International Journal for Research in Applied Sciences and Biotechnology
ISSN: 2349-8889
Volume-6, Issue-5 (September 2019)
www.ijrasb.com
https://doi.org/10.31033/ijrasb.6.5.3

Effect of Different Levels of K on Growth Performance of Immature Oil Palm in Devithurai Estate Sri Lanka

S. M. Dissanayake[1], I. R. Palihakkara[2], G. P. Gunaratna[3] and S. D. Wanniarachchi[4]
[1]Elpitiya Plantations PLC, Department of Crop Science, Faculty of Agriculture, University of Ruhuna, SRI LANKA
[2]Department of Crop Science, Faculty of Agriculture University of Ruhuna, SRI LANKA
[3]Department of Soils and Plant Nutrition, Tea Research Institute of Sri Lanka, SRI LANKA
[4]Department of Soil Science, Faculty of Agriculture University of Ruhuna, SRI LANKA

[1]Corresponding Author: dissatri@gmail.com

ABSTRACT

Initial growth of oil palm in the field highly depends on quality of the planting materials, management practices and availability of macro and micro nutrients. Failure in supply of these nutrients badly affects initially the vegetative growth performance and finally the yield. An experiment was initiated to investigate the available nutrient levels on plant growth performance at Devithurai estate. Field trial was conducted with RCBD design and six treatments of different K levels and constant levels of N, P, and Mg with four replicates (T1=0, T2 =60, T3 =90, T4 =120, T5 =150, T6 =180 of K_2O/Kg/Ha/Ye). Soil nutrient levels and plant growth performances were recorded and data were analyzed with Minitab statistical tool. Results revealed that higher the soil Potassium level plant height was also high (recorded up to 263 cm) although the recommended soil Potassium level is 0.3 cmol/Kg for the Oil Palm. This trial shows rather very low levels of soil K in four replicates in T1 (0.21, 0.18, 0.34 and 0.19coml/Kg respectively) except the replicate three (0.34cmol/Kg). It was shown that there were clear increases in number of fronds in the third replicate. This could be attributed to the fact of initial high soil K level in the soil with periodical application of fertilizer treatments to the trial plots. All the four replicates were showing very good soil available P levels at the initial stage of the trial. The recommended soil Mg level is 0.3cmol/Kg for Oil Palm. In this trial Mg level is very low in all the four replicates. It is concluded that the initial soil nutrient levels especially K is playing a significant role in young Oil Palm growth (P>0.05). Therefore periodical application of fertilizer is a must for better performance of this crop.

Keywords-- Plant Growth, Oil Palm, Available Nutrients, Sri Lanka

I. INTRODUCTION

Oil palm Elaeisguineensisjacq has emerged as the major oil crop in the world and belongs to the palm family (Gatto, M., et al (2015). It was introduced to Sri Lanka as a commercial crop, around 50 years ago and first establish in Galle district as a rain fed perennial cash crop (Palihakkara, I.R.,). The palm with its superior productivity as an oil yielder and moreover, with its large annual total production of dry matter, in general removers considerable amount of nutrients from the soil (Sparnaaij, L.D. (1960).. For normal growth and development, the oil palm needs sufficient nutrients, both macro and micro nutrients (Goh, K. J., 2015).

Nitrogen is an essential nutrient of the plant (Bhavanandan, V.P. and Sunderalingam, S. (1971). The oil palm needs nitrogen in large amounts, not only for vegetative growth but also for the reproductive growth. Phosphorus (Beater, B. E. (1949) is also an indispensable nutrient, although the palm requires it in far smaller amounts than N and K. Phosphorus not only effects the growth of the plant, but also for the productivity. Potassium plays a very important role in the nutrition of the oil palm (Tripler, A.,etal 2011). It is not only essential for photosynthesis and the synthesis for protoplasm but it is also a regulating factor in the water economy of the plant (Panapanaan, V. etal 2009). Potassium can indeed be regarded as the most important nutrient with respect to the oil yielding capacity of the oil palm. Since the potassium needs of the oil palm are large and its deficiencies are widespread. Magnesium plays vital role for the plant growth and deficiency produces striking visual symptoms which appear first on the oldest leaves. To maintain a healthy plantation, it is very important to have a well-balanced nutrient levels write at the beginning (Oberthür,T., etal 2014).

Therefore this research was conducted considering the role of K on growth performance of Immature Oil Palm for the initial growth of the oil palm.

II. METHODOLOGY

This research was conducted at Devithura estate of Elpitiya Plantations PLC. The study was designed with RCBD design and there are six treatments with four replicates. Fertilizer treatments were with different initial levels of K (T1=0, T2 =60, T3 =90, T4 =120, T5 =150, T6 = 180 of K_2O/Kg/Ha/Ye) and constant levels with Nitrogen, Phosphorus, Magnesium and Boron. Each plot consists with eight Oil Palm plants. Soil and Leaf sampling was carried out prior to the application of company recommended fertilizer levels. Soils sample

ISSN: 2349-8889
Volume-6, Issue-5 (September 2019)
www.ijrasb.com
https://doi.org/10.31033/ijrasb.6.5.3

were obtained from two depths of 0-15 cm and 15-30 cm respectively. Trial was carried out starting from October, 2016 to October, 2017. Fertilizers were given as recommended by the plantation in three months for the each four treatments. Growth parameters were collected as non-distractive method from each individual plant of the trial plots at three months intervals. Data were analyzed with SAS statistical tool and mean separation were done at $\alpha \leq 0.05$ level.

III. RESULTS AND DISCUSSION

Results were evaluated considering the current Potassium fertilizer (K_2O) application recommendation of Elpitiya Plantations PLC (i.e. 120 K_2O Kg/Ha/Year). Other nutrients such as, P and Mg were kept constant.

Data were summarized in four replicates (considered as four treatments (table 1) representing plot of above K_2O level and growth parameters in three different intervals with addition of fertilizer treatments.

In the third replicate the soil Potassium level recorded the highest and plant height also was recorded up to 263 cm Although the recommended soil Potassium level is 0.3 cmol/Kg for the Oil Palm this trial shows rather very low levels in three replicates (0.21, 0.18, 0.34 and 0.19coml/Kg respectively) except the replicate three (0.34cmol/Kg). This has been resulted the highest plant height recorded in this replicate. It was shown that there was clear increase in number of fronds in the third replicate. This could be attributed due to the fact of initial high soil Potassium level in the soil backed with periodical application of fertilizer treatments to the trial plots.

Second replicate was shown the highest level of soil Phosphorus (P) level. Recommended available Soil P level for the Oil Palm is above 20ppm. In that context all the tree replicates were showing very good soil available P levels at the initial stage of the trial. This is indicating us that the soil in this field is having sufficient P and it has not directly impact on the variation of plant height or frond count. Soil P is mostly responsible for number of fronds at the initial stage of the palm.

Although the recommended soil Mg level is 0.3cmol/Kg for Oil Palm, in this trial this level is very low in all the four replicates. Thus this has not shown in plant height, fond number. Oil palm is a perennial crop with low soil Mg levels will definitely affect detrimentally on all aspects of plant growth.

Results revealed that there was an improvement in the formation of fronds in replicate three where the soil Potassium was higher than other replicates which could be the reason that initial high soil Potassium level in the soil backed with periodical application of fertilizer treatments to the trial plot.

4.1 Effect of different levels of K on soil nutrient status

Table 4.1: Effect of different levels of K on soil pH, available P, K and Mg at 0 -15cm depth

Treatment	**Soil pH**	**Soil P**	**Soil K**	**Soil Mg**
		mg/kg		
0 K_2O (kg/ha/yr) - T 1	5.04	318	81c	55c
60 K_2O (kg/ha/yr) - T 2	5.54	452	82c	72c
90 K_2O (kg/ha/yr) - T 3	5.42	377	90c	207ab
120 K_2O (kg/ha/yr)- T 4	5.95	458	95bc	290a
150 K_2O (kg/ha/yr)- T 5	5.28	321	111b	112bc
180 K_2O (kg/ha/yr)- T 6	5.58	334	134a	73c
Probability % (F value)	0.875 (0.35)	0.518 (0.85)	0.0001 (12.87)	0.005 (5.21)
LSD	NS	NS	17.06	124.35
CV %	19.01	40.07	11.49	61.19

*Means followed by same letter are significantly different at 0.05

Soil pH in different treatments were not significantly different (df=23, F value=0.35, p>0.8757). However, the lowest value was observed in the plants that received 0 K_2O kg/ha/yr and relatively higher pH values with increasing K levels may be due to alkalinity caused by application of potash fertilizer. Generally, N fertilizers, irrespective of the source, reduce the soil pH. Any ammonium fertilizer when nitrified by nitrifying bacteria releases H^+ ions to the soil solution (Bhavanandan and Sunderalingam, 1971; Sandanam et al., 1980; Wickremasinghe et al., 1986). The optimum pH range for oil palm plant growth is 4.0- 7.0 (Palihakkara,I.R., 2018). The results show that irrespective of the addition of K fertilizers, the soil pH remains unchanged and within the optimum range.

Soil available P content did not varies significantly with the treatments (df=23, F value=0.85, P>0.5187). The sufficiency range of phosphorus content in the soil is ≥10ppm (Coconut Research Institute, Sri Lanka). However, very high level of soil P was observed as the applied P rates were very high.

Significant differences in soil available K content were observed when different levels of K were applied (df=23, F value=12.87, p<0.0001). However, T2, T3 and T4 did not significantly change soil K compared to T1. Nevertheless soil K levels in T5 and T6 were significantly different from T1, T2 and T3, where as soil K levels in T5 did not differ from T4 (Table 4.1).

According to the recommendation of the Coconut Research Institute, Sri Lanka, the optimum level of soil available K for better growth of oil palm should be greater than 191 mg/kg K of soil. None of the K levels tested in this experiment increased the soil K levels above the optimum level.

Significant difference in soil available (df=23, F value=5.21, p<0.005) Mg content was observed among treatments. The optimum level of soil available Mg for better growth of oil palm plant should be greater than 118mg/kg K of soil (Coconut Research Institute, Sri Lanka).

4.2. Effect of application of different levels of K on leaf nutrient status

Leaf N, P, K and Mg content one year after the treatment application is given in Table 4.2. No significant differences in leaf N content (df=23, F value = 0.765, p<0.5997) were observed among the treatments. The optimum range of leaf N level for better growth of oil palm has to be greater than 2.4-2.8% (Coconut Research Institute, Sri Lanka).

Table 4. 2: Effect of different levels of Potassium (K) on plant nutrient concentration

Treatment	N	P	K	Mg
	%			
0 K_2O (kg/ha/yr) - T 1	2.45	0.087c	0.93c	0.268
60 K_2O (kg/ha/yr) - T 2	2.59	0.125ab	1.19ab	0.265
90 K_2O (kg/ha/yr) - T 3	2.12	0.149a	1.08bc	0.281
120 K_2O (kg/ha/yr)- T 4	2.48	0.101bc	1.26ab	0.257
150 K_2O (kg/ha/yr)- T 5	2.59	0.112bc	1.37a	0.251
180 K_2O (kg/ha/yr)- T 6	2.65	0.110bc	1.40a	0.264
Probability % (F value)	0.599 (0.75)	0.035 (3.23)	0.012 (4.32)	0.986 (0.12)
LSD	NS	0.0358	0.2576	NS
CV %	17.85	20.82	14.10	22.09

Leaf P content significantly differed among the treatments. Highest plant P (df=23, F value=3.23, p<0.0355) content was observed in 90 K_2O (kg/ha/yr) applied plots. The optimum level of leaf P content for better growth of oil palm has to be greater than 0.15-0.18% (Coconut Research Institute, Sri Lanka). However, the leaf P contents observed in this trial were lower than optimum level.

Significant differences in leaf K (df=23, F value=4.32, p<0.0123) content were observed among the treatments. Highest leaf K concentration was observed in 180 K_2O (kg/ha/yr) applied plots. The optimum level of leaf K for potential growth of oil palm has to be greater than 0.9-1.2% (Coconut Research Institute, Sri Lanka).

Leaf Mg content did not significantly differ (df=23, F value=0.12, p<0.9862) among the treatments. The optimum level of leaf Mg for better growth of oil palm has to be greater than 0.25 -0.4% (Coconut Research Institute, Sri Lanka). However, the leaf Mg contents observed in this trial were higher than optimum level.

4.3. Effect of application of different levels of K on growth of oil palm

In this section, pre treatment growth measurements were used as co-variates for adjustment of post treatment means. Therefore, adjusted values of vegetative growth measurements were used in the statistical analysis. Different levels of K did not significantly affected any of the vegetative growth measurements namely height (df=23, F value=2.26, P>0.0.1054), girth (df=23, F value=2.20, P>0.1129) and the total number of fronds (df=23, F value=1.56, P>0.2349) (Table 4.3).

Table 4.3: Effect of different levels of Potassium (K) on growth measurements

Treatment	Height cm	Girth cm	Fronds
0 K_2O (kg/ha/yr) - T 1	130.93	62.19	23
60 K_2O (kg/ha/yr) - T 2	167.33	63.34	23
90 K_2O (kg/ha/yr) - T 3	147.84	97.54	24
120 K_2O (kg/ha/yr)- T 4	116.23	89.03	23
150 K_2O (kg/ha/yr)- T 5	145.19	81.78	23
180 K_2O (kg/ha/yr)- T 6	128.20	92.35	22
Probability % (F value)	0.105 (2.26)	0.112 (2.20)	0.234 (1.56)
CV %	17.08	28.025	4.796

IV. CONCLUSION

There were significant differences in soil available K content among treatments applied. Higher values were observed in K applied pots, compared with, zero level K applied control plots. Highest soil K concentration were observed in 180 K_2O (kg/ha/yr) applied plots.

ISSN: 2349-8889
Volume-6, Issue-5 (September 2019)

https://doi.org/10.31033/ijrasb.6.5.3

Significant differences in leaf K concentration were observed among the treatments. Highest leaf K concentration were observed in 180 K_2O (kg/ha/yr) applied plots.

The height and girth of plant and number of fronds did not significantly vary among treatments. The 60 K_2O (kg/ha/yr) applied plots recorded the maximum height while the palms that received 90 K_2O (kg/ha/yr) reported the highest girth and number of fronds.

The number of male flowers, female flowers and bunches did not significantly vary among different treatments.

Since the applied K levels did not show any significant effect on the vegetative or reproductive parameters albeit they showed significant effect in increasing the plant K content, a suitable K fertilizer level cannot be recommended from the experiment reported here and further analysis are necessary to come to a firm conclusion.

REFERENCES

[1] B. E. Beater. (1949). A rapid method for obtaining readily soluble phosphates and phosphate fixation in soils. *Plant and Soil, 1*(3), 215–220.

[2] Bhavanandan V.P. and Sundaralingam S. (1971). The effect of nitrogen fertilizers on soil acidity, soil urease activity, leaf nutrient content and yield of tea. *Tea Quarterly, 42,* 40-47.

[3] Marcel Gatto, Meike Wollni and Matin Qaim. (2015). Oil palm boom and land-use dynamics in Indonesia: The role of policies and socioeconomic factors. *Land Use Policy*, 46,292-303

[4] Goh, K. J. (2004). Fertilizer recommendation systems for oil palm: estimating the fertilizer rates. *Applied Agricultural Research (AAR) Sdn. Bhd.*, MALAYSIA.

[5] Oberthür,T., Hoffmann, M.P.H., Castaneda, A., Vera, M.T., Wijk,K.E., Giller, C.,Donough, A.M., Whitbread (2014). Simulating potential growth and yield of oil palm (Elaeis guineensis) with PALMSIM: Model description, evaluation and application. *Agricultural Systems*, 131, 1-10.

[6] Balasuriya A. (2002). Oil Palm in Sri Lanka. *A Review Based on the Seminar and Panel Discussion*, Held at the Auditorium of the SLAAS, Colombo 07 on 04th April, 2002.

[7] Virgilio Panapanaan, Tuomas Helin, Marjukka Kujanpää, Risto Soukka, Jussi Heinimö, Lassi Linnanen. (2009). *Sustainability of palm oil production andopportunities for finnish technology andknow-how transfer*. Lappeenranta University of TechnologyFaculty of Technology, LUT EnergyResearch Report 1. Available at: https://pdfs.semanticscholar.org/db0e/858c4d96dcc817940e4cafc3292e399b69a3.pdf

[8] L. D. Sparnaaij (1959). *The analysis of bunch production in the oil palm*. J. W. Afr. Inst. Oil Palm Res., pp 63-64.
Available at: http://edepot.wur.nl/183270

[9] Effi Triplera, Uri Shania, Yechezkel Mualema and AlonBen-Galb. (2011). Long-term growth, water consumption and yield of date palm as a function of salinity. *Agricultural Water Management*, *99*(1), 128-134. doi: 10.1016/j.agwat.2011.06.010