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Application Of Manure And Plant Spacing On The Growth Of Indigofera Ratoon

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Abstract

Indigofera sp. is one of the legume genus plants that is easily cultivated and highly adaptable to a wide range of environments. In addition, it has a high protein content of biomass production and leaves, thus making it a potential source of animal feed. The purpose of this study is to see the effect of manure application and plant spacing on the growth and biomass of Indigofera plants. The research used Two-Factor Factorial Randomized Complete Block Design (RCBD). The first factor is the type of manure consisting of M1 = cow manure at 20 t/ha dose and M2: goat manure at 20 t/ha dose. The second factor is the plant spacing consisting of J1: spacing at 100 cm x 100 cm; J2: spacing at 100 cm x 125 cm: J3: spacing at 100 cm x 150 cm; and J4: spacing at 100 cm x 175 cm. The results showed that cow manure application and plant spacing of 100 cm x 175 cm significantly affected the growth and biomass of Indigofera plants.

Keywords: Indigofera, manure, plant spacing

I. INTRODUCTION

Indigofera sp. is one of the legume genera with many industrial uses. The natural dye industry is known to use this plant because its leaves contain indigo pigment, a colorant with a bluish-green color, which can be used as a source of blue dye for traditional fabrics, such as batik production, and as a new innovation that is more environmentally friendly. In addition, *Indigofera sp*. also offers a potential source of animal feed for the livestock industry due to its high protein content. Based on its nutrition, it has been reported that Indigofera sp. is classified as a shrub legume plant capable of producing high-quality green fodder (Abdullah et al., 2010 in Abdullah, 2014). This plant has economic value because the use of *Indigofera sp*. can cover up to 20-30% of feed costs.

Agronomically, *Indigofera sp*. is very easy to develop because of its high reproductive potential to produce pods with well-lined seeds. Moreover, it has the ability to regrow after harvest (ratooning) due to its good regrowth nature, which allows progressive development of branches resulting in high

leaf production. Indigofera plant has deep and strong roots, so it is able to adapt to areas with low rainfall. In other words, this plant is tolerant of drought in addition to being resistant to pruning. *Indigofera sp.* has good potential for a cover crop for semi-arid and dry areas (Herdiawan and Krisnan, 2014). For this reason, it is necessary to promote the cultivation of *Indigofera sp.* for its many benefits.

According to Samekto (2006) in., Andayani and Sarido (2013), fertilization is the provision of fertilizers to increase the supply of soil nutrients needed by plants as a way to increase production and quality of plant products. Manure is basically organic matter that is used as organic fertilizer, which mainly consists of animal feces, either in the form of solid manure (feces) or mixed with food scraps and urine (urine) such as cows and goats. Manure does not only contain macro elements such as nitrogen (N), phosphate (P), and potassium (K), but it also contains microelements, such as calcium (Ca), magnesium (Mg), and manganese (Mn), which plants need. It also plays a vital role in maintaining nutrient balance in the soil because manure has a long-term effect on the soil as it becomes a storehouse of food for plants.

Manure can be classified into organic fertilizers, which have advantages. Some of the advantages of manure are so favored by farmers, such as improving the structure and texture of the soil, increasing the absorption of soil to water, increasing living conditions in the soil, and as a source of food for plants. As a consequence, farmers use a large amount of manure in crop cultivation, ranging from 20-30 tonnes per hectare. The method of its administration depends on the type of plant, one of which is by spreading it evenly over the soil surface.

Manure contains different nutrients because each animal has its own characteristics, which are determined by the type of food and age of the animal. For example, the nutrients found in cow manure are N 2.33%, P_2O_5 0.61%, K_2O 1.58%, Ca 1.04%, Mg 0.33%, Mn 179 ppm, and Zn 70.5 ppm. Nutrients in goat manure consist of N 2.10%, P_2O_5 0.66%, K_2O 1.97%, Ca 1.64%, Mg 0.60%, Mn 233 ppm, and Za 90.8% (Samekto, 2006 in., Andayani and Sarido, 2013). The nutrient content of manure varies, but in principle, all types of manure must be completely mature before being applied to plants. Immature manure will be harmful to plants because it still emits gas during the decomposition process (Samekto, 2006).

Plant density is a factor that affects plant growth due to the absorption of solar energy by the leaf surface. If the space between plants is too dense, it can affect vegetative growth and crop yields due to reduced photosynthesis rates and decreased area development of leaves. Therefore, optimum spacing is needed to obtain maximum vegetative results. Irregular spacing will allow for competition for sunlight, nutrients, and water among individual plants. Thus, it is necessary to have appropriate spacing to reduce competition against plant growth factors.

The plant spacing is done to allow better plant growth by avoiding much competition between one plant to another. Spacing is an act of manipulation so that the canopy and plant roots can take advantage of the environment optimally (Gardner et al., 1991). Therefore, spacing must be considered to get the optimum population. The larger the plant canopy size, the wider the requirement for plant spacing to prevent overlapping, which can eventually result in competition for sunlight. The optimum density level will lead to the optimum Leaf Area Index (ILD) with the maximum formation of dry matter because the formation of the amount of photosynthate in leaves is more optimal.

The application of manure and spacing are some alternative methods to consider in an effort to increase the yield (biomass) of Indigofera plants. Thus, it is necessary to make sure the extent of the role of each factor in influencing the growth and yield components. This research is expected to reveal the appropriate types of manure and spacing for Indigofera plants in ratooning to obtain high plant growth and yield or biomass of Indigofera plants.

On this basis, the purpose of this research is to determine the effect of the application of manure and plant spacing on the growth of Indigofera ratoon.

II. RESEARCH MATERIALS AND METHODS

The research was conducted in the practical garden of the UPN "Veteran" Yogyakarta Faculty of Agriculture in Sempu, Wedomartani, Sleman, Yogyakarta Special Region located at an altitude of ± 115 m above sea level. The research was performed from June to October 2020 using some materials, including Indigofera plants, cow manure, goat manure, insecticides, and fungicides. It also used some tools, including hoses, buckets, sprayers, calipers, ovens, analytical scales, and pruning shears.

Based on its nature, this research is classified as a field experiment using a completely randomized block design consisting of two factors. The first factor is the kind of manure consisting of M1 = cow manure at a dose of 20 t/ha and M2: goat manure at a dose of 20 t/ha. The second factor is the spacing consisting of: J1: spacing 100 cm x 100 cm; J2: 100 cm x 125 cm: J3: 100 cm x 150 cm; and J4: 100 cm x 175 cm. Thus, there were eight treatment combinations that were repeated three times, and each treatment combination consisted of 6 plants, thus making the total number of plants amounting to 144 plants. The observed parameters were plant height, stem diameter, number of branches, and biomass. Data were collected when the plants were at the age of 1 month after ratooning or pruning was carried out. The data obtained were analyzed by means of variance at the 5% level.

III. RESULTS AND DISCUSSION

III.1. Plant Height and Number of Branches

The results of variance showed that the application of manure and plant spacing on Indigofera ratoon had a significant effect on plant height and number of branches. The average value of plant height and number of branches aged one month after ratooning is presented in Table 1.

The obvious effect of the treatment based on the different types of manure is because each manure can contribute nutrients to plant growth. In this case, this contribution is indicated by plant height and number of branches. The application of cow manure has an effect on higher plant height and more number of branches than the Indigofera plants treated with goat manure.

In the treatment of 100 cm x 175 cm spacing, the highest plant height and a number of branches were obtained, and the result was significantly different from the result of the spacing of 100 cm x 100 cm, 100 cm x 125 cm, and the spacing of 100 cm x 150 cm (Table 1). The setting plant spacing can affect the intensity of sunlight received by plants. The extent of sunlight intensity received by plants can be used for plant growth and development. At a spacing of 100 cm x 100 cm, 100 cm x 125 cm, and 100 cm x 150 cm, the intensity of sunlight received by the plants is lacking. This condition results from the fact that the canopy plants begin to shade each other, and thus leading to the stunting plant

growth and lower plant height. These stunted plants also had a fewer number of branches than those at the spacing of 100 cm x 175 cm.

Table 1. Plant height and number of branches of Indigofera plants in the observation one month after ratooning

Treatment	Plant Height (cm)	Number of Branches (number)
Types of Manure		
Cow Manure	281,97 a	23,61 a
Goat Manure	256,94 b	19,00 b
Plant Spacing Settings		
100 cm x 100 cm	262,78 q	16,33 q
100 cm x 125 cm	268,28 q	17,06 q
100 cm x 150 cm	269,44 q	18,11 q
100 cm x 175 cm	287,33 p	20,72 p

Note: The mean data in the column followed by the same letter shows there is no significant difference in the DMRT test at the 5% level.

III.2. Stem Diameter

The results of variance revealed that the application of manure and plant spacing on Indigofera ratoon had no significant effect on stem diameter.

Table 2 below presents that the application of manure treatments, namely cow manure and goat manure, each of which can contribute a number of nutrients with no different effect on stem diameter.

Table 2. Stem diameter and biomass of Indigofera plants observed one month after rationing

Treatments	Stem Diameter (cm)	Biomass (g)
Types of Manure		
Cow Manure	2,76 a	3250,69 a
Goat Manure	2,39 a	2796,00 b
Plant Spacing Settings		
100 cm x 100 cm	2,45 q	2218,00 q
100 cm x 125 cm	2,58 q	2458,12 q
100 cm x 150 cm	2,63 q	2825,56 q
100 cm x 175 cm	2,65 q	3183,94 p

Note: The mean data in the column followed by the same letter shows there is no significant difference in the DMRT test at the 5% level.

The treatment using the spacing of 100 cm x 100 cm gave the same effect on the development of stem diameter as that using the spacing of 100 cm x 125 cm, 100 cm x 150 cm, and with a spacing of 100 cm x 175 cm. Although the spacing affects the intensity of sunlight that plants can receive, the magnitude of the intensity of sunlight received by plants has not yet resulted in different growth

and development of stem diameter. This may be due to the short period of stem diameter observation, which was conducted only for one month since the ratooning took place.

III.3. Biomass

The results of the variance test showed that the application of manure and plant spacing on Indigofera ratoon had a significant effect on the biomass of the Indigofera plant. The average biomass at one month after ratooning is presented in Table 2 above.

The real effect of the application based on various types of manure is due to the fact that each manure can contribute nutrients to plant growth; in this case, it is the biomass of Indigofera plants. The application of cow manure has an effect on biomass, which is heavier than the biomass of Indigofera plants treated with goat manure. The application of manure as an organic material to provide nutrients has a different effect on the biomass. Cow manure contains more nutrients than goat manure.

The treatment of 100 cm x 175 cm spacing led to the highest plant biomass, and the result was significantly different from the treatment using the spacing of 100 cm x 100 cm, 100 cm x 125 cm, and the spacing of 100 cm x 150 cm (Table 2). The plant sequencing setting can affect the intensity of sunlight received by the plants. Sunlight is a source of energy for photosynthesis. According to Kuyik et al. (2012), photosynthesis is the basic process in plants to produce food. The amount of food produced will determine the availability of energy for plant growth and development. Photosynthesis is, thus, a key process for other metabolic processes in plants.

Treatment spacing of 100 cm x 175 cm had an effect on better plant growth, as shown by a higher plant and more branches than the plants treated with the spacing of 100 cm x 100 cm, 100 cm x 125 cm, and 100 cm x 150 cm. As a result, it also led to more number of leaves. The biomass is indicated by the higher number of leaves. The more chlorophyll in the leaves, which is an important organ of photosynthesis, the more absorbance of sunlight for the plants, which can increase the yield of photosynthesis, especially glucose, which is used by plants to grow and develop. This process can be seen in the increase in the number of leaves and the number of branches. The plant spacing of 100 cm x 100 cm, the spacing of 100 cm x 125 cm, and the spacing of 100 cm x 150 cm showed a no different level of biomass. Sari et al. (2016) stated that increasing the number of leaves and the number of branches will increase the level of biomass.

IV. CONCLUSION

Based on the research on the application of manure and plant spacing of Indigofera ratoon growth, it can be concluded that:

1. Application of cow manure at a dose of 20 tonnes/ha gives better results for the growth of Indigofera ratoons
2. Plant spacing of 100 cm x 175 cm leads to the better growth of Indigofera ratoon as indicated by higher plant height, more number of branches, and a higher level of biomass than that using other plant spacing setting.

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