

Potential Use of Composted Sugar Palm Solid Waste in Improving The Availability of Nitrogen in Regosol and Its Uptake by Sweet Corn

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Abstract.

The Heap of sugar palm solid waste often become pollutants, potentially used as organic fertilizer by making it compost, because it contains organic matter and high N. Regosol is soil that has poor physical and chemical soil conditions for corn growth because it is constrained by sand dominated soil texture and low N. This study aims to determine the effect of compost from sugar palm solid waste on the availability of N Regosol and its uptake by corn. This research is a pot experiment, using Complete Random Design method (CRD) with 5 treatments, each treatment was replicated 3 times. The five treatments are: K0 = Compost at a rate of 0 tons / ha (control), K1 = Compost at a rate of 22.24 tons / ha, K2 = Compost at a rate of 44.48 tons / ha, K3 = Compost at a rate of 66.72 tons / ha and K4 = compost at a rate of 88.96 tons / ha. The results showed that the application of palm sugar solid waste compost could increase the Nitrogen availability of Regosol and Nitrogen uptake of corn. Application of palm sugar solid waste compost at a rate equivalent to 44.48 tons/ha significantly responds to the increased availability of Nitrogen Regosol and the best Nitrogen uptake of corn.

Keywords: compost, Regosol, Nitrogen, uptake, corn.

1. Introduction

Sweet corn is one of the sources of carbohydrate plants. In Indonesia, the need for corn from year to year continues to increase, but the average national production is still low. Corn plants are sensitive to aspects of soil fertility especially by the low availability of nutrients such as N. To get good corn growth and high yields, nutrient elements available and able to be used by plants must be an insufficient condition. Nitrogen is one of the important nutrients for the growth of corn (Sutoro et al., 1988). Nitrogen absorption by corn takes place during its growth. At the beginning of growth, Nitrogen accumulation in plants is relatively slow and after the plants are 4 weeks old Nitrogen accumulation is very fast. At the time of flowering (male flowers appear) corn plants have absorbed N as much as 50% of all their needs, therefore to get good results, Nitrogen in the soil must be sufficiently available at this growth phase. Corn that lack Nitrogen elements will show stunted growth and yellowish-

green plant leaves in the shape of the letter V from the leaf tip to the leaf bone and start from the bottom leaf first (Suntoro, et al., 1988).

Corn can grow on various types of soil as long as it gets good processing. Good soil for corn is loose and fertile because this plant needs good aeration and drainage. Regosol is one of the potential soils for growing corn but has some physical constraints including sand texture, grained structure, loose consistency, very porous, so that water and nutrient buffer capacity is very low (Pusat Penelitian Tanah dan Agroklimat, 1994), while the chemical constraints including low organic matter content so that it is sensitive to erosion, Cation Exchange Capacity (CEC) and low base saturation and low nutrient availability especially N. nutrients (Sarief, 1985).

To overcome these obstacles, manipulation was carried out so that Regosol can be used as a medium for growing sweet corn. Manipulation that can be done is by adding organic fertilizer in the form of compost from sugar palm solid waste so it is expected to provide benefits to improving the quality of soil structure and chemical properties of the soil. With improved soil structure and good pore balance and spread, soil aggregates can provide a dense balance and pore space that is more beneficial for corn growth. The improvement of the physical properties of the soil, the chemical properties of the soil will also be improved including an increase of soil cation exchange capacity and the availability of nutrients, especially nitrogen.

Compost from sugar palm solid waste is very good to use because the material from this compost is a mixture of compost from sugar palm solid waste and manure and microbial starter. The results of compost analysis of sugar palm solid waste show that the total N and available N content which is very high influences the reduction in the C / N ratio (Nugroho, 2009). Application of sugar palm solid waste compost which is rich in organic matter and N nutrients is expected to be able to increase the availability of Regosol N and its uptake by corn. This study aims to determine the effect of sugar palm solid waste compost on the availability of N Regosol and its uptake by corn plants.

2. Method

This research is a pot experiment, using a completely randomized design (CRD) method with 5 treatments, each treatment was replicated 3 times. The five treatments are: K0 = Compost with a dose of 0 tons / ha (control), K1 = Compost with a dose of 22.24 tons / ha equivalent to 80 g / pot, K2 = Compost with a dose of 44.48 tons / ha equivalent to 160 g / pot, K3 = Compost with a dose of 66.72 tons / ha equivalent to 240 g / pot and K4 = Compost with a dose of 88.96 tons / ha equivalent to 320 g / pot.

This research was conducted in the greenhouse of Programme of Study in Soil Science of UPN "VETERAN" Yogyakarta. Soil chemical analysis was carried out at the Laboratory of Balai Pengkajian Teknologi Pertanian (BPTP) Yogyakarta and of Programme of Study in Soil Science of UPN "VETERAN" Yogyakarta.

Table 1. Physical and Chemical Properties

Soil Properties	Values	Rate (PPT, 2005)
C-Organic (%)	0,39	Very Low
N-Total (%)	0,04	Very Low
N-Available (%)	0,0009	Very Low
pH (H ₂ O)	6,15	Neutral

Table 2. Composition of Sugar Palm Solid Waste Compost

Soil Properties	Values	Rate (PPT, 2005)
C-Organic (%)	20,50	Very High
N-Total (%)	1,36	Very High
pH (H ₂ O)	7,0	Neutral

This research is a pot experiment, using a completely randomized design (CRD) method with 5 treatments, each treatment was repeated 3 times. The five treatments are: K0 = Compost with a dose of 0 tons / ha (control), K1 = Compost with a dose of 22.24 tons / ha equivalent to 80 g / pot, K2 = Compost with a dose of 44.48 tons / ha equivalent to 160 g / pot, K3 = Compost with a dose of 66.72 tons / ha equivalent to 240 g / pot and K4 = Compost with a dose of 88.96 tons / ha equivalent to 320 g / pot.

The Regosol taken from the field were air dried and sieved through a 2 mm. This soil is put in a plastic pot, each pot is equivalent to 10 kg of absolute dry soils. Weigh the compost from sugar palm solid waste according to the calculation results into the pot, then mix the compost into a pot of soil. After being mixed between soil and compost sugar palm solid wastecompost, then given water to reach the field capacity, then incubated for two weeks. The soil moisture is maintained at the field capacity by water weighing. The amount of water is determined by weighing the trial pots every day. The difference between the weight at the original weight is the weight of water that must be added.

As a bioassay to determine the response of cultivated plants to soil conditions and treatments, corn seeds were planted in the soil in pots that had been treated. Planting is carried out on soil samples with a weight equivalent to 10 kg of absolute dry soils. Before planting, the soil is softened and then in each pot is planted with 3 sweet corn seeds.

At the age of 7 days after planting, thinning leaves one of the best plants per pot. Plants treated reach a maximum vegetative phase. After the maximum vegetative phase is reached, soil sampling is carried out to test nutrient uptake and plant growth.

To find out the effect of treatment on the parameters of the experiment using Analysis of variance with significant of 5%, whereas to find out the comparison between treatments used Duncan's Multiple Range Test (DMRT) with significant of 5% (Gomez and Gomez, 1995)

3. Results and Discussion

From table 1 it can be seen that the Regosol used in this study has very low N-total and soil N available, there is 0.04% for N-total and available N levels of 0,0009%. The results of the C-Organic are very low at 0.39% and organic matter is also very low at 0.67%. From table 2 it can also be known that sugar palm solid waste compost N-total levels of 1,360% and available N levels are also high at 0.42%. C-Organic levels are very high at 20.50% and the pH of the sugar palm solid waste compost is neutral, which is 7. The C/ N value of compost is a medium level of 15.08 so it can supply the mineralized nitrogen.

Nutrient uptake is an indicator of soil response to fertilization. The response of nutrient uptake of N to the application of sugar palm solid waste compost in Regosol can be seen from the parameters of Nitrogen availability, plant growth and N nutrient uptake at maximum vegetative age (table 3).

Table 3 Effect of sugar palm solid wastecomposton available N, plant height, dry weight, N content and N uptake of corn

Treatment	N-Available (%)	Plant Height (cm)	Dry Weight (g)	Tissue Nitrogen Content(%)	N Uptake (mg/plant)
K0	0,0024 c	40,21 c	2,05 c	0,46 b	0,002 a
K1	0,02 b	76,99 b	10,41 b	0,80 a	0,027 b
K2	0,043 a	83,43 a	17,24 a	0,87 a	0,050 b
K3	0,040 a	80,32 a	14,05 a	0,84 a	0,046 b
K4	0,014 b	71,60 b	12,36 b	0,85 a	0,029 b

Description : Average followed by the same letter in the same row or column shows there is no significant difference based on Duncan's Multiple Range Test at the level of 5%.

K0 = Compost with a dose of 0 tons / ha (control)

K1 = Compost with a dose of 22.24 tons / ha equivalent to 80 g / pot

K2 = Compost with a dose of 44.48 tons / ha equivalent to 160 g / pot

K3 = Compost with a dose of 66.72 tons / ha equivalent to 240 g / pot

K4 = Compost with a dose of 88.96 tons / ha equivalent to 320 g / pot.

From table 3, the results of analysis of variance of 5% significance level can be seen that sugar palm solid waste compost has a significant effect on increasing the availability of N Regosol, plant height, plant dry weight, tissue N content and corn N nutrient uptake. This condition indicates that sugar palm solid waste compost application plays a role in increasing these parameters. This is due to the addition of N nutrients resulting from the mineralization of palm starch solid waste, as evidenced by compost of sugar palm solid waste used which has a very high N content (table 2).

Regosol N-available increases with increasing amounts of sugar palm solid waste compost given up to the equivalent of 44.48 tons / ha (K2) (table 3, figure 1). Compost equal to 22.24 tons / ha (K1) and 44.48 tons / ha (K2) showed a significant increase of K0. This means that compost application has an effect on increasing the level of available N soil. The highest N available in the compost of sugar palm solid waste is equivalent to 44.48 tons / ha (K2), giving a dose above equal to 66.72 tons / ha (K3) and the equivalent of 88.96 tons / ha (K4) decreases yield. This condition is caused by environmental changes that cause a decrease in pH. According to Mengel and Kirkby (1987) cit. Wardani (2007) at low pH, nitrate is absorbed faster than ammonium; whereas at neutral pH, the absorption of both is possible. This is caused by the competition of OH anion with NO₃⁻ anion so that nitrate absorption is slightly inhibited. At pH 4.0 nitrate absorption is more than that of ammonium. Rosmarkam (2002) says that when giving Nitrogen is raised above the optimal point, then some assimilated Nitrogen separates as amide, so giving excessive nitrogen only raises N levels in plants but reduces carbohydrate synthesis. According to Agus cit. Wardani (2007), nitrogen needs for corn plants last a lifetime. The increase in N available Regosol due to the compost used is very high N content (table 2).

The increase in N available in the soil seems to respond to plant growth, which is indicated by an increase in plant height, plant dry weight (biomass), levels of N and uptake of N-plant tissue (table 3), in this case Corn absorbs N from the soil in available forms (NH⁴⁺ and NO₃⁻), due to the addition of N from sugar palm solid waste compost (table 2).

Increased nutrient uptake of N by corn occurs as the amount of sugar palm solid waste compost is increased. This increase in nutrient uptake is due to an improved plant root system as evidenced by an increase in plant height and total dry weight of plants at the maximum vegetative age (table 3). This increase in plant height and total dry weight was caused by increased availability of N Regosol nutrients. This

is because photosynthate in plant tissue that is formed due to the increased dose of sugar palm solid wastecompost given is widely used for cell division. N is needed by corn in very large quantities. Nitrogen in plants functions to plant growth process, affect the work of chlorophyll, and increasing protein levels in the body of the plant (Hakim et al. 2006). While the need for nitrogen for corn lasts throughout life. Nitrogen uptake is not the same in every phase of growth of corn, so plants want nitrogen availability continuously at all stages of growth. Therefore, if there is an addition of N in the soil, plant growth will increase.

Figure 1. Effect of sugar palm solid wastecompost on available N Regosol

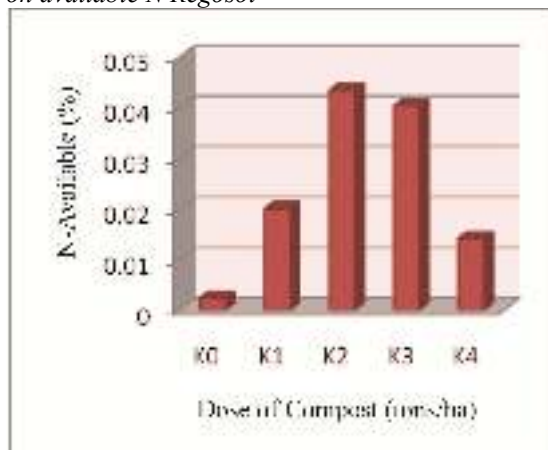
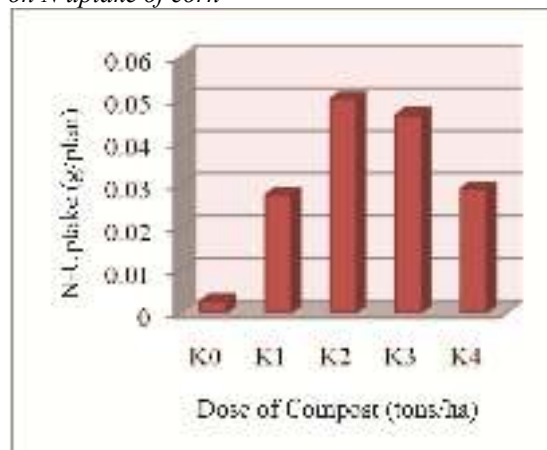


Figure 2. Effect of sugar palm solid wastecompost on N uptake of corn



Description :
 K0 = Compost with a dose of 0 tons / ha (control)
 K1 = Compost with a dose of 22.24 tons / ha equivalent to 80 g / pot
 K2 = Compost with a dose of 44.48 tons / ha equivalent to 160 g / pot
 K3 = Compost with a dose of 66.72 tons / ha equivalent to 240 g / pot
 K4 = Compost with a dose of 88.96 tons / ha equivalent to 320 g / pot.

From table 3 and figure 2 it is known that the uptake of plants at the maximum vegetative age increases with increasing compost doses. The highest N uptake was achieved in the provision of compost equivalent to 44.48 tons / ha (K2), the application of the above dose was equivalent to 66.72 tons / ha (K3) and the equivalent of 88.96 tons / ha (K4) actually decreased. This phenomenon is as said by Mitscherlich in the law of decreasing yield (law of diminishing yield increment), the addition of nutrients increases the yield to a certain point, however the subsequent addition of nutrients provides an increase singly diminished yield (Mitscherlich 1910 cit. Nasih 2010). This is understandable because sugar palm solid waste compost equivalent to 44.48 tons / ha (K2) has the highest percentage in increasing N-available soil, plant height, plant dry weight, N levels in plants (table 3).

4. Conclusion

- a. sugar palm solid waste compost application significantly increases the availability of N in Regosol and N uptake in sweet corn.
- b. Application of sugar palm solid waste compost at a rate of 44.48 tons / ha (K2) gives the best response to the Nitrogen availability of Regosol and Nitrogen uptake in sweet corn.

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