Conference Paper

Improvement of Physical Properties of Inceptisols and Yield of Sweet Corn Affected by Arbuscular Mycorrhizal Fungi and Manure Applications

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Abstract

Local resources such as Arbuscular Mycorrhizal Fungi (AMF) and manure can be applied to improve the soil properties and the maize productivity. This trial was to determine the effect of Arbuscular Mycorrhizal Fungi and manure on some physical characteristic of Inceptisols and yield of sweet corn. This study was conducted at Babakan village, Ciparay distric, Kabupaten Bandung at 07°04′ 40,9″ S and 107°41′ 32,6″ from May to August 2015. The experiment was arranged as Randomized Block Design with factorial pattern consisted of 2 factors and 3 replications. The first treatments were AMF rate (5, 10, 15 g crop^{-1}) and the second treatments were type of manure (chicken, sheep, and cow) at 30 ton ha^{-1}. The AMF and type of manure could decreased the bulk density, increased soil porosity, and improved weight of the corn cob up to 94% of its maximum potential.

Keywords: Competitiveness, RCA, EPD, IIT, Panel Regression.

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1. Introduction

Sweet corn is an interesting horticultural commodities among farmers to cultivate due to early-ripening harvest time at the age of 70-80 days and sweeter taste hence it leads much consumer demand, while there is a low production at the farm level. The problem of the low production of sweet corn relates to the low fertility of the soil caused by intensive use over a long period so that the soil becomes nutrionally poor and decrease the capacity to sustain the growth of the plant, including the low C-organic (<2%), whereas to obtain optimum productivity required organic C > 2.5% [1].

Approach on increasing crop productivity can be started on the improvement of soil fertility by adding organic matter both from plants and animals residue. Organic materials given to the soil can improve the physical, biological, and chemical properties as well. Organic matters used can utilize a variety of manure from chicken manure,

sheep, and cow. The characteristics of each of manure varies, as of the nutrient content, pH, and C / N.

In addition to improving the physical properties of the soil, organic matters become a source of nutrients for plants, also have an important role as an energy and carbon source for soil microorganisms. In this study, three kinds of organic material such as manure applied simultaneously with inoculation Arbuscular Mycorrhizal Fungi (AMF). Organic matter increases the AMF indigenous growth in soils that are nutrient-deficiency [2]. Organic matter provide nutrients for hyphae growth. Hyphae serves as apparatus in the absorption of nutrients. Expansion of hyphae growth beneficial to soil aggregation process and open the way for nutrient uptake increase, especially for immobile element like phosphorus. The AMF can increase N uptake significantly. N element is essential to support vegetative growth and P element that required for the formation of cob, cob filling, and accelerate the ripening of corn kernels [3].

Thus the application of organic matters and the AMF is expected to be synergistic in physical improvement soil and increase crop yields of sweet corn. The aim of research was to get the fertilizer technology formula containing manure and AMF which is synergistic on the physical improvement of the soil and yield of sweet corn.

2. Materials and Method

The research was conducted in Babakan village, Ciparay distric, Kabupaten Bandung at coordinate 07°04′40,9″ S and 107°41′32,6″, from May to August 2015 using a randomized block design (RBD) factorial with 2 factors and 3 replications. Factor 1: Manure consisted of 3 levels (p_1 = manure chicken 30 tons ha^{-1}, p_2 = Manure cow 30 ton ha^{-1}, p_3 = Manure sheep 30 ton ha^{-1}), factor 2 FMA inoculum with 3 level s (f_1 = FMA 5 g $plant^{-1}$, f_2 = FMA 10 g $plant^{-1}$, f_3 = FMA 15 g $plant^{-1}$). The parameters observed in this study were soil bulk density, soil type weight, total porosity, corn cob weight per fruit. Those observation parameters were analyzed by analysis of variance at 5% using DSAASTAT statistical program.

The study was conducted on a land area ± 200 m^2 using a size (2.5 × 1) m, so there were 36 plots with a distance 0.5 meters between plots. When the plots were ready then each was given appropriate treatment of manure by mixing 30 tons ha^{-1} or 13.5 kg $plot^{-1}$. The AMF applied was 5 g, 10 g and 15 g for each planting hole. Further planting of 2 corn seeds per hole placed 3 cm above the AMF inoculum with a spacing of (75 × 25) cm.

Inorganic fertilizer application in accordance with the recommendation of sweet corn crop fertilization, namely: urea 300 kg ha^{-1}; SP-36 50 kg ha^{-1} (SP-36 fertilizer dose 50% dose recommendation) and KCl 50 kg ha^{-1}. Urea was given three times, i.e ⅓ part along

Table 1: Effect of Manure and AMF on Soil Bulk Density.

Treatment	Average of Soil Bulk Density (g/cm^3)
Manure	
Chicken 30 ton ha^{-1}	0,85 a
Cow 30 ton ha^{-1}	0,87 a
Sheep 30 ton ha^{-1}	0,78 a
FMA	
5 g	0,81 a
10 g	0,83 a
15 g	0,86 a

Explanation: Figures followed by the same letter are not significantly different according to Duncan further test at 5%

with SP-36 and KCl at planting, ⅓ part was given at the age of 21 days after planting, and ⅓ part again given at 35 days after planting [4].

3. Results and Discussion

3.1. Soil Bulk Density

The effect of manure and AMF on soil bulk density can be seen in Table 1. There was no interaction effect between the manure and the AMF on the soil bulk density. The data in Table.1 indicates that manure types and dose of AMF 5 g plant^{-1} treatments could decrease soil bulk density (BD). Topsoil which has clay texture and granular structure has BD between 1.3-1.5 g cm^{-3}. In this study the type of manure produced soil bulk density of 0.78- 0.85 g cm^{-3}. The AMF provision made the value of soil bulk density in the range of 0.81 to 0.86 g cm^{-3}. Soil bulk density value of the manure of sheep, cows, and chickens as much as 30 tons ha^{-1} and inoculation AMF 5 g plant^{-1}, 10 g plant^{-1}, 15 g plant^{-1}managed to decrease BD of 1.48 g cm^{-3} were measured at beginning of research. The average reduction of soil bulk density due to manure application amounted to 55.18 percent, meanwhile AMF inoculation amounted to 55.19 percent. BD decrease was significant as a result of the application of manure and AMF [5]. The BD decrease compare to normal range values for texture soils of clay represents that the type of chicken manure, cow manure and sheep manure given as much as 30 tons ha^{-1} can increase the pores of Inceptisol soil used which has high clay content (81%) and low organic material (C = 1.92). A decrease in bulk density through organic matter application because the organic matter has a low density so the volume of soil can increase and the bulk density will decrease [6].

The AMF application that contains three species also succeeded in reducing the value of BD. AMF through external hyphae help the soil more crumbly by improving the

Table 2: Effect of Manure and AMF on Soil Porosity.

Treatment	Average of Soil Porosity
Manure	
Chicken 30 ton ha^{-1}	0,56 a
Cow 30 ton ha^{-1}	0,69 a
Sheep 30 ton ha^{-1}	0,53 a
FMA	
5 g	0,60 a
10 g	0,64 a
15 g	0,58 a
Explanation: Figures followed by the same letter are not significantly different according to Duncan further test at 5%	

soil structure. AMF external hyphae change clay-textured soil becomes more crumbly by the presence of more pores.

3.2. Soil Porosity

Mineral soil porosity ranges from 0.3 to 0.6 [7]. The effect of manure and AMF on soil porosity can be seen in Table 2.

The addition of sheep and chicken manures 30 ton ha^{-1} can make the soil porosity 0.53 and 0.56 respectively. This figure is included as medium category (0.31 to 0.63) for soil porosity. Cow manure with the same dose increased soil porosity from medium to be high category if the value was above 0.63. Inoculation of AMF 5 g $plant^{-1}$ and 15 g $plant^{-1}$ produces porosity values of 0.6 and 0.58 respectively which were categorized as medium, whereas inoculation 10 g $plant^{-1}$ raised class into the category of high porosity.

3.3. Weight of Corn Cob

The results of the analysis showed that manure and FMA did not significantly affect the weight of the corn cob either as combination or as independent which can be seen in Table 3.

When comparing the weight of corn cob by manure or AMF with doses of 5, 10, and 15 g $plant^{-1}$ with weight corn cob in the description which ranges 221.2 to 336.7 g, then the two treatments each had succeeded to produce corn cobs weight that 94 per cent of its maximum potential. One of the influencing factors of the cob weight is nutrients. N elements play a role in the improvement of pollen and corn cobs. Most of the energy used for the improvement of pollen and cob one week before anthesys. N deficiency or disorders of N metabolic at a certain time range will limit the size of

Table 3: Effect of Manure and FMA on Weight of Corn Cob.

Treatment	Average of Weight of Corn Cob (g)
Manure	
Chicken 30 ton ha^{-1}	335,48 a
Cow 30 ton ha^{-1}	323,51 a
Sheep 30 ton ha^{-1}	289,94 a
FMA	
5 g	304,07 a
10 g	332,07 a
15 g	312,78 a

Explanation: Figures followed by the same letter are not significantly different according to Duncan further test at 5%

the cob. Therefore, to obtain high production of cob nutrients should be provided with enough N during the growth. In this study, the low N content in soil and the absorption was aided by the AMF.

AMF and manure additions decreased soil bulk density (Table 1). The decreasing process in soil bulk density can make the soil physical environment more suitable for root growth. This process important in play a role in nutrients absorption to support the growth plant and increase the crop production. The manure can increase husked fresh cob weight, fresh weight cob without husks and marketable cob [8].

4. Conclusion

The application of AMF as much as 5-15 g $plant^{-1}$ and manure of cow, sheep, and chicken as much as 30 t ha^{-1} can reduced the soil bulk density, increased porosity class, and produced corn cob weight until 94 percent of its maximum potential.

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