RESEARCH PAPER ON VERMICULTURE AND VERMICOMPOSTING
UNDERTAKEN BY BACHELOR OF SECONDARY EDUCATION,
BIOLOGICAL SCIENCE MAJOR THIRD YEAR STUDENTS
AT RAMON MAGSAYSAY TECHNOLOGICAL UNIVERSITY,
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INTRODUCTION

About 2,350 years ago Aristotle has said, “Earthworms are intestines of the earth.” Only in the twentieth century has the truth in this statement been verified and found correct. He was ahead of our times by two and half of millennia. Darwin was another one to state: “No other creature has contributed to building of earth as earthworm.”

Vermiculture is basically the science of breeding and raising earthworms. It defines the thrilling potential for waste reduction, fertilizer production, as well as an assortment of possible uses for the future (Entre Pinoys, 2010).

Vermicomposting is the process of producing organic fertilizer or the vermicompost from bio-degradable materials with earthworms. Composting with worms avoids the needless disposal of vegetative food wastes and enjoys the benefits of high quality compost.

The earthworm is one of nature’s pinnacle “soil scientists.” Earthworms are liberated and cost effective farm relief. The worms are accountable for a variety of elements including turning common soil into superior quality. They break down organic matter and when they eat, they leave behind castings that are an exceptionally valuable type of fertilizer (www.bjmp.gov.ph, 2010).

This research paper would rationalize the methodologies as well as the laboratory findings undertaken by the Bachelor of Secondary Education (BSEd), Biological Science Major, Third Year Students of RMTU San Marcelino Campus on their innovative approach on Vermiculture and Vermicomposting.
Advantages of Vermiculture and Vermicomposting

Vermiculture and vermicomposting is one of the most valuable ecological endeavors we have engaged in as it caters not only environmental protection but also helped us acquire knowledge on its proper methodology.

Vermiculture is environment friendly since earthworms feed on anything that is biodegradable, vermicomposting then partially aids in the garbage disposal problems. No imported inputs required, worms are now locally available and the materials for feeding are abundant in the locality as market wastes, grasses, used papers and farm wastes. It is also highly profitable, both the worms and castings are saleable (www.bpi.da.gov.ph, 2010).

Vermicompost does not have any adverse effect on soil, plant and environment. It improves soil aeration and texture thereby reducing soil compaction. It improves water retention capacity of soil because of its high organic matter content. It also promotes better root growth and nutrient absorption and improves nutrient status of soil, both macro-nutrients and micro-nutrients (Punjab State Council for Science and Technology, 2010).

Precautions for Vermiculture and Vermicomposting

Vermiculturists should also be aware of the several precautions in doing such process to ensure that the project would turn out successful and fruitful. From our hands-on experiences, vermicompost pit should be protected from direct sun light so that the vermi worm would survive. Direct heat possibly causes the worms to die. Spray water on the pit as when required to maintain moisture level because vermi worms are fond of it. We should also protect the worms from ant, rat, bird and excessive rain.
METHODOLOGY

Vermiculture is the science of worm composting. Worms can eat their body weight each day in fruit and vegetable scraps, leaving castings as the byproduct. Worm castings are called worm compost (www.gardens.com).

Clean-up and Preparation of Vermi Beds. Our group started the vermiculture project on July 1, 2010 with the clean-up and preparation of the previously built vermiculture beds located at the back of the RET Center, RMTU San Marcelino Campus. There are two vermi beds, 1 x 2 in size and made with hollow blocks. We have cleaned each vermi beds and started to gather substrates.

Substrate Application. After some days of gathering, we put the substrates to both vermi beds on July 7. We put a mixture of loam soil, carabao manure and partially decomposed leaves in the first vermi bed while in the second bed; we put a mixture of carabao manure, partially decomposed rice straw and rice hull and shredded moist newspapers. The succeeding application made used of mixed and different substrates.

Before putting the substrate, we made sure that the materials are cut or break into smaller pieces. Finer materials could easily decompose (partial decomposition). We also mixed the different media together well for the worms to easily digest these. We have moistened the materials and cover the vermi beds with roof and tarpaulin cover to initiate anaerobic decomposition. The substrates were kept in the beds for ten days before we put the vermi worms. It took 10 to 15 days to complete anaerobic decomposition and only then that they are ready for worm consumption.
Introducing the Vermi Worms, Red wriggler (*Eisenia foetida*). After 10 days upon putting the substrates into the vermi beds, we introduce the vermi worms into the substrate on July 17. We used the Red wriggler (*Eisenia foetida*) in our vermicompost. Aerobic decomposition lasts for 7 – 14 days depending on the materials used and the ratio of the worms to the substrate. In our case, we have a total of 100 kilograms of substrate each bed enough to feed a half kilogram of worm for two weeks. Within the period, we moistened (not soggy) the substrate regularly to provide the right moisture (60 - 80%) for the vermi worms to grow and multiply.

Feeding the Vermi Worms. After introducing the red wrigglers, we fed the worms by placing vegetable wastes and also *saluyot* (*Corchorus capsularis*) leaves and *malunggay* (*Moringa oleifera*) leaves. We placed the vegetable wastes in a different place each time for the worms to easily feed into it. After two weeks, the red wrigglers have eaten the food waste leaving behind worm casting or compost.

Harvesting of Vermicast. Harvesting will commence 10 to 14 days or 2 weeks after stocking of worms. Prior to harvest, we refrained from watering the substrate for the last three days to ease the separation of castings from worms and likewise preventing the castings to become compact. On August 4, we had the first harvest of the vermicast or the worm manure; we actually harvested a total of 100 kilograms or two sacks of organic fertilizer from the first vermi bed which contains mixture of loam soil, carabao manure and partially decomposed leaves. On August 11, we had another harvest of vermicast coming from the second vermi bed which contains a mixture of carabao manure, partially
decomposed rice straw and rice hull and shredded moist newspapers. We harvested another 100 kilograms or two sacks of organic fertilizer from it. The succeeding harvests done by the group is illustrated in the timeline of the activity (see Table 1.1).

**Re-Applying Substrates.** After the harvest of the vermi cast, we applied substrates in the vermi beds anew. In the first bed, we put pure carabao manure without any loam soil like what we put before. And in the second bed, we applied a mixture of carabao manure and partially decomposed rice straw.

**Re-introduction of the Vermi Worms, Red wriggler (Eisenia foetida).** The application of new substrates into the vermi beds require the re-introduction of the vermi worms or the red wrigglers (Eisenia foetida) for the continuity of the worm’s culture and for their production of the vermi cast which are very good organic fertilizer. After introducing the worms into the substrates, we sprinkled it with water to keep the moisture on which worms can easily digest these substrates. And these steps will go over and over again until such time that the red wrigglers are cultured into a big number and vermicast are produced well that it can be sold to gardening companies.

**Using the Harvested Vermicast.** Our harvested vermicast or worm manure was used as organic fertilizer for pechay (Brassica rapa) seedlings which we transplanted in the greenhouse near our vermiculture project. The other sacks of organic fertilizers were stored for future use.
DATA AND ANALYSIS

The Vermi Worms. The vermi worms used in the vermiculture and vermicomposting project came directly at the Tarlac College of Agriculture (TCA) Vermiculture Project Laboratory at Camiling, Tarlac. These vermi worms are identified as Red wrigglers or scientifically known as *Eisenia foetida*.

According to Wikipedia these worms are known under various common names, including redworms, brandling worms and tiger worms. These are a species of earthworm adapted to decaying organic material. They thrive in rotting vegetation, compost, and manure. They are rarely found in soil and are used for vermicomposting. They are native to Europe, but have been introduced (both intentionally and unintentionally) to every other continent except Antarctica, occasionally threatening native species.

When roughly handled, red wrigglers exude a pungent liquid, most probably as a chemical self-defense, thus the specific name fetida means fetid odor or having a rotten or offensive smell. This is presumably a defense. Like other earthworms, *E. foetida* are hermaphroditic. However, two worms are still required for reproduction. The two worms join clitellums (contains reproductive organs and only visible when ready to reproduce, large orangish band) and exchange sperms. Both worms then, rather than laying eggs directly, secrete cocoons that contain several eggs. These cocoons are lemon-shaped and begin as pale yellow when first laid, and become more brownish as four to six worms mature. These cocoons are clearly visible to the naked eye.

*E. foetida* is especially adapted to living in a decaying environment, especially ones such as rotting vegetables, manure and actual compost, which makes it a very good choice for vermicomposting. It does not burrow into soil, and is found in habitats where
other worms will have a very difficult time surviving, therefore lessening the competition for food and space for them.

On the other hand, earthworm is one of nature’s pinnacle “soil scientists.” The basic body plan of an earthworm is a tube, the digestive system, within a tube, the muscular slimy, moist outer body. The body is annular, formed of segments that are most specialized in the anterior. Most earthworms are decomposers feeding on undecayed leaf and other plant matter.

From the laboratory activity, we have observed that the vermin worms range from 1 cm to 18 cm. From the 1 kilogram introduced vermi worms, it increases 400 grams each harvest.

**Vermicast.** The vermicast is a good organic fertilizer and soil conditioner. It is produced by the decomposition of organic matter or agricultural wastes. High-quality vermicast can be produced by worms such as the red wrigglers (*E. foetida*). It contains humus with high levels of nutrients such as nitrogen, potassium, calcium, and magnesium.

The vermicast produced in the project was black and crumbly. It is rich in nutrients. It will be used in gardens, landscaping, horticulture, and agriculture. The vermicompost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil.

Indeed, the use of red wriggler worms to produce vermicast has good potential for the production of organic fertilizer.
Substrates. The substrates, or media where the red wriggler worms exist, were ubiquitous in the community. We applied several substrates in the vermi beds in our several substrate treatments. We used substrates such as manure of livestock including carabao, chicken and goat; decomposed and partially decomposed plant wastes such as rice straw and rice hull; shredded moist newspapers; and vermicast containing red wrigglers.

Manures of the carabao, chicken and goat contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen, that are trapped by bacteria in the soil. Meanwhile, rice straw is the only organic material available in significant quantities to most rice farmers. About 40 percent of the nitrogen, 30 to 35 percent of the phosphorus, 80 to 85 percent of the potassium and 40 to 50 percent of the sulfur taken up by rice remains in vegetative plant parts at crop maturity. Thus, rice straw was one of the substrates we applied for our vermicomposting project.

Another substrate we used is the rice hulls; these are the hard protecting coverings of grains of rice. Rice hulls are organic material and can be composted. However, their high lignin content can make this a slow process. Sometimes earthworms are used to accelerate the process. Using vermicomposting techniques, the hulls can be converted to fertilizer. We likewise used shredded moist newspapers which can give sufficient moisture for the red wrigglers to survive and be able to replicate its number.
## TIMELINE OF THE ACTIVITY

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Description</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1, 2010</td>
<td>Clean-up and Preparation of Vermi Beds</td>
<td>Start of the vermiculture project with the cleaning and preparation of the existing vermi beds.</td>
<td>The vermi bed was cleaned and prepared for substrate application.</td>
</tr>
<tr>
<td>July 2-6, 2010</td>
<td>Gathering of Substrates</td>
<td>Collection of substrates to be applied in the vermi beds.</td>
<td>Substrates such as manure of carabao, chicken and goat; rice straw, rice hull and shredded newspapers were gathered.</td>
</tr>
<tr>
<td>July 7, 2010</td>
<td>Substrate Application</td>
<td>Putting of the collected substrates in the two vermi beds.</td>
<td>One hundred kilograms of collected substrates were applied in the vermi beds for anaerobic decomposition.</td>
</tr>
<tr>
<td>July 17, 2010</td>
<td>Red wrigglers (Eisenia foetida) Introduction</td>
<td>The vermi worm introduced in the substrated vermi beds were the Red wrigglers (Eisenia foetida).</td>
<td>Half a kilo of Red wrigglers were introduced in each vermi beds.</td>
</tr>
<tr>
<td>July 17- August 1, 2010</td>
<td>Moistening the Substrates and Feeding the Red wrigglers</td>
<td>Keeping the substrates moist and feeding the red wrigglers.</td>
<td>Moisture of 60% - 80% of the substrate was provided regularly upon vermi worm introduction. Foods for the worms were also provided every other day such as vegetable wastes.</td>
</tr>
<tr>
<td>August 4, 2010</td>
<td>First Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
</tr>
<tr>
<td>August 11, 2010</td>
<td>First Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
</tr>
<tr>
<td>August 5, 2010</td>
<td>Re-applying of Substrates</td>
<td>Application of new substrates in the vermi beds.</td>
<td>One hundred kilograms of collected substrates were re-applied in the vermi beds for anaerobic decomposition.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Details</td>
<td></td>
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<tr>
<td>--------------------</td>
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<td>-------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>August 5, 2010</td>
<td>Re-introduction of the Red Wrigglers</td>
<td>The Red wrigglers were re-introduced in the vermi beds.</td>
<td></td>
</tr>
<tr>
<td>August 12, 2010</td>
<td></td>
<td>Atleast 1 kg. of Red wrigglers were re-introduced in each of the vermi bed.</td>
<td></td>
</tr>
<tr>
<td>August 13, 2010</td>
<td>Using the Harvested Vermicast</td>
<td>Using the harvested vermicast for fertilizing the transplanted seedlings at the Greenhouse.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Harvested vermicast was applied in the transplanted seedlings.</td>
<td></td>
</tr>
<tr>
<td>August 18, 2010</td>
<td>Second Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>August 19, 2010</td>
<td>Second Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>August 25, 2010</td>
<td>Third Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>August 26, 2010</td>
<td>Third Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
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<tr>
<td>September 1, 2010</td>
<td>Fourth Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
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<tr>
<td>September 2, 2010</td>
<td>Fourth Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>September 8, 2010</td>
<td>Fifth Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>September 9, 2010</td>
<td>Fifth Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>September 15, 2010</td>
<td>Sixth Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>September 16, 2010</td>
<td>Sixth Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>September 22, 2010</td>
<td>Seventh Harvesting of Vermicast</td>
<td>Collecting the vermicast from Bed A.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Action</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------</td>
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<td>---------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>September 23, 2010</td>
<td>Seventh Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
</tr>
<tr>
<td>September 29, 2010</td>
<td>Eight Harvesting of Vermicast (Bed A)</td>
<td>Collecting the vermicast from Bed A.</td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
</tr>
<tr>
<td>October 6, 2010</td>
<td>Eight Harvesting of Vermicast (Bed B)</td>
<td>Collecting the vermicast from Bed B.</td>
<td>Two sacks (100 kgs.) of vermicast were collected.</td>
</tr>
</tbody>
</table>

Table 1.1. Timeline of the Vermiculture and Vermicomposting Activity
RECOMMENDATIONS

Vermiculture is a way of composting using earthworms to speed up the process. We, in the group, have engaged ourselves in our unique way of innovative vermiculture and vermicomposting activity for almost three months. From that span of time, we recommend that:

1. Sufficient time should be allotted for the project in order to maintain it towards its sustainable development;

2. Better location for the project should be identified for easy supervision and monitoring;

3. Appropriate roofing materials should be used in establishing the beds’ roofings to prevent excessive rain in penetrating the culture beds that can possibly kill the vermi worms;

4. Proper ventilation in the vermi beds should be provided, this can be done through proper roofing because partially closed vermi beds might hinder the worms to access oxygen which they need for them to replicate;

5. Schedule of the project-in-charge of the day should be systematically planned and designated so that the project will be monitored regularly to prevent circumstances that might destruct or hinder the progress of the project.

From these given recommendations, we look forward that the upcoming activity similar to this, would be more organized and systematic in its planning, more appropriate in execution and successful in its evaluation.
CONCLUSIONS

The Vermiculture and Vermicomposting activity is such a worthwhile and exciting venture. We have learned a lot specifically in the methodologies, benefits and significance of this activity. After almost three months, project delivery and execution, we can therefore conclude that:

1. Vermiculture is a substantial way of reducing wastes, producing fertilizers and maintaining the balance of the ecological environment;
2. Vermicomposting can produce high-quality fertilizers which are better compared to other commercial fertilizers in the market;
3. Vermiculture converts farm wastes into organic fertilizer, making it an environment-friendly technology;
4. Vermiculture increases crop yield and lessens dependence on chemical fertilizers thus mitigating climate change;
5. Vermiculture can be made into a livelihood program and become a source of extra income through selling the vermicast and also the vermi worms;
6. Taking worms out of their natural environment and placing them in the vermi beds creates a human responsibility. They are living creatures with their own unique needs, so it is important to create and maintain a healthy habitat for them to do their work. If you supply the right ingredients and care, your worms will thrive and make compost for you.
BIBLIOGRAPHY


APPENDICES

A. FIGURES

Figure 1. John Arthur and Andrew lead the cleaning and preparation of the vermiculture beds for substrates application.

Figure 2. Danilo, Edjohn and Jestony collect substrates to be applied in the vermiculture and vermicomposting project.
Figure 3. The group applies the collected substrates into the vermi beds as Edjohn scrapes the substrates in place.

Figure 4. Red wrigglers (*Eisenia foetida*) ready for introduction into the substrated vermi beds.
Figure 5. Danilo maintains the moisture of the substrates regularly for the Red wrigglers to survive.

Figure 6. Lashaundra feeds the Red wriggler worms with vegetable wastes and vegetable leaves such as malunggay and pechay.
Figure 7. The vermibeds constructed with improvised roofing to protect the worms from direct sunlight and excessive rain.

Figure 8. Cultivating the substrates with Hazel, Monina and Lashaundra at the helm.
Figure 9. Vermibeds with substrates; Bed A, mixture of manure and decomposed leaves and Bed B which contains rice hull, rice straw and shredded moist newspapers.

Figure 10. The vermiculturists at work with Prof. Mila M. Patriana looks on and supervises the group’s activity.
**Figure 11.** The group separate the worms from the vermicast before the harvest.

**Figure 12.** Lashaundra and Werlyn lead the group in harvesting the vermicast.
Figure 13. Cultured vermi worms from the project, size of the worms ranges from 1 cm to 18 cm.

Figure 14. Produced vermicast which is black and crumbly, and a high-quality fertilizer.
Figure 15 & 16. The Bachelor of Secondary Education (BSED) – Biological Science Major Third Year students of RMTU San Marcelino Campus with their Ecology subject professor, Prof. Mila Mariñas Patriana during their project entitled, “Vermiculture and Vermicomposting.”