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Growth And Yield of Soybean Devon I Variety With Application of Cow Manure And Mycorrhiza

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ABSTRACT

One of the environmentally friendly ways to increase soybean production was to use organic fertilizers and mycorrhiza. This study aimed to determine the effect of cow manure dose and a dose of mycorrhiza on the growth and yield of soybean varieties Devon I. The study was conducted in April to September 2019 in Teguhan village, Sragen Regency, altitude 86 masl, with the grumosol soil type. This study used a randomized block design Complete by a factor of two treatments, the first factor dose of cow manure consists of four levels ie K0 = 0 tonnes / ha, K1 = 5 tonnes / ha, K2 = 10 tonnes / ha, K3 = 15 ton / ha and a dose of mycorrhiza consists of three levels ie M0 = 0 g, M1 = 3 g, M2 = 6 g per plant. The use of fertilizer was reduced half a dose recommendation. The results showed the dose of cow manure significantly affected the growth and yield of soybean, the mycorrhiza dose had no significant effect on the growth and yield of soybean. The lowest productivity in this study in the treatment without cow manure (1.158 tonnes/ha) and the highest productivity in the treatment of cow manure is 15 tonnes/ha (1, 46 tonnes/ha).

Keywords: Soybean, Devon I, cow manure, mycorrhiza.

1. INTRODUCTION

Soybeans were a very important agricultural commodity in Indonesia since they consumed daily in various preparations such as tofu, tempeh, soy milk, soy sauce. Soybean served as a source of vegetable protein which is relatively cheap compared to animal protein sources. Nutrient content in 100 g of soy comprising 35 g protein, 53 g carbohydrate, 18 g fat, 8 g of water even for particular variety, the protein content reaches 40-43g. Soybeans also contain minerals such as Ca, P and Fe and the amount of vitamins A and B (Adisarwanto, 2005).

The consumption of soybeans from year to year increase but production capacity was unable to meet so that continued imports. According to data from the Central Bureau of Statistics (BPS), the national soybean production in 2014 reached 892.6 thousand tons of dry beans, up 14.44 percent or 112.61 thousand tons compared to 2013 amounted to 779.99 thousand ton. Data of the National Soybean Council mentioned the need for domestic soybean consumption in 2014 of 2.4 million tonnes so that there was a shortage of supply (deficit) as much as one million tonnes more were met through imports (Ministry of Agriculture, 2014). National soybean productivity was still very low, about 1,3 tonnes/ha (Atman, 2009), even though that's potential can be increased up to 2.5 tonnes/ha.

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Increasing soybean production could be done in various ways such as the use of fertilizers efficiently, proper planting time, the carrying capacity of suitable land, and the use of varieties with high adaptability to the various agro-ecosystems (Martodireso and Suryanto, 2001). One of the problems to improve soybean productivity today was the lack of productive land capacity due to the degradation and land damage as a result of the current conventional farming practices that prioritize the use of high inputs like fertilizers and chemical pesticides. The application of fertilizer had a positive impact on the improvement of crop production but can impact negatively on environmental pollution and inefficiency fertilization. The used of total fertilizers continuously and excessive and was not offset by the use of organic fertilizers can result in the soil becomes hard and long-term productivity will decline. For reducing the use of inorganic fertilizers it is necessary to use organic fertilizers. Organic fertilizer has a role to improve the fertility of the chemical, physical and biological soil, other than as a nutrient source for plants. Organic materials provide nutritional sources of soil microorganisms so that improving soil fertility (Subowo, G., 2010).

The use of biological fertilizers was one way to help the absorption of nutrients that plants can grow optimally. Biological fertilizer is inoculants contain live microorganisms that function to tie up certain nutrients or facilitating the availability of nutrients in the soil for plants (Simanungkalit et al., 2006). One type of biological fertilizer was mycorrhiza (mycorrhizal arbuscular fungi). Mycorrhiza was a form of mutualism symbioses between fungi and higher plants root system. Mycorrhiza can improve the absorption of macronutrients and micronutrients. Plant roots that contain mycorrhiza can absorb the nutrients in the form of bound and unavailable to plants growth. Mycorrhiza also serves as a biological shield for the root pathogen infection.

Beside can improve growth and yield, mycorrhiza also increased the uptake of P (Kabirun, 2002). This was important because soy was a plant that needs phosphorus (P) more for the establishment of legume seeds as compared to others. Phosphorus was the main limiting factor in the tropics because it is often fixed by aluminum and iron (Hanum, C., 2013). Mycorrhiza has a role in improving the survival of plants to disease, drought, and other extreme conditions and increase plant growth by increasing the ability of roots to absorb nutrients. Mycorrhizal hyphae that have infected the plant can be stretched up to 10 meters so as to absorb nutrients and water in an area not accessible root (Kartika, 2010).

Research on the use of organic fertilizer and mycorrhizal well on soy and various other commodities, in general, proved a positive influence. The results of the study Malik, M. et al., (2017) concluded the use of cow manure growth soybean production more and application of mycorrhiza increase soybean yields but the combination of the two treatments did not interact. Muktiyanta, M.N.A., et al. (2018) combines the cow manure and mycorrhiza with various doses on



soybeans obtained results of the use of cow manure significantly increased plant height and root length, while the mycorrhizal dose significantly increases the weight of the dry weight of 100 seeds and plants.

The use of superior soybean varieties was one way to increase soybean production. Soybean varieties that have been widely known among the Wilis, Argomulyo, Anjasmoro, Grobogan, Baluran, Burangrang. One high-yielding variety that is still relatively new, namely Variety Devon I issued by Balitkabi (Assorted Nuts Crops Research Institute and tubers) in 2015. Devon I was a variety derived from crosses between varieties with strains IAC Kawi 100 with a potential yield of 3.09 tonnes / Ha. This variety has large seeds (100-seed weight 14-18g). Larger soybean seeds were preferable to community as a base material for tempeh.

This study aimed to determine the influence of cow manure and mycorrhiza at various doses on the growth and yield of soybean (variety Devon I). To reduce the use of fertilizer, this study use half of a dosage recommendation.

2. MATERIALS AND METHODS

Place and time

This study was conducted in April - September 2019 in Teguhan village, Karangmalang District, Sragen Regency, altitude 86 masl, with the grumosol soil type.

Materials and Tools

Materials used in this study are soybean seed varieties Devon I of Balitkabi, Malang. Solid manure from Rukun Makaryo Farmers Group, Karanganyar (total N 2.65%; P₂O₅ 3.32; K₂O 1.58%; organic C 31.78%; Organic Materials 54.79%; C / N ratio 11, 99%). Mycorrhizal inoculant of the Laboratory of Biological Agents, Temanggung, (16 spores / g zeolite, infected root density 100%, advocated the use of 5 g per plant in the early planting). Urea fertilizer. SP 36, KCl, liquid smoke pesticide, leftover soil from peanut crop. The tools used in this study was the hoe, water pump, roll meter, ruler, sprayer, digital scales, electric oven.

Research design

This study uses a randomized complete block design with two factor treatments, the first factor dose of cow manure consists of four levels ie K₀ = 0 tonnes / ha, K₁ = 5 tonnes / ha, K₂ = 10 tonnes / ha, K₃ = 15 ton / ha and a dose of mycorrhiza consists of three levels ie M₀ = 0 g, M₁ = 3 g, M₂ = 6 g per plant. The study was repeated 3 times.



Stages of Research

Tillage

Land that is used was dry land that ever were used to soybean study the treatment of goat manure and mycorrhiza. Land prepared by cleaned from the remains of plants and weeds then made research plots. Plot size 2 m x 1 m. Drainage channels made with a width of 20 cm depth of 30 cm.

Preparation of seed

Soybean seed varieties used are Devon 1. Before planting the seeds moistened with water and mixed with ground peanut crop marks as Rhizobium inoculant.

Cultivation

Planting the seeds of soybean by inserting 2 soybean seeds per hole, a depth of 3 cm, the spacing of 20 x 25 cm (there were 30 plants per plot).

Irrigation

Watering by way inundates drainage channels. Water from the drainage channel and then pour to patches of plants. The water source of the river near the study area. Watering was done 1 week at the beginning of planting until the time of flowering and seed formation. Three weeks before the harvest watering was not done or soil in a dry state.

Fertilization

Fertilizers used was Urea, SP 36, KCl half dose recommendation. The dose recommendation of fertilizer for soybeans is 50 kg urea, 75 kg of TSP and 50 kg KCl per hectare (Irwan, A.W., 2006).

Irrigation land has been done before the application of cow manure until the land becomes soft and easily mixed. Cow manure was give 7 days before planting, the soil was mixed with patches of crops by means of hoe. Inorganic fertilizer and mycorrhizal biofertilizers administered once at 1 week after planting with a method be included in two different holes at opposite positions on the right and left around the roots of plants.

Pest and disease control

Pest and disease control using liquid smoke pesticide. Spraying began at age 1 week after planting and once a week for 60 days so that the plants are protected from pest attack.

Harvest

Signs of the soybean was ready for harvest when the leaves have yellowed, plant stems begin to dry, dark brown pods. Based on the description of varieties of Devon I, harvesting is about 83 days. In this study, the harvest was done at 73 days after planting because of Mosaic Virus



disease forced the harvest to accelerated. Harvesting was done by pulling out the plant with roots carefully.

Observation

Observations were made against the growth parameters of height, number of leaves, plant fresh weight and dry weight of plants, and the result parameter consists of number of pods per plant, number of filled pods per plant, weight of pods per plot, dry seed weight per plant, dry seed weight per plot, weight of 100 seeds.

Data analysis

Data obtained from the observation results were analyzed by analysis of variance (ANOVA). If significantly different then continued by Duncan's Multiple Range Test (DMRT) the α 5%.

3. RESULTS AND DISCUSSION

The general condition of the research

Hot weather conditions during the study because of drought with a daily average temperature is quite high. Soybean plants generally grow well. But ten days before harvesting in accordance descriptions, found plant mosaic virus disease that is characterized by yellowing of the leaves and stems of plants, while the plants are the healthy color of the leaves, stems, pods are still green. Therefore harvested early has been done to avoid the increased extent of the attack and death of the plant. Results of ANOVA of the growth parameters and the results of this study are presented in Table 1.

Table 1. Anova Result Effect of Cow Manure and Mycorrhiza on Growth and yield of Soybean Plant Varieties Devon I

Parameter	The source of diversity		
	K	M	KxM
Plant height (cm)	**	ns	ns
Number of trifoliolate leaves	**	ns	ns
Plant fresh weight (g)	*	ns	ns
Plant dry weight (g)	*	ns	ns
Number of pods per plant	ns	*	ns
Number of filled pods per plant	*	**	ns
Weight of pods per plant (g)	**	ns	ns
Seed weight per plant (g)	ns	ns	ns
Weight of pods per plot (g)	**	ns	ns
Seed weight per plot (g)	*	ns	ns
Weight of 100 seeds (g)	**	ns	ns

Information :

K : factor doses of cow manure



M : mycorrhizal dose factor
KxM : interaction of cow manure dose and mycorrhizal dose
(*) : have a real impact
(**) : very significant
(Ns) : not significant

From the ANOVA results showed that treatment of cow manure doses had very significant effect on plant height and a number of leaves, significantly affect the fresh weight and dry weight of plants. In yield components, dosage of cow manure did not significantly affect the number of pods per plant and seed weight per plant. Dosage of cow manures have a significant effect on the number of pods per plant and seed weight per plot also has very significant effect on the weight of pods per plant and weight of pods per plots and weight of 100 seeds. While the dosage of mycorrhiza had no significant effect on almost all parameters of growth and yield, except in the parameter number of filled pods per plant significantly and the weight of pods per plant was highly significant.

Dose Effect of Cow Manure

Cow manure is generally a good effect on the growth and yield of soybean varieties Devon I are shown on the figure on all parameters of growth and the results tend to be higher than without the provision of cow manure. Significantly increased growth occurs in cow manure at a dose of 15 tonnes/ha (Table 2).

Table 2. Effect of Dose Cow Manure on Growth and yield of Soybean Plant Varieties Devon I

The growth parameters	Doses of cow manure (tons / ha)			
	0	5	10	15
Plant height (cm)	65.99 b	74.46 a	76.94 a	79.11 a
Number of leaves	15.07 c	16.37 bc	16.76 ab	17.92 a
Plant fresh weight (g)	36.87 b	45.83 b	44.74 b	62.43 a
Plant dry weight (g)	12.09 b	15.98 ab	15.26 ab	17.85 a
Number of pods / plant	36.37 b	42.37 ab	45.39 ab	48.52 a
Number of filled pods / plant	31.48 b	37.48 ab	39.63 a	41.24 a
Weight of pods / plant (g)	42.55 b	56.24 a	58.76 a	65.94 a
Weight of seed / plant (g)	9.87 b	14.91 a	12.48 ab	13.93 ab
Weight of pods / plot (g)	809.00 b	1188.90 a	1162.20 a	1392.70 a
Seed weight per plot / plot (g)	231.67 b	250.33 ab	281.78 a	292.44 a
Weight of 100 seeds (g)	16.89 b	18.22 a	17.78 a	18.44 a

Description: The numbers followed by the same letter on the same line are not significantly different shows based DMRT on the level of α 5%.

In this study, soybean crops in all treatments get macronutrients (N, P, K) with a relatively equal amount of an organic fertilizer (Urea, TSP, KCl) given at a dose of half recommendation of 25 kg urea, 37.5 kg TSP and 25 kg KCl per ha. By reducing the dose of fertilizer half of the



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dosage recommendation, the addition of cow manure at doses of 5 and 10 tonnes/ha provides varied influences on the growth and yield.

At the height parameters of the plant, cow manure 5 tonnes/ha significantly been increased plant height. but between the doses of 5, 10 and 15 tonnes/ha is not significantly different from each other. Lowest plant height in treatment without cow manure and the highest dose treatment of cow manure 15 t / ha. On the number of leaves, giving a dose of 10 tonnes/ha provides increased significantly recently. The number of leaves on the treatment without cow manure was minimum, while the highest number of leaves on the treatment dose of 15 tonnes/ha.

Among the plant fresh weight without cow manure and cow manure, 5 tones and 10 tonnes/ha are not significantly different from each other. Cow manure at a dose of 15 tonnes/ha can increase the fresh weight of the plant significantly. Plants that grow well able to make up the organs of plants such as stems, branches, leaves properly so that it will produce a fresh weight of higher plants. Plant fresh weight is also influenced by the amount of water content that can be absorbed by plants. Cow manure at a dose of 15 tonnes/ha was able to improve the physical properties of soil crumb structure becoming more and be able to store more water thereby increasing the plant fresh weight.

The dry weight of the plant reflects the net result of the process of photosynthesis and absorption of nutrient elements was then dumped in the plant body. Getting better and better photosynthesis the plants absorb nutrient elements from the soil it will produce a higher dry weight. From table 2 it can be seen at a dose of 15 tonnes/ha can give real effect to the higher plant dry weight. While the dose of cow manure 5 and 10 tonnes/ha is not significantly different from that without cow manure.

The results of this study indicate the role of cow manure that can improve the physical, chemical, and biological soil so that the soybean plants can grow better so as to have the plant height and number of leaves is higher. Muhidin (2000) states that cow manure able to improve the macro and micronutrients, can improve soil structure, improve hold water, increasing the cation exchange capacity (CEC) and spur the activity of soil microorganisms involved in the reform process of organic matter into nutrients that plants need.

The tendency of increasing numbers on various parameters and new growth is obvious at a dose of 15 tonnes/ha indicates that the plants are still responsive to the dose of cow manure and are likely to produce better growth when the dose is increased.

From table 2 it can be seen that the provision of a positive effect of cow manure can improve soybean yields are shown on almost all parameters was higher than without the addition of cow manure. Cow manure 5 tonnes/ha and 10 t / ha have not led to a noticeable increase in the



number of pods/plant. At a dose of 15 tonnes/ha increased the number of pods/plant significantly. The number of pods/plant on treatment without cow manure is not significantly different from the treatment of manure 5 tonnes/ha, but significantly different from the number of pods on the treatment of manure 10 tonnes/ha and 15 tonnes/ha. Weight of pods per plant on manure treatment without significantly different from the manure at all doses, but among treatments using manure in doses of 5, 10 and 15 tonnes/ha there is no real difference. Cow manure dose of 10 tonnes/ha yield seed weight/plant were significantly different from that without the provision of cow manure, but among treatments using various doses of cow manure produce seed weight/plant were not significantly different.

In line with the results on the weight of pods per plant, various parameters other results are weight pods per plot, seed weight/plot and weight of 100 seeds, tend to show the same pattern that is on treatment without manure obtained the lowest yield and significantly different from the results achieved the treatment uses cow manure both doses of 5, 10 or 15 tonnes/ha. Soybean yields of the various parameters seem to reveal that the increase in the dose of 15 tonnes/ha. Although all treatments obtain an organic fertilizer the same, the amount of nutrient elements provided is not optimal (Ali, Purwanti, & Hidayati, 2019). Soybean plants can grow and produce even better with the addition of organic fertilizer because it can provide additional nutrients more complete both macro and microelements, able to improve properties chemistry, Physical and biological soil. Organic materials as well as a nutritional source of soil microorganisms, so the presence of soil microorganisms improving soil fertility (Subowo, 2010).

With the nutrient content in more as well as the physical, biological better be a contributing factor in shaping the outcome of soybean plants as seeds. From table 2 it can be seen cattle manure application start dose of 5 tonnes/ha been able to increase crop in forming pods in terms of both the total number, number of pods and seed size. Results achieved between cow manure 5 tonnes/ha at a dose of 10 and 15 tonnes/ha showed the numbers increased although not significantly different. This shows the need for sufficient nutrients for the seed formation process.

Soybean productivity calculation results in this study are the lowest in the treatment without cow manure that is 1,158 tonnes/ha, whereas the highest productivity in the treatment of cow manure dose of 15 tonnes/ha is 1,46 tonnes/ha. When compared with descriptions of soybean varieties Devon I, productivity is much lower than the potential yield (3.09 t / ha) and average yield (2.75 t / ha). It was because of their yellow mosaic virus disease attacks that were harvested earlier. Uncooked plant conditions maximally cause results to be lower than the description. Of the various parameters that figure actually achieved in this study of all treatments was higher than the description. Plant height, the weight of 100 seeds, number of pods per plant in a row description



58.1 cm; 14.3; and 29 whereas in this study successively in the range of 66-79 cm; 16-18 and 36-48.

Dose Effect of Mycorrhiza

Dose Effect of mycorrhiza as single-factor on growth and yield of soybean varieties Devon I are shown in Table 3.

Table 3. Effect of Dose Mycorrhiza on Growth and yield of Soybean Plant Varieties Devon I

Parameter	Dose mycorrhizal (g / plant)		
	0	3	6
Plant height (cm)	76.35 a	73.49 a	72.50 a
Number of leaves	17.01 a	16.56 a	16.04 a
Plant fresh weight (g)	47.48 a	53.68 a	41.24 a
Plant dry weight (g)	16.76 a	15.30 a	13.82 a
Number of pods / plant	45.83 a	46.98 a	36.67 b
Number of filled pods / plant	34.24 a	42.04 a	31.01 b
Weight of pods / plant (g)	56.40 a	60.40 a	50.82 a
Weight of seed / plant (g)	12.54 a	14.67 a	11.18 a
Weight of pods / plot (g)	1232.25 a	1104.08 a	1078.25 a
Seed weight per plot / plot (g)	285.00 a	256.67 a	250.50 a
Weight of 100 seeds (g)	17.67 a	17.83 a	18.00 a

Description: The numbers followed by the same letter on the same line are not significantly different shows based DMRT on the level of $\alpha = 5\%$

Prasetya (2011) states mycorrhiza served to increase the absorption of nutrients, stimulate root growth resulting from growth hormone, increase plant resistance to drought, protect the roots from pathogen attack, protect the roots of heavy metal poisoning and release phosphate. Boian (1991) add mycorrhiza can release occluded P by Al and Fe to produce phosphatase enzymes so that P becomes available to plants.

In this study, the mycorrhizal application did not significantly affect the growth and yield of soybean. This may happen because several possibilities as happens in some other studies. Research Buhaira et al (2013) in soybean with treatment a compost mix mycorrhiza and water stress conditions, getting the mycorrhiza treatment had no significant effect because the content available on the initial soil P is high enough and the addition of P fertilization, the leading role of mycorrhizal unreal (Hariyadi, Huda, Ali, & Wandik, 2019). Lakitan (1993) states based on the nature of the association between mycorrhiza and plants, fungi subtle benefits if the conditions are fertile ground. Similar results also occur in Wangiyana, W. et al (2007) research, where the application of mycorrhiza only real effect on the growth component. Johnson et al (1997) in Wangiyana, W. et al (2007) explains that soils with high P content, dry weight of plant with mycorrhiza lower than a plant without mycorrhizae or no real difference because there is the possibility of association that occur tend to be parasitic. Wangiyana, W. et al (2007) further states



that the effect of mycorrhizal not real could happen because of the possible number of indigenous mycorrhizal preexisting high enough so that the addition of mycorrhiza had no effect or even rivalry between microbes because their numbers are quite high.

Research Khadjah, S. (2017) with a dosage of mycorrhiza (0, 10, 15 g/polybag) and dose of Liquid Organic Fertilizer (0, 15 and 20 ml/l) to get the application of mycorrhiza no real effect on the components of growth and soybean yields except in the number of branches. Mycorrhiza application dose of 10 g/polybag gives the best results on the parameters of flowering dates, a number of pods, seed yield and weight of 100 seeds. While research Maulana Malik et al. (2017) with and without mycorrhiza treatment and dosage of cow manure (0, 5, 10, 15, 20 tonnes/ha) to get the soybean crop by application of mycorrhiza can improve soybean production on land ultisol indicated by parameters number of pods per plant, weight of pods per plant, number of seeds per plant and weight of 20 seeds, but the response of plants to mycorrhizal not influenced by dose of cow manure.

Research Rusdi et al. (2011) on commodity pineapple Bogor (local Bangka) single-dose treatment with mycorrhiza (0, 2.5, 5, 7.5 and 10 g/plant) gives various results on parameters of observation. Mycorrhizal high doses are not directly proportional to the growth of plants. Treatment without mycorrhiza produces a higher height than the treatment dose of 10 g/plant. The success of spores colonizes the roots will be influential in helping the process of absorption of nutrients by plant roots.

Results of research Irwan and Wahyudin (2017) with a dosage of fertilizer complementary liquid (10, 15, 20 cc / l) and dose Mycorrhiza (5, 10, 15 g / polybag), in this study media weight 10 kg with a dose of manure 5 tonnes/ha, get the result that there is no interaction between treatment effect of mycorrhiza and liquid fertilizer to the dry weight of the plant, but independently of factors such treatment, there is a real effect. Dosage of mycorrhizal 5 and 10 g / polybag produce dry weight better. The number of pods is best achieved in the treatment of mycorrhiza 5 g / polybag, higher than the 10 and 15 g / polybag.

Important role of mycorrhiza in plant growth and development is its ability to absorb nutrients both macro and micro. Mycorrhiza -containing roots can absorb nutrients in a bound form that is not available to plants. Mycorrhizal role in improving the survival of plants to disease, drought, and other extreme conditions and increase plant growth by increasing the ability of roots to absorb nutrients. Mycorrhizal hyphae that have infected the plant can be stretched up to 10 meters so as to absorb nutrients and water in an area not accessible root (Kartika, 2010).



The use of mycorrhiza in this study although not show the real effect, there is a trend of increasing doses of 0 to 3 g/plant increased the number of pods/plant, but at a dose of 6 g/plant, there are indications of lowering growth and results.

Interactions Treatment Dose of Cow Manure and Mycorrhiza

In this study, the interaction of cow manure treatment dose and dose mycorrhiza not significantly affected all parameters of growth and yield. Variations mycorrhizal dose in this study refer to the user guide of the manufacturer ie 5 g/plant, but a variety of factors can affect the development in the field of mycorrhizal inoculants are given in order to get different results. Mycorrhizal treatment combined with organic fertilizer in the hopes of a positive synergy where the presence of organic fertilizer, creating conditions favorable to the development of microorganisms in the soil. Various factors can affect the development of mycorrhizal spores such as temperature, moisture, nutrient availability, competition with existing microorganisms in the research area as described.

4. CONCLUSIONS

From these results it can be concluded:

1. Dose of cow manure had significant effect on the growth and yield of soybean, dose of mycorrhiza had no significant effect on almost all parameters of growth and yield, except the parameter of the number of pods per plant .
2. Interaction dosage of cow manure and mycorrhiza had no significant effect on all parameters of growth and yield.
3. Soybean productivity in this study is the lowest in the treatment without cow manure is 1.16 tonnes/ha, while the highest productivity in the treatment of cow manure is 15 tonnes/ha which is 1.46 tonnes/ha.

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