Bioconversion of organic wastes to fortified vermibooster using isolates of NFB and PSB

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Abstract: In recent years vermicomposting biotechnology has emerged as an efficient method for recycling varying kinds of organic wastes in the form of compost with the help of gut microorganisms of epigeic earthworms. The amounts of different plant nutrients in vermicompost are generally higher as compared to traditional composts. Yet, any effort for further improvement of the nutrient content as well as microbial quality of this compost will help to increase its efficiency in upgrading the soil health. However, in spite of all these efforts, information on microbiological management on nutrient enrichment of vermicompost is limited. In this paper an effort is made to increase the number of NFB and PSB by using gut isolates of the indigenous worms. The bioavailability of N, P, K has increased in the compost considerably due to the addition of NFB and PSB. Moreover it was found that the after addition of NFB and PSB the rate of decomposition has improved and the shelf life of the compost has increased up to six months from the date of harvest if proper moisture is maintained. Thus suitable microbiological management practice with the help of bio-fertilizers will be particularly helpful for improvement of the major nutrient status of vermicompost leading to increased acceptability of this organic input not only as a source of the plant nutrients but also as a source of vermibooster.

Key words: Vermibooster, plant nutrients, bio-fertilizer, soil health, NFB, PSB

INTRODUCTION:

Organic agriculture is the need of present world. Low cost soil fertility boosters are actually the prime focus of green agriculture. Incorporation of locally available biofertilizing agents like Nitrogen Fixing Bacteria (NFB) and Phosphorus Solubilising Bacteria (PSB) along with organic inputs are of modern concept for sustainable agricultural methods through which yield maximization as well as natural resource conservation practices can be achieved by lowering the inputs of traditional agro-chemicals considerably. More over bio-fertilizers procured from market has poor shelf life and the microbs has lesser adaptability to the area of application so it is found that local indigenous variety of earthworm and their casts are rich in biofertilizing agents which could be isolated in-vitro and the cultivated for enhancing their population and can then be applied in the fields to overcome the above mentioned problems. In recent years vermicomposting biotechnology has emerged as an efficient method for recycling varying kinds of organic wastes in the form of compost with the help of gut microorganisms of epigeic earthworms. The amounts of different plant nutrients in vermicompost are generally higher as compared to traditional composts. Yet, any effort for further improvement of the nutrient content as well as microbial quality of this compost will help to increase its efficiency in upgrading the soil health. However, in spite of all these efforts, information on microbiological management on nutrient enrichment of vermicompost is limited. Suitable microbiological management practice with the help of bio-fertilizers will be particularly helpful for improvement of the major nutrient status of vermicompost leading to increased acceptability of this organic input not only as a source of the relevant nutrients for plants but also as a source of bioboosters. Soils of our state Tripura is acidic and with poor nutrient availability so microbial management for such soils with enriched site specific biofertilizing agents are highly encouraged for improving the biology and fertility of soil. Use of microbial enriched vermicompost is a new dimension of study for the state so hopefully fortified microbial enriched vermicompost may be very useful green-technology for the coming days. This greener approach is expected to solve many issues in a single shot, like site specific nutrient management providing slow and sustained release of micro and macronutrients, increased shelf life for the bio-inoculants, batter storage and handling facility and hopefully would become a green biotechnological approach for the state where technology transfer is very easy and simple and very cost effective so can surely be considered as a **"Peoples Technology"** in the coming days. Students of colleges are to learn all these techniques as per their CBCS syllabus so this project will give them the opportunity to learn the techniques practically and they will be able to see the result of their work done in farmers filed during field trials. Therefore, keeping in view of the above facts, the present concept focuses on use of local indigenous variety of earthworms and their casts as a cheaper method of providing bio-boosting/biofertilizing agents for enhancing biological fertility and productivity of soil. This project aims to use existing vermibiotechnology method one step ahead by suitably modifying conventional vermicompost to **vermibooster** an even batter biofertilizer.

NEED STATEMENT & RELEVANCE:

Microbial management for acidic and poor nutrient loaded soil of Tripura; with enriched site specific biofertilizing agents are highly encouraged. Use of microbe's enriched vermicompost is a new dimension of study. Fortified microbial enriched vermicompost may be very useful technology for the coming days for the small and marginal farmers of our state and more over technology transfer from lab to land would be very easy after optimization and establishing a suitable biotechnology in the upcoming days. These fortified compost has many advantages: i) Developed for site specific nutrient management ii) Low operating cost for production and slow release fertilizers so effects lasts long iii) Easy to handle and with more shelf life iv) Local microbial strains are used so batter adaptability in soil v) Students/ entrepreneurs and farmers can learn the technique easily i.e. the technology is peoples friendly and reduces the use of traditional chemical fertilizers considerably so cheaper and eco-friendly promoting the goals of "***Organic Agriculture***".

AIMS & OBJECTIVES

Vermicompost has much more nutrients as compared to traditional compost but the problem of vermicompost is with the shelf life where it is found that after harvest within 45-60 days the quality of vermicompost declines considerably as the bio-boosting activity decreases with reduction of desired number of microbial population. So in these circumstances enrichment of vermicompost with desired microbial inoculums retains its activity once again considerably helping the farmers using the same vermicompost for an extended duration up to 180 days from harvest. Here bacterial inoculums of Nitrogen fixing Bacteria (NFB) and Phosphate Solubilizing Bacteria (PSB) would be very useful as it will help to maintain the shelf life of the vermicompost and enhances grater bioavailability of the plant nutrients which are otherwise less available. In addition these biofertilizing agents are also responsible for secretion of various biofertilizing agents like exo-enzymes, hormones and other PGPRs which boosts the quality of compost in a considerable manner.

- To isolate competent local varieties of earthworms adaptable for composting
- Isolation of Gut microflora (w. r. t. NFB & PSB) and culturing in laboratory scale
- Enriching the vermicompost with targeted biofertilizing agents and to see the efficiency of the compost in laboratory condition
- Large scale production of the enriched vermicompost and its farm trial in "Barobhiya Progeny Orchard under Tripura Biotechnology Council Bagma, Gomati"
- Transferring the technology to Farmers and student Entrepreneurs by workshops and hands on training.

METHODOLOGY:

Step-1: Isolation and Characterization of Suitable indigenous variety of Earthworm Species: earthworms of different categories like epigeic, endogeic species of indigenous origin shall be isolated from different agricultural regime. The species is to be cultivated in laboratory condition after proper acclimatization. Growth rate is to be monitored at regular interval.

Step-2: Culture of worms in laboratory condition in microcosm environment:

Worms are to be given substrates (Cow dung + FYM+ household Organic west for their growth and production of compost. At regular interval the substrate bed is to be turned on and specific moisture is maintained by sparkling water so as to maintain the moisture 50-60%. Maintenance of pH, Temperature, moisture is to be monitored at regular interval

Step-3: Isolation of Gut desired microflora (w. r. t NFB & PSB) and culturing them in laboratory scale:

Gut microflora will be isolated from earthworm gut, vermicast and targeted soil from agricultural field and to be cultivated in enrichment medium for NFB and PSB and regular monitoring of the growth parameters are to be monitored.

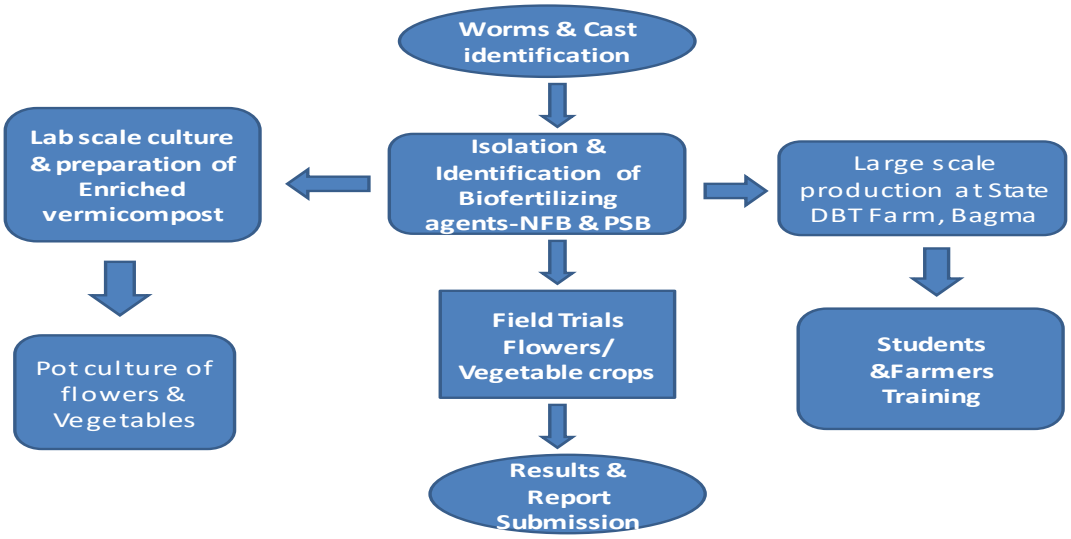
Step-4: Preparation of Enrich vermicompost:

During the mesophilic stage of vermicompost targeted biofertilizing agents (NFB, PSB and other growth promoting microorganisms) are to be added to see the efficiency of the compost in laboratory condition. Analysis of pH, EC, OC, NPK and Microbial Biomass Carbon (MBC) etc will be evaluated after harvest to measure the quality of the compost.

Step-5: Large scale production of the enriched vermicompost:

Once satisfactory results are found in lab scale study and pot cultivation of different plants the enriched vermicompost is to be prepared in large scale at "Barobhiya Progeny Orchard under Tripura Biotechnology Council, Bagma, Gomati District. Field Trial is to be given in the farm for two seasonal crops/ vegetables.

Work Plan summary:



A. Collection of Organic wastes (OW)

1. Organic waste as a means of biomass were collected from various places...


B. Preparation of the Vermicompost Bed/Substrate:

1. The collected Organic wastes (OW) are thoroughly Mixed with Cow Dung (CD)


C. Preparation of the pre-compost Bed :

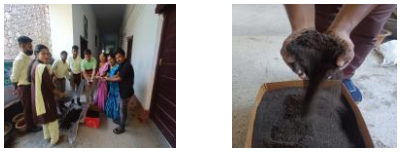
1. The dried up OW are then mixed with paddy straw..

2. Then this mixture is transferred to a containers.

F. Extractor and collection of the prepared compost:

1. Sieved the compost to remove the unwanted materials..

2. The mature compost is then collected in a sac..



RESULTS AND DISCUSSION:

Bio fortification is a popular biotechnology in various fields of biology it maims to enrich the compost material with more number of beneficial microorganisms so that bioavailability of macro as well as micro nutrients is enhanced in the compost material with grater shelf life. In this study the physic-chemical analysis of compost (C), Vermicompost (VC) and Fortified vermicompost (FVC) shows grater bioavailability of different nutrients (NPK) in fortified vermicompost as compared to C and VC this could be due to greater rate of decomposition as evident by the values of total organic carbon (TOC) and thus the pH of the substrate also reaches to near neutral value. It is seen at the mature stage of composting mass reduction (weight /kg) is about 55-60% of the initial level and the moisture regime is maintained at the level of 45-55%

TABLE-1: PHYSICOCHEMICAL AND NUTRIENT PARAMETERS OF DIFFERENT COMPOST: A COMPARISON

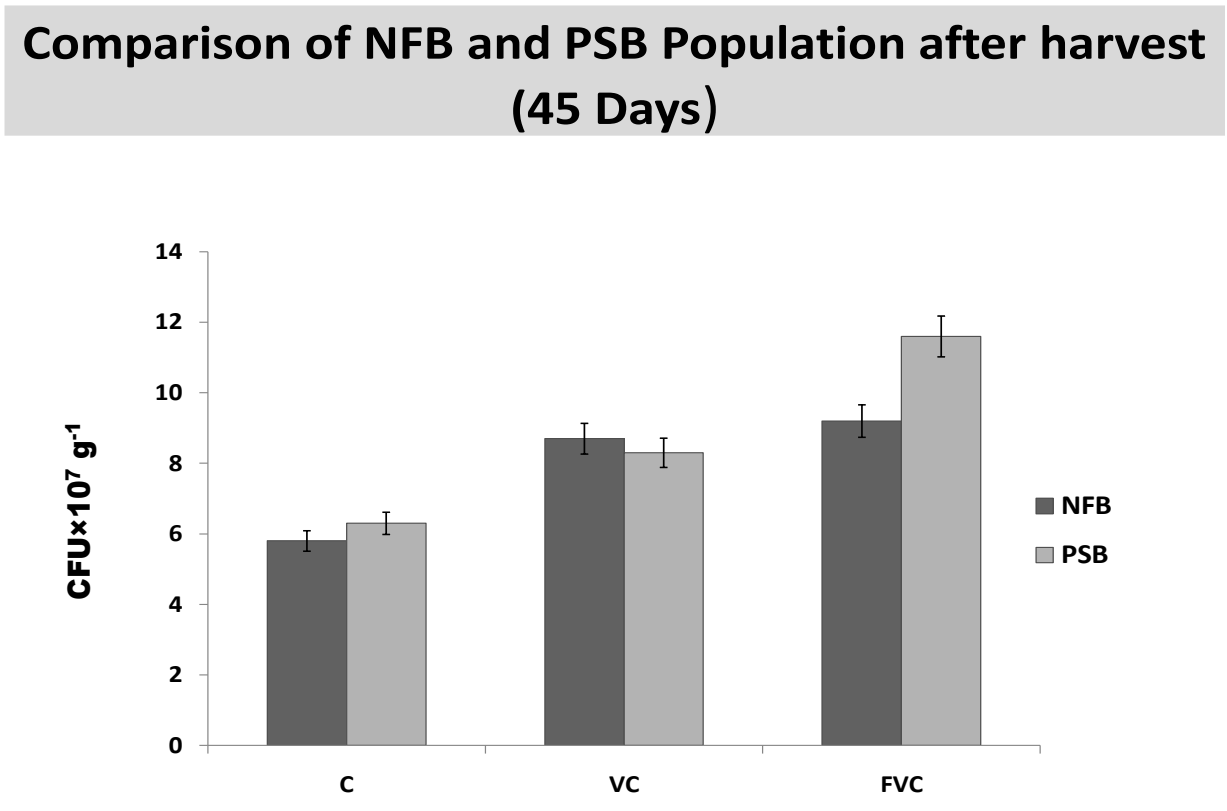
Comparison of nutrient status of compost (C), vermicompost (VC) and fortified vermicompost (FVC)

Parameters	C	VC	FVC
pH	6.4	6.7	6.9
TOC	18.6	18.5	18.2
Total Nitrogen (%)	1.31	1.42	1.51
Total P(%)	1.52	1.85	2.12
Total K (%)	1.37	1.62	1.60

TOC: Total Organic Carbon

Microbial decomposition of organic material is another important parameter of process of composting and its maturity. Usually the exo-enzymes present in the microbes accelerate the process and also causes the mineralization process making the nutrients bio-available for the plants. In this experiment also when microbial load (NFB and PSB) is considered at maturity it shows that fortified vermicompost (FVC) has highest value of NFB and PSB as compared to normal Compost and Vermicompost. Addition of these microbial inoculants has enhanced the rate of decomposition and thus made the nutrient availability at a greater level as compared to compost and vermicompost.

FIGURE-1: MICROBIAL LOAD OF NFB AND PSB OF DIFFERENT COMPOST MATERIALS



C = Compost

VC = Vermi Compost

FVC = Fortified Vermi Compost

SUMMERY/ CONCLUSSION

- Normal composting is more time taking process
- Vermicomposting is faster and has more bio-available nutrients
- Bio-fortification with desired microorganisms
- (NFB & PSB) makes the compost more suitable for plants
- Decomposition faster and shelf life is more
- Suitable microbiological management practice so can be considered as Vermi-booster

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