Seriwaste vermicompost- A trend of new sustainable generation – A Review

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ABSTRACT
Research in the field of agriculture has thickened very rapidly during the core of this technology revolutionized decade. Many of these compounded changes have bestowed to new innovative technologies like recycling the residues which are left in the agriculture field and agro based industries. This residue recycling is lending agriculture to maintain the soil fertility and reduce the cost of inputs. The new trend comes into the picture of compost is seriwaste. Besides silk production sericulture industry also produces large amount of waste which goes unutilized in our country. This organic waste can be profitably utilized for composting which has a lot of market potential as well as possible fertility impact over the cultivation land. Hence, this paper provides an overview of Seriwaste and its advantages.

Key words: Recycling, Residues, Sericulture, Seriwaste, Technology.

Recent issue of problem is fertility decline, it is necessitated a down-to-earth approach for management of diverse sources of fertility within the context of integrated nutrient management (INM). The integrated nutrient supply aims at balancing the soil fertility and plant nutrient status to an optimum level through the judicious and efficient use of mineral fertilizers, biofertilizers, crop residues and organics. One such among them is a new trend of seriwaste compost. Seriwaste which includes all the left out materials from the silk worm rearing unit as well as from silkworm industry. In sericulture farms, the left over mulberry leaves from rearing bed and field and other waste including silk warm litter are not properly utilized in preparing compost of high nutritive value. Since the seriwaste contains high amount of nutrients, there is potential for the bio conversion of seriwaste to enriched compost and can be utilized as an excellent nutrient source for the production of crops.

Indian scenario of sericulture industry: India has the unique distinction of being the only country producing all the five kinds of silk – Mulberry, Eri, Muga, Tropical tasar and temperate tasar. India occupies second position among the silk producing countries in the world besides being the largest silk consumer. Sericulture industry engages 60 lakh persons in the country, especially in rural areas and no other industry generates this kind of employment. Sericulture is used as a tool for rural reconstruction.

The rural agro-based mulberry sericulture industry includes cultivation of food plants, rearing silkworms, conducting silk reeling, twisting, dyeing, weaving etc., The current annual production of 16360 MTs of mulberry raw silk and proportionate consumption of food plants in 170 thousand hectares spread over 51 thousand villages, generation of 125 thousand tons silk cocoons and 24 crore silkworm seed indicate the massive quantum of by product generation in sericulture sector, require perceptive management for adding additional employment and value. Women constitute over 60% of those employed in the activities of sericulture in the country, starting from mulberry garden management, leaf harvesting, silkworm rearing and silk reeling. It is more effectively and largely supported by the women folk.

Sericulture waste: Sericulture is a commercially sustainable farm based economic enterprise favouring rural poor in the unorganized sector, because of its relatively low requirement of fixed capital and high return.

The waste in sericulture contains organic matter like larval excreta, leaf litter, dead larvae, moth and cocoons (Kamili and Mosoodi, 2000). Presently the Seri-waste rich in organic matter are not utilized properly for any productive propose by the tribal farmers. Organic wastes from animal and plant origin are presently best utilized for vermi composting by indigenous and exotic earthworms (Nath et al., 2009). Earlier reports have shown that the seriwaste from mulberry culture can also be utilized for production of organic manure by this method.
In recent years, recycling of crop residues has received considerable interest. In sericulture farms, the left over mulberry leaves from rearing bed and field and other waste including silk worm litter are not properly utilized in preparing compost of highly organic and nutritive value. Hence, it is essential to convert the sericulture farm waste into valuable compost by adopting suitable technology. Sericulture waste serves as good source of organic nutrients for the crops. Seri waste contains more amounts of plant nutrients like macro and micro nutrients which contribute to increased production.

Seri waste compost practiced only in mulberry to produce high yielding and healthy leaves to improve the silkworm yield. As a new trend, to use the seri waste in field crops for increasing yield and quality of the food grains has emerged. The success of future agriculture depends upon sustainability of production system. This has necessitated research on use of organic manures. It helps farmers to reduce input of commercial fertilizers, thereby increasing profit margin. Nutrients contained in organic manures are released more slowly and stored for a long time in the soil, ensuring a long residual effect (Sharma and Mittra, 2007). Safeties of environment as well as public health are also important reasons for advocating increased use of organic materials (Hazra, 2007). But, the use of organic manure alone, cannot sustain the cropping system due to unavailability of required quantities and their relatively low nutrient content in a long term basis (Palm et al., 1997).

Seri waste compost: Seri waste compost was prepared in the farmer field in Avinashi, Tiruppur District as per the following standard recommended procedure.

Composting with micro organisms: Rearing waste and mulberry farm residues and weeds (removed before flowering) are collected in a pit of convenient size with 1 m depth. The left over stems/shoots can also be decomposed. However, they should be crushed before putting them in pit, which makes their decomposition faster. The thin layer of cow dung and water or spent slurry of biogas plant are spread into the pit regularly after every collection of one foot thick compacted layer of the wastes. When the pit is filled, it is plastered with a layer of mud and cattle dung. The pit should be protected from rain and direct sunlight by providing a thatched shed over it. As decomposition process usually takes about 4-5 months, the pit should be left undisturbed and opened only after 5 months.

The decomposition of organic waste is a complex process involving various biochemical activities of microorganisms, especially the Bacillus, Pseudomonas, Trichoderma, Aspergillus, Belaromyces, etc. Therefore, to speed up the process of decomposition, the culture of these microbes can be added along with sericultural wastes. As the species of Bacillus, Pseudomonas, Trichoderma and Verticillium are also known to be the potential biocontrol agent of plant diseases, the compost enriched with these microbes are effective in controlling the soil borne diseases of mulberry.

Method of compost: The farm waste can be collected in pits of convenient size. Two pits of size 3 x 1 x 1 m are adequate to receive farm waste from 1 acre. Sericulture waste like silk worm litter, left over mulberry leaves weeds etc., should be collected every day and special in a thin layer. A layer of fresh cow dung, ash and water is sprinkled over the layer and compacted. At the end of the rearing, the left over leaves of the garden along with the young mulberry twigs can also be added to the pit. Super phosphate is also added to enrich the compost. When the pit is filled and when the bed height is 30-40 cm above the ground level, it is plastered with 2.5 cm layer of a mixture of mud and cow dung. Thatched shed is provided to protect the compost pit from rain and direct sunlight.

To enhance the decomposing process, a consortium of lignocellulose decomposing fungi like Aspergillus sp., Trichoderma sp., and Belaromyces sp., could also be added @ 1 kg ton⁻¹ of organic waste. By adopting anaerobic and aerobic process of composting it is possible to generate approximately 10-15 tonnes of well decomposed and nutritionally rich seri waste compost from a sericultural farm of one hectare every year.

Preparation of vermicompost using sericulture waste:

- A thatched shed in an area of approximately 7.5 x 6.0 m is constructed on a slight elevated ground for a mulberry farm of one ha area. Stone bunds are constructed all around the shed to prevent predators.
- Eight trenches each measuring 2.4 x 0.6 x 0.45 m are prepared parallel to each other in two rows with 4 each. The shed is lined with polythene sheet or stone at the bottom and side walls on the inner side to avoid migration of earthworms. The depth of the trench should not be more than 0.45 m.
- As a feed for the earth worms the sericulture waste including weeds are mixed with cow dung slurry and mixed with 100 liters of water for every ton of waste. It is left in an open pit for about 7-10 days for partial decomposition. While decomposing, the material should contain a minimum of 30-40 percent moisture. During the decomposition process, the temperature of the semi decomposing material will rise to
50-60 °C. Hence, the material is turned upside down once or twice to bring the temperature to normal to normal state.

- Later each trench is filled up with 200-300 kg if semi decomposed sericulture waste having moisture content of 30-40 per cent
- A mixer culture of earthworms viz., Eudrillus euginae, Eisenia fetida and Perionyx excavatus in juvenile stage is introduced in the feed @ 1.5Kg per metric tones of wastes in each trench and left aside for 6-7 weeks. While releasing earth worms care is taken to ensure approximately 30-40 % moisture and normal temperature in the feed. During feed preparation, temperature of the decomposing waste increase beyond 50 °C which may kill the worms and hence it is essentials to bring down the normal temperature.
- After 2-3 days of release of earthworms, water is sprinkled regularly to keep the feed moist a protective cover of coconuts fronds or any green leaves is provided to avoid evaporation. Once a week the materials is turned upside down for proper composting
- After 6-7 weeks time if most of the feed is found as loose granular casts (brown to black in colour) the material can be harvested and sieved through wire mesh to separate earthworms and cocoons for reuse.
- After sieving brown to black loose granules of vermicasting can be collected and used as manures. While harvesting moisture is evaporated for better result. Maximum quantity of vermicasting can be harvested if the material is allowed to dry for sometime inside the shed.
- It is necessary to keep the shed dark moist and cool while vermicompost is under progress to get best result as earthworms do not prefer light.
- The final product, vermicompost should be used for crop production without much delay to get best results.
- Seri waste vermicompost is blackish brown humus like coarse, granular material which is loose, fine, soft to touch, light in weight and free from any foul smell, having electrically charged particles meant for improved adsorption of plant nutrients in the soil.
- As such it can be broadcasted.
- The resultant seri compost will contain approximately 30%-moistre, 2.0-2.24 % Nitrogen 0.93-1.0 % Phosphrous and 1.5-1.8 % Potash beside zinc, iron, manganese and copper as micronutrient.

**Nutrient content of different organic sources:** Das et al. (1997) stated as a comparison, seriwaste contains the following increasing nutrient contents as compared to any other organic manure (Table 1).

### TABLE 1: Nutrient content

<table>
<thead>
<tr>
<th>Organic sources of nutrients</th>
<th>Nutrient content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Farmyard manure</td>
<td>0.50</td>
</tr>
<tr>
<td>Vermicompost</td>
<td>1.74</td>
</tr>
<tr>
<td>Seriwaste</td>
<td>2.30</td>
</tr>
</tbody>
</table>

The chemical analysis of vermicast vs Farmyard manure is given in Table 2.

### TABLE 2: Micro nutrients of vermicompost compared with farmyard manure

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Vermicast</th>
<th>Farm Yard Manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc</td>
<td>84.6ppm</td>
<td>14.5ppm</td>
</tr>
<tr>
<td>Iron</td>
<td>1247ppm</td>
<td>1465ppm</td>
</tr>
<tr>
<td>Manganese</td>
<td>509.7ppm</td>
<td>69.0ppm</td>
</tr>
<tr>
<td>Copper</td>
<td>61.5ppm</td>
<td>2.8ppm</td>
</tr>
</tbody>
</table>

**Seriwaste usage:** Kalaiyarasan (2011) reported that integrated use of organic manures and NPK levels had significant influence on grain and stover yield of maize (Table 2). The experiments were laid out in randomized block design with three replications. Two source of organic manures, viz., seriwaste compost at 5 t ha⁻¹ and vermicompost 5 t ha⁻¹ were imposed along with Nitrogen (N), Phosphorus (P), Potassium (K) levels (150:75:75 kg ha⁻¹) viz., 100% of Recommended Dose of Fertilizer (RDF), 75% of RDF + 25% seriwaste compost, 50% of RDF + 50% seriwaste compost, 25% of RDF + 75% seriwaste compost, seriwaste compost 100%, vermicompost 100% , seriwaste compost 50% + vermicompost 50% and absolute control. Seriwaste at 50 per cent + 50 per cent RDF increased the grain and stover yield, which was followed by seriwaste at 25 per cent + 75 per cent RDF. This was followed by seriwaste at 75 per cent + 25 per cent RDF and 100 per cent RDF application. This might be due to the mineralization of N during the decomposition of seriwaste compost would have enhanced the N availability resulting in increased N uptake by maize which in turn would have promoted higher yield attributes and yield. In this investigation also similar trend was observed. The increase yield of maize with seriwaste compost might be attributed to the potential effect of the amendment in improving water holding capacity, micronutrients and nutritional properties of the soil.

Seriwaste could be easily converted to high quality vermicompost. Eisenia fetida is considered as most efficient worm for commercial productions of vermicompost. Earthworms are not able to efficiently digest nitrogen as a result; their excrement contains 73% of the nitrogen found in the composted seriwaste (Pandey et al., 2008). The significant increase in mulberry leaf quality in terms of N, P, K, moisture...
TABLE 3: Effect of seriwaste vermicompost on hybrid maize

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No.of rows / Cob</th>
<th>No.of grains /row</th>
<th>Cob length(cm)</th>
<th>Cob girth (cm)</th>
<th>Cob weight (g)</th>
<th>Grain yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ - 100% of Recommended Dose of Fertilizer</td>
<td>15.64</td>
<td>39.32</td>
<td>16.4</td>
<td>5.6</td>
<td>140.2</td>
<td>5271</td>
</tr>
<tr>
<td>T₂ - 75% of RDF + 25% Seriwaste compost</td>
<td>13.83</td>
<td>42.63</td>
<td>16.5</td>
<td>5.8</td>
<td>147.6</td>
<td>5547</td>
</tr>
<tr>
<td>T₃ - 50% of RDF + 50% Seriwaste compost</td>
<td>19.76</td>
<td>53.62</td>
<td>20.6</td>
<td>6.2</td>
<td>201.5</td>
<td>6447</td>
</tr>
<tr>
<td>T₄ - 25% of RDF + 75% Seriwaste compost</td>
<td>17.76</td>
<td>41.48</td>
<td>17.2</td>
<td>6.0</td>
<td>164.4</td>
<td>5862</td>
</tr>
<tr>
<td>T₅ - Seriwaste compost 100% (5 t/ha)</td>
<td>12.50</td>
<td>32.46</td>
<td>11.52</td>
<td>5.5</td>
<td>107.26</td>
<td>4033</td>
</tr>
<tr>
<td>T₆ - Vermicompost 100% (5 t/ha)</td>
<td>12.43</td>
<td>30.47</td>
<td>10.62</td>
<td>4.8</td>
<td>78.8</td>
<td>3790</td>
</tr>
<tr>
<td>T₇ - Seriwaste compost 50% + Vermicompost 50%</td>
<td>13.72</td>
<td>36.62</td>
<td>13.36</td>
<td>5.6</td>
<td>113.73</td>
<td>4037</td>
</tr>
<tr>
<td>T₈ - Absolute control</td>
<td>12.31</td>
<td>28.68</td>
<td>10.24</td>
<td>5.3</td>
<td>77.2</td>
<td>3297</td>
</tr>
<tr>
<td>SEd</td>
<td>0.3</td>
<td>1.6</td>
<td>0.5</td>
<td>0.2</td>
<td>2.3</td>
<td>159.3</td>
</tr>
<tr>
<td>CD (0.05)</td>
<td>0.6</td>
<td>3.5</td>
<td>1.1</td>
<td>0.5</td>
<td>4.9</td>
<td>341.7</td>
</tr>
</tbody>
</table>

percentage and chlorophyll content is due to application of seriwaste compost with full dose of chemical fertilizer. This indicates that the superior nutritive value of the seriwaste compost is produced from sericulture waste (Choudhury et al., 1993).

Application of compost manure produced out of sericulture waste including silkworm litter is highly beneficial for mulberry cultivation and is much effective than conventional use of farm yard manure (Bhogesha et al., 1997). A sericultural farm waste comprising of silkworm litter, left over leaves, soft twig and farm weeds of one hectare can generate annually an approximate quantity of 12-15 Million tonnes of waste. This waste has a tremendous manurial value of nitrogen (280-300 kg), phosphorus (90-100 kg) and potassium (150-200 kg) as well as micronutrient like iron, zinc, copper etc. (Das et al., 1997).

Thermo guard mat has been devised by using waste mulberry twigs and local grass Imperta cylinderica. Thermo guard mats are highly economic and easily affordable by the farmers in maintaining required temperature and relative humidity of seriwaste vermeries (Singhal et al., 2008). Bio-consortium formulation of potential isolates of beneficial microbes helps in hastening the decomposition of seriwaste; a microbial enriched seri-compost can be prepared by inoculating them to organic residues during the process of composting (Gupta et al., 2009). A rapid technique of composting of seriwaste within 50-60 days, using earthworms as versatile bio-reactor can also be used, which is found to be highly remunerative in sericulture industry.

Advantages
- It is an eco friendly technology
- The composting of the waste can be performed quickly.
- Composting is completed in 50-60 days in vermi casting where as anaerobic composting takes 120-150Days

CONCLUSION
Seriwaste compost practiced only in mulberry to produce high yielding and healthy leaves to improve the silk yield and also sericulture waste serves as good source of organic nutrients. It contains more amounts of plant nutrients like macro and micro nutrients which contribute to increased production. For the new trend to using the seriwaste to the field crops to increase their yield and quality of the agricultural crops and products. The success of future agriculture depends upon sustainability of agricultural production system.

REFERENCES


