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# Chemical Nutrient Analysis of Vermicompost and Their Effect on the Growth of SRI Rice Cultivation

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**ABSTRACT:** The importance of composts as a source of humus and nutrients to increase the fertility of soil and growth of plant has been well recognized in the present study. Vermicompost and Chemical fertilizer were taken first for chemical analysis and then to find the effect of these composts on the growth of SRI Rice Cultivation. It was found that the vermicompost was rich in nutrients like Potassium, Nitrate, Sodium, Calcium, Magnesium, and Chloride and have the potential for improving plant growth than Fertilizer. The optimal growth of SRI Rice in our study conducted for a period of four month. The study also showed distinct differences between vermicompost and Chemical fertilizer in terms of their nutrient content and their effect on SRI Rice plant growth.

**KEYWORDS:** Solid waste, Earthworms, Vermicompost, chemical fertilizer, Rice Cultivation.

### I. INTRODUCTION

It has been estimated that organic resources available in the country alone can produce not less than 20 million tones of plant nutrients (NPK). The disposal of ever increasing amounts of organic wastes is becoming a serious problem. The hygienic disposal of organic wastes by composting is an environmentally sound and economically viable technology resulting in the production of organic fertilizer which is a basic and valuable input in organic farming. In India, about 350 million tons of agricultural wastes are generated annually in a major portion. The biological treatment of these wastes appears to be most cost effective and carry a less negative environmental impact. In Many areas the traditional management practice of post harvest residues is the elimination by open air burning leads to release of green house gases and the production of particulate matter are obvious. Therefore as an alternative to burning of agricultural residue, the incorporation into the soil stands to reason, this has been widely accepted. However, these materials take a long time for decomposition under normal conditions; application of vermiculture technology for recycling of these organic residues gives valuable manure with in short period. Vermicomposting is an eco biotechnological process that transforms energy rich and complex organic substances into stabilized humus like product vermicompost; hence the research work is formulated to study the possibilities of adopting vermiculture technology for recycling of organic residues and its comparative evaluation with normal composting. From vermiculture, we get well decomposed worm casts, which can be used as manure for crops, vegetables, flowers, gardens, etc. In this process, earthworms also get multiplied and the excess worms can be converted into vermiprotein which can be utilized as feed for poultry, fish, etc. Vermi-wash can also be used as spray on crops.

### II. MATERIALS AND METHODS

The present investigation entitled "Vermicomposting for effective waste management" involved preparation of vermicomposts from Agricultural residues was carried out at Regional Agricultural Research Station, Vriddachalam,

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Cuddalore district of Tamilnadu, India during 2014. The basic raw materials used for vermicomposting were: 1) Sugarcane trash 2) Weeds and 3) Paddy straw. Earthworm species used for vermicomposting was *Eisenia foetida*. As an accelerator 5 % dung slurry was used in composting. Pit method of composting was done with the dimensions of 6.0 x 1.0 x 0.6 m.

### III. EARTHWORM: A SOIL CONDITIONER

Earthworms are small, soft, cylindrical bodied invertebrates that play a vital role in soil ecosystem maintenance. Earthworms are an important organism in the soil doing great service for mankind for millions of years now. A newer branch of biotechnology called 'Vermiculture Technology' is emerging by the use of earthworms to solve various environmental problems from waste management to land (soil) improvement. Earthworms when present in soil inevitably work as 'soil conditioner' to improve its physical, chemical and biological properties and also its nutritive value for healthy plant growth. This they do by soil fragmentation and aeration, breakdown of organic matter in soil & release of nutrients, secretion of plant growth hormones, proliferation of nitrogen-fixing bacteria, increasing biological resistance in crop plants and all these worm activities contribute to improved crop productivity.

### IV. VERMICOMPOSTING TECHNOLOGY

The cane trash and paddy straw obtained during harvest of sugarcane and rice crops were collected. The weed species available in sugarcane field. These organic residues were shade dried for few days and cut into small pieces. It is preferable to select a composting site under shade, in an elevated level, to prevent water stagnation in pits during rains. Make small holes on the side of pits The organic residues were spread in the pit (6.0 x 1.0 x 0.6 m) up to 6<sup>2</sup> heights and 5 % dung slurry was uniformly distributed on the top of the organic residue sufficient to wet the surface. Over this layer another layer of organic residues was spread followed by spraying of dung slurry uniformly. This process was repeated till the spread of the organic residues 6<sup>2</sup> above the top of the pit. After partial decomposition of organic residues (attained in 15 days) the earthworms (*Eisenia foetida*) were released @ 1 kg (around 1000 worms) per 1 ton organic residues in to the bed by making holes at the top of the bed on four corners and centre of the pit. Throughout the composting process, sufficient moisture was maintained i.e. at 50 percent of maximum water holding capacity of a material. Sprinkling of water should be stopped when 90 % bio-wastes are decomposed. Maturity could be judged visually by observing the formation of granular structure of the compost at the surface of the pit. Normally after 60 days, organic refuse changes into a soft, spongy, sweet smelling; dark brown compost will be ready for collection. Harvest the vermicompost by scrapping layer wise from the top of the pit and heap under shed. This will help in separation of earthworms from the compost. Sieving may also be done to separate the earthworms, cocoons and eggs. The temperature and moisture content were maintained by sprinkling adequate quantity of water at frequent intervals.

### V. RESULTS

The organic residues used for vermicomposting taken from different intervals were analyzed for physico-chemical and chemical properties by using standard procedures. Vermicompost samples were collected at 0, 15, 30, 45, and 60 days. Which were processed for analysis of major nutrients nitrogen (N), available phosphorus (P), exchangeable potassium (K), calcium (Ca), and magnesium (Mg). The temperature (°C), moisture (%), pH, and electrical conductivity (EC) were recorded. Temperature was noted daily using a thermometer, and moisture content was measured gravimetrically. The pH and EC of samples were recorded by a digital pH meter and conductivity meter, respectively. The N was estimated by the Kjeldahl method, and the P and K contents of the samples were analyzed by calorimetric method and flame photometric method respectively. The Ca and Mg contents of the samples were also analyzed using atomic absorption spectrophotometer. The C: N ratio was calculated from the measured values of C and N.

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Table 1 .shows the nutrient content of vermicompost

S.No	Chemical Parameters	Vermicompost
1	pH	8.41
2	Conductivity(mho)	3.11
3	TDS (mg/l)	2140
4	Na (mg/l)	91
5	K(mg/l)	1485
6	Chloride (mg)	13
7	Nitrate	1.394
8	Calcium(mg)	13
9	Magnesium(mg)	8

A series of experiments were conducted at Peralaiyur Village, Vriddachalam, Cuddalore, and TamilNadu to study growth and yield characteristics of paddy rice with different cultivation techniques under the SRI (system of rice intensification using organic manure) management, in comparison with CF(conventional Farming system using Chemical Fertilizer).

### VI. DISCUSSION

Vermicompositing appears to be the most promising as high value biofertilizer which not only increases the plant growth and productivity by nutrient supply but also is cost effective and pollution free. Use of vermicompost promotes soil aggregation and stabilizes soil structure. This improves the air- water relationship of soil, thus increasing the water retention capacity and encourages extensive development of root system of plants. The mineralization of nutrients is observed to be enhanced, therefore results into boosting up of crop productivity. The vermicomposts have a higher base exchange capacity and more exchangeable calcium, magnesium, potassium than the soil in which worms live. Nitrogen fertilizer is “the third major threat to our planet, after biodiversity loss and climate change.” John Lawton, former Chief Executive, Natural Environment Research Council, and UK. All the farmers expressed that they would prefer to use organic material if available in adequate quantities. Green manure and farm yard manure application will enhance the growth and yield of rice in this system approach. SRI was developed in the 1980s with fertilizer use, and this does enhance yield. But soil that is enriched with compost or manure will usually have better structure so that plant roots can grow more easily and deeply, and soil organic matter supports the growth of microbial populations and greater biodiversity within the soil. Compost releases its nutrients more slowly than chemical fertilizer so plants usually get more benefit. We think that SRI soil management practices (no flooding, the use of compost, and rotating-hoe weeding) help increase the populations of micro-organisms in the soil which can produce nitrogen for the plant. They can also assist with phosphorus solubilization. Also there is more oxygen in soil which has more worms, ants, termites, etc., which are less abundant in chemically fertilized soil.

Table 2. Comparison of Parameters between SRI and Conventional Methods

S.No	Parameter in (DAS)	Rice With Organic Manure( SRI)	Rice with Chemical Fertilizer(CF)
1	Plant Height (cm)	101	99
2	No.of.Effective tillers/Hill	29	8
3	Panicle length	26.89	23.57
4	Panicle weight (g)	4.176	2.929
5	Filled grains per panicle	181.9	113.7
6	Grain yield (mt/ha-1)	6.95	4.18
7	Straw yield (t ha-1)	9.1	6.5
8	Harvest index (HI)	0.41	0.39
9	Water productivity ( kg/m3)	0.514	0.259

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The result in table demonstrate that the growth of Rice grown in Organic Manure -vermicompost (SRI) and Conventional Farming (CF) using Chemical Fertilizer. Tall plant height (101 cm) was observed in SRI method and at the same observation short plant height (99 cm) was observed in CF. Tiller was maximum in SRI (29) than the CF (8) grown in Chemical Fertilizer. The tillering, its growth and development phase is also known as Phyllocron stage of the crop. . Longer panicle length of SRI method is (26.89 cm). Significantly shorter panicle length was observed in CF method (23.57cm). Panicle weight of SRI method (4.176 g) .Significantly lower panicle length was observed in CF method (2.929 g). Filled grain per panicle was the highest in SRI method (181.9)

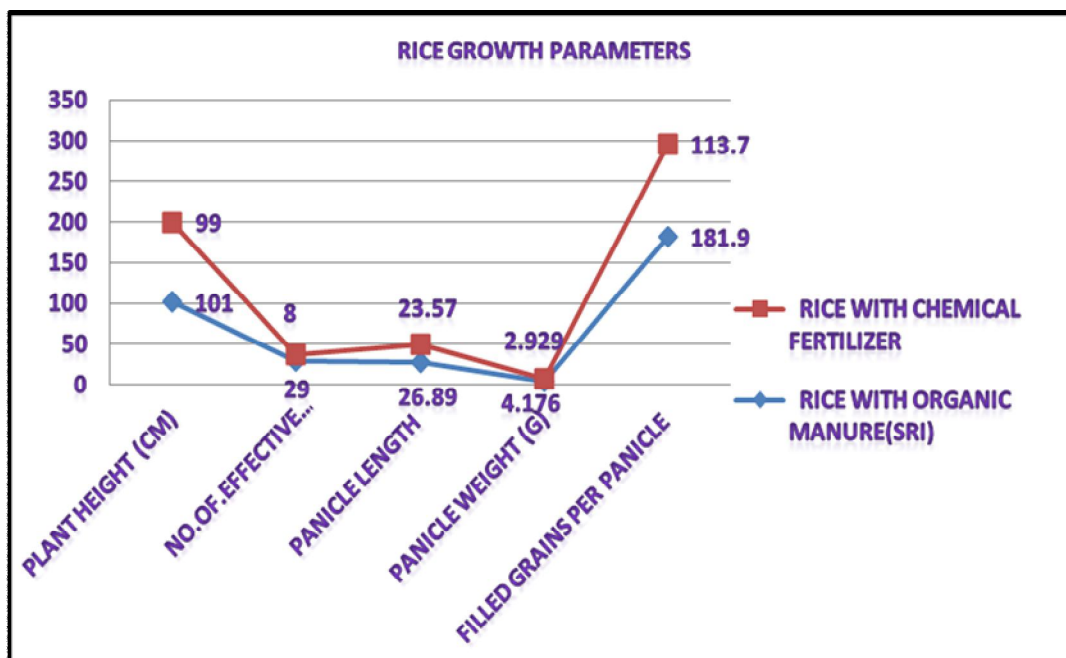


Fig. 1 Rice growth Parameters

Lower number of filled grain was observed in CF method and was (113.7). The longer SRI panicles carried nearly 1.7 times more number of grain compared to panicles obtained from conventional methods. Thus, lower number of filled grains per panicle in CF method might be due to shorter panicle length and higher sterility percentage. SRI method of crop establishment had produced significantly higher grain yield (6.95 mt/ha) and the lowest yield was under CF method i.e. 4.18 mt/ha. The straw yield was the highest (9.1 t ha<sup>-1</sup>) in SRI method which was significantly superior to the straw yield from CF (6.5 mt/ha). Harvest index indicates the efficiency of assimilate partition to the parts of economic yield of the rice plants (i.e. panicle). Significantly higher harvest index was obtained in by SRI (0.41), and the lowest was of CF (0.39). The experiment shows the highest water productivity in SRI methods (0.514 kg/m<sup>3</sup>), followed by CF (0.259 kg/m<sup>3</sup>).

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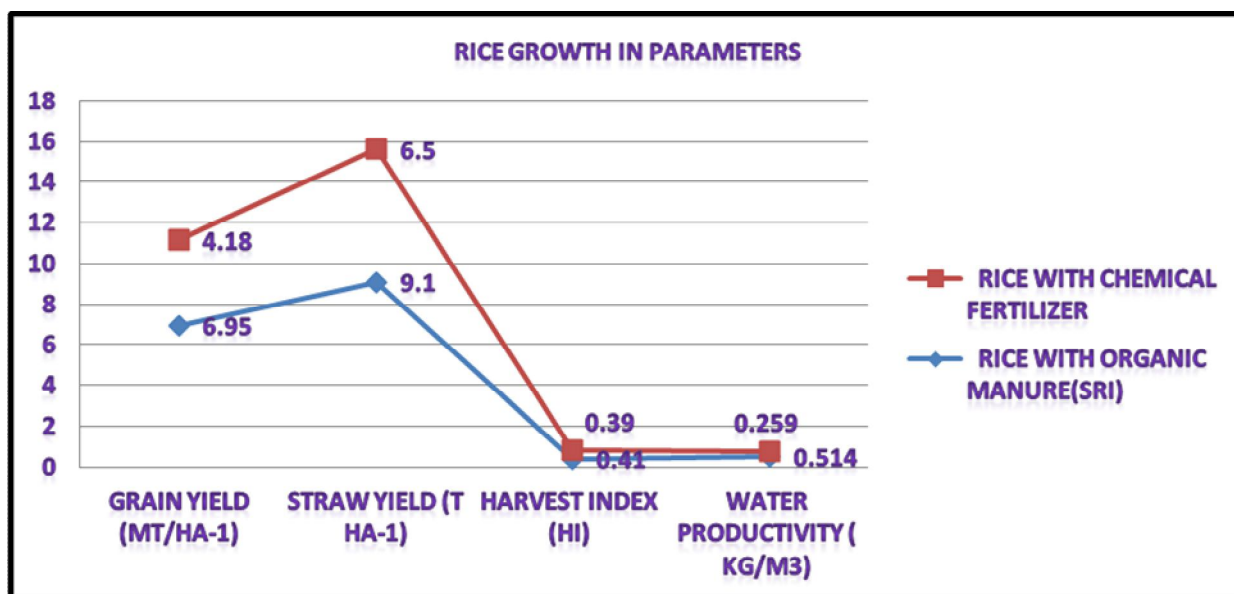


Fig. 2 Rice growth Parameters

Thus it was observed that the vermicompost contains nutrient content to such an extent that enhances the growth of Rice at a faster rate in comparison to Chemical Fertilizer. Unlike other composts, vermicompost also contains worm mucus which helps prevent nutrients from washing away, holds moisture better and thus helps in increased plant growth.



Fig. 3 Plant Height of SRI Rice with Organic Manure



Fig. 4 Plant Height of SRI Rice with Chemical Fertilizer

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Fig. 5 Tillers of SRI Rice with Organic Manure



Fig. 6 Tillers of SRI Rice with Chemical Fertilizer



Fig. 7 Growth of Panicle in SRI Rice with organic Manure



Fig. 8 Growth of Panicle in Rice with Chemical Fertilizer

### VII.CONCLUSION

Thus the results indicate that the nutrients present in vermicompost results in the increased growth of SRI Rice plants in a very short period of time. Vermicompost also played a crucial role in improving soil properties, increases crop yield and has a tremendous effect on the growth of SRI Rice as compared to Chemical fertilizer. It is conclude that SRI offers three major benefits that have significant climate implications if applied on a large-scale: Reduced demand for water, reduced methane gas emissions, reduced use of chemical fertilizers. In addition, with SRI practices, rice plants have stronger stems and root systems that are more resistant to flooding and storm damage compared to those grown using conventional practices. Perhaps even more important, their deeper root systems make crops more drought-resistant.

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