

Effectiveness of cow manure and mycorrhiza on the growth of soybean

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Abstract. Soybean is one of the major food crop commodities in Indonesia. The needs of soybean each year is always increasing, but the the production rate is low. The research aimed to know the influence of treatment doses of cow manure and mycorrhiza towards growth and yield of soybeans. This research was conducted using Randomized Complete Block Design with two factors. The first factor is the dose of cow manure: S₀ (0 g/plot), S₁ (781.25 g/plot), S₂ (1562.5 g/plot), and S₃ (2343.75 g/plot). The second factor is the dose of mycorrhiza: M₀ (0 g/plot), M₁ (100 g/plot), and M₂ (200 g/plot). The observed parameters is plant height, the number of productive branches, weight of 100 seeds, root length, fresh weight of biomass, dry weight of biomass, conversion calculation results of soybeans per hectare and the percentage of roots infected with mycorrhiza. Data were analyzed with ANOVA at 5% significance level, continued with Duncan test at 5% confidence level. The results showed that no interaction between the two treatments. Doses of cow manure provides significant influence to plant height and the length of the root. Whereas, the doses of mycorrhiza provides significant effect to the number of productive branch, weight of 100 seeds, dry weight of biomass, and the conversion of soybean yield per hectare.

1. Introduction

Soybean is one of the main food crops in Indonesia after paddy and maize. National need for soybeans reaches 2.54 million tons every year. Soybean production in 2015 amounted to 998.87 thousand tons of dry beans or increased by 43.87 thousand tons (4.59 percent) compared to 2014 [1]. The constraint in increasing soybean productivity today is the lack of productive land supporting capacity.

One option to increase soybean productivity is by fertilizing efficiently [2]. Fertilization to overcome the low productivity of soybean and the decrease of soil fertility can be done by means of manure and biological fertilizer (mycorrhiza). Provision of organic fertilizer into the soil, in addition to increasing the pH and soil organic matter content, can also increase mycorrhizal activity in infecting plant roots. Thus, it is necessary to conduct research on the application of cow manure and mycorrhiza in effect on increasing soybean productivity. The purpose of this research is to know the effect of dosage of cow manure and mycorrhizal dose on growth and yield of soybean crop, to know the effect of interaction between dose of cow manure and mikoriza on growth of soybean crop.



2. Methods

2.1. Location and Time Research

Field trials conducted in February 2016 until April 2016 in the BPP of Selogiri District, Wonogiri. Analysis of the results carried out in the Laboratory of Ecology and Management of Plant Production, analysis of mycorrhiza took place in the Laboratory of Biological Soil and soil analysis took place in the Laboratory of Chemistry and Soil Fertility in Faculty of Agriculture, Universitas Sebelas Maret.

2.2. Tools and Materials

The tools used in this study include field analysis equipment are hoes, ruler, cameras, stationery, logbook and sprinkler hose; equipment for laboratory analysis include an analytical balance, oven, scissors, waterbath, etc. Materials used in this study include soil samples and chemical for laboratory analysis covering 70% alcohol, distilled water, 10% KOH, 1 N HCl, 0.05 % trypanblue, 1 N ammonium acetate, 10% NaCl, 45% NaOH, 0.1N HCl, 2% boric acid and other chemical materials.

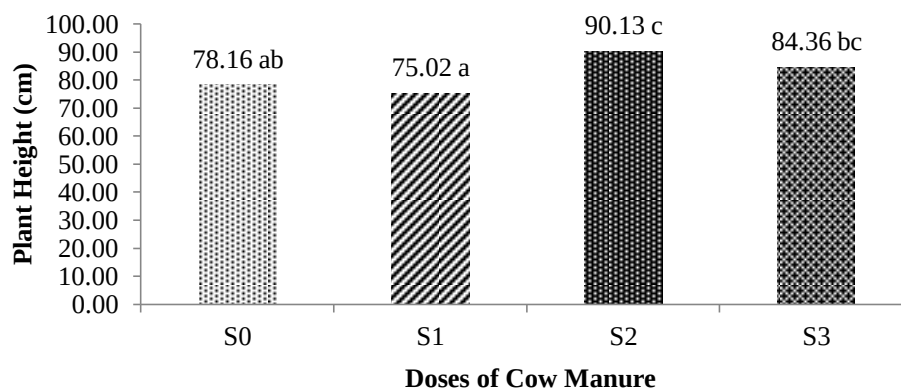
2.3. Research Design and Data Analysis

This research used a Randomized Complete Block Design (RCBD) with two factors. The treatment used was dose of cow manure (S0 = 0 g / plot, S1 = 781.25 g / plot, S2 = 1562.5 g/plot, and S3 = 2343.75 g/plot). The second factors is the dose of mycorrhiza: M0 (0 g/plot), M1 (100 g/plot), and M2 (200 g/plot). Data was analyzed with ANOVA at 5% level, continued by test of Duncan at 5% level.

3. Results and Discussion

3.1. Plant height

The result of variance analysis showed that the dosage of cow manure had significant effect on soybean plant height. Giving mycorrhiza had no significant effect and there was no interaction between the two treatments. The results of this study are in line with [3] stated that organic fertilizers can create better soil conditions, such as available nutrients, oxygen, and water needed by soybean plants in optimal and balanced quantities, so as to increase soybean growth.



Inter figures followed by the same letter are not significantly different in the Duncan Multiple Range Test of 5%

Figure 1. Effect of doses cow manure on soybean plant height

Treatment of dosage of cow manure 1562.5 g / plot was significantly different with dosage of cow manure 0 g / plot.[4] states that manure derived from cows contains many decompost microorganisms that are beneficial to the increasing of the type and population of soil microorganisms. Microorganisms can improve the physical properties so that the drainage and aerase of the soil become good.

3.2 Productive Branch

The result of variance analysis showed that the dosage of mycorrhizal dose gave a real effect to the productive branch of soybean crop. This result is in line with the study of [5] which states that mycorrhizal affects the number of branches because mycorrhiza is able to provide nutrients for plants. [6]) states that mycorrhiza plays a role in the absorption of phosphorus nutrients. This nutrient can help in the formation of flowers and soybean pods.

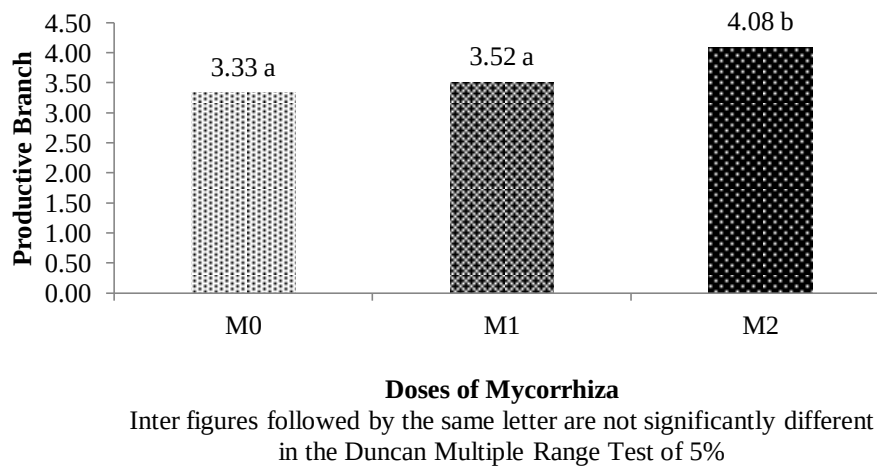


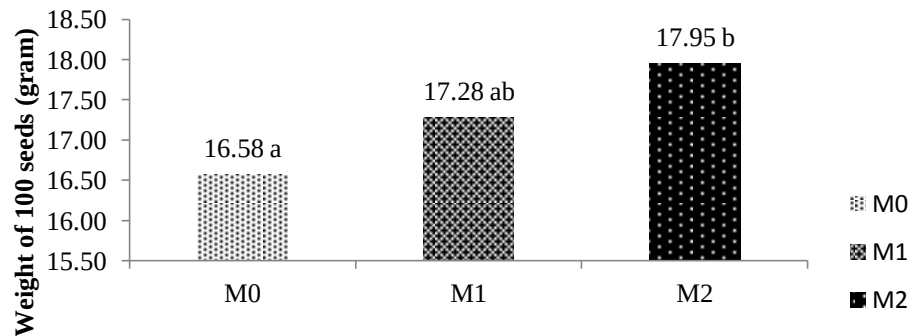
Figure 2. Effect of doses mycorrhiza on productive branch of soybean

Treatment of mycorrhizal doses of 200 g / plot has the highest mean value of productive branches of 4.08 branches. Treatment of mycorrhizal dose of 200 g / plot was significantly different from the dose of mycorrhizal 0 g / plot and mycorrhizal dose of 100 g / plot. [7] states that mycorrhiza can help the absorption of water and nutrients so that plant growth can increase along with the addition of mycorrhiza.

3.3 Weight of 100 seeds

Variation analysis results obtained that the dosage of mycorrhizal dose gave a significant effect on the weight of 100 seeds. The dosage of manure and the interaction between the two treatments did not significantly affect the weight of 100 seeds. [8] state that giving different doses of mycorrhizae increasing the weight of soybean seeds because mycorrhiza can help nutrient uptake and improved nutrient uptake status especially phosphorus.

The picture 3 shows that the effect of mycorrhizal administration of 200 grams / plot has the highest average to the weight of 100 seeds is 17.95 grams. The dosage of mycorrhizal doses of 200 grams / plot was significantly different from the 0 gram / plot dosage treatment, while the dosage of mycorrhizal 100 gram / plot was not significantly different from the dosage of mycorrhizal 0 gram / plot. [9] state that mycorrhiza can nourish plants, especially phosphorus from the soil.



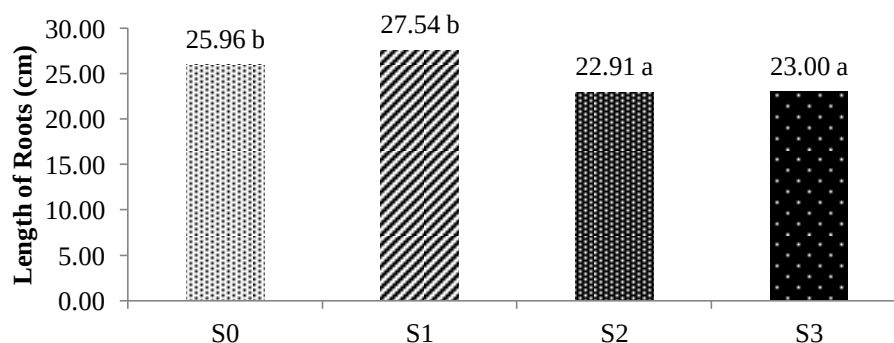
Doses of Mycorrhiza

Inter figures followed by the same letter are not significantly different in the Duncan Multiple Range Test of 5%

Figure 3. Effect of doses mycorrhiza on weight of 100 seeds

3.4. Length of Roots

Variation analysis results obtained that the treatment of doses of cow manure has a real effect. This result is in line with [10] it states that the addition of organic material from manure into the soil will improve the physical properties of the soil, it facilitates the roots in its growth. Manure is able to improve the physical and chemical conditions of the soil, and encourage the life (development) of microorganisms.



Doses of Cow Manure

Inter figures followed by the same letter are not significantly different in the Duncan Multiple Range Test of 5%

Figure 4. Effect of doses mycorrhiza on length of roots

Figure 4 shows that the average dose of cow manure is highest to root length that is at dose 781.25 gram / plot with average root length 27.54 cm. Dosage of cow manure 0 g / plot has no significant effect on dosage of cow manure 781.25 g / plot. The dose of cow manure 1562.5 g / plot and 2343.75 g / plot has a significant effect on dosage of cow manure 0 g / hectare.

3.5. Dry Weight of Biomass

Variation analysis result showed that dosage of mycorrhizal dose gave a significant effect on dry weight of biomass. This result is in line with [11] study that the increase in dry weight is due to an association between mycorrhiza and plants. Mycorrhizas symbiotic with plant roots can increase water and phosphorus uptake to be exploited by leaves and stems.

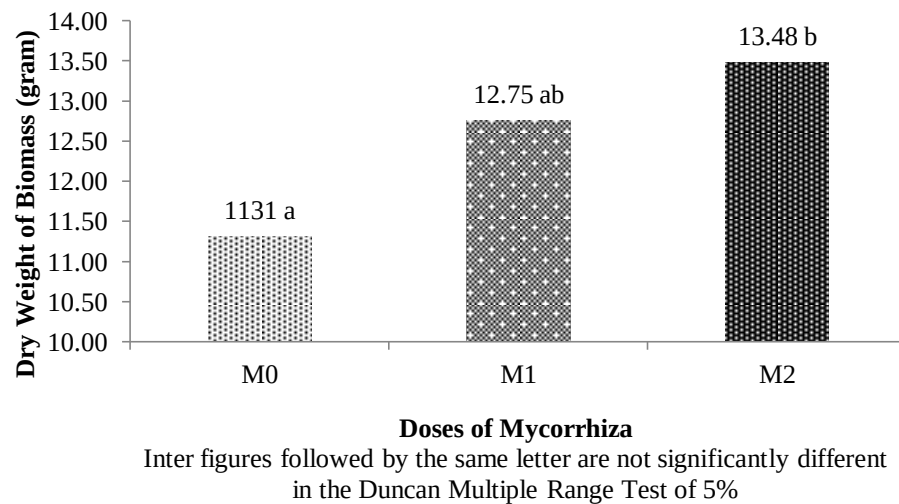


Figure 5. Effect of doses mycorrhiza on dry weight of biomass

Figure 5 shows that the highest dry weight is found in the dose of mycorrhizal 200 gram / plot with an average weight of 13.48 grams. Treatment dose mycorrhizal 0 gram / plot has a real difference to the treatment dose of mikoriza 200 gram / plot. Treatment of 0 gram / plot of mycorrhizal doses was not significantly different from the treatment of mycorrhizal doses of 100 grams / plot, and mycorrhizal treatment of 100 grams / plot was also not significantly different from the treatment of mycorrhizal doses of 200 grams / plot. Mycorrhizal doses may increase the dry weight of the plant. Plants which are given mycorrhiza will grow more fertile because of the larger root surface area to absorb nutrients and the number of leaves more to support the process of photosynthesis so as to produce more dry matter [12].

3.6. The Conversion of Soybean Yield Per Hectare

The result of variance analysis showed that the dosage of mycorrhizal dose gave a significant effect on the conversion of soybean yield per hectare. The dose of cow manure and the interaction between the two treatments did not significantly affect the conversion of soybean yield per hectare. Mycorrhizae can increase the ability of plants to utilize the available resources on the land so that the plants are not lack of nutrients and can increase production yield [13].

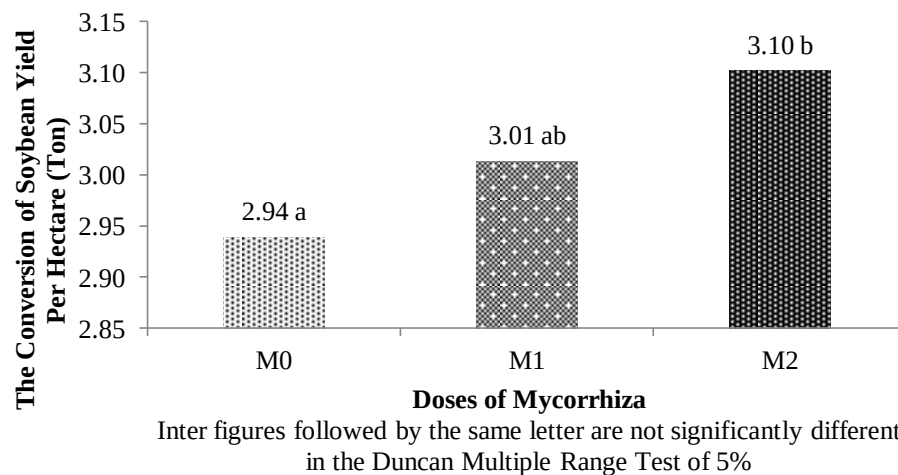


Figure 6. Effect of doses mycorrhiza on the conversion of soybean yield per hectare

Figure 6 shows that the highest average calculation of soybean yield per hectare is found in the treatment of 200 gram / hectare of mycorrhizal dose with an average of 3.10 ton / hectare. Treatment of mycorrhizal 0 grams / hectare was not significantly different from the treatment of mycorrhizal doses of 100 grams / hectare and the treatment of 100 grams / hectare was also not significantly different from the treatment of mycorrhizal dose of 200 grams / hectare. Treatment of 0 gram / hectare mycorrhizal dose was significantly different from the treatment of mycorrhizal dose of 200 gram / hectare. Plants which are given mycorrhizal applications will have higher yields than non-mycorrhizal plants [14].

3.7 The percentage of infections Mycorrhiza

Mycorrhiza as a biological fertilizer can give benefit plants in the supply of nutrients, especially Phosphor for plants. Mycorrhizal infecting the root system of plants can increase the capacity to absorb nutrients. Infected mycorrhizal roots will produce internal hyphae, external hyphae, and spores that are effective sources of inoculum [15].

Table 1 The effect of fertilizer dose and mycorrhizal fertilizer on percentage of fertilizer efficiency (%)

Doses of mycorrhiza	Doses of Cow Manure				Average
	S0	S1	S2	S3	
M0	0.00	0.00	0.00	0.00	0.00
M1	1.00	1.00	1.00	1.00	1.00
M2	1.00	1.00	1.00	1.00	1.00
Average	0.67	0.67	0.67	0.67	0.67

Based on Table 1 shows that the percentage of soybean plants infected with mycorrhiza is 67%. According [16]. states that giving mycorrhiza can increase the percentage of infected roots and form symbiotic associations that can increase root growth. Symbiotic mycorrhizas with host plants will result in external hyphae that can increase the ability of roots to absorb water and nutrients in the soil.

4. Conclusions

Based on the results of research Effectiveness Of Cow Manure And Mycorrhiza On The Growth Of Soybean showed no interaction between the two treatments. Doses of cow manure provides significantly influence to the high of plants and the length of the root. Whereas, the doses of mycorrhiza provides significantly influence to the number of productive branch, weight of 100 seeds, dry weight of biomass, and the conversion of soybean yield per hectare.

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