BORON REQUIREMENT OF HYBRID COCONUT SEEDLINGS GROWN IN AN INLAND COCONUT SOIL OF DAVAO

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ABSTRACT

A study on the response of hybrid coconut seedlings (Yellow Malayan Dwarf x West African Tall) to increasing levels of boron was conducted using an inland-upland, brownish clay loam soil of Davao.

The application of borax with blanket application of $(NH_4)_2SO_4$ + KCl did not significantly influence the growth (girth, leaf production, height) of the seedlings. On the contrary, increasing levels of borax correspondingly increased tip burning of coconut seedlings which was closely associated with increased uptake of boron in the leaves.

As revealed by leaf analysis, the critical level of boron in the leaves (leaf rank 3) was likely to fall within the range of 13 to 14 ppm. Hence, to prevent any abnormal development of the hybrids caused by boron deficiency, the rate of 1 to 1.5 g borax per seedling is suggested and may be a reasonable basis for an interim recommendation for hybrid seedlings particularly that of the dwarf x tall crosses.

INTRODUCTION

The dwarf x tall hybrid coconuts will be used in the country's coconut replanting program which will start in 1980. This planting material would likely have high requirements of nutrients considering its yield potential being twice as high as the local West African tall in the Ivory Coast (Ouvrier and Ochs, 1978).

Prior to the planned massive replanting, pilot hybrid farms were established throughout the country to test, among other things, the adaptability of the hybrids to the country's agro-climatic conditions.

While these seedlings, now planted on the pilot farms, were still in the nursery, Fremond (1976) recommended the application of 1 g borax per liter per seedling at one month old, 2 g at three months, and 3 g at seven months old for a total of 6 g borax per seedling for the whole duration of the nursery stage. After the application of borax however, leaf tip-burns were noted in several coconut nurseries which Fremond regarded as a symptom of B toxicity common on micronutrient application. He mentioned further that the very fast growth of the seedlings may deplete the available B in the soil, which may bring about B deficiency. Eventually this may kill the hybrids in the field the reason for which could be wrongly attributed to 'dry bud rot'.

In this regard, the micronutrient needs of the hybrid seedlings especially those of foreign introductions is still undetermined under Philippine conditions, while its macroelement needs have been well-studied in the Ivory Coast. As reported by Coomans (1977) a balance application of N, K and Mg is indispensable from the time of planting especially on poor soils.

On the nutrition of bearing palms, the positive role of B had been established in India. The addition of 50 g borax per palm resulted to an increase in yield from 40-50 nuts over the untreated palms (Chakrabarthy and Goswami, 1973). While on young palms, Brunin and Coomans (1973) were successful in preventing symptoms of B deficiency with the application of 15 g boracine per palm (46% B_2O_3) two weeks after planting and another 15 g six months later.

In oil palms, seedlings with low or without B application were observed to have more concentration of red spider mites than those with higher B application (Rajaratnam and Law, 1975).

This study was conducted to shed light on: 1) the effect of B on the growth and nutrient status of coconut hybrid seedlings; 2) the proper rate of B for hybrid coconut seedlings under Davao conditions and similar places in the country; and 3) the occurrence of 'dry bud rot' in polybag-raised seedlings as a reuslt of the non-application and/or deficiency in B.

MATERIALS AND METHODS

Soil and climatic conditions. The soil used in this study is classified as tugbok clay loam (Bureau of Soils). It is a reddish brown, residual inland-upland soil with good internal and external drainage, representing about 80,000 hectares of Davao area. The physical and chemical properties of the soil are shown in Table 1. The soil was placed in black polyethylene bags with dimensions of 18" x 18" x 0.008". The place of study (PCA Davao Research Center) has an almost even distribution of rainfall throughout the year. For the past 15 years, average rainfall amounted to 2,478 mm per year with 200 rainy days. During the period of the study, rainfall data averaged 165 mm per month in 12 rainy days.

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Adequate sunshine prevails throughout the year, with satisfactory relative humidity.

Experimental design. The study was arranged in a randomized complete block design consisting of five levels of B, replicated four times with 12 experimental seedlings per treatment.

Experimental seedlings. The Yellow Malayan Dwarf x West African Tall (YMD x WAT) hybrids were used in this study. The seednuts were trimmed just above the germinating "eye" on one ridge opposite the widest segment to facilitate germination. The seednuts were horizontally set end-to-end in the germination bed with trimmed side positioned up. About one-half of the nut was buried and partially covered with previously cultivated soil. Watering of the seednuts was done as deemed necessary.

About 50 per cent of the seedlings were selected based on earliness of germination, general vigor and other agronomic characters. Six weeks after germination, the seedlings were transferred to the 'polybagged' soil and remained in the nursery until they were ready for field-planting. The polybagged seedlings were arranged in an equilateral triangular system at 60 cm spacing. Watering of the seedlings was made when necessary.

Fertilizer treatment. The rates of borax (36.5% B_2O_3 or 11% B) application were as follows: B_0 (control), B_1 (1 g borax/seedling), B_2 (2 g borax/seedling), B_4 (4 g borax/seedling) and B_8 (8 g borax/seedling); with blanket application of 60 g ammonium sulfate + 70 g KCl per seedling. Borax were applied in three separate applications: 1/6 of the total amount of borax dissolved in one liter of water per seedling, was applied one month from polybagging; 2/6 per liter per seedling at three months and 3/6 at seven months in the nursery.

Indexing. Data on seedling girth, height, leaf production and tip-burning (toxicity) were taken. Boron toxicity rating was taken two weeks after the whole amount of borax had been fully applied.

Leaf sampling. Collection of leaf samples (leaf rank 3) for foliar analysis was made when the seedlings were seven months old in the nursery.

RESULTS AND DISCUSSION

Vegetative Growth.

The application of B did not significantly affect the vegetative growth of the hybrid coconut seedlings (Table 2). The girth, height, and leaf production failed to show significant variations for all treatments despite increasing rates of borax application. Similar result was obtained by Rajaratnam (1973) on adult oil palms, in which yield was not significantly affected by B application at various rates, although foliar B contents increased from 14.9 to 18.9 ppm.

In this study, the lack of response of the hybrid seedlings to borax application strongly indicated an adequate supply of B in the soil for normal growth and development of the seedlings.

Boron Toxicity

Tip burning of leaflets, a characteristic symptom of B toxicity appeared two weeks after the application of 1/6 of the total amount of borax (first application). Although most of the leaves were affected, the symptoms appeared only on the B_2, B_4 and B_8-treated seedlings. No symptoms appeared on seedlings under the B_1 treatment (Fig. 3) even after the second application of 2/6 (three months from bagging) of the total borax requirement. This clearly suggests that 0.5 g borax per seedling does not produce any toxic effect on hybrid coconut seedlings.

Two weeks after the whole amount of borax had been fully applied, burning of leaflet tips increased significantly with the application of 2.0 g borax or more per seedling (Table 3, Fig. 4). Apparently, this was due to high concentrations of B in the leaves as a result of seedling absorption of B applied to the soil. Also, correlation analysis (Fig. 1) indicated that tip burning was positively correlated with leaf B content. On the other hand, no correlation existed between tip burning and other elements.

Occurrence of tip-burn was observed in all of the seedlings applied with the B_2, B_4 and B_8 treatments affecting respectively, 88, 94 and 95 per cent of the total number of leaves (Table 3, Fig. 2). On the other hand, for seedlings applied with 1 g borax, only 13 per cent of the leaves was affected with a very low tip-burn rating (Table 3). Where no borax was applied, no symptom of boron toxicity was observed in the leaves of the experimental seedlings.

While it is difficult to assess accurately the tolerable limit of tip burning, it appears that the application of 2 g or more borax per seedling is already toxic to the plants in the nursery stage. In this case, 88 to 95 per cent of the leaves of all the seedlings exhibited tip-burns.

Leaf Nutrient Levels

Boron uptake increased linearly with increasing rates of borax, even where toxicity occurred (Table 4). Except for P, all other elements (N, K, Ca, Mg, Na, Cl, S) were not significantly affected by borax application. Phosphorus uptake was significantly enhanced by the application of 2 g borax. Beyond this rate, a slight reduction in P concentration in the leaves was noted. This indicates some sort of a positive interaction between B and P up to a certain extent. Similar findings were forwarded by Gopal (1976) and Awada (1976) in their separate studies, stating that P application increases B uptake or vice versa.

By relating B concentration in the leaves with tip burning, (Fig. 1) it was noted that the critical level of B in the leaves (leaf rank 3) of nursery seedlings is likely

to be in the range of 13-14 ppm. Hence an amount of 1–1.5 g borax per seedling during nursery stage is apparently adequate for its normal growth and as a prevention against abnormal development resulting from B deficiency.

Dry Bud Rot

The symptoms of the disease that occurred in the nursery, fit the description given by Renard *et al.* (1976) in the Ivory Coast which they referred to as dry bud rot. The same disease exhibited the symptoms of 'shoot rot' (type II) as described by Abad and San Juan (1978) at the PCA-Davao Research Center. It is typified by rotting of the growing point with no pronounced odor and with unaffected nut content and roots. The sword leaf could later be pulled out very easily while the older leaves remain green but will likewise succumb to infection later.

In this study, six seedlings died of 'dry bud rot'. However, the mortalities were not consistent with the various levels of borax applied. In fact, the control seedlings were not affected by the disease, thus, a suspicion arises that B deficiency has something to do with 'dry bud rot'. Because of this, further investigation of the possible relationship of B deficiency with dry bud rot of hybrids in the field is in progress at the PCA-Davao Research Center.

SUMMARY AND CONCLUSION

Increasing levels of borax did not significantly influence the growth of coconut hybrid seedlings in terms of girth, height and leaf production. Instead, tip burning, a characteristic symptom of B toxicity was significantly increased with the application of 2, 4 and 8 g borax per seedling affecting respectively 88, 94 and 95 per cent of the total number of leaves. On the other hand, one-gram borax treatment affected only 13 per cent of the leaves of some seedlings with a very low tip-burn rating. Where no borax was applied, no symptoms of B toxicity was observed in any of the seedlings.

This toxicity symptom could be due to high levels of B in the plant tissue brought about by increased plant uptake which correspondingly increased with increasing borax application in the soil.

As revealed by leaf analysis, the critical level of B in the hybrid seedlings is likely between 13–14 ppm (leaf 3). Hence, an amount of 1–1.5 g borax per seedling during its nursery stage is recommended for normal growth and development of the seedlings as well as prevention against occurrence of B deficiency.

The seedlings used in this study had been field-planted for further investigation of the B requirement of young hybrids in the field.

The findings may be used for dwarf x tall hybrids grown on Tugbok clay loam soil (deep, reddish brown, well-drained upland soil) and as a guide for other areas in the country where hybrids will be planted.

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