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Potential of Goat Urine and Soaking Time on the Growth of *Mucuna bracteata* D.C. Cuttings

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Abstract **– This study aims to determine the potential of goat urine and soaking time on the growth of *Mucuna bracteata* cuttings. The method used is the experimental method with a randomized block design (RBD) factorial pattern with 2 replications. The first factor is the concentration of goat urine with 4 levels, namely 0 ml (K0), 75 ml (K1), 150 ml (K2), 300 ml (K3). The second factor is soaking time with 4 levels: 0 minutes (T0), 30 minutes (T1), 60 minutes (T2), 90 minutes (T3). Data were analyzed by analysis of variance then followed by Duncan's Multiple Range Test (DMRT) at a 95% confidence level. The results showed that the application of goat urine concentration with different soaking times could significantly increase the growth of tendrils length from *Mucuna bracteata* cuttings in the 7th week after planting. The application of 300 ml of goat's urine with 60 minutes soaking time has the potential to increase the growth of the highest tendrils length of *Mucuna bracteata* cuttings (69.95 cm). Application of 150 ml of goat urine has the potential to increase the highest number of leaves (19.63 leaves) and the highest total dry weight (6.54 g), and the application of 300 ml of goat urine has the potential to increase the highest total fresh weight (14.18 g) from cuttings. Application of 75 ml of goat's urine without soaking time effectively increased the growth of *Mucuna bracteata* cuttings in the 7th week after planting. Goat urine has the potential as a liquid organic fertilizer in the growth of *Mucuna bracteata* cuttings.**

Keywords – Mucuna bracteata **D.C., Goat Urine, Soaking Time, Stem Cuttings.**

I. INTRODUCTION

Mucuna bracteata is a type of Leguminosae Cover Crop (LCC) that is able to bind nutrients, especially Nitrogen, capable of producing large amounts of biomass in a short time, more often planted as cover crops in oil palm and rubber plantations, and has a better nutrient content than other LCCs [1]. On plantations, the policy of applying land cover has long been implemented including oil palm plantations. This LCC application aims to tackle erosion and leaching of soil nutrients, enrich organic matter, Nitrogen fixation to enrich N soil nutrients, improving soil structure, and suppress the growth of weeds [2].

At present, almost all State Estates that cultivate oil palm and rubber plants have planted *Mucuna bracteata*, although it has not been evenly distributed throughout the plantation area [3]. Since it was first used as a ground cover plant in 1999, *Mucuna bracteata* has never produced flowers and fruit or seeds. Because it is difficult to bear fruit, multiplication can be done by means of vegetative propagation [4]. The advantage of multiplication is to produce plants that have the same properties as the parent tree, can produce seeds in bulk, and are easy to do because they do not require complicated equipment and techniques [5]. But the multiplication of *Mucuna bracteata* through cuttings is very susceptible to death (the mortality rate reaches 90%). Failure to determine *Mucuna bracteata* is mainly due to the difficulty of getting cuttings whose root feathers have begun to appear (white roots) and lack of acclimatization after the cuttings have been cut from the parent plant [4].To increase growth in cuttings, fertilizer is also an important factor. Liquid organic fertilizer (LOF) is one form of breakthrough in the utilization of livestock urine. Besides saving on agricultural costs, the use of LOF can restore soil fertility. The use of inorganic or chemical fertilizers for a long time will reduce soil fertility, and these

conditions can be reduced by the use of organic fertilizers [6]. Urine can be an alternative solution to lack of sanitation and the high cost of mineral fertilizers inherent in developing countries. Urine is an environmentally friendly natural material without residual effects, economical and easily available, so that it can be used as a potential liquid organic fertilizer [7].

Goat urine waste contains Nitrogen, Potassium, Phosphorus is relatively high compared to other livestock wastes [8]. Besides being easily absorbed by plants, goat urine also contains the hormones auxin and cytokinin [9]. Auxin plays a role in stimulating root growth in cuttings. Giving auxin (IBA) and urine can accelerate the formation and growth of root cells in cuttings [10]. The potential of hormones contained in natural ingredients is not significantly different from natural hormones. Auxin has the potential to grow the number of roots in cuttings of plant stems [11]. The hormone auxin content in goat urine can stimulate the formation of shoots on cuttings of plants. Urine grass-eating animals are rich in the hormone auxin. The levels of auxin contained were 162-763 mg/L [12]. The best types of natural auxin and the highest content of auxin hormones are found in goat urine compared to cow urine and coconut water [13, 14]. With its potential, this goat urine can be a liquid organic fertilizer as a substitute for liquid chemical inorganic fertilizers, especially to prevent waste pollution due to the disposal of this urine. Liquid organic fertilizer including 100% goat urine has the potential to increase biomass production in *Indigofera spp* plants [15], also in manglid plants up to the age of 19 months [16], and in pepper plants [14]. The administration of natural auxin through 25% of effective goat urine to increases 96% of the percentage of life of dragon fruit cuttings [13]. Besides being potential as a liquid organic fertilizer and growth regulator, urine can also be an antifungal [17] and as a biopesticide [18]. Thus, the use of goat urine can increase the growth and development of plants that are free of pests and diseases. But the potential of this goat's urine has never been done to the growth of *Mucuna bracteata* cuttings. Therefore, in the propagation of *Mucuna bracteata* cuttings need to investigate the potential of the goat urine in different soaking time on the growth of *Mucuna bracteata* cuttings.

II. Materials and Methods

This research was conducted in January - March 2017 on a demonstration plot with a height of 30 meters above sea level. The tools used are analytical scales, sieves, cutters, hoes, bolts, sprayers, buckets, meters, raffia ropes, paper labels, rulers and stationery. The materials used were polybags, paranet, bamboo, top soil soil, *Mucuna bracteata* plant, and goat urine fertilizer. This study used an experimental method with a randomized block design (RBD) factorial pattern with 2 replications and 16 treatments. The first factor was giving goat urine concentration with 4 levels, namely: 0 ml (K0), 75 ml (K1), 150 ml (K2), and 300 ml (K3). The second factor is immersion time with 4 levels, namely: 0 minutes (T0), 30 minutes (T1), 60 minutes (T2), and 90 minutes (T3). The plant population is 96 plants, with 3 samples per treatment. Procedure for conducting research: land preparation, preparation of planting media, providing goat urine according to the prescribed concentration, soaking *Mucuna bracteata* cuttings according to predetermined immersion time, planting cuttings, maintenance, and observing growth parameters: plant tendrils length (cm), number of leaves, root length, total fresh weight, total dry weight. Data were analyzed using Analysis of Variance with a significant 5%. If there is a real effect, continue with Duncan's Multiple Range Test with a significant 5%. Data were analyzed using SAS program version 9.1.3.

III. Results and Discussion

A. *Potential of Goat Urine and Soaking Time in the Growth of Tendrils Length of Mucuna bracteata* D.C.*Cuttings*

Based on the analysis of variance, the application of goat urine concentration and soaking time has the potential to significantly increase the growth of tendrils length in *Mucuna bracteata* cuttings aged 7 weeks after planting (WAP). Based on statistical tests, the results showed that *Mucuna bracteata* cuttings soaked in 300 ml of goat's urine for 60 minutes (K3T2) could increase the growth of the highest tendrils by about 69.95 cm (1.36 times higher than the controls). This treatment (K3T2) was not significantly different from the administration of 75 ml of goat's urine without soaking time (K1T0), treatments K1T1, K1T2, K1T3, K2T2, K2T3, and K3T0. But the application of goat urine at the highest concentration (300 ml) with a longer soaking time (90 minutes) (K3T3), the growth of the resulting tendrils was lower than the K3T2 treatment. The potential of K3T2 treatment was significantly different from K3T3 treatment. This can be seen more clearly in Table 1. Thus, from all treatments applied to *Mucuna bracteata* cuttings, the treatment of 75 ml goat urine without immersion (K1T0) is effective potentially increasing the growth of tendrils length of 56.40 cm (37.39% higher from control) from *Mucuna bracteata* cuttings. This shows that goat urine has the potential besides being an easily decomposed organic liquid fertilizer which also has the potential as a specific natural growth regulator which stimulates the growth and development of cells in the cuttings tissue of *Mucuna bracteata*.

According to Dubey *et al*. [19] urine contains Nitrogen, Phosphorus and Potassium and other micronutrients such as those contained in organic fertilizers, so urine can be used as fertilizer. Nwite [20] also said that giving goat urine can improve soil fertility, plant growth and production. Urine can increase soil pH, total N, organic carbon, P availability and soil cations exchange and crop production. Besides being easily absorbed by plants, goat urine also contains the hormones auxin and cytokinin [9]. According to Ardisela [21] hormones act as biocatalysts that can accelerate the synthesis of various compounds in plant cells and increase the capacity of plants to use available reserves in the formation of new plant organs. The hormones auxin and cytokinin act as the main regulators of plant growth and development by regulating the dynamic processes of cells, tissues, and organs at low concentrations. Cytokinins and auxins regulate each other's synthesis, suggesting a mechanism for mutual feedback to harmonize plant hormone levels in meristems that develop from roots and shoots [22], including in regulating apical meristems, root patterns, and organogenesis. The hormones auxin and cytokinin interact to regulate the mechanism of bud, stem, leaf and root formation, which involves aspects of biosynthesis, inactivation, transportation, perception, and signals from hormones [23]. Salisbury and Ross [24] also argue that the growth of shoot length is influenced by the hormones auxin and cytokinin. Cytokinin will stimulate cell division through increasing the rate of protein synthesis, while auxin will trigger cell extension. Cytokinins participate in regulating shoot initiation and nutrient mobilization. Both of these hormones participate in regulating the cell cycle, auxin can regulate events that cause DNA replication while cytokinins regulate events that lead to mitosis. Auxin also regulates the extension of young segments and enlargement of young leaf strands, stimulates tissue and organ growth, and inhibits the development of lateral buds [25]. Thus the possibility of nutrient action, the hormones auxin and cytokinin contained in goat urine can control the growth of the tendrils of *Mucuna bracteata* to reach the highest of tendrils length at a specific concentration.

According to Sharma [26], almost every aspect of plant growth and development is under a certain degree of

hormone control. Single hormones can regulate the composition of cellular processes and developments that are very diverse, while at the same time several hormones often affect a single process. Including regulation of the cell cycle by auxin and cytokinin. Historically, the effects of each hormone have been defined largely by the application of exogenous hormones. So the administration of exogenous hormones (auxin and cytokinin, as well as various nutrients) contained in goat urine at low concentrations (75 ml) without immersion time, has the potential to significantly increase bud formation and roots at *Mucuna bracteata* cuttings and potentially increase the growth of *Mucuna bracteata* cuttings in 7th week after planting. However, to obtain the highest length of tendrils, cuttings of *Mucuna bracteata* require a higher concentration of urine goat (300 ml) with 60 minutes immersion time (K3T2), whereas if the immersion time is longer (90 minutes) (K3T3) then the potential decreases (Table 1). This shows the possibility of cooperation between exogenous hormones and endogenous hormones that are influenced by type, concentration, and immersion time in controlling the process of formation and growth of shoots and roots in *Mucuna bracteata* cuttings so as to accelerate the growth of tendrils up to 7 weeks after planting. Then Nordstro¨ *et al*. [27] also reported that the process of plant growth and development was controlled by the ratio of both auxin and cytokinin hormones at the action site. Auxin mediates very fast negative control in the cytokinin pool by suppressing biosynthesis through the isopentenyladenosine-5-Monophosphate-independent pathway. Conversely, the effect of excess cytokinin on all auxin pools in plants is slower. Thus these two hormones can interact at the metabolic rate in controlling plant development.

Table 1. Potential of goat urine and soaking time on the growth of tendrils length of *Mucuna bracteata* cuttings in the 7th week after planting

No	Treatment	Mean
1	K0T0	41.05 f
2	K0T1	46.40 def
3	K0T2	51.40 cdef
4	K0T3	45.35 ef
5	K1T0	56.40 abcdef
6	K1T1	61.95 abcd
7	K1T2	59.65 abcde
8	K1T3	65.75 abc
9	K2T0	51.10 cdef
10	K2T1	52.75 bcdef
11	K2T2	68.30 ab
12	K2T3	57.70 abcde
13	K3T0	65.10 abc
14	K3T1	51.70 cdef
15	K3T2	69.95 a
16	K3T3	50.25 cdef

Note : The numbers followed by the same letters on each line show no significant difference with Duncan's average difference test at the level of 5%.

Lakitan [28] also argues that shoot length growth is the result of cell growth and development which depends on the supply of nutrients given by the roots for metabolism and protein synthesis. In addition to the hormones contained in goat urine, nutrients are also available to meet the needs of *Mucuna bracteata* cuttings in cell

metabolism. All plants use Nitrogen, Phosphorus and Potassium to improve crop yield and quality by playing important roles in biochemistry and physiology in plant growth and metabolism [29, 30]. Nitrogen fertilizer can increase shoot growth [31], fertilizing Phosphorus and Potassium can increase the stem height of plant [32]. This shows that nutrient elements Nitrogen, Phosphorus, and Potassium and other micro elements contained in goat urine are also nutrients to the *Mucuna bracteata* cuttings so that it can increase the growth of tendrils length in the 7thweek after planting.

B. *Potential of Goat Urine on the Growth of Leaf Number, Fresh Weight, Dry Weight, and Root Length of Mucuna bracteata* D.C. *Cuttings.*

Based on the analysis of variance, results showed that the application of goat urine significantly affected the growth of leaf number, fresh weight, dry weight after *Mucuna bracteata* cut, except for root length parameters at 7 weeks after planting. Based on Duncan's test results obtained that the administration of goat urine with a concentration of 150 mL (K2) can increase the growth of the number of leaves from *Mucuna bracteata* cuttings which can reach the highest number of leaves around 19.63 strands (1.09 times higher than controls). This treatment was not significantly different from treatments K1 and K3. Likewise for fresh weight and dry weight growth parameters, although the application of 300 ml of goat urine (K3) can increase the highest fresh weight the growth of *Mucuna bracteata* until it reaches around 16.29 g / plant (1.82 times higher than the control) and 150 ml application goat urine (K2) can increase the growth of dry weight of the highest *Mucuna bracteata* cuttings around 6.54 g / plant (1.21 times higher than the control), but the application of 75 ml of goat urine (K1) was also not significantly different from K2 and K3 treatments (Table 2). So it can be said that the application of 75 ml of goat urine is effective for increasing growth: number of leaves, fresh weight, and dry weight of *Mucuna bracteata* cuttings in the 7th week after planting. However, to obtain the highest growth in the number of leaves and the highest dry weight, the optimum concentration of goat urine (150 ml) is needed, whereas at higher concentrations (300 ml) the growth potential decreases. Unlike the case with fresh weight from cuttings, the higher the concentration of goat urine applied, the higher the fresh weight growth of *Mucuna bracteata* cuttings. This can be seen more clearly in Figure 1.

Table 2. Average of goat urine potential in different concentrations on growth: leaves amount, fresh weight, and dry weight of *Mucuna bracteata* D.C cuttings.

No	Treatment	Mean		
		Number of leaves	Fresh weight (g)	Dry weight (g)
1	0 ml (K0)	9.38 b	5.78 b	2.96 b
2	75 ml (K1)	17.88 a	10.81 ab	5.11 ab
3	150 ml (K2)	19.63 a	14.18 a	6.54 a
4	300 ml (K3)	19.38 a	16.29 a	6.39 a

Note: The numbers followed by the same letters on each line show no significant difference with Duncan's average difference test at the level of 5%.

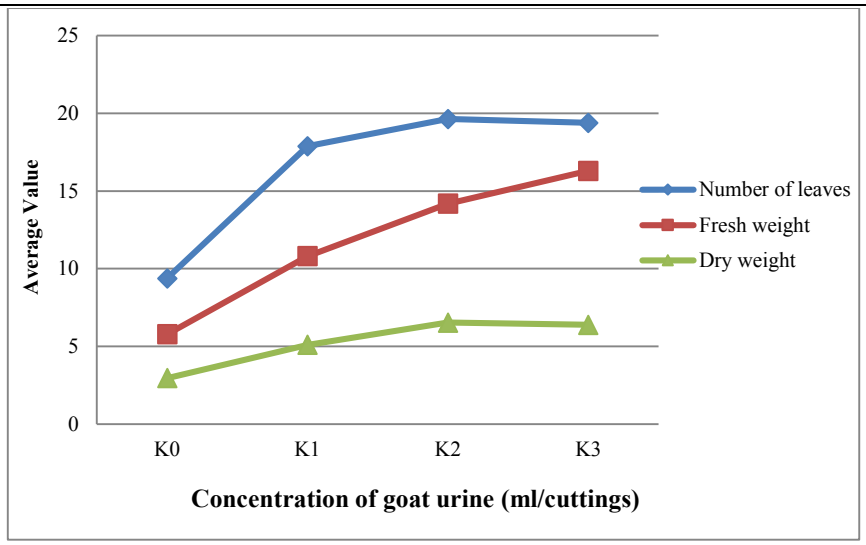

Fig. 1. Potential of goat urine on growth of leaf number, fresh weight, and dry weight of *Mucuna bracteata* at 7 weeks after planting.

According to Werner *et al.* [33], cytokinins are a specific type of hormone that plays a central role during the cell cycle and affects many developmental programs. Plants that lack cytokinin will show growth of stunts inhibited by smaller apical meristems, and produce more limited leaf cells. Absolute plants need cytokinins for leaf growth. Cytokinins are regulators of plant meristem activity and morphogenesis, with opposite roles in shoots and roots. Then Salisbury and Ross [24] also argue that auxin can stimulate the work of cytokinins in the process of cell division and enlargement, and induce enzymes that function in cell division especially in leaf primordia. Vegetative growth can be seen by increasing the number of leaves. The number of leaves is also determined by the number of shoots produced. The buds formed can develop into leaves [34]. This can not be separated from the influence of exogenous hormone factors that work with endogenous hormones. According to George *et al*. [35] two or more hormones can interact synergistically or antagonistically in many situations. Thus exogenous hormones can affect biosynthesis or metabolism of other hormones, thus affecting endogenous levels. Cytokinins can stimulate protein synthesis and participate in controlling the cell cycle. Maybe this hormone can regulate the initiation of chloroplast development and delay leaf aging.Thus to obtain the highest number of leaf growth in cuttings of *Mucuna bracteata*, the application of goat urine (as an exogenous factor) is required at optimal concentration.

Giving goat's urine also not only can act as a natural growth regulator but also can be a liquid fertilizer that provides various nutrients needed for growth of cuttings. To increase the growth of total fresh weight, *Mucuna bracteata* cuttings are needed by specific growth regulators to stimulate and activate specific enzymes that play a role in expressing vegetative growth from cuttings. If auxin and cytokinin stimulate cell division and cell enlargement especially in meristematic tissues, buds will form (which will produce stems and leaves) and roots. The formation of leaves will facilitate the occurrence of metabolic processes in meeting the growth needs of plants. In general, the increase in growth in plants also increases the total fresh weight and total dry weight of the plants. In this study, the total fresh weight still increased but the dry weight decreased at the highest concentration (300 ml) of goat urine. According to George *et al*. [35] auxin hormones (especially combinations with cytokinins) stimulate organ growth, and regulate the direction of morphogenesis. At the cellular level, auxin controls the process of cell division and cell elongation. So that this hormone is involved in the formation of meristems that give rise to certain tissues or organs. In organized networks, auxin is involved in the formation and maintenance

of polarity. The action of auxin and cytokinin in controlling the growth and development of cells, tissues, organs or plants is influenced by many factors including the type and concentration of exogenous and endogenous hormones [25]. Thus, at a higher concentration (300 ml) of goat urine (exogenous factor), the possibility of action of auxin and cytokinin in plant cells decreases, but on the other hand growth requires nutrients and water availability, resulting in increased fresh weight while decreasing dry weight. According to Jandaik *et al.* [17] application of urine to plants, can increase the biochemical content (chlorophyll and protein) in these plants. Then Gardner *et al*. [34] also argue that nutrition and water availability can affect growth, as in vegetative organs can also increase the fresh weight of plants.

Then based on analysis of variance, the results obtained that the application of goat urine and immersion time did not significantly influence the growth of the root length of the *Mucuna bracteata* cuttings until the 7th week after planting. According to Gardner *et al*. [34] the presence of auxin hormones at low concentrations plays a role in stimulating root initiation in cutting tissue, and encouraging root formation. While auxin at high concentrations will inhibit root initiation, although the hormone cytokinine exists but its presence does not make auxin work stimulate root initiation significantly. Cytokinin hormones can increase cell differentiation in plant roots by suppressing auxin transport and response to auxin at the boundary between the meristem and root extension zone [36]. However, the lack of cytokinin will accelerate the development of root meristems, accelerate root growth and more branching [33]. Perhaps because of this, the concentration of goat urine and immersion time on cuttings have not been able to cooperate with endogenous hormones so that it is not maximal in stimulating cell enlargement and extension, and cell division in the growth of root extension after 7 weeks after planting.

According to Hidayanto *et al*. [37] roots are the center of metabolism of plants for the formation of new plant organs that are influenced by the interaction between endogenous hormones and exogenous hormones in plants. The treatment of exogenous hormones accelerates cell division, stimulates the synthesis of endogenous hormones (auxin, cytokinin, and giberellin) and stimulates the accumulation of carbohydrates, and then induces root formation.Exogenous hormones also increase peroxidase (POD) and polyfenol oxidase (PPO) activity, reduce IAAO activity and then stimulate root formation. The treatment of exogenous hormones mainly acts during the root initiation stage, accelerates the synthesis of antioxidant enzymes (POD, SOD, and PPO), reduces root time, and consequently encourages root formation [38]. The type and concentration of auxin hormones significantly affects root growth in stem cuttings from plants. The application of high hormone doses causes no increase in root weight and number of roots, but the application of low hormone doses does not affect root length [39]. Likewise the application of goat urine concentration and immersion time to *Mucuna bracteata* cuttings, possibly at certain levels can cause a decrease in activity of some enzymes involved in the growth and extension of the cuttings root. So that the treatment significantly did not affect the growth parameters of the root length of the *Mucuna bracteata* cuttings at 7 weeks after planting.

IV. Conclusion

The application of goat urine concentration and soaking time has the potential to significantly increase the growth of tendrils length of *Mucuna bracteata* cuttings at 7 weeks after planting. The best treatment for the growth of tendrils length *Mucuna bracteata* (69.95 cm) (1.36 times higher than the control) was found in the application of 300 mL goat urine with 60 minutes soaking time (K3T2). The application of goat urine concentration significantly has the potential to increase the growth of leaf number, fresh weight, and dry weight of *Mucuna*

bracteata at 7 weeks after planting, while soaking time and its interaction with goat urine concentration have no significant potential. Growth in the number of leaves (19.63 leaves) (1.09 times higher than the control) and the highest total dry weight (6.54 g) (1.21 times higher than the control) was obtained in the application of 150 ml of goat urine, while for the growth of total fresh weight of *Mucuna bracteata* cuttings were highest (14.18 g) (1.82 times higher than the control) 300 ml of goat's urine is needed. The effective treatment that can increase the growth of *Mucuna bracteata* cuttings after the 7th week after planting is the application of 75 ml of goat urine without soaking time. Urine goat has the potential to be a liquid organic fertilizer on *Mucuna bracteata* cuttings.

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