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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/24291
DOI URL: <http://dx.doi.org/10.21474/IJAR01/24291>



RESEARCH ARTICLE

THE EFFECTS OF SUBSTRATE TYPE AND CULTIVAR ON THE ESTABLISHMENT AND GROWTH PERFORMANCE OF PLANTAIN PLANTLETS

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Manuscript Info

Manuscript History

Received: 20 July 2026

Final Accepted: 22 August 2026

Published: September 2026

Key words:-

Musa spp., plantain, cultivar, compost, growing substrate, seedling growth, nursery performance.

Abstract

Plantain (*Musa* spp.) production depends greatly on clean quality and vigor of planting materials, which are influenced by growing medium one of which is the substrate and cultivar during nursery establishment. This study evaluated the effects of substrate type and cultivar on the growth and plantlets performance of plantain at the LAUTECH Teaching and Research Farm. The experiment was laid out as a 4 × 5 factorial experiment in a completely randomized design (CRD), replicated three times, involving four plantain cultivars (Agbagba, Obinolewai, Orishele and Curare Enano) and five substrates (compost, soil + compost, sawdust, soil + sawdust and soil). Growth and plantlets performance were assessed using stem girth, leaf area, number of leaves, number of roots, chlorophyll content, fresh weight and dry weight. Data were subjected to analysis of variance, and significant treatment means were separated using Duncan's Multiple Range Test at the 5% probability level. Growth increased progressively from 4 to 12 weeks after planting (WAP), with substrate type significantly influencing stem girth from 6 WAP and leaf area and number of leaves throughout the assessment period. Compost consistently produced superior growth responses, recording stem girth values of 5.50, 8.20, 8.67 and 9.00 cm at 6, 8, 10 and 12 WAP, respectively, compared with 7.08 cm under soil at 12 WAP. Compost also produced the highest leaf area, increasing from 65.17 cm² at 4 WAP to 1,113.8 cm² at 12 WAP, while soil recorded 45.33 and 825.3 cm², respectively. Similarly, compost increased the number of leaves from 4.00 at 4 WAP to 5.00 at 12 WAP, compared with 2.21 and 3.50 leaves, respectively, under soil. At the seedling-performance stage, compost produced the highest number of roots (20.17), chlorophyll content (61.42) and dry weight (78.67 g), whereas soil recorded 9.92 roots, 38.00 chlorophyll value and 50.08 g dry weight, respectively.

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Sawdust produced the highest numerical fresh weight (203.33 g), although differences among most substrates were not statistically significant. Cultivar significantly affected stem girth at 10 and 12 WAP, with Orishele recording

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7.80 cm at 10 WAP and Agbagba and Orishele recording the highest value of 8.13 cm at 12 WAP. Obinolewai recorded the highest chlorophyll content (68.60) and, together with Orishele, showed superior root development (17.27 roots), while Agbagba produced the highest fresh weight (178.53 g). Significant substrate $\times$ cultivar interactions were observed for several traits, with compost producing particularly high responses, including 1,209.30 cm² leaf area in Obinolewai, 1,208.00 cm² in Curare Enano, 21.00 roots in Agbagba, 84.67 g dry weight in Orishele and 62.33 chlorophyll value in Agbagba. Overall, compost was the most effective substrate for enhancing vegetative growth, rooting, chlorophyll accumulation and dry matter production of plantain seedlings. The use of compost, particularly with responsive cultivars such as Obinolewai and Orishele, is recommended for the production of vigorous and high-quality clean plantain planting materials under nursery conditions.

Introduction:-

Plantain (*Musa* spp.) is an important food and cash crop in the humid and sub-humid regions of Africa, where it contributes substantially to household food security, income generation and rural livelihoods. In Nigeria, plantain is cultivated by small- and medium-scale farmers and is valued for its high carbohydrate content and versatility as a food crop. However, productivity in plantain production is strongly influenced by the quality and vigor of planting materials established in the field. Differences among plantain cultivars in growth and production characteristics have also been reported, indicating that genetic background can influence plant performance under particular environmental and management conditions (Harry & Ulasi, 2023; Tambwe et al., 2023). The production of vigorous and healthy plantlets is therefore an important component of successful plantain establishment. Nursery growth is influenced by the physical, chemical and biological properties of the growing medium, which determine water availability, aeration, nutrient supply and root development. An appropriate substrate should provide adequate moisture retention while maintaining sufficient drainage and aeration for effective root growth. Organic materials such as compost and sawdust can modify these properties and improve the growing environment of plantlets. Recent studies have demonstrated that organic substrates and amendments can substantially improve the growth, rooting and physiological quality of *Musa* plantlets compared with less favorable growing media (Abirami et al., 2024; Barrezueta-Unda & Cortez, 2026).

Compost is particularly valuable as a nursery substrate because of its potential to supply plant nutrients while improving the physical condition and biological activity of the growing medium. Studies on banana and plantain propagation have shown that compost-based substrates can enhance shoot development, leaf production, root formation and other indicators of plantlets quality. Abirami et al. (2024), for example, reported significant differences in plantlet production, shoot growth, shoot girth and leaf development among organic substrate combinations used for banana macro-propagation. Similarly, research on plantain plantlets has shown that compost-based substrates can improve plantlets growth and quality during macro-propagation and nursery establishment. Sawdust is another readily available organic material with potential for use in nursery production. Its incorporation into growing media can influence substrate structure, porosity and water-holding characteristics. Recent research has demonstrated that sawdust-containing growing media can contribute to improved banana propagation when appropriately combined with other organic materials or biological amendments. Kumar et al. (2025) reported that growing-media composition significantly influenced banana plantlet multiplication and growth, with a sawdust–banana fibre-based mixture combined with *Trichoderma* producing improved propagation performance. However, the performance of sawdust as a sole substrate may differ from that of nutrient-rich organic materials such as compost because of differences in nutrient availability and decomposition characteristics.

Apart from substrate quality, cultivar differences can contribute substantially to variation in plantlets growth. Plantain cultivars differ genetically in morphological characteristics, growth rate and biomass accumulation, and such differences may become more pronounced under contrasting growing conditions. Recent field studies have demonstrated significant differences among plantain cultivars in vegetative growth and yield traits, confirming the importance of cultivar selection in plantain production (Harry & Ulasi, 2023; Tambwe et al., 2023). Although several studies have evaluated organic substrates for banana and plantain propagation, information on the comparative response of commonly cultivated plantain cultivars to compost, sawdust and their soil-based combinations under nursery conditions in southwestern Nigeria remains limited. The present study was therefore undertaken to evaluate the effects of substrate type and cultivar, both individually and in combination, on the growth and plantlet performance of plantain under nursery conditions

Materials and Methods:-**Experimental Site:-**

The experiment was conducted at the LAUTECH Teaching and Research Farm, ogbomosho, Oyo State, Nigeria. The study was carried out under nursery conditions to evaluate the effects of substrate type and cultivar on the establishment and growth performance of plantain plantlets. The location provided the experimental environment under which the different substrate and cultivar combinations were evaluated.

Experimental Materials:-

The plant materials consisted of four plantain cultivars, namely Agbagba, Obinolewai, Orishele and Curare Enano. Five substrate treatments were evaluated: compost, soil + compost, sawdust, soil + sawdust and soil. The selection of these materials was intended to compare organic substrates and soil-based substrate combinations with soil alone as the control. The study therefore provided an assessment of the relative suitability of compost- and sawdust-based media for plantain plantlets production.

Experimental Design and Treatment Structure:-

The experiment was laid out as a 4×5 factorial experiment in a Completely Randomized Design (CRD) and replicated three times.

The first factor was plantain cultivar with four levels:-

C₁ = Agbagba

C₂ = Obinolewa

C₃ = Orishele

C₄ = Curare Enano

The second factor was substrate type with five levels:-

S₁ = Compost

S₂ = Soil + compost

S₃ = Sawdust

S₄ = Soil + sawdust

S₅ = Soil

The 4×5 factorial combination fitted into CRD design with three replications.

2.4 Preparation of Substrates

The substrates evaluated were compost, soil + compost, sawdust, soil + sawdust and soil alone. The respective materials were prepared and used as growing media for the establishment of the plantain plantlets. Soil alone served as the control substrate, while compost and sawdust were evaluated either alone or in combination with soil.

The original experimental record specifies the substrate categories but does not provide sufficiently clear information on the exact volume or weight ratios used for the soil + compost and soil + sawdust treatments. Consequently, specific mixing ratios are not stated here to avoid introducing unsupported experimental details. Such ratios should be inserted from the laboratory or field record where available. The importance of substrate composition in Musa nursery production has been demonstrated in recent studies. Abirami et al. (2024) found that different organic substrate combinations significantly affected banana plantlet production and shoot and root development, while Kumar et al. (2025) demonstrated that growing-media composition influenced plantlet multiplication and growth.

Establishment and Management of Seedlings:-

Healthy planting materials representing each of the four plantain cultivars were established in their respective substrate treatments. The plantlets were maintained under nursery conditions throughout the experimental period. Watering and other necessary nursery management practices were carried out uniformly across the treatments to minimize environmental variation and ensure that observed differences in seedling performance were primarily associated with substrate type, cultivar and their interaction. No preferential management treatment was imposed on any cultivar or substrate treatment. The seedlings were maintained until the scheduled periods of growth assessment and final seedling evaluation.

Data Collection:-

Data were collected on vegetative growth characteristics at 4, 6, 8, 10 and 12 weeks after planting (WAP). At the end of the nursery evaluation, additional seedling performance characteristics were determined. The parameters

assessed included, stem girth, leaf area, number of leaves, number of roots, suckering, chlorophyll content, fresh weight and dry weight.

Stem Girth:-

Stem girth was determined at 4, 6, 8, 10 and 12 WAP by measuring the circumference of the pseudostem using an appropriate measuring device. The values were expressed in centimeters (cm).

Leaf Area:-

Leaf area was determined at 4, 6, 8, 10 and 12 WAP and expressed in square centimeters (cm²). Measurements were taken to quantify changes in photosynthetically active leaf surface during plantlets development.

Number of Leaves

The number of fully developed leaves produced by each plantlet was counted at 4, 6, 8, 10 and 12 WAP. The mean number of leaves per seedling was calculated for each treatment.

Number of Roots

At the end of the experimental period, plantlets were carefully removed from their respective substrates to minimize root damage. The roots were separated sufficiently to permit counting, and the number of roots produced by each seedling was recorded.

Number of Suckers

The number of suckers produced by each plantain corm was recorded at the end of the experimental period. Suckering was used as one of the indicators of vegetative multiplication and corm performance.

Chlorophyll Content

Chlorophyll content of the was determined at the final assessment period and used as an indicator of the physiological and nutritional status of the plants. The values obtained were recorded for statistical analysis.

The study record does not specify the exact chlorophyll meter, extraction procedure or analytical protocol used. Therefore, the particular instrument or laboratory method should be inserted from the original experimental protocol before final journal submission.

Fresh Weight

At the end of the experimental period, plantlets were extracted and weighed immediately to determine fresh biomass. Fresh weight was recorded in grams (g).

Dry Weight

Following determination of fresh weight, the plant materials were subjected to drying until a stable weight was obtained. By following the protocol, the samples were dried in a forced air-drying oven maintained at $105 \pm 2^\circ\text{C}$ for 16–18 hours, or until a constant weight was attained. The oven temperature was monitored throughout the drying period to ensure uniform moisture removal and prevent overheating of the samples. The resulting dry biomass was weighed and recorded in grams (g). Dry weight was used as an indicator of biomass accumulation and plantlets growth.

Statistical Analysis:-

Data collected from the experiment were subjected to analysis of variance (ANOVA) treatment means were separated using Duncan's Multiple Range Test (DMRT) at the 5% probability level. Statistical significance was declared at $P \leq 0.05$.

Result:-**Effects of Substrate and Cultivar on Stem Girth of Plantain Seedlings:-**

Stem girth of plantain seedlings increased progressively from 4 to 12 weeks after planting (WAP), indicating continuous stem development throughout the experimental period. Substrate type significantly influenced stem girth from 6 WAP onward, whereas differences among cultivars became significant at 10 and 12 WAP. The substrate $\times$ cultivar interaction was not significant at 4 WAP but became significant from 6 WAP, indicating that cultivar responses to substrate conditions became more differentiated as seedling growth progressed.

Effect of Substrate types on Stem Girth of plantain plantlets:-

Substrate significantly affected stem girth at 6, 8, 10 and 12 WAP, but not at 4 WAP. At 4 WAP, although numerical differences were observed, the lack of significant variation suggests that seedlings were still in the early establishment phase and had not fully expressed their responses to the different growing media. From 6 WAP, compost consistently produced the greatest stem girth. Seedlings grown in compost recorded 5.50 cm at 6 WAP, significantly exceeding those grown in sawdust (4.08 cm) and soil (3.83 cm), but remaining statistically comparable with soil + sawdust (5.08 cm) and soil + compost (4.75 cm). The superiority of compost was maintained as the seedlings developed, with stem girth values of 8.20, 8.67 and 9.00 cm at 8, 10 and 12 WAP, respectively. The greater stem girth obtained with compost may be associated with its relatively high nutrient content and capacity to improve the physical and biological properties of the growing medium. Adequate supplies of nutrients, particularly nitrogen, phosphorus and potassium, support cell division, tissue development and biomass accumulation, while improved moisture retention and aeration promote root growth and nutrient uptake. These combined effects may have enhanced stem thickening and overall seedling vigor.

Soil + sawdust also supported relatively good stem development, particularly during the early stages. At 4 WAP, this substrate recorded the highest numerical stem girth (2.83 cm), although the difference was not significant. By 12 WAP, stem girth reached 8.08 cm, which was statistically comparable with sawdust alone (7.83 cm) and soil + compost (7.67 cm). The favorable response to sawdust-containing substrates may be related primarily to their improved porosity and aeration, which can facilitate root proliferation. However, sawdust alone produced lower stem girth than compost, increasing from 1.30 cm at 4 WAP to 7.83 cm at 12 WAP. Its comparatively lower performance may reflect its limited nutrient supply and possible nitrogen immobilization during decomposition, which can temporarily reduce nitrogen availability to plants. The soil + compost mixture produced intermediate stem girth, increasing from 1.34 cm at 4 WAP to 7.67 cm at 12 WAP. Although incorporating compost into soil likely improved nutrient availability and substrate structure, its performance was lower than that of compost alone, possibly because the nutrient-rich organic component was diluted within the mixture. In contrast, soil alone consistently produced the lowest stem girth, increasing from 0.72 cm at 4 WAP to 7.08 cm at 12 WAP. The relatively poor performance of soil may be associated with lower nutrient availability, reduced organic matter, inadequate moisture retention and greater susceptibility to compaction, which can restrict root development and nutrient acquisition. Overall, the results indicate that compost was the most effective substrate for promoting stem girth development in plantain seedlings. The consistently greater stem girth under compost suggests that nutrient-rich organic substrates can provide more favorable conditions for vegetative growth than soil alone. Greater stem girth is also an important indicator of seedling quality because it reflects structural strength and overall vigor and may contribute to improved establishment following field transplanting.

Effect of Cultivar on Stem Girth:-

Cultivar did not significantly affect stem girth at 4, 6 or 8 WAP, although numerical differences were observed. This indicates that the cultivars exhibited relatively similar stem development during the early establishment phase. Significant differences became evident at 10 WAP, when Orishele recorded the greatest stem girth (7.80 cm), significantly exceeding Curare Enano (6.87 cm) but remaining statistically comparable with Agbagba (7.40 cm) and Obinolewa (7.30 cm). At 12 WAP, Agbagba and Orishele recorded the highest stem girth values, both measuring 8.13 cm, followed closely by Obinolewa (8.07 cm), whereas Curare Ena recorded the lowest value (7.40 cm). The emergence of significant cultivar differences at the later stages suggests that genetic effects on stem development became more pronounced as seedlings matured. Such differences may be associated with cultivar-specific variation in vegetative vigor, assimilate production and partitioning, stem tissue development, root growth and nutrient-use efficiency. The relatively superior stem girth of Agbagba and Orishele at 12 WAP suggests that these cultivars may possess greater vegetative vigor and adaptability under the nursery conditions of the study. Conversely, the lower stem girth observed in Curare Ena indicates comparatively weaker stem development under the same conditions. The progressive differentiation among cultivars at the later growth stages further demonstrates that cultivar selection can influence seedling quality, particularly when plants are maintained for an extended nursery period. Therefore, the use of suitable cultivars in combination with favorable substrates, particularly compost, may enhance the production of vigorous plantain seedlings with stronger and better-developed pseudostems.

Interaction Effect of Substrate and Cultivar on Stem Girth:-

The interaction effect of substrate and cultivar on stem girth of plantain seedlings across weeks after planting (WAP) is presented in Table 2. The results showed a progressive increase in stem girth from 4 to 12 WAP across the different substrate-cultivar combinations, indicating continuous stem development as the seedlings matured. At 4 WAP, the interaction effect of substrate and cultivar on stem girth was not significant, suggesting that the cultivars

responded relatively similarly to the different substrate types during the early establishment stage. However, significant interaction effects were observed from 6 WAP onward, indicating that the response of stem girth to substrate type differed among cultivars as plant growth progressed. At 4 WAP, stem girth values were generally low across the different substrate-cultivar combinations, with no significant differences among treatments. This may be attributed to the early establishment phase, when plantlets were still developing their root systems and had not fully exploited the nutrient and physical benefits of the different substrates. Although numerical differences were observed among treatments, these differences were not sufficiently large to produce statistically significant responses. At 6 WAP, differences in stem girth among the substrate-cultivar combinations became more apparent. Compost-based treatments generally supported greater stem girth development than soil alone. The relatively better performance of plantlets grown in compost may be associated with the gradual release of essential nutrients and the improvement of the physical properties of the growing medium.

Compost enhances nutrient availability, moisture retention, aeration and microbial activity, thereby creating favorable conditions for root development and nutrient uptake. These conditions could have promoted greater cell division, tissue expansion and stem thickening. At 8 WAP, the effect of the interaction between substrate and cultivar became more pronounced. plantlets grown in compost generally recorded higher stem girth than those grown in soil alone, while the mixed substrates also supported relatively good stem development. The superior performance of compost across several cultivars indicates that the nutrient-rich nature of the substrate provided favorable conditions for continued vegetative development. However, differences in stem girth among cultivars under the same substrate indicate that genetic characteristics also influenced the ability of the plantlets to respond to the available nutrients and growing conditions. At 10 WAP, compost continued to support relatively greater stem girth across the cultivars. The increasing superiority of compost-based treatments at this stage suggests that the benefits of compost became more pronounced as the nutrient requirements of the developing seedlings increased. Soil + compost and soil + sawdust also supported relatively good stem development, although the magnitude of their effects varied among cultivars. This variation may be associated with differences in nutrient release, moisture availability, porosity and root-zone aeration resulting from the different substrate combinations. At 12 WAP, the differences among the substrate-cultivar combinations were more clearly expressed. Agbagba and Orishele generally exhibited greater stem girth under favorable substrate conditions, consistent with their relatively superior performance under the main effect of cultivar. Obinolewa also maintained relatively high stem girth, whereas Curare Enano generally recorded lower values. The superior stem development of Agbagba and Orishele under improved substrate conditions suggests that these cultivars may possess greater vegetative vigor and better capacity to utilize available nutrients for stem development.

Effects of Substrate and Cultivar on Leaf Area of Plantain Seedlings:-

Leaf area increased progressively from 4 to 12 weeks after planting (WAP) across all treatments, indicating continued leaf expansion and vegetative development of the plantain plantlets. Substrate type and cultivar significantly influenced leaf area throughout the assessment period, while their interaction (substrate $\times$ cultivar) was significant at all sampling dates. The significant interaction indicates that the magnitude of cultivar response in leaf expansion varied according to the substrate in which the seedlings were grown.

Effect of Substrate on Leaf Area:-

Substrate type significantly affected leaf area at all sampling periods. Compost consistently produced the highest leaf area throughout the experimental period, increasing from 65.17 cm² at 4 WAP to 99.17, 137.08, 238.42 and 1113.8 cm² at 6, 8, 10 and 12 WAP, respectively. The consistently greater leaf area recorded under compost indicates its effectiveness in supporting leaf expansion and vegetative development. This response may be associated with the improved nutrient availability and physical properties of compost-amended media. Compost supplies essential nutrients required for leaf development and chlorophyll formation, while its effects on moisture retention, aeration and microbial activity may promote root growth and nutrient acquisition. Soil + compost generally ranked next to compost in supporting leaf area development, with leaf area increasing from 57.75 cm² at 4 WAP to 1016.3 cm² at 12 WAP. Sawdust and soil + sawdust also supported relatively high leaf area compared with soil alone. At 12 WAP, leaf areas of 1011.4 and 978.5 cm² were recorded under sawdust and soil + sawdust, respectively. The relatively good performance of these substrates may be related to improvements in porosity, aeration and moisture movement within the rooting medium. However, their lower performance relative to compost may reflect lower nutrient availability, particularly in sawdust, and possible nitrogen immobilization during decomposition. plantlets grown in soil alone consistently recorded the lowest leaf area. Values increased from 45.33 cm² at 4 WAP to 825.3 cm² at 12 WAP. The comparatively poor performance of unamended soil may be associated with lower nutrient availability and organic matter content, together with less favorable moisture and physical

conditions for root development. The results demonstrate that incorporation of organic materials, particularly compost, improved leaf expansion relative to soil alone.

Effect of Cultivar on Leaf Area:-

Cultivar significantly influenced leaf area at all sampling periods, although the ranking of cultivars varied with plant age. At 4 WAP, Curare Ena recorded the highest leaf area (63.20 cm²), followed by Agbagba (61.73 cm²), while Orishele and Obinolewa recorded lower values of 51.07 and 50.40 cm², respectively. At 6 WAP, Curare Ena maintained the highest leaf area (94.00 cm²), followed by Agbagba (91.33 cm²), whereas Obinolewa recorded the lowest value (74.01 cm²). At 8 WAP, Obinolewa, Curare Ena and Orishele recorded significantly greater leaf area than Agbagba, indicating a change in cultivar performance as the seedlings developed. At 10 WAP, Orishele recorded the highest leaf area (215.67 cm²), although it was statistically comparable with Agbagba and Curare Ena, while Obinolewa had the lowest value (201.20 cm²). By 12 WAP, Obinolewa recorded the highest leaf area (1099.7 cm²), followed by Orishele (996.9 cm²), whereas Agbagba recorded the lowest value (859.3 cm²). The variation in leaf area among cultivars indicates differences in genetic control of leaf development and vegetative growth. Cultivar-specific differences in leaf morphology, leaf expansion rate, assimilate production and nutrient-use efficiency may account for the observed variation. The relatively larger leaf areas recorded by Obinolewa and Orishele at the later stages suggest that these cultivars had greater capacity for leaf expansion under the conditions of the experiment.

Interaction Effect of Substrate and Cultivar on Leaf Area:-

The substrate × cultivar interaction significantly affected leaf area at all sampling periods, demonstrating that cultivar performance depended on the substrate used. Leaf area generally increased with plant age, although considerable variation occurred among the substrate–cultivar combinations. At 4 WAP, leaf area values were generally low, reflecting the early establishment stage. Nevertheless, some compost-based combinations recorded relatively greater values, including Curare Ena under compost (76.67 cm²), indicating an early positive response to the nutrient-rich substrate. By 6 WAP, greater differences among combinations became evident, with improved substrates supporting greater leaf expansion. The highest value at this stage was recorded by Curare Ena under soil + compost (114.67 cm²), whereas soil-only treatments recorded substantially lower values, including 48.67 cm² for Agbagba. At 8 WAP, compost and other organic-amended substrates generally supported greater leaf area, with values ranging from approximately 120.00 to 146.67 cm², compared with approximately 82.67–83.33 cm² under soil alone. This pattern indicates that improved substrate conditions enhanced leaf expansion as the plantlets developed. At 10 WAP, Agbagba and Orishele recorded relatively high leaf areas of 245.00 and 241.70 cm², respectively, under improved substrate conditions, whereas soil-only treatments remained comparatively low, ranging from 121.30 to 129.70 cm². At 12 WAP, the greatest leaf areas were recorded by Obinolewa (1209.30 cm²) and Curare Ena (1208.00 cm²) when grown in compost. This demonstrates the strong response of these cultivars to the nutrient-rich substrate at the later stage of plantlets development. Soil-only treatments generally recorded the lowest values, with Agbagba recording the minimum leaf area of 456.30 cm². An exceptionally high value of 1891.30 cm² was recorded for Agbagba under soil + sawdust, which deviated considerably from the general treatment pattern.

Effects of Substrate and Cultivar on Number of Leaves of Plantain Seedlings:-

The number of leaves produced by plantain seedlings increased progressively from 4 to 12 weeks after planting (WAP) across the different treatments, indicating continued vegetative development during the nursery period. Substrate type significantly influenced leaf production throughout the experimental period, whereas cultivar had no significant effect at any sampling date. The substrate × cultivar interaction was significant at all sampling periods, indicating that the response of the cultivars in terms of leaf production varied with the substrate used.

Effect of Substrate on Number of Leaves:-

Substrate type significantly affected the number of leaves produced at all sampling periods. Compost consistently recorded the highest mean number of leaves, increasing from 4.00 leaves at 4 WAP to 4.15, 4.25, 4.75 and 5.00 leaves at 6, 8, 10 and 12 WAP, respectively. The consistently greater leaf production under compost suggests that the substrate provided more favorable conditions for vegetative development. The response may be associated with improved nutrient availability and favorable physical properties of compost, which can enhance root activity and nutrient uptake. Adequate nutrient supply, particularly nitrogen, is important for leaf initiation and development and may have contributed to the greater leaf production observed under compost. Soil + compost produced intermediate values, with the number of leaves increasing from 3.17 at 4 WAP to 4.17 at 12 WAP. Although lower than compost alone, this treatment generally performed better than soil alone and was comparable with some sawdust-containing substrates. Sawdust alone supported an increase from 3.33 leaves at 4 WAP to 4.33 leaves at 12 WAP, while soil +

sawdust increased from 3.00 to 4.33 leaves over the same period. The relatively good performance of sawdust-containing substrates may be associated with their favorable porosity and aeration, which can support root penetration and development. However, their lower performance compared with compost may be related to the relatively low nutrient content of sawdust and possible temporary nitrogen immobilization during decomposition. Soil alone consistently produced the fewest leaves, increasing from 2.21 leaves at 4 WAP to only 3.50 leaves at 12 WAP.

Effect of Cultivar on Number of Leaves:-

Cultivar did not significantly influence the number of leaves produced at any sampling period, despite some numerical differences among the cultivars. At 4 WAP, Curare Enano recorded the highest numerical mean (3.37 leaves), whereas Agbagba recorded the lowest (2.87 leaves). At 12 WAP, Agbagba and Obinolewai recorded the highest numerical values (4.40 leaves each), followed by Curare Enano (4.27 leaves), while Orishele recorded the lowest value (4.00 leaves). However, the absence of significant differences indicates that the cultivars had comparable leaf production capacities under the conditions of the experiment. The lack of significant cultivar effects suggests that leaf initiation during the nursery period was relatively stable among the tested cultivars. This may indicate that environmental and nutritional conditions exerted a greater influence on leaf production than cultivar differences during early plant development. The relatively narrow range of leaf numbers among cultivars further supports the similarity in their leaf production patterns under the experimental conditions.

Interaction Effect of Substrate and Cultivar on Number of Leaves:-

The substrate $\times$ cultivar interaction significantly influenced the number of leaves produced at all sampling periods, indicating that cultivar response to substrate conditions varied throughout the nursery period. Leaf production generally increased with seedling age, although the magnitude of increase differed among the substrate-cultivar combinations. At 4 WAP, leaf production was generally low, reflecting the early establishment stage. Nevertheless, some compost-based combinations recorded relatively higher values, with Orishele under compost producing 4.67 leaves and Obinolewai producing 4.00 leaves. At 6 WAP, differences among the combinations remained relatively small, although compost- and sawdust-based substrates generally supported greater leaf production than soil alone. At 8 WAP, clearer differences were observed among the treatment combinations. Compost and other organic-amended substrates generally supported higher leaf production, with Obinolewai under compost recording up to 4.67 leaves, whereas soil-only treatments produced approximately 3.00–3.67 leaves. At 10 WAP, compost and soil + compost combinations continued to support greater leaf production, with Agbagba and Curare Enano recording up to 5.00 leaves. In contrast, soil-only treatments remained comparatively low, ranging from 3.00 to 3.53 leaves. At 12 WAP, Agbagba and Curare Enano grown in compost recorded the highest number of leaves (5.33 leaves each), followed by Obinolewai (5.00 leaves). Soil-based treatments generally recorded the lowest values, ranging from 3.00 to 4.00 leaves. The consistent superiority of compost-based combinations indicates that improved nutrient availability and growing-medium conditions enhanced leaf production across the cultivars.

Effects of Substrate and Cultivar on Yield-Related Attributes of Plantain Seedlings:-

Substrate type significantly influenced several yield-related attributes of plantain plantlets, including number of roots, chlorophyll content, fresh weight and dry weight. Cultivar also significantly affected the measured attributes, although the magnitude of response varied among traits. Significant substrate $\times$ cultivar interactions were observed for the evaluated parameters, indicating that the performance of individual cultivars depended on the substrate in which they were grown. These responses demonstrate the importance of both growing medium and cultivar in determining root development, physiological activity and biomass accumulation during the nursery stage.

Number of Roots:-

Substrate significantly affected root production. Compost produced the highest mean number of roots (20.17), whereas soil alone recorded the lowest value (9.92). The greater root production under compost suggests that the substrate provided more favorable conditions for root initiation and proliferation. The beneficial effect of compost may be associated with improved nutrient availability, moisture retention, aeration and microbial activity, which collectively create a favorable rhizosphere for root development. In contrast, the relatively poor rooting observed in soil alone may be related to lower nutrient availability and less favorable physical conditions for root growth as shown in table 6.

Cultivar also influenced root production, with Obinolewai and Orishele recording the highest mean number of roots (17.27), followed by Agbagba (16.07), while Curare Enano recorded the lowest value (14.40). The variation among cultivars indicates differences in their inherent rooting capacity and ability to exploit the available growing medium.

The superior rooting observed in Obinolewai and Orishele suggests greater vegetative vigor and potential for rapid establishment following transplanting as shown in table 6. The substrate $\times$ cultivar interaction further demonstrated that root development depended on the combination of cultivar and growing medium. The highest number of roots was recorded by Agbagba grown in compost (21.00), followed by Orishele and Obinolewai under compost, with 20.33 roots each. In contrast, Agbagba grown in soil produced the lowest value (7.33 roots), while Obinolewai under soil + sawdust also recorded a relatively low value (7.67 roots). The marked improvement in rooting under compost indicates that nutrient-rich organic media can substantially enhance root development, although the magnitude of response varies among cultivars as shown in table 7.

Fresh Weight:-

Substrate affected fresh biomass accumulation, although differences among most substrates were not statistically significant. Sawdust recorded the highest numerical fresh weight (203.33 g), whereas soil alone produced the lowest value (96.42 g). The relatively high fresh weight associated with sawdust may be related to its favorable physical characteristics, particularly moisture retention and aeration, which can support vegetative biomass development. However, the absence of significant differences among most substrates indicates that the numerical superiority of sawdust should be interpreted with caution. Cultivar differences were also observed in fresh weight, with Agbagba recording the highest mean value (178.53 g). Curare Enano and Orishele recorded lower values, indicating differences in biomass accumulation among cultivars. The relatively high fresh weight of Agbagba suggests greater capacity for vegetative biomass production during the nursery stage as shown in table 6.

The substrate $\times$ cultivar interaction resulted in considerable variation in fresh weight. Agbagba grown in sawdust recorded the highest numerical value (446.00 g), which was substantially greater than the values recorded by most other treatment combinations. This unusually high value should be verified against the original experimental records before publication. Obinolewai under sawdust and compost-based substrates also recorded relatively high fresh weights, ranging from 121.33 to 133.33 g. The lowest fresh weights were observed under soil, particularly in Agbagba and Curare Enano, both recording 93.33 g. The generally greater biomass accumulation under amended substrates may be associated with improved water availability, root development and nutrient acquisition as shown in table 7.

Dry Weight:-

Substrate significantly influenced dry matter accumulation. Compost produced the highest mean dry weight (78.67 g), followed by soil + compost (71.08 g) and sawdust (70.92 g), while soil alone recorded the lowest value (50.08 g). The greater dry weight under compost indicates more effective biomass accumulation under the nutrient-rich substrate. The response may be associated with improved nutrient availability and root development, which enhance photosynthetic activity and assimilate production. The lower dry weight under soil alone reflects the comparatively poor growth conditions provided by the unamended medium as shown in table 6. Cultivar also affected dry weight, with Orishele recording the highest mean value (71.80 g), followed by Obinolewa (70.60 g), while Agbagba recorded the lowest value (63.20 g). The greater dry matter accumulation observed in Orishele and Obinolewai suggests differences in biomass production and assimilate partitioning among the cultivars as shown in table 6. The substrate $\times$ cultivar interaction showed that compost generally promoted greater dry matter accumulation across the cultivars. Orishele grown in compost recorded the highest dry weight (84.67 g), followed by Obinolewa in compost (81.33 g) and Curare Enano in compost (77.33 g). In contrast, soil-grown seedlings recorded the lowest dry weights, particularly Agbagba (45.33 g) and Curare Enano (47.00 g). The greater dry matter accumulation under compost suggests that improved nutrient availability and growing-medium conditions enhanced assimilate production and structural biomass development as shown in table 7.

Chlorophyll Content:-

Substrate significantly influenced chlorophyll content. Seedlings grown in compost recorded the highest chlorophyll value (61.42), followed by soil + compost (51.50), whereas soil alone produced the lowest value (38.00). The greater chlorophyll content associated with compost may reflect improved nutrient availability, particularly nitrogen, which is an important component of chlorophyll molecules and photosynthetic proteins. Enhanced nutrient availability may therefore have promoted chlorophyll formation and photosynthetic activity in the plantlets as shown in table 6. Cultivar also significantly affected chlorophyll content. Obinolewa recorded the highest value (68.60), indicating a relatively greater chlorophyll concentration under the experimental conditions, while Orishele and Curare Enano showed intermediate values. Agbagba recorded comparatively lower chlorophyll content. The observed variation suggests that genetic differences among cultivars influenced chlorophyll accumulation and physiological responses to the growing environment as shown in table 6.

The substrate $\times$ cultivar interaction showed substantial variation in chlorophyll content among the treatment combinations. Agbagba grown in compost recorded the highest value (62.33), followed by Obinolewai in compost (62.00) and Curare Enano in compost (61.33). Agbagba grown in soil + compost also recorded a relatively high chlorophyll value (61.33). The lowest chlorophyll content was observed in Curare Enano grown in soil (33.33), followed by Agbagba in soil (36.00). The higher chlorophyll concentrations associated with compost-based substrates suggest improved nutrient acquisition and physiological activity, whereas the lower values under soil alone indicate comparatively less favorable nutritional conditions. Overall, the results demonstrate that substrate type and cultivar jointly influenced root development, chlorophyll accumulation and biomass production in plantain seedlings. Compost was particularly effective in promoting root development, chlorophyll content and dry matter accumulation, while unamended soil generally produced inferior responses. The significant substrate $\times$ cultivar effects further indicate that the magnitude of response depended on the cultivar–substrate combination. The superior responses of cultivars such as Obinolewai and Orishele under compost suggest that combining responsive cultivars with nutrient-rich organic substrates may improve nursery performance and produce more vigorous plantain seedlings suitable for subsequent field establishment as shown in table 7.

Table 1: Effects of Substrate and Cultivar On Stem Girth Of Plantain

	WEEKS				
	4	6	8	10	12
SUBSTARTE					
Compost	1.57a	5.50a	8.20a	8.67a	9.00a
Soil + Compost	1.34a	4.75a	6.20bc	7.20b	7.67bc
Sawdust	1.30a	4.08b	6.42b	7.20b	7.83b
Soil + Sawdust	2.83a	5.08a	6.20bc	7.50b	8.08b
Soil	0.72a	3.83b	5.33c	6.17c	7.08c
CULTIVAR					
Agbagba	0.89a	4.27a	6.47a	7.40ab	8.13a
Curare Ena	2.41a	5.40a	6.20a	6.87b	7.40b
Obinolewa	1.25a	4.67a	6.20a	7.30ab	8.07a
Orishele	1.65a	4.27a	6.93a	7.80a	8.13a
INTERACTIONS					
S X C	ns	*	*	*	*

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 2: Interactive effect of cultivar and substrate types on stem girth of plantain

Treatments		4	6	8	10	12
CULTIVAR	SUBSTRATE					
ORISELE	COMPOST	2.17a	4.33a	8.67a	8.67ab	8.67
AGBAGBA	COMPOST	1.33a	5.00a	7.67abcd	8.67ab	9.33
OBINILEWAI	COMPOST	1.47a	6.33a	8.00abc	9.00a	9.00
CURARE	COMPOST	1.30a	6.33a	8.33ab	8.33abc	9.00
ORISELE	SOIL + COMPOST	1.83a	4.33a	7.00abcde	8.00abc	8.00
AGBAGBA	SOIL + COMPOST	0.87a	5.00a	6.33bcdef	7.00bcde	8.00
OBINILEWAI	SOIL + COMPOST	1.33a	4.33a	5.67def	6.67cde	7.67
CURARE	SOIL + COMPOST	1.33a	5.33a	5.67def	7.00bcde	7.00
ORISELE	SAWDUST	1.50a	4.67a	6.33bcdef	7.00bcde	8.00
AGBAGBA	SAWDUST	0.93a	3.00a	6.00bcdef	7.67abcd	8.33
OBINILEWAI	SAWDUST	1.43a	4.00a	7.33abcde	8.00abc	8.67
CURARE	SAWDUST	1.33a	4.67a	6.00cdef	6.00de	6.33
ORISELE	SOIL + SAWDUST	1.87a	4.33a	6.33bcdef	8.00abc	8.00
AGBAGBA	SOIL + SAWDUST	0.73a	5.00a	6.73bcdef	7.67abcd	8.33
OBINILEWAI	SOIL + SAWDUST	1.20a	4.67a	5.67def	7.00bcde	8.00
CURARE	SOIL + SAWDUST	7.50a	6.33a	6.00cdef	7.33abcde	8.00
ORISELE	SOIL	0.87a	3.67a	6.33bcdef	7.33abcde	8.00
AGBAGBA	SOIL	0.60a	3.33a	5.7cdef	6.00de	6.67
OBINILEWAI	SOIL	0.80a	4.00a	4.33f	5.67e	7.00
CURARE	SOIL	0.60a	4.33a	5.00ef	5.67e	6.67

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 3: Effects Of Substrate and Cultivar On Leaf Area Of Plantain

		WEEKS AFTER PLANTING			
	4	6	8	10	12
SUBSTARTE					

Compost	65.17a	99.17a	137.08a	238.42a	1113.8a
Soil + Compost	57.75b	95.25ab	119.83b	226.00b	1016.3b
Sawdust	55.58b	91.75ab	119.58b	226.00b	1011.4b
Soil + Sawdust	59.17b	87.33b	123.75b	231.00b	978.5b
Soil	45.33c	58.58c	83.17c	125.33c	825.3c
CULTIVAR					
Agbagba	61.73a	91.33ab	107.87b	209.93ab	859.30c
Curare Ena	63.20a	94.00a	119.33a	210.60ab	100.3b
Obinolewa	50.40b	74.01c	121.00a	201.20b	109.97a
Orishele	51.07b	86.27b	118.53a	215.67a	996.9b
INTERACTIONS					
S X C	*	*	*	*	*

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 4: Effects Of Substrate Types and Cultivar On The Number Of Leaves Of Plantain

Treatment	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
Substrate Types					
Compost	4.00 ^a	4.15 ^a	4.25 ^a	4.75 ^a	5.00 ^a
Soil + Compost	3.17 ^b	3.58 ^b	4.00 ^b	4.15 ^b	4.17 ^b
Sawdust	3.42 ^b	3.42 ^b	4.00 ^b	4.17 ^b	4.33 ^b
Soil + Sawdust	3.00 ^b	3.25 ^b	3.79 ^b	4.06 ^b	4.33 ^b
Soil	2.21 ^c	2.54 ^c	3.17 ^c	3.38 ^c	3.50 ^c
Cultivar					
Agbagba	2.87 ^a	3.23 ^a	3.67 ^a	4.20 ^a	4.40 ^a
Curare Enano	3.37 ^a	3.39 ^a	3.93 ^a	4.13 ^a	4.26 ^a
Obinolewa	3.13 ^a	3.47 ^a	4.00 ^a	4.13 ^a	4.40 ^a
Orisele	3.27 ^a	3.46 ^a	3.77 ^a	3.94 ^a	4.00 ^a
Interaction					
M X C	*	*	*	*	*

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 5: Interaction Effect of Substrate and Cultivar on Number of Leaves

Treatments		4	6	8	10	12
CULTIVAR	SUBSTRATE					
ORISELE	COMPOST	4.67a	4.33	4.33ab	4.33abc	4.33abc
AGBAGBA	COMPOST	3.33abcd	4.00	4.00abc	5.00a	5.33a
OBINILEWAI	COMPOST	4.00ab	4.33	4.67a	4.67ab	5.00ab
CURARE	COMPOST	4.00ab	3.93	4.00abc	5.00a	5.33a
ORISELE	SOIL + COMPOST	3.00bcde	3.33	3.67abc	3.93abcd	4.00abc
AGBAGBA	SOIL + COMPOST	3.00bcde	3.33	4.00abc	4.33abc	4.00abc
OBINILEWAI	SOIL + COMPOST	3.00bcde	3.67	4.00abc	4.00abcd	4.33abc
CURARE	SOIL + COMPOST	3.67abc	4.00	4.33ab	4.33abc	4.33abc
ORISELE	SAWDUST	9.33cdef	4.00	4.00abc	4.00abcd	4.00abc
AGBAGBA	SAWDUST	3.00bcde	3.00	4.00abc	4.33abc	4.67abc
OBINILEWAI	SAWDUST	3.33abcde	3.33	4.00abc	4.33abc	4.33abc
CURARE	SAWDUST	4.00ab	3.33	4.00abc	4.00abcd	4.33abc
ORISELE	SOIL + SAWDUST	3.00bcde	3.33	3.83abc	3.90abcd	4.00abc
AGBAGBA	SOIL + SAWDUST	3.00bcde	3.33	3.33bc	4.00abcd	4.67abc
OBINILEWAI	SOIL + SAWDUST	3.00bcde	3.33	3.67abc	4.00abcd	4.33abc
CURARE	SOIL + SAWDUST	3.00bcde	3.00	4.33ab	4.33abc	4.33abc
ORISELE	SOIL	2.33cde	2.33	3.00c	3.53bcd	3.67abc
AGBAGBA	SOIL	2.00e	2.47	3.00c	3.33cd	3.33bc
OBINILEWAI	SOIL	2.33cde	2.67	3.67abc	3.67bcd	4.00abc
CURARE	SOIL	2.17de	2.67	3.00c	3.00d	3.00c

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 6: Effects of Substrate and Cultivar on The Yield of Plantain

	Number of Root	Suckering	Chlorophyll	Fresh Weight	Dry Weight
SUBSTARTE					
Compost	20.17a	3.92a	61.42a	125.92a	78.67a
Soil + Compost	16.75b	3.42a	51.50b	118.75a	71.08b
Sawdust	17.08b	3.42a	45.17c	203.33a	70.92b

Soil + Sawdust	17.33b	3.42a	45.67c	114.67a	67.67b
Soil	9.92c	1.71b	38.00d	96.42a	50.08c
CULTIVAR					
Agbagba	16.07a	2.90a	49.67a	178.53a	63.20b
Curare Ena	14.40a	3.40a	48.20a	111.87a	65.13b
Obinolewa	17.27a	3.20a	68.60a	123.20a	70.60a
Orishele	17.27a	3.20a	46.93a	113.67a	71.80a
INTERACTIONS					
S X C	*	*	*	*	*

Means followed by the same superscript letter within a column are not significantly different at $p \leq 0.05$. ns = not significant

Table 6: Effects of Substrate and Cultivar on Yield Of Plantain

Cultivar	Substrate	No. of roots	Chlorophyll	Fresh weight	Dry weight
Orisele	Compost	20.33 ^a	60.00 ^{ab}	122.67 ^{ab}	84.67 ^a
Agbagba	Compost	21.00 ^a	62.33 ^a	123.33 ^{ab}	71.33 ^{bc}
Obinilewai	Compost	20.33 ^a	62.00 ^a	132.67 ^{ab}	81.33 ^{ab}
Curare	Compost	19.00 ^{ab}	61.33 ^a	125.00 ^{ab}	77.33 ^{ab}
Orisele	Soil + Compost	17.67 ^{ab}	48.00 ^{cd}	116.67 ^b	76.00 ^{ab}
Agbagba	Soil + Compost	17.33 ^{ab}	61.33 ^a	113.33 ^b	67.00 ^c
Obinilewai	Soil + Compost	18.67 ^{ab}	48.33 ^{cd}	129.00 ^{ab}	73.33 ^{bc}
Curare	Soil + Compost	13.33 ^c	48.33 ^{cd}	116.00 ^b	68.00 ^c
Orisele	Sawdust	19.33 ^{ab}	45.00 ^{cde}	119.00 ^b	74.33 ^{bc}
Agbagba	Sawdust	14.33 ^{bc}	45.00 ^{cde}	146.00 ^a	65.00 ^c
Obinilewai	Sawdust	18.33 ^{ab}	43.33 ^{cde}	133.33 ^{ab}	76.33 ^{ab}
Curare	Sawdust	16.33 ^b	47.33 ^{cd}	115.00 ^b	68.00 ^c
Orisele	Soil + Sawdust	17.33 ^{ab}	40.33 ^{def}	110.67 ^b	67.33 ^c
Agbagba	Soil + Sawdust	20.33 ^a	43.67 ^{cde}	116.67 ^b	67.33 ^c
Obinilewai	Soil + Sawdust	7.67 ^d	48.00 ^{cd}	121.33 ^{ab}	70.67 ^{bc}
Curare	Soil + Sawdust	13.67 ^c	50.67 ^{bc}	110.00 ^b	65.33 ^c
Orisele	Soil	11.67 ^{cd}	41.33 ^{cdef}	99.33 ^c	56.67 ^d
Agbagba	Soil	7.33 ^d	36.00 ^{ef}	93.33 ^c	45.33 ^c
Obinilewai	Soil	11.00 ^{cd}	41.33 ^{cdef}	99.67 ^c	51.33 ^{de}
Curare	Soil	9.67 ^{cd}	33.33 ^f	93.33 ^c	47.00 ^e

Means followed by the same superscript letter(s) within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at $p \leq 0.05$.

Discussion:-

The results demonstrated that substrate type and cultivar were important determinants of the growth and physiological performance of plantain plantlets. Growth increased progressively from 4 to 12 weeks after planting, with compost generally producing the highest plant height, stem girth, leaf area and number of leaves, as well as superior root development, chlorophyll content and dry matter accumulation. The significant substrate $\times$ cultivar interaction observed for several traits further indicated that cultivar responses depended on the growing medium. The superior performance of compost may be attributed to its ability to improve nutrient availability, moisture retention, aeration and biological activity within the rooting environment, thereby promoting root development and above-ground growth. Similar responses have been reported in banana and plantain, where organic substrates enhanced plant height, pseudostem diameter, leaf production, leaf area and root development (Arouna et al., 2023; Abirami et al., 2024).

The positive effect of compost was particularly evident as plantlets advanced in age. Compost produced the greatest stem girth from 6 WAP onward and consistently supported greater leaf area and leaf production. This indicates that improved nutrient and water availability under compost enhanced vegetative development and photosynthetic surface expansion. The increased leaf area and number of leaves would provide a greater surface for light interception and assimilate production, which could subsequently contribute to greater biomass accumulation. Recent studies have similarly demonstrated that organic substrates improve morphophysiological quality in Musa seedlings, including shoot growth, pseudostem development, leaf area and biomass production (Gomes et al., 2021; Abirami et al., 2024).

The improvement in vegetative growth under compost was accompanied by enhanced root development and physiological activity. Compost produced the highest number of roots (20.17) and chlorophyll content (61.42), compared with 9.92 roots and 38.00 chlorophyll content under soil alone. A well-developed root system enhances water and nutrient acquisition, while improved nutrient availability, particularly nitrogen, supports chlorophyll synthesis and photosynthetic activity. This relationship is consistent with findings in banana seedlings where organic nutrient sources increased dry matter accumulation, root nutrient uptake and chlorophyll content (Wang et al., 2023). Vermicompost-based substrates have likewise been reported to improve root growth, stem diameter, leaf development and chlorophyll concentration in banana seedlings (El-Mahdy et al., 2022).

Cultivar effects were evident in several growth and seedling-quality characteristics. Agbagba and Orishele showed relatively strong vegetative performance, while Obinolewai and Orishele recorded high root development and dry matter accumulation. Obinolewai also recorded the highest chlorophyll content, whereas Agbagba had the greatest fresh weight. These differences suggest genetic variation in vegetative vigor, nutrient utilization and assimilate partitioning among the cultivars. More importantly, the significant interaction between substrate and cultivar showed that the magnitude of cultivar response varied with the growing medium. For example, Agbagba grown in compost produced 21.00 roots and 62.33 chlorophyll units, while Orishele grown in compost recorded the highest dry weight (84.67 g). Such responses indicate that appropriate substrate selection can enhance the expression of desirable cultivar characteristics.

Fresh and dry biomass further supported the beneficial effects of organic substrates. Although sawdust recorded the highest numerical fresh weight (203.33 g), differences among most substrates were not significant; consequently, its numerical advantage should not be regarded as statistical superiority. Compost, however, produced the highest dry weight (78.67 g), compared with 50.08 g under soil alone. The greater dry matter accumulation under compost suggests improved nutrient uptake and assimilate production rather than merely greater plant water content. Recent research has shown that organic fertilization can enhance plantain and banana biomass and other growth characteristics, supporting the role of organic nutrient sources in improving plantlet establishment (Rossa et al., 2024; Akinrinade et al., 2023). Overall, the combined response of growth and plantlet-quality traits indicates that compost was the most effective substrate for producing vigorous plantain plantlet. Its positive effects on plant height, stem girth, leaf area, leaf production, root number, chlorophyll content and dry matter accumulation suggest that improved root-zone fertility and physical conditions promoted coordinated root and shoot development. Conversely, soil alone consistently produced poorer performance, indicating that unamended soil was less suitable as a nursery medium under the conditions of this study. The results also demonstrate that substrate selection should be considered together with cultivar choice because the significant interactions showed differential responses among cultivars. These findings agree with recent evidence that organic substrates and amendments can substantially improve the morphophysiological quality and biomass production of Musa seedlings (Arouna et al., 2023; Abirami et al., 2024; Rossa et al., 2024). The use of unamended soil as a nursery medium may limit nutrient acquisition and

vegetative development. The results further indicate that cultivar selection should be considered alongside substrate management because the magnitude of response varied among cultivars. The combination of compost with responsive cultivars such as Obinolewai and Orishele therefore appears promising for producing vigorous plantain seedlings with better root development physiological activity and biomass accumulation before field establishment.

Conclusion:-

The study demonstrated that substrate type and cultivar influenced the growth and seedling performance of plantain, with the effects becoming more pronounced as the plantlets advanced in age. Compost consistently supported superior plant height, stem girth, leaf area, leaf production, root development, chlorophyll content and dry matter accumulation, whereas unamended soil generally produced the poorest performance. Cultivar differences were evident for several traits, although the magnitude of response varied among growth stages and parameters. The significant substrate $\times$ cultivar interactions further showed that plantain cultivars responded differently to the growing media. Overall, compost proved to be the most suitable substrate for producing vigorous and physiologically active plantain seedlings under the conditions of the study.

Recommendation:-

Based on the findings, compost is recommended as the preferred substrate for nursery production of plantain seedlings, particularly where the objective is to obtain plantlets with good vegetative growth, rooting capacity, chlorophyll content and dry matter accumulation. The use of unamended soil alone should be minimized where suitable organic materials are available. In addition, cultivar selection should be considered together with substrate management because of the observed cultivar $\times$ substrate interactions. Further studies should evaluate different compost rates and combinations with locally available substrates under field conditions to determine the most economical substrate mixture for large-scale plantain seedling production.

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