The effect of dung and local microorganism of banana corm application on the growth and the yield of mung beans (*Vigna radiata* L) Vima - 2 variety

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Abstract. Mung beans are plants that have high economic value but the production of mung beans in Indonesia is still low. Dung serves to provide nutrients for plants, improve soil structure, and retain water in the soil. MOL (local microorganisms) banana corm has a number of microorganisms that can help plants absorb nutrients found in the soil. The purpose of this study was to determine the effect of the interaction between types of dung (dung) and banana corm local micro organization (MOL) on the growth and yield of mung beans Vima 2 and to determine the type of dung and the MOL dose of banana corm that was best for the growth and yield of mung bean plants. The method used in this study was a randomized block design with 2 factors and 3 replications. The first factor is the type of dung = no dung (j0), chicken dung (dung) (j1), goat dung (j2) and cow dung (j3). The second factor was the MOL dose of banana weevil, 0 ml plant⁻¹ (m0), 50 ml plant⁻¹ (m1) and 100 ml plant⁻¹ (m2). The results showed that the application of dung and the MOL dose of banana corm did not show any interaction, but there was an independent influence by the type of dung on the parameters of plant height, number of pods per plant, number of seeds per plant, weight of seeds planted, and harvest index, so that the type of dung that gives optimum results in mung bean cultivation is chicken dung.

1. Introduction
Mung beans are an important commodity in agronomy, economy, nutrition and health. The advantages in terms of agronomy are easy to cultivate, can be planted in less fertile soils, are more drought tolerant, and can be harvested at 56-60 days after planting depending on the variety. Based on data from the Central Statistics Agency (BPS) in 2018 the production of mung bean plants in West Java has decreased from 2014-2018, which originated from 12,749 ton to 9,006 ton.

According to Andrianto & Indarto [1], one of the causes of low mung bean production is fertilization that is not in accordance with recommendations, low soil fertility, so that the soil is less productive due to excessive use of inorganic fertilizers.

One way to increase mung bean production is by adding organic matter, dung and local microorganisms. Banana corm is an option for providing plants material vegetatively. One way to increase agricultural crop production is the addition of organic matter with dung, that chemical and biological properties of the soil is improved  [2]. Dung that is usually used by farmers is cow dung, goat or sheep dung and chicken dung which is economically cheaper and easier to find by farmers [3].
Dung is a solid mixture of plant debris. Some of the solids contained in dung consist of organic compounds, among others: cellulose, starch and sugar. The most important compilers of dung are living components, namely soil organisms [4].

Chicken dung is a type of dung that is usually used as a basic fertilizer to support plant growth because it contains quite a lot of nitrogen nutrients. All plants use the nitrogen nutrients contained in fertilizers to support plant growth in the vegetative phase. Apart from nitrogen, it will play a role in the generative period along with the macro elements of phosphorus and potassium [5].

Goat dung is very good for plants because it can provide organic matter and can improve soil physical properties, increase root length and density, biomass, leaf area, nitrogen uptake in seed production and efficiency in water absorption [6]. Fertilization with cow dung can increase the permeability and content of organic matter in the soil and can increase soil resistance to erosion [7].

According to Wulandari et al. [8] local micro-organism or mikro organamisme lokal (MOL) is a group of microorganisms that can be propagated by providing food as an energy source which functions as a starter in composting. MOL solution is a fermented solution made from various sources of organic material. MOL solutions contain micro and macro nutrients and also contain bacteria that function as pest and disease control agents, so MOL is good for use as a decomposer, biological fertilizers, organic pesticides and fungicides. Budy Frasetya et al [9] stated that organic material may contain elements important as micro nutrient and play role as strigger the metabolism of plants and Raden Budiasih et al [10] said beside the nutrients metabolism of plant need hormon to innitiate process of physiological of plant.

Research on the organic material used to prefare microorganism as fertilizer starters was found that banana corm gave better response on number of productive branches of green beans. Means of productive branches was 9 at the level treatment of 300 ml L⁻¹ [8].

2. Methods
This research was conducted from August 2019 to October 2019 in the experimental garden of Padjajaran University, Ciparanje, Jatinangor Sumedang which has an altitude of 750 meters above sea level. The tools in this study include gloves, caps, boots, hoes, coir, sacks, emruts, hoses, wooden tugs, thermohigrometers, buckets, knives, rulers, raffia ropes, meters, scales, measuring cups, shovels, cameras, stationery, laptops, label paper and notebooks. The materials used in this study include mung bean seeds (Vigna radiata L) vima 2 variety, soil, chicken dung, goat dung, cow dung, banana corm, MOL, rice washing water, sugar, water, and NPK fertilizer.

Experimental design used was a factorial randomized block design (RBD) consisting of 2 factors, namely the type of dung (j) consisting of 4 levels of treatment and 3 levels of banana corm (m) with 3 repetitions. The first factor was the type of dung which consists of 4 levels, namely: j₀ = without using dung; j₁ = chicken dung; j₂ = goat dung; and j₃ = cow dung. The second factor is the banana corm dose which consists of 3 levels, namely: m₀ = banana corm MOL = 0 ml plant⁻¹ (0 ml / plot) ; m₁ = banana corm MOL = 50 ml plant⁻¹ (450 ml / plot); m₃ = banana corm MOL = 100 ml plant⁻¹ (900 ml / plot). All of the treatments were applied in media preparation or befor the planting. Out of these two factors, 12 experiments were obtained and 3 replications were carried out, so they were 36 treatment combinations.

3. Result and Discussions
The results of the study of Yulin [11] that MOL of banana corm contains the following nutrients: NO₃ 3087 ppm, NH₄ 1120 ppm, P₂O₅ 439 ppm, K₂O 574 ppm, Ca 700 ppm, Mg 800 ppm, Cu 6.8 ppm, Zn 65.2 ppm, Mn 98.3 ppm, Fe 0.09 ppm, C-organic 1.06%, and C / N 2.2. In addition, the banana corm solution also contains 5 microorganisms which are very useful for plants, namely: Azospirillium, Azotobacter, Bacillus, Aeromonas, Aspergillus, phosphate solubilizing microbes and cellulolytic microbes. Types of microorganisms that have been identified in banana corms include Bacillus sp., Aeromonas sp., Aspergillus nigger, Azospirillium, Azotobacter and cellulolytic microbes. There are some parameters to measure the growth and the yield, as follow:
3.1. Plant Height

The result of height of plant analysis is presented in the Table 1 below showing the growth at the age of 14 DAP (day after planting), 21 DAP, 28 DAP and 35 DAP.

| Plant Height | Table 1. The effect of dung and MOL doses of banana corm application on the height of mung bean plants. |
|--------------|------------------------------------------------------------------------------------------------------------------|
| Dungs (j)    | 14 DAP | 21 DAP | 28 DAP | 35 DAP |
| j0           | 4.36 a  | 6.00 a  | 15.94 a | 32.38 a |
| j1           | 6.10 b  | 8.41 c  | 28.40 c | 41.80 c |
| j2           | 5.61 b  | 7.52 bc | 21.35 b | 36.23 b |
| j3           | 5.48 b  | 6.89 ab | 20.74 b | 35.80 b |
| MOL (m)      | 14 DAP | 21 DAP | 28 DAP | 35 DAP |
| m0           | 5.5 a   | 7.29 a  | 20.47 a | 35.92 a |
| m1           | 5.22 a  | 7.17 a  | 22.08 a | 36.79 a |
| m2           | 5.43 a  | 7.16 a  | 22.27 a | 36.84 a |

Description: Figures marked with the same italic in the same column are not significantly different based on Duncan's test at a 5%.

Table 1 shows the independent influence of the dung given to the height of mung bean plants. There was an effect of the independent application of dung indicated by different notations of J0 against J1, J2, and J3. This is because dung improves soil structure and provides a source of nutrients that plants need to increase in height, this is in line with the opinion of Nyoman and Mayadewi [12] application of dung can improve soil structure as well as increase nutrient availability.

Plants need more N and P nutrients for metabolic processes, plant height increase, and flower formation. Wilda [13] explains that the element N (Nitrogen) is an element. The main nutrients for plant growth, which are generally indispensable for formation or growth. Vegetative parts of plants such as leaves, stems, and roots, while the element P (Phosphorus) is present in the form of phytin, nuclein, and phosphatide, it is part of the protoplasm and cell nucleus which plays an important role in cell division, as well as for the development of meristem tissue, young tissue growth and roots, accelerate flowering and fruit ripening, compilers of protein and nutrient fat and the growth of microorganisms.

The most influential dung on mung bean plant height is chicken dung (j1) which is marked with the highest yield on plant height, namely at 14 DAP as high as 6.10 cm, 21 DAP as high as 8.41 cm, 18 DAP as high as 28.40 and 35 DAP as high as 41.80 cm. In line with Latuamury's opinion, (2015) that giving chicken dung produced the highest average of Vigna Radiata L. plants at the age of 4 WAP (32.01 cm), 6 WAP (50.57 cm) and 8 WAP (68.06 cm) and were significantly different compared to other dung treatments.

Application of chicken dung is the best compared to other dung because the nutrient elements contained in chicken dung are higher than goat and cow dung, the analysis results show that chicken dung contains N-total 1.72%, P2O5 3.67% and K2O 1.87%, while goat dung contains goat dung containing N total 0.78%, P2O5 0.90%, K2O 1.23% cow dung containing N-total as much as 1.27%, P2O5 0.81%, and K2O 0.61%. In accordance with the statement of Widowati et al [14] chicken dung has advantages in the speed of nutrient absorption, the composition of nutrients such as N, P, K and Ca is higher than goat and cow dung.

Apart from providing a higher amount of nutrients than other dung. Chicken dung is easier to decompose, which causes chicken dung to give the best plant response from the early to the late vegetative phase [14]. Subandi et al [15] said that decomposision of organic material will make the nutrition available for plant but excessive decomposition will make fertilized soil degrade rapidly.

The results showed that the MOL application of banana corm had no effect on the height of the mung bean plant, which was indicated by no difference between the control and the treatment given. This is presumably because the pH of the banana corm MOL is relatively acidic, namely 2.91 so that the microorganisms cannot develop and grow. It is impossible for microorganisms to develop at an
acidic pH according to Syahputra's [16] statement that if the pH is acidic, the activity of microorganisms will decrease. Resulted in the lack of microorganisms that can survive at an acidic pH. The absence of microorganisms that are able to develop means that the nutrients in the soil cannot have an effect on the growth of mung bean plants.

3.2. Number of Pods plant

| Table 2. The effect of dung and MOL doses of banana corm application on the number of pods |
|---------------------------------|------------|
| **Dungs (j)** | **Means of pods** |
| j0  | 3,44 a  |
| j1  | 8,52 c  |
| j2  | 4,80 b  |
| j3  | 4,75 b  |
| **MOL (m)**  |  |
| m0  | 5,23 a  |
| m1  | 5,31 a  |
| m2  | 5,62 a  |

Description: Figures marked with the same italic in the same column are not significantly different based on Duncan's test at a 5%.

Table 2. shows that chicken dung (j1) has an average number of pods of 8.52 showing the best effect compared to other dung. This is because the nutrients contained in chicken dung are more than other dung because chicken dung (j1) has the highest P2O5 nutrient, which is 3.67%, compared to goat dung (j2) P2O5 0.90% , and cow dung (j3) containing 0.81% P2O5. The P element plays a role in the formation of pods and seeds so that the more P elements are available, the mung beans will form the more optimal pods, this is in line with the statement of Neni et al [19]. P elements are needed by plants for seed and root development, P elements and organic matter help form and fill pods, which is also in line with the statement of Zainal et al [20] many organic materials have been overhauled so that these elements are readily absorbed by these plants as well as P elements which are very important for the formation and filling of pods which eventually lead to seed formation.

Besides the P element, the K element also plays an important role in the pod formation process, because chicken dung (J1) has the highest number of K elements compared to other types of fertilizers, namely K₂O 1.87%, while goat dung is K₂O 1.23% and fertilizer Cowshed contains 0.61% K₂O, K elements play a role in pod formation in line with Novizan [21] explains that nutrients available to plants such as potassium have functions such as translocation of sugar in the formation of starch and protein, increasing plant resistance to pest attacks and disease, improve fruit size and quality during the generative period. Pest attacking the leaves monitored in Figure 1.

![Figure 1. Pest attacked the leaves.](image_url)
The application of chicken dung (j₁) which is the best for the number of pods compared to other dung is also in line with Latuamury [22] which states that giving chicken dung produces the highest number of pods and is significantly different from other dung, this is because dung is able to change the soil structure for the better, causing optimal vegetative growth. Giving a dose of MOL banana corm still cannot have an independent effect on the number of pods per crop. This is presumed because the microorganisms contained in MOL are not able to develop because the pH of the MOL is 2.91 in the absence of microorganisms that grow and develop then the MOL of banana weevils has not can help the absorption of nutrients in the soil optimally so that there is no effect on the number of pods in mung bean cultivation. Application of chicken dung (j₁) gave the best effect compared to other treatments. However, when compared with the plant description, the results in this study still do not meet the potential yield of mung beans. This is presumably due to the high environmental temperature at the time of the study, so that the water given to the soil quickly evaporates, which causes the availability of water in the soil that does not meet the water needs for plants. Lack of water causes the stomata to close, inhibiting the absorption of carbon dioxide so that it reduces the rate of photosynthesis, as a result of which the amount of photosynthate produced decreases [23].

### 3.3. Number of seed planted

**Table 3.** The effect of dung and MOL doses of banana corm application on the number of seeds of mung bean plants

| Dungs (j) | Means of number of beans |
|----------|-------------------------|
| j₀       | 20,22 a                 |
| j₁       | 48,22 a                 |
| j₂       | 29,00 a                 |
| j₃       | 26,60 a                 |
| MOL (m)  |                         |
| m₀       | 32,16 a                 |
| m₁       | 32,08 a                 |
| m₂       | 28,83 a                 |

Description: Figures marked with the same italic in the same column are not significantly different based on Duncan’s test at a 5%.

Based on Table 3, the observation of the number of seeds shows that the type of dung is significantly different. The highest value was shown by the provision of chicken dung (J₁) with a value of 48.22 which was significantly different from other treatments, but the MOL dose of banana corm had not had a significant effect on the number of seeds planted. This is presumably because the microorganisms contained in MOL are still insufficient to assist the nutrient absorption that helps the process of forming mung bean seeds.

The number of mung bean seeds depends on the number of pods produced. However, not all pods produced by mung bean plants contain seeds. This causes the number of seeds per plant to be less than the description. The highest number of seeds was 48.22 seeds with the treatment of chicken dung (j₁). The application of chicken dung provides the most availability of P nutrients compared to other dung. Chicken dung (j₁) which contains P₂O₅ of 3.67% with this much P element, the mung beans will form seeds optimally.

The nutrient P is absorbed by plants to trigger good plant growth and photosynthesis [24]. P elements are needed by plants in the phase of ATP formation and seed formation, which affects the number of seeds. The formation and filling of pods requires sufficient N, P and K elements for the formation of protein in seeds [25]. Figure 2 showed the pods yielded in plants.
Hardjowigeno [26] states that the element P functions for the formation of energy in the form of ATP which is used by plants for growth and production, therefore the P element is needed in filling seeds and pods.

Hidayat [27] stated that the supply of P elements in plant organs increases metabolism in plants, especially in the seed filling phase, which can increase seed weight. The P element plays an important role in the formation of seeds which is also supported by the statement of Elly et al [28] in addition to genetic factors, the availability of P nutrients triggers an increase in the percentage of flowers into fruit and seeds helps assimilation while accelerating fruit ripening and affecting seed weight.

The provision of chicken dung (j1) has an effect on the number of seeds in accordance with the statement of Latuamury [22] giving chicken dung produces the highest number of seeds per pod and is significantly different from other dung treatments. Chicken dung also has advantages, especially because it has higher nitrogen content (5% -8%) and phosphorus (1% -2%) compared to other dung [29].

The application of chicken dung (j1) gives the best effect on the number of seeds is also influenced by the nature of chicken dung (j1) which decomposes easily in the soil so that it is easy for plants to absorb the nutrient content contained in chicken dung. The nature of chicken dung which is easily decomposed makes chicken dung always give the best plant response [14].

3.4. Weight of the seeds planted

Table 4. The effect of dung and MOL doses of banana corm application on seed weight of mung bean plants

| Dungs (J) | Means of weight of seeds |
|----------|-------------------------|
| j0       | 1.78 a                  |
| j1       | 4.70 c                  |
| j2       | 2.58 b                  |
| j3       | 2.38 b                  |

| MOL (M) | Means of weight of seeds |
|---------|-------------------------|
| m0      | 2.86 a                  |
| m1      | 2.85 a                  |
| m2      | 2.88 a                  |

Description: Figures marked with the same italic in the same column are not significantly different based on Duncan's test at a 5%.

Based on Table 4, weight observation shows that the treatment of dung giving an independent effect with the treatment value of chicken dung treatment (j1) is 4.70 g, which is significantly different from the treatment without fertilizer (J0), goat dung (j2) and fertilizer cow shed (j3). The application of chicken dung (j1) gave the best results in observing the weight of the seeds of the plant because the
amount of P element in chicken dung was greater, namely containing 3.67% P$_2$O$_5$ compared to goat dung containing P$_2$O$_5$ of 1.23% and cow dung which contains P$_2$O$_5$ of 0.81%.

The P element is needed by plants for the process of ordering fruit and seeds. This is in accordance with Syafrina's [30] statement that the function of P for plants is to stimulate generative growth, such as ordering flowers, fruit and filling seeds. Widarawati [25] states that ordering and filling pods requires sufficient N, P and K elements to make protein in seeds. Seed weight in mung bean plants in addition to genetic factors supporting factors can also increase the proportion of flowers to fruit and seeds help accelerate fruit ripening and affect seed weight [28].

Research by Latuamury [22] shows that giving chicken dung produces the highest average weight of 1000 seeds and offering chicken dung produces the highest average seed weight (1.03 kg per plot) and is significantly different from other dung treatments. This study is in accordance with the research cage, which shows that chicken dung treatment has a significant effect on the weight of the seeds per plant. In addition, the effect of this chicken dung is due to its high N content. With high levels of N, the photosynthesis process will run well, then it will produce photosynthate which will affect the weight of the seeds. In accordance with the statement Hardjowigeno and Widiatmaka [31] which states that photosynthate will be used for cell elongation and cell filling.

3.5. Harvest Index

Table 5. The effect of dung and MOL doses of banana corm application on the harvest index of mung bean plants

| Dungs (j) | Harvest index |
|----------|---------------|
| j0       | 0.23 a        |
| j1       | 0.48 b        |
| j2       | 0.25 a        |
| j3       | 0.26 a        |

| MOL (m) | Harvest index |
|---------|---------------|
| m0      | 0.33 a        |
| m1      | 0.29 a        |
| m2      | 0.29 a        |

Description: Figures marked with the same italic in the same column are not significantly different based on Duncan's test at a 5%.

The harvest index is a value that describes the system of sharing photosynthetic products between the vegetative part and the seeds, so that through the harvest index it can be seen the photosynthetic ability of plants and the amount of photosynthate translated into mung bean seeds [32]. Based on Table 5, the observation of the chicken dung harvest index (j1) shows the highest value, namely 0.48. This is presumably because the nutrient found in chicken dung is higher than the nutrient found in other dung, with the availability of high K and P nutrients in chicken dung it will increase the process of seed formation and be able to regulate various mechanisms. In accordance with Sedjati's [33] statement that K element is very important in the process of seed formation with P element which is able to regulate various mechanisms in metabolic processes such as photosynthesis, respiration, flower formation, root development, and nutrient transportation from roots to leaves. Chicken dung (j1) gave the best results on the harvest index because the results from other observation parameters such as number of pods, number of seeds, and weight of seeds also showed that chicken dung (j1) was the dung that had the best effect on the mung bean cultivation process. The application of chicken dung (j1) gave the best results on the harvest index in accordance with the statement of Harjosoto et al [32] which states that the effect of chicken dung which gives the best results on the observation variable causes the harvest index to also increase. When compared with the harvest index results in the study of Harjosoto et al [32] which is worth 12.89%, the yield index yield in this study is more optimal because it can spread photosynthate yield by 48%.
The application of dung with chicken dung can have an independent effect on the index of mung bean harvest, but the MOL dose of banana corm has not been able to have an effect on the harvest index of mung beans optimal so that the allocated photosynthate to the seeds is still lacking. Subandi et al [34] said amount of harvest diminished with the extent of plant pests that attacked.

4. Conclusion

There was no interaction with all the observed parameters, but there was an independent influence by the type of dung on the parameters of plant height, number of pods per plant, number of seeds planted, weight of seeds planted and harvest index, but there was no effect on the MOL dose of banana corm given. So that the type of dung that gives optimum results in mung bean cultivation.

One way to increase agricultural crop production is the addition of organic matter with dung, that chemical and biological properties of the soil is improved. The application of chicken dung get the most optimum treatment for the growth and the yield of mung beans.

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