Application of Cow Manure at different Height of Mound to Increase Sweet Potato potatoes Productivity

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Abstract. Lack of soil fertility and improper cultivation systems will reduce the productivity of sweet potatoes (Ipomoea batatas L.) significantly. Effort to increase the productivity of sweet potato can be achieved by administering of cow dung and managing the height of mounds to support the crops growth and development. The experiment was arranged as factorialized block design, consisted of 2 factors, namely cow dung with (5, 10 and and 15 tons ha-1) and. mound height (20, 30 and 40 cm). The observed parameters were the length of the main stem, number of leaves, number of tendrils, and diameter of sweet potato, weight of sweet potato planted, weight of sweet potato per plot, economical and uneconomical yield of sweet potato. Different dosage of organic manure or mound height resulted the same yield components and the yield of commercially of sweet potatoes. The highest of tuber weight per plant was obtained by the application of 15 ton ha⁻¹ organic. This finding conclude that the application 15 ton ha-1 of organic manure and 20 cm of mound height could be adopted for sweet potatoes cultivation.

1. Introduction
Sweet potato is one of the staple foods for the Indonesian population after rice and corn. It has economic value as a food ingredient, sweet potato has a high nutritional content and has a fairly good sale value but in the implementation of the field of sweet potato cultivation is still not much attractive the cultivators [1].

Lack of balanced use of organic and inorganic fertilizers leads to decrease of soil fertility and productivity. Application of organic manure such as cow manure will improve the physical, chemical and biological properties of the soil that support and facilitate the growth of sweet potatoes, especially the lengthening of sweet potatoes [2]. In addition, cow manure as organic material contain a relative amount of essential nutrients [3]. Briefly, the adding organic fertilizer into the soil plays an important role in improving the state of the structure, aeration, the capacity to hold ground water, influencing or regulating the condition of soil temperature and providing a substance produced by overhaul that can help plant growth [4].

It is reported that the better the soil structure, the easier the yam develops [5]. Application of 15 tons ha⁻¹ cow manure increased the number of shoots, length of sweet potatoes, weight of fresh sweet potato per-plot in sweet potatoes as results of optimum nutrients supply combined with the good process the formation and development of sweet potatoes [6]. In addition, mound height is also important in sweet potato cultivation Mound height affects the length of the plant aged 5 MST (week after planting). The planted crop at 40 cm mound height resulted the highest plant height (27.19 cm) and the lowest in the treatment of 20 cm mound (23.94 cm). This is correlated with development of tubers that begin 5 MST and the activity of photosynthesis [7].

The sweet potato is planting on mound and it make easier to farmers for crop maintenance and to prevent sweet potato plants from standing water when it rains [8]. Mounds that are too high will result
in the formation of long-sized sweet potatoes and so difficult when harvesting [9]. If the mound is too shallow, the growth and development of tubers is easily attacked by Lanas [9]. It is expected that application of cow manure and optimum of mound height could influence growth and yield of sweet potato significantly [10].

2. Research Method
This research was conducted in Majalengka. The experimental method used was a field trial method using the randomized block design with in factorial patterns and provided with 3 replications. The treatments was cow manure application (O₁ = 5 tons ha⁻¹, O₂ = 10 tons ha⁻¹ and O₃ = 15 tons ha⁻¹) and mound height (t₁ = 20 cm, t₂ = 30 cm and t₃ = 40 cm). The observed variables length of the main stem, number of tendrils, at 2, 4 and 6 MST (week after planting), yam diameter, yam weight, economical yield and non-economical yield. The materials used were sweet potato seedlings with cuttings of sweet potato stem varieties Ac. In addition, the crops were fertilized with 200 kg ha⁻¹ of Urea, 100 kg ha⁻¹ SP-36, 75 kg ha⁻¹ of KCL.

3. Results
Component of Growth

The main stem, number of leaves, number of tendrils at 2, 4 and 6 MST (weeks after planting) were not affected by the interaction of organic manure and mound height. In contrast, the main effect of this treatments gave a significant effect on the length of main stem (Table 1), number of leaves (Table 2) and number of tendrils (Table 3).

| Table 1. Main effect organic manure and mound height on length of main stem |
|-----------------------------|-----------------------------|-----------------------------|
| Treatment                  | Main Bar Length             |                            |
|                            | 2 MST          | 4 MST          | 6 MST          |
| Dosage of Cow manure       |                            |                            |
| O₁ (cow manure 5 ton/ha)   | 21.33a         | 29.27a         | 49.91a         |
| O₂ (cow manure 10 ton/ha)  | 22.94a         | 37.91b         | 52.41a         |
| O₃ (cow manure 15 ton/ha)  | 26.13a         | 39.87b         | 52.52a         |
| Mound height               |                            |                            |
| T₁ (Mound height 20 cm)    | 22.76a         | 35.08a         | 45.30a         |
| T₂ (Mound height 30 cm)    | 24.13a         | 37.44a         | 50.21b         |
| T₃ (Mound height 40 cm)    | 23.52a         | 34.52a         | 59.34b         |

The value followed by the same letter within a column is not difference significantly according to the Duncan Test at 5% level.

Data in Table 1 revealed the application of different dose of organic manure resulted a relative same of stem height until 6 MST. In contrast, the mound height resulted a different of plant height and the higher main stem height was resulted by 30 cm of mound. The same effect was also seen on the number of leaves (Table 2). In addition, the application different dosage of organic manure or mound height resulted the same of number tendrils (Table 3).

| Table 2. Number of leaves (strands) on sweet potato plants aged 2 MST, 4 MST and 6 MST |
|-----------------------------|-----------------------------|-----------------------------|
| Treatment                  | Number of Leaves (strands)  |                            |
|                            | 2 MST          | 4 MST          | 6 MST          |
| Dosage of Cow manure       |                            |                            |
| O₁ (cow manure 5 ton/ha)   | 13.07a         | 92.11a         | 60.11a         |
| O₂ (cow manure 10 ton/ha)  | 12.50a         | 87.56a         | 62.24a         |
| O₃ (cow manure 15 ton/ha)  | 12.83a         | 83.33a         | 62.41a         |
| Mound height               |                            |                            |
| T₁ (Mound height 20 cm)    | 12.41a         | 26.07a         | 52.98a         |
| T₂ (Mound height 30 cm)    | 12.44a         | 30.11a         | 62.61b         |
| T₃ (Mound height 40 cm)    | 13.56a         | 31.47a         | 69.17b         |
The value followed by the same letter within a column is not difference significantly according to the Duncan Test at 5% level

**Table 3. Number of tendrils (stems) on sweet potato plants at 2, 4 and 6 MST**

| Treatment                       | Number of tendrils (stems) |
|---------------------------------|-----------------------------|
|                                 | 2 MST          | 4 MST          | 6 MST          |
| **Dosage of Cow manure**       |                |                |                |
| O₁ (cow manure 5 ton/ha)       | 3.19a          | 3.72a          | 4.78a          |
| O₂ (cow manure 10 ton/ha)      | 3.13a          | 3.59a          | 4.63a          |
| O₃ (cow manure 15 ton/ha)      | 3.24a          | 3.83a          | 4.98a          |
| **Mound height**               |                |                |                |
| T₁ (Mound height 20cm)         | 3.00a          | 3.52a          | 4.30a          |
| T₂ (Mound height 30cm)         | 3.39a          | 4.11b          | 5.00a          |
| T₃ (Mound height 40cm)         | 3.13a          | 3.52a          | 5.09a          |

Yield Component

The yield component of sweet potatoes (tuber diameter, yam weight per plant and yield per plot) and the marketable yam were not affected significantly by interaction of organic manure and mound height. The main effect of dosage organic manure or different mount height on yield component are presented in Table 4 and the commercial able of yam (Table 5).

**Table 4. Effect of organic manure and mound height on tuber diameter (cm), tuber weight (g) and tuber yield per plot (kg)**

| Treatment                       | Tuber diameter (cm) | Weight of tuber per plant (g) | Tuber yield per plots (kg) |
|---------------------------------|---------------------|--------------------------------|---------------------------|
| **Dosage of Cow manure**       |                     |                                |                           |
| O₁ (cow manure 5 ton/ha)       | 16.41a              | 367.78a                        | 11.63a                    |
| O₂ (cow manure 10 ton/ha)      | 17.98a              | 373.89a                        | 12.40a                    |
| O₃ (cow manure 15 ton/ha)      | 16.41a              | 496.67b                        | 13.11a                    |
| **Mound height**               |                     |                                |                           |
| T₁ (Mound height 20cm)         | 14.77a              | 330.56a                        | 12.92a                    |
| T₂ (Mound height 30cm)         | 20.30a              | 367.78a                        | 11.63a                    |
| T₃ (Mound height 40cm)         | 15.73a              | 560.0a                         | 12.59a                    |

Briefly, data in Table 4 and Table 5, either different dosage of organic manure of different mound height resulted the same yield component (except the weight tuber per plant about 496.67 g per plant was obtained by the application of 15 ton of organic manure) and commercial able (marketable) of yam

**Table 5. Commercial yams (kg) and non-commercial yams (kg) in sweet potato plants**

| Treatment                       | Average commercial sweet potatoes (kg) | Average non-commercial sweet potato (kg) |
|---------------------------------|---------------------------------------|------------------------------------------|
| **Dosage of Cow manure**       |                                       |                                          |
| O₁ (cow manure 5 ton/ha)       | 7.17a                                 | 4.47a                                    |
| O₂ (cow manure 10 ton/ha)      | 7.58a                                 | 4.50a                                    |
| O₃ (cow manure 15 ton/ha)      | 8.42a                                 | 4.69a                                    |
| **Mound height**               |                                       |                                          |
| T₁ (Mound height 20cm)         | 6.94a                                 | 5.98a                                    |
| T₂ (Mound height 30cm)         | 8.07a                                 | 4.24a                                    |
| T₃ (Mound height 40cm)         | 8.16a                                 | 4.43a                                    |
The value followed by the same letter within a column is not difference significantly according to the Duncan Test at 5% level

4. Discussion
Application organic manure gave a significant effect on the length of the main stem in plants at 4 MST [11]. This is due to the fact that cow manure has a high nutrient content and could contribute and useful for the development of plant growth. Cow manure contains nutrients such as N, P and also K. In addition, cow dung contain very high fiber, including high cellulose content [12]. According to research results [13] associated with the presence of element K which is higher than other elements in cow manure (1.03% K levels, N 0.92%, P 0.23%). Others research reported that roots will move towards water sources in the soil [14]. Thus, the length of the roots is strongly influenced by the availability of water and minerals in the soil, and soil moisture.

The different height of mound affects the length of the main stem at 6 MST, the number of leaves at 6 MST and the number of tendrils at 4 MST. It seems, the roots of the sweet potato plant optimally spread and absorb nutrient elements needed from the soil, nutrients absorbed to the leaves to be assimilated in the photosynthesis process to support the development of other plant organs [15].

Generally, the yield component and marketable were effected significantly by different dosage of organic manure or different height of mound. It seems, application of 5 ton ha\(^{-1}\) organic manure and the mound height of 20 cm were able to support the plants growth. In addition, the plots was also fertilized with inorganic fertilizers (200 kg of urea, 100 kg of SP-36 and 75 kg ha\(^{-1}\) of KCL). Moreover, during the research (the vegetative period the) average rainfall was 1,516 mm / month. Based on the opinion of a researcher [16] sweet potato does not need much water, the average monthly rain needed by sweet potato plants is 70-150 mm/month during the planting period, if the rainfall is either smaller or larger can reduce the yield of sweet potatoes sweet. But during generative rainfall only reaches 72 mm/month, causing soil conditions to dry up and inhibit and suppress the development of sweet potatoes in the soil. In addition, application of cow manure doses and mound height did not influence the results of the yield parameters [17]. It seems also affected by too high precipitation during vegetative period (average rainfall reached 1,516 mm/month). Tuber formation of sweet potatoes will be hampered if the soil lacks oxygen and ground water is too high [18]. Studied results indicates that the yield of sweet potatoes will increase in balance with increasing Potassium [19]. This relates to the function of the element K, which is to transfer photosynthate from source to sink (yam formation). Moreover, water, temperature, light intensity and nutrients have a significant role in the tuber formation of sweet potatoes which will ultimately affect the yield of sweet potatoes [20].

5. Conclusion
Based on the results and discussion, the following conclusions can be drawn: Application of different dosage of organic manure and different mound height resulted the same yield parameters and the yield of commercially of sweet potatoes (marketable). The highest of tuber weight per plant was obtained by the application of 15 ton ha\(^{-1}\) organic. This finding conclude that the application 15 ton ha\(^{-1}\) of organic manure and 20 cm of mound height could be adopted for sweet potatoes cultivation.

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