Impact of fertilizers on Raphia hookeri (Mann and Wendl.) palm wine production

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Abstract

The impact of fertilizer on Raphia hookeri palm wine production was investigated with the view to determine the optimum fertilizer rates required by R. hookeri for optimum palm wine yield. Field experiment was conducted at the Nigerian Institute for Oil Palm Research (NIFOR) Raphia Sub Station, Ouebhum, Bayelsa State. The experiment was a 4 x 4 factorial arrangement fitted into Randomized Complete Block Design (RCBD) replicated four times. The treatments were nitrogen at 0, 0.5, 1.0 and 1.5 Kg N/palm/year and potassium at 0, 0.5, 1.0 and 2.0 Kg /palm/year with basal application of 0.5 Kg P2O5 and 0.2 Kg MgSO4/palm/year respectively. Data were collected on yield traits and data collected were subjected to analysis of variance (ANOVA) and means separated using New Duncan’s Multiple Range Test. Applied varied rates of N and K fertilizers significantly (p<0.05) influenced R. hookeri flowering, number of healthy green leaf cut at tapping, number of spadices open at tapping, tapping duration and palm wine yield. Nitrogen and potassium rates at 1.0 Kg N and 1.0 Kg K/palm/ year produced the highest percentage of flowered palms, healthy green leaf cut, number of spadices open, tapping duration and palm wine production. In conclusion application of N and K fertilizer at the rates of 1.0 kg /palm/year gave optimum yield.

Key words: Palm wine, yield, optimum, tapping, fertilizers.

Introduction

Soil is a major contributor to crop yield, because fertile soil supply enough plant nutrients which are essential for the growth, development and yield of crops. Declining yields as a result of poor soil nutrient is becoming a threat to food and livelihood security across the country. The major challenge therefore is to reverse the tide of poor inherent soil fertility and increase the soil stocks through soil fertility management. Usman (2008) reported that poor soil fertility in small holder farms is the fundamental root cause of declining per capital food production in Africa. No matter how effectively other conditions are met, per capital food production in Nigeria will continue to decline unless soil fertility is effectively addressed. A very crucial aspect of improving and maintaining soil fertility is the application of nutrients to soils deficient in such nutrients (Omoti, 1989).

Nitrogen, phosphorus, potassium and magnesium are the most important plant nutrients in palm cultivation both in the nursery and on the field. Application of inorganic fertilizer has been found to improve crops yield and soil chemical properties such as soil pH, total nutrient content and nutrient availability (Ojeniyi, 2000). The nutritional requirement of Raphia palms has not been established in Nigeria. This dearth of literature on the palm nutritional needs on the field may be attributed to the ecology in which the palm thrives. The only available literatures on nutritional needs of Raphia palms in Nigerian are on nursery trials (Udosen and Adesanya, 1985; Imogie et al., 2007 and 2008). A good fertilizer management programme is important to achieve good soil nutrient status that will sustain Raphia hookeri growth and development which will lead to high...
Materials and Methods

The study was conducted at the Nigerian Institute for Oil Palm Research (NIFOR) Raphia Sub Station, Onuebum, Bayelsa State latitude 4°15’ N to 5° 23’ S and longitude 6° 22’ W to 6° 45’ E from 2004 to 2013. The rainfall is high (with mean annual rainfall ranges from 1500 to 4000mm) with a bimodal pattern alternating with a very short (about 2 months) of dry season. The experiment was a 4 x 4 factorial arrangement fitted into a Randomized Complete Block Design (RCBD) replicated three times. The treatment consists of two factors namely: - nitrogen (N) at four levels of 0, 0.5, 1.0 and 1.5 Kg / palm / year and potassium (K) at four levels of 0, 0.5, 1.0 and 2.0 Kg / palm / year respectively. All treatment palms received basal application of phosphorus (P) and magnesium (Mg) at 0.5 Kg and 0.2 Kg / palm / year respectively based on the result of soil initial test. Soil samples were collected before treatments application and eight months after each treatments application respectively. Fertilizers was applied from 2005 until 2011 when R. hookeri palms started flowering. The collected soil samples were subjected to soil physical and chemical analysis using standard laboratory analytical procedures. The sources of N and K fertilizers were Urea and Murate of Potash, while the sources of P and Mg were Single Supper Phosphate and Kieserite.

Data were collected on both agronomics and yield traits. Data collected on yield traits were number of flowered palm, percentage of flowering palm, number of green frond cut to access tapping of the palm for wine, number of spadices opened at tapping, duration of tapping, palm wine yield (litres / palm ) were collected from 2010 to 2013 respectively. Data collected were subjected to analysis of variance (ANOVA) using the GenStat (2008) procedure. Significant means were separated using the Duncan’s New Multiple Range Test (DNMRT) method (Steel and Torrie, 1984) at $P\leq0.05$.

Results and Discussion

The results of the effect of varied rates of nitrogen and potassium on number of flowered R. hookeri palm and percentage of flowered palm is presented in Table 1 and Figure 1. The result of the statistical analysis showed that plots treated with varied rates of N and K, the number of flowered palm per hectare were significantly ($P\leq0.05$) higher than the control plots while effect of varied rates of nitrogen and potassium on number of green healthy palm frond removed when preparing the palm for tapping and number of spadices opened at tapping is presented in Tables 2. Applied nitrogen and potassium fertilizers had significant ($P\leq0.05$) effects on number of green healthy palm frond removed and number of spadices opened at tapping. The number of healthy palm frond removed and the number of spadices opened at tapping increased as rates of nitrogen and potassium increased until optimum rates of 1.0 kg N and 1.0 kg K$_2$O / palm / year was reached beyond which there were no significant increased in the corresponding increased in number of green healthy palm frond and number of spadices opened at tapping at highest rates of 1.5 kg N and 2.0 kg K$_2$O / palm / year.

Tapping duration and palm wine production of R. hookeri as affected by applied varied rates of nitrogen and potassium fertilizers are presented in Figures 2 and 3 respectively. Raphia hookeri duration of tapping and palm wine yield were significantly ($P\leq0.05$) affected by applied N and K fertilizers. Highest palm wine production 1,630 liters / palm / year was obtained when nitrogen and potassium were applied at 1.0 kg N and 1.0 kg K / palm / year respectively which is 180 % increased over the palm wine production of 496 litres / palm obtained at the control plot. All parameters measured that is number of flowered palms, number of healthy green leaf cut at tapping, number of spadices opened at tapping, duration of tapping and palm wine yield increased as rates of nitrogen and potassium increased until optimum rates of 1.0 kg N and 1.0 kg K$_2$O / palm / year was reached beyond which there was no significant increased in the corresponding increased at highest rates of 1.5 kg N and 2.0 kg K$_2$O / palm / year respectively.

The significant effect of applied nitrogen and potassium on all parameters measured could be attributed to the fact that nitrogen and potassium are essential elements for growth, development and plant photosynthesis. Palms treated with N and K fertilizer exhibited vigorous and healthy growth which enhanced proper nutrient assimilation which makes the palm to flower earlier than the control palms. Raphia palm commenced reproductive phase from 6 years upward after planting and for a hectare it takes 3 to 4 years for all palms in a hectare to flower. Palms treated with varied rates of nitrogen and potassium fertilizers commenced flowering exactly 6 years after planting while the control palms were no fertilizers were applied commenced flowering 8 years after planting.

Low nitrogen and potassium rates affect the overall development of the palms from vegetative growth to the reproductive stage. Nutrient deficiency could constitute a stress factor as could be observed by the low performance of palms at 0 kg N and 0 kg K / palm / year respectively. The percentage of flowered palms that received N and K fertilizers ranged from 77.5 to 97.6 % over the control where no N and K was applied ranged from 55 to 63.5 % respectively. Highest percentage of flowering palms (97.6 %) was obtained when N and K was applied at 1.0 kg N and 1.0 kg K / palm / year. Potassium according to Aghimien et al., (2011) is the most important plant nutrient at flowering, tapping and fruiting stages of
R. hookeri. The palms take much of K from the soil at these stages of development which is the most economically useful stages of growth of R. hookeri palm.

**Conclusion and Recommendation**

The effects of N or K are not isolated from those of other essential nutrients, thus adequate levels of other nutrients such as phosphorus (P) and Magnesium (Mg) must be maintained for the effect of applied N and K to be manifested in palm wine production. Nitrogen and potassium fertilizers application exhibited synergistic relation, as N and K rates increased, number of green leaf cut, number of spadices opened, tapping duration and palm wine yield also increased until optimum levels of 1.0 kg N and 1.0 kg K₂O / palm / year was reached beyond which the palm respond was not significant at higher rates of 1.5 kg N and 2.0 kg K₂O / palm / year respectively.

This result also strengthened the need for balanced nutrition of R. hookeri palms. Raphia hookeri is a heavy user of nutrients and the nutrients must be present in available form in the top horizons of the soil. Nitrogen and potassium should be applied at the rates of 1.0 kg N and 1.0 kg K₂O / palm / year, while higher levels will not bring economic benefits and fertilizer application should be done between late January and early February.

**References**


Fig. 1: Effects of nitrogen and potassium on flowering percentage of *R. hookeri* palms.

Fig. 2: Effects of nitrogen and potassium fertilizers on *R. hookeri* duration of tapping.

Fig. 3: Effect of nitrogen and potassium on palm wine yield of *R. hookeri* palm.