GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 9, NO. 2, MARCH 2003: 213 - 216
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THE INFLUENCE OF MACRONUTRIENT DEFICIENCIES ON CHEMICAL COMPOSITION OF DWARF GREEN COCONUT *(COCUS NUCIFERA LINN)* SEEDLING.

B. O. EJEDEGBA, and E. C. ONYENEKE

(Received 23 November 2001; Revision accepted 7 June 2002).

ABSTRACT.

The influence of macro nutrient deficiencies on chemical composition of Dwarf green coconut seedling was studied in the Nursery site of NIFOR substation Abak for a period of 15 (fifteen) months. Reduction in magnesium improves protein content while reduction of nitrogen, magnesium and potassium reduces height and girth of shoots. Elimination of magnesium also lead to reduction in the concentration of chlorophyll. Starch and sugar concentrations improved with nitrogen and potassium but decreased with magnesium reduction. Differences were more pronounced in roots than shoots in all cases.

Key words: *Macronutrient effect on dwarf green coconut.*

INTRODUCTION.

The coconut palm is a member of the palmae family, order palmales, subfamily cocoidae which is characterised by three celled ovary, drupaceous fruit with a woody or stony endocarp provided with three germ pores while the fruit is usually seeded (Smith, 1970).

In Nigeria the average yield of coconut palms are low. Increased production will require additional input of macronutrients. Technically, the solution lies in a better knowledge of the roles of these elements in the biochemical requirements leading to high yield of the coconut palm

Macronutrients have been shown to influence growth, increase girth, height and leaf production (Loganathan and Balakinshnamurti, 1980; Leather, 1972; Vernon et al. 1976; Nathanael, 1961), lower the age of flowering and have effect on nut and copra yield (Nathanael, 1961; Nethsinghe, 1963; Balakrishnmurti, 1972; Mathew and Ramadasan 1964; Longanathan, 1982; Maciot et al. 1981; Magat et al. 1975; Dufour et al. 1981; 1984), and chlorophyll production (Brunin, 1970).

Else where several workers have stressed the importance of potassium and chlorine in the nutrition of coconut (Ollagnier and Ochs,1971; Von Vexkull,1972; 1985, Magat et al. 1975; Maciot et al. 1979; Dataffin and Quencez, 1980; Ollagnier and Mardiana; 1984).

Coconut seedlings are usually grown in nurseries for a period of 9-11months before field planting. In the nursery then, any treatment designed to improve the growth of a seedling should guarantee its post transplanting performance and yield. Description of major nutrient deficiency symptoms in coconut have been reported by Freemond et al. (1966) and Child (1974).

However these reports were based on adults palms in established plantations. A knowledge of the influence of mineral nutrient deficiencies on a normal coconut seedling leaf and growth with other biochemical parameters should enable early detection of these maladies and their subsequent correction in the nursery and possibly in the field by the supply of deficient nutrient.

The present study is aimed at determining the influence of reduced Nitrogen (N), Magnesium (M) and Potassium (K) on growth, dry matter production and some biochemical components of dwarf green coconut seedling in the nursery.

MATERIAL AND METHODS.

The experiment was conducted at the nursery site of NIFOR substation Abak from April 1997 to June 1998. Dwarf green coconut seedlings were used. Seednuts were planted in February 1997 in River sand and seedlings were transplanted into polybags (40 x 40cm) laid flat with a single 2.5cm inverted V cut drainage hole half filled with soil which was allowed to consolidate. The remaining part was later on filled with more soil after planting. The chemical composition of the soil used is shown in table 1.

There were ten (10) seedlings per treatment and each treatment comprise a subtraction series of the major elements Nitrogen (N), Potassium (K)

B. O. EJEDEGBA, Chemistry Division, Nigerian Institute for oil palm research (NIFOR), Benin City
E. C. ONYENEKE, Department of Biochemistry, University of Benin, Benin City.

Table 1. Chemical composition of Abak nursery site soil used for the Experiment.

PH H_2O	KCl	ECEC Meq/100g soil	C%	N%	Av.P ppm	Na	K	Ca	Mg
						← Meq/100g soil →			
5.1	4.2	70.5	1.05	0.022	20.5	0.41	0.10	1.0	0.20

Table 2. Effect of N, Mg, and K on Growth of seedlings.

Treatment	Height(cm)	%Change	Girth cm	%Change	Leaf no	%Change
Control	186.0	-	23.73	-	16.67	-
- N	141.60	23.9	14.97	39.50	11.33	3.00
- Mg	154.83	16.8	17.60	28.8	10.33	11.5
- K	160.07	13.9	31.33	26.7	12.33	5.7
SEM	±1.91***		±0.04***		±0.44N.S	
	$P \leq 0.001$		$P \leq 0.001$			

(-) Indicates elimination

Table 3. Effect of N, Mg, and K on dry weight of seedlings

Treatment	Dry weight of shoot (g)	% Change	Dry weight of Root(g)	% Change
Control	376.50	-	21.90	-
- N	126.03	66.53	14.63	33.20
- Mg	163.67	56.50	15.33	30.00
- K	244.23	35.13	26.37	20.40
SEM	±8.84***		±0.53***	
	$P \leq 0.001$		$P \leq 0.001$	

(-) Indicates elimination.

and Magnesium (Mg). Forty three grams (43g) of fertilizer mixture of N as ammonia sulphate, K as potassium chloride and Mg as magnesium sulphate mixed in a ratio of 12:17:2 were applied in two doses of 21.5g each. Biometric observation was taken from time to time and at the end of the experiment.

Height was measured by placing a ruler from the base of seedling to the tip of the longest leaf. Girth was determined by placing a string round the base and measuring with a ruler and leaf number by counting. At the termination of the experiment, the seedling were separated into shoots and roots, weighed fresh and oven dried to constant weight at 80°C. Chemical analysis of the respective plants were carried out. Total Nitrogen and Magnesium were estimated after ashing and digestion of samples using technican model 11auto analyser, while total potassium and calcium were estimated using a flame photometer (E.E.L. Model).

Sugar and starch contents were estimated by a modified phenol-sulphuric acid colorimetric method (Ciha and Brun, 1978). Total lipids were determined by the method of Bligh and Dye (1959). Total chlorophyll was by colorimetric method after extraction of fresh leaves in 80% acetone (Holden, 1965). The data obtained were then statistically analysed using student t-test and Duncan multiple range analysis of means.

RESULTS AND DISCUSSION

Table 2 shows the effect of N, Mg and K on growth of coconut seedlings. A significant relationship was obtained for both height and girth but not for leaf number. Results obtained showed reduction in growth whenever any of the macronutrients was eliminated and it was significant ($P \leq 0.001$). The effect on growth was more pronounced when nitrogen was eliminated and least with potassium. The same trend was observed with dry matter production (cf table 3). The effect was however more pronounced in the roots than shoots (cf table 3). Various macronutrients have been shown to affect growth of seedlings of most plants when deficiency occurs.

Nitrogen is an indispensable elementary constituent of numerous organic compounds of general importance such as amino acids, protein and nucleic acid (Mcyard and Barker, 1969). The reduction in growth as it affects potassium may be due to the fact that potassium is an activator of various enzymes associated with protein synthesis. Protein contributes substantially to dry matter production and growth in any plant material (Evans and Sorger, 1966).

Table 4 shows the effect of macronutrients on chlorophyll concentration; which was significantly reduced (P ≤ 0.001) whenever any of the macronutrients was eliminated.

The effect was however more with Mg and least with K.

The chlorophyll molecule is known to contain one atom of Mg that is 2.7% of its weight (Arnon, 1959). There are also four atoms of nitrogen in each chlorophyll molecule. This explains why the elimination of these elements greatly affected the synthesis of chlorophyll in the seedling hence the decreased concentration.

Table 5 shows the effect of macronutrients on carbohydrate concentration. It was observed that starch accumulation was more in the shoots than roots i.e. 281.00, 257.53,197.50 and 187.67 for control, -N, -Mg and –K respectively for shoots and 235.67,112.33,90.80 and 128.70 for control, -N, -Mg and –K respectively for roots. Starch was also higher than sugar in both shoots and roots, (P ≤ 0.001). Starch and sugar concentrations were however low whenever Mg was eliminated (cf table 5) from nutrient supplied. This trend is followed with nitrogen and finally potassium. N and Mg are constituents of chlorophyll therefore photosynthesis is hindered because these elements are required in al photosynthetic phosphorylation (Arnon, 1959). The high concentration of starch in both roots and shoots can be due to easy conversion of sugars produce during photosynthesis to starch. Plants normally store carbohydrates in the form of starch. During potassium deficiency, lack of starch synthesis could be the result of reduced energy supply since potassium is necessary for glycolysis oxidative phosphorylation, photophosphyorylation and adenine synthesis (Evans and Sorger, 1966).

Table 4. Effect of N, Mg and K on chlorophyll concentration of Nursery seedlings.

Treatment	Chlorophyll concentration (ppm)	% Change
Control	0.87	
- N	0.47	46.0
- Mg	0.38	56.3
- K	0.61	29.9
SEM	±0.02***	
	P < 0.001	

(-) Indicates elimination

Table 5: Effect of N, Mg and K on carbohydrate concentration of Nursery seedlings.

ent	Total sugar in roots (ppm)	% Change	Total starch in roots (ppm)	% Change	Total sugar in shoots (ppm)	% Change	Total starch in shoot (ppm)	% Change
rol	18.10	-	235.67	-	48.95	-	281.00	-
N	29.37	62.3	112.33	53.3	79.41	62.2	257.53	8.4
lg	17.22	4.9	90.80	61.5	39.35	19.6	197.50	29.7
:	26.68	47.4	128.70	45.4	67.02	36.9	187.67	33.2
M	±0.55***		±2.9***		±0.60***		±5.2***	
	P ≤ 0.001		P ≤ 0.001		P ≤ 0.001		P ≤ 0.001	

(-) Indicates elimination.

Table 6. Effect of N, Mg and K on protein concentration of nursery seedlings.

Treatment	Concentration of protein in Roots (% dry weight)	% Change	Concentration of protein in Shoots (% dry weight)	% Change
Control	3.63	-	5.22	-
- N	2.43	33.1	3.89	25.5
- Mg	4.88	34.4	7.17	37.4
- K	2.63	27.6	3.64	30.3
SEM	±0.223***		±0.54***	
	P < 0.001		P ≤ 0.001	

Table 6 shows the effect of macronutrients on concentration of protein. Protein was found to accumulate ($P \leq 0.001$) with the elimination of Mg while there was reduction of protein when nitrogen and potassium were eliminated.

This trend however differs from what was obtained by Hewith and Smith (1975) who showed that magnesium is a readily dissociable ionic activator of many enzymes and that it stabilizes ribosomal particles in the configuration necessary for protein synthesis.

On the other hand, the reduction of nitrogen, which is a constituent of protein, is expected to affect the synthesis of protein hence the reduced level of protein obtained from the study.

CONCLUSION.

This study has demonstrated that a deficiency of certain macronutrients adversely affects the performance and yield of dwarf green coconut. By extrapolation supplementation with these nutrients can greatly enhance yield.

Reduction in magnesium improves protein content while reduction in magnesium, nitrogen and potassium reduces height and girth of shoots particularly nitrogen as well as concentration of chlorophyll particularly magnesium. Starch and sugar concentration improved with nitrogen and potassium but decreased with magnesium reduction. Differences were more pronounced in roots than shoots in all cases.

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