IMPROVING THE GROWTH OF OIL PALM SEEDLINGS WITH BIOSTIMULANTS NEB-26 AND NEB-29

F. Danso[1], A. Opoku[2], K. Baidoo-Addo[1], I. Danso[1] and P.A. Afari[1] and B.N. Nuertey[1]
[1]CSIR-Oil Palm Research Institute, Box 74, Kade, Ghana
[2]Department of Crop & Soil Science,
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

ABSTRACT
Biostimulants appear an emerging option to improving seedling growth and development and as a production cost reduction strategy. They are known to stimulate the biological activities of the soil microbes, increase root growth, enhance root nutrient uptake and reduce the need for additional fertilizer application. The study was to evaluate the effect of two biostimulants (NEB-26 and NEB-29) and their combinations with other fertilizer formulations on the growth of oil palm seedling at the nursery. The experiment, conducted at Okyinso near Kade from May 2005 to March 2006, was a randomized complete block design with twelve treatments in three replications. Plant growth parameters such as plant height, butt circumference, frond dry weight, leaf area and leaf area index were measured monthly. The results on the vegetative measurement indicate that a mixture of NEB-26 with NPKMg fertilizer formulation and NEB-29 with NPKMg fertilizer formulation promoted growth of the seedlings better than sole application of NEB-26 and NEB-29 alone.

INTRODUCTION
The application of inorganic fertilizers at the nursery is one of the major means of boosting the vigour of the growing seedling. However, the high cost of fertilizers has focused research attention on the development of alternatives that could effectively supply plant nutrients at a lower cost while improving growth and development. The use of biostimulants appears an emerging option to improving seedling growth and development and as a production cost reduction strategy. These are biological preparations developed to improve plant productivity directly or indirectly via widely varying mechanisms including: inoculation of soil with beneficial microorganisms, activation of soil microbial activity, promotion of the activities of critical soil enzymes, addition of plant growth hormones, and supplementation with micronutrients (Su-Jung, 2006). The application of biostimulants has yielded varying degree of results. Berlyn and Russo (1990) reported that biostimulants could reduce plant stress as well as enhance plant nutrient uptake, and decrease the need for inorganic fertilizer application for plant growth. Albregts *et al.* (1988) and Csizinszky (1990) however, argued that some biostimulants do not always show improved plant growth. The aim of this research was to evaluate the effects of two biostimulants, NEB-26

and NEB-29 and their combination with either NPKMg or polyfeed fertilizer formulations on the growth of oil palm seedlings in the main nursery.

MATERIALS AND METHODS

The experiment was carried out at Okyinso near Kade from May 2005 to March 2006 in a randomized complete block design with twelve treatments in three replications. Each plot consisted of 40 seedlings planted in a 70cm x 70cm triangular planting design. The treatment details are provided below:

Treatment 1	30g Polyfeed/seedling/month
Treatment 2	30g NPKMg /seedling/month
Treatment 3	30g Polyfeed +Mg/seedling/month
Treatment 4	30g Polyfeed + 6.0 ml NEB-26/ seedling/month
Treatment 5	30g NPKMg + 6.0 ml NEB-26/ seedling/month
Treatment 6	30g Polyfeed +Mg + 6.0 ml NEB-26/ seedling/month
Treatment 7	30g Polyfeed + 3.0 ml NEB-29
Treatment 8	30g NPKMg + 3.0 ml NEB-29/ seedling/month
Treatment 9	30g Polyfeed +Mg+ 3.0 ml NEB-29/ seedling/month
Treatment 10	6.0 ml NEB-26
Treatment 11	3.0 ml NEB-29
Treatment 12	Control

Sixty millilitres of NEB-26 and 30 ml of NEB-29 were each diluted in 3 litres of water. Six millilitres of the diluted solutions of NEB-26 and 3.0 ml of NEB 29 were applied to seedlings in treatments 10 and 11. The same rates of NEB -26 and NEB-29 were added to the fertilizers applied in treatments 4-9. Polyfeed is a water soluble compound fertilizer of NPK 19:19:19 with micro elements which is applied by fertigation method in commercial drip irrigation systems. NPKMg is a fertilizer mixture of Ammonium Sulphate, Triple Super Phosphate, Muriate of Potash and Kieserite in a 1:1:1:2 ratio recommended by Oil Palm Research Institute Ghana. All the treatments were applied monthly for eleven months in rings around the seedlings. Daily watering was done manually, using a watering can. Weed control involved hoeing in-between bags and hand picking in the bags.

Data collection

Eight plants per plot were randomly selected within each row and tagged for monthly data collection. Growth responses were evaluated as plant height, butt circumference, number of leaves, frond dry weight, leaf area and leaf area index. Plant height was measured from the soil surface in the polybag to the highest point of the spear leaf. Butt circumference was taken as the average of two measurements in opposite directions using a vernier caliper. Frond dry weight was determined by Corley's (1971) method. Leaf area and leaf area index were evaluated by the method of Hardon (1972). GENSTAT statistical package was used for data analysis. Treatment means were obtained using the ANOVA and differences were determined using the Least Significance Difference at 5% level of probability.

RESULTS

The effects of the application of three inorganic fertilizers and their combinations with two biostimulants (NEB-26 and NEB-29) on the vegetative growth of oil palm seedlings are presented in Tables 1-3 and Figures 1-3.

Butt circumference

Butt circumference increased from 4.0 cm to 25.5 cm over the experimental period (Table 1). The pattern of increase was gradual until the 10^{th} month, after which there was a rapid increase during the 11^{th} month.Treatments10 and 11 recorded the lowest butt circumference values compared to the other fertilizer treatments from the 7^{th} to the 12^{th} month. However, application of NEB-26 and NEB-29alone recorded greater butt circumference values than the con-

Table 1: Effect of treatments on the mean butt circumference of oil palm seedlings (cm)

Treatments	Months after treatment application								
	4	5	6	7	8	9	10	11	12
T1	4.2	5.6	6.8	7.7	7.9	11.7	12.6	21.3	24.1
T2	4.1	5.6	7.3	8.2	8.4	10.5	12.6	21.0	24.8
T3	4.9	6.3	7.4	9.1	9.3	12.1	13.2	23.0	25.4
T4	4.2	5.8	7.3	8.5	8.8	11.7	13.6	23.3	24.4
T5	4.5	5.9	7.2	8.8	9.2	12.4	13.8	23.5	24.3
T6	4.7	6.1	7.8	8.9	9.6	11.8	13.1	22.7	23.9
T7	4.4	5.7	7.6	8.5	8.8	11.7	13.2	23.2	24.2
T8	4.4	5.9	7.8	8.7	9.0	12.8	14.0	24.6	25.5
T9	4.7	6.3	8.1	9.1	9.5	12.1	13.3	23.8	23.9
T10	4.5	5.9	6.7	7.3	7.7	9.1	9.6	18.3	15.9
T11	4.0	5.3	6.6	6.8	7.2	8.4	9.8	19.5	17.7
T12	4.3	5.5	6.5	6.9	7.4	8.5	9.7	16.4	15.5
LSD (0.05)	0.7	0.6	0.9	0.7	0.7	1.8	1.4	2.4	2.6
C.V (%)	8.8	6.1	7.7	5.0	5.1	9.5	6.8	6.5	7.1

trol treatment. Significant differences were noted among T 10, T11 and T 12 and the rest of the treatments. Enhanced growth and development was observed when any of the inorganic fertilizers were combined with either NEB-26 or NEB-29.

Plant height

Results on seedling height are presented in Table 2. Seedling height increased gradually from the 4th to 6th months irrespective of the treatment applied. By the 11th to 12th month, seedling height had increased by 55% from the lev-

Table 2: Effect of treatments on the mean height of oil palm seedlings (cm)

Treatments	Months after treatment application								
	4	5	6	7	8	9	10	11	12
T1	49.8	52.2	52.8	41.8	43.0	50.0	50.0	99.4	110.6
T2	53.7	55.4	56.0	44.3	45.4	50.4	54.1	108.1	121.5
T3	54.2	56.7	55.6	46.9	48.1	53.1	55.2	104.8	119.2
T4	50.6	52.9	53.2	43.5	45.1	52.6	55.3	104.9	125.2
T5	51.9	55.5	56.1	43.3	44.5	52.7	55.1	103.8	125.2
T6	51.7	54.1	57.0	46.2	47.1	48.9	53.3	104.1	124.8
T7	53.5	55.2	55.9	44.6	45.8	52.8	55.2	112.8	130.6
T8	54.5	56.1	56.5	47.3	48.6	54.2	56.8	106.9	128.3
T9	50.0	54.6	54.9	42.7	43.8	52.3	54.7	107.7	135.2
T10	51.0	53.0	53.4	45.9	47.4	47.9	46.4	67.5	72.7
T11	51.9	56.0	56.5	38.8	40.2	41.2	43.1	79.0	86.1
T12	49.1	50.6	51.2	41.5	42.5	43.0	44.9	68.0	75.9
LSD (0.05)	7.4	6.3	6.5	5.6	5.7	5.2	4.89	10.9	12.7
C.V (%)	8.2	6.8	6.9	7.4	7.4	6.1	5.5	6.6	6.7

ls of the 7th month values. On the 12th month, he highest seedling height of 135.2 cm was neasured in the T9 treatment. During the same period the T10 and T11 treatments recorded the owest seedling height among the fertilizer reatments. This is an evidence of a generally better effect of inorganic fertilizers and NEB combination than individual application of NEB-26 or NEB-29.

Number of leaves

Table 3 summaries the number of leaves of the seedlings produced by the various treatments. In all treatments, leaf formation was gradual from the 4th to 5th months. A decline of about 36%in leaf numbers were recorded across all treatments in the 6th month. There was, however a steady rise for all treatments from the 8th to the 9th month of the study. The highest number of leaves 8 was observed for seedlings in T1 – T8 and lowest of 5 recorded by T10 and T11.

Leaf area

The effects of treatments on leaf area are presented in Table 4. Leaf area values of the T10,T11and T12 treatments for the 11th and 12th months were all below 0.10 m^2. The greatest leaf area of 0.17 m^2 was recorded in the T2 and T8 treatment on the 12th month.

Leaf area index (LAI)

Treatment effects on leaf area index values are presented in Table 5.Differences that were significant were observed among T10 and the rest of the treatments on the 12th month. For the period of the trial, the highest leaf area index value of 0.40 was recorded by T8 whilesT10 recorded the lowest of 0.16.

Frond dry weight (FDW)

Presented in Table 6 are the effects of treatments on frond dry weight. Treatments 10 and 11 recorded lower frond dry weight values than the control. Seedlings treated with T5 gave the greatest frond dry weight of 0.38 kg whiles0.28 kg the lowest for seedlings treated withT10.

Frond dry weight (FDW)

Presented in Table 6 are the effects of treatments on frond dry weight. Treatments 10 and

Table 3: Effect of treatment on the mean number of leaves of oil palm seedlings

Treatments	Months after treatment application					
	4	5	6	7	8	9
T1	4.0	4.7	3.3	4.0	7.0	8.0
T2	3.7	5.0	3.7	4.0	6.3	8.0
T3	4.3	5.0	3.3	4.0	6.7	8.0
T4	4.7	5.3	3.3	4.3	7.0	8.0
T5	4.7	5.3	3.3	3.7	7.0	8.0
T6	4.3	5.3	3.7	4.3	7.3	8.0
T7	4.3	5.0	3.7	4.3	7.3	8.0
T8	4.3	5.0	4.0	4.3	7.0	8.0
T9	4.3	5.0	3.7	3.7	5.7	7.7
T10	4.7	5.3	2.3	3.3	5.0	5.3
T11	4.3	4.7	2.0	3.3	4.7	5.3
T12	4.0	5.0	2.3	2.0	3.0	5.7
LSD (0.05)	0.1	1.0	0.8	0.6	1.4	0.5
C.V (%)	8.1	12.3	15.6	9.5	13.1	4.3

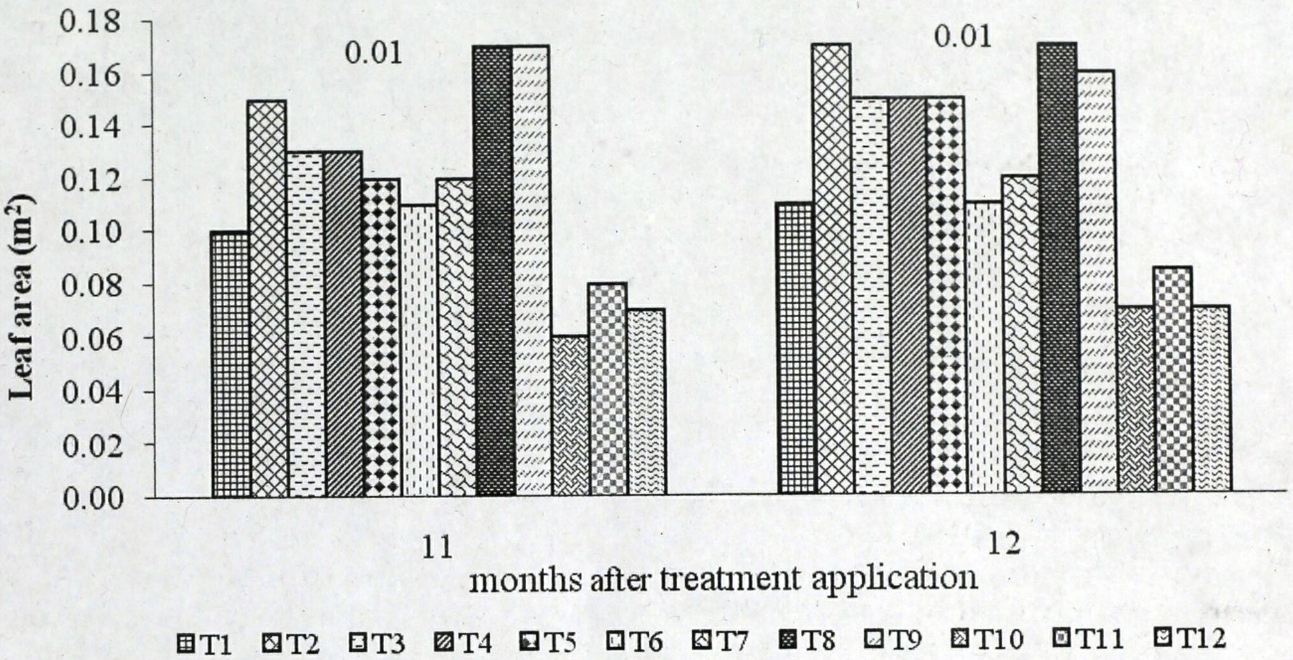


Fig.1: Effects of treatments on leaf area

**Figures on top of bars represent LSD values*

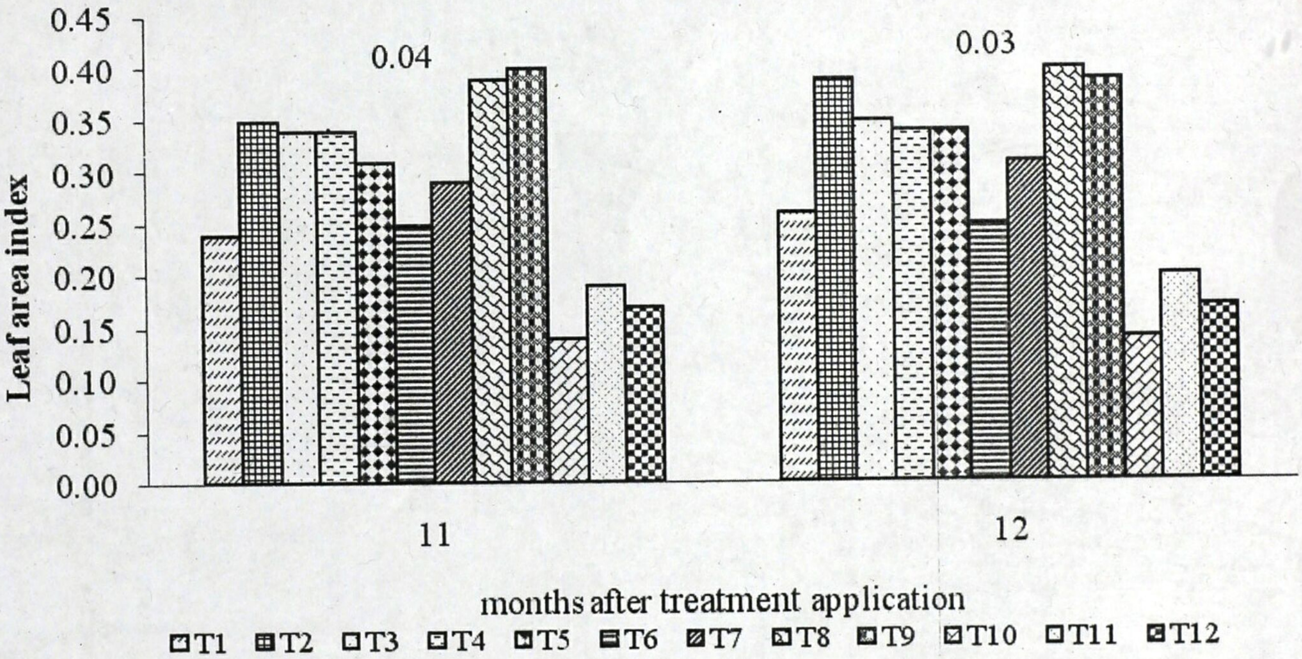
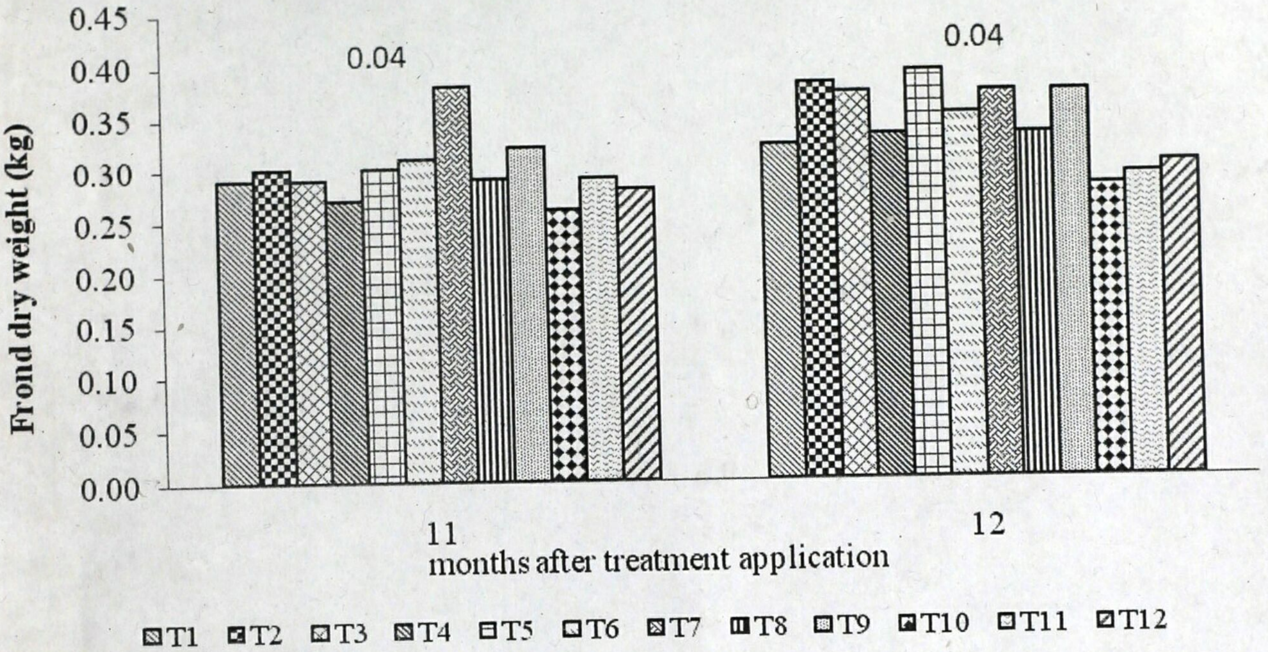


Fig.2: Effects of treatments on leaf area index

**Figures on top of bars represent LSD values*



ig.3: **Effects of treatments on frond dry weight**

recorded lower frond dry weight values than control. Seedlings treated with T5 gave the atest frond dry weight of 0.38 kg whiles 8 kg the lowest for seedlings treated hT10.

SCUSSION

equate nutrient supply in the nursery is a jor determinant of the growth and development of oil palm seedlings. The performance of palm seedlings showed an initially slow wth from the 4th to 6th months. This was dent in the number of leaves, butt circumference and seedling height. The lack of significe ($p<0.05$) among these parameters is atuted to the seedlings inherent sluggish wth pattern. The number of leaves of seedgs produces an estimate of its photosynthetic ential. According to Mohd and Mohd (2004) t the dry matter production of a crop is liney related to the amount of radiation interpted by the leaves, provided that factors such nutrients or water are non-limiting. This acunted for the steady rise in butt circumfere to the end of the trial (Fig. 1).

dings by Mohd and Mohd (2004) have wn that increasing nutrient supply to the palm tree will increase the leaf area, which will have a direct effect on leaf area index values and frond dry weight. Leaf area and frond dry weight exhibited significant differences among all the treatment for the 11th and 12th months (Fig. 3). These values remained below 1.0 for all the treatments. Dwarko (2001) explained that in oil palm seedlings, leaf area index remain below 1.0 for sometime, since total leaf area of the young seedling is negligible in relation to the land area on which they stand.NEB with either combination of NPKMg or polyfeed fertilizer improved seedling height, butt circumference, leaf area, leaf area index and frond dry weight than sole NEB-26 and NEB-29 application. Vernieri *et al.* (2005) explained that biostimulants worked by increasing plant mineral uptake and improving its nutrient use efficiency. Better development of the seedling in terms of nutrient availability was probably the reason for greater vegetative growth in NEB-inorganic fertilizer combination than sole application of NEB treatments. Adediran and Akande (2005) reported significant difference in the growth performance and yield of tomato due to inorganic fertilizer and biostimulant application. This supports the findings of Albregts *et al.* (1988) that there were no advantages in the use of sole biostimulant in the promotion of plant growth. According to Jaquemard *et al.* (2002) oil palm nutrition is dependent on the store of mineral nutrient available in the soil. This makes the supply of adequate nutrients an important aspect of the growth and development of oil palm seedlings. The low response of seedlings to NEB-26 and NEB-29 treatment suggests the inadequacy of nutrient released by NEB-26 and NEB-29. Probably the difference in the quantity of the constituent of the NEB product could account for the low performance of the growth and development of the oil palm seedlings. The selection of an appropriate biostimulant according to Fraser and Percival (2003) was therefore critical as effects on growth could vary widely as a result of the differing active ingredients used in the formulation of the product. The slight differences in plant height, butt circumferences and the number of leaves for sole inorganic fertilizer and NEB-inorganic fertilizer combinations corroborate results of Serra-Wittling *et al.* (1995) who studied the effects of integrated use of inorganic fertilizer and biostimulant on plant growth. These authors observed that it was unnecessary to integrate the application of inorganic fertilizers and biostimulant.

CONCLUSION

The results obtained on vegetative growth indicate that the practice of applying sole NEB-26 and NEB-29 biostimulant did not improve seedling growth. However, the combined application of NEB with either the standard practice or polyfeed treatments proved to be a better option in terms of vegetative growth than the sole application of NEB products. The superior performance of the standard practice in terms of growth parameters measured suggests that the recommendation of (30g/seedling/month) of OPRI was adequate. The NPKMg as observed was agronomically the best treatment. The performance of polyfeed treatments was also good. They have the potential to be used at the oil palm nursery for manuring.

REFERENCES

Adediran, J.A. and Akande, M.O. (2005). Effect of organic root plus (biostimulant) on nutrient content, growth and yield of tomato. *Nigerian Journal of Soil Sci.* 15: 26-36.

Albregts, E.E., Howard, C.M., Chandler, C. and Mitchell,R.L. (1988). Effects of biostimulants on fruiting of strawberry. Proc. Fla. State. *Hort. Soc.*10(3):70-372.

Berlyn, G.P. and Russo, R.O. (1990). The use of organic biostimulants to promote root growth. *Belowground Ecology*.2:12-13.

Corley, R.H.V. (1971).Analysis of growth of the oil palm (Elaeis guineesis Jacq.)1. Estimation of growth parameters and application. Bree ex. T. Euphtica. Corley, R.H.V.

Csinzinszky, A.A. (1990). Response of two bell peppers (*Capsicum annum* L.) cultivars to foliar and soil-applied biostimulants. *Soil and Crop Sci. Soc. Fla. Proc*. 49:199-203.

Dwarko, A. (2001). Effects of moisture and different shade regimes on two progenies of oil palm seedlings. MPhil thesis submitted to the University of Ghana.

Fraser, G.A. and Percival, G.C. (2003). The influence of biostimulants on growth and vitality of three urban tree species following transplanting. *Arboricultural Journal* 27(1):43-57.

GENSTAT. (2007). GENSTAT 7.0 Release 4.23DE, Discovery Edition, Lawes Agricultural Trust, Rothamsted Experimental Station, UK.

Hardon, J.J. (1972). Analysis of growth in oil palm (ii) Estimation of genetic variance of growth parameters and yield of fruit bunches. *Euphytica*. 21: 252-262

Jacquemard, J.C., Edyana, H.S., Asmady, H. and de Chenon, D.R. (2002).Oil palm (*Elaeis guineesis*) and orycetes Rhinoceros L. planting material effect. International Oil palm Conference, Nusa Dua, Bali. Pp 197-204.