INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 26, No. 4, p. 1-12, 2025

RESEARCH PAPER OPEN ACCESS

# Coelomic Vermi-Fluid Influenced Shoot Generation and Development of Macro-Sectioned Lakatan Banana *(Musa acuminate* Colla) Corms

**Marites P. Pedroso[1], Junito P. Marcelino[*2]**

[1]*South East Asian Institute of Technology, Tupi, South Cotabato, 9505, Philippines*

[2]*College of Agriculture, Sultan Kudarat State University, ACCESS, EJC Montilla, 9800, Philippines*

**Key words:** *Musa acuminate*, Macro-section, Coelomic, Corms, Macro propagation

http://dx.doi.org/10.12692/ijb/26.4.1-12 Article published on April 03, 2025

## Abstract

Global banana demand faces challenges due to slow regeneration and disease-free read to plant material, which macro propagation using coelomic vermi-fluid can help boost small-scale farmers. Hence, to hasten shoot generation in lakatan banana using corm bits, this experiment was conducted to find out the effect of coelomic vermi fluid on the shoot generation and development of macro-sectioned banana corm. This was laid out in a 4x2 factorial experiment arranged in a Complete Randomized Design (Factorial in CRD) with three replications. Treatments were varying levels of coelomic vermi-fluid as factor A and varying application frequencies as factor B. The treatments were as follows: $A_1$- 50% coelomic vermin fluid + 50 % water, $A_2$- 75% coelomic vermin fluid + 25 % water, $A_3$-100% coelomic vermin fluid, $A_4$ – Synthetic Growth hormone (ANAA).Result showed that the application of coelomic vermi-fluid at macro-sectioned lakatan banana corms with 100% survival rate. The coelomic vermi-fluid significantly influenced the macro-sectioned lakatan banana corms in terms of number of shoot, number of leaves, number of roots, plant height, length of roots and stem girth. However, there was no significant interaction effect between varying levels of coelomic vermi fluid and varying frequencies of application. The application of 100% coelomic vermi-fluid boosted the growth of macro-sectioned lakatan banana in terms of survival rate, plant height, number of shoot, number of roots, length of roots, number of leaves, and stem girth.

* **Corresponding Author:** Junito P. Marcelino ✉junitomarcelino@gmail.com

## Introduction

Banana is the fourth most important fruit crop in the world (Saha *et al.,* 2010).Global banana production and trade will continue to grow steadily, with production, import and export volumes projected to reach approximately 160 million tons by 2030, representing a 33% increase over 2020 levels ( ZOU *et al.*, 2022). They also insisted that the banana industry faces challenges such as climate change, banana wilt, and soil acidification. To achieve sustainable development, improve quality and safety, and ensure global food security, producing disease-resistant, high-yield banana varieties, affordable and accessible planting materials, and utilizing high-quality production technologies are essential.

Banana crops are sterile and parthenocarpic (Heslop-Harrison and Schwarzacher, 2007), resulting in slow propagation and often an inadequate supply of suckers of desired varieties (Kasyoka *et al.*, 2010). Tissue-cultured banana plants, after repeated sub-culturing, can exhibit soma-clonal variation, potentially reducing their adaptability (Sahijram *et al.*, 2003). Furthermore, tissue cultures also present challenges. It is expensive due to the specialized equipment and expertise required. The process is complex and requires high level of skill and sterile condition to prevent contamination, and creates clones vulnerable to diseases (Bandewar *et al.*, 2017). Macro propagation is a form of production that lies somewhere between tissue culture and traditional systems of sucker production (Lorenzo, 2008). Macro propagation offers a lower-cost and simpler setup compared to tissue culture, making it well-suited for on-farm use. In vivo macro propagation provides a method for mass producing banana planting material under natural conditions (Patel and Rath, 2018). This technique is simpler, less expensive, and produces pest-free, genetically identical plantlets more quickly than in vitro methods (Kindimba *et al.*, 2014).

Coelomic fluid, found in the coelom of earthworms, contains diverse enzymes (proteases, amylases, phosphatases), hormones (auxin, cytokines), and essential nutrients (calcium, magnesium, chlorine, chelate, copper, phosphorus, and sodium) crucial for plant growth and disease resistance (Packilakshmi and Mahalakshmi, 2011). This fluid, along with earthworm excretory substances and mucus secretions (Ansari and Sukhraj, 2010), humic acid present in the soil, and organic waste materials, provides readily absorbable nutrients for plant tissues (Nath and Singh, 2012). Coelomic fluid contains a variety of beneficial components for soil health, including hormones such as cytokines and auxin, macronutrients, amino acids, vitamins, and enzyme cocktails of proteases, amylases, urease, and phosphatase (Tripathi *et al.*, 2005).

Thus, this study was conducted to ascertain the effect of coelomic vermi-fluids on the shoot generation and development of macro-sectioned banana lakatan corms.

## Materials and methods

*Preparation and macro sectioning of banana corm*

A healthy sword sucker of banana (Musa acuminate Colla) was collected (Figure 1A). The stem was cut off from the suckers. Roots were removed from a harvested corm. The sheaths were removed one by one with a sharp knife, 2 mm above the corm and at the leaf base.

This process exposed all the buds and/or the meristem. Exposed buds on top were scarified. The corm was divided into ten (10) bits (Figure1B) and planted in the plot with decomposed coco coir as the growing medium for buds to sprout . The prepared material was air-dried for 24 hours.

*Nursery Preparation*

The upper part of the nursery structure had covers that provided protection from heavy rain and sun. Inside was a rooting chamber that housed the macro-sectioned banana bulbs that were used in the study. All plots were covered with vacuum-sealed plastic cellophane for four (4) months (Figure 1E). Vacuum can potentially stimulate cell expansion in macro-sections of the plant by creating a more controlled

environment for cell growth. Vacuum can help regulate the pressure gradient within cells, promoting efficient water uptake and turgor pressure, which were essential for cell elongation (Kaiser and Scheuring, 2020). The size of the enclosure was designed to contain twenty-four plots, each measuring 1m x 1m. The main support poles for the construction of the huts, which were nine meters high, were bamboo poles. Garden soil and decomposed coconut coir purchased in Tupi, South Cotabato were used as growing media. Coco coir exhibited very high air content together with low easily-available water holding capacity (Noguera *et al.*, 2000) (Figure 1D).

*Collection of Coelomic Vermi Fluid*

African night crawlers (*Eudrilus eugeniae*) were collected and subjected to cold shock (Figure 1C). One kilogram of worms was immersed in one liter of cold distilled water for approximately 30 minutes to induce the cold shock. This treatment caused the release of coelomic fluid through the dorsal pores. Nadana *et al.* (2020) reported that cold-treated coelomic fluid (CF) from earthworms enhanced seed germination and growth parameters of *Vigna radiata* compared to CF collected through normal or warm treatments.

*Dilution of Coelomic Fluid with Water ($H_2O$)*

Collected coelomic vermi fluid was diluted on water base on the varying level in treatment factor: $A_1$ 50% coelomic vermin fluid + 50 % water; $A_2$- 75% coelomic vermin fluid + 25 % water; $A_3$-100% coelomic vermin fluid.

*Planting of Macro Sectioned Banana Corms*

Macro sectioned banana corm bits was planted individually. Corms were planted at a depth of 20 cm, at a spacing of 5 cm x 20 cm and covered with up to a 5 cm thick layer of growing medium Ntamwira *et al.* (2007).

*Application of Coelomic Vermi Fluid*

Coelomic vermi-fluids, usually applied as a foliar spray, provide nutrients effectively and rapidly (Nayak *et al.*, 2019).Banana corm bits were sprayed once a week (Factor $B_1$) and twice a week (Factor $B_2$) as specified to provide the needed for the shoot generation and development. The amount of solution as treatments was applied on the plots by the use of sprayer enough to evenly wet the entire plot. This was done one week after planting.

*Maintenance of Seedlings*

Keep the seedling healthy by avoiding overwatering and weeding regularly. Furthermore, to guarantee the health of the seedlings, frequent inspections and the removal of young weeds will be carried out (United States Department of Agriculture 2019)

*Evaluation of Percentage of survival.*

Percent survival was calculated by dividing the number of dead seedlings by the total number of transplanted seedlings and then multiplying the result by 100. The average data from five samples for each treatment served as the basis for this computation. The formula is expressed below (Gortari *et al.*, 2019):

$$\text{Survival Rate} = \frac{\text{number of dead corms}}{\text{number of corms planted}} \times 100$$

*Number of Shoot Evaluation*

Number of shoot was obtained by counting the shoot generates per bits planted per plot. The average data from samples for each treatment will serve as the basis for computation (Lepoint *et al.*, 2013).

*Number of Leaves per Shoot Evaluation*

Number of leaves per shoot was determined by physically counting every visible leaf including those newly emerged leaves on each shoots.

The average data from samples for each treatment will serve as the basis for this computation (Lepoint *et al.*, 2013).

*Number of Roots Evaluation*

The total number of roots for each shoot was recorded. Data from samples for each treatment will be the basis for this computation (Ntawira *et al.*, 2019).

*Evaluation of Plant Height (cm), Length of Roots (cm) and Stem Girth (cm)*

The plant height was measured using meter stick from the base of the plant to the tip of the highest leaf (Perez-Harguindeguy *et al.*, 2013).The root length of each shoot was calculated by measuring from the base to the tip of the most dominant root (Ntawira *et al.*, 2019).The stems of the ten sample plants were marked approximately 10 cm above ground level. The marked sections were measured using a caliper. Data was collected and recorded after the measurements (Patil *et al.*, 2010).

*Statistical Analysis*

Data gathered were analyzed using Completely Randomized Design (CRD). Test for significant differences among treatment means, subjected to the Tukey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant. (Gomez *et. al.*, 1984).

**Results and Discussion**

*Percentage of survival (%)*

Table 1 shows the percentage of survival of the macro-sectioned banana corm as influenced by different levels of coelomic vermi-fluid. Results shows that macro-sectioned banana corms applied with different levels of coelomic vermi-fluid have a 100% survival rate regardless of the frequency of application.

This conforms to the findings of Nadana *et al.* (2019), who noted that seedlings applied with different CVFs were examined for their biological properties, including microstructure, total phenolics, and antioxidants, to determine the role of compounds in triggering the seed germination process. By enhancing the germination and survival rates of crop plants grown on nutrition-depleted soils, it can pave the way for sustainable agriculture through organic farming practices (Fathima and Sekar, 2014).

**Table 1.** Percentage of Survival of Macro Sectioned Banana Corm.

| Factor A: Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor B Mean $^{ns}$ |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 100 | 100 | 100 |
| $A_2$. 75 % Coelomic fluid + 25 % water | 100 | 100 | 100 |
| $A_3$. 100% Coelomic fluid | 100 | 100 | 100 |
| $A_4$. ANAA* (RR) | 100 | 100 | 100 |
| Factor A Mean $^{ns}$ | 100 | 100 | 100 |

*ns – not significant; *ANAA* -* Alpha Naphthalene Acetic Acid.

They also insisted that the presence of nutrients and growth-promoting substances in coelomic fluid, which has been shown to have potential for seed germination and seedling vigor, could be responsible for this. In addition to, coelomic fluid formed from municipal solid wastes is composed of organic matter, plant nutrient and soluble salt which increase soil nutrient and moisture content that is responsible for shoot germination and increases the survival rate of seedlings (Sayyad, 2017). They also claimed that besides serving as a plant growth promoter coelomic fluid has tremendous biopesticide properties. It is highly toxic against insect-pest survival.

*Number of shoots*

Table 2 shows the number of shoots of macro sectioned banana corm as influenced by different levels of coelomic vermi fluid as applied in varying frequency. Results revealed no significant effects on the number of shoots of the macro sectioned banana corm on the frequency of application. However, numerically the highest mean is observed in factor $B_2$ (twice a week) with the mean of 1.41 followed by factor $B_1$ (once a week) with the mean of 1.36. The result indicates that the number of shoots can be influenced by the frequency of application, but the differences observed were not statistically significant

in these particular circumstances. However, significant differences in the number of shoot were observed among varying level of coelomic vermi-fluid as influenced on the macro section banana corm. The greatest number of shoots was observed in $A_3$ (100% coelomic vermin fluid) with a mean of 1.70 followed by the $A_2$ (75% coelomic vermin fluid + 25% water) with a mean of 1.35 which was comparable to $A_1$ (50% coelomic vermin fluid + 50 % water) and ANAA (RR) with the mean of 1.32,1.17, respectively.

**Table 2.** Number of Shoot of Macro Sectioned Banana Corm.

| Factor A: Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean [1/] |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 %water | 1.23 | 1.40 | $1.32^b$ |
| $A_2$. 75 % Coelomic fluid + 25 % water | 1.33 | 1.37 | $1.35^b$ |
| $A_3$. 100% Coelomic fluid | 1.77 | 1.63 | $1.70^a$ |
| $A_4$. ANAA* (RR) | 1.10 | 1.23 | $1.17^b$ |
| Factor B Mean [ns] | $1.36^{ns}$ | $1.41^{ns}$ | 1.39 |

CV = 6.33 %; [1/] - Means with common letter superscripts are not significantly different at 5% level the Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant*; **ANAA* - Alpha Naphthalene Acetic Acid.

The various levels Coelomic Vermi-fluid revealed significant results in terms of number of shoots, number of leaves, number of roots, length of roots, stem girth, and plant height. The presence of enzymes, nutrients, and small molecules in Coelomic Vermi Fluid (CVF) could be crucial for plant growth.

**Table 3.** Number of Leaves of Macro Sectioned Banana Corm.

| Factor A Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean [1/] |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 3.07 | 2.73 | $2.90^b$ |
| $A_2$. 75 % Coelomic fluid + 25 % water | 2.83 | 3.17 | $3.00^b$ |
| $A_3$. 100% Coelomic fluid | 3.67 | 4.00 | $3.83^a$ |
| $A_4$. ANAA* (RR) | 2.90 | 2.70 | $2.80^b$ |
| Factor B Mean [ns] | $3.12^{ns}$ | $3.15^{ns}$ | 3.11 |

CV = 19.96 %; [1/] - Means with common letter superscripts are not significantly different at 5% level the Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant*; **ANAA* - Alpha Naphthalene Acetic Acid.

Nadana *et al.* (2019) confirmed that the optimal pH of coelomic Vermi fluid (CVF) supports enzymatic activity during shoot germination. They also added that heneicosane and squalene may further contribute to the enhanced effects of cold-treated CF on shoot germination and plant growth.

Furthermore, the higher quality of coelomic vermi fluid which may be attributed to the presence of plant growth promoters like gibberellins, cytokines and auxins (Ansari and Sukhraj, 2010) that is accountable for the regulation of apical dominance, bud activation and cell division.

*Number of Leaves*

Table 3 shows the number of leaves of macro sectioned banana corm as influenced by different level of coelomic vermin fluid applied in varying frequency. The statistical analysis revealed that there was no significant difference in the number of leaves between the treatments tested and applied at different frequencies. Nevertheless, the highest count of leaves was observed in factor $B_2$ (twice a week) with a mean of 3.15, followed by the factor $B_1$ (once a week) with a mean of 3.12. This implies that the frequency of application might influence the growth and development of the leaves of the shoots; however, under these specific conditions, the observed differences were not statistically significant. Meanwhile, different levels of coelomic vermin fluid significantly affected the number of leaves of macro-section banana corm.

**Table 4.** Number of Roots of Macro Sectioned Banana Corm.

| Factor A<br>Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean [1/] |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 4.33 | 4.67 | 4.50[b] |
| $A_2$. 75 % Coelomic fluid + 25 % water | 3.97 | 5.43 | 4.70[b] |
| $A_3$. 100% Coelomic fluid | 6.63 | 6.67 | 6.65[a] |
| $A_4$. ANAA* (RR) | 4.50 | 4.93 | 4.72[b] |
| Factor B Mean [ns] | 4.86 [ns] | 5.43 [ns] | 5.15 |

CV = 6.03 %; [1/] - Means with common letter superscripts are not significantly different at 5% level using Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant*; **ANAA* - Alpha Naphthalene Acetic Acid.

The greatest number of leaves was observed in $A_3$ 100% colonic vermin fluid with a mean of 3.83 followed by $A_2$ (75% colonic vermin fluid + 25% water) with a mean of 33.00, which was comparable to $A_1$ (50% colonic vermin fluid + 50% water) and $A_4$ (ANAA (RR)) with a mean of 22.90 and 22.80, respectively. The CF of earthworm had been used in plant tissue culture media along with coelomic fluid extract and was shown to promote the callus or vegetative growth of plants (Kashyap *et al.*, 2019).

Coelomic fluid is a valuable source of plant nutrition in sustainable agriculture due to its rich composition of mucus, worm excretory products, macro- and micronutrients, beneficial microorganisms, growth hormones, vitamins, enzymes, and amino acids playing a significant role in leaf development and potentially influencing the number of leaves formed (Tripathi *et al.*, 2005).

In addition to, the seedlings of *Vigna mungo*, *Vigna radiate* and *Sesamum indicum* resulted in increase of growth parameters such as the root length, shoot length, number of twigs and leaves and total biomass of the plant after spraying the coelomic vermi fluid (Hatti *et al.,* 2010).

**Table 5.** Plant Height of Macro Sectioned Banana Corm.

| Factor A:<br>Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean [1/] |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 31.83 | 31.03 | 31.43[b] |
| $A_2$. 75 % Coelomic fluid + 25 % water | 29.57 | 31.80 | 30.68[b] |
| $A_3$. 100% Coelomic fluid | 40.67 | 39.37 | 40.02[a] |
| $A_4$. ANAA* (RR) | 24.63 | 25.03 | **24.83[b]** |
| Factor B Mean [ns] | 31.68 [ns] | 31.81 [ns] | 31.75 |

CV = 18.94 %; [1/] - Means with common letter superscripts are not significantly different at 5% level using Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant*; **ANAA* - Alpha Naphthalene Acetic Acid.

*Number of Roots*

Table 4 shows the number of roots of macro sectioned banana corm as influenced by different level of coelomic vermin fluid as applied in varying frequency. Statistical analysis revealed that the number of roots did not differ significantly based on the frequency of application. Numerically, the greatest number of roots was observed in factor $B_1$ (twice a week), with a mean of 5.43, while the least number of roots was observed in factor $B_2$ (once a week), with a mean of 4.86. The result implies that the varying frequency of application might influence the number of roots; however, under these specific conditions, the observed differences were not statistically significant.

Despite this, the different levels of coelomic vermin fluid showed significant impacts on the number of roots.

**Table 6.** Length of Roots of Macro Sectioned Banana Corm.

| Factor A Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean 1/ |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 16.23 | 17.70 | $16.97^b$ |
| $A_2$. 75 % Coelomic fluid + 25 % water | 11.57 | 20.23 | $15.90^b$ |
| $A_3$. 100% Coelomic fluid | 24.30 | 23.03 | $23.67^a$ |
| $A_4$. ANAA* (RR) | 18.13 | 18.57 | $18.35^b$ |
| Factor B Mean ns | 17.60 ns | 19.89 ns | 18.75 |

CV= 16.94 %; 1/ = Means with common letter superscripts are not significantly different at 5% level using Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant; *ANAA* - Alpha Naphthalene Acetic Acid.

The greatest number of roots was observed in $A_3$ (100%) coelomic vermin fluid, with a mean of 6.65, followed by $A_4$ (ANAA (RR)), with a mean of 4.72, which was comparable to $A_2$ (75% coelomic vermin fluid + 25% water) and $A_1$ (50% coelomic vermin fluid + 50% water), with means of 4.70 and 4.50, respectively. Suthar (2010) was found out that 100% Coelomic vermi fluid treatment resulted in the highest number of roots. This statement was supported by Nadana *et al.*, 2020, that the coelomic fluid secreted through dorsal pores in the form of mucus as a mechanism of defense when irritated and to possess insecticidal, antifungal , and pesticidal bioactive compound that resulting to produce more pest free roots. Furthermore, Elumalai *et al.*, (2013) insisted that the coelomic vermi fluid also contains sugars, amino acids and phenols along with plant growth promoting hormones such as in Indole acetic acid and humic acid that is vital role in regulating root number, promoting the formation of new roots and the development of lateral roots, ultimately contributing to a more extensive and robust root system.

*Plant Height (cm)*

Table 5 shows the plant height of macro sectioned banana corm as influenced by different levels of coelomic vermin fluid as applied in varying frequency. Results revealed no significant effects on the plant height of macro section banana corms regarding the varying frequency of application. However, numerically, the tallest mean was observed in factor $B_2$ (twice a week) with a mean of 31.81, while the shortest mean was observed in factor $B_1$ (once a week) with a mean of 31.68. This result implies that the varying frequency of application did not affect the height of the shoot of the macro section banana corms. Meanwhile, the height of the shoots was revealed to be significantly influenced by the different levels of coelomic vermi fluid. The tallest shoots were observed in $A_3$ (100% coelomic vermi fluid) with a mean of 40.02, followed by $A_1$ (50% coelomic vermi fluid + 50% water) with a mean of 31.43, which was comparable to $A_2$ (75% coelomic vermi fluid + 25% water) and $A_4$ (ANAA (RR)) with means of 30.68 and 24.83, respectively. According to Sundararasu (2016), the mucus, enzymes secreted by bacteria,

microorganisms, plant nutrients, vitamins, and substances that aid plant growth are present in the coelomic fluid that drips from dorsal pores. Coelomic vermi-fluid application has been shown to benefit plant growth and yield. Sudararasu and Jeyasankar (2014) demonstrated improved growth and yield parameters in brinjal plants treated with a coelomic fluid spray, while Kumar *et al.* (2013) reported increases in plant height and leaf number in other plant species. In addition to, Verma *et al*, (2018) insisted that coelomic vermi fluid is source of vitamins, hormones, enzymes, macronutrients and micro nutrients when applied to plant help in efficient growth which are crucial for plant growth, including stem elongation, cell division and elongation, contributing to increased plant height.

**Table 7.** Stem Girth of Macro Sectioned Banana Corm.

| Factor A Varying Levels of Vermi Tea | Factor B: Frequency of Application of Coelomic Vermi-Fluid | | Factor A Mean 1/ |
|---|---|---|---|
| | Once a week | Twice a week | |
| $A_1$. 50 % Coelomic fluid + 50 % water | 15.77 | 15.97 | 15.87[b] |
| $A_2$. 75 % Coelomic fluid + 25 % water | 16.10 | 15.60 | 15.85[b] |
| $A_3$. 100% Coelomic fluid | 19.30 | 20.17 | 19.73[a] |
| $A_4$. ANAA* (RR) | 14.70 | 16.37 | 15.53[b] |
| Factor B Mean [ns] | 16.47 [ns] | 17.03 [ns] | 16.75 |

CV = 11.50 %; 1/ = Means with common letter superscripts are not significantly different at 5% level using Turkey's Honest Significant Difference (HSD) test. Probabilities ($p<0.05$) were considered significant; *ns = not significant; *ANAA* - Alpha Naphthalene Acetic Acid.

*Length of Roots (cm)*

Table 6 shows the length of roots of macro sectioned banana corm as influenced by different levels of coelomic vermin fluid as applied in varying frequency. The results showed that the frequency of application had no significant impact on the length of roots of macro section banana corms. However, numerically the longest mean was observed in factor $B_2$ (twice a week) with a mean of 19.89 and the shortest length of roots was observed in $B_1$ (once a week) with a mean of 17.60. This result implies that the varying frequency of application did not affect the root length of the shoot of the macro section banana corms.

The application of different levels of coelomic vermi fluid resulted in significant differences in root length. The longest length of roots was observed in $A_3$ (100% coelomic vermin fluid) with a mean of 23. 67 followed by the $A_4$ (ANAA (RR)) with a mean of 18.35, which was comparable to $A_1$ (50% coelomic vermin fluid + 50% water) and $A_2$ (75% coelomic vermin fluid + 25% water) with the mean of 16.97 and 15.90, respectively. The benefits of coelomic fluid, as noted by Nayak *et al.* (2019), improved soil aeration, tilth, and texture, combined with enhanced water-holding capacity and nutrient status (macro- and micronutrients), create optimal conditions for root growth and development, including root length. They also confirmed that the coelomic fluid is believed to have positive effects on the eco-morphological characteristics of *Abelmoschus esculentus* by increasing growth and improving plant height, length and diameter of internodes, number leaves and root length. Furthermore, the application of coelomic vermi fluid along with vermicompost also resulted in enhanced growth of plant parameters such as number of leaves, leaf length, plant height and root length to higher level (Tharmaraj *et al.,* 2011).

*Stem Girth (cm)*

Table 7 shows the stem girth of macro sectioned banana corm as influenced by different levels of coelomic vermin fluid as applied in varying frequency. Results revealed no significant effects on the stem girth of macro section banana corms when it comes to the varying frequency of application.


**Fig. 1.** Documentation of (A) Banana (Lakatan) suckers (B) Banana (Lakatan) Macro Sectioned Corm (C) African Night Crawler after Collection of Coelomic Fluid (D) Incorporation of Coco Coir as growing media (E) Nursery establishment Vacuum Installation (F) Seedlings applied with 50% coelomic vermi fluid + 50 % water (G) Seedlings applied with 75% coelomic vermi fluid + 25 % water (H) Seedlings applied with 100% coelomic vermi fluid (I) Seedlings applied with Synthetic Growth hormone (ANAA).

However, numerically the widest mean was observed in factor $B_2$ (twice a week) with a mean of 17.03 followed by $B_1$ (once a week) with a mean of 16.47. The result implies that the varying frequency of application might influence the stem girt however, under this condition observed differences were not significant. On the other hand, different levels of coelomic vermi-fluid revealed significant differences in terms stem girth. The widest stem girth was observed in $A_3$ (100% coelomic vermin fluid) with a mean of 19.73 followed by $A_1$ (50% coelomic vermi fluid + 50% water) with a mean of 15.87 which was

comparable to $A_2$ (75% coelomic vermi fluid and 25 % water) and $A_4$ ( ANAA (RR)) with a mean of 15.87 and 15.53 respectively. Moreover, stem girth was significantly affected by phosphorus, calcium, and magnesium. This is in accordance with the statement of Manyuche *et al.* (2013) that phosphorus has a higher content of 84% in coelomic vermi fluid than vermicompost. The Coelomic fluid had a greater concentration of Calcium (Ca) and Magnesium (Mg) than vermicompost, with 89% and 98% more respectively; they also confirmed that the Coelomic fluid was 98 percent more sodium (Na) richer than vermicompost. Buckerfield *et. al.*, 1999 as cited by Verma *et al.*, 2018, coelomic fluid extraction contains several enzyme, plant growth hormones like cytokines, gibberellins and vitamins along with micro and macro nutrients that contribute to the overall vigor and health of the seedling, which indirectly influences stem development.

## Conclusion

In the view of foregoing results, it can be concluded that the use of 100% coelomic vermi-fluid was the optimal level of coelomic vermi-fluid influencing the shoot generation and growth development of macro-sectioned banana corms. These was observed in terms of survival percentage, number shoots generate, root length, number of roots, number of leaves, plant height, and stem girth. Furthermore, the varying application frequency did not affect the shoot generation and growth development of macro sectioned banana corms. Hence, further studies are highly recommended, focusing on other banana corm varieties and higher application frequencies of coelomic vermi-fluid.

## Conflict of interest

This paper declares that it has no conflict of interest among authors.

## Acknowledgment

This experiment is not funded by any institution. The authors are grateful to Keiven Mark B. Ampode, PhD, MAST Program Chairpersonfor untiring supports, constant reminders, and encouragement and assistance in the preparation of this manuscript from proof reading, formatting, and publication of this research. To Marissa C. Hitalia, PhD and Mitos D. Delco, PhD, the examining committee, for their wisdom, encouragement, and untiring support. To Mildred F. Accad, PhD, Dean, Graduate School, for for untiring supports, constant reminders, and encouragement in finishing the manuscript;

## References

**Ansari AA, Sukhraj K.** 2010**.** Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana **5,** 1794–1798.

**Bandewar SVS, Wambugu F, Richardon E, Lavery JV.** 2017**.** The role of community engagement in the adaptation of new agricultural biotechnology by farmer: the case of Africa harvest tissue-culture banana in Kenya **17,** 1.

**Blomme G, Swennen R, Tenkouano A.** 2000**.** Assessment of variability of the root system characteristics of banana (*Musa* spp) according to genome group and ploidy level **9 ,** p 4-7**.**

**Bucker Field JC, Flavel T, Lee KE, Web Ster KA.** 1999. Vermicompost soil and liquid form as plant growth promoter. Pedobio logia; **42,** 753-759.

**Elumalai D, Kaleena PK, Fathima M, Hemavathi M.** 2013**.** Influence of vermiwash and plant growth regulators on the exo-morphological characters of *Abelmoschus esculentus* (Linn.) Moench. African Journal of Basic and Applied Sciences **5(2),** 82-90.

**Fathima M, Sekar M.** 2014.Studies on growth promoting effects of vermiwash on the germination of vegetable crops. International Journal of Current Microbiology **3(6),**564- 570.

**Heslop-Harrison JS, Schwarzacher T.** 2007**.** Domestication, genomics and the future for banana, **100(5),** 10 73-84.

**Jacobsen K, Omondi BA, Almekinders C, Alvarez E, Blomme G, Dita M, Staver C.** 2019**.** Seed degeneration of banana planting materials: strategies for improved farmer access to healthy seed. Plant Pathology **68(2),** 207-228**.**

**Gudeta K, Julka JM, Kumar A, Bhagat A, Kumari A.** 2021**.**Vermiwash: An agent of disease and pest control in soil, a review, **7,** e06434

**Kasahun Gudeta JM, Julka Arun Kumar, Ankeet Bhagat, Amita Kumari.** 2021.Vermiwash: An agent of disease and pest control in soil, a review, Heliyon. https://doi.org/10.1016/j.heliyon.2021.e06434

**Kashyap S, Tharannum S.** 2019**.** Influence of formulated organic Plant tissue culture medium in the shoot regeneration study of *Brassica juncea*(l.) - Indian mustard **46(2),** 114–118**.**

**Kasyoka MR, Mwangi M, Kori N, Gitonga N, Muasya R.** 2010**.** Evaluating the macro propagation efficiency of banana varieties preferred by farmers in Eastern and Central Kenya1-6 p.

**Kindimba GV, Msogoya TJ.** 2014. Effect of benzylaminopurine on in vivo multiplication of French plantain (Musa spp. AAB) cv. 'Itokesege'. Journal of Applied Biosciences **74,** 6086– 6090

**Kumar P, Shekhar C, Basoli M, Kumar V.** 2013. Sequential spray of vermiwash at critical stages influences growth and quality in gladiolus cv. white prosperity. Annals of Horticulture **6(1),** 71-75.

**Lepoint P, Iradukunda F, Blomme G**. 2013. Macro propagation of *Musa spp*. in Burundi: a preliminary study. In CABI eBooks. 58–65p.

**Lorenzo J.** 2008. Growing bananas from "seeds" research-for-development (R4D) review IITA transforming African agriculture **1, 31-35.**

**Nadana Rajesh, Kavitha Sivakumar Sridevi, Palanichelva**. 2020. Induction of growth and defense mechanism in rice plants towards fungal pathogen by eco-friendly coelomic fluid of earthworm Environ **9,** 10-11 p.

**Nadana GRV, Selvaraj K, Sivakumar P, Palanichelvam K.** 2020. Coelomic fluid of earthworms extruded by cold stress method has commercially significant compounds and trigger seed germination in *Vigna radiata* L. Environmental Technology and Innovation **19,** 100814.

**Nath G, Singh K.** 2015. Effect of vermiwash of different vermin composts on the kharif crops **13(2),** 379-402.

**Nath G, Singh K.** 2015. Combined Effect of Vermiwash with Biopesticides against Infestation of Pod Borer (*Helicoverpa armigera* Hub.) **1(1),** 40-51.

**Ntamwira J, Sivirihauma C, Ocimati W, Bumba M, Vutseme L, Kamira M, Blomme G**. 2017. Macro propagation of banana/plantain using selected local materials: a cost-effective way of mass propagation of planting materials for resource-poop households **1,** 38-53.

**Patel MK, Rath SS.** 2018. Standardization of Macro Propagation in Banana cultivars **7(09),** 390–400.

**Pérez-Harguindeguy, Natalia, Diaz, Sandra, Garnier E, Lavorel Sandra, PoorterHendrik, Jaureguiberry Pedro, Bret-Harte M, Cornwell W, Craine, Joseph, Gurvich, Diego, Urcelay, Carlos, Veneklaas Erik, Reich, Peter, PoorterLourens, Wright I, Ray P, Enrico Lucas Pausas J, Vos A, Cornelissen Johannes.** 2013. New handbook for standardized measurement of plant functional traits worldwide. Australian Journal of Botany **61,** 167-234.

**Sahijram L, Sonej JR, Bollamma KT.** 2003. Invited review: Analyzing soma-clonal variations in macro propagated banana (*Musa* spp) **6,** 551-556.

**Sayyad NR.** 2017 Utilization of vermiwash potential against insect pests of tomato **6(1),**44-46.

**Sundararasu K, Jeyasankar A.** 2014. Effect of vermiwash on growth and yield of brinjal, *Solanum melongena* (eggplant or aubergine) **5(3),** 171-173.

**Tenkouano A, Hauser S, Coyne D, Baly O.** 2006. Clean planting materials and management practice for sustainable production of banana and plantain in Africa. Chronically horticulture **46(2),** 14-18.

**Thejano Ngullie, Chitta Ranjan Deb.** 2024. Development of a simple macro propagation technique of banana through corms splitting and formulation of effective potting media.South African Journal of Botany **174,** p 870-875.

**Tripathi YC, Hazarika P, Pandey BK.** 2005. Vermicomposting: an Ecofriendly Approach to Sustainable Agriculture. Verms and Vermitechnology, SB Nangia APH Publishing Corp., New Delhi 22-39 p.

**Verma S, Babu A, Patel A, Singh SK, Pradhan SS, Verma SK, Singh RK.** 2018. Significance of vermiwash on crop production **7(2),** 297-301.