RESPONSE OF COCONUT SEEDLINGS TO SPACING AND APPLICATION OF NITROGEN AND POTASSIUM

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ABSTRACT

Significant variations in the effects of spacing were observed on the vegetative growth and overall vigor of coconut seedlings in the nursery. Plants grown at a distance of 40 cm and farther (60 and 80 cm) had bigger girth diameter, more split leaves, and greater vigor index value than plants grown at 30 cm apart. Similarly, nitrogen-potassium application exerted a significant influence on the vegetative growth of coconut seedlings. All plants applied with inorganic fertilizer, irrespective of the rate, were taller, had bigger girth diameter, and greater vigor index value than those which did not receive fertilizer. There were no significant interaction effects of nitrogen-potassium application and spacing on all parameters considered.

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INTRODUCTION

Spacing is an important factor to consider in growing coconut seedlings in the nursery. Closer spacing not only produces unhealthy seedlings due to mutual shading, but also facilitates the rapid transfer of disease from one plant to another. On the other hand, wider spacing encourages vigorous growth of seedlings, but requires a bigger land area to attain the desired number of plants. More labor is also needed for the care and maintenance of the seedlings.

Nutrition, an essential factor in plant growth, should be emphasized in the production of good quality coconut seedlings. Studies have shown that fertilizer application improves both the vegetative growth and reproductive performance of coconut palms. Coconut palms need nitrogen and potassium in great amounts, but these two elements are commonly found in the soil in inadequate quantities (Child,

1974).

It is possible, however, that the amounts of nitrogen and potassium required by coconut seedlings for optimum growth and development may vary with plant spacing. This is based on the premise that plant metabolic processes vary with the amount of light intercepted by the leaves, the native soil fertility, soil moisture, and others.

This study presents the effects of spacing and varying levels of nitrogen and potassium fertilizer application on the vegetative growth of coconut seedlings, and the interaction effects of nitrogen-potassium application and spacing on coconut at the nursery stage.

MATERIALS AND METHODS

Preparation of Planting Materials. — Mature seednuts of "Laguna" cultivar, having almost the same maturity and with no deformities and mechanical injuries, were used as planting materials. Dead-ripe nuts were selected and were laid immediately on the germination bed. Seednuts were set at ground level on a well-tilled bed, trimmed-end up, and were partially covered with soil.

Soil samples were taken from the field and analyzed for pH, total nitrogen, available phosphorus, exchangeable potassium and organic matter content. The seedlings were transplanted in the field when the embryonic shoots were about 15-20 cm tall.

Seedlings in the experimental area were set in a triangular arrangement. They had the following spacing (cm x cm) measured from girth to girth:

D_1 - 25 x 25
D_2 - 40 x 40
D_3 - 60 x 60
D_4 - 80 x 80

Application of Fertilizer to the Seedlings. — Ammonium sulfate (20-0-0) and muriate of potash (0-0-60) were applied as fertilizers to supply the nitrogen and potassium requirements, respectively, of the plants. No phosphorus was applied. The amounts of fertilizers used per seedling were:

F_1 - zero fertilizer
F_2 - 30 g ammonium sulfate + 30 g muriate of potash
F_3 - 60 g ammonium sulfate + 58 g muriate of potash
F_4 - 90 g ammonium sulfate + 86 g muriate of potash

Two applications of each fertilizer in equal amounts were made. The first application was done on the second month after transplanting, while the second application on the sixth month. Fertilizers were applied around the base of the seedlings.

Experimental Design. — A split plot arranged in a randomized complete block design was used. Spacing served as the main plot and level of nitrogen and potassium fertilizers as sub-plot. The experiment was replicated three times using 15 seedlings per treatment.

Data Gathered. — Immediately after

transplanting and every month thereafter, initial measurements of the parameters were taken. However, only the data obtained at the seventh month from transplanting were analyzed statistically. Girth diameter was measured at the base of the seedlings close to the husk of the nut using a vernier caliper. Seedling height was measured from the base up to the tip of the highest point attained, with the leaves straightened upward. Coconut leaves that were fully exerted from the leafsheaths were counted. Only the leaves that had produced three pairs of leaflets along the rachis were counted to determine the number of days from transplanting to leaf splitting. Vigor index was obtained by using the formula patterned after Child (1974):

$$VI = \frac{C^2}{2\pi\sqrt{H^2 + L^2/4}}$$

where C = circumference of the girth
H = height
L = width of the crown
π = 3.1416

RESULTS AND DISCUSSION

Girth Diameter.

Table 1 shows the effects of spacing and fertilizer level on girth diameter of coconut seedlings. Although significant effects were observed on spacing, no significant differences among treatment means for D_2 (40 x 40 cm), D_3 (60 x 60 cm), and D_4 (80 x 80 cm) were noted. Means for the three treatments were significantly higher than for D_1 (25 x 25 cm) at 5% level of significance. If coconut seedlings were grown for 7 months in the nursery, a spacing of 40 x 40 cm seemed enough to effect a considerable increase in girth diameter. Menon *et al.* (1960) suggested a spacing of from 24-25 x 36 cm from nut to nut, if the seedlings were to be pulled out in the nursery in about 1 to 1 1/2

Table 1. Average increase in girth diameter (cm) of coconut seedlings as affected by spacing and fertilizer levels 7 months after transplanting.[1]

Spacing	Girth Diameter (cm)					
(cm x cm)	0-0-0	30-0-30	60-0-58	90-0-86	Total	Mean
25 x 25	4.16	4.86	4.67	4.67	18.10	4.52b
40 x 40	4.70	5.15	5.37	5.04	20.26	5.06a
60 x 60	4.60	5.26	5.40	5.41	20.67	5.17a
80 x 80	4.87	5.64	5.80	5.31	21.62	5.40a
Total	18.33	20.91	21.24	20.17		
Mean	4.58d	5.23b	5.31a	5.04c		

CV% (b) 7.68%

[1] Treatment means having letters in common are not significantly different from each other at 5% level based on Duncan's Multiple Range Test.

years; PCARR (1975) recommended a spacing of 30 x 30 cm for unpolybagged seedlings, while PCA (1976) recommended a spacing of 50 x 50 cm.

All the seedlings applied with fertilizer, irrespective of the nitrogen-potassium rates used, developed bigger stem girth than those that did not receive fertilizer. The response of the seedlings to the application of nitrogen-potassium fertilizer established its peak at F_3 level. Beyond this level, girth diameter decreased significantly as observed in F_4. It should be mentioned that the soil samples taken at random from the experimental area contained the following elements: 45 ppm phosphorus; 1440 ppm extractable potassium; 2% organic matter and pH of 6.2. Probably, the amount of fertilizer at F_4 and the inherent nutrient in the soil, especially nitrogen, had exceeded the normal requirements of the seedlings. This result follows that of Bachy *et al.* (1962) as cited by Child (1974), which noted a depressing effect on coconuts with excess N. On the other hand, Magat (1978) suspected that NH_4 toxicity was responsible for the negative response of seedlings to NH_4Cl especially at a higher level. These results approximate the recommendation of PCA (1976) to apply 20 g of ammonium sulfate and 18 g of muriate of potash per seedling on the first or second month of growth, and 40 g of ammonium sulfate combined with 35 g of muriate of potash to be applied later.

Despite the significant individual effects of spacing and fertilizer levels on girth diameter, data analysis failed to show significant interactions between them.

Plant Height.

The closest spacing (D_1) produced the tallest seedlings, while the widest spacing (D_4) produced the shortest seedlings (Table 2). These results indicate that with

Table 2. Average increase in height (cm) of coconut seedlings as affected by spacing and fertilizer levels 7 months after transplanting. [1]

Spacing	Plant Height (cm)					
(cm x cm)	0-0-0	30-0-30	60-0-58	90-0-86	Total	Mean
25 x 25	147.10	162.77	156.13	156.67	622.67	155.67a
40 x 40	147.06	155.44	160.10	153.24	615.84	153.96a
60 x 60	122.64	145.71	146.76	138.49	553.83	138.40b
80 x 80	128.0	134.34	145.76	137.06	545.16	136.29b
Total	544.81	598.26	608.75	555.46		
Mean	136.20b	149.57a	152.19a	146.37a		

CV% (b) 1.89%

[1] Treatment means having letters in common are not significantly different from each other at 5% level based on Duncan's Multiple Range Test.

closer spacing, tall but lanky coconut seedlings tend to grow. Since coconut is normally a light-loving plant, seedlings compete for light when planted close to each other. Close spacing favors a spindly growth of plants.

Significant variations in plant height as affected by fertilizer levels were noted. There was no significant variation in height among the fertilized treatments, although F_3 produced the tallest seedlings. Plant height in F_4 tended to decline although not significantly. Maximum response of coconut seedlings to nitrogen-potassium fertilizer may have already been attained at F_3 as far as plant height was concerned. Hence, it would be uneconomical and may even be detrimental to the seedlings if higher levels of nitrogen-potassium fertilizer were applied.

As in girth diameter, there were no significant interaction effects between spacing and fertilizer levels as far as plant height was concerned.

Number of Fully-Opened Leaves.

Spacing and fertilizer levels did not have significant effects on the number of fully-opened leaves. There were no significant interaction effects between the two variables. The average increase in the number of leaves ranged from 7.20 to 7.51 and 7.10 to 7.56 as affected by spacing and fertilizer levels, respectively. These results implied that production of leaves in coconut seedlings is not correlated to spacing and rate of nitrogen-potassium application. Similar results were obtained by Santiago (1978).

Number of Days from Transplanting to Leaf Splitting.

There were no significant differences noted in the effects of spacing and fertilizer levels, and their interactions. Spacing and rate of nitrogen-potassium fertilizer application did not influence the number of days required from transplanting to leaf splitting. On the average, the effects of spacing and fertilizer levels on this parameter ranged from 205.6 to 207.45 and 205.58 to 207.58 days, respectively. Nevertheless, unduly splitting of leaves could also possibly occur due to poor nitrogen-potassium nutrition.

Number of Split Leaves.

Table 3 presents the effects of spacing and fertilizer levels and their interactions on the number of split leaves. Plants in D_2, D_3 and D_4 produced significantly more split leaves than those in D_1. However, the effects of these three spacings did not vary from each other significantly. These observations implied that wider spacings (D_2, D_3 and D_4) promoted greater leaf splitting. No significant differences were observed among fertilizer levels and their interactions with spacing.

Vigor Index.

The highest average increase in vigor index was obtained from D_4,

Table 3. Average number of split leaves of coconut seedlings as affected by spacing and fertilizer levels 7 months after transplanting.[1]

Spacing (cm x cm)	Number of Split Leaves/Plant					
	0-0-0	30-0-30	60-0-58	90-0-86	Total	Mean
25 x 25	2.38	2.43	2.43	2.52	9.76	2.44b
40 x 40	2.58	3.68	3.12	2.98	12.36	3.09a
60 x 60	3.28	2.73	3.28	3.47	12.76	3.19a
80 x 80	3.28	3.33	3.47	3.25	13.33	3.33a
Total	11.52	12.17	12.3	12.22		
Mean	2.88a	3.04a	3.08a	3.06a		

CV% (b) 11.94%

[1] Treatment means having letters in common are not significantly different from each other at 5% level based on Duncan's Multiple Range Test.

followed by D_3 and D_2 (Table 4). These results implied that with wider spacing, plants had a wider area for nutrient absorption and competed less for light. At closer spacing, on the other hand, there was limited feeding area and keen competition for light among plants; thus, nutrient absorption was minimal and photosynthetic activity was reduced.

The overall vigor index of the seedlings was significantly influenced by nitrogen-potassium fertilization. Vigor indices of plants in F_3, F_4, F_2, and F_1 were significantly different from each other in that decreasing order. This indicates that F_3 was the best among the four fertilizer levels in improving seedling vigor.

Table 4. Average increase in vigor index of coconut seedlings as affected by spacing and fertilizer levels 7 months after transplanting.[1]

Spacing (cm x cm)	Vigor Index					
	0-0-0	30-0-30	60-0-58	90-0-86	Total	Mean
25 x 25	0.0129	0.0148	0.0195	0.0167	0.0639	0.016b
40 x 40	0.0131	0.0168	0.0238	0.0211	0.0748	0.0187b
60 x 60	0.0133	0.0232	0.0277	0.0231	0.073	0.0218ab
80 x 80	0.0233	0.0286	0.0324	0.0272	0.1115	0.0279a
Total	0.0626	0.0834	0.1034	0.0881		
Mean	0.0156d	0.0208c	0.025a	0.0220b		

CV% (b) 21.2%

[1] Treatment means having letters in common are not significantly different from each other at 5% level based on Duncan's Multiple Range Test.

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