RESEARCH ARTICLE

EVALUATION OF PARED SUCKERS IN NEEM DIPS AND FERTILIZER SOURCES ON SUSTAINABILITY OF INFLORESCENCE DICHOTOMOUS PLANTAIN CULTIVARS IN TROPICAL ULTISOL OF SOUTHEASTERN NIGERIA

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ABSTRACT

Inflorescence dichotomous cultivars of false horn plantain (*Musa spp.*) is facing potential genetic erosion and extinction of its gene pool as a result of desertion, poor management practices, pests and diseases. Field trials were conducted at the University of Uyo Teaching and Research Farm during the 2017/2018 and 2018/2019 planting seasons to determine the effect of paring plantain suckers dipped in neem extracts and fertilizer sources on growth and yield related components of dichotomous plantain. The experiment was laid out in a randomized complete block design RCBD and replicated four times. The treatments consisted: pared sucker + 10% neem extract + 10 t ha⁻¹ poultry manure (PM); pared sucker + 10% neem extract + 20 t ha⁻¹ PM; pared sucker + 10% neem extract + 400 kg ha⁻¹ NPK 15-15-15 fertilizer; pared sucker + 0 t ha⁻¹ PM and unpared sucker + 0 t ha⁻¹ (which served as controls). Data collected on growth and yield related components were subjected to analysis of variance at 5% level of significance. Results indicated that pared suckers treated with neem extract and fertilizer sources had positive effect on growth and yield of inflorescence dichotomous plantain. However, unpared suckers + 0 t ha⁻¹ were significantly ($p > 0.05$) poor in growth and yield. The growth and yield parameters in the mother and first ratoon plants of pared suckers + 10% neem extract + 20 t ha⁻¹ PM were significantly ($p < 0.05$) superior than other treatment applications, notably, with taller pseudostem height which ranged from 306.50 to 309.50 cm, larger pseudostem girth ranged between 60.70 and 65.60 cm, number of suckers produced at harvest ranged from 9.50 to 10.00, fruit length ranged from 24.17 to 24.42 cm while the fruit diameter were between 17.83 and 18.17 cm respectively. In addition, the fruits in treated suckers increased significantly with yield ranging from 22.72 to 23.28 t ha⁻¹ respectively. Consistently, pared plantain suckers dipped in 10% neem extract cum 20 t ha⁻¹ PM in the field could effectively improve yield and encourage sustainability of inflorescence dichotomous plantain performance.

KEYWORDS

Dichotomous-plantain, pre-treatments, fertilizer sources, yield-performance, conservation.

1. INTRODUCTION

Inflorescence dichotomous plantain is an indigenous fruit crop considered to be rare to absent in some African countries including Ghana, Nigeria and others (Gerda, 1998). Its polymorphic orientation occurs in a manner that a plant could have more than one bunch on a pseudostem with hermaphrodite flowers (Ekanem and Brisibe, 2018). They have potential for dietary diversification as vitamins and minerals found in food and medicine. The peels of dried ripe fruits are used for the treatment of ulcers and stomach aches while the peels of dried unripe fruits are used for soap production and soup preparation in southeastern part of Nigeria. Dried leaves, sheath and petioles are sources of tying, sponges and roofing materials (Akinyemi et al., 2010). Water extraction from decayed pseudostem is used for treatment of internal heat (Etukudo, 2003). Although the plant traits have become a source of curiosity to many small scale farmers, yet, inherent characteristics of reversion/switching pattern

of bunches, off type bunch, smaller bunches/fruit sizes, fewer hands (if/without extensive propping fall off), pest and disease as well as poor soil fertility seem to hinder their exploitation and production. The fruits may be accepted by few consumers depending on location and cultivation. Apart from these hindrances, the major precarious situation that forces the farmer to abandon the crop include poor yield and unstable bunch sizes. Novel techniques are still developed by researchers to better the production of plantain (FAO, 2010).

Clean planting materials are said to be a good source for crop production. Tissue culture is known to promote production of clean planting materials but the technology is not universally affordable (Seshu, 1989). The cultural method within the reach of farmers is planting of clean suckers obtained by paring (peeling corm) to remove infested tissue and the use of plant extract applied as corm/root dips (Musabyimena et al., 2001 and Sikora et al., 2005). Hence, there is urgent need to utilize integrated

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cultural approach such as corm paring, dipping in biocides before planting and nutrients management. Treatment of suckers with biocides improve plant quality and productivity as well as long-term root-health for nutrient use efficiency (Bwogi et al., 2014). The technique of corms paring with neem dips adopted for pre-planting operation have been reported (Mgenzi et al., 2006; Umeh et al., 2010; Shukla, 2010; Bwogi et al., 2014). A group researcher reported that surface sterilization of planting materials in plantain is done to effectively reduce pest and disease infestation (Tinzaara et al., 2002). Several plants such as *Azardracha indica*, *Tephrosia vogelii*, *Tegetes erecta*, *Phytoloca dodecandra*, *Ricinus communis* and *Nicotiana tabacum* possess great pesticidal properties and have relevance in organic farming practice (Sahayaraj and Kombiah, 2010). In other study, a group researcher reported that, neem leaves have been variously tested by researchers and proven to have potent active ingredients against insects such as weevils, stem borers and nematodes (Oso et al., 2015; Oso, 2017). Derivatives of neem have been shown to be the best biocide that act as repellants and reduce sucker mortality (Fogain et al., 1994; Messiaen et al., 1998).

Besides the use of biocide, organic and inorganic fertilizer sources are needed for high yield enhancement, soil fertility and productivity of plantain (Roy et al., 2006). In other words, fertilizer application is a catalyst to promote soil fertility, high sustainable production of plantain in order to ensure biodiversity and food security. Kannaiyan also reported that the nutrient supply system of the soil achieved through the native or applied sources (fertilizers) to a very large extent governs the yield and uptake of nutrient by crops (Kannaiyan, 1999). The availability of pest and disease-free suckers and uptake of the nutrients from fertilizer sources are very important if heavy bunches and fruits of plantain are to be produced (Ndukwe et al., 2012). However, to overcome the constraints that hinder the wider production, the quality and quantitative attributes could be improved by using clean planting materials, adequate integrated nutrients, pest and disease management strategies to encourage its conservation and sustainability. Therefore, field studies were conducted to evaluate the effect of pre-treatment of pared corms with neem extract and fertilizer sources on the growth and yield performance of inflorescence dichotomous plantain cultivar. Also, the study seeks to improve the present agronomic practices used by plantain farmers in southeastern Nigeria.

2. MATERIALS AND METHODS

2.1 Description of study area

The study was carried out at the University of Uyo Teaching and Research Farm, Akwa Ibom State (Lat. 5°20' N and 5°30' N, Long. 7°27' E and 5°62' E at 68.0 m above sea level, average annual rainfall 2500 mm, relative humidity 79.8%, monthly mean temperature range: 26.88 – 32°C, soil type: ultisol during the 2017 and 2019 cropping seasons (UCCDA, 2002; Agbede, 2015).

2.2 Soil sampling and analyses

Twenty-five core soil samples were collected randomly with a soil auger at the depth of 0-15 cm and 15-30 cm. The soil samples were thoroughly mixed, bulked, air dried, crushed with mortar and pestle and sieved using a 2 mm mesh sieve for physicochemical analyses in various methods described (Bouyoucos, 1962; McLean, 1965; Jackson, 1967; Syers et al., 2012; AOAC, 2016; de Souza et al., 2019).

2.3 Sources and processing of organic and inorganic fertilizer used for the experiment

The poultry manure was obtained from Animal Unit, Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo. The poultry manure was air-dried and stacked under shade to allow mineralization. The laboratory analysis of poultry manure was done in the two cropping seasons in the Soil Science Laboratory, University of Uyo. NPK 15-15-15 fertilizer was purchased from State Ministry of Agriculture, Akwa Ibom State, Nigeria.

2.4 Collection and preparation of neem leaf suspension

Figure 1: Neem leaf extract

Fresh neem leaves were collected from Pharmacy Research Farm, University of Uyo, Uyo. The leaves were rinsed under flowing tap water to remove debris, air-dried for five days in the greenhouse and milled into powder. A weighing balance was used for measuring 1000 g of the neem powder into a plastic container with 10 l of distilled water. Thereafter, the powder was added into the water stirred thoroughly and the mixture was left for 24 hours to obtain a crude extract of 10% concentration (v/w). The mixture was then filtered using Whatman Filter Paper No.1 and a sticking agent, Sandovit (Pratik Agro-Agencies, India), 5 ml was added to the filtrate. This was carried out to ensure that the leaf extract spread and stick on the surface of the pared corms (Figure 1).

2.5 Collection and treatment of plant suckers

Figure 2: Dichotomous plantain cultivars. (a) double bunch (b) triple bunch

Plant suckers of dichotomous plantain (double and triple-bunch cultivars) were collected from mother stools in the Teaching and Research Farm, University of Uyo (Figure 2). The suckers consisted of conventional uniform and vigorously growing sword suckers with a minimum pseudostem height and girth of 50 cm and 15 cm, respectively as suggested (Nelson et al., 2006; Oluwafemi, 2013). The entire sword suckers were cut back to 1.5 m and separated into pared and the unpared groups (Figure 3a and b). In pared group, all roots and approximately 5 mm outermost layer of the corms and all discolored tissues were peeled off with sharp a knife. The pared plantain corms were dipped into 10% (v/w) neem leaf suspension for 20 minutes before planting while there was no corm neem dips treatment for the unpared suckers (Oso et al., 2017).

Figure 3: a) Pared suckers; b) Unpared suckers

2.6 Field experiment and design

The total size of land area of 50 m x 45 m (0.225 ha) was used for this study. The field was divided into plots representing an experimental unit of 10 m x 7.5 m dimension and the distance between the plots was 0.6 m x 1 m. Suckers were planted in a hole of 0.3 m x 0.3 m x 0.3 m depth at 2.0 m x 3.0 m spacing between plants and within plants giving a population of 1,667 plants per hectare under a monocropping system in the field (Shiyam, 2010 and Akinro et al., 2012). Treatments include: pared + 10% neem extract + PM at 10 t ha⁻¹, pared corms + 10% neem extract + PM at 20 t ha⁻¹, pared corms + 10% neem extract + 400 kg ha⁻¹ NPK (15:15:15) fertilizer, pared corms + 0 t ha⁻¹ PM and unpared corms + 0 t ha⁻¹ (which served as the control) were randomly applied eight weeks after planting (WAP). The experiment was laid out in a randomized complete block design and the treatments replicated four times. The experiment continued into the first ratoon generation without any modification and similar data obtained from the parent plants were also collected in order to validate the data.

2.7 Data collection and statistical analyses

Data on some growth parameters and yield related components of the

plantain cultivars were collected according to the methods described by (Dadzie and Orchard, 1997; PPFM, 2013; NAREI, 2013). The data were subjected to analysis of variance (ANOVA) using Statistical Analysis Systems (SAS) procedure outlined for randomized complete block design (SAS 9.2 version, 2009). Fisher's LSD (least significant difference) was used to detect differences among treatment means at 5% level of probability ($p < 0.05$).

3. RESULTS AND DISCUSSION

Data on soil analysis are presented in Table 1. The result showed the soil pH range of 5.05 - 5.71 at the depth of 0-15 cm in 2017/2018 and 5.44 - 5.32 at the depth of 15-30 cm in 2018/2019 cropping seasons, respectively. Exchangeable acidity decreased from 2.06 - 1.92 in 2017/2018 and 2.16 - 1.98 in 2018/2019 cropping seasons, respectively. This is in line with those who described the soil of southern eastern Nigeria as acidic sand (Udoh et al., 2008). The soil textural class is sandy loam characterized with low pH, organic matter, potassium, magnesium and total nitrogen decrease with high infiltration rate indicating that the soil fertility status was low.

Table 1: Physicochemical properties of experimental soil and poultry manure

Physicochemical property	2017/2018			2018/2019		
	Soil depths			Soil depths		
	0-15 cm	15-30 cm	Poultry manure	0-15 cm	15-30 cm	Poultry manure
pH	5.65	5.44	-	5.71	5.32	-
Organic carbon (%)	1.43	1.40	29.32	1.44	1.21	36.32
Organic matter (%)	3.21	3.02	50.75	3.58	3.04	53.25
Sand (%)	81.60	74.02	-	77.40	70.62	-
Silt (%)	6.40	8.24	-	8.31	7.21	-
Clay (%)	10.50	15.21	-	15.35	15.50	-
Base saturation (%)	60.66	68.42	-	64.41	68.98	-
Nitrogen (g/kg)	0.06	0.04	4.52	0.07	0.05	4.89
Phosphorus (mg/kg)	33.26	24.08	42.17	44.26	35.42	50.22
Potassium (g/kg)	1.60	0.60	9.46	0.60	1.60	9.51
Calcium (cmol/kg)	2.25	2.40	3.85	2.70	2.65	3.88
Magnesium (cmol/kg)	1.20	1.62	0.38	1.67	1.77	0.36
Sodium (mg/kg)	0.13	0.05	0.45	0.18	0.09	0.42
Effective cation exchange capacity (ECEC)(cmol/kg)	4.27	4.11	-	4.34	4.57	-
Base saturation % Exchangeable acidity	2.06	1.92	-	2.16	1.98	-
Textural class	Sandy loam	Sandy loam	-	Sandy loam	Sandy loam	-

3.1 Vegetative growth parameters

Pared suckers dipped in 10% neem extract and fertilizer sources on emergence and growth of inflorescence dichotomous plantain is shown in Table 2. The result indicated that pseudostem height and girth, number of suckers produced, functional leaves at bunch emergence and functional leaves at harvest increased significantly ($p < 0.05$) with pared suckers + fertilizer sources compared with unpared suckers + 0 t ha⁻¹ which served as control (Table 2). Poultry manure at 20 t ha⁻¹ on neem treated pared

suckers had significant ($p < 0.05$) effect in the mother plant and first ratoon crop on pseudostem height (305.50 cm, 309.50 cm), pseudostem girth (60.70 cm, 65.60 cm), number of suckers produced (9.50, 10.00), functional leaves at bunch emergence (15.67, 15.93) as well as number of functional leaves at harvest (4.33, 5.00), respectively. Similar trends were observed in the first ratoon crop (Table 2). Furthermore, treatments significantly promote vigorous growth in the mother and first ratoon crop compared with the control and other fertilizer application rates in 2017/2018 and 2018/2019 planting seasons.

Table 2: Effect of neem-treated pared suckers and fertilizer sources on the vegetative growth of dichotomous plantain in the first crop cycle (mother plant)

Treatments	Height (cm)	Girth (cm)	Suckers at harvest	Functional leaves at bunch emergence	Functional leaves at harvest	Number of days to bunch emergence	Number of days from bunch emergence to harvest
PM 10 t ha ⁻¹ (pared)	277.83	58.10	7.83	15.38	3.50	361.23	91.18
PM 20 t ha ⁻¹ (pared)	306.50	60.70	9.50	15.67	4.33	376.07	91.25
NPK 400kg ha ⁻¹ (pared)	280.00	56.85	7.33	15.67	4.00	280.45	92.03
0 + t ha ⁻¹ (pared)	277.33	54.56	6.67	14.83	4.33	333.72	91.02
Control (unpared)	253.33	48.82	4.66	13.69	2.39	315.29	92.61
LSD ($p < 0.05$)	19.09	5.28	1.53	0.74	0.82	85.88	5.16

There were no significant ($p>0.05$) differences in the number of days to bunch emergence and bunch emergence to harvest. The length of time taken ranged from 280 – 361 days in the days to bunch emergence (Table 2). In the first ratoon crop, the length of time taken to bunch emergence ranged from 304.87 – 381.47 days and the time taken from bunch emergence to harvest ranged from 79.45 – 92.88 days (Table 3). The rapid vegetative growth parameters recorded on neem treated pared suckers +

PM at 20 t ha^{-1} may be attributed to clean and healthy planting materials obtained by sucker paring treated with neem extract and the availability of nutrients that enhanced good rooting system for anchorage nutrient absorption from the soil. In addition, pared suckers + PM at 20 t ha^{-1} application reaffirmed the previous work reported by those who noted that PM at 20 t ha^{-1} enhanced growth, fruit quantity and yield of plantain hybrid (Baiyeri and Tenkouano, 2007; Ndukwe et al., 2011).

Table 3: Effect of neem-treated pared suckers and fertilizer sources on the vegetative growth of dichotomous plantain in the second crop cycle (first ratoon)

Treatments	Height (cm)	Girth (cm)	Suckers at harvest	Functional leaves at bunch emergence	Functional leaves at harvest	Number of days to bunch emergence	Number of days from bunch emergence to harvest
PM 10 t ha^{-1} (pared)	288.00	59.98	8.00	15.57	4.17	364.83	90.68
PM 20 t ha^{-1} (pared)	309.50	65.60	10.00	15.93	5.00	381.47	90.25
NPK 400kg ha^{-1} (pared)	288.83	58.83	7.83	15.75	4.50	304.87	90.42
0 + t ha^{-1} (pared)	267.17	56.08	5.50	14.82	3.50	327.30	92.88
Control (unpared)	228.83	41.65	3.17	10.94	2.33	308.57	79.45
LSD ($p<0.05$)	64.91	11.34	1.09	3.04	0.83	91.13	20.59

The results also indicated that unpared + 0 t ha^{-1} application (control) recorded the lowest significant ($p>0.05$) value in pseudostem height 253.33 and 228.83, pseudostem girth 48.82 and 41.65, number of suckers produced 4.66 and 3.17, functional leaves at bunch emergence 13.69 and 10.94, functional leaves at harvest 2.39 and 2.33 in mother plant and first ratoon crop suggesting that the plant may be affected by poor rooting system obtained from unpared suckers, infestation and nutrient deficiency. This corroborates the work of those who reported that poor rooting system may affect the supply of nutrient to the crop (Goss et al., 1993).

3.2 Yield and yield related component

The result on Table 3 showed that yield and some yield related

components significantly ($p<0.05$) increased in neem-treated pared suckers and fertilizer sources. Pared suckers dipped in 10% (v/w) + PM at 20 t ha^{-1} produced larger fruit (24.7 cm and 24.42 cm), larger fruit diameter (17.83 cm and 18.17 cm) as well as higher yield (22.72 t ha^{-1} and 23.28 t ha^{-1}), respectively in the mother plant and first ratoon crop (Tables 4 and 5) while the number of bunches was significant ($p<0.05$) only in the first ratoon crop cycle compared with the control (Table 5). The increase in the number of bunches and other yield related components in the neem-treated pared suckers + 20 t ha^{-1} PM could be due to the cultivation of healthy planting materials, mineralization as well as release of nutrients from organic fertilizer may have improved the soil structure by increasing the soil water holding capacity which gave rise to good aeration and drainage that encouraged better root growth and nutrient absorption. Similar result had been obtained in plantain (Obiefuna, 1990).

Table 4: Effect of neem-treated pared suckers and fertilizer sources on yield and yield related components of dichotomous plantain in the first crop cycle (mother plant)

Treatments	No. of Bunches	Hands per bunch	Fingers and Fruits per bunch	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Bunch weight (kg)	Yield t ha^{-1}
PM 10 t ha^{-1} (pared)	1.50	9.55	38.42	20.73	15.85	327.05	11.40	19.01
PM 20 t ha^{-1} (pared)	1.50	10.52	46.52	24.17	17.83	314.93	13.63	22.72
NPK 400kg ha^{-1} (pared)	1.00	9.93	48.82	21.85	15.93	335.25	12.12	20.20
0 + t ha^{-1} (pared)	1.50	9.12	42.48	20.17	16.03	315.62	11.05	18.42
Control (unpared)	1.00	7.07	27.28	17.68	12.48	158.52	7.21	12.04
LSD ($p<0.05$)	0.73	1.32	7.01	2.02	1.30	53.49	1.56	2.61

Table 5: Effect of neem-treated pared suckers and fertilizer sources on yield and yield related components of dichotomous plantain in the second crop cycle (ratoon crop)

Treatments	No. of Bunches	Hands per bunch	Fingers and Fruits per bunch	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Bunch weight (kg)	Yield t ha^{-1}
PM 10 t ha^{-1} (pared)	1.17	9.65	44.40	21.23	16.50	327.83	12.40	20.77
PM 20 t ha^{-1} (pared)	2.33	10.23	41.97	24.42	18.17	342.40	13.97	23.28
NPK 400kg ha^{-1} (pared)	1.67	10.50	57.37	21.62	16.85	344.03	12.87	21.45
0 + t ha^{-1} (pared)	1.50	8.28	39.73	17.44	15.18	305.22	11.38	18.47
Control (unpared)	0.83	4.35	17.73	12.65	9.18	105.78	4.33	7.45
LSD ($p<0.05$)	0.66	1.49	6.91	3.78	2.76	32.46	1.36	2.18

The assimilates accumulated by the follower suckers (since suckers are sinks and so depends on the mother plant during early growth), in addition to the nutrient released from organic fertilizer could have contributed to the earlier flowering and better vegetative growth of all the genotypes especially in the hybrids, PITA 14 and 29525 (Ndukwe et al., 2011). They also affirm that hybrid plantain (genotype 304546-3) naturally exhibited vigorous growth habit especially in a well fertilized soil. Also, inflorescence dichotomous plantain performed poorly in the control plots and could not withstand stress (as the plants in the control

plots produce lower yield in the two cropping cycles) (Ndukwe et al., 2011). The reports that bunches in inflorescence dichotomous plantain are unstable genetic traits is in tandem with this study (Tenkauono et al., 2007; Ekanem and Brisibe, 2017). It is also an indication of incomplete penetrance and variable expressivity in the fruiting among inflorescence dichotomous plantain (Ortiz and Vuylsteke, 1994).

This corroborates with the work of those who reported that planting materials treated with appropriate formulations could improve crop

resilience and productivity (Oliveira et al., 2020). This further implies that sucker paring and nutrient integration management strongly influenced growth and yield of dichotomous plantain and agrees with the work of those who recommended that sucker paring is a good sanitation method compatible with manuring for producing healthy plants and enhanced plantain yield (Oso et al., 2015). In addition, reports had it that yields of plantain were positively correlated to fertilization (Stover and Simmonds, 1987). This suggested that some nutrients may be limited in the soils of the experimental area in relation to the nutrient requirement of plantain. The significant increase in the bunch weight and the number of fruits per bunch by organic and inorganic fertilizers may be attributed to the nutrient release and availability, especially nitrogen and potassium which are important for normal crop growth and fruit filling of plantain. High yield of plantain is usually associated with heavy application of potassium and nitrogen (Obiefuna, 1984; Arntzen and Ritter, 1994). Organic fertilizer had greater yield than inorganic fertilizer and could be as a result of improved soil physical conditions, moisture retention and increased organic matter content (Obiefuna, 1990; Mbagwu, 1992; Zhou, 2002).

The least vegetative growth and yield component in mother plant and first ratoon crop were obtained from the unpared + 0 t ha⁻¹ application (control). The minimum value obtained on unpared suckers + 0 t ha⁻¹ is a pointer to low quality planting materials, infestation by pests and diseases, insufficient physiological stimulation for growth leading to decrease or low yields. This agrees with the report of those who noted that poor planting material and inadequate nutrients undermine crop performance potentials (Patil and Patil, 2017). The result of the study showed that all pared suckers with or without fertilizer sources increase growth and yield than the unpared suckers + 0 t ha⁻¹ application rate (control). This is as a result of good planting material employed and availability of sufficient nutrient. This is supported by who recommended that clean planting material and management practices could sustain the production of banana and plantain (Tenkouano, 2006). It is also in line with the work of who reported that pared suckers with fertilizer application had sufficient physiological stimulation for absorption of nutrients for growth and yield (Hauser, 2017). The hindrances and limitation to exploitation of inflorescence dichotomous plantain usually include smaller bunches, hands, fingers and yield and could be improved by using good quality planting materials and application of adequate nutrients to enhance production, acceptability and conservation of the rare genotype by farmers.

4. CONCLUSION

Crop improvement and conservation is of paramount concern in any breeding program. Application of sucker paring, sucker decontamination in neem dips (plant extract that possess pesticidal properties), proper fertilization and soil management appeared to be a good measure which led to enhance growth and yield performance of inflorescence dichotomous plantain. This agronomic technique is assayed to be economical and ecofriendly. All neem-treated pared suckers with or without fertilizer sources in the mother plant and first ratoon crop were superior in performance than the unpared suckers without fertilizer sources (control) in the following increasing order: pared + PM at 20 t ha⁻¹ < pared + 400 kg ha⁻¹ NPK < pared + PM at 10 t ha⁻¹ < pared + 0 t ha⁻¹ < unpared + 0 t ha⁻¹ (control). Hence, inflorescence dichotomous plantain production and sustainability could be achieved through sucker paring in neem dips + PM at 20 t ha⁻¹ application for desirable traits and optimum yield. It is also recommended for wider adoption and applicability by farmers in southeastern Nigeria.

CONFLICT OF INTEREST

Authors have declared that there was no conflict of interest.

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