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Full Length Research Paper

Efficacy of vimpel as fertilizer for raising oil palm seedlings

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Oil palm seedlings response to vimpel and NPKMg 12:12:17:2 was investigated at the main nursery of the Nigerian Institute For Oil palm Research (NIFOR) for 2015 and 2016 cropping season. Three rates vimpel and NPKMg 0, 28g and 56g / seedling were tested respectively. The trial was laid out in Randomized Complete Block Design (RCBD) in four replicates. Data were collected on seedling height, girth, leaf number, leaf area, dry matter yield, fresh matter yield and percentage of transplantable seedlings at 12 months after transplanting. Data collected were subjected to analysis of variance (ANOVA) and their mean compared with Least Significance Difference (LSD) at 5% level of probability. Results showed that all parameters measured were significantly ($p \leq 0.05$) affected by the applied varied rates of fertilizers. The highest palm height (114.7cm), girth (22.8cm), number of fronds (13), leaf area (78.8 cm^2), fresh and dry matter yield (108g and 76g) and percentage transplantable (89.5%) was obtained in seedlings treated with combined application of 28g vimpel + 28g NPKMg 12:12:17:2 while the least palm height (102.7cm), girth (16.8cm), number of fronds (11), leaf area (70.8 cm^2), fresh and dry matter yield (98g and 56g) and percentage transplantable (71.5%) was obtained in the control seedlings.

Keyword: Response, fresh, dry, seedling, rate, vimpel

INTRODUCTION

In Nigeria, the use of inorganic fertilizers has been low, whereas land uses intensification and expansion for crop cultivation has been on the increased (Ilori *et al*, 2014). Oil palm places a high demand on plant nutrient (Omoti, 1989). In oil palm production nutrient management is the key to success. To meet this demand of nutrients, standard compound fertilizer NPKMg 12:12:17:2 is applied at the rate of 28g to 42g/seedling (Ugbah and Ututu, 2005). The use of this inorganic fertilizer NPKMg 12:12:17:2 has been limited by scarcity, rising cost, low quality and unavailability at the period of peak demand. Other limitations of the use of inorganic fertilizers is the declined in soil organic matter content, soil acidification as a result of the residual effects, as well as degradation of certain soil physical properties with resultant increased incidence of soil erosion (Goh and Hardter, 2003). Crop performance is definitely improved by adequate use of fertilizers and of mineral fertilizers in particular, provided they are applied in accordance with good and quality concepts and knowledge. In the nursery and early years in the field, nitrogen, potassium and magnesium (in that order) are the most important, while in the bearing year's potassium and nitrogen become most important (Imogie *et al*., 2005). Hence emphasis has been on the application of N, P, K and Mg fertilizers to effect growth, development and yield. The common practice is to supply N, P, K, and Mg in the form of NPKMg 12:12:17:2, or mixture of straight fertilizers in the equivalent ratio of 12:12:17:2 in the form of Urea, Sulphate of ammonia, Single super phosphate, Murate of potash and Kerserite (Imogie *et al*., 2005). Various research conducted by Scientists on palm nutrition in the Nigerian Institute for Oil palm Research (NIFOR) have shown that potassium, nitrogen, phosphorus and magnesium are the key elements required by the oil palm for optimum vegetative growth and high bunch yield (Corley and Tinker, 2003).

The alternative to depending on these inorganic fertilizers (NPKMg 12:12:17:2) is to explore potential alternative sources. Vimpel is a plant growth regulator and is a newly manufactured liquid fertilizer which is high in micro-nutrients such as iron, zinc, calcium oxide and magnesium and also act as growth stimulator, soil activator, disease inhibitor, anti stress agent, heat protectant and drought resistance. Vimpel liquid fertilizer is readily available, cheap and environmental friendly. Although vimpel according to the manufacturer has been found to be effective on arable crops, orchards, cocoa and rubber production as evident in an unpublished literature provided by the company (Chaslit Chemical Limited 2000). However, there is a dearth of information on its efficacy on oil palm seedlings or perennial crops growth and development, thus, there is a need for it to be tested or investigated. This study therefore, investigates the efficacy of vimpel as alternate fertilizer for raising oil palm seedling.

MATERIALS AND METHODS

The experiment was conducted at the main nursery of the Nigerian Institute For Oil palm Research (NIFOR) in 2015 and 2016 cropping season. The Nigerian Institute For Oil palm Research (NIFOR) is located at KM 17, Benin - Akure Road in Ovia North East Local Government Area of Edo State. It lies within latitudes 6º 33" and 7º 25" north of the Equator and longitudes 5º 15" and 5º 37" east of the Greenwich Meridian. Liquid fertilizer (Vimpel) which was obtained from Messrs Chaslit Chemical Industry Limited Abuja was tested along the conventional fertilizer (NPKMg 12:12:17:2) at three rates namely; 0, 28 and 56g/seedling. The details of the treatments are as follows:

(i) 0g (control)
(ii) 28g vimpel
(iii) 56g vimpel
(iv) 28g NPKMg 12:12:17:2
(v) 56g NPKMg 12:12:17:2
(vi) 14g vimpel+14gNPKMg 12:12:17:2
(vii) 28g vimpel +28g NPKMg 12:12:17:2

The experiment was laid out as Randomized Complete Block Design, in four replicates. Black polythene bags measuring 40cm x 35cm (500 gauges) were used. Each was filled with rich top soil from nursery site classified as inceptisols. The filled bags were arranged at 45cm x 45cm and left to consolidate for three weeks before three month oil palm seedlets were transplanted from pre - nursery into the main nursery. Each treatment plot consists of 12 oil palm seedlings and treatments were applied at 3, 5 and 8 month after transplanting. The vimpel was applied by foliar application, while NPKMg was applied by band placement method. The fertilizers were weighed using electric operated weighing balance and container calibrated for the fertilizer measurement. The liquid fertilizer, vimpel, was dissolved in 20 milliliters of water and sprayed on the palm fronds. Soil samples were collected before and at eight months after treatments application at depth of 0-15 cm using soil sampling auger. The collected soil samples were analyzed for soil physical and chemical properties using standard analytical tools. The chemical properties of vimpel were determined using kjedahl method, spectrophotometer, flame photometer, atomic absorption spectrophotometer and EDTA titration for N, P, K, Fe, Zn, Mg and CaO respectively. Biometric data on palm height, girth, leaf number, leaf area, transplantable seedling percentage and dry matter yield were collected. The palm height was measured with a graded long metric ruler, from the palm base 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 area was estimated by the method described by Hardon *et al.,* (1969) and Corley, (1976). Dry matter yield was estimated using 12 months old seedlings. Destructive sampling was done by carefully removing the seedling from the polythene bags without damages to the seedlings. The ball of the earth was carefully loosed off the seedlings and the root rinsed in water to wash off the soil completely. Therefore, fresh weight of the seedlings was obtained by weighing and the weight recorded. The harvested seedling were labeled and transplanted to the Agronomy laboratory and the seedling parts were separated into root and stem according to treatments. The root and stems were then oven dried at 85ºC for 48-72 h until a constant weight was obtained. The transplantable seedling percentage was obtained by physical observation. Transplantable seedlings were healthy palm without any growth abnormalities with height 105cm, at least 10-12 green leaves, minimal girth of 15cm and above (NIFOR, 2005). Data collected were subjected to analysis of variance (ANOVA) and when F calculated was found to be significant, their means were compared using the least significant difference at 5% level of probability.

RESULTS AND DISCUSSION

Soil physical and chemical properties

The soil physical and chemical analysis is presented in (Table 1). Results of the soil analysis showed that the applied fertilizers had effect on soil physical and chemical properties. The soil total N was low before transplanting (1.25g/kg) but increased to 1.59g/kg on termination of the experiment due to the applied treatments. The soil available P was 36.2g/kg before transplanting and increased to 38.60g/kg on termination of the experiment

Table 1. Physical and chemical properties of the experimental soils.

Soil properties	Before planting	After harvest
Sand (g/kg)	862	856
Silt (g/kg)	20	25
Clay (g/kg)	118	119
Texture	Loamy Sand (LS)	Loamy Sand (LS)
Bulk density (g/cm^3)	13.8	12.8
pH	5.6	5.4
Organic Matter(g/kg)	16.1	14.5
Total Nitrogen(g/kg)	1.25	1.59
Available P (mg/kg)	36.16	38.60
Exchangeable Cation (cmol/kg)		
Mg	1.60	1.25
Ca	4.80	0.98
K	0.231	0.108
Na	0.052	0.116

Table 2. Chemical properties of Vimpel.

Element	%
N	-
P	-
K	-
Zn	8
Mg	8
Fe	8
CaO	8

following treatments application. The textural class was loamy sand. The soil is generally high in sand in the surface layer (0-15 cm). The soil pH ranges from slightly acidic to moderately acidic (5.4) on this favour oil palm cultivation. According to Goh and Chew, (1997), oil palm requires or does well in soils with pH of 4.0 to 5.5. This indicated that the soil pH was adequate for the growth of the seedlings. Generally the soil native nutrient status was very low before transplanting on the critical level for optimal growth, development and yield (NIFOR, 2005).

Chemical properties of vimpel

Table 2 shows the chemical properties of vimpel and the results shown that the primary nutrients needed for growth and development of oil palm, that is nitrogen, phosphorus and potassium (NPK) are absent. Vimpel contains 8% zinc, 8% Magnesium, 8% iron and 8% calcium oxide. According to Ugbah and Utulu, (2005) oil palm seedlings places a high demand on soil nutrients in the nursery stage and to meet this demand, NPKMg 12:12:17:2 is applied at the rate of 28g to 42g/seedlings (NIFOR, 2005).This is one of the reasons why vimpel must be applied in combination with the conventional fertilizer NPKMg 12:12:17:2 for proper growth and development of oil palm seedlings. The micronutrients strengthen the root formation and increased availability and utilization of macro nutrients in the soil and also played vital role in growth.

EFFECT OF FERTILIZER APPLICATION ON GROWTH PARAMETERS OF OIL PALM SEEDLINGS

Plant height, leaf numbers, and seedling girth and leaf area of seedling

Table 3 shows the effect of fertilizer application on plant height, number of leaf production and seedling girth of oil palm seedlings. Effect of treatments on plant height, seedling girth and leaf area were significant (P≤0.05) at 12 months after transplanting and for leaf numbers production statistical analysis did not show any significant difference in terms of treatment application except in the control where a significant difference was observed when compared with the other treatments.. Plant height of seedlings that received treatment combination of 28g vimpel and 28g NPKMg 12:12:17:2 were significantly superior (114.7cm) to plant height of seedlings that received other rates of fertilizer application either singly or in combination. Oil palm seedlings had its least height of 84.67 at 12 months after transplanting (MAT) when no fertilizer was applied (that is the control). The combined fertilizer application of 28g vimpel and 28g NPKMg 12:12:17:2 and 56g NPKMg 12:12:17:2 applied singly

Table 3. Effect of fertilizer application on growth parameters of *elaeis guineensis* 12.

Treatment	Plant height (cm)	Leaf number	Girth(cm)	Leaf area (cm^2)
Control (0kg)	84.67	11	16.8	55.75
28g Vimpel	91.99	12	19.32	59.65
56g Vimpel	89.66	12	19.31	68.25
28g NPK Mg 12:12:17:2	99.53	12	20.50	65.70
56g NPK Mg 12:12:17:2	101.22	12	19.20	69.58
14g Vimpel + 14g NPK Mg 12:12:17:2	88.19	12	18.57	58.90
28g Vimpel + 28g NPK Mg 12:12:17:2	114.7	13	22.8	78.8
Mean	94.28	12	19.45	63.82
CV	4.5	4.8	5.6	3.6
SEM	2.118	0.291	0.542	1.136
LSD ($P \leq 0.05$)	6.292	0.866	1.609	3.375

MAT: Months after Transplanting, C.V: Coefficient of Variation; SEM: Standard Error Between Means; LSD: Least Significance Difference.

gave the highest leaf numbers (13) while the control gave the least leaf numbers (11). The treatments had significant effect on oil palm seedling girth. Seedlings treated with 28g vimpel and 28 NPKMg 12:12:17:2 in combination (22.8cm), were significantly different and better than all other treatments. However, it was not significantly different from seedlings treated with 28g NPKMg 12:12:17:2. Seedlings that received no fertilizer singly or in combination (control) produced significantly smallest stem girth (16.8cm).

At 12 months after transplanting (MAT), leaf area of seedlings treated with 28g vimpel plus 28g NPKMg 12:12:17:2 fertilizer was statistically superior ($P \leq 0.05$) to other treatments applied. Although 56g NPKMg gave the highest seedling leaf area (69.58cm2), this value was not significantly different from values gotten when seedlings were treated with 28g vimpel + 28g NPKMg 12:12:17:2 and 56g vimpel.

The lowest leaf area was observed in seedlings with no treatment application (control). At 12 months after transplanting, there was significant variation in height, girth, leaf area and numbers of leaf production.. Oil palm seedlings treated with fertilizers (singly and in combination) either liquid or solid performances were significantly better than oil palm seedlings that received no fertilizers (control).

The significant effects of applied fertilizers on the palm height, girth, leaf area and leaf numbers production over the control is due to the importance of adequate soil nutrients due to applied fertilizer. The soil initial nutrient composition could not support optimal palm growth, thus application of external input such as fertilizer the granular and liquid fertilizer which resulted to better performance of oil palm treated with fertilizer over control. This result is in agreement with the findings of (Imogie *et al*., 2015) were conventional NPKMg 12:12:17:2 fertilizer was used in combination with liquid fertilizers (Operon 22:0:0, advantage 20:20:10 and Boost xtra 20:20:20).

Percentage transplantable, fresh matter yield and dry matter yield of oil palm seedlings at 12 months after transplanting

Effect of fertilizer application on percentage transplantable, fresh and dry matter yield of oil palm seedlings at 12 months after transplanting is shown in (Table 4). Treatments application significantly ($P \leq 0.05$) affected oil palm seedlings percentage transplantable, fresh and dry matter yield. At 12 months after transplanting (MAT), 28g vimpel in combination with 28g NPKMg 12:12:17:2 fertilizer gave the highest transplantable percentage (89.04%) when compared with the other treatments. This value was significantly different from those obtained from seedlings treated with 14g vimpel + 14g NPKMg 12:12:17:2, 28g NPKMg 12:12:17:2, 56g vimpel, 28g vimpel and control, except in seedlings treated with 56g NPKMg 12:12:17:2 , where no significant difference was observed. While the control gave the least transplantable percentage (59.58%). At 12 months after transplanting (MAT), seedlings treated with 28g vimpel + 28g NPKMg 12:12:17:2 fresh matter yield were statistically superior and performed better (75.0g/palm) than seedlings treated with the other applied fertilizers. The least fresh matter yield was observed in seedlings without treatments (control). At 12 months after transplanting, the analysis showed that the treatments significantly affected this variable. Seedlings treated with combinations of 28g vimpel and 28g NPKMg 12:12:17:2 gave the highest dry matter yield (51.6g). However, this value was not significantly different from values obtained from seedlings treated with 14g vimpel + 14g NPKMg 12:12:17:2, 56g NPKMg 12:12:17:2, 28g NPKMg 12:12:17:2, and 28g vimpel except when compared with the control. The control also gave the least dry matter yield. Treatments application significantly affected seedling fresh and dry matter yield and transplantable seedlings. The better performance of oil palm seedlings

Table 4. Effect of fertilizer application on fresh and dry matter yields (FMY and DMY) and percentage transplantable seedlings (%TPL) at 12 months after transplanting.

Treatment	FMY(g/palm)	DMY(g/palm)	TPL(%)
Control (0kg)	55.1	25.8	59.58
28g Vimpel	64.7	42.3	70.37
56g Vimpel	66.7	41.1	74.29
28g NPK Mg 12:12:17:2	72.3	47.6	82.00
56g NPK Mg 12:12:17:2	72.2	42.9	88.38
14g Vimpel + 14g NPK Mg 12:12:17:2	65.8	42.2	69.38
28g Vimpel + 28g NPK Mg 12:12:17:2	65.0	51.6	89.04
Mean	67.4	41.9	76.15
CV	10.3	15.3	3.6
SEM	3.48	4.53	1.381
LSD ($P \leq 0.05$)	10.35	9.51	4.104

C.V: Coefficient of Variation; SEM: Standard Error Between Means; LSD: Least Significance Difference

in terms of of fresh matter yield, dry matter yield and percentage transplantable seedlings over the control is an indication that for optimum oil palm seedlings growth and development, adequate nutrient must be made available to the palm. This is because the palm needs both macro and micro nutrients in adequate form to actualize its genetic potential. These findings support earlier observation by Imogie *et al*., (2005) that application of NPKMg 12:12:17:2 in combination with foliar fertilizer (power plant) enhanced the growth and development of oil palm seedlings.

Conclusion

The significant response of oil palm seedlings to applied liquid fertilizer (vimpel) and NPKMg 12:12:17:2 at various rates over the control showed the need for fertilizer supplements in oil palm nurseries. Applied liquid fertilizer all significantly affected the oil palm height, girth, leaf area, dry matter yield and percentage of transplantable seedlings. Vimpel competed with the conventional fertilizer NPKMg 12:12:17:2, in enhancing seedling development. The fertilizers contain magnesium. However, primary nutrients such as nitrogen, phosphorus, and potassium must be supplied in appropriate dosage to prevent nutrient imbalance in the soil that may lead to poor seedlings development. In conclusion, 28g vimpel in combination with 28g NPKMg 12:12:17:2 per seedling could be used as alternate fertilizer to NPKMg 12:12:17:2/ seedling alone due to economic cost, scarcity and its effect on soil following continuous use. In addition vimpel should not be used alone but in combination with NPKMg at the appropriate rate and proportion (28g NPKMg 12:12:17;2 and 28g vimpel).

Authors' declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

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