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Effect of moringa leaf extract and cow-manure on soya bean growth and yield

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Abstract. *Glycine max.* L. Merril. is one of Indonesia's strategic commodities, whose productivity can be increased by using moringa leaf extract and cow manure. This study aims to determine the effect of the dose of moringa leaf extract and cow manure on the growth and yield of soya beans. The research was carried out from October to December 2020. The soil type was regosol in Jagalan Village, Karangnongko District, Klaten Regency, Central Java. The research design used the factorial method with a completely randomized design (CRD) which consisted of 2 factors; the first factor was dose variations of moringa leaf extract (M) were 0, 10, 20, 30, 40, and 50 ml./L (M0, M1, M2, M3, M4, and M5), the second factor is cow manure (C) which is 30 and 60 g/polybag (P1 and P2). The results showed that the combination treatment of M5P2 at a dose of 50 ml/L of moringa leaf extract and 60g/polybag of cow manure had the highest growth and yield compared to other treatments. This research provides information on appropriate doses of moringa leaf extract and cow manure on soya bean growth and yield.

1. Introduction

Soya bean is an important commodity in Indonesia that acts as a source of vegetable protein used for tempeh, tofu, oil, cakes, beverages, and other forms [1]. The nutritional content of dry soya beans is 36% protein, 19% oil, 35% carbohydrates, 17% dietary fiber, 5% minerals, and several other components, including vitamins [2]. In 2018, the harvested area was 680.373 ha, soya bean productivity was 14.44 quintals/ha, with a production of 982.598, and the average requirement was 3 million tons/year. Soya bean imports in 2020 reached 1 million tons from the United States, Canada, Brazil, Malaysia, France, India, and others [3]. The Grobogan variety has an average yield of 2.77 tons/ha and a potential result of 3.40 tons/ha, weighing 100 seeds of 18g. Selecting the suitable variety for the development environment is very important to directly affect soya bean yields [4].

One of the actions to reduce imports by increasing production can be done with agronomy measures by applying Moringa leaf extract and cow manure fertilizer. Moringa oleifera is an alternative that affects plant growth and yield so that it can be tested as a supplement or substitute for inorganic fertilizers. *M. oleifera* has a benefit effect increases plant fertility and drought tolerance [5]. Moringa leaves have a high zeatin content between 5 mcg to 200 mcg/g leaves [6]. Plant nutritional needs can be met with moringa leaf extract, which functions as a biofertilizer [7]. Moringa leaves contain 2.23% crude fat, 7.13 ash, 27.51% crude protein, 43.88% carbohydrates, 19.25% crude fiber, %, 76.53% moisture, and 1296.00 Kj/g calories [8].

Cow-manure is given to accelerate the availability and utilization of nutrients for soya beans [9], while cow-manure contains macronutrients such as 0.5% N, 0.25% P₂O₅, 0.5% K₂O, 0.33% magnesium, 6.62% C organic, 10.18 C/N ratio, and other ingredients. 11.41% organic with 0.5% water content [10]. Cow manure affects leaf area, number of flowers and fresh weight of plants, number of fruits, and production (tons/ha) [11]

The availability of nutrients for plants determines soya bean growth and yield. The use of Moringa leaf extract [12] and cow manure can provide nutrients for soya beans and reduce the use of chemical fertilizer [13]. The need for soya beans has increased every year, followed by an increase in imports, so an increase in domestic production needs to be carried out through studies. Based on this description, it is necessary to test to increase the growth and yield of local soya beans using Moringa leaf extract and cow manure.

1. Material and methods

The study was conducted from October to December 2020. The experiment using pots/polybags was carried out in Jagalan Village, Karangnongko District, Klaten Regency, Central Java. Laboratory analysis was carried out at the Plant Agronomy Laboratory, Faculty of Agriculture, Universitas Tunas Pembangunan Surakarta (UTP).

The equipment used in this study consisted of analytical scales, hoes, polybags, glassware, sprayers, and stationery. The ingredients used were local varieties of Grobogan soya beans, Moringa leaf extract, and cow manure. Soya bean seeds of the Grobogan variety were pre-soaked with fungicides before planting to avoid infection with soil-borne pathogens [14].

The soya bean growing media used refers to Rahayu et al., [13] planted in 40 x 40 plastic polybags containing about 7 kg of soil with Regosol soil type. Variations in the dose of moringa leaf extract using references [15] marked with M consisting of 0, 10, 20, 30, 40, and 50 ml /L (M0, M1, M2, M3, M4, and M5). The dose of cow manure according to the treatment refers to Hidayati & Soelistyono, [16] of 30 and 60g per polybag marked with P1 and P2. They are giving Moringa leaf extract and cow manure at intervals of 2 weeks to 4 times.

Manure was given according to each treatment, seven days before planting, then seven days after planting (DAT) given Moringa leaf extract. Every treatment was repeated five times during the growth of the Grobogan soya bean variety soya bean plants, also given inorganic fertilizer, according to the reference Rahayu et al., [13] using a dose of 50 kg/ha⁻¹, SP-36 100 kg/ha⁻¹ and KCl 100 kg/ha⁻¹. Urea fertilizer is given three times, as much as 1/3 part when the plant is 7 DAP, 1/3 share at 20 days after planting (DAP), and 1/3 share at 32 DAP SP-36 and KCl fertilizers are given once at the age of 60 DAP.

Observation growth of the soya bean plant was carried out four weeks after the first treatment of Moringa leaf extract and cow manure, the height of the plant (measured from the base of the stem to the top of the stem), dry weight of all leaves were observed on fresh leaf weight by drying the leaves and continued in an oven at 105 °C for 2 hours and continuously at 80 °C until the weight was constant [17] some pods and weight of seeds per plant. The data obtained from the observation were analysed using ANOVA, and if they were significantly different between treatments, followed by the DMRT (Duncan Multiple Range Test) at the 5% level.

3. Result and Discussion

Data analysis showed that the dosage of Moringa leaf extract was significantly different for the plant's height, dry weight, number of seeds, and weight of seeds per plant. This is because of the ability of Moringa leaf extract to provide nutrients and the ability of plants to absorb optimally for later use in plant metabolic processes.

Table 1. Effect of moringa leaf extract (M) to the height of the plant, dry weight of the plant, number of pods, and weight of seeds per plant on soya bean plants,

Treatment	Parameters
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	Height of the plant (cm)	The dry weight of plant (g)	Number of pods	Weight of seeds per plant (g)
Moringa leaf extract				
M0	64.58 ^c	10.21 ^b	109.83 ^b	20.41 ^b
M1	71.08 ^{bc}	10.22 ^b	129.17 ^a	22.79 ^a
M2	72.83 ^b	12.74 ^{ab}	130.17 ^a	24.34 ^a
M3	70.42 ^{bc}	13.69 ^{ab}	130.42 ^a	24.62 ^a
M4	70.63 ^{bc}	14.04 ^{ab}	131.91 ^a	24.61 ^a
M5	79.04 ^a	14.59 ^a	132.5 ^a	25.52 ^a

Note:

M0= Moringa leaf extract 0 ml /L, M1= Moringa leaf extract 10 ml /L, M2= Moringa leaf extract 20 ml /L, M3= Moringa leaf extract 30 ml /L, M4= Moringa leaf extract 40 ml /L, and M5= Moringa leaf extract 50 ml /L.

Numbers followed by the same letter show no significant difference in the Duncan multiple range test (DMRT) 5% level

The highest plant height (M5) was significantly different from M0, M1, M2, M3, and M4. These results are based on phytochemical analysis showing that *M. oleifera* contains natural cytokinin hormones natural plant cytokinin hormones, essential amino acids, and phenolics that can trigger plant growth and development [18]. Supported by Emongor [19] testing, the administration of Moringa leaf extract with a concentration of 20-30% increased the growth of long bean plants, which was shown based on plant height variables.

The dry weight of plant parameter M0 was significantly different from M5 but not significantly different from M1, M2, M3, and M4, indicating that the higher the dose of Moringa leaf extract, the higher the dry weight of the plant. Moringa contains nutrients, and water can trigger photosynthesis [20]. According to Kartika, the addition of 40% Moringa leaf extract increased the dry weight of the Pakchoy (*Brassica rapa L*) plant [21]

The number of pods and weight of seeds per plant parameters (M1.M2.M3.M4.M5) significantly differed from M0. Indicating that Moringa leaf extract affected the availability of nutrients and water for plants as supported by research [22], increasing the number and weight of pods due to an increase in the rate of photosynthesis supported by the availability of nutrients and water for plants.

Table 2. Effect of cow manure (P) on the height of the plant, dry weight of plants, number of pods, and weight of seeds per plant on soya bean plants,

Treatment	Parameters			
	Height of plant (cm)	The dry weight of plant (g)	Number of pods	Weight of seeds per plant (g)
Moringa leaf extract				
P1	69.42 ^b	12.69 ^a	125.72 ^a	23.26 ^a
P2	73.44 ^a	12.46 ^a	128.94 ^a	24.18 ^a

Note:

P1= Cow manure 30 g, P2= Cow manure 60 g

Numbers followed by the same letter show no significant difference in the Duncan multiple range test (DMRT) 5% level

Plant height is one of the parameters of plant growth and development due to cell division and elongation. Table 2 shows that treatment P2 gives a higher value than treatment P1. The nutrients contained in cow-manure increase the photosynthetic ability of plants [23]. The gibberellin hormone found in soya beans plays a role in synthesizing the enzyme α -amylase, which stimulates cell elongation.

The results of the study on cow manure dose of 60g/polybag per plant showed the highest yield of plant height parameters [16]

The parameters of plant dry weight, number of pods, and weight of seeds per plant in soya beans were not significantly different between P1 and P1 because the need for cow manure was insufficient. Cow drum fertilizer dose of 120g/polybag per plant showed the highest yield compared to the application of Nadira fertilizer of 75g/polybag per plant on edamame pods [24]

Table 3. The interaction effect of moringa leaf extract (M) to the height of the plant, dry weight of the plant, number of pods, and weight of seeds per plant on soya bean plants

Treatment	Parameters			
	Height of plant (cm)	The dry weight of plant (g)	Number of pods	Weight of seeds per plant (g)
Moringa leaf extract and cow manure				
M0P1	66.33 ^a	9.55 ^a	111.67 ^a	20.298 ^a
M1P1	62.83 ^a	11.36 ^a	108 ^a	20.52 ^a
M2P1	73.17 ^b	14.83 ^a	130.33 ^a	24.62 ^a
M3P1	69.00 ^a	14.36 ^a	128 ^a	24.62 ^a
M4P1	74.00 ^b	7.57 ^a	134.17 ^a	25.13 ^a
M5P1	71.67 ^a	12.21 ^a	129.67 ^a	24.11 ^a
M0P2	69.50 ^a	13.51 ^a	130.67 ^a	24.36 ^a
M1P2	74.50 ^b	13.31 ^a	129.83 ^a	24.32 ^a
M2P2	71.83 ^b	14.01 ^a	136.83 ^a	25.95 ^a
M3P2	69.00 ^a	11.46 ^a	128.17 ^a	25.1 ^a
M4P2	71.75 ^a	13.88 ^a	129.67 ^a	24.69 ^a
M5P2	83.58 ^c	14.79 ^a	131 ^a	25.08 ^a

Note:

M0= Moringa leaf extract 0 ml /L, M1= Moringa leaf extract 10 ml /L, M2= Moringa leaf extract 20 ml /L, M3= Moringa leaf extract 30 ml /L, M4= Moringa leaf extract 40 ml /L, and M5= Moringa leaf extract 50 ml /L, P1= Cow manure 30 g, P2= Cow manure 60 g

Numbers followed by the same letter show no significant difference in the Duncan multiple range test (DMRT) 5% level

Plant height parameters in the treatment of 50 ml/polybag of Moringa leaf extract and 60g/polybag of cow manure (M5P2) gave an increased effect and was significantly different from other treatments. Due to nutrient content, Moringa leaf extract increased *Eruca sativa* (Italian lettuce) and *Phaseolus vulgaris*. Essential minerals and amino acids play a role in forming protoplasm and phytohormones. Auxins and cytokinins facilitate rapid cell division [25]. Several studies reported that Moringa leaf extract could increase plant height and yield by 20-35% [26], especially in the number of pods and seed weight of mung bean and edamame [27]. Cow Manure fertilizes the soil and contains the micro quantities needed by plants. Cow manure contains 85% H₂O, 2.2-2.6% N, 0.26-0.45% P, and 0.13-1.37% K in each tonne. The content helps cell elongation to form plant height *Phaseolus vulgaris* L [16]

The interaction of treatment with increasing doses of Moringa leaf extract and cow manure was followed by an increase in the parameters of the dry weight of plant, a number of pods, and weight of seeds per plant but not significantly different. This was because the highest dose of treatment (M5P2) was not sufficient for plant needs. Moringa leaf extract of cow drum fertilizer 120g/polybag on *Phaseolus vulgaris* L. [16] edamame [27] and *Eruca vesicaria subsp. Sativa* [25]

3. Conclusion

Effect of application of Moringa leaf extract and cow manure on soya bean showed that the combination treatment of C5P2 at a dose of 50 ml/L of Moringa leaf extract and 60g/polybag of cow manure had the highest growth and yield compared to other treatments. This research provides information on the use of appropriate doses of Moringa leaf extract and cow manure on soya bean growth and yield.

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