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GROWTH PERFORMANCE OF ROOTED CUTTINGS OF *Annona muricata* Linn. IN DIFFERENT POTTING MIXTURES

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ABSTRACT

Poor seedling propagation rates can be attributed to inadequate knowledge of their requirements including appropriate growth media that can enhance their growth at the nursery. The objective of the study was to assess the effects of different growing media on the growth of rooted seedlings of Annona muricata. The experiment was laid out using Completely Randomized Design (CRD) with four treatments and ten replicates. The treatments were combinations of green manure (Moringa oleifera leaf powder), gravel and top soil. The results showed that 63.6% Topsoil, 27.3% Gravel, and 9.1% Moringa oleifera leaf powder did well across the study, this media was also found to be the best media for the growth of Annona muricata seedlings as it gave the highest parameters in terms of seedlings height for the double and single node cuttings: T_1 (10.96cm and 4.8cm) respectively while T_3 and T_4 gave the least seedling height in double and single node cuttings: (2.2cm and 0cm) respectively. For leaf number double and single node cuttings, T_1 and T_3 the mean number of leaves were 8.7 and 5.2 respectively and stem girth in double and single T_1 and T_2 (4.5 and 3.6mm) respectively. Biomass accumulation was also influenced by the potting mixture. However, the higher the quantity of moringa leaf constituent in the potting mixture, the lower the biomass accumulation. In terms of the number of nodes it was observed that seedlings from two node cuttings grew better in terms of height, collar diameter, and number of leaves. Number of nodes also had a significant influence on biomass accumulation with seedlings from two nodes cuttings having higher biomass compared to seedlings from one node. This treatment also significantly indicated that potting mixtures and nodal number enhanced the growth and biomass accumulation of Annona muricata.for healthy seedlings production.

Keywords: *Annona muricata*, seedling growth, green manure, adaptability percentage.

INTRODUCTION

Annona muricata (soursop) has been grouped as one of the recognized medicinal plants in Nigeria. It is a member of the Annonaceae family comprising approximately 130 genera and 2300 species (Orwa *et al.*, 2009). It is a small slender evergreen tree, 4-8m tall when fully mature (Pinto *et al*., 2005) and grows at a temperature of 25-30^{o}, mean annual rainfall of over 1000mm, and a pH ranging from 5.5-6.5 (Orwa *et al.*, 2009). Due to its acidic taste it is being called soursop. The aroma is somewhat pineapple-like. The fruit contains a single oval, hard, smooth, black seed. It has a minimum of 100-200 seeds per fruit (Abad *et al.*, 2002). *Annona muricata* belongs to the Annonaceae family having about 130 genera and 2300 species. The fruit is slightly acidic in taste when ripe (Leoeuf *et al.*, 1980; Mashira *et al.*, 2013). It is likely to have originated from the warmest tropical areas in South and North America and is now widely distributed throughout tropical and sub-tropical parts of the world, including Malaysia, India and Nigeria (Adewole and Cation, 2006).

To support the growth of *Annona muricata* and sustainability of the species due to its numerous benefits to human health there is a need to improve its growth development by the use of vegetative

propagation with the support of green manure to aid the growth (Roesker, *et al.,* 2007). There is paucity of information on species need for regeneration and the most suitable growth media for the propagation of the species. With increase in consumer demand for soursop fruits and other parts and its increased popularity in this part of the world due to its medicinal benefits and cure for cancer (Joseph-Adekunle, 2014), A decoction of the young shoots or leaves is regarded as a remedy for gallbladder trouble, as well as coughs, catarrh, diarrhea, dysentery, fever and indigestion, mashed leaves are used as a poultice to alleviate eczema and other skin problems and rheumatism the root bark is use as an antidote for poisoning. Soursop flowers are believed to alleviate catarrh. Based on the studies of (Roesker, *et al.,* 2007) who reported that the plant has close kinship are likely to contain similar compounds so, a report from previous studies had shown that the plant *Annona muricata* (soursop) is a potent anticancer. There is need to examine how best to raise healthy seedlings for field establishment to enable poor farmers and interested individuals to cultivate and/or domesticate the species.

Therefore, this study aims to assess the effects of different growing media on the growth of rooted seedlings of *Annona muricata,* with a view to providing best treatment to enhance nursery seedling production of the species. Soursop has been acceptable nutritionally as a food products, source of the medicinal, food security, supplementary household income for small- and medium-scale farmers (Abad *et al*., 2002). It is not only a delicious and healthy fruit but it is used medicinally to treat different kinds of illness such as stomach ailments to worms, the seeds can be used in the treatment of vomiting, the leaf decoction is effective for head lice, bedbugs, on skin eruptions, the fruit can be taken orally as a remedy for liver problems?, a decoction of the young shoots or leaves is regarded as a remedy for gallbladder trouble, as well as coughs, catarrh, diarrhea, dysentery, fever, and indigestion, leaves are mashed used as a poultice to alleviate eczema and other skin diseases and also for rheumatism. The root bark is used as an antidote for poisoning, soursop flowers are believed to alleviate catarrh. Oil can be sourced from the seeds and used as an insecticide (Hernandez and Angel, 1997).

Growing media is a medium in which the roots of planted plants grow and their major function is to give support for plant growth (Kampf, 2000). Leaching is one of the sources by which nutrients can be lost, normally thought to be mainly by erosion and surface runoff. But studies have shown that losses by leaching sometimes can be significant. Relatively little concern has been shown to the effects of green manures on nutrient losses, any effect is likely to be more noted under the conditions of high soil fertility. A good medium is an elementary factor to produce healthy and thriving plants (Adams *et al.,* 2003). Growth medium has been reported to be the most critical factor determining seedling quality in the nursery (Baiyeri and Mbah, 2006). Sa'id *et al.,* (2015) also reported that the quality of seedlings raised is significantly influenced by growth medium. Poor seedling propagation rates can be attributed to inadequate knowledge of their requirements including appropriate growth media that can enhance their growth at the nursery (Keyagha *et al.,* 2016).

Green manures are often used to add nitrogen to the soil. In organic systems, this serves as the main source of nitrogen, whilst for industrial growers; it can be a way of minimizing fertilizer uses. Ekpo and Site, (2010) report that growth media are similar materials to soil that helps the plants to grow well and sustained them. Potting media affects the nursery seedlings either negatively or positively (Agbo and Omaliko, 2006). The quality of seedlings obtained from a nursery has an effect on the growth development of plants on the field when established and eventually on the productivity of an orchard (Baiyeri, 2006). Akintoye, *et al.,* (2013) reported that selecting the most supportive growing media for successful plant production is very important in potted plant growth; it plays key roles; to support the plant in soil, enable plant roots to get enough amount of oxygen also to hold to provide water and nutrients (Dewayne *et al.,* 2003). Some organic materials required to amend some physical and chemical characteristics of growth media in plant production include the use of organic manure,

sawdust, peat, paper water, etc. (Shadanpour *et al.*, 2011; Aklibasinda *et al.*, 2011). Both the physical and chemical properties of the growth media reveal an important effect on the growth of plants. Among the physical properties, aeration and water holding capacity are so important factors while among the chemical properties, nutritional status and salinity level play a crucial role in plant development (Dewayne *et al.*, 2003).

MATERIALS AND METHODS

Study Area

The study was carried out in the greenhouse of the central nursery at the Department of Sustainable Forest Management, Forestry Research Institute of Nigeria Ibadan Oyo State. The area is between Latitude 7^{o} N and 7.2 ^{o} N and Longitude 26 ^{o} E and 27 ^{o} E. The climate is mainly tropical with rainfall patterns ranging between 1000mm and 14500mm, the average temperature is about 30^{0}C while relative humidity is about 65%. There are two different climatic seasons which are the dry (November - March) and the rainy seasons (April - October). The climate of the area is dominated by rainfall pattern ranging from 1400mm to 1500mm. The average temperature is about 26^{0}C and relative humidity is about 65% (FRIN, 2013)

Preparation of compost

The compost manure was prepared from the *Moringa oleifera* leaves. The moringa leaves were harvested from the mother plant and kept in a sack. The leaves were removed from the woody stem and air-dried at room temperature under the weaning shed. The dried leaves were sorted from other debris and stones before taking them to the mill where they were ground into powder before mixing with the soil.

Preparation of Potting Media

Four potting media were prepared to contain head pans of topsoil, gravel, and manure. The topsoil was collected from forest soil dried and sieved to get a fine soil while the gravel was obtained from Adejumo area. The potting mixtures were thoroughly mixed in T_1 ratio 7:3:1 (7 topsoils, 3gravel, and 1 manure), T_2 ratio 5:3:3 (5 topsoils, 3gravel, and 3 manure), T_3 ratio 3:3:5 (3 topsoil, 3 gravel, and 5 manure) and T_4 ratio 1:3:7 (1topsoil, 3 gravel, and 7 manure) with a shovel and left for two weeks for the green manure to cure. T_c is the control. The potting mixture was filled into polythene pots.

Collection of planting and seedlings materials

Seven hundred and twenty seedlings of *Annona muricata* were raised through cuttings in the Central nursery of the Forestry Research Institute of Nigeria. Rooted cuttings of *Annona muricata* were planted in the filled media and allowed for two weeks to stabilize before the assessment of growth variables.

Experimental Design

The experiment was laid in a Completely Randomized Design (CRD) with 20 single plants per replicate.

Data Collection

Data were collected on the following variables; Plant height (cm); the height was measured from the soil level to apical bud using a meter rule, Leaf number-the number of leaves produced from randomly selected cuttings was counted. Stem Diameter (mm)- the stem diameters of the randomly selected cuttings were measured at about 2cm above the root collar with the use of a digital caliper.

Biomass Assessment

The biomass assessment was done three times during the experimental period. The first assessment was carried out before the rooted cuttings were transferred into the potting media which will serve as a baseline. Subsequent assessments were at monthly intervals. The plants were excised with a sharp razor blade into leaves, stem, and root. The leaves were separately gathered, so also the stems and roots. Their fresh weights were determined using a sensitive weighing balance and then oven-dried at 60°C to constant weight. The combined weights of the leaves, stems, and roots accounted for the total weight.

Data Analysis

The data were analyzed using analysis of variance (ANOVA) at 5 % probability level. The means were separated using Duncan Multiple Range Test.

RESULTS

Effect of the green manure on the Plant height

Double node cuttings gave the greatest plant height compared with single node cuttings except in the control (T_c) where the single node cuttings which was higher than the double node cuttings. However, in double node cuttings, T_1 had the highest plant height (10.96cm), followed by single node cuttings T_2, (5.2cm), and the least (2.2cm) was found in T_3 and Tc. In single-node cuttings, T_1 had the highest plant height of 4.8cm while T_3 had the least plant height (0.92cm) while in the T_4 there was no record of seedlings due to loss of seedlings in the treatment due to high concentration of acid released by the green manure. Across the four potting mixture, the result of the Analysis of Variance showed that there were significant differences in the plant height. Duncan Multiple Range Test was used to separate the means (Table1).

Effect of the green manure on Collar diameter

In collar diameter, double node cuttings produced a higher girth diameter in T_1, T_4, and T_C and the single node was higher in T_2 and T_3. However, in double node cuttings, T_1 had the highest diameter (4.5 mm), followed by T_C (3.5 mm), and the least (2.2 mm) was found in T_3. In single-node cuttings, T_2 has the highest diameter (3.6 mm) while T_4 has the least (1.5mm). There were significant differences in collar diameter across the four potting mixture in the result by the Analysis of Variance. Duncan Multiple Range Test was used to separate the means (Table1).

Effect of the green manure on the Number of leaves

For the number of leaves, double node cuttings were higher in T_1, T_2, and T_4 and a single node was higher in T_3 and T_C. However, in double node cuttings, T_1 had the highest number of leaves (8.7), followed by T_2 (6.0), and the least (1.4) was found in T_3. In single-node cuttings, T_C has the highest number of leaves (5.2) while T_4 had the least (0.3) (Fig. 4.6). The result of the Analysis of Variance shows that there were significant differences in the number of leaves across the four potting mixture. Duncan Multiple Range Test was used to separate the means (Table1).

Table 1: Means for plant height, collar diameter and number of leaf across different treatments

Treatment	Height (cm)	Collar diameter (mm)	Number of leaves
T_1S	4.78 ± 0.07^{b}	2.86 ± 0.07^{d}	3.20 ± 0.03^{d}
T_1D	10.96 ± 1.02^{a}	4.48 ± 0.09^{a}	8.70 ± 0.07^{a}
T_2S	3.71 ± 0.04^{c}	3.64 ± 0.06^{b}	4.10 ± 0.04^{d}
T_2D	5.19 ± 0.07^{b}	3.03 ± 0.01^{c}	6.00 ± 0.08^{b}
T_3S	0.92 ± 0.02^{f}	2.82 ± 0.05^{c}	0.20 ± 0.00^{g}
T_3D	2.15 ± 0.03^{d}	2.18 ± 0.03^{e}	1.40 ± 0.01^{f}
T_4S	1.18 ± 0.04^{e}	1.54 ± 0.02^{e}	0.30 ± 0.01^{g}
T_4D	2.67 ± 0.03^{d}	2.94 ± 0.04^{c}	2.20 ± 0.02^{e}
TCS	4.41 ± 0.05^{b}	2.52 ± 0.05^{d}	5.20 ± 0.05^{c}
TCD	2.17 ± 0.07^{d}	3.48 ± 0.06^{b}	2.50 ± 0.03^{e}

Means carrying the same alphabet are not significantly different ($p\leq 0.05$) from each other

TS – Treatment for single node; TD – Treatment for double node

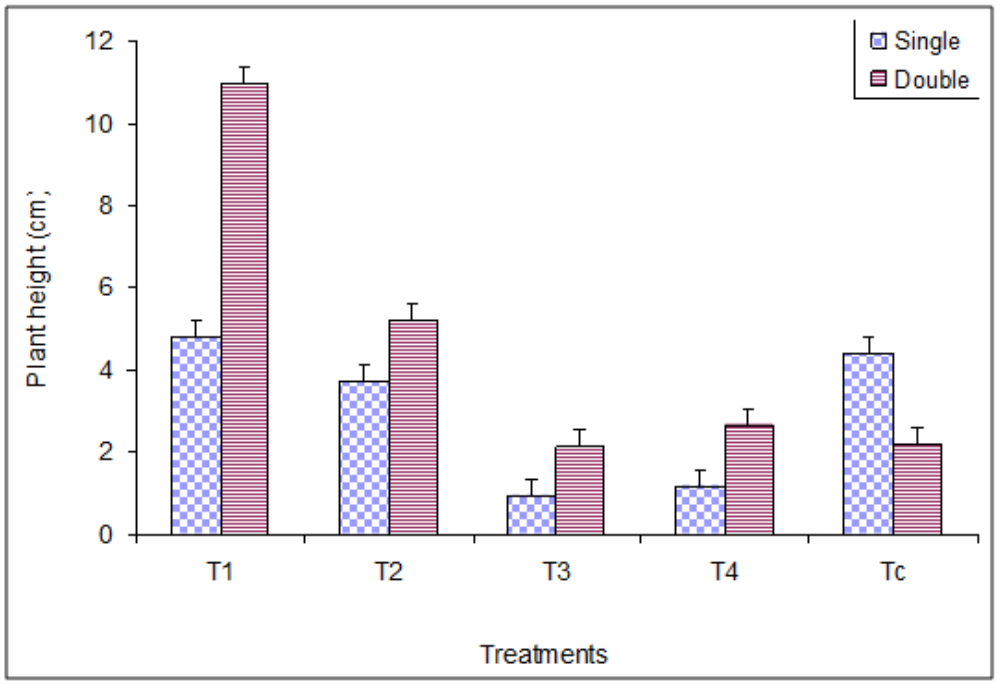

Fig. 1: The Mean Plant Height Exhibited by Treatments after Planting

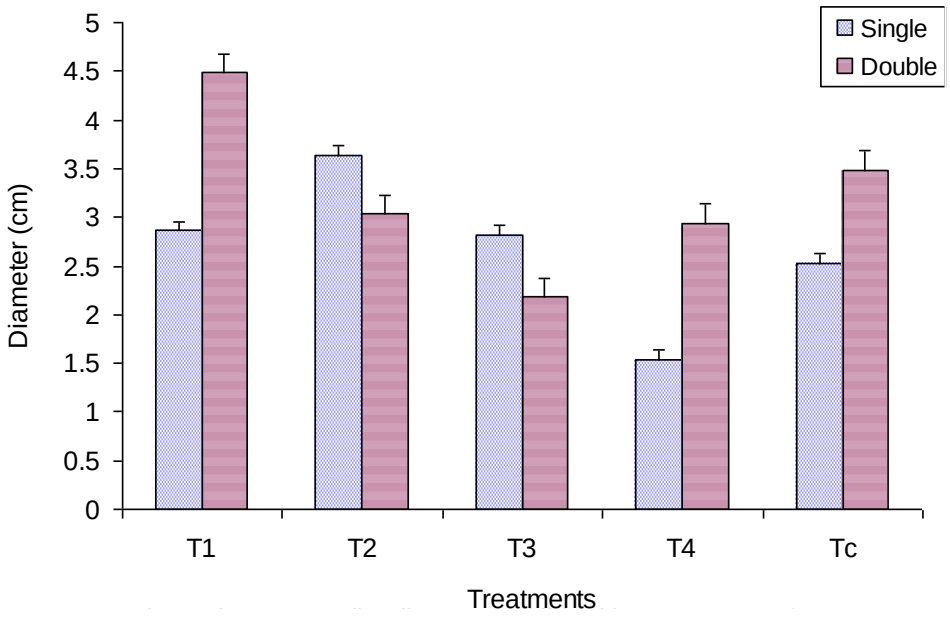

Fig. 2: The Mean Collar Diameter Exhibited by Treatments after Planting

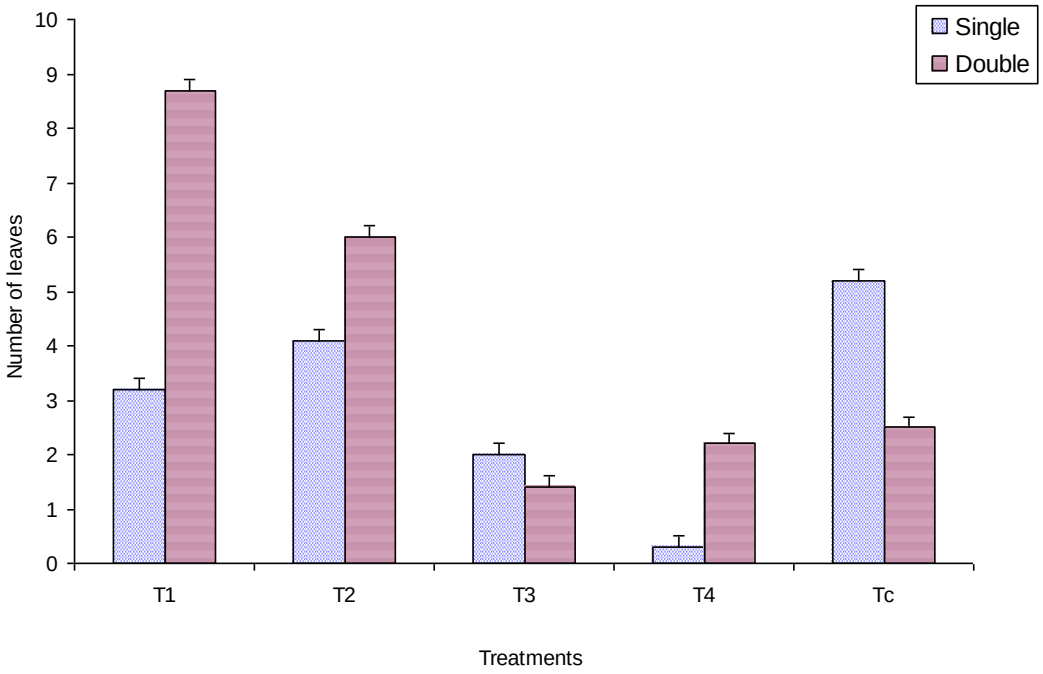

Fig. 3: The Mean Number of Leaves Exhibited by Treatments after Planting

Effect of the potting mixture on plant biomass

Leaf biomass varied significantly across the potting mixtures and node number with double nodes in potting mixture 7:3:1 (T_1) having the highest mean leaf biomass followed by potting mixture 5:3:3 while the potting mixture 1:3:7 had the least leaf biomass. In the stem biomass potting mixture 7:3:1 with double node also had the highest mean stem biomass of 0.62g, followed by potting mixture 5:3:3 with single node while no biomass was recorded in T4. Root biomass showed that the potting mixture 7:3:1 with a single node had the highest mean root biomass of 0.44g this is followed by T_1 D and T_3D while T_4 had no biomass recorded. The result of Analysis of Variance showed that there is a significant difference in mean leaf biomass, stem biomass, and root biomass among the treatments and Duncan Multiple Range Test was used to separate the means (Table 2).

Table 2: Mean biomass of leaf, stem and root

Treatment	leaf biomass (g)	Stem biomass (g)	Root biomass(g)
T_1S	0.8c ±0.10	0.30b ±0.03	0.44c ±0.08
T_1D	2.07a ±0.10	0.62a ±0.07	0.06b ±0.06
T_2S	0.92b ±0.27	0.38b ±0.06	0.05a ±0.05
T_2D	0.71d ±0.31	0.21c ±0.03	0.06b ±0.06
T_3S	0.37e ±0.07	0.20c ±0.02	0.01d ±0.01
T_3D	0.79c ±0.22	0.24c ± 0.04	0.07b ±0.07
T_4S	-	-	-
T_4D	-	-	-

Means carrying the same alphabet are not significantly different ($p \leq 0.05$) from each other
TS – Treatment for single-node cuttings; TD – Treatment for double-node cuttings

DISCUSSION

Modern organic agriculture builds on principles of improving soil fertility through incorporation of legumes and compost materials. Organic farming based on the use of *Moringa oleifera seed cake* as fertilizer on a maize farm achieved significant improvement in soil nutrients which in turn

increased the yield of test sample (Maize) (Emmanuel *et al*., 2011).

Abad *et al*., (2001) reported that 80% of organic matter is adequate for potting media. The pH values of the potting mixtures remained almost unchanged with increasing substitution of composts. This contravenes the findings of this study as pH values of the potting mixture changed with addition of Moringa leaf powder as organic compost but agrees with the findings of Tyler *et al*., (1993) who reported increases in the substrate pH with increasing concentrations of composted turkey litter added to the potting medium. This is due to mineralization occurrence; organic acid is produced which reduces the pH of the soil and lead to increase in the acidity of the soil. The phytotoxicity tests showed that all compost extracts were suitable for germination and growth of tomato and radish, in spite of the well-known sensitivity of radish to plant extracts (Tsuzuki *et al.,* 1995) which is in agreement with the result of this study.

Potting mixtures influence the biomass significantly in terms of root, stem and leaves. This is in line with the findings which show that application of manure enhances biomass accumulation due to availability of more nutrients in the soil supplied by the Moringa leaf component of the potting mixture. However, excess release of certain minerals from the Moringa leaf compost may increase the acidic content of the soil which caused the scotch of some of the potted plants. This is similar to the findings of Yang *et al.,* (2002) who reported that sawdust hurt the growth of *Highbush blueberry* relative to bad soil which was shown in T_4 (1:3:7). The result of this study shows that the planting medium may harm the seedling development of *A. muricata* as the least values in all the parameters taken were recorded in the ratio 1:3:7 (topsoil, gravel, and green manure). This could be that there is a higher concentration of acid released during the mineralization of the soil and the plant cannot withstand the concentration. This agreed with Wilson, *et al.,* (2001) who reported that the growing medium should not only act as a growing place but should also be a source of required nutrients for plant growth.

CONCLUSION

The results of this study indicated that the growth of *Annona muricata* can be enhanced with the use of potting mixture. The results also indicate that Moringa leaf powder can be used as green organic compost for proper growth and development of the species at 63.6% Topsoil, 27.3% Gravel and 9.1% Moringa leaf powder which performed so well. Meanwhile excessive use of Moringa leaf powder could be detrimental as observed in this study with scotch of the plants experienced in treatment four (T_4) where all the plants died with the addition of excess green manure. Biomass accumulation was also influenced by the potting mixture. However increase in the quantity of Moringa leaf powder constituent of the mixture reduced the biomass accumulation. In terms of number of nodes it was observed that seedlings from two nodes cutting better in terms of height, collar diameter and number of Leaves. Node also had significant influence on biomass accumulation with seedlings from two nodes having higher biomass compared to seedlings from one node cuttings. In a nutshell, potting mixture and node number in cuttings enhance the growth and biomass accumulation of *Annona muricata.*

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