Plant Response Due to Inoculation of Fr.Mull Earthworm 
(Pontoscolex Corethrurus): Pakchoy (Brassica Rapa L) 

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Abstract: The study aimed to determine the effect and number of Pontoscolex corethrurus Fr.Mull earthworms which gave the best effect on pakcoy crop production. The experiment was conducted experimentally with a completely randomized design (CRD) with 6 levels of treatment with 3 replications with observation parameters were plant height, number of leaves, leaf width and consumption weight. Observation data were analyzed statistically by variance, if F calculated was greater or equal to F Table 5%, followed by Duncan's multiple distance test at 5% level. Inoculation of the Pontoscolex corethrurus earthworm Fr.Mull can improve the growth and production of Pakchoy plants, with the best number of earthworms being 8 per pot.

Keywords: Pakcoy, Earthworm Pontoscolex corethrurus Fr.Mull

1. Introduction

Pakcoy plant is one of the most popular vegetable plants, has high economic and nutritional value because the fiber can smooth the digestive process, can bind bile acids causing cholesterol, beta-protein prevent cataracts, vitamin K which can help prevent stroke and heart disease and vitamins E is good for skin health. Pakcoy is easily cultivated and with the market demand that is high enough to provide bright prospects for farmers, the problem is the type of soil in Riau is Red Yellow Podsolik (PMK) whose physical, chemical and biological characteristics are poor so that its productivity is low. One of the ways to overcome it is by giving worms soil.

Earthworms can change the structure of the soil to be better through the biopori they make and create good regional conditions for the development of plant roots, so that absorption of nutrients also becomes better, besides living in the soil also becomes better. Besides that, earthworm impurities contain microorganisms and nutrients that can be absorbed directly by plants, so that the development of the plant becomes good and fertile. Research on the effect of vermicompost has been done a lot, but the effect of earthworm inoculation is still rare, so research was conducted with the aim to determine the effect and number of earthworm inoculations that have the best effect on the growth and production of Pak Choy plants.
*Pontoscolex corethrurus* earthworms are very widespread in Indonesia and are found in shrubs and grasslands. The external signs of the *Pontoscolex corethrurus* earthworm are body length ranging from 50-105 mm, 3.5-4.0 mm in diameter and number the segment is 190-209. Whitish body color with a little brown. Clitellum on XV or XVI segment up to segment XXI or XXIII [12]. Soil quality can be monitored physically (temperature and humidity), chemistry (pH and organic matter) and biology. Soil quality shows the physical, chemical and biological properties of the soil that play a role in providing conditions for plant growth, biological activity and regulating water flow [9].

The existence of earthworms can be used as a biological indicator of soil fertility because earthworms are one of the soil biotas that are saprophagous and geophagous which plays an important role in the nutrient cycle in the soil (Subowo, 2008). Earthworms with soil activity both vertically and horizontally that play a role in mixing the soil with organic matter and improving soil structure, leaving many burrows in the soil as "biopores" which increase soil porosity and the rate of infiltration in the soil. Earthworms play a role in the decomposition of organic matter and mixing organic matter. Increased infiltration can increase the number of nutrients washed into deeper soil layers, one of which is nitrogen (N) especially in the form of NO₃ due to the weak NO₃ bond with negatively charged clay surfaces (Amirat, Hairiah, and Kurniawan, 2014). The transport of water and nutrients from the upper layer to the bottom layer to the groundwater occurs through the soil macropore mainly through the hole produced by the earthworm [4].

Makulec and Kusinha (1997) also found that the C content in casting was always higher (± 2 times) than the surrounding C content of the soil. Martin (1991) also found that C mineralization at casting was 4 times slower (3% / year) than in soil (11% / year). In time after the soil organisms die in principle is also one source of soil organic matter, Subowo (2011), inoculant earthworm inoculants can increase the available soil P and the number of cations, decrease C / N, eliminate Al in the soil, increase total pore space, decreases bulk density, and increases pore drainage and soil permeability. According to Hieronymus (2010) the role of earthworms due to their activities is distinguished in biology, chemistry and physics. biological earthworms convert organic matter into humus to improve soil fertility by bringing organic matter to the underground for food and strengthening its burrows and producing 40% humus-containing castings compared to the soil in which the worms live, chemically, organically dead digested worms are then secreted in the form of casting above the soil surface, physically, the worm keeps its burrows allowing for the ongoing process of aeration and drainage. Soil with high population density of earthworms will become fertile because earthworms mix and break mineral particles into smaller units and help mix between top and bottom soils, resulting in longer distribution and C-organic cycle on the ground (Subowo, 2008). Earthworms produce casting which has high nutrient content and C than soil because it contains a mixture of soil minerals and decomposed organic materials (Hieronymus, 2010).

2. Research Methods

The study was conducted experimentally with a completely randomized design (CRD) of 6 treatments, 3 replications with treatment of C0 (without inoculation of earthworms), C2 (inoculation of earthworms 2 tail/pot), C4 (4 tail/pot), C6 (6 tail/pot), C8 (8 tail/pot), C10 (10 tail/pot).

Data were analyzed by variance and continued with Duncan test for New Multiple Range Test (DNMRT) level of 5%.

2.1. Research Implementation

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Soil topsoil mixed with cow manure (5: 1) is put into the pot (3 kg), then left for a week. After a week each pot is filled with an adult Pontoscolex corethrurus worm in accordance with the treatment. For pots treated with earthworms are given cow dung that has been ground smooth in adlibitum. The pot is kept moist and the surface of the pot is covered with gauze.

Planting is carried out two weeks after being treated with earthworms. Seeds are planted 14 days after seedling, healthy and uniform with 4 pieces of leaves. Then watering is done, then the pot is closed with gauze.

Watering done in the morning and afternoon with the same volume according to the circumstances in the field and age of the plant.

Maintenance is done in the form of weeding, pest control and disease done by using vegetable pesticides garlic. Control is done starting 2 MST at intervals twice a week

Parameters observed included: plant height, number, length and width of leaves, stem diameter, number and length of lateral roots, fresh weight and weight of consumption.

3. Results and Discussion

Inoculation of earthworms has a significant effect on the growth and production of Pakcoy plants seen in plant height, number, length and width of leaves, stem diameter, number and length of lateral roots, fresh weight and consumption weight.

Table 1. Average Plant Height, Leaf Amount, Leaf Width, Leaf Length, Stem Diameter, Number of Lateral roots, Lateral Root Length, Fresh Weight and Weight of Pakcoy Plant Consumption Due to Inoculation of Pontoscolex corethrurus Earthworms Fr Mull

| Pengamatan               | Inoculation of earthworm Pontoscolex corethrurus Fr Mull (individuals/pot) |
|--------------------------|----------------------------------------------------------------------------|
|                          | 0       | 2       | 4       | 6       | 8       | 10      |
| Plant Height             | 16,03 a | 19,95 a | 22,02 bc| 22,03 bc| 22,65 c | 23,57 c |
| Leaf Amount              | 14,00 a | 15,50 a | 16,83 b | 17,17 b | 17,17 b | 17,33 b |
| Leaf Width               | 15,82 a | 18,62 b | 20,45 b | 20,87 b | 20,88 b | 21,20 b |
| Leaf Length              | 6,75 a  | 7,98 a  | 8,30 b  | 8,93 b  | 9,12 b  | 9,15 b  |
| Stem Diameter            | 0,60 a  | 0,70 ab | 0,70 ab | 0,70 ab | 0,71 ab | 0,77 b  |
| Number of lateral roots  | 6,16 a  | 8,67 ab | 10,17 bc| 13,17 c | 13,30 c | 13,67 c |
| Lateral Root Length      | 6,60 a  | 7,85 a  | 11,35 b | 11,83 b | 12,27 b | 12,92 b |
| Fresh Weight             | 68,42 a | 87,50 a | 94,12 b | 94,66 b | 119,15 c| 123,74 c|
| Weight of Pakcoy Plant Consumption | 50,29 a | 75,76 a | 80,93 b | 81,43 b | 102,40 c| 103,12 c|

The numbers in the row followed by the same lowercase letters are not significant in the 5% DMRT test.

The lowest growth and production of Pakcoy is found in plants without earthworm inoculation, whereas pakcoy plants which are inoculated with earthworms grow and produce tend to increase in line with the increasing number of inoculated earthworms.

The growth and production of Pak Choy plants tend to increase, it is suspected that earthworm inoculation can improve soil fertility, because of its ability to improve soil properties.

Earthworms through movement in the soil will increase soil porosity, so that erosion conditions and drainage are better. This will increase the work of the roots in absorbing water and nutrients in the soil, thus increasing plant growth and production. This is consistent with the results of Wiryonos (2006) study that the addition of earthworms to the planting medium can increase the diameter, wet weight and dry weight of the lamtoro and turi plants. Furthermore, Subowo (2010) plants will be able to grow well as long as given habitat conditions that are good for the activities of the introduced organisms.
Earthworms are one of the invasive fauna in the soil which is decomposer (decomposers) and can increase soil fertility. The type of earthworm inoculated in this study is *Pontoscolex corethrurus* is a type of worm that is beneficial to the soil and is widely found. Adianto, Sapitri, and Yuli (2004) study that with inoculation of earthworms (*Pontoscolex corethrurus*) can increase the growth of green beans.

The main function of other earthworms is as the first decomposition macroorganism (primary) of organic matter so that the organic matter becomes split in the smaller form for further described by a microorganism (Wibowo, 2015). The existence of earthworms in the planting medium will certainly accelerate the decomposition of organic material as basic fertilizer (cow manure). Cow manure will be decomposed faster than media that are not inoculated with earthworms. This process will certainly accelerate the availability of nutrients for plants. In addition to decomposing organic materials, organic matter as a source of food for earthworms. The earthworm dust (casting) has nutrients such as N, P and K that can be directly absorbed by plants (Adianto et al., 2004). This activity will improve soil chemical properties.

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The addition of nutrients in the media by the activity of earthworms such as N which functions in vegetative growth one of them in the formation of chlorophyll. Element P functions in translocation of photosynthesis, while element K plays a role in strengthening stem stands. With some of the advantages of inoculation of earthworms, this is evidenced by the inoculation of earthworms that can increase the growth and production of pakcoy plants compared to the non-inoculated pakcoy plants.

Inoculation of earthworms can increase the growth and production of pakcoy crops, the more the number of earthworms inoculated, the effects on growth and production of the pakcoy plants are better.
4. Conclusion

Based on the results of the study it can be concluded that earthworm inoculation significantly affected the growth and production of pakcoy plants, inoculation of 8 individuals /pot gave the best results for pakcoy crop production.

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