these levels. However, high concentration of phosphorous causes maximum growth of Okra. The inclusion of organic materials improves the texture of the soil. The organic materials helps the soil to handle water and hold nutrients better. Besides, recent studies have shown that people who constantly eat organic, natural food products are less likely to suffer from skin disorders, heart attacks or stroke. This positive correlation is linked to the natural nutrients that are absorbed when fertilizing with organic fertilizers. On the other hand, this event was opposed to heavy, toxic nutrients absorbed by the plants when using the chemical fertilizers. The application of organic materials increased the soil available phosphorous, showing the potentials of organic materials as a source of P to the soil (http://www.haworthpress.com/store/products.asp?). The observation was agreed with Omoti et al. (1990) and Obatoolu (1999) who reported that oil palm bunch ash, and cow dung applied at 15t ha\(^{-1}\) increased the plant height of Cocoa seedlings. These findings were agreed with that of Adv-Daphh et al. (1994) and Folorunso (1999) who reported that Cocoa pod husk and oil palm bunch ash were good sources of N, P, K, Ca, and Mg to the soils for uptake of coffee and okra crops. Moyin Jesu (2002) reported that one important mechanism to improve nutrient recycling is through the use of applied organic inputs and retention of crop residues. Yet in many tropical cropping systems, little or no agricultural residues are returned to the soils leading to decline in soil organic matter (OM). The type of fertilizer greatly governed the quality of product. Farmers all over the world are using chemical fertilizers; however, many are now shifting to organic fertilizers due to the apparent benefits of the latter. Most of the organic fertilizers can be prepared locally or in the farm itself. Hence the cost of these fertilizers is much less than the cost of chemical fertilizers. Organic fertilizers ensure that the farms remain fertile for hundreds of years. Land in ancient
civilizations such as India and China are still fertile though agriculture has been practised since thousands of years. The fertility is still maintained as organic fertilizers were used in the past. However, now with the increased usage of chemical fertilizers, land is rapidly becoming infertile forcing many farmers to further increase the chemical fertilizer inputs or leave farming. Organic fertilizers are easily biodegradable and hence do not cause environmental pollution. On the other hand, chemical fertilizers contaminate land and water which is the cause of diseases for human beings and extinction of a number of plant, animal and insects. The carbon nitrogen ratio of organic materials is the most important aspect of composting. The process of conversion of organic materials into manure is chiefly microbiological and is, therefore influenced by the proportion of carbonaceous and nitrogenous materials that are present in organic wastes to start with. Microorganisms need carbon for growth and nitrogen for protein synthesis. If the organic materials are poor in N or in other words, carbon: nitrogen ratio is wide, biological activities diminish and several successions/cycles of organisms may be required degrade carbonaceous materials. High C:N are generally caused by organic materials poor in nitrogen (FAO, 1980).

The analyzed results of applied fertilizer showed that moisture and total nitrogen content of cow dung was the highest (40.19% and 1.73%). The phosphorous content of bleaching earth was the highest (2.73%) (Table 4.1 and 4.2). However, organic matter and K contents of organic waste fertilizer were highest (40.53% and 1.12%). When compared the C:N of applied three fertilizers, organic waste fertilizer was the highest (13.13). The C:N of organic materials is the most important aspect of composting. The C:N of 30 could be the most desirable for efficient composting. The C:N between 26-55 as reported by many workers, provide for rapid and efficient composting (FAO, 1980). Moyin- jesu (2007) reported that wood ash and cocoa husk were the most effective in improving okra pod weight, pod nutrients, ash content, root length and soil fertility. This was because of the wood ash and cocoa husk had lower C:N and higher nutrient composition and thus, the former enhanced an increase in pod nutrients, composition for better human dietary intake, increased the root length, pod weight of okra and improved soil fertility and plant nutrition crop. In addition, the increase in plant nutrition and soil fertility would help to reduce the high cost of buying synthetic inorganic fertilizers and maintain the long term productivity of soils for sustainable cultivation of okra.
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