HSPI The Open Access Publisher

A F N S ARCHIVE OF FOOD AND NUTRITIONAL SCIENCE
ISSN 2575-0194

Research Article

Response of Chemical Fertilisation on Six-year-old Oil Palm Production in Shambillo-Padre Abad- Ucayali

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Abstract

It was proposed to determine the response of chemical fertilization in the production of oil palm (*Elaeis guineensis Jacq*.) six years old in the area of Rio Negro Shambillo Padre Abad in order to have a sustainable and economic alternative of chemical fertilization in the field stage, which contributes to the survival of the palm and provides the necessary resistance against pests and diseases. A completely randomized block design (DBCA) was used with four repetitions and treatments, 96 plants / UE / treatment were used, the spacing was 9x9 in rows and plants. Results obtained indicate the treatments; T3 and T2 (16,54 – 15,48 kg / plant) obtained the highest averages by bunch weight, T1 and T3 (17,48 – 15,42 fruits / bunch) obtained the highest averages regarding number of fruit / bunch, T1 and T3 (13,93 – 11,59 to 45 cm) obtained the highest averages for bunch length, T1 and T3 (7,33 – 5,52 cm) obtained the highest averages regarding fruit length, T1 and T3 (11.37 – 9.54 g) obtained the highest averages regarding fruit weight, T1 and T3 (10,46 – 10,37 kg) obtained the highest averages to yield per plant. The addition of chemical fertilizers or organic amendments increases the weight of the oil palm bunch, consequently the production in soils with medium, low fertility; chemical fertilization influences the number of clusters of oil palm produced on a given surface, any dose is used as an alternative to phosphorous fertilization in oil palm with a direct relationship between plant height and root length.

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Submitted: July 18, 2024
Approved: September 12, 2024
Published: September 13, 2024

How to cite this article: Nolberto EDE, Cabello GGC, Rafael-Rutte R, Salvador JLB, Dapozzo CLA, Ochoa GV, et al. Response of Chemical Fertilisation on Six-year-old Oil Palm Production in Shambillo-Padre Abad-Ucayali. Arch Food Nutr Sci. 2024; 8(1): 024-028. Available from: https://dx.doi.org/10.29328/journal.afns.1001058

Keywords: African palm; Triple superphosphate; Molimax; Micro essential; Chemical fertilization

Introduction

At present, the oil palm (*Elaeis guineensis Jacq*.) is the most important source of vegetable oil in the world because, among other qualities, it has a higher yield than other oleaginous plants, being able to produce up to 4,5 t/ha of oil per year.

To support this high yield, chemical fertilization is employed to enhance soil nutrient availability and ensure the optimal growth and fruit production of oil palms. This practice involves the application of essential nutrients that soils in tropical regions often lack, making it a critical component of successful oil palm cultivation [1].

This species requires fertile soils, with a depth of between 90 cm to 150 cm, with a loamy texture and a non-heavy clay subsoil, with a continuous supply of moisture.

Soils with these characteristics allow the crop to develop optimally by adequately supplying it with water and facilitating the absorption of nutrients. In Peru, not enough studies have been carried out to determine the optimum fertilisation doses for the different growing regions. It must be taken into account that an adequate fertilisation is beneficial to properly nourish the crop, improve fresh fruit yields and increase the profitability of commercial plantations.

The field stage of the African palm is one of the most

vulnerable periods for the plant, because if it is deficient in nutrients, it will show slow growth, poor bunch formation, poor pollination activity, low resistance to pests and diseases, so it requires proper care and nutritional intake for proper development of the plant, which has a significant influence on subsequent stages, as the first days of life of the plant are directly related to the subsequent stages of growth and production.

It is hoped that this document will contribute to increased production and the productivity of the palm industry and contribute to the consultation of technical assistants involved in the cultivation of African palm. This research focuses on the evaluation of phosphorus fertiliser sources in the nutrition of the oil palm crop in the nursery stage and is also intended to be one of the alternatives for solving nutritional problems, as it will determine the source of phosphorus fertiliser that gives the best results for plant development.

The interest in chemical fertiliser response is due to its enormous potential in tropical soils, which usually exhibit low availability of Molimax and Micro Essentials, where the components could serve as a low-cost, non-polluting agricultural bio-input. Chemical sources play a lock-in role in nutrient cycles, contribute to maintaining the stability and diversity of natural ecosystems, and buffer biotic and abiotic stresses that affect the adaptability of plants in the soils in which they grow.

The objective of this article is to evaluate the response in bunch weight, number of fruits per bunch, bunch size, fruit diameter and fruit length in oil palm. In addition, the effects of the sources of triple superphosphate, Molimax, Microescenciales at different concentrations, as well as the influence of environmental factors during the development and growth of the plant were evaluated. The hypothesis was that the response of chemical fertilization applied in oil palm production will have a positive influence on phenological activity during the field stage.

Materials and methods

Location

The present investigation was carried out between 2018 and 2020, in the "La lluvia" farm "Rio Negro hamlet". This place is located 16 kilometres from the district of Boquerón, Padre Abad, via the hamlet of Shambillo. The study site is geographically located and has the following geographical characteristics: Longitude: 75º34'53.06" West Latitude: 09º01'56.18" South Altitude: 376 masl.

The place is characterized by being tropical with an average temperature of 25.84 ºC, with a wide variation between a maximum of 30.36 ºC and a minimum of 21.66 ºC with a relative humidity of 85.22% and a rainfall of 5,919 mm/year, as shown in Table 2.

Type of research project

The present research work will correspond to the Experimental type, it is oriented to know the response of fertilization with three sources of chemical mixtures in the production of oil palm (*Elaeis guineensis Jacq*.) which has been established for six years in the area of Shambillo-Padre Abad.

Research method

This method leads to qualitative and quantitative research, which implies that certain hypotheses are derived from a general theory, which are subsequently tested against observations of the phenomenon. It is a predominantly experimental scientific research method whose methodological procedures are synthesis, experimentation, comparison of characteristics and their respective evaluation.

T1: Triple Superphosphate 16N-8P-20K + 3 MgO + 4 S

T2: Molimax 14N-4P-25K + 4 MgO + 5 S

T3: Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S

T4: NPK 0-0-0 absolute control

Research design

A randomised complete block design with 4 treatments and 4 replicates was used, having a total of 16 experimental units.

Population, sample and sampling

Population: The population of oil palm plants was constituted by the total number of 715 palm plants existing in the Shambillo area estate.

Sample: A representative sample of 96 plants of the CIRAD variety, aged 6 years, planted at a distance of 9 x 9 m, will be taken.

Sampling: Sampling was carried out at the study locations, so that all samples will be ready for evaluation

Results and discussions

Table 1; the result of the Duncan's multiple comparison of means tests a $\alpha = 0,05$ for the variable number of fruits per experimental unit, this test confirms that there is a significant difference between the chemical fertilizers in the oil palm crop. The Túkey's comparison of means indicates the following: The fertilizations: with Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S (16,54 kg), Molimax 14N-4P-25K + 4 MgO + 5 S (15,48 kg), Triple Superphosphate 16N- 8P-20K + 3 MgO + 4 S (13,42kg) are statistically similar and the fertilization with NPK 0-0-0 absolute control (11,21 kg) are statistically different from the fertilizations of treatments 3, 2 and 1. Confirming [2] indicates that 59,26% have 48-213

Table 1: Duncan's test for the variable number of fruits per bunch per experimental unit.

N°	Fertilizations	Bunch weight (Kg.)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	16,54	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	15,48	A
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	13,42	BA
4	NPK 0-0-0 absolute witness	11,21	B

Note: Number of fruits per bunch per experimental unit.

number of fertile fruits; 51,85% fertile fruit weight weighs from 49-1207 (gr); 85,19% residue weight weighs from 37-365 (gr); 40,74% bunch weight weighs from 856-2340 (gr) corroborated by [3] The evaluated variables, Yield, Number of bunches and, Average weight of bunches. It is concluded that: T3 (the combination Naturcomplet-G at 100 kg.dm3/ha/year with Naturvital-plus and Raiza), at the general level, is the treatment with the best response and, therefore, statistically the most recommendable. In general averages, T3 had 2 leaves/month, 9,75 bunches/pl and 46,25 kg/pl.

Table 2; the result of the Duncan's multiple comparison of means tests at α = 0.05 for the variable fruit weight/bunch per experimental unit, this test confirms that there is a significant difference between the chemical fertilizers in the oil palm crop. The Túkey's comparison of means indicates the following: The fertilizations: with Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S (20,79 kg), Molimax14N-4P-25K + 4 MgO + 5 S (17,48 kg). Triple Superphosphate 16N- 8P-20K + 3 MgO + 4 S (15,42 kg) are statistically similar and the fertilization with NPK 0-0-0 absolute control (6,54 kg) are statistically different from the fertilizations of treatments 3, 2 and 1. confirmed by [2] the (Elaeis oleifera H.B.K.) in natural conditions, reported on morphological characterization of the (Elaeis oleifera H.B.K.) in natural conditions, in the province of Puerto Inca, district of Honoria, Huanuco-Peru region; 51,85% the weight of fertile fruits weighs 49-1207 (gr); 85,19% the weight of residues weighs 37-365 (gr); 40,74% the weight of the cluster was 856-2340 (gr).

Table 3; the result of the Duncan's multiple comparison of means tests at α = 0,05 for the variable bunch length per experimental unit, this test confirms that there is a significant difference between the chemical fertilizers in the oil palm crop. The Túkey's comparison of means indicates the following: The fertilizations: with Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S (15,69 kg), Molimax 14N-4P-25K + 4 MgO + 5 S (13,93 kg), Triple Superphosphate 16N- 8P-20K + 3 MgO + 4 S (11,52kg) are statistically similar and fertilization with NPK 0-0-0 absolute control (8,54 kg) are statistically different from the fertilizations of treatments 3, 2 and 1. Confirming by It is confirmed by reported by [2]. Where the field results were processed by means of a distribution analysis. Of frequencies (TDF); thus we have that 25,93% of the population has a bunch length measuring from 38 to 43 (cm); 29,63% has a larger bunch diameter measuring from 30-:3,3 (cm); 33,33% has a stipe length: e 2 to 5 (m); 22,22% has a peduncle length measuring from 27,30 (cm); 37,04% has a basal spike length measuring from 11-12,5 (cm).

Table 2: Duncan's test for the variable weight of fruit per bunch per experimental unit.

N°	Fertilizations	Bunch Weight (Kg.)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	20,79	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	17,48	BA
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	15,42	BA
4	NPK 0-0-0 absolute witness	5,54	B

Note: Fruit weight per bunch per experimental unit.

Table 3: Duncan's test for the variable oil palm bunch length per experimental unit.

N°	Fertilizations	Bunch length (Cm.)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	15,59	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	13,93	BA
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	11,52	BA
4	NPK 0-0-0 absolute witness	8,54	B

Note: Bunch length per experimental unit.

Table 4; the result of the Duncan's multiple comparison of means test at α = 0,05 for the fruit length variable per experimental unit, this test confirms that there is a significant difference between the chemical fertilizers in the oil palm crop. The Túkey's comparison of means indicates the following: The fertilizations: with Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S (9,49 cm), Molimax 14N-4P-25K + 4 MgO + 5 S (7,33 cm), Triple Superphosphate 16N- 8P-20K + 3 MgO + 4 S (5,52 cm) are statistically similar and the fertilization with NPK 0-0-0 absolute control (3,14 cm) are statistically different from fertilization of treatments 3, 2 and 1. According to [2], 62,96% have fruit length measuring 3-3,5 (cm); 92,59% have mean fruit diameter of 25,3 (cm); 25,93% have seed weight of 5,5-6 (gr).

Table 5; the result of the Duncan's multiple comparison of means test at a = 0,05 for the variable fruit weight per experimental unit, this test confirms that there is a significant difference between the chemical fertilizers in the oil palm crop. The Túkey's comparison of means indicates the following: The fertilizations: with Micro Essentials SZ 16N-8P-20K + 3 MgO + 4 S (13,59 gr), Molimax 14N-4P-25K + 4 MgO + 5 S (11,37 gr), Triple Superphosphate 16N- 8P-20K + 3 MgO + 4 S (9,54 gr) are statistically similar and the fertilization with NPK 0-0-0 absolute control (5,24 gr) are statistically different from fertilization of treatments 3, 2 and 1. Confirmed by [2], 51,85% have fruit weight of 8-1 O (gr); Also reports have mesocarp thickness of 2-2,5 (cm); 40,74% have mesocarp weight of 3-4 (gr); 37,04% have thickness of 3-3,5 (mm).

Table 6; The result of the Túkey's multiple comparison of means test at *a* = 0,05. The Tuckley's comparison of means indicates the following: Triple Superphosphate fertilization 16N- 8P- 20K + 3 MgO + 4 S (10,40 t/ha-1), Micro Essentials SZ 16N-8P-20K + 3 MgO (10,37 t/ha-1), Molimax 14N-4P-25K + 4 MgO + 5 S (8,54 t/ha-1) are statistically similar and different from the control fertilizations. While the treatment without fertilization (4,27 t/ha-1) was in the last place and different from the other fertiliza SZ 16N-8P-20K + 3 MgO + 4 Stions.

Table 4: Duncan's test for the variable oil palm fruit length by experimental unit.

N°	Fertilizations	Fruit length (Cm.)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	9,49	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	7,33	BA
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	5,52	BA
4	NPK 0-0-0 absolute witness	3,14	B

Note: Fruit length per experimental unit.

Table 5: Duncan's test for the variable oil palm fruit weight by experimental unit.

N°	Fertilizations	Fruit weight (gr.)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	13,59	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	11,37	BA
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	9,54	BA
4	NPK 0-0-0 absolute witness	5,12	B

Note: fruit weight by experimental unit.

Table 6: Duncan's test for the variable Yield (t/ha-1) oil palm length per experimental unit.

N°	Fertilizations	Yield (t/ha-1)	Duncan α = 0,05
3	Micro Essentials SZ 16N – 8P – 20K + 3 MgO + 4 S	10,40	A
2	Molimax 14N – 4P – 25K + 4MgO + 5 S	10,37	A
1	Triple Superfosfato 16N – 8P – 20K + 3MgO + 4S	8,54	BA
4	NPK 0-0-0 absolute witness	4,24	C

Note: Yield (t ha - 1) oil palm length per experimental unit.

The results of this study align with recent findings by Jaramillo [4], who reported significant yield improvements in oil palms using controlled-release fertilizers. Similarly, Ewulo, et al. [5] observed enhanced leaf nutrient content and seedling growth when oil palms were treated with specific fertilizer combinations. These studies collectively highlight the varied responses of oil palms to different fertilization strategies, underscoring the importance of tailored nutrient management plans based on specific plantation soil conditions and palm growth stages.

The practical applications of the methodologies detailed in this study are evident in their potential to increase the oil yield per hectare, which directly translates to higher profitability for growers. By adopting the fertilization techniques demonstrated, plantation managers can effectively address the nutrient deficiencies common in tropical soils, thus optimizing the overall health and productivity of the oil palms. Incorporating insights from Borrero [6] and Salinas [7-10] into our methodology provides a comprehensive approach to understanding the impact of various fertilizers on oil palm growth [11-16].

Conclusion

In this work, the response of chemical fertilization on the production of oil palm (*Elaeis guineensis Jacq*.) six years old in the area of Rio Negro Shambillo Padre Abad was analysed. The following conclusions were reached: Oil palm bunches produced in a given area, are the result of fertilizations on yield Fertilization with Triple Superphosphate 16N- 8P- 20K + 3 MgO + 4 S (10,40 t ha-1), Micro Essentials SZ 16N-8P-20K + 3 MgO (10.37 t ha-1), Molimax 14N-4P-25K + 4 MgO + 5 S (8,54 t/ha-1) are statistically similar and different from the fertilizations with control. While the treatment without fertilisation (4,27 t/ha-1) was statistically similar and different to the control fertilization.

It is also important to note the significant increase in fruit weight, bunch weight per unit area. Chemical fertilization does influence oil palm bunch yield per unit area and the best alternatives for palm cultivation.

In that sense, bunch weight, fruit weight, fruit set and pollination capacity in oil palm cultivation per unit area and surface area are affected when adequate fertilization is not carried out according to the nutritional requirements of the plant.

Finally, any of the doses could be used as an alternative dose of chemical fertilization of oil palm, since there is a direct relationship between plant height and root length and with environmental factors.

Acknowledgment

I thank all the authors involved in the development of this research.

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