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Research

Effects of growth hormones, auxin, gibberlin and cytokinin on the performance of African oil palm (*elaeis guineensis)* seedlings

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Abstract

African oil palm is a tropical plant. Plant hormones, plant growth regulators and phytohormones are chemicals that regulate plant growth. The objective of the study is to determine the effects of growth hormones: Auxin, Gibberellin and Cytokinin on the performance of African oil palm seedling. 2 rates of cytokinin used, 0.00 g and 0.4 g and 4 rates of NPK fertilizer at treatment levels of 0,150, 200, and 250 g. The hormones were applied 4 weeks after planting. 2 rates were applied. Data was subjected to Analysis of variance (ANOVA) using SAS (2003). Means were separated using least significant differences (LSD) at 5% probability level. The numbers of leaves were obtained from Auxin (12.60) followed by Cytokinin (12.30) while Gibberellins had least leaves (11.00) in sole applications and the combination of Auxin and Gibberellin (A+G) recorded lowest number of leaves (1.50). Highest root length was obtained from Auxin (32.17) closely followed by the Gibberellin (31.57) while Cytokinin recorded the least value (31.00). combine application of A+G significantly improved root length. Highest fresh and dry weight was obtained from Auxin followed Gibberellin while Cytokinin had least value. It is recommended that auxin or its combination with gibberellins should be used in order to influence an increase in the production of oil palm seedlings.

Keywords: Auxin, Gibberelin, Cytokinin, Oil Palm, Growth

Introduction

The African oil palm is a tropical plant common to the inter-tropical humid region of the African continent. The oil plants distribution expanded from tropical West Africa to Central Africa during the pre-colonial era and is one of the important economic crops in the tropics (Carrere, 2010; Ibitoye, Akinsorotan, Meludu & Ibitoye, 2011). The oil palm was traditionally used by local populations of this region of the world for its resources which are palm oil and palm wine. *Elaeis guineensis* belongs to the family palmae and the family contains about 225 genera of which over 2600 species are known. The oil palm belongs to the subfamily *cocoideae* of which it is the most important member (I b i t o y *et al*, 2011). The origin of oil palm is still a matter of contention, however, as some early writing suggest, it originated from the Amazon forest or coastal areas of Brazil. Subsequently, a number of studies have excavated fossils, historical and linguistic evidence to confirm its African origin, most accept the tropical rain forest of West Africa as the centre of oil palm evolutionary genesis, this is mainly because of its large number of uses which are deeply embedded in local cultures (Forbes magazine, 2007).

The use of palm oil are many and varied (Adegbola *et al.,* 1979), wherever it grows naturally, oil palm has for centuries provided local communities with a large number of benefits such as palm oil, sauces, soap, wine, fertilizer (ashes), roofing (leaves), building material (trunk), medicines (roots). All of these traditional uses are until today, very much part of the African culture in oil palm countries (Carrere, 2010). In Nigeria, the Oil Palm tree is fondly regarded as *"igi owo"* (money tree) in the Yoruba culture, it is a tree which all its parts have commercial value. The flesh of the palm of the fruit is used to produce palm oil, the palm's kernel provides another kind of oil, (Palm kernel oil) which in its natural state is used as an ingredient and for cooking and it is particularly appreciated as an ingredient in the manufacture of beauty products. The sap of the oil palm forms the basis for the production of palm wine, after it has been distilled transform into a homemade and highly alcoholic beverage. The stems of palms leave in addition serve as

firewood and for making brooms. The fiber obtained from its leaves is also used to make brooms and matting while the fibers around after the oil has been pressed from the kernels serves as cattle fodder (Dada, 2012).

Plant hormones also known as plant growth regulators and phytohormones are chemical that regulate plant growth. Plant hormones are signal molecular and occur in extremely low concentrations. They affect tissue growth, shape of plant, seed growth, time of flowering the sex of flowers, senescence of leaves and fronts (Helgi *et al.*, 2005). Plant hormones affect gene expression and transcription levels, cellular division and growth. Plants needs hormones at very specific times during plant growth and at specific locations on the plant (Srivastava, 2002). Plant hormones (auxins, gibberellins, cytokinin, abscisic acid, and ethylene) have their roles in plant growth and developments, Auxins are the hormones first discovered in plants and later gibberellins and cytokinins were also discovered (Suman, Sangma & Meghawal, 2017). They can occur naturally or can be synthesized and could be applied to base in powder form. The effects of plant hormones are short-lived, and they may need to be re-applied in order to achieve the desired effect. Oil palm needs micronutrients as Nitrogen, potassium and magnesium for proper cell functioning, growth and development, plant Nutrients affect the rate of crop yield, photosynthetic rate and equally chlorosis (Opeke, 1987).

Palm oil and palm kernel oil, the major products of oil palm, were once very vital to Nigeria's export trade as Nigeria was a leading producer of oil palm produce in the world, however, since 1965, there has been a noticeable decline in her oil palm production (Gourichon , 2013). It is therefore important that the effects of these hormones are assessed to observe their effect on oil palm and improve cultivation in larger quantity thereby empowering farmers financially. The objective of this study is to determine the effects of growth hormones: auxin, Gibberellin and cytokinin on the performance of oil palm seedling.

Materials and method

The experiment was carried out at the Teaching and Research Farm, Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Seedlings were collected from the National Institute for Oil palm Research (NIFOR), Benin City, Nigeria. The experiment was a pot experiment. Planting materials for the project were oil palm seedlings, polythene bags, Virgin Forest top soil, watering can and the growth hormones (auxins, gibberellins, cytokinin) The polythene bags were filled with the virgin forest top soil. A total of 30 polyethene bags were filled and 10 pots per replicate. The seedlings were planted at the rate of one per pot and the pots were laid out at a spacing of 1 m by 1 m. The experiment lasted for 8 months – 32 weeks. The experiment was laid out using completely randomized Design (CRD)

There were 2 rates of cytokinins hormone at treatments level of 0.00 g and 0.4 g and 4 rates of NPK fertilizer at treatment levels of 0, 150, 200, and 250 g. The hormones were applied 4 weeks after planting. Treatment was 2 rates 0.00 g and 0.40 g of cytokinin, Auxin and Gibberellin each Gibberellin at 0.2 g of each hormone thus making 0.4 kg combine effect per plant. Four rates of NPK fertilizer treatment at levels 0, 150 200 and 250 g per plant. Weeding was done at 2 weeks interval, watering at 3 days interval, pests were controlled by spraying with pesticides as needed. The following data were collected at the end of the experiment: Height (cm); Number of leaves; Number of roots; Roof length (cm); Fresh weight and dry weight.

Following the experimental Design (complete Randomized Design) all data collected were subjected to Analysis of variance (ANOVA) using SAS (2003) package. Means were separated using least significant differences (LSD) at 5% probability level.

Results and discussion

The numbers of leaves of oil palm seedlings were significantly increased by the application of hormone types or by the application of

various hormones. The highest numbers of leaves from sole application of hormones were obtained from Auxin (12.60) closely followed by Cytokinin (12.30) while Gibberellins record the least value (11.00) The combined application of various hormone types showed significant differences in the number of leaves with the lowest value recorded from the combination of Auxin and Gibberelin (A+G) (1.50) followed by combination Gibberelin and Cytokinin (G+C) and Auxin and Cytokinin having the same number of leaves (12.00). The values obtained from the applied hormone type and their combinations were significantly higher compared to that of the control value (Table 1). The increase number of leaves recorded by Cytokinins and Auxin can be attributed to their ability to regulate plant growth especially the downward and upward formation of leaf and the growth of stem (Helgi *et al.*, 2005), furthermore the reduce number of leaves with the addition of gibberelin addition can be linked to a study by George (2008) which opined that the use of gibberelin is detrimental to plant growth, producing narrow and weak leaves. Furthermore, auxin hormones have been found to keep leaves from falling until the right time, encouraging more numbers of leaves on the stems.

The types and concentrations of auxins have different effects on root induction, percentage of explant forming roots, and length of roots produced per explant. The numbers of roots of oil palm seedlings were significantly increased by the application of hormone types. The highest numbers of root were obtained from Auxin (32.17) closely followed by the Gibberellin (31.57) while Cytokinin recorded the least value (31.00). The combined application of various hormone types significantly improved the number of root with the highest value recorded from A+G (32.03). The values obtained from the applied hormone seedlings were significantly higher compared to that of the control (Table 1). In a study by Al-Khateeb *et al.* (2014), it was declared that root formation was better in Auxin hormones which was similar to findings in this study. Contrary to findings by Daphne *et al.* (2005) that a combination of Auxin and Cytokinin controls growth of root, this study revealed otherwise that combination A+G

recorded the highest combination value. Cytokinins and Giberelin, while it is often used to stilmulate growth, root formation is generally inhibited, a statement establishing the result found in this study (Gana, 2010).

The root length of oil palm seedlings was significantly increased by the application of hormone types. The highest root length was obtained from Auxin (28.60) closely followed by the Gibberellin (28.00) while Cytokinin recorded the least value (26.70). in sole hormone application. The combine application of various hormone types significantly improved the root length with the highest value record from A+G (28.57) The value obtained from the application of hormone are significantly higher than that of the control (Table 1). Gibberellin has been documented to be important in rooting by Ivan, Paponov, Fliegmann, Ravishankar, Maffei (2021) and Sondahl *et al.* (1985) especially when was applied directly to shoots at the time they were excised for rooting.

The fresh and dry weight of oil palm seedling was significantly increased by the application of hormones types or by the application of various hormones. The highest fresh and dry weight was obtained from Auxin closely followed gibberellin while cytokinin recorded the least value, this was expected as gibberellin-induced growth involves both cell division and cell elongation (Smith *et al.,* 1985). The combine application of these various hormones types significantly improved dry with highest value recorded from A+G. the value obtained from the application of hormone of types are significantly difference and higher than that of the control (Figure. 1).

Table 1: Effect of Auxin, Cytokinin, Gibberellin and their combination on growth parameters of oil palm seedlings

Treatment	Number of Leaves	Number of Root	Root Length
Control	10.63[d]	15.50[e]	17.33[e]
Auxin	12.60[a]	32.17[a]	28.60[b]
Cytokinin	12.30[ab]	31.00[d]	26.70[d]
Gibberellin	11.00[d]	31.57[c]	28.00[b]
A+C	12.00[b]	31.70b[c]	27.30[c]
A+G	1.50[c]	32.03[ab]	28.57[a]
G+C	12.00[b]	31.53[c]	27.33[c]
LSD	**0.49**	**0.44**	**0.50**

means on the same row having the same superscripts are not significantly different (p>0.05)

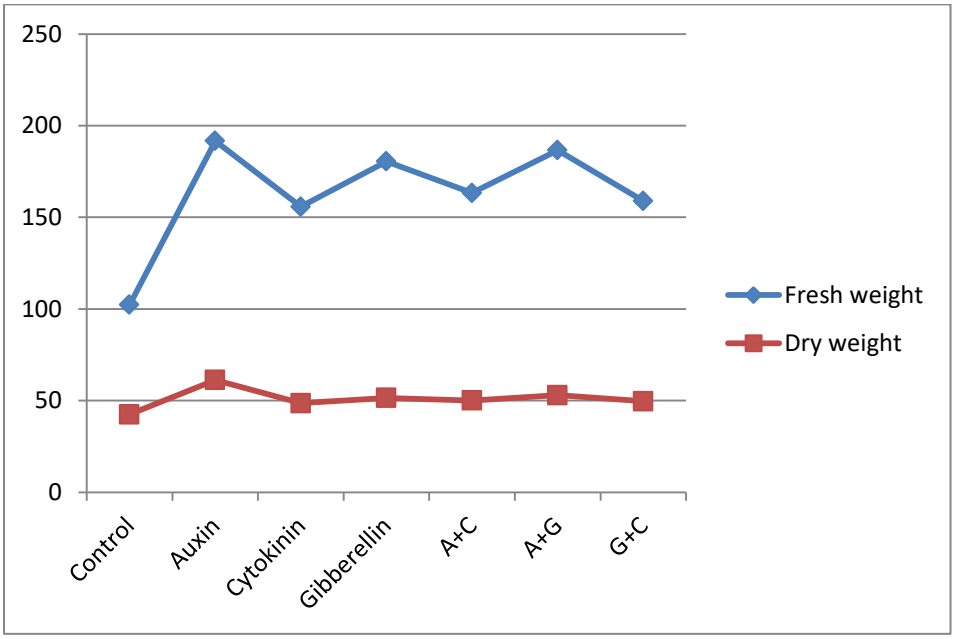

Figure 1: Effect of Auxin, Cytokinin, Gibberellin and their combination on fruit weight

These results are similar to that of Daphne *et al.* (2005) who reported that auxins positively influence cell enlargement, bud formation and roof initiation of oil palm plants, they also

promote the production of other hormones. Also reported was that auxins in conjunction with gibberellins control the growth of stems, root, flowers and fruit. These hormones also affect cell elongation by altering cell wall plasticity. Auxins act to inhibit the growth of buds lower down the stems affecting a process called apical dominance and also promote lateral and adventitious root development and growth. Adequate auxin production increase fruit yield just as 10% auxin induces 100% rooting in some tropical crops.

Conclusion

The application of different hormones and their combinations affect the growth parameters of oil palm seedlings. The hormone combinations all affect the fresh and dry weights of oil seedlings. The use of auxin gave the most significant increase in the growth parameter (i.e. Number of roots, Number of leaves, leaf area, girth, height fresh and dry weight) followed by cytokinin while gibberellin recorded the least value. The combination of auxin and gibberellin (A+G) influenced the growth parameters in the most significant way. It is therefore recommended that auxin or its combination with gibberellins should be recommended and/ or used, in order to improve the production of oil palm seedlings significantly. It is also recommended that further studies should be done, considering the cost implication of applying these growth hormones to the farmers and how it affects their profits positively or negatively.

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