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Effects of Plant Growth Regulators on Rooting Potentials of Caesalpinia bonduc (L) Roxb. Cuttings

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Abstract

Over exploitation and inappropriate conservative strategies have reduced the natural population of most valuable forest tree species to a large extent. Seed dormancy of *Caesalpinia bonduc* has being a hindrance to its regeneration. The study therefore was carried out to investigate the effect of plant growth regulators on rooting potential of *Caesalpinia bonduc.* Naphthalene Acetic Acid (NAA), Indole Butyric Acid (IBA) and a combination NAA/IBA at different hormone concentrations, 0, 50, 100 and 150 mg/l were applied to stem cuttings of *Caesalpinia bonduc.* The percentage survival, sprouting and rooting ability of single node cuttings were assessed using 3x4 factorial experiments in a Completely Randomized Design. Data obtained were analyzed using Analysis of Variance (ANOVA). The result in terms of sprout development based on sprout count and length showed that hormonal treatment of NAA had the highest mean value of 8.25 and 1.92 cm respectively. There was no significant difference (α=0.05) observed in the sprout development in terms of hormonal treatment. The control recorded the highest survival percentage with the mean value of 7.5%followed by cuttings treated with NAA at 150 mg $L^{-1}$with a mean value of 7.08. However in terms of rooting ability, the number of roots and length was also observed to be high with NAA application with mean value of 2.25and 2.92 cm respectively. NAA application had the highest rooting ability and can be used as hormonal treatment for macro propagation of *C. bonduc.*

Keywords: *Caesalpinia bonduc*, growth regulators, hormone concentration, rooting ability

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Introduction

Caesalpinia bonduc is a vine-like shrub that reaches a length of 6 m or more (20 ft) usually armed with robust prickle and scrambles over other vegetation. Plants usually have a single stem arising from the ground but often branch low on the stem. *C. bonduc* is intolerant of shade and is usually open grown or at least grown in broken sunlight. It competes well with grass and herbs and may ascend into the crowns of low trees (Francis, 2000). Traditionally extracts of its leaves, bark and roots are taken to treat fever, relieve skin eruptions and headache. The seed is claimed to be useful in colic, malaria, hydrocele and leprosy (Francis, 2000). The oil from the seeds is used in convulsions and paralysis. The seeds are ground in water and given internally in snake bite. Leaves and twigs are traditionally used for the treatment of tumors, inflammation and liver disorders (Singh and Raghav, 2012). It effectively suppresses or cures infections of several species of roundworms in children. Thus, *Caesalpinia bonduc* plays an important role as medicinal plant which is presently contributing to the healthcare system of most rural communities.

The benefits obtained from large number of different plant species have multiple effects on the livelihood of both rural and urban populace (Oladumoye and Kehinde (2011); Adewunmi *et al.* (2001)). The search for medicinal plants has improved recently and this has led to the production of most valuable and economic plant species. In recent times, habitat destruction, over exploitation and inappropriate conservative strategies have reduced the natural population of most valuable forest tree species to a large extent. At the propagation level, slow growth rate and seed dormancy period have also been hindrances to the mass production (Kazeem *et al*., 2016). In order to enhance the germination and increase the number of seedlings available for planting, appropriate treatment must be applied for successful production of most forest tree crops and NTFPs species. Vegetative propagation among others presents a distinctive chance of preventing the challenges of raising forest tree species from seeds in tropical regions.

According to Puri and Khara (1992), vegetative propagation encourages the transfer of the genetic potential and non-additive variance of the parent to the new plant. The use of plant growth hormones

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plays an important role in influencing the development of stem cuttings. Indolebutyric acid (IBA) and Naphthalene acetic acid (NAA) are being the most widely used auxins for rooting in stem cuttings and for rooting tissue-culture-produced micro cuttings (Baul,*et al*., 2008). It has been repeatedly confirmed that auxin is required for initiation of adventitious roots on stems and indeed, it has been shown that divisions of the first root initial cells are dependent upon either applied or endogenous auxins (Baul,*et al*., 2008; Davis andHaissig,1990). IBA has been found to occur naturally. The formation of root primordium cells depends on the endogenous auxins in the cutting and on a synergic compound such as a diphenol.

These substances lead to the synthesis of ribonucleic acid (RNA), which act upon root initiation (Hartmann *et al*., 2002). The application of some plant growth retardants, together with auxin, has been used to improve the rooting capacity of cuttings in some species (Davis and Haissig, 1990; Pan and Zhao, 1994). Plant growth regulators have gained wide acceptance for optimizing the yield of plants by modifying growth, development and stress behaviour (Shukla and Farooqi, 1990). Synthetic plant growth regulators, such as auxins, cytokinins and various growth retardants when applied exogenously to the plant, influence various aspects of plant development and biosynthesis of its important components (Shukla and Farooqi, 1990; Kewalanand and Pandy, 1998). Therefore, the study was carried out to investigate the effect of plant growth regulators on rooting potential of *Caesalpinia bonduc.*

MATERIALS AND METHODS

480 single node leafy stem cuttings were obtained from 6 month old seedlings. The seedlings were decapitated and stem cuttings were obtained from single node position of the seedlings. The cuttings were then treated with the following growth regulators; NAA, IBA and a combination of NAA/IBA in ratio 1:1 at the following concentrations, 0, 50, 100 and 150mgL^{-1}. The cuttings were treated with the growth regulators using the quick dip method (Akinyele, 2010) and set in washed, sterilized river sand in germination trays and laid out in 3x4 factorial experiments in a completely randomized design under the high humidity propagator. Ten cuttings were allocated to each treatment and replicated four times. Watering was done daily with a handheld sprayer while the following parameters were assessed after 60 days of the experiment; percentage survival of cuttings, sprout count, length of sprout, number of roots

per cutting and root length per cutting. Data collected was analysed using ANOVA while Duncan was used as post hoc test.

RESULTS

Effect of plant growth regulators and concentrations on *C. bonduc* stem cuttings

High rate of survival was found among the stem cuttings of juvenile seedlings of *C. bonduc* as most of the stem cuttings retain their freshness six (6) weeks after planting. The number of sprouts varied in accordance to the type of growth regulators used, though control showed little variations.

Percentage survival

Percentage survival differed among the growth regulators and their concentrations. The cuttings from control had the highest mean percentage survival of 7.5. However, there was no significant difference between the mean values of NAA, IBA and the combination of NAA/IBA (Table 1). Cuttings treated with no concentration (control) had the highest mean value of 7.50, followed by those treated with 150 mg L^{-1} had mean value of 6.67. There was significant difference among the mean survival of seedlings treated with concentrations, 0, 50, 100 and 150mgL^{-1} (Table 2). The growth regulators were observed to affect the survival of the cuttings.

Sprout count

The highest mean value of 8.25 sprout count was observed in cuttings treated with IBA, followed by a value of 6.00 (control). The lowest mean value of 5.33 was observed in the cuttings treated with combination of NAA/IBA. There was no significant difference in control, IBA and combination of NAA/IBA (Table 1).However, the number of sprout developed from the cuttings propagated was not significantly influenced by different concentrations but the highest mean value of 7.08 was recorded for 150mg L^{-1} (Table 2).The sprout count was significantly affected by the growth regulator concentration but growth regulator and their interaction had no significant effect.

Length of sprout count

The cuttings with the NAA treatment had the highest mean value of 1.92 for the length of sprouts followed by combination of IBA/NAA with the mean value of 1.48. While the length of sprouts was least in cuttings treated with IBA and control with the mean values of 1.31 and 1.14 respectively (Table 1). The length of sprout developed per sprouted stem cutting propagated were also significantly (α=0.05) influenced by different concentrations. However, the length of sprout increased as the concentrations increases (Table 2). The effect of the growth regulator and growth regulator concentration was significant on the sprout length while the interaction between growth regulators and regulator concentration was not significant.

Number of rooted cuttings

There was no significant difference between the mean values of the control, IBA and combination of NAA/IBA. Cuttings treated with NAA, IBA and combination of NAA/IBA had a mean value of 2.58, 1.08 and 1.00 respectively (Table 1). The control had no rooted cuttings. The number of rooted cuttings was not significantly influenced by 50 and 150 mgL^{-1} concentrations. The development of roots was significantly affected by the growth regulator concentration while the growth regulator type and their interaction had no significant effect.

Root length

Control had no rooted cuttings. Cuttings treated with NAA, combination of NAA/IBA and IBA had mean values of 2.92, 1.49 and 1.20 respectively. There was no significant difference between cuttings treated with IBA and a combination of NAA/IBA (Table 1).Root length of the cuttings was not significantly affected by concentrations 50, 100 and 150 mgL^{-1} (Table 2). The length of the rooted cuttings was significantly influenced by the growth regulator concentration while the effect of growth regulator type and the interaction between them were not significant.

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Table 1: Effect of growth regulators on the stem cuttings of *C. bonduc*

Growth regulators	Percentage survival	Sprout Count	Sprout length	Root number	Root Length
Control	7.50±0.64[b]	6.00±0.81[a]	1.14±0.23[a]	0.00[a]	0.00[a]
NAA	6.17±0.32[a]	8.25±0.39[b]	1.92±0.14[b]	2.58±0.48[b]	2.92±0.43[c]
IBA	5.83±0.32[a]	5.91±0.23[a]	1.31±0.13[a]	1.08±0.26[a]	1.20±0.33[b]
NAA/IBA	5.66±0.28[a]	5.33±0.45[a]	1.48±0.21[ab]	1.00±0.32[a]	1.49±0.14[b]

* Means with the same letter under each column are not significantly different from each other at α= 0.05 according to Duncan multiple range of test.

Table 2: Effect of Hormone concentrations on stem cuttings of *C. bonduc*

Concentration mg L^{-1})	Percentage survival	Sprout Count	Sprout Length	Root number	Root Length
0	7.50±0.64[c]	6.00±0.82[a]	1.15±0.23[a]	0.00[a]	0.00[a]
50	5.17±0.27[a]	6.42±0.42[a]	1.35±0.14[ab]	2.00±0.43[b]	1.80±0.36[b]
100	5.83±0.27[ab]	6.00±0.52[a]	1.45±0.92[ab]	1.00±0.35[ab]	1.79±0.45[b]
150	6.67±0.28[bc]	7.08±0.58[a]	1.91±0.23[b]	1.67±0.45[b]	2.02±0.37[b]

*Means with the same letter under each column are not significantly different from each other at α= 0.05 according to Duncan multiple range of test.

DISCUSSION

This study has shown that macro-propagation techniques could be utilized to rapidly enhance the rooting ability of *C. bonduc*. The stem cuttings had greater chances of survival as they were able to retain their leaves. Akinyele (2010) explained that the retention of leaves is important for cuttings as they do not possess large reserves. Fadwa and Yahia (2014) further explained that persistence of physiologically active leaves and development of buds into branches are prominent signs of rooting in cuttings. Among the growth hormones, NAA at 150mg L^{-1} was found to be more effective followed by IBA at 150mg L^{-1} in terms of mean percent survival, number of sprouts length, sprout root number and length of *C. bonduc* cuttings. This is in line with findings of Zia *et al*., (2013) who also recorded maximum sprout at higher concentration of NAA. The NAA, IBA and combination of NAA and IBA with the concentrations of 50, 100 and 150 mg L^{-1} showed considerable mean values of survival rate. The maximum number of sprouts produced in cuttings treated with NAA at 150 mg L^{-} is in contrast with the findings of Singh *et al.* (2011) who observed that the maximum number of sprouts was produced in response to treatment of IBA on *Bouganvillea*.

However, Wahab *et al.* (2001) observed better sprouting from cuttings of guava when treated with NAA at 2000ppm. Length of sprout was also observed to be highly influenced by the growth regulators and their concentration, NAA at 150mg L^{-1} identified to be the highest. For the rooting ability of the cuttings, cuttings treated with NAA had the highest mean number of roots (2.58) than cuttings treated with IBA which had a value of 1.08 and combination of the two growth regulators (1.00) while the controls (untreated cuttings) produce no roots. Hajano *et al.* (2015) reported that long soak method of covered stem cuttings at 2000 and 4000 mgL^{-1} of NAA exhibited better rooting percentage. It is evident from the study that the application of different concentrations of growth regulators had different effects on the mean values of growth parameters. These findings are similar to reports given by Gbadamosi and Oni (2005) that higher concentration of NAA on the cuttings of *Enatia chlorantha* did not support rooting potentials of the species. Meanwhile, IBA at 50ppm gave high percentage of roots.

CONCLUSION

Stem cuttings of *C. bonduc* can be successfully regenerated via young single node cuttings with hormone treatment using NAA, IBA and their combination at different level of concentrations. Preferably NAA at 150 mg L^{-1} would give better results to promote mass propagation of the species. Hence, vegetative propagation of *C. bonduc* through stem cuttings could be a sure thing and a reliable alternative to production of seedlings of *C. bonduc* aside from use of seeds.

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