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Influence of Different Leaf Litter Vermicompost Substitution on the Growth of Eucalyptus Hybrid (Eucalyptus camaldulensis Dehn x E. tereticornis Sm)

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ABSTRACT

Due to environmental problems caused by improper waste management like burning of leaf litter and intensive use of chemical fertilizers, scientists around the world are seeking for management alternatives. The aim of this study was to see the effect of different vermicompost treatments [prepared from leaf litters of eucalyptus, parthenium, poplar, sal and pine needles, individually mixed with municipal solid waste (MSW) in 1:1 ratio (v/v)] and control (nursery soil) on the growth of Eucalyptus hybrid. For this, nursery soil and vermicomposts were mixed in three different proportions 1:1, 1:2 and 1:3. The results showed that vermicompost substitution significantly increased waste (MSW) in 1:1 ratio (v/v) and control (nursery soil) on the growth of plants. Vermicompost treatments (prepared from leaf litter mixed with municipal solid waste) and nursery media on germination and different growth parameters of selected for this study and were collected from Forest Research Institute (FRI) campus. The leaf litters of each species were first composted by individually mixing them with equal amounts (v/v) of municipal solid waste (MSW) and then moistened with cow dung slurry (following Gajalakshmi et al. 2001). Organic wastes (leaf litter + MSW) were composted thermophilically for 47-82 days (depending on the leaf litter) with manual turning every 3rd day.

INTRODUCTION

Disposing-off the considerable quantity of leaf litter produced by trees growing in the forests, along the roads, rail lines, in the backyard, etc. has always been a problem. Improper management of such wastes (burning of leaf litters and uncared dumping in public places) and intensive use of synthetic fertilizers and chemical pesticides since the Green Revolution some five decades ago has deteriorated the health of the environment to a large extent. In the rural areas, residents generally collect and use leaf litter as biomass fuel for cooking. In India, approximately 5 lakh women and children die due to indoor air pollution caused by using solid biomass as cooking. In the cities, leaf litters are burnt which causes several health problems, especially respiratory like asthma and heart diseases (Sannigrahi 2009). The conversion of a negative waste into beneficial material is an important aspect of resource recycling and environmental cleaning (Tripathi and Bhardwaj 2004). Leaf litters are a potential energy resource if properly and biologically converted to organic matter. In this regard vermicomposting is an easy and effective way to recycle leaf litter along with bioconversion of organic waste materials into nutritious compost by earthworm activity (Mall et al. 2005). It is the best alternative of the present day’s environmental degradation to make proper use of the available unutilized organic biodegradable wastes in order to convert them into compost within a short period. Vermicomposting of organic waste and their application in the fields could decrease the use of chemical fertilizers and eventually replace it. Due to increasing awareness, farmers are now returning to natural methods of cultivation san chemicals.

Several studies have been carried out and reported which prove that vermicompost could be used as an excellent soil amendment for main fields and nursery beds. Gajalakshmi and Abbasi (2004) and Gajalakshmi et al. (2005) have reported vermicomposting of neem and mango leaves respectively. The ability of some species of earthworms to consume and breakdown a wide range of organic residues especially crop residues is well known (Karmegam and Daniel 2009; Patnaik and Reddy 2010). Nutrients such as nitrates, phosphates, and exchangeable calcium and soluble potassium present in vermicompost are mostly in plant available forms (Orozco et al. 1996). It is now scientifically proved that vermicompost can influence the growth and productivity of plants significantly.

The main objectives of the present study were to access the effects of the application of different ratios of different vermicompost treatments (prepared from leaf litter mixed with municipal solid waste) and nursery media on germination and different growth parameters of Eucalyptus hybrid, namely plant height (cm), number of leaves per plant, number of branches per plant, root length (cm), number of lateral roots and total leaf area (cm²).

MATERIALS AND METHODS

The leaf litters of Eucalyptus hybrid, Pinus roxburghii, Parthenium hysterophorus, Populus deltoides and Shorea robusta were selected for this study and were collected from Forest Research Institute (FRI) campus. The leaf litters of each species were first composted by individually mixing them with equal amounts (v/v) of municipal solid waste (MSW) and then moistened with cow dung slurry (following Gajalakshmi et al. 2001). Organic wastes (leaf litter + MSW) were composted thermophilically for 47-82 days (depending on the leaf litter) with manual turning every 3rd day.

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day initially and later turned in accordance with temperature evolution and water was added to maintain moisture content near 60% (Aakol and Tripathi 2010).

The compost obtained was then subjected to vermicomposting using the epigeic species Eisenia fetida. The methodology followed for vermicomposting was as per Gajalakshmi et al. (2001). The compost and vermicompost produced were analyzed for different physico-chemical nutrients (Aakol and Tripathi 2010). For the nursery experiments, treatment mixtures were prepared by thoroughly mixing nursery soil and five different vermicompost in three different ratios (1:1, 1:2 and 1:3) and nursery soil was set as control. Seeds of E. hybrid were collected from the local nursery. 50 seeds were sown in plastic trays filled with the treatment mixture. Out of the 50 seeds germinated, 5 seedlings (replicates) were transplanted into polybag of size 0.73 liters (approx.) filled with the treatment mixture after 30 days of sowing. An individual plant was considered as a replicate. The nursery study was carried out for a period of six months (from December, 2006 to May, 2007). The detail of the treatments prepared is as follows: Nursery soil (control)

Nursery soil + EuLMSWV - 1:1, 1:2 and 1:3
Nursery soil + PiLMSWV - 1:1, 1:2 and 1:3
Nursery soil + PoLMSWV - 1:1, 1:2 and 1:3
Nursery soil + SrLMSWV - 1:1, 1:2 and 1:3

| Treatments Germination % Height (cm) No. of leaves No. of branches Total leaf area (cm²) Root length (cm) No. of lateral roots |
|---------------------------------|------------------|-----------------|----------------|----------------|-----------------|-----------------|
| Control                         | 96.4 ± 2.19      | 99.3 ± 11.84    | 56.9 ± 13.12   | 2.4±1.98       | 1043.3 ± 624.92 | 44 ± 10.17      | 7.4 ± 1.52     |
| EuLMSWV 1:1 94 ± 1.41           | 93.6 ± 10.09     | 914.5 ± 10.34   | 48.2 ± 10.14   | 2.7±1.89       | 852.3 ± 624.92  | 44 ± 10.17      | 7.4 ± 1.52     |
| EuLMSWV 1:2 94 ± 1.41           | 105.9 ± 21.25    | 86 ± 6.25       | 2.7±1.89       | 1043.3 ± 624.92| 44 ± 10.17      | 7.4 ± 1.52     |
| EuLMSWV 1:3 96 ± 1.41           | 97.8 ± 13.01     | 916.3 ± 13.12   | 59 ± 6.25      | 2.7±1.89       | 1043.3 ± 624.92 | 44 ± 10.17      | 7.4 ± 1.52     |
| PiLMSWV 1:1 98 ± 1.22           | 115.4 ± 9.18     | 96.7 ± 10.25    | 4.6±2.13       | 1577.96 ± 195.36| 34 ± 2.14       | 7 ± 1.22       |
| PiLMSWV 1:2 99.33 ± 3.04        | 136.9 ± 8.15     | 73 ± 23.72      | 6.6±2.75       | 1854.32 ± 235.18| 46.8 ± 5.63     | 8.6 ± 1.14     |
| PiLMSWV 1:3 99.67 ± 2.34        | 122.7 ± 12.36    | 72.4 ± 15.68    | 5.3±2.64       | 1618.75 ± 233.79| 39 ± 4.75       | 8.2 ± 1.14     |
| ParLMSWV 1:1 96.67 ± 2.27       | 102.9 ± 28.3     | 75.7 ± 26.09    | 3.9±1.59       | 1279.1 ± 288.23| 34.6 ± 4.39     | 7.4 ± 1.52     |
| ParLMSWV 1:2 98 ± 1.22          | 117 ± 14.73      | 65.3 ± 10.71    | 4.8±3.29       | 1585.48 ± 217.48| 49.2 ± 9.78     | 9 ± 1.58       |
| ParLMSWV 1:3 98 ± 1.22          | 113 ± 15.90      | 62.8 ± 19.89    | 4.3±2.58       | 1363.08 ± 589.55| 42.8 ± 6.61     | 8.2 ± 1.64     |
| PoLMSWV 1:1 98 ± 1.22           | 106 ± 7.03       | 63 ± 6.81       | 4.1±2.76       | 1225.4 ± 517.82 | 45 ± 3.94       | 8.4 ± 1.14     |
| PoLMSWV 1:2 97.67 ± 1.27        | 119.3 ± 18.94    | 66.9 ± 11.25    | 5.7±3.23       | 1672.8 ± 455.08| 51.6 ± 4.50     | 9.9 ± 4.01     |
| PoLMSWV 1:3 99.67 ± 3.12        | 108 ± 13.19      | 66.1 ± 6.41     | 4.6±2.31       | 1499.5 ± 498.71| 49.4 ± 4.39     | 9 ± 3.46       |
| SaLMSWV 1:1 93 ± 4.41           | 90 ± 8.21        | 45.8 ± 10.51    | 1.7±1.49       | 562.32 ± 149.68| 41.3 ± 4.27     | 8.1 ± 1.59     |
| SaLMSWV 1:2 92 ± 3.46           | 98.7 ± 13.01     | 56.9 ± 18.66    | 1.9±1.37       | 916.11 ± 112.38| 48.7 ± 10.59    | 9.3 ± 4.02     |
| SaLMSWV 1:3 94 ± 2.44           | 93.6 ± 10.09     | 54.3 ± 10.59    | 2.7±2.1        | 822.96 ± 125.57| 46 ± 4.33       | 8.6 ± 1.14     |
| CD 38.27                        | 21.88                         | 23.34                          | 2.29                | 542            | 10.154           | 1.544          |

Significance ** ** ** ** **

The values are mean of five replicates ± standard deviation, **, **, ***, significant at 0.01, 0.001 probability levels, respectively.

Table 1 Effect of different treatment mixtures on germination percentage and growth parameters of Eucalyptus hybrid.

**Statistical analysis**

The experiment was a completely randomized design with 5 replicates of each treatment. The experimental data was expressed as mean ± Standard Deviation. Two-way ANOVA was used to analyze the significant (P ≤ 0.05) difference between the treatments and among ratios using General Linear Model (GLM) procedure of SPSS v. 11 [FRI, Dehradun] statistical software for windows.

**RESULTS**

The seeds of E. hybrid were sown in the month of December and germination was noticed after four weeks. The data recorded for different growth parameters are presented in Table 1. Application of vermicompost significantly increased the plant growth. The results indicated that under identical laboratory conditions the plants grown in the media containing soil amended with different vermicompost had better height, larger number of leaves and branches per plant, root length, number of lateral roots and total leaf area.

**Germination percent**

Higher germination of seedlings was recorded in the treatments (leaf litter vermicomposts) as compared to the control. Maximum germination was noticed in the treatment PiLMSWV and minimum in SrLMSWV. It was noted that the germination of eucalyptus seedlings increased with increasing vermicompost concentration, i.e., in 1:3 ratio (Table 1). Significant differences (P < 0.001) were seen between the treatments, between the ratios and in the interactions between the treatments and ratios.

**Growth parameters**

Most of the growth parameters (mean height, number of leaves, number of branches and total leaf area) responded well with the treatment PiLMSWV and the least effective treatment was SrLMSWV. Regarding increment of root length and number of lateral roots, the treatment PoLMSWV was best suited (Fig. 1E). Here an opposite trend to that germination was noted, i.e., the plant growth and morphology decreased with increasing vermicompost concentration.
compost concentration (1:3 ratio). Higher growth was noted in a 1:2 ratio (Table 1). The growth of eucalyptus plant was significantly different ($P < 0.001$) with each treatment. Non-significant differences were seen between the ratios.

**DISCUSSION**

The results of this experiment show that it is possible to substitute leaf litter vermicompost as soil amendment in nurseries although substantially different effects were observed between these substrates in plant morphology and growth depending on the dose used. There are several greenhouse experiments to prove that vermicompost can enhance the growth of a wide range of plant species (Edwards et al. 2004; Hashemimajd 2003). There are similar examples in the literature proving that compost and vermicompost are able to further enhance the growth of plants (Edward and Burrow 1988). The effect of different types of vermicomposts as potting or soil amendments on plant growth and yield has been reported in many studies (Garcia-Gomez et al. 2002; Castillo et al. 2004; Herrera et al. 2008) and to the presence of excessive nutrient levels (Hashemimajd et al. 2004).

Root morphology was also significantly improved through the increase in root length and number of lateral roots as compared to the control. These improvements in plant growth and morphology are basically due to enhancement of post-transplant success. Nutrient-rich environments and the presence of hormones like auxins improve root growth. This enables the plant to optimize the exploitation of the available resources which are in turn transformed into photoassimilates and transported again to the root consequently influencing plant growth and morphology in a systemic manner (Forde and Lorenzo 2001; López-Bucio et al. 2003).

**CONCLUSION**

The results of this study show that good quality vermicompost can be produced from the leaf litters of forest tree species. Such studies could prove to be helpful in dealing problems like uncared dumping and burning of leaf litter in public places. Due to increasing interest in organic farming, use of composted and vermicomposted organic waste as soil conditioner is on the rise. Thus vermicomposting of leaf litter holds promise to play a significant role both in cleaning the environment and building up of soil fertility for sustainable agriculture.

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**REFERENCES**

Aalok A, Tripathi AK (2010) Composting-vermicomposting of different leaf litters using earthworm species Eisenia fetida. In: Karmegam N (Ed) Vermitechnology II. Dynamic Soil, Dynamic Plant 4 (Special Issue 1), 139-144


Canellas LP, Olivares FL, Okorokova Faancha AL, Faancha AR (2002) Humic acids isolated from earthworm compost enhance root elongation, late-


