Application of various source animal manure and dosage on the growth and yield *Phaseolus vulgaris* L.

A Taofik, B Frasetya* and A Kusmana

Department of Agrotechnology, Faculty of Science and Technology UIN Sunan Gunung Djati Bandung, Bandung, West Java, Indonesia 40614

*budyfrasetya@uinsgd.ac.id

Abstract. Animal dung in Indonesia has many types; each type of manure gives different plant growth response. This study aims to determine the type of manure and its adequate dosage to increase the growth of bean plants. The research has been carried out in the experimental field of Universitas Padjadjaran, Jatinangor, Sumedang-West Java with altitude 753 m above sea level (asl). The study used a factorial randomized block design. The first factor is the type of manure (k1 = cow manure, k2 = sheep manure, k3 = chicken manure, and k4 = rabbit manure) and the second factor is the dose (d1 = 10 t ha⁻¹, d2 = 20 t ha⁻¹, and d3 = 30 t ha⁻¹). Each unit was repeated three times. The growth parameters observed were plant height, dry plant weight, number of pods, and pod weight per plant. The data from observations were then analyzed using analysis of variance at 5% significance level and then followed by Duncan's test at 5% significance level. The results showed the application of chicken manure 20 t ha⁻¹ gives better growth results than other manure, but the type of manure at various dosage levels has not been able to increase the weight of pods per plant.

1. Introduction

The potential for animal husbandry development in Indonesia is quite promising, including cattle (dairy and broilers), sheep, goats, chickens (broilers and laying eggs), ducks, and rabbits. Common farms are managed on a large scale, namely cattle farms and chicken farms. Small scale and large scale farms produce livestock manure. Animal waste, if not appropriately managed, can pollute the environment [1]. The use of manure as an organic fertilizer has ecological and economic functions. The purpose of applying manure to the soil is to add nutrients and organic matter so that soil fertility and soil structure get better [2]. The use of synthetic fertilizers continuously can have an impact on soil damage [3]. The combination of organic fertilizer and synthetic fertilizer can increase soil fertility while maintaining soil quality. Manure originating from different animals have different nutrient content [4].

Previous studies have shown that the same types and doses of manure provide diverse growth and yield responses in different types of plants [5,6]. Bean plants are plants that are harvested in pods, and the nutrient requirements of plants that are harvested from leaves and fruit or pods will be different [7]. Plants that are harvested by their leaves or harvested when the plant enters the vegetative phase require more nitrogen (N) content, while plants that are harvested in addition to requiring the N element in the vegetative phase need the element phosphorus (P) to help the formation of flowers and fruit. The percentage of the nutrient content of each manure is different so that the combined application at different doses can be obtained the best combination to support plant growth. The availability of
manure in each region is different according to the potential of the area so that the combination of fertilizer types and dosages can reduce the dependence of farmers on certain manure, such as the use of chicken manure.

Testing several types of manure and the dose of manure on bean plants is needed to increase the growth, yield of beans and maximizing the potential of manure in each area. This study aims to obtain a recommendation for the type of manure and its dosage that is well used in the cultivation of green beans.

2. Methods
This research was conducted in April 2019 - May 2019 in the experimental garden of the Faculty of Agriculture, Padjadjaran University. The research method used was an experimental study using a completely randomized factorial design. The first factor consists of four levels, namely cow manure, sheep manure, chicken manure, and rabbit manure. The second factor is the dose of manure 10 t ha\(^{-1}\), 20 t ha\(^{-1}\), and 30 t ha\(^{-1}\). Each unit of the experiment was repeated three times so that 36 unit experiments were obtained. Each experimental unit consisted of nine bean plant populations, while five plants were selected after being randomized.

Equipment and materials used in this study are digital scales, measurement tape, thermo-hygrometer, digital camera, bean seeds, SP-36, KCl, Urea, cow manure, sheep manure, chicken manure, and rabbit manure. This research was carried out through several stages, namely:

- Processing land with a plot size of 100 cm x 120 cm totaling 36 plots,
- The application of treatment in accordance with the level of each factor is applied directly together with tillage.
- Application of basic fertilizer with a dose of SP-36 250 kg ha\(^{-1}\), KCl 250 kg ha\(^{-1}\) and Urea 300 kg ha\(^{-1}\), application of SP-36, and KCl is given \(\frac{1}{2}\) dose after tillage, and urea fertilizer is given twice when plants 7 DAT and 21 DAT.
- Planting with a spacing of 30 cm x 40 cm
- Maintenance, namely watering, weeding and controlling pests and diseases.
- Harvesting is carried out at 45 days after transplanting

The growth parameters observed were plant height (14, 21, 28, and 35 days after transplanting), fresh plant weight, shoot-root ratio, number of pods, and pod weight per plant. Data from observations were then analyzed using analysis of variance at 5% level and then followed by Duncan's multiple range test \(\alpha = 5\%\).

3. Results and discussion

3.1. Research environmental conditions
Environmental conditions observed during the study were the analysis of soil chemistry, air temperature, and humidity. The condition of the land during the study was that the soil had low soil fertility. The C-organic content of the soil is 0.48%, including the low minimum condition of soil having 2% organic carbon N-total 0.07% is classified as very low, P2O5 HCL 25% with a yield of 28.50 mg 100 g\(^{-1}\) is classified as moderate, P2O5 (Olsen) with a yield of 4.59 ppm P is classified as low, K2O HCl 25% with a result of 18, 27 mg 100 g\(^{-1}\), Cation Exchange Capacity (CEC) with a value of 19.32 cmol kg\(^{-1}\) is classified as medium, base saturation with a value of 27.22% is classified as low. The land used includes textured clay with 77% clay composition, sand 3 %, and 20% dust.

Observations of temperature during the study period are a maximum temperature of 29°C, a minimum temperature of 13.60°C, and an average daily temperature of 23.20°C. Temperature controls the stage of plant development, and temperature is related to the total heat needed by a plant to carry out its metabolic processes. Observations of daily humidity during the study are 98% maximum humidity, minimum humidity 75%, and the average daily humidity of 92%.
3.2. Plan height
The results of the analysis of variance showed that there were no interactions or independent effects of manure types and doses to increase plant height at 35 DAT. Whereas at 14, 21, and 28 DAT, there was an independent effect of fertilizer type and dosage on plant height.

Table 1. Duncan test results mean height of plant height.

| Treatments  | Day After Transplanting (DAT) | --cm-- | 4 DAT | 21 DAT | 28 DAT | 35 DAT |
|-------------|-------------------------------|--------|-------|--------|--------|--------|
| Manure (k)  |                               |        |       |        |        |        |
| k1 (Cow)    |                               |        | 14,51 | 39,77  | 46,90  |
| k2 (Sheep)  |                               |        |       |        |        |        |
| k3 (Chicken)|                               |        |       |        |        |        |
| k4 (Rabbit) |                               |        |       |        |        |        |
| Dosage (d)  |                               |        |       |        |        |        |
| d1 (10t ha⁻¹)|                               |        | 14,57 | 39,83  | 46,88  |
| d2 (20t ha⁻¹)|                               |        | 15,78 | 43,28  | 49,52  |
| d3 (30t ha⁻¹)|                               |        | 16,04 | 47,27  | 49,52  |

Note: Numbers followed by the same letter show no significant difference according to the Duncan Test (DMRT) at the 5% level.

3.3. Plant dry weight
The results of the analysis of variance showed that there were no interactions or independent effects of the type of manure and the dose of manure on the plant dry weight. The results of the different mean values (Table 2) show that the different types of fertilizers used and the dosages used are the same for the formation of plant biomass. The formation of plant biomass is not only influenced by the availability of nutrients, but the availability of sufficient water in the root zone also plays a role in the formation of biomass [6-8].

Table 2. Duncan test results for dry weight of bean plants.

| Treat (g) Manure (k) | Dry Weight |
|----------------------|------------|
| k1 (Cow)             | 15,06 a    |
| k2 (Sheep)           | 15,73 a    |
| k3 (Chicken)         | 15,83 a    |
| k4 (Rabbit)          | 15,59 a    |
| Dosage (d)           |            |
| d1 (10t ha⁻¹)        | 14,77 a    |
| d2 (20t ha⁻¹)        | 15,84 a    |
| d3 (30t ha⁻¹)        | 16,04 a    |

Note: Numbers followed by the same letter show no significant difference according to the Duncan Test (DMRT) at the 5% level.

3.4. Number of pods per plant
The results of the analysis of variance showed an interaction between the types of manure and the dose of manure on the number of pods per plant. The highest number of pods is produced by a combination of 10 t ha⁻¹ cow manure and 30 t ha⁻¹ chicken manure. The lowest number of pods produced by the treatment of chicken manure and rabbit manure at a dose 10 t ha⁻¹. Nutrient content of N in manure sequentially chickens> rabbits> cattle> sheep, nutrient P in sequential manures chickens> rabbits> cows> sheep [9]. In the generative phase, cow manure 10 t ha⁻¹ shows a higher number of pods, but this large number of pods does not affect the weight of the planting pods, meaning that the pods
produced by fertilizing cow manure per pod are smaller than chicken manure.

### Table 3. Duncan test results average number of pods per plant.

| Treatments  | Average Number of Pods Per Plant |
|-------------|----------------------------------|
|             | d1 (10 t ha⁻¹) | d2 (20 t ha⁻¹) | d3 (30 t ha⁻¹) |
| k1 (Cow)    | 13.47 b        | 11.73 ab       | 11.20 a        |
|             | C               | A              | A              |
| k2 (Sheep)  | 10.40 a        | 12.53 b        | 12.40 b        |
|             | B               | A              | AB             |
| k3 (Chicken)| 8.13 a         | 11.73 b        | 13.47 b        |
|             | A               | A              | B              |
| k4 (Rabbit)| 8.13 a         | 11.40 b        | 13.27 b        |
|             | A               | A              | B              |

Note: The average number of the same letter (uppercase vertical and lowercase horizontal) shows no significant difference according to the Duncan Test (DMRT) at 5% level.

#### 3.5. Weight of pods per plant

The results of the analysis of variance in pod weight parameters per plant showed that there was no interaction or independent effect of the type of manure and the dose of manure on the increase in plant pod weight as a component of bean crop yield. Chicken manure has higher N and P elements compared to other manure. High N content in manure helps plants to grow better in the vegetative phase, but in the vegetative phase, the high N content influences the formation of pods and pod development.

Organic fertilizers have the advantage of being able to provide nutrients for plants, improve soil physical properties and soil organisms. The weakness of organic fertilizer is that the composition of nutrients produced does not meet the needs of plant nutrients at each growth phase [6].

### Table 4. Duncan test results in average weight of pods per plant.

| Treat (k) | weight of pods per plant (g) |
|-----------|------------------------------|
| Manure    |                             |
| k1 (Cow)  | 50.61 a                      |
| k2 (Sheep)| 51.06 a                      |
| k3 (Chicken)| 56.36 a                     |
| k4 (Rabbit)| 57.51 a                      |
| Dosage    |                             |
| d1 (10 t ha⁻¹) | 51.23 a                     |
| d2 (20 t ha⁻¹) | 54.19 a                     |
| d3 (30 t ha⁻¹) | 56.23 a                     |

Note: Numbers followed by the same letter show no significant difference according to the Duncan Test (DMRT) at the 5% level.

#### 4. Conclusion

Types of manure and dose of manure show interactions with the number of plant pods. The growth of bean plants in various types of manure at a dose of 10 t ha⁻¹-30 t ha⁻¹ has not been able to increase crop yields. The application of 20 t ha⁻¹ chicken manure has the potential to be developed as a fertilizer recommendation on soils that contain low levels of nutrients.

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