EFFECT OF CHLORINE SOURCES AND AMMONIUM SULFATE ON THE GROWTH OF COCONUT SEEDLINGS GROWN ON FOUR SOIL TYPES

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ABSTRACT

Fertilizer requirements of coconut seedlings belonging to Baybay Tall variety grown on four most important "coconut soil" types (Palo clay loam, Maasin clay, Guinbala-on clay and Fara-on clay) in the Island of Leyte were studied. Four fertilizer rates were tried, namely: 30 g $(NH_4)_2SO_4$ + 35 g KCl, 60 g $(NH_4)_2SO_4$ + 70 g KCl, 30 g $(NH_4)_2SO_4$ + 30 g NaCl, and 60 g $(NH_4)_2SO_4$ + 60 g NaCl per seedling. Results showed that application of 30 g $(NH_4)_2SO_4$ + 30 g NaCl produced taller seedlings with bigger girths and lesser degree of leaf spot/blight disease infection compared to unfertilized seedlings. Other fertilizer treatments did not cause better seedling growth than did the above mentioned rate. However, none of the fertilizer treatments exerted any significant effect on leaf production rate and number of days to leaf splitting. These observations were true regardless of soil types. Application of 30 g NaCl was found to be more effective than 35 g KCl and as effective as 70 g KCl in reducing the disease incidence. Considering both the effectiveness and cost of NaCl, $(NH_4)_2SO_4$ + NaCl at 30 g each per seedling is recommended for coconut seedlings grown on soils in Leyte. This rate is about half of the national recommended rate.

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KEY WORDS: Coconut seedling. Baybay Tall. Soil type. Fertilizer level. Chlorine source. Ammonium sulfate.

INTRODUCTION

Coconut seedlings allowed to grow in the nursery for more than 6 months respond positively to the application of fertilizers, particularly those containing nitrogen and chlorine (Abad et al., 1978; Santiago, 1978; Magat et al., 1979; Oguis and Magat, 1979; Almaden and Santiago, 1980; Alonzo and Palomar, 1980). Oguis and Magat (1979) found that NaCl and KCl were equally effective in reduc-

ing the incidence of leaf spot/blight disease. On the other hand, Alonzo and Palomar (1980) mentioned that seedlings fertilized with seaweed salt, sea water or NaCl showed consistently higher disease resistance compared to those either unfertilized or fertilized with KCl.

On the basis of various fertilizer experiments conducted mostly on soils in the southern part of the Philippines, Magat (1982) formulated an interim fertilizer recommendation for general use. This recommendation has not been verified on "coconut soils" in Eastern Visayas. Therefore, this study was conducted mainly because of 2 considerations: (1) the kind and amount of fertilizer for coconut seedlings may vary with soil types and locations, and (2) knowledge on the exact fertilizer needs is useful for coconut growers since fertilizers are expensive.

MATERIALS AND METHODS

Treatments and Experimental Design. — The split-plot arranged in a randomized complete block design with 3 replications was used. Main plots consisted of 4 most important "coconut soil" types in Leyte, namely Palo clay loam, Maasin clay, Guinbala-on clay and Fara-on clay. Subplots were composed of 4 fertilizer treatments and a control.

Control = no fertilizer application.
F_1 = 30 g $(NH_4)_2SO_4$ + 35 g KCl/seedling.
F_2 = 60 g $(NH_4)_2SO_4$ + 70 g KCl/seedling.
F_3 = 30 g $(NH_4)_2SO_4$ + 30 g NaCl/seedling.
F_4 = 60 g $(NH_4)_2SO_4$ + 60 g NaCl/seedling.

KCl and NaCl used were assumed to contain 44% Cl and 50% Cl, respectively (Magat et al., 1977).

A half dose of each fertilizer rate was soil-applied on the first month after the seedlings had been polybagged and the other half on the fourth month. Fifteen polybagged seedlings were used of each treatment per replication.

Soil Collection and Preparation. — Surface soils to a depth of about 30-35 cm were collected from different places in the island of Leyte and were air-dried thoroughly under the shed. One composite sample from each soil type was analyzed for pH, P, K and organic matter content (Table 1).

Black polyethylene bags (45.7 cm wide x 45.7 cm long x 0.0152 cm thick), perforated at the bottom and sides, were filled up with 15 kg air-dried soil per bag.

Preparation and Bagging of Seedlings. — Medium-sized seednuts of Baybay Tall cultivar with almost similar maturity and free from mechanical injuries and deformities were sown on elevated strips of soil for germination. Germinated nuts having shoots of about 5-14 cm long were transferred to the soil-containing polybags, one seedling per bag. The polybagged seedlings were arranged 60 cm apart in an equi-

Table 1. Some important physical and chemical properties of the 4 soil types used.

Property	Maasin Clay	Palo Clay Loam	Fara-on Clay	Guinbala-on Clay
Physical[1]				
Sand (%)	38.6	30.8	22.8	24.8
Silt (%)	16.2	34.8	16.8	21.5
Clay (%)	45.2	34.6	60.4	53.7
Chemical[2]				
pH	6.2	5.7	6.0	7.2
OM (%)	2.0	1.5	4.0	2.0
P (Olsen's ppm)	13.0	9.0	9.0	18.0
K (K_2SO_4 extractable, ppm)	272.0	240.0	240.0	792.0

[1] Barrera et al., 1954. Soil Survey of Leyte Province, Philippines. Department of Agriculture and Natural Resources.

[2] Analyzed by the Bureau of Soils, Tacloban City, Leyte, Philippines.

lateral triangular system.

Care. — The seedlings were fertilized as required by the treatments under study. Watering was done as often as necessary. Weeds in the polybags were removed periodically by hand. Tropical kudzu *(Pueraria phaseoloides),* as a cover crop, was allowed to grow in the experimental area but not to interfere with the growth of coconut seedlings.

Data Gathered. — The following data were taken 7 months after the seedlings were transferred to polybags, except for the number of days to leaf splitting:

Girth circumference (cm) - was measured at seedling base, close to the husk.

Height (cm) - was measured from the seedling base up to the highest point of the leaves when straightened upward.

Incidence of leaf spot/blight disease - a rating scale from 0 to 3 was adopted with the following descriptions:

0 - normal, leaf spot is absent in all fronds

1 - slight, with 1 or 2 fronds infected

2 - moderate, with 3 or 4 fronds infected

3 - severe, with 5 or more fronds infected

A leaf was considered infected when at least one-third of the total leaf area was affected by the disease.

Number of leaves - fully opened

leaves were counted.

Number of days to leaf splitting - splitting was considered to have started as soon as the first 3 pairs of split leaflets were observed in a seedling.

RESULTS AND DISCUSSION

Height and Girth Size of Seedlings.

Regardless of kind and rate, all fertilizer treatments produced taller seedlings with bigger girths than the unfertilized ones. Such effect of fertilizers was true in all soil types under study (Tables 2 and 3). This finding conforms with those reported by other researchers (Magat et al., 1977; Oguis and Magat, 1979; Almaden and Santiago, 1980). Oguis and Magat (1979) pointed out that the application of $(NH_4)_2SO_4$ and NaCl increased the height and

Table 2. Girth circumference of 7-month-old coconut seedlings as influenced by soil type and fertilizer level.

Soil Type	Fertilizer Level					Soil Type Mean
	Control	30 g $(NH_4)_2SO_4$ + 35 g KCl	60 g $(NH_4)_2SO_4$ + 70 g KCl	30 g $(NH_4)_2SO_4$ + 30 g NaCl	60 g $(NH_4)_2SO_4$ + 60 g NaCl	
	Girth Circumference (cm)					
Maasin clay	15.74	17.69	17.82	18.67	18.34	17.65
Palo clay loam	14.76	16.93	17.59	17.50	17.99	16.95
Fara-on clay	15.09	18.08	18.08	18.17	19.59	17.80
Guinbala-on clay	15.18	16.85	17.68	17.06	17.84	16.92
Fertilizer Level Mean	15.19	17.39	17.79	17.85	18.44	

LSD 0.05 : Between soil type means = NS
Between fertilizer level means = 0.84
Between means for fertilizer levels within soil type = 1.67
Between soil type means for the same fertilizer level or for means among fertilizer levels for different soil types = NS

C.V. (main plot) = 12.98% C.V. (subplot) = 5.81%

Table 3. Height of 7-month-old coconut seedlings as influenced by soil type and fertilizer level.

Soil Type	Fertilizer Level					Soil Type Mean
	Control	30g $(NH_4)_2SO_4$ + 35 g KCl	60 g $(NH_4)_2SO_4$ + 70 g KCl	30 g $(NH_4)_2SO_4$ + 30 g NaCl	60 g $(NH_4)_2SO_4$ + 60 g NaCl	
	Height (cm)					
Maasin clay	163.73	182.95	185.61	189.80	193.62	183.42
Palo clay loam	154.35	170.88	179.10	176.56	176.37	171.45
Fara-on clay	170.64	186.15	199.53	191.63	192.73	188.14
Guinbala-on clay	156.62	167.39	174.78	166.76	178.44	168.80
Fertilizer Level Mean	161.34	176.84	184.76	181.19	185.29	

LSD 0.05 : Between soil type means = NS
Between fertilizer level means = 7.48
Between means for fertilizer levels within soil type = 14.57
Between soil type means for the same fertilizer level or for means among fertilizer levels for different soil types = NS

C.V. (main plot) = 20.64% C.V. (subplot) = 4.92%

girth size of the seedlings, respectively.

Tables 2 and 3 further show that varying the rate of fertilizer application and source of chlorine did not result in any significant difference in height and girth size of fertilized seedlings. This result clearly indicates that an application of only 30 g $(NH_4)_2SO_4$ + either 30 g NaCl or 35 g KCl per seedling is sufficient for coconut seedlings grown on these soils. This rate was about half of that found by Oguis and Magat (1979) and Almaden and Santiago (1980) to be optimum for seedling growth.

Soil types did not significantly affect height and girth circumference of seedlings (Tables 2 and 3). Textural analysis showed that the lowest silt content (16.2%) was found in Maasin clay and the highest (34.8%) in Palo clay loam (Table 1). Likewise, the lowest percent clay (34.6%) was found in Palo clay loam and the highest (60.4%) in Fara-on clay. Palo clay loam was reported to have a pH of 5.7 (lowest) while Guinbala-on clay had a pH of 7.2 (highest). Despite the rather wide range of textural composition and pH value of these soils, the growth of seedlings in terms of height and girth size was not significantly different. This observation further substantiates many earlier reports that coconut can adapt to a wide range of soil conditions.

Incidence of Leaf Spot/Blight Disease.

All fertilizer treatments, except the one with 30 g $(NH_4)_2SO_4$ + 35 g KCl, produced seedlings with less disease infection than the unfertilized ones (Table 4). Such effect of fertilizers was similarly manifested in all soil types. These observations agree with those made by previous researchers who attributed the reduction in disease infection to the chlorine-containing fertilizers (Magat et al., 1977; Abad et al. 1978; Oguis and Magat, 1979; Alonzo and Palomar, 1980). Oguis and Magat (1979) reported an inverse relationship between chlorine content of the leaves and the degree of disease infection.

Table 4 further shows that the degree of disease infection was influenced by chlorine sources. At the lowest rate of application, NaCl was found more effective than KCl in reducing the disease infection. Although the amount of chlorine applied was the same for both sources (NaCl and KCl), chlorine uptake in seedlings applied with NaCl might have been more compared to those applied with KCl. The above speculation was based on an established fact that Na^+ is more readily absorbed by plants than K^+. Thus, in order to maintain a cation-anion balance in plant cells, the uptake of chlorine by coconut seedlings could have been adjusted depending upon its accompanying cation. However, this speculation needs to be proven yet since no leaf analysis for chlorine was made.

Data in Table 4 and those presented earlier (Tables 2 and 3) strongly suggest that application of 30 g $(NH_4)_2SO_4$ + 30 g NaCl is sufficient to produce good quality

Table 4. Incidence of leaf spot/blight disease of 7-month-old coconut seedlings as influenced by soil type and fertilizer level.

Soil Type	Fertilizer Level					Soil Type Mean
	Control	30 g $(NH_4)_2SO_4$ + 35 g KCl	60 g $(NH_4)_2SO_4$ + 70 g KCl	30 g $(NH_4)_2SO_4$ + 30 g NaCl	60 g $(NH_4)_2SO_4$ + 60 g NaCl	
	Incidence Rating					
Maasin clay	2.26	1.70	1.45	1.38	1.15	1.59
Palo clay loam	1.27	1.01	0.58	0.62	0.40	0.78
Fara-on clay	1.81	1.75	1.17	0.61	0.86	1.24
Guinbala-on clay	1.36	0.98	0.73	0.63	0.69	0.88
Fertilizer Level Mean	1.68	1.36	0.98	0.81	0.78	

LSD 0.05 : Between soil type means = 0.33
Between fertilizer level means = 0.32
Between means for fertilizer levels within soil types = 0.65
Between soil type means for the same fertilizer level or for means among fertilizer levels for different soil types = NS

C.V. (main plot) = 32.53% C.V. (subplot) = 34.43%

seedlings grown on these soils. Application of higher rate of fertilizers did not bring about better seedlings than the above-mentioned rate.

Significant variation in the disease incidence was noted among soil types (Table 4). Degree of infection was highest in seedlings grown on Maasin clay followed by Fara-on clay while those grown on Guinbala-on clay and Palo clay loam had the least infection. Perhaps, the soil types under the study vary in their capacity to make soil-chlorine available for plant use.

Number of Fully Opened Leaves and Days to Leaf Splitting.

At 7 months after bagging, the average number of fully opened leaves over 4 soil types was lowest (6.6) in seedlings that did not receive fertilizers while the highest value (7.2) was obtained in seedlings applied with 30 g $(NH_4)_2SO_4$ + 30 g NaCl. However, statistical analysis revealed that none of the fertilizer treatments was significantly different from the unfertilized treatment. This indicates that while the application of fertilizers improve seedling height, girth size and disease resistance, the rate of leaf production was not at all affected. Probably, this growth character is principally controlled by the seedling's genetic make-up. Consequently, the number of days from bagging to leaf splitting was not shortened by fertilizer application since this parameter is directly related to the leaf production rate.

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