International Journal of Agricultural Policy and Research Vol.4 (12), pp. 271-275, December 2016
Available online at http://www.journalissues.org/IJAPR/
http://dx.doi.org/10.15739/IJAPR.16.028

ISSN 2350-1561

*Original Research Article*

# Response of oil palm seedlings to combined application of NPKMg 12:12:17:2 and liquid fertilizers (humikon and metalon)

Received 3 August, 2016 | Revised 14 September, 2016 | Accepted 16 September, 2016 | Published 16 December, 2016

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**Response of oil palm seedlings to combined application of NPKMg 12: 12:17: 2 and liquid fertilizers (humikon and metalon) was studied in the main nursery of the Nigerian Institute for Oil Palm Research (NIFOR) for two cropping seasons. The trial consisted of 8 treatments laid down in Randomized Complete Block Design (RCBD) in three replicates. Treatments were Zero application (control), 28g NPKMg + 15g metalon, 28g NPKMg + 15g humikon, 42g NPKMg + 30g humikon, 42g NPKMg + 30g metalon, 28g NPKMg only and 42g NPKMg only. Treatments were applied at 3, 5 and 8 months after planting and data were collected on seedling height, girth, leaf number, leaf area, dry matter yield and percentage of transplantable seedlings at 3, 6, and 12 months after planting. Data collected were analysed using analysis of variance and their mean compared with Turkey's Honest Significance Difference (THSD) at 5 % level of probability. At 3 and 6 months after planting seedling height, girth, leaf number and leaf area were not significantly affected by the treatment. However, at 9 and 12 months after planting the palm height, girth, leaf number, leaf area, dry matter yield and the number of transplantable seedlings were significantly affected by the treatments. The highest palm height (118.5 cm), girth (27.0 cm), leaf number (14), transplantable percentage (95.7 %) and dry matter yield (195.7 g) were obtained in seedlings that received combined application of 28g NPKMg 12: 12:17 : 2 and 15ml metalon, while the least palm height, girth, number of leaf, leaf area, transplantable percentage and dry matter yield were obtained from the control.**

**Key words:** Fertilizer, seedling, response, yield

## INTRODUCTION

The major problem encountered by farmers in Nigeria is low crop yield occasioned by inherent soil fertility. Most of the soils are generally classified as oxisols and ultisols of which the fertility is limited by high Fe and Al contents, low activity clay and low organic matter content. Those soils do not produce optimally when cultivated since available nutrients are low. In order to improve the oil palm seedling production capacity, the need to properly manage the soil becomes important. Improving the soil fertility has consistently been pinpointed as one of the most critical factors in the bid to promote the sustainability of agriculture in Nigeria (Omoti, 1989). That is achieved by the use of fertilizer which could be organic or inorganic (Zia et al., 1991) . Oil palm seedlings in its nursery state places a high demand on soil nutrients to attain adequate growth and vigour, which is necessary for optimum field establishment. To meet that demand of nutrients, standard compound fertilizer NPKMg 12:12:17:2 is applied at the rates of 28g to 42g / seedling (Omoti, 1989; Ugbah and Utulu, 2005). In Nigeria at present, the use of this inorganic

**Table 1.** Chemical composition of humikon and metalon

| Elements | Metalon (%) | Humikon (%) |
|---|---|---|
| K | - | 15% |
| Mg | 4 | - |
| Mn | 4.5 | - |
| Cu | 0.5 | - |
| Zn | 0.5 | - |
| Fe | 1.5 | - |
| Boron | 1.5 | - |
| Co | 0.3 | - |
| Mo | 0.01 | - |
| Humic acid | 0.01 | 80 |

Source: Highdawn 2007

fertilizer NPKMg 12:12:17:2 has been limited by scarcity, rising cost, low quality and unavailability at the period of peak demand (Obatolu and Osajuyigbe, 1984). The alternative to dependency on these inorganic fertilizers (NPKMg 12:12:17:2) is to explore potential alternative sources.

Among these alternative sources are liquid fertilizers (humikon and metalon). Humikon and metalon are relatively new in the market and have been found to increase yield of arable crops like rice, maize, millet and sorghum and also fruit crops such as tomatoes, orange, apple and pineapple (Highdawn Nigerian Limited 20074). According to their findings, humikon and metalon enhanced the crops growth and helped the crop to develop resistance to some fungal diseases.

However, their use in perennial crops such as oil palm has not been reported. Thus this study investigates the effect of combined application of NPKMg 12: 12: 17: 2 and liquid fertilizer (humikon and metalon) on oil palm seedling growth and development with the view to determining their suitability as fertilizer for oil palm seedlings production.

## MATERIALS AND METHODS

The experiment was conducted at the main nursery of the Nigeria Institute for Oil Palm Research (NIFOR) in 2008/2009 cropping season and was repeated in 2009/2010 cropping season. Two liquid fertilizers humikon and metalon were tested along with conventional inorganic fertilizer NPKMg 12: 12: 17: 2. The liquid fertilizers were supplied by Highdawn Nigeria Limited; Lagos. The experiments consist of seven treatments namely

(a) zero application (control)
(b) 28 g NPKMg + 15 g Metalon
(c) 28 g NPKMg + 15 g humikon
(d) 42 g NPKMg + 30 g humikon
(e) 42 g NPKMg + 30 g Metalon
(f) 28 g NPKMg only
(g) 42 g NPKMg only

The experiments were laid down as Randomized Complete Block Design (RCBD) replicated three times. Each treatment consists of 12 seedlings per plot and each plots and block were separated by guard row seedlings. Treatments were applied thrice in a year at 3, 5 and 8 months after planting in split dosage. Watering and weeding were carried as when due.

Palm height, number of leaves and girth were measured at 3, 6, 9 and 12 months after planting while dry matter yield and percentage transplantable seedlings were measured at 12 months after planting. Prior to treatment application, the chemical composition of the humikon and metalon was determined (Table 1). The physical and chemical properties of the experimental soil were determined as described by (Juo,1981). Data were collected on palm height (cm), girth (cm), number of leaves, leaf area, percentage of transplantable seedlings, yield (fresh and dry). The palm height was measured with a graded two metres long metric ruler, from the palm base to the top of the drawn up leaf, while the girth was the circumference of palm base which was measured using a thread which was then placed on a graded metric ruler to read. Leaf number was done by counting, while the leaf area was estimated by the methods (Hardon et al., 1969) and (Corley, 1976). Dry matter yield was estimated using 12 months old seedlings. Destructive sampling was carried out by carefully removing the seedlings from the polythene bags without damage to the seedlings. The ball of the earth was carefully loosed off the seedling and the root washed in water to remove the soil completely. Fresh weights of the harvested seedling were measured and the harvested seedlings were then taken to the laboratory for oven drying in order to obtain the dry matter yield. The dry matter yield was obtained by oven drying the seedlings at 85$^{o}$C for 48 – 72 hours until a constant weight was obtained. Transplantable seedlings were healthy plants without any growth abnormalities with at least 10 – 12 green leaves and with minimal girth of 13 cm and above (Hartley, 1967). Data collected were subjected to analysis of variance (ANOVA) and when F calculated was found to be significant their means were separated by the Turkey's Honest Significance Difference

**Table 2.** Soil physical and chemical properties of the experiment site

| Properties | Initial | Post |
|---|---|---|
| pH | 5.1 | 6.0 |
| N gkg-1 | 0.10 | 0.09 |
| C g kg-1 | 0.02 | 0.048 |
| P mg kg -1 | 19.95 | 16.00 |
| **Exchangeable cation** | (cmol / kg) | |
| K | 8.10 | 6.48 |
| Ca | 2.34 | 1.26 |
| Mg | 1.02 | 2.08 |
| Na | 0.30 | 0.20 |
| **Particle sizes** | | |
| Sand (%) | 85.3 | 86.3 |
| Silt (%) | 2.9 | 1.9 |
| Clay (%) | 11.8 | 11.8 |
| Texture | Sandy Loam | Sandy Loam |

(THSD) at 5 % level of probability.

## RESULTS AND DISCUSSION

### Chemical properties of humikon and metalon

Chemical composition of the liquid fertilizers, humikon and metalon is presented in Table 1. The results of the chemical analysis showed that humikon and metalon contained no nitrogen. Metalon contained magnesium, manganese, iron, boron, sulphur and other micro nutrient while humikon contained only potassium and humic acid respectively. By this it means that humikon and metalon fertilizers cannot be used alone to raise oil palm seedlings because oil palm seedlings require high nitrogen at early stage of growth than any other nutrient. According to (Omoti, 1989), oil palm require large quantity of nitrogen, potassium and magnesium in the nursery stage in this order and in the bearing years potassium and nitrogen becomes more important. Thus absence of nitrogen in the liquid fertilizer is an indication that they can only be used in combination with other sources of nitrogen fertilizer.

### Physical and chemical properties of experimental soil

The physical and chemical properties of the soil show that the soils are slightly acidic, with low total nitrogen, organic carbon and exchangeable cation Table 2. However the soil available phosphorus is moderate while the soil texture is sandy loam. Fertilizer application improved the soil nutrient composition as the soil pH was increased from moderately acidic to slightly acidic. Also, the soil K, Mg and other nutrients were not depleted 12 months after treatments application. The significant performance of seedlings that received fertilizer over the control is an indication that the applied fertilizer enhanced the soil nutrient composition which in turn affected the seedlings. responses.

### Effect of fertilizers on Oil palm seedling height, number of leaves produced, Seedling girth

Data on the effects of combined application of NPKMg 12: 12: 17: 2 and liquid fertilizers on seedling height at 3, 6, 9 and 12 months after planting are presented in Table 3. At 3 and 6 months after planting there were no significant variations in height until at 9 months after planting. The non significant effect of applied fertilizer on seedling height at 3 and 6 month after planting may be attributed to the fact that the first application was made at 3 months after planting which was actually the time the initial data collection was made and also the treatment applied needed to be absorbed and assimilated before being transformed to development by the seedlings and this require sometime which become visible at 9 and 12 months after planting. The vigorous and healthy growth of the oil palm seedlings at 9 and 12 months is due to effect of applied treatment. Combined application of NPKMg 12: 12: 17: 2 and metalon at 28 g and 15 g respectively gave the highest seedling height. This was not significantly different from application of 42 g NPKMg 12:12:17: 2 and 30 g of humikon. Seedling receiving fertilizer either combined or single application significantly performed better than the control. At 9 and 12 months after planting, combined application of NPKMg 12:12:17:2 and liquid fertilizer significantly influenced the number of leaves produced (Table 4).

Seedlings receiving fertilizers did not show any significant difference from each other in the number of leaves produced, except over the control. Significant difference in the number of leaves produced by the fertilizer treated seedlings over the control is an indication that the applied fertilizer enhanced the seedlings at differentiation which in turn improved the seedlings growth and development. Seedling girth at 3 and 6 months were not significantly different from each other (Table 5).

The effect of combined application of NPKMg 12:12:17: 2 and liquid fertilizer becomes evident at 9 and 12 months

**Table 3.** Mean height of oil palm seedling at 3, 6, 9 and 12 months after planting as affected by treatments

| Treatment | 3 | 6 | 9 | 12 |
|---|---|---|---|---|
| Control | 25 | 40.3 | 95.5[c] | 84.3[c] |
| 28 g NPKMg 12 : 12 : 17 : 2 | 27 | 50.6 | 93.4[a] | 107.0[a] |
| 42 g NPKMg 12 : 12 : 17 : 2 | 26.5 | 51.5 | 85.4[b] | 103.7[a] |
| 28 g NPKMg + 15 g metalon | 25.2 | 53.4 | 99.3[a] | 118.5[a] |
| 28 g NPKMg + 15 g humikon | 25.0 | 50.4 | 97.5[a] | 107.5[a] |
| 42 g NPKMg + 30 g metalon | 25.5 | 49.7 | 85.9[b] | 101.2[a] |
| 42 g NPKMg + 30 g humikon | 24.5 | 48.7 | 88.5[ab] | 99.8[ab] |

Mean with the same alphabet are not significantly different from each other at 5% level of probability by Turkey's Honest Significance Difference.

**Table 4.** Mean number of leaf of oil palm seedlings at 3, 6, 9 and 12 months after planting

| Treatment | 3 | 6 | 9 | 12 |
|---|---|---|---|---|
| Control | 5 | 8 | 9[b] | 11[b] |
| 28 g NPKMg 12 - 12 – 17 – 2 | 6 | 8 | 10[a] | 13[a] |
| 42 g NPKMg 12 - 12 – 17 – 2 | 5 | 9 | 10[a] | 13[a] |
| 28 g NPKMg + 15 g metalon | 6 | 8 | 10[a] | 14[a] |
| 42 g NPKMg + 15 g humikon | 6 | 9 | 11[a] | 13[a] |
| 42 g NPKMg + 30 g metalon | 5 | 9 | 11[a] | 12[a] |
| 42 g NPKMg + 30 g humikon | 6 | 8 | 10[c] | 13[a] |

Mean with the same alphabet are not significantly different from each other at 5% level of probability by Turkey's Honest Significance Difference (THSD).

**Table 5.** Means of oil palm seedling girth (cm) at 3, 6, 9 and 12 months after planting as affected by treatments

| Treatment | 3 | 6 | 9 | 12 |
|---|---|---|---|---|
| Control | 4.6 | 7.5 | 11.5[c] | 16.2[c] |
| 28 g NPKMg 12 :12 : 17 : 2 | 5.0 | 10.9 | 16.5[a] | 23.2[b] |
| 42 g NPKMg 12 : 12 : 17 : 2 | 4.8 | 9.0 | 15.0[b] | 22.4[b] |
| 28 g NPKMg + 15 g metalon | 4.3 | 10.5 | 17.5[a] | 27.0[a] |
| 28 g NPKMg + 15 g humikon | 4.0 | 8.9 | 16.5[a] | 24.0[b] |
| 42 g NPKMg + 30 g metalon | 4.9 | 10.2 | 16.7[a] | 24.3[b] |
| 42 g NPKMg + 30 g humikon | 5.1 | 10.5 | 16.0[a] | 23.1[b] |

Mean with the same alphabets are not significantly different from each other at 5% level of probability by Turkey's Honest Significance Difference (THSD).

after planting and treatment significantly influenced seedling girth. Higher rate of NPKMg 42 g / seedling reduced seedling girth compared with NPKMg 28 / seedling and combined application of NPKMg and liquid fertilizer gave the highest seedlings girth. The least seedling girth was obtained from the control plot.

**Effect of Leaf area, total dry matter and percent transplantable seedling**

The effects of combined application of NPKMg 12:12:17:2 and liquid fertilizer on seedling leaf area, fresh and dry matter yield and percentage transplantable seedlings are presented in Table 6. Combined application of NPKMg 12:12:17:2 and liquid fertilizer resulted in significant difference in seedling leaf area, fresh and dry matter production and transplantable seedlings. Seedling treated with combined application of NPKMg 12:12:17:2 and liquid fertilizer performed better than seedlings treated with only NPKMg 12:12:17:2 at 28 g and 42 g respectively. This may be attributed to the fact that the liquid fertilizer, humikon and metalon are high in Potassium and Magnesium which are easily absorbed by the plant when compared with the solid inorganic NPKMg 12:12 :17:2 which need to be dissolved before being absorbed by translocated through the conducting tissue for utilization.

**Conclusion**

The significant response of oil palm seedlings to NPKMg 12:12:17:2 and liquid fertilizer application showed the need for fertilizer supplements in oil palm nurseries.

Metalon for instance contains micro nutrients which may be deficient in the nursery soil. As these liquid fertilizers (humikon and metalon) contain no nitrogen and because of the importance of nitrogen in oil palm seedlings growth and

**Table 6.** Mean yield of fresh and dry matter and percentage transplantable seedling at 12 months after planting

| Treatments | Fresh weight (g) | Dry weight (g) | % Transplantable |
|---|---|---|---|
| Control | 160.0[c] | 85.8[c] | 74.0[c] |
| 28 g NPKMg 12 : 12 : 17 : 2 | 316.3[b] | 158.5[b] | 84[b] |
| 42 g NPKMg 12 : 12 :17 : 2 | 314.3[b] | 147.9[b] | 82[b] |
| 28 g NPKMg + 15 g metalon | 361,2[a] | 195.7[a] | 95.7[a] |
| 42 g NPKMg + 15 g humikon | 347.6 [a] | 173.7[a] | 89.0[a] |
| 42 g NPKMg + 30 g metalon | 344.2[a] | 189.4[a] | 87.7[a] |
| 42 g NPKMg + 30 g humikon | 332.9 [b] | 179.7[a] | 85.0[a] |

Mean with the same alphabets are not significantly different from each others at 5% level of probability by Turkey's Honest Significance Difference (THSD).

development, humikon and metalon are only suitable for use as oil palm fertilizer when combined with NPKMg 12 :12 : 17: 2 or organic fertilizer or inorganic fertilizers that are rich in nitrogen.

**Acknowledgement**

The authors are grateful to the Executive Director of the Nigerian Institute for Oil Palm Research for the permission granted to conduct the trial at NIFOR Main Station Nursery. We are also grateful to Mr. Utulu John, Head, Seed Production Division, for providing the planting material and Mr Charles, Head, Nursery Division for his assistance during the trial.

**Conflict of interests**

The authors declare that they have no conflicting interests

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