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MICROBIAL DIVERSITY OF VERMICOMPOST AND ITS EFFICACY ON ORGANIC VEGETABLES

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ABSTRACT: Microbial diversity of vermicompost and its efficacy on organic vegetables were studied. Vermicompost was acquired from the Hindustan College of Arts & Science, campus vermicomposting plant and was prepared by using cow products such as milk, curd, urine, ghee, dung and vegetable wastes. The vermicompost was applied to the plants once in a week for 120 days. The morphological characters such as shoot length, internode length, diameter of the internode, number of leaves and leaf surface area of plants were recorded in all groups. Remarkably, vermicompost treated plants showed better growth promoting effects compared to control groups. The microbial examination of vermicompost was performed, it showed the presence of three bacterial strains such as *Bacillus sp*, *Klebsiella sp* and *Azatobacter sp*; four fungal isolates were identified such as *Aspergillus sp*, *Microsporum sp*, *Penicillium sp* and *Trichophyton sp*. Thus, the obtained results undoubtedly suggest that vermicompost can be recommended as effective for the improved growth of vegetable crops such as (Brinjal) *Solanum melongena*, (Ladies finger) *Abelmoschus esculentus*, (Chilli) *Capsicum annuum*, (Tomato) *Solanum lycopersicum.*

KEYWORDS: *Abelmoschus esculentus*, *Capsicum annuum*, *Solanum lycopersicum, Solanum melongena*, and Vermicompost.

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1.INTRODUCTION

Vermicompost has enormous potential as plant growth media and has been exposed to support the growth of vegetables, cereals, ornamental plants etc. Vermicomposting can also be used as a

structural adding for deprived soils. A significant characteristic is that in the handing out of wastes by earthworm, a lot of of nutrients that they contain are distorted into forms which are further readily in use by plants such as soluble potassium, nitrates, exchangeable phosphorus, calcium, magnesium and ammonium nitrogen [1]. The vermin casts, epidermal gland, mucus deposits, cell and ceolomic fluid showed that they restrain plant growth factor and group of B-vitamins. The cast includes auxin like matter that alters the effects of plant auxins and improved plant growth and the use of vermicompost to plants. Vermicompost is a dark brownish matter collected during vermicomposting of organic waste. Vermicompost can also supply as a precious foliar scatter since it is composed of excretory products and mucus oozings from earthworms and micronutrients from the organic molecules in the soil. These nutrients are captivated and then transported to the foliages, shoots and other parts of a plant. Foliar nutrients are known as an essential method of fertilization since foliar nutrients normally go through the leaf cuticle, stomata and pierce the cells assisting effortless quick consumption of nutrients. The vermicompost in addition contains enzymes and emissions of earthworms and would arouse the growth and yield of crops. Kale [2] has more over reported that vermicompost as foliar spray was effective in increasing the growth and yield response of anthurium. A vermicompost foliar squirt is more beneficial from inexpensive and ecological perspectives remaining to the lack of nutrient leakage, which is frequently come across when performing soil improvement. In addition, vermicompost was also described to have intrinsic things of performing not lone as manure but also as a slight biocide. Scarce reviews have shown that the application of vermicompost or waste tea enhances plant condition, harvest and nutritive value [3][4]. Further researches have revealed that vermicompost infusion comprises plant growth-promoting elements e.g., humic, fulvic and additional carbon-based acids [5], auxin-like components [6] and cytokinin-like materials [7]. Effects of application of in the form of seed treatment and foliar shower to Southern Sunnhemp Mosaic Virus infected sunnhemp plants were studied. Growth and biochemical factors considered revealed improved growth in treated plants. Numerous concentrations from virus infested plants were verified on cluster bean a local abrasion assess host for this virus. Treated plants presented slighter pathological concentration than control. The outcome of foliar spray of on virus absorption in the local abrasion host too studied, by injecting the plants with virus of altered time intervals later foliar spray. A significant modification in viral absorption was observed [8]. From the foregoing accounts, the current study was designed to assess the growth stimulating properties of vermicompost in *Abelmoschus esculentus*, *Capsicum annuum*, *Solanum lycopersicum, Solanum melongena*, under pot experimental conditions for 120 days.

2. MATERIALS AND METHODS

Preparation of vermicompost

Vermicomposting plant (9×4×5 feet, lbh) was fixed up through strata of sand, garden soil, gravel, by products of Cow Shed and sufficient water for the growth of *Eisenia foetidae*. Earthworms were

obtained from a NGO called Earth Cycler, in Vellore. About 2 kg of this species accounting 350 worms were added to the Vermicomposting tank. The outlet tap was set at the bottom to collect the excess drained water. Earthworms were cultivated in the vermicomposting unit using cowdung as breeding medium for 45 days before the start of experiments. The vermibed mixtures were mixed carefully once in a week without damaging the worms. Vermicompost was collected from the vermibeds for the application of experimental plants as well as microbial examination.

Pot experimental condition

(Brinjal) *Solanum melongena*, (Ladies finger) *Abelmoschus esculentus*, (Chilli) *Capsicum annuum*, (Tomato) *Solanum lycopersicum* seeds were procured from the Agricultural Technology Information Centre (ATIC), Kattuppakkam is located at a distance of 53 Km from Chennai and were sown in pots containing soil. Initially, the plants were grouped into two categories; Group 1 was made as two sets. One without vermicompost (Control) and other with vermicompost(Experimental) for *Solanum melongena*; like that group II as *Abelmoschus esculentus*; group III as *Capsicum annuum;* and group IV as *Solanum lycopersicum* respectively. The vermicompost was added to the plants once in every week for 120 days during early morning or late evening.

Analysis of morphological characters

At the end of every week at zero hour, *i.e.* just before adding the vermicompost, the morphological characters such as shoot length, internode length, diameter of the internode, number of leaves and surface of leaf were recorded in the control and experimental groups during the study period.

Microbial examination of vermicompost

Vermicompost were collected and stored at ambient temperature. All samples were collected in triplicates using sterilized polythene bags. Serial dilutions of vermicompost samples were prepared, from each dilution 0.1 ml of sample was inoculated in to appropriate media for the isolation of microorganisms. Sabarouds dextrose agar supplemented with 0.01% Streptomycin sulphate were used for isolation and enumeration of fungi. Nutrient agar and SDA agar was used for isolation of bacteria and fungi for total viable count of bacteria. The isolated colonies were sub cultured in agar slants and conserved under preservation temperature. Bergey's Manual of Determinative Bacteriology was referred to identify the bacteria based on the macroscopic and microscopic examination [9]. The fungus was identified by lacto phenol cotton blue staining method with the key characters [10].

Statistical analysis

The obtained results were analyzed by using SPSS statistical software package (SPSS, Version 17.0).

3. RESULTS AND DISCUSSION

Morphological characters of organic vegetables

Shoot length

The shoot length was found to be increased in vermicompost treated plants compared to control

group. However, maximum shoot length 87.85 Cm was observed in group I *Solanum melongena* applied with vermicompost; 86.18 Cm in group II *Abelmoschus esculentus*; 79.23 Cm in group III *Capsicum annuum* and 71.17 Cm in group IV *Solanum lycopersicum* respectively. In the case of control group I showed 53.15 Cm; group II 69.60 Cm; group III 68.59 Cm and group IV 61.67 Cm respectively. On the other hand better growth was found in *Solanum melongena* after 120 days of vermicompost application (Figure No. 1).

Length of the internode

Internode length was increased in vermicompost treated plants than the control plants; highest internode length 8.15 Cm was observed in group III applied with vermicompost; *Capsicum annuum;* 7.62 Cm in group IV *Solanum lycopersicum*; 5.62 Cm in group II *Abelmoschus esculentus* and 5.27 Cm in group I *Solanum melongena* respectively. In the case of control group III maximum internode length showed 7.06 Cm; group IV 6.86 Cm; group II 5.15 Cm and group I 4.54 Cm respectively. However better growth was found in *Capsicum annuum* after 120 days of vermicompost application (Figure No. 2).

Diameter of the internode

Similar results were also recorded in case of diameter of the internode. The diameter was found to be increased in vermicompost treated groups than the control. Interestingly, highest internode diameter5.96 mm was observed in group II *Abelmoschus esculentus* applied with vermicompost; 5.56 mm in group I *Solanum melongena*; 4.82 mm in group III *Capsicum annuum* and 4.56 mm in group IV *Solanum lycopersicum* respectively. In the case of control group II maximum internode diameter showed 4.83 mm; group IV 4.28 mm; group III 4.27 mm and group I 3.24 mm respectively better effect was observed. In vermicompost treated group followed the diameter of internode was increased more than five-fold after 120 days (Figure No. 3).

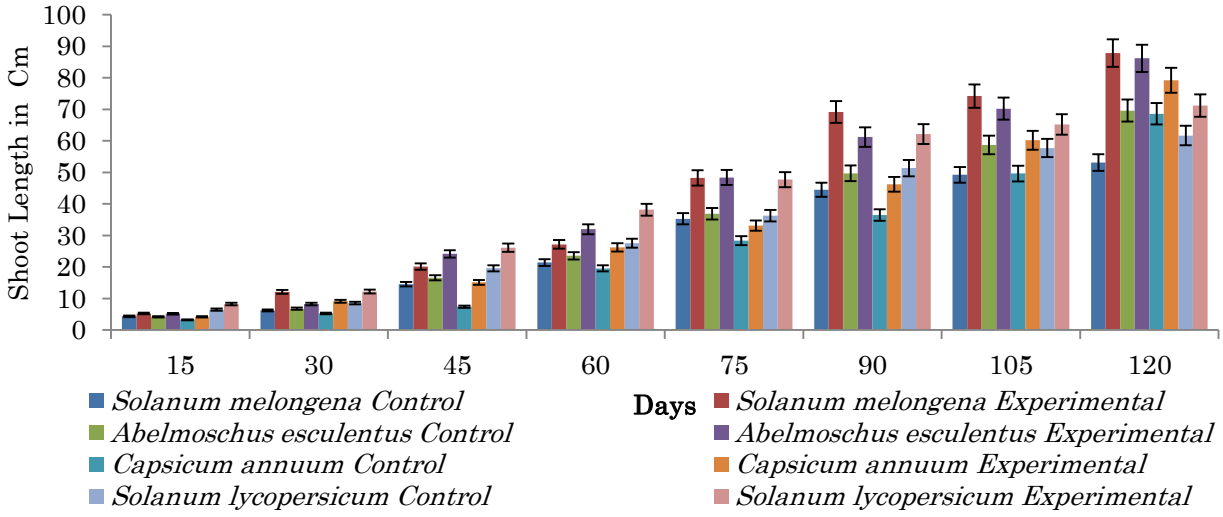


Fig No 1: Effect of Vermicompost on shoot length in Cm of *Solanum melongena*, *Abelmoschus esculentus*, *Capsicum annuum* and *Solanum lycopersicum*

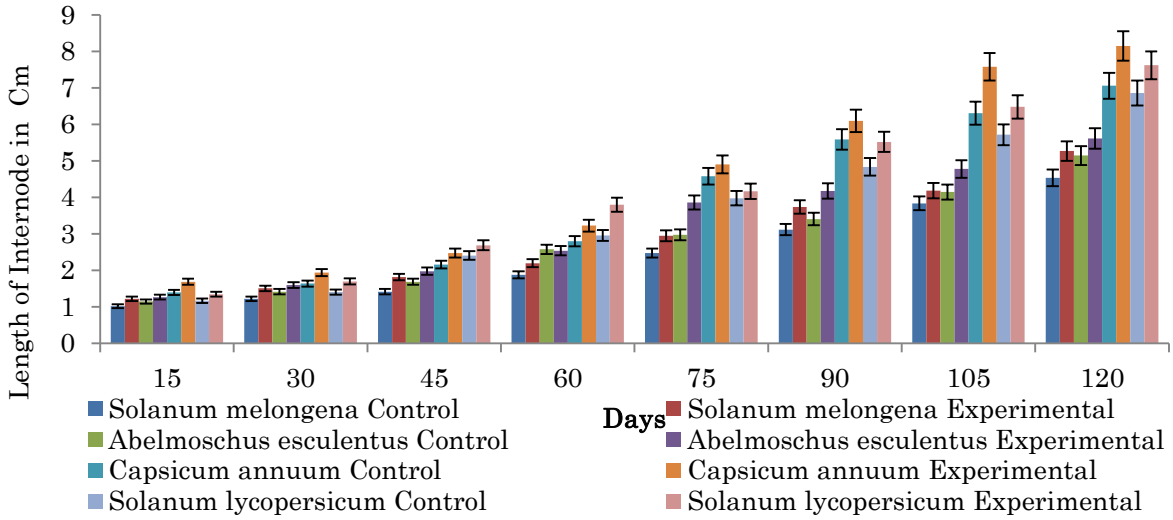


Fig No 2: Effect of Vermicompost on length of internode in Cm of *Solanum melongena*, *Abelmoschus esculentus*, *Capsicum annuum* and *Solanum lycopersicum*

Number of leaves

Number of leaves was found to be increased in vermicompost treated groups than the control plants. However, maximum number of leaves 131.30was noticed in group IV *Solanum lycopersicum* applied with vermicompost;121.19 in group III *Capsicum annuum;* 81.99 in group II *Abelmoschus esculentus* followed by79.17 group I *Solanum melongena* respectively. Whereas maximum number of leaves 112.24 observed in control group IV *Solanum lycopersicum*; 97.48in group III *Capsicum annuum*; 62.04 group II *Abelmoschus esculentus* and56.68 in group I *Solanum melongena*. After 120 days, the number of leaves was increased (Figure No. 4).

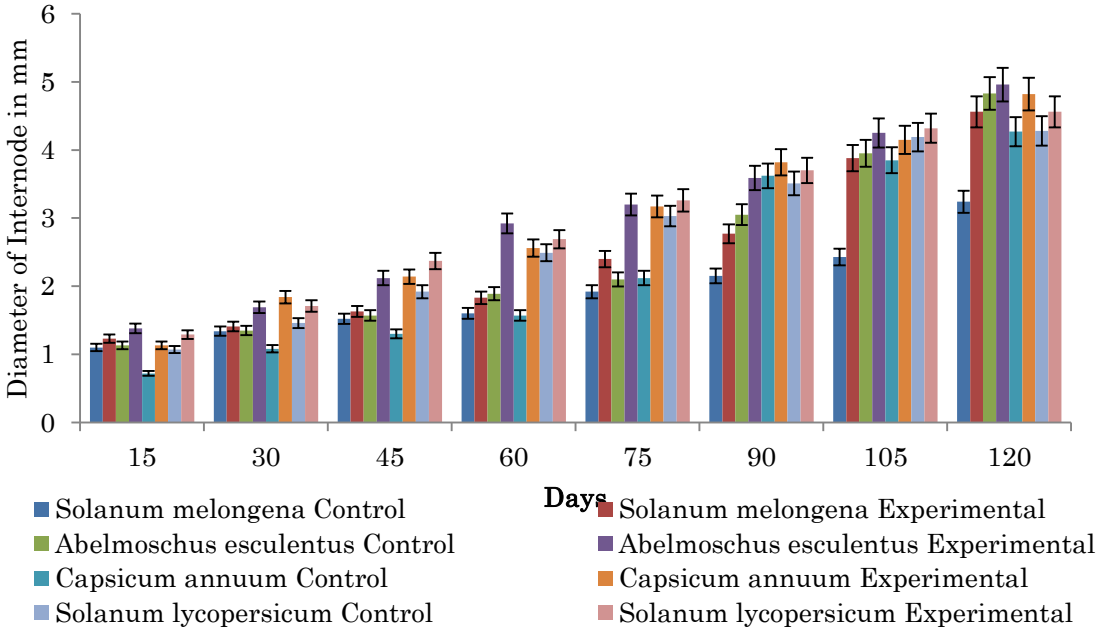


Fig No 3: Effect of Vermicompost on diameter of internode in mm *Solanum melongena*, *Abelmoschus esculentus*, *Capsicum annuum* and *Solanum lycopersicum*

Leaf surface area

Increased leaf surface area was observed in vermicompost treated plants compared to normal control group. Better growth was recorded in 42.40 Cm. was observed in group II *Abelmoschus esculentus* applied with vermicompost; 38.29 Cm in group I *Solanum melongena;* 22.32 Cm in group IV *Solanum lycopersicum* and 19.37 Cm in group III *Capsicum annuum* respectively. Whereas maximum leaf surface area 24.33 Cm was observed in control group II *Abelmoschus esculentus*; 22.82 Cm in group I *Solanum melongena*; 20.34 Cm in group IV *Solanum lycopersicum* and 15.59 Cm in group III *Capsicum annuum*; After 120 days, the surface area of leaves were increased (Figure No. 5).

Microbiological examination of vermicompost

The sample collected from the vermicomposting unit showed the bacterial colony morphology on the first nutrient agar plate was pale-white, circular, flat, opaque, round, medium and the white-dull, entire, pulvinate or umbonate, opaque, irregular, large. In the case of second plate white, entire, convex, opaque or translucent, circular, medium and the white-dull, entire, pulvinate or umbonate, opaque, irregular, large colonies were observed. Third plate showed creamish-white, entire, raised, translucent, irregular large, the white-dull, entire, pulvinate or umbonate, opaque, irregular, large colonies (Figure No. 6 and Table No. 1). In the first sabarouds dextrose agar plate two different dark green and black spongy colonies were observed. In the case of second plate two white spongy colonies were observed. The third plate showed six white, button shaped colonies. Irregular, dark white, spongy colonies were observed (Figure No.7 and Table No. 2).

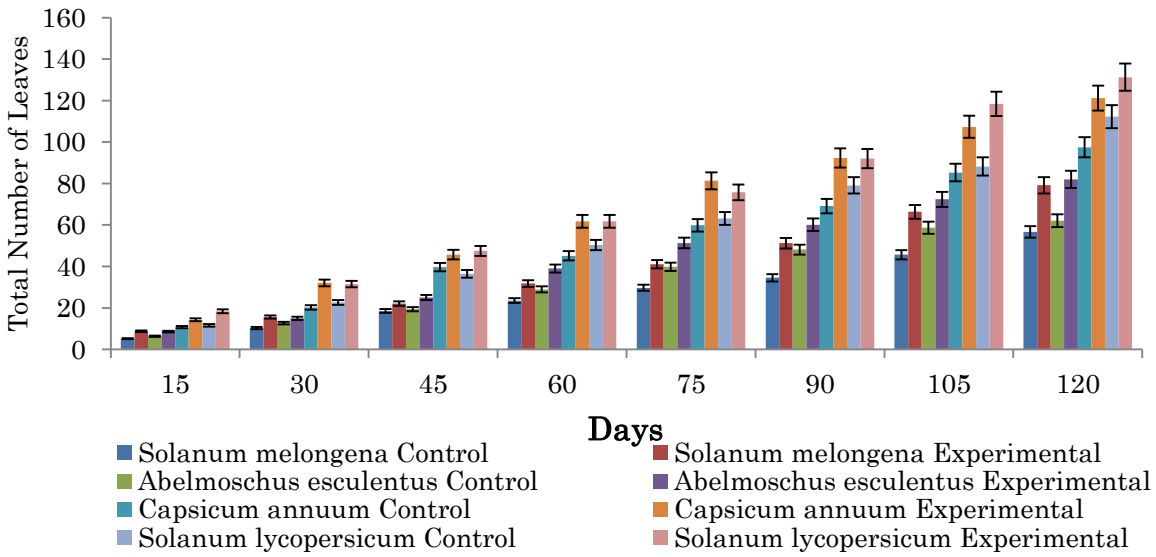


Fig No 4: Effect of Vermicompost on number of leaves on *Solanum melongena*, *Abelmoschus esculentus*, *Capsicum annuum* and *Solanum lycopersicum*

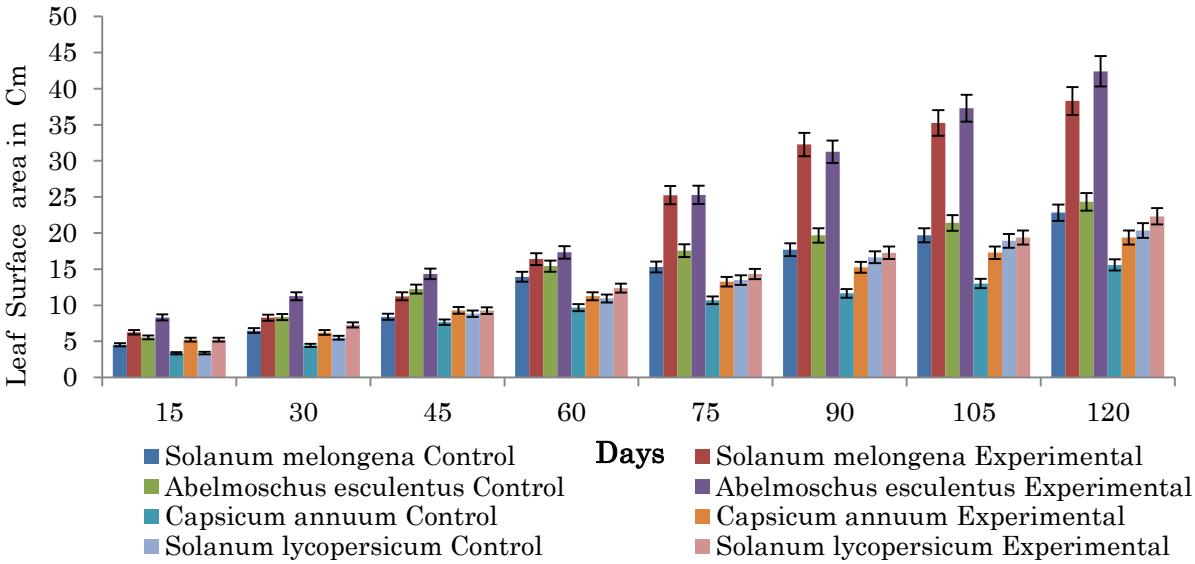
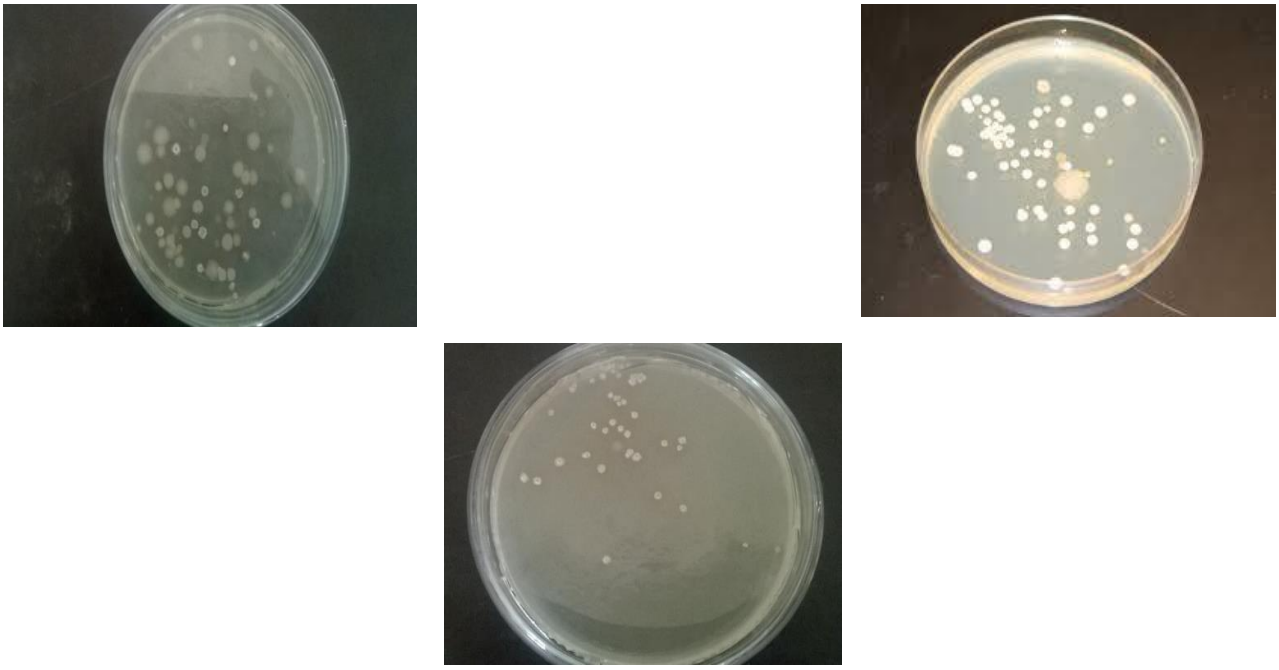


Fig No 5: Effect of Vermicompost on leaf surface area in Cm of *Solanum melongena*, *Abelmoschus esculentus*, *Capsicum annuum* and *Solanum lycopersicum*

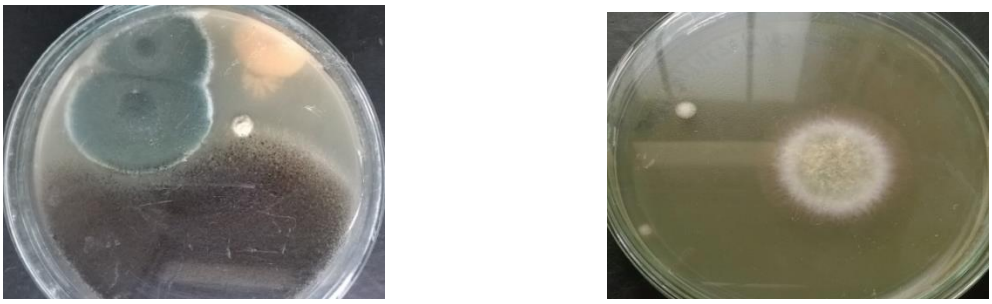
Preliminary tests

The gram staining technique showed the following results. The first and third plate showed gram-positive rods; whereas in plate 2 gram negative rods were observed (Figure No. 8 and Table No. 1). Lacto phenol cotton blue staining is showed some interesting results. The first plate showed stalk with cluster of sterigmata. In culture plate 2 barrel shaped; brown colored; macro conidia were observed. The third plate three branched; brush shaped; conidiophores were observed. Fourth plate branched; microconidia were observed (Figure No. 9). Organic farming only can serve up as holistic approach towards achieving sustainable farming as it is environmental friendly and make sure the protection of resource for the future. Earthworms and its vermicompost work like wonder growth supporter and are nutritionally better to the conservative manure and chemical fertilizers. Both earthworms and its vermicast and body liquid (vermicompost) are exactly proving as both growth promoters and protectors for crop plants. In the experiments through tomato and egg-plants, corn and wheat crops, vermicompost showed tremendous growth performances in conditions of tallness of plants, color and consistency of leaves, emergence of flowers and fruits, kernel ears etc, contrasted to chemical fertilizers and the usual fertilizer [11]. An organic input used by the farmers to progress the crop yield. More than a few reports specify the improvements in growth and biochemistry of plants when applied with vermicompost [12,13,14].



A. *Bacillus sp* B. *Klebsiella sp* C. *Azatobacter sp*

Fig No: 6 Colony morphology isolated bacterial strains from vermicompost



A. *Aspergillus sp* B. *Microsporum sp*

C. *Pencillium sp* D. *Trichophyton sp*

Fig No: 7 Colony morphology isolated fungal strains from vermicompost

To the best our knowledge, this may be the first study in which and were applied to assess the growth supporting effects on (Brinjal) *Solanum melongena*, (Ladies finger) *Abelmoschus esculentus*, (Chilli) *Capsicum annuum*, and (Tomato) *Solanum lycopersicum*. In this study, four different plants were tested with vermicompost among them *Abelmoschus esculentus*, showed better growth

promoting effects in all the morphological characters such as shoot length, internode length, diameter of the internode, number of leaves and leaf surface area followed by *Solanum melongena*, *Capsicum annuum* and *Solanum lycopersicum* respectively. However, the vermicompost applied plants showed better effects than the control group. These results were found to be consistent with the earlier reports shown by [15, 16]. However, they have observed the growth promoting effects using vermicompost. In addition, effective pest control was observed in vermicompost treated plants than the control plants. Similar to our results, Sinha [11] have also observed less incidences of pest and disease attack and reduced demand of water for irrigation in plants grown on vermicompost. Presence of live earthworms in soil also makes significant difference in flower and fruit formation in vegetable crops [11]. The enhanced growth may be due to the presence of growth regulatory substances such as Gibberallic Acid, Indole Acetic Acid and Cytokinin, essential plant nutrients, effective microorganisms and biofertilizers like Azatobacter, Azosprillum and Phosphobacterium in [12]. Arancon [17] proved that increase in growth and yield at high amounts of vermicompost in potting medium could perhaps be due to enhancement in the physiochemical properties of the medium, increased in microbial diversity and activity and nutritional factors. Result acquired from this experiment revealed that growth and yield parameters such as leaf area shoot length and yield of vegetables increased by adding vermicompost which coincided with Atiyeh [18].

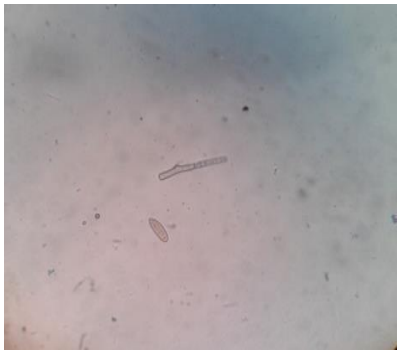
A. *Bacillus sp* B. *Klebsiella sp* C. *Azatobacter sp*

Fig No: 8 Photomicrograph of isolated bacterial strains under 100X magnification

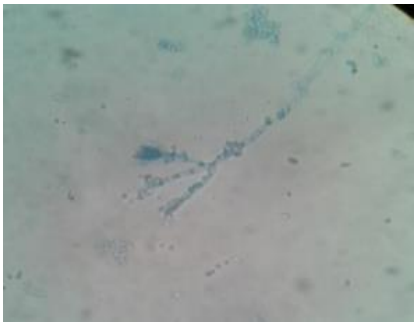
Table No: 1 Colony morphology of the isolated bacterial strain on the basis of serial dilution from vermicompost

S.No	Colony Morphology & Preliminary Tests	**Isolate 1** *Bacillus sp*	**Isolate 2** *Klebsiella sp*	**Isolate 3** *Azatobacter sp*
1	Colony colour	Pale-white	White	Creamish-White
2	Margin	Circular	Entire	Entire
3	Elevation	Flat	Convex	Raised
4	Opaque / Translucent	Opaque	Opaque / Translucent	Translucent
5	Shape	Round	Circular	Irregular
6	Size	Medium	Medium	Large
7	Motility	Non-Motile	Non-Motile	Motile
8	Gram Staining	Gram-Positive rods	Gram-Negative rods	Gram-Positive rods
9	Catalase	Positive	Positive	Positive
10	Oxidase	Positive	Negative	Positive

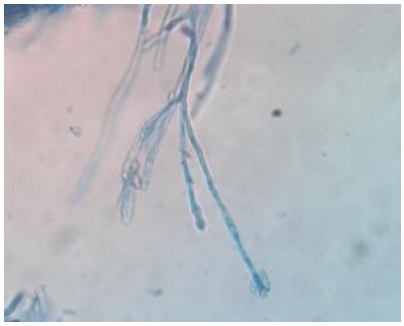
A. *Aspergillus sp*



B. *Microsporum sp*



C. *Pencillium sp*



D. *Trichophyton sp*

Fig No: 9 Photomicrograph of isolated fungal strains under 40X magnification

Table No: 2 Colony morphology and Microscopic features of the isolated fungal strains from vermicompost

S.No	Colony Morphology & LPCB Staining	**Isolate 1** *Aspergillus sp*	**Isolate 2** *Microsporum sp*	**Isolate 3** *Pencillium sp*	**Isolate 4** *Trichophyton sp*
1	Colony colour	Dark green, Brown	Greenish white	White	White
2	Size	400-800 µm	300-500 µm	200-300 µm	200-300 µm
3	Surface	Filamentous, elevated	Filamentous, irregular	Umbonate, elevated	Undulate, lobate and filiform
4	Vesicle Serration	Biseriate	Spherical	Branched sterigmata	Spherical
5	Shape	Globose, ellipsoid	Segmented and branched	Granule, chain	Filamentous
6	Medulla Covering	Entirely	Medulla not seen	3/4	Medulla not seen
7	Conidia Surface	Smooth, finely roughened	Barrel shaped microconidia	Branched with conidiophores	Arranged in cluster

Different isolates of *P. fluorescens* and *Trichoderma sp*. were identified as biocontrol agents of groundnut stem rot and other soil-borne diseases [19, 20] where as in our study we isolated three bacterial strains such as *Bacillus sp, Klebsiella sp* and *Azatobacter sp* and four fungal strains fungal organisms such as *Aspergillus sp, Microsporum sp*, *Pencillium sp,* and *Trichophyton sp.* Most of the prevailing biocontrol agents for controlling of soil-borne diseases were secluded from the rhizosphere. There is a chance to reconnoiter antagonists from other habitats as effective biocontrol agents. Endophytes, which inhabit and live in the internal plant habitats, were evidenced effective in plant growth preferment and infection control in an extensive kind of crops [21]. Certain biocontrol agents have also been sequestered from the seed surfaces [22]; in their study antagonistic bacteria and *Trichoderma sp* isolated from the groundnut seed were assessed for control of *S. rolfsii* septicity in groundnut in meticulous environmental circumstances. The fungicide forbearance and in vitro compatibility of the recognized biocontrol agents were determined and exploited for effective management of stem rot disease. *Pseudomonas sp* are effective root colonizers and biocontrol agents, by production of antibiotics and other antifungal metabolites including antibiotics, hydrogen cyanide and siderophores [23]. Five strains each of *P. fluorescens* and *Trichoderma sp* has been found to destroy the root rot of black pepper triggered by *Phytophthora capsici* [24]. There are numerous studies in the works relating several substantial results in the synergistic contact between arbascular mycorrhizae and asymbiotic Nitrogen fixing bacteria such as *A. chroococcum,*

Azospirillum sp and *Acetobacter diazotrohicus* [25, 26, 27, 28]; which is coincided with our study that the isolated organisms from the vermicompost which enhances the growth of the experimental plants. It has also been well renowned that the biosynthesis of auxins through their excretion into soil creates a major influence to the bacterial plant growth-promoting consequence [29, 30]. Not as well understood as indole acetic acid, cytokinins and gibberellins have also been shown to stimulate root and shoot development in several ways [31]. Cytokinins, for instance, have been involved in cell division and nitrogen fixing nodule development [32, 33]. The present study showed the prepared vermicompost possessed the presence of bacterial organisms such as *Bacillus sp, Klebsiella sp* and *Azatobacter sp*; fungal organisms such as *Aspergillus sp, Microsporum sp*, *Pencillium sp,* and *Trichophyton sp.* which enhanced the growth of the experimental plants. In addition, has also been reported to contain bacteria producing plant growth promoting substances as well as bacteria having biological detergent activities. Presence of such beneficial microbial biomass resulted in improved seed germination, seedling length and seed vitality in wheat. Thus, it is clear from this study that vermicompost promotes the growth of (Brinjal) *Solanum melongena*, (Ladies finger) *Abelmoschus esculentus*, (Chilli) *Capsicum annuum*, and (Tomato) *Solanum lycopersicum* significantly.

4. CONCLUSION

In the present study, improved growth effects were observed in vermicompost treated plants than the control plants. Fascinatingly, remarkable growth promoting effects were recorded in *Abelmoschus esculentus* and *Solanum melongena*. Consequently, the observed results influentially suggest that vermicompost and its beneficial microbes might be explored as efficient for the enhanced growth of vegetable crops in the near future.

CONFLICT OF INTEREST

Authors have no any conflict of interest.

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