Effectiveness of the use of organic waste as fertilizer and physical scarification of seeds on growth of seeds nila plants (*Indigofera* sp.)

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Abstract. *Tilapia* (*Indigofera* sp.) is used as animal feed because it has a crude protein content of 28.98 % and crude fiber content is 8.49 %, so it is considered as an energy source rich in nutrients. *Tilapia* plants are plants that are adaptable in a variety of diverse environmental conditions, such as acid soils and long dry climates. Utilization of tilapia as animal feed is very limited because farmers and breeders are reluctant to cultivate it. The limitation of providers of *tilapia* seedlings is one of the causes of the small number of *tilapia* cultivated by farmers and breeder so that the need for forage feeds of ruminants to meet protein needs is still lacking. During this time for the needs of ruminants, breeders only depend on natural grass and crop residues. The process of seed germination and tilapia growth after the germination period can be increased by scarifying seeds and using organic fertilizers. The study aimed to determine the effect of using organic waste and the length of physical seed scarification on the growth of *tilapia* seedlings. The study used factorial experiments (two factors) arranged randomly in groups. The first factor is the type of waste: M0 (without waste); M1 (banana [*Musa* sp.] hump waste); M2 (papaya fruit [*Carica papaya* L.] waste). The second factor is the duration of physical scarification (70 °C hot water immersion): S0 (without soaking); S1 (soaked for 7.5 min); S2 (soaked for 15 min). The results showed that there was an interaction between the types of organic waste and the length of seed scarification for tilapia growth. The best treatment is banana hump waste with physical scarification of 15 min of seed.

Keywords: banana hump, organic fertilizer, *tilapia* (*Indigofera* sp.).

1. Introduction

*Tilapia* (*Indigofera* sp.) is a type of legume plant that is adaptable in a variety of diverse environmental conditions, such as acid soils and long dry climates [1]. *Tilapia* can be used as ruminant animal feeds, the leaves are used [2, 3]. Forage in general is the main energy source of ruminants, and only about 75 % of forage feed is given to ruminant animals, especially natural grass and crop residues in the country of Indonesia [1, 2]. *Tilapia* can be dried and then converted into flour which can then be used as a mixture of poultry animal feeds. Leaves from *tilapia* are used to feed poultry in the form of flour. *Tilapia* top flour can be used as a good feed ingredient because it has a fairly high crude protein content of 28.98 % and a low crude fiber content of 8.49 % [3, 4]. This plant is known to contain protein, vitamins and minerals, which have a much higher concentration than the type of herb, and therefore have the potential as a high source of protein and can be produced locally [5, 6].
The scarification treatment is often done to overcome seed dormancy, which is to soften the hard seed skin, so that it becomes permeable to water and gas [7, 8]. The scarification treatment can be done by soaking the seeds in hot water which can soften and open the pores of the dry and hard seed skin so that it can improve the imbibition process of the seeds [9, 10]. The growth of tilapia after the germination period can be increased by giving organic fertilizer. Organic fertilizers can be made from waste that has undergone a decomposition process, or other organic materials that have been delayed [11]. Organic materials that have been decomposed have advantages such as increasing soil fertility chemically, physically, and biologically and containing hormones that are important to plant growth [10, 12, 13]. The study aimed to determine the effect of using organic waste and the length of physical seed scarification on the growth of tilapia seedlings.

2. Materials and methods

2.1. Location of the experimental site
The study was conducted at the Green House Experimental Garden of the Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang, East Java, Indonesia. The research was conducted from October to December 2017.

2.2. Experimental design
The study used factorial experiments (two factors) arranged randomly in groups. The first factor is the type of waste: M0 (without waste); M1 (banana [Musa sp.] hump waste); M2 (papaya fruit [Carica papaya L.] waste). The second factor is the duration of physical scarification (70 °C hot water immersion): S0 (without soaking); S1 (soaked for 7.5 min); S2 (soaked for 15 min). There were nine combination treatments and each combination treatment was repeated three times.

Before applying fermented organic waste first, ferment for 21 d in a cool place, not directly exposed to the sun. Every 2 d an opening on a bubbling fermented bottle cap are opened. Each banana hump and papaya waste is mixed with molasses and leri (rice washing water) with a size of 2 kg of banana weed waste or papaya fruit waste, 200 g of molasses, 4 L of leri. Then the ingredients are mixed in the tank and placed in a place that is not directly exposed to sunlight. Every 2 d the lid is opened to release gas. After 21 d the decomposed organic waste is filtered, and the filtrate solution is diluted to a concentration of $10^{-1}$.

Seed selection is done to select seeds that are uniform in size, small (0.004 g to 0.0059 g), medium (0.006 g to 0.0079 g) large (0.008 g to 0.099 g). Selection is done by soaking it in water and choosing seeds that sink in the water base and physical scarification treatment using hot water at 70 °C.

Media growing germination of tilapia plants with a ratio of 1 compost : 1 husk charcoal : 1 soil, then the mixture is filled in the tray. While the growing media for tilapia nursery is soil and compost with a ratio of 2 : 1, the mixture is put in a polybag. Moving plants is done after the age of 21 d after the seedling. The application of organic waste is done 7 d after transplanting as much as 100 mL per plant. The growth variables observed included: number of leaves, plant height, stem base diameter, plant wet weight, plant dry weight, microorganism density, organic waste nutrient content.

2.3. Statistical analysis
Data obtained from the observations obtained were analyzed using analysis of variance with the Fisher test, where differences between the mean treatments were carried out by further testing using a Duncan distance test (UJD) with a level of 5 %.

3. Result and Discussion

3.1. Result

3.1.1. Number of leaves. Based on the results of variance analysis, there was no real interaction between the treatment of types of organic waste and the length of physical scarification of the
variables of the number of leaves of tilapia seedlings. To find out the differences between combinations of types of organic waste treatment and the length of physical scarification of the variables of the number of leaves of tilapia seedlings Duncan distance tested was conducted 5 %, the results of which are presented in table 1.

Table 1. Average number of leaves of tilapia (strands) seedlings.

| Treatment                  | Weeks after planting |
|----------------------------|----------------------|
|                            | 3        | 4        | 5        | 6        | 7        |
| Without waste              | 3.756    | a        | 4.711    | a        | 5.644    | a        | 6.511    | a        | 7.578    | a        |
| Banana hump waste          | 3.844    | a        | 5.244    | b        | 6.600    | b        | 8.178    | c        | 10.200   | c        |
| Papaya fruit waste         | 4.200    | b        | 5.222    | b        | 6.200    | b        | 7.178    | b        | 9.178    | b        |
| Without soaking            | 3.867    | a        | 4.889    | ab       | 5.778    | a        | 6.578    | a        | 8.067    | a        |
| Soaked for 7.5 min         | 3.800    | a        | 4.911    | a        | 6.022    | a        | 7.311    | b        | 8.978    | b        |
| Soaked for 15 min          | 4.133    | a        | 5.378    | b        | 6.644    | b        | 7.978    | b        | 9.911    | c        |

Note: The average value accompanied by the same letter in the same column shows no significant effect based on the Duncan distance test (UJD) 5 %

In table 1, it appears that the treatment of banana hump waste and papaya fruit waste does not show a significant difference in the number of tilapia leaves. The treatment of physical scarification by soaking hot water for 15 min is better than 7.5 min.

3.1.2. Seedling height. Based on the results of variance analysis, there was no real interaction between the treatment of types of organic waste and the length of physical scarification of the variables of the height of the tilapia seeds except at the age of 5 wk after planting. To find out the differences between combinations of types of organic waste treatment and the length of physical scarification of the variables of the number of leaves of tilapia seedlings, Duncan distance tested was conducted 5 %, the results of which are presented in table 2.

Table 2. The high mean of tilapia seedlings 5 wk after planting (cm).

| Treatment                | Physical scarification | Seedling height |
|--------------------------|------------------------|-----------------|
| Type of waste            |                        |                 |
| Without waste            | Without soaking        | 2.833           | a               |
| Without waste            | Soaked for 7.5 min     | 3.060           | a               |
| Without waste            | Soaked for 15 min      | 3.647           | b               |
| Banana hump              | Without soaking        | 4.073           | bc              |
| Banana hump              | Soaked for 7.5 min     | 4.700           | d               |
| Banana hump              | Soaked for 15 min      | 5.933           | e               |
| Papaya fruit             | Without soaking        | 3.960           | bc              |
| Papaya fruit             | Soaked for 7.5 min     | 4.220           | cd              |
| Papaya fruit             | Soaked for 15 min      | 4.417           | cd              |

Note: The average value accompanied by the same letter in the same column shows no significant effect based on the Duncan distance test (UJD) 5 %
Table 3. The high mean of tilapia seedlings (cm).

| Treatment                   | Weeks after planting |       |       |       |       |       |
|-----------------------------|----------------------|-------|-------|-------|-------|-------|
|                             |                      | 3     | 4     | 6     | 7     |       |
|                             |                      | Original | Transf.* |       |       |       |
| Without waste               | 2.349 a              | 2.660 a | 4.358 a | 6.469 A | 2.618 a |       |
| Banana hump waste           | 2.751 b              | 3.567 b | 7.404 c | 11.831 C | 3.484 c |       |
| Papaya fruit waste          | 2.782 b              | 3.449 b | 5.900 b | 9.547 B  | 3.163 b |       |
| Without soaking             | 2.447 a              | 2.896 a | 5.027 a | 7.342 A  | 2.773 a |       |
| Soaked for 7.5 min          | 2.622 a              | 3.284 b | 5.662 b | 8.827 B  | 3.034 b |       |
| Soaked for 15 min           | 2.813 a              | 3.496 b | 6.973 c | 11.678 C | 3.458 c |       |

Note: The average value accompanied by the same letter in the same column shows no significant effect based on the Duncan distance test (UJD) 5%. *Tranformation by \( \sqrt{x+0.5} \).

In table 2 and table 3, appear that the treatment of banana hump waste shows that the height of tilapia seeds is better than the treatment of papaya fruit waste. The treatment of physical scarification by soaking hot water for 15 min is better than 7.5 min.

3.1.3. The diameter of the stem base. Based on the results of variance analysis, there was no real interaction between the treatment of kinds of organic waste and the length of physical scarification of the variables of the base diameter of the stem of the indigo plant. To find out the differences between the types of treatment of organic waste and the physical scarification of the variables of the number of leaves of tilapia seedlings, Duncan spacing to test was carried out 5%, the results of which are presented in table 4.

Table 4. The average diameter of a base of the stem of indigo plant seeds (cm)

| Treatment                  | Weeks after planting |       |       |       |       |       |
|----------------------------|----------------------|-------|-------|-------|-------|-------|
|                            |                      | 3     | 4     | 5     | 6     | 7     |
|                            |                      | Original |       |       |       |       |
| Without waste              | 0.060 a              | 0.064 a | 0.074 a | 0.101 a | 0.145 a |       |
| Banana hump waste          | 0.076 b              | 0.089 b | 0.116 b | 0.158 b | 0.238 c |       |
| Papaya fruit waste         | 0.070 ab             | 0.082 b | 0.103 b | 0.145 b | 0.200 b |       |
| Without soaking            | 0.059 a              | 0.065 a | 0.084 a | 0.124 a | 0.163 a |       |
| Soaked for 7.5 min         | 0.070 ab             | 0.080 ab| 0.094 a | 0.128 a | 0.193 b |       |
| Soaked for 15 min          | 0.076 b              | 0.089 b | 0.115 b | 0.152 a | 0.228 c |       |

Note: The average value accompanied by the same letter in the same column shows no significant effect based on the Duncan distance test (UJD) 5%.

In Table 4, it appears that the treatment of banana hump waste and papaya fruit waste does not show a significant difference in the diameter of stem base of tilapia leaves. The treatment of physical scarification by soaking hot water for 15 min is better than 7.5 min.

3.1.4. The weight of tilapia plant seed (g). Based on the results of the variance analysis showed that there was a real interaction between the treatment of types of organic waste and the length of physical scarification of the variables of wet weight and dry weight of tilapia plants. To find out the differences between combinations of types of organic waste treatment and the physical scarification of the variables of the number of leaves of tilapia seedlings Duncan spacing to test has been carried out 5%, the results of which are presented in table 5.

In table 5, it appears that the combination of banana hump wasted treatment and physical scarification of soaking seeds with hot water for 15 is best for producing wet weight and dry weight of tilapia plants.
experiencing a decomposition process can act as a fertilizer for plants [13, 14]. Waste from banana is very abundant and can be used as an energy source of microorganisms. Organic waste after papaya fruit waste includes N elements 0.45 %, P = 274.67 ppm, K = 199.16 ppm, Ca = 159.63 ppm, humps contains more nutrients than papaya fruit waste. After 15 d fermentation, nutrient contained in nutrient content on each organic waste, the results of which are presented in table 6. Papaya fruit waste observed variabels. This is better than the results of Hidayat and Marjani's study [15], that immersion wastes and papaya fruit waste are presented in table 6.

### Table 5. Average wet weight and dry weight of tilapia plant seeds (g).

| Treatment                | Physical scarification | Observation parameters |
|--------------------------|------------------------|------------------------|
|                          |                        | Wet weight             | Trans. * WW | Dry weight |
| Without waste            | Without soaking        | 1.356 a                | 1.355 a     | 0.154 a    |
| Without waste            | Soaked for 7.5 min     | 2.918 ab               | 1.874 b     | 0.394 ab   |
| Without waste            | Soaked for 15 min      | 3.962 bc               | 2.106 bc     | 0.580 bc   |
| Banana hump              | Without soaking        | 5.212 c                | 2.378 c     | 0.719 c    |
| Banana hump              | Soaked for 7.5 min     | 7.233 de               | 2.776 de     | 1.116 d    |
| Banana hump              | Soaked for 15 min      | 13.405 f               | 3.725 f     | 1.940 e    |
| Papaya fruit             | Without soaking        | 4.438 bc               | 2.211 bc     | 0.588 bc   |
| Papaya fruit             | Soaked for 75 min      | 5.417 cd               | 2.431 cd     | 0.746 c    |
| Papaya fruit             | Soaked for 15 min      | 7.806 e                | 2.880 e     | 1.118 d    |

Note: The average value accompanied by the same letter in the same column shows no significant effect based on the Duncan distance test (UJD) 5 %. *Tranformation by $\sqrt{x+0.5}$ Wet Weight.

### Table 6. The nutrient content of each banana hump waste and papaya fruit waste

| Type of waste     | N (%) | P (ppm*) | K (ppm*) | Ca (ppm*) | Fe (ppm*) | Zn (ppm*) | Cu (ppm*) |
|-------------------|-------|----------|----------|-----------|-----------|-----------|-----------|
| Papaya fruit waste| 0.14  | 569      | 1 798    | 1 216     | 20        | 417       | 56        |
| Banana hump waste | 0.18  | 795      | 4 535    | 1 014     | 68        | 475       | 99        |

*Note: SI: (ppm = mg kg$^{-1}$).

In table 6 it appears that the largest elements contained in organic waste are potassium nutrients compared to other elements (N, P, Ca, Fe, Zn, Cu). Nutrient content of banana hump waste is more than the nutrient content of papaya fruit waste.

### 3.1.5. The nutrient content.

The results of nutrient analysis contained in each of the banana hump wastes and papaya fruit waste are presented in table 6.

### Table 6. The nutrient content of each banana hump waste and papaya fruit waste

| Type of waste     | N (%) | P (ppm*) | K (ppm*) | Ca (ppm*) | Fe (ppm*) | Zn (ppm*) | Cu (ppm*) |
|-------------------|-------|----------|----------|-----------|-----------|-----------|-----------|
| Papaya fruit waste| 0.14  | 569      | 1 798    | 1 216     | 20        | 417       | 56        |
| Banana hump waste | 0.18  | 795      | 4 535    | 1 014     | 68        | 475       | 99        |

In 15 d fermentation, nutrient contained in papaya fruit waste includes N elements 0.45 %, P = 274.67 ppm, K = 199.16 ppm, Ca = 159.63 ppm, Mg = 1 457.16 ppm, Fe = 6.50 ppm, Zn = 0.64 ppm, Mn = 2.80 ppm, C-organic content = 13.61 %, C/N ratio = 30.24, and organic matter = 23.46 % [11].

The scarification treatment of 70 °C hot water soaking for 15 min is the best, which is shown in all observed variables. This is better than the results of Hidayat and Marjani's study [15], that immersion in 80 °C water for 3 h was able to break dormancy and increase Yute (Corchorus olitoris L.) seed germination. Scarification is a way of solving seed dormancy, which among others is carried out by chemical treatment or heating [16, 17]. Before planting, seed treatment needs to be done to overcome dormancy because the seed coat is too thick so that plant growth is as expected [18, 19].
4. Conclusion
Based on the results of the study it can be concluded that there is an interaction between the type of treatment of organic wastes and the physical scarification of the seeds of tilapia on biomass. The combination of banana hump waste treatment and scarification of soaking hot water for 15 min can increase the growth of seeds of value plants.

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