# Application Legume Compost with Bio-Activator Trichoderma sp as Inorganic Fertilizer Substitution in Sweet Corn (Zea mays L. Saccharata) Cultivation

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**Submission date:** 29-Mar-2023 02:17PM (UTC+0700)
**Submission ID:** 2049802269
**File name:** wanti_2020_IOP_Conf._Ser.__Earth_Environ._Sci._411_012063_1.pdf (743.62K)
**Word count:** 3005
**Character count:** 15424

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**Abstract.** Legume litter can be used as compost with the help of bio-activator Trichoderma sp. as a decomposing microorganism. Legume compost can function as a source of organic fertilizer for plants and can reduce the use of inorganic fertilizers. This study aims to determine the best dose combination using inorganic fertilizer balanced with legume compost fertilizer. The study used non factorial randomized block design with 5 levels of treatment that were control, legume compost 20 ton/ha + 100% inorganic fertilizer, legume compost 30 ton/ha + 75% inorganic fertilizer, legume compost 40 ton/ha + 50% inorganic fertilizer, and legume compost 50 ton/ha + 25% inorganic fertilizer. Based on Anova test showed that the application of various combinations of inorganic fertilizer (Urea, SP-36, KCl) and legume compost had significant effect on the age of 2 WAP, 4 WAP and 5 WAP on the parameters of plant height, significant to the parameters cob weight, and had no significant effect on the sweetness level of sweet corn.

## 1.Introduction

Sweet corn (*Zea mays saccharata Sturt*.) including annual crops whose life cycle is completed within 80-150 days. Sweet corn is a multi-functional plant, because in addition to the fruit is used as food, its by products namely leaves and stems can be used as alternative feeds on ruminants. Seeing this, demand for sweet corn will continue to increase and sweet corn farming has prospects for development

Sweet corn farming cultivated by farmers has constraints in cultivation techniques, and one that needs attention is fertilization. Fertilization serves to increase nutrient content with the aim of improving soil fertility and increasing crop production. Sweet corn plants will provide maximum results if the necessary nutrients are available in sufficient quantities. Urea fertilizer as a source of nitrogen is the main nutrient for corn growth. Corn requires nitrogen in the form of ammonium in large amounts, because corn plants do not have the ability to produce nitrogen.

The use of inorganic fertilizers without being matched by the use of organic fertilizers can have a negative impact on soil fertility which ultimately decreases crop productivity. In addition, another obstacle faced by farmers in the use of inorganic fertilizers is the higher fertilizer prices and resulting in increased production costs. Increased production costs will have an impact on profits obtained by farmers. The solution that can be done to overcome this problem is to combine inorganic fertilizers with organic fertilizers appropriately. Besides being good for soil fertility, it is also beneficial in reducing farming costs for purchasing inorganic fertilizers.

Legume plants are a source of organic fertilizer. Legumes have the ability to bind nitrogen in the air very efficiently. Legume plants such as peanuts, soybeans, edamame, and green beans can bind

nitrogen in the air into the soil as much as 50-250kg / ha [1]. Legume litter can be used as compost as a source of organic fertilizer for plants, mainly a source of Nitrogen. The amount of nitrogen available from legume compost will reduce the use of inorganic fertilizer.

The process of composting litter of legume plants will quickly take place by using a microorganism as bio activator. One microorganism that can be used as a bioactivator in the composting process is the fungus Trichoderma sp. Trichoderma sp. is a saprophyte that can be found in soil, weathered wood and plant residues [2]. Trichoderma sp. produce cellulase enzymes in the composting process works accelerate in the process of weathering organic matter. The results of previous studies showed compost legume with bioactivator Trichoderma sp. significant effect on the harvest age of red chili plants [3]. Application time of legume compost fertilizer with bioactivator Trichoderma sp. two weeks before planting is the best treatment to speed up the harvest life of red chili plants.

This study aims to determine the composition of legume compost with the bio activator Trichoderma sp, as well as to determine the effect of using legume compost. From the results of the study can be seen the right dosage of legume compost to reduce the dose of inorganic fertilizer, primarily N fertilizer. Application organic fertilizer and reduce chemical fertilizer is expected to be obtained long-term benefits to safeguard soil fertility and sustainability increase agricultural production.

## 2. Research Methods

This research has been carried out in Politeknik Negeri Jember field research, Tegalgede Village, Sumbersari District, Jember Regency. The time of this research is August to October 2019. Material used in this research is corn seeds of New Lorenza F1 variety, litter leguminosa edamame, bio-activator Trichoderma sp, pesticides, cow manure, urea, SP36, KCl, and dolomite.

The research was carried out experimentally using a Randomized Block Design (RBD) consisting of 5 levels of treatment with 5 replications, so we get 25 units of experiment. Each unit has an area of 3 $m^2$. As for the treatment given includes:

K0 = without legume compost (Cow Manure 20 tons / ha + 100% Inorganic Fertilizer)
K1 = legume compost 20 tons / ha + 100% Inorganic Fertilizer
K2 = legume compost 30 tons / ha + 75% Inorganic Fertilizer
K3 = legume compost 40 tons / ha + 50% Inorganic Fertilizer
K4 = legume compost 50 tons / ha + 25% Inorganic Fertilizer.

Sweet corn planting 2 weeks after treatment by making planting with a plant spacing of 75 cm x 25 cm. In each unit experiment will be obtained 24 plants with 5 sample plants, so that the total population is 120 plants for each treatment. Dosage for 100% inorganic fertilizer using an urea 435 kg /ha, TSP 335 kg/ha, and KCL 250 kg/ha. The parameters studied were plant height (cm); weight of cob (grams); and sweetness level (brix). Data were analyzed with ANOVA test, and then continued with Duncan's New Multiple Range Test (DMRT) level of 5%.

## 3.Result and Discussion

### *3.1. Plant Height*

The analysis results showed that the application of various combinations of inorganic fertilizer (Urea, SP-36, KCl) and legume compost had significant effect on the age of 3 WAP and 4 WAP on the parameters of sweet corn plant height (Table 1). Based on the analysis of varians (anova test), the treatment of manure and various combinations of the use of inorganic fertilizers (Urea, SP-36, KCl) and legume compost significantly affected the parameters of plant height in the age of 3 WAP and 4 WAP. Based on the results of the DMRT test, it was found that at 4 WAP, K4 treatment was significantly different from K0, K1, K2 and K3. K4 treatment showed better growth in sweet corn plant height, which reaches a plant height of 43,70 cm. It is suspected that because nitrogen needs have been met and can stimulate metabolic activity in plants. The availability of N nutrients is adequate for plant growth in the application of legume compost at a dose of 50 tons/Ha and reduces the dose of inorganic fertilizer until 75% (K4 treatment).

**Table 1**. Average Height of Sweet Corn Plants

| Treatment | Average Plant Height (cm) | | | |
|---|---|---|---|---|
| | 2 WAP | 3 WAP | 4 WAP | 5 WAP |
| K0 = Manure 20 tons / ha + 100% Inorganic Fertilizer | 16,48 bc | 29,90 ns | 33,70 a | 65,83 bc |
| K1 = Legume compost 20 tons / ha + 100% Inorganic Fertilizer | 14,14 a | 31,20 ns | 36,90 a | 64,34 bc |
| K2 = Legume compost 30 tons / ha + 75% inorganic fertilizer, | 15,38 ab | 29,11 ns | 34,60 a | 56,93 a |
| K3 = Legume compost 40 tons / ha + 50% inorganic fertilizer | 17,26 c | 30,80 ns | 36,90 a | 61,18 ab |
| K4 = Legume compost 50 tons / ha + 25% inorganic fertilizer. | 17,28 c | 32,20 ns | 43,70 b | 70,04 c |

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

The plants will grow well if the conditions for growth is available. Environmental conditions that according to each growth phase and nutrient availability is very influential on plant growth. Every phase of plant growth needs certain nutrients for support the physiological processes, especially in vegetative phase. On that period the plant requires sufficient nutrients for their activities. Nitrogen is a nutrient which is very important for plant growth. Nitrogen works as a constituent of amino acids, protein, a component of the chlorophyll pigment important in the process of photosynthesis. If nitrogen deficiency causes plant growth and development disturbed and decreased crop yields caused by disruption of formation chlorophyll which is very important for roses photosynthesis.

Based on the results of laboratory analysis it is known that the content of the Nitrogen is 1,985%, almost close to cow manure which has a nitrogen nutrient of 2.00%. Nitrogen is a major nutrient for plant growth and is generally very necessary for vegetative growth of plants, namely leaves, stems and roots. Another study states that average total N contents of the leguminous tree leaves and leguminous cover crops were high and give the function to accelerate vegetative growth of plants such as plant height [4]. Nitrogen is also beneficial for the formation of chlorophyll which is very important for the photosynthesis process so that it can increase the vegetative growth of plants [5].

Furthermore, other study [6] states that giving nitrogen in sweet corn plants is very important because nitrogen can stimulates the growth of roots, stems, leaf height and plant height increase. The availability of sufficient nitrogen cause a balance ratio between leaves and roots, then vegetative growth runs normally and perfectly [7].

*3.2. Cob Weight*

Results of analysis of variance showed that the combination treatment of various doses of legume compost and the use of inorganic fertilizers had a very significant effect on the weight of cob/plants. The analysis test was continued with the DMRT test at the 5% level and is presented in Table 2.

Table 2 shows that the weight of cob per plant with the treatment of using legume compost 30 tons/ha and 75% of inorganic fertilizer (K2) is significantly different compared to the treatments K0, K1, K3, and K4. The results showed that the optimal dose for sweet corn cob production was K2. Application of legume compost 30 tons/ha + 75% inorganic fertilizer shows that the cob weight per plant is 372.48 grams, and is bigger than to other treatments.

**Table 2**. Cob Weight of Sweet Corn Plants

| Treatment | Cob Weight (gram) |
|---|---|
| K0 = Cow Manure 20 tons / ha + 100% Inorganic Fertilizer | 272,84 a |
| K1 = Legume compost 20 tons / ha + 100% Inorganic Fertilizer | 295,12 a |
| K2 = Legume compost 30 tons / ha + 75% inorganic fertilizer | 372,48 b |
| K3 = Legume compost 40 tons / ha + 50% inorganic fertilizer | 298,72 a |
| K4 = Legume compost 50 tons / ha + 25% inorganic fertilizer | 308,44 a |

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

Legume compost also contains phosphate and potassium nutrients [8]. Based on the results of laboratory analysis, the Phosphate (P) and Potassium (K) of legume compost are 0.661 and 2.543. The P and K nutrients in legume compost provide a function in the formation of cob. Especially the P nutrients that affect the growth in the size of the cob and corn. Other study states that P nutrient is functioning to accelerate the formation of fruit and seeds and increase production [9]. In accordance with other studies states that P nutrient is needed by corn in the generative phase in the formation of cob [10].

The application of legume compost has an impact on improving soil texture and making the soil more fertile. So that it can improve soil structure so that it helps the roots absorb P nutrients which gives an important function in the formation of cob. P nutrient is an essential part of the reaction in the photosynthesis process. During the generative period, the high availability and translocation of photosynthesis is immediately corrected to get more fruit. The application of legume compost has an impact on improving soil texture and making the soil more fertile. So that it can improve soil structure so that it helps the roots absorb P nutrients which gives an important role in the formation of cob. P nutrient is an essential part of the reaction in the photosynthesis process.

K nutrient provide a function in increasing synthesis and accelerating the translocation of carbohydrate in increasing the quality of cob [11][12]. Potassium is an important element for growth and development plants and is the most cation abundant in plants [13].

*3.3. Sweetness Level*

Results of analysis of variance showed that the combination treatment of various doses of legume compost and the use of inorganic fertilizers had no significant effect on the sweetness level of sweet corn.

**Table 3**. Sweetness Level of Sweet Corn

| Treatment | Sweetness Level (brix) |
|---|---|
| K0 = Cow Manure 20 tons / ha + 100% Inorganic Fertilizer | 14,068 ns |
| K1 = Legume compost 20 tons / ha + 100% Inorganic Fertilizer | 13,368 ns |
| K2 = Legume compost 30 tons / ha + 75% inorganic fertilizer | 13,020 ns |
| K3 = Legume compost 40 tons / ha + 50% inorganic fertilizer | 13,012 ns |
| K4 = Legume compost 50 tons / ha + 25% inorganic fertilizer | 13,624 ns |

Note: Numbers not followed by the same lowercase letter indicate not significantly different according to further tests DMRT at the level of 5%.

Table 3 shows that various dosage combinations using legume compost and inorganic fertilizers (Urea, SP-36, KCl) had no significant effect on the sweetness level of sweet corn. The sweetness level was an indicator that determined the quality of fresh sweet corn. The results showed that the application of a combination of compost legume dosage and inorganic fertilizer had no significant effect on the sweetness level of sweet corn. This is indicates that the level of sweetness in sweet corn is more influenced by genetic traits than environmental factors. The sweetness level of sweet corn is caused by

the genes su-1 (sugary), bt-2 (britlle) or sh-2 (shrunken). This gene can prevent the change of sugar into starch in endosperm so that the amount of sugar in sweet corn is more [14][15].

## 4. Conclusion

Various combinations of the use of inorganic fertilizers (Urea, SP-36, KCl) and legume compost significantly affected on the age of 2 WAP, 4 WAP and 5 WAP on the parameters of plant height, significant to the parameters cob weight, and had no significant effect on the sweetness level of sweet corn. The optimal dose for sweet corn cob production is K2 treatment, with the application of 30 tons/ha legume compost + 75% inorganic fertilizer, which shows that the weight of cobs per plant is 372.48 grams.

## Acknowledgment

This Research was sponsored by PNBP Politeknik Negeri Jember 2019. We would like to thank for all participant in this research.

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