The study of distribution of chicken manure fertilizer for papaya growth and production beneath unproductive palm oil

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Abstract. The research was conducted in Naga Sari village, Muaro Jambi regency, from February 2020 to June 2020. The design applied was a group-randomized design with 2 treatment factors. The first factor was the California variety (V\textsubscript{1}) and ruby rise red variety (V\textsubscript{2}). The second factor was chicken manure distribution: without fertilizer distribution (P\textsubscript{0}), 50 g of (P\textsubscript{1}), 100 of (P\textsubscript{2}), 150 of (P\textsubscript{3}), and 200 of (P\textsubscript{4}). The result of this research showed that the distribution of 150 g has a real impact on the plant's height and stem diameter, and the number of fruits on 5 Months After Cultivating to 6 Months After Cultivating. Variety treatment doesn't have a real impact on the papaya observation parameter. The interaction among the varieties with a dose of chicken manure has a real impact on the papaya observation parameter. The interaction among the varieties with a dose of chicken manure has a real impact on the papaya observation parameter. The organoleptic test shows that the variety of Ruby papaya is preferred.

1. Introduction
The use of non-organic fertilizers has received international attention. This is due to the negative impact that can be caused by non-organic fertilizers. Non-organic fertilizers are reported to have caused contamination of surface water, soil, rivers, beaches, and agricultural areas in various regions of the world. The use of non-organic fertilizers is reported to have increased the content of heavy metals such as Cd, Hg, Pb, Cu, As, Ni, and As; natural radionuclides like 238U, 232Th, and 210Po. Currently, the use of non-organic fertilizers continues to increase and is causing serious environmental problems\cite{1–3}.

The use of non-organic fertilizers has also been reported to cause pollution to water, air, and soil. The use of non-organic fertilizers in several developing countries is reported: Chemical fertilizer used per hectare in Turkey (N+P+K) is determined as 100.4. These values are 665.5 in the Netherlands; 624.8 in Egypt; 373.2 in Japan; 301.5 in China; 287.5 in Britain; 205.4 in Germany; 180.1 in France; 160.8 in the USA; 126.4 in Italy; 121.4 in India; 115.4 in Greece and 106.9 in Indonesia kg/ha respectively\cite{4}.

Plants cannot absorb all the chemical fertilizers that are given so that the residue from the fertilizers that are not absorbed will have an impact on the environment\cite{5}. The residual chemical fertilizer left on the soil will turn hard like glue when exposed to water, this will cause the soil to become hard and
acidic[6]. Also, microorganisms that are beneficial in soil sustainability will decrease, so that the soil quality will decrease. Some animals that loosen the soil like worms are unable to live in the area and lose their natural elements. When this happens, the soil can no longer provide food independently, and eventually becomes very dependent on additional fertilizers, especially chemical fertilizers. Some efforts that can be made to reduce the negative impact and dependence on chemical fertilizers are using organic fertilizers.

Organic fertilizers are reportedly an alternative that can be done to reduce the use of chemical fertilizers. One of the materials that could potentially be used as a substitute for chemical fertilizers is chicken manure. Chicken manure contains a complete NPK so it is good for plants. This paper will discuss the impact of papaya growth among oil palm trees by applying chicken manure fertilizer.

2. Materials and methods

This study was conducted in Kebun Rakyat in Naga Sari village, Mestong, Muaro Jambi. The site is located 30 above sea level, with C2 climate and red-yellow podzolic land. This research was started from February to June 2020. Materials and tools used are plant materials which were palm oil plants aged 2 years old. The dumpy variety and Californian papaya and ruby papaya, chicken manure fertilizer, Mutiara fertilizer, tractor, hoe, cleaver, hose, measurement, rope, scissor, and sprayer were also utilized.

Randomized complete block design structured with 2 factors and 4 repetitions was applied. The first factor was variety (V) which was V1 (California), V2 (Ruby). The second factor was chicken manure fertilizer (P) which was P0 (Without Fertilizer), P1 (50g of chicken manure fertilizer), P2 (100g of chicken manure fertilizer), P3 (150g of chicken manure fertilizer), and P4 (200g of chicken manure fertilizer).

Therefore, there were 10 combinations of treatment and each combination was repeated 4 times, resulting in 40 units of treatment. Every unit of treatment involved 3 papaya plants. To understand the impact of the treatments on the observed parameter, analysis of variance was done followed with an analysis of different middle values with 5% of Duncan, first nutrient analysis, and final nutrient analysis.

3. Results and discussion

3.1. Plant height (cm)

The average of the plant height of papaya variety and each of chicken manure fertilizer distribution examined at the age of 5 – 6 months after the distribution can be seen in Table 1.

| Variety | Chicken Manure Fertilizer | Average |
|---------|---------------------------|---------|
|         | Without Fertilizer | 50 g | 100 g | 150 g | 200 g |
| 5 MAC   | California           | 21.75 a | 22.75 a | 21.75 a | 23.25 a | 20.25 a | 21.95 |
|         | Ruby                 | 19.25 a | 21.00 a | 21.00 a | 25.00 a | 20.50 a | 21.35 |
|         | Average              | 20.50 a | 21.88 ab | 21.38 ab | 24.13 b | 20.38 a |
| 6MAC    | California           | 21.50 a | 21.50 a | 21.50 a | 22.75 a | 21.75 a | 21.80 |
|         | Ruby                 | 21.00 a | 21.00 a | 22.00 a | 27.50 b | 22.25 a | 22.75 |
|         | Average              | 21.25 a | 21.25 a | 21.75 a | 25.13 b | 22.00 ab |

From the table 1, it can be concluded that the distribution of chicken manure had a real impact on the plant height aged 5 – 6 MAC. The interaction between the two treatments showed a real impact on plant height. However, the variety of papaya plants didn’t show a real impact on plant height.
3.2. Plant diameter (cm)

This research informed that the distribution of chicken manure fertilizer had a real impact on the plant, aged 6 months after cultivating, diameter, the interaction between two variety treatments with chicken manure fertilizer had a real impact on the plant diameter, especially those aged 5 – 6 MAC. However, the various treatment didn’t show a real impact on the planned diameter.

| Variety | Chicken Manure Fertilizer | Average |
|---------|---------------------------|---------|
|         | Without Fertilizer 50 g 100 g 150 g 200 g |         |
| 5 MAC   |                           |         |
| California | 27.00 a 27.25 a 27.75 a 26.75 a 27.75 a | 27.30   |
| Ruby    | 24.50 a 24.25 a 26.00 a 28.75 a 23.75 b | 25.45   |
| Average | 26.00 a 25.75 a 26.38 a 28.25 a 25.75 a |         |
| 6 MAC   |                           |         |
| California | 30.25 b 30.50 b 29.75 a 31.25 a 28.25 a | 30.00 b |
| Ruby    | 26.00 a 26.25 a 28.50 a 32.25 a 26.50 a | 27.90 a |
| Average | 28.13 a 28.38 a 29.13 ab 31.75 b 27.38 a |         |

From Table 2, it can be seen that from every treatment of chicken manure fertilizer distribution, the highest average obtained is at the age of 6 months after the cultivating with a dose of 150g of chicken manure fertilizer. The result is 31.75 cm. meanwhile at the interaction among ruby papaya with a dose of 150 g of chicken manure fertilizer on 6 months after the cultivating (MAC), the diameter obtained is 32.25 cm.

3.3. Number of leaves (strand)

The average number of leaves on the various doses of chicken manure fertilizer and varieties can seem in Table 3.

| Variety | Chicken Manure Fertilizer | Average |
|---------|---------------------------|---------|
|         | Without fertilizer 50 g 100 g 150 g 200 g |         |
| 5 MAC   |                           |         |
| California | 27.00 a 27.25 a 27.25 a 26.75 a 27.75 b | 27.30   |
| Ruby    | 24.50 a 24.25 a 26.00 a 28.75 a 23.75 a | 25.45   |
| Average | 25.75 a 25.75 a 26.88 a 27.75 a 25.75 a |         |
| 6 MAC   |                           |         |
| California | 29.75 a 30.25 b 30.25 a 32.75 a 30.50 b | 30.70   |
| Ruby    | 27.00 a 26.25 a 28.25 a 32.25 a 26.25 a | 28.00   |
| Average | 28.38 a 28.25 a 29.25 a 32.50 a 28.38 a |         |

Table 3 shows that the distribution of chicken manure fertilizer doesn’t give a real impact on the number of leaves, however, the distribution of 150 g of chicken manure shows the highest average on 5 months after cultivating, which is 27.27 strands and increases on 6 months after cultivating, which is 32.50 strands. The interaction between 150 g of chicken manure treatments and ruby papaya gets the
real impact on 5 months after cultivating, which is 28.75 strands and 32.25 strands on 6 months old plant.

3.4. **Fruit length (cm)**

From the result, it is known that the distribution of chicken manure has area impact on the fruit length, especially the fruits aged 6 months old after the cultivating. The varieties treatment gives a real impact on the length of papaya fruit and the interaction between two variety treatments with chicken manure fertilizer gives the real impact on papaya fruit aged 6 months old after the cultivating.

| Varieties | Chicken Manure Fertilizer | Average |
|-----------|---------------------------|---------|
|           | Without Fertilizer | 50 g | 100 g | 150 g | 200 g |       |
| California | 24.00 a | 27.75 a | 27.75 a | 33.35 a | 35.00 a | 29.55 b |
| Ruby      | 22.50 a | 24.75 a | 26.00 a | 29.50 a | 32.25 a | 27.00 a |
| Average   | 23.25 a | 26.25 b | 26.88 b | 31.38 c | 33.63 c |       |

**Table 4. Papaya fruit length (cm) 6 MAC**

Table 4 shows that the chicken manure fertilizer distribution impacted the length of papaya fruit. The distribution of chicken manure fertilizer with a dose of 200 g has the highest average on 6 MAC fruit, which is 33.63 cm, and the interaction between the distribution of 200 g of chicken manure and Californian papaya gives the real impact, especially for the fruit ages 6 MAC, which is 35.00 cm. the California papaya fruit length is superior to ruby papaya.

3.5. **Fruit circumference (cm)**

The result shows that chicken manure fertilizer treatment gives a real impact on the fruit circumference, aged 6 months old after cultivating. Variety treatment gives a real impact on the papaya fruit circumference. However, the interaction between the chicken manure fertilizer treatment and veracity treatment doesn’t give the real impact on the papaya fruit circumference.

| Varieties | Chicken Manure Fertilizer | Average |
|-----------|---------------------------|---------|
|           | Without Fertilizer | 50 g | 100 g | 150 g | 200 g |
| California | 28.25 | 30.50 | 30.25 | 32.50 | 34.00 | 30.90 a |
| Ruby      | 30.75 | 34.00 | 34.00 | 35.50 | 36.75 | 34.20 b |
| Average   | 29.50 a | 32.25 abc | 32.12 ab | 33.50 bc | 35.38 c |       |

**Table 5. Papaya fruit circumference aged 6 MAC**

Table 5 shows that chicken manure distribution has a real impact on the papaya fruit circumference. The distribution of chicken manure with a dose of 200 g has the highest average on 6 months after cultivating, which is 35.38 cm and a variety treatment of Ruby papaya gives a real impact on the fruit circumference and superior to Californian papaya. The average of ruby papaya reaches 34.20 cm, however, the interaction between various treatment and 200 g of chicken manure treatment doesn’t give a real impact on the fruit circumference.

Analysis of variance showed that the interaction between California papaya and the distribution of chicken manure as much as 200 g, there was no interaction with the circumference parameter of the fruit. In general, giving chicken manure can increase the length and circumference of papaya fruit. Dividing 200 grams of chicken manure by measuring the length and circumference of the best fruit for all varieties. This phenomenon shows that in the productive phase, papaya fruit grown as a side crop in oil palm requires a lot of nutrients.
3.6. *Organoleptic examination*

Organoleptic examination on Californian papaya and ruby papaya was conducted by 10 trained researchers. The measured parameters in an organoleptic examination on papaya fruit are taste, color, and texture. From the test done, the result shows at Figure 1.

![Figure 1. Organoleptic value](image)

Based on the color test on the papaya fruit, most of the panelists gave orange, which means the taste is so sweet and smooth texture on the V₂P₁, V₂P₃ and V₂P₄ treatments.

**Table 6.** The impact of the intercropping technique on palm oil plant and Californian papaya and ruby papaya in terms of height, plant diameter, and several leaves.

| Treatment                        | Palm Oil Plant Growth |
|----------------------------------|-----------------------|
|                                  | 1 MAC  | 2 MAC  | 3 MAC  | 4 MAC  | 5 MAC  | 6 MAC  |
| **Plant height (cm)**            |        |        |        |        |        |        |
| Palm oil plant + Californian papaya | 16.10 a | 16.00 a | 18.20 a | 19.85 a | 21.95 a | 21.80 a |
| Palm oil plant + ruby papaya     | 15.50 a | 16.10 a | 18.05 a | 19.80 a | 21.35 a | 22.75 a |
| **Plant diameter (cm)**          |        |        |        |        |        |        |
| Pal oil plant + Californian papaya | 16.40 a | 20.60 a | 22.55 a | 25.25 b | 27.30 a | 30.00 b |
| Pal oil plant + ruby papaya      | 16.15 a | 19.20 a | 21.20 a | 23.10 a | 25.45 a | 27.90 a |
| **Number of leaves (strand)**    |        |        |        |        |        |        |
| Palm oil plant + Californian papaya | 17.65 a | 26.60 a | 22.55 a | 22.55 a | 27.30 a | 30.70 a |
| Palm oil plant + ruby papaya     | 16.45 a | 19.20 a | 21.20 a | 21.20 a | 25.45 a | 28.00 a |

The palm oil plant and papaya growth as a side plant at the age of 2 months after cultivating doesn’t show any competition during the growing period. It is shown in table 4. The plant height, diameter, and the number of leaves, which is planted as side plant are presented in the table 6. On the plant height and number of leaves, there is no different growth with palm oil plant which is planted with a monoculture technique. However, there is a difference in the diameter of the plant, especially those aged 4 and 6 months after cultivating.

**Table 7.** The analysis result of the first land

| No   | Sample Code | pH H₂O | C Organic | N Total | P HCl 25% (mg P₂O₅ 100⁻¹) | K HCl 25% (mg K₂O100⁻¹) | P Total | K Total |
|------|-------------|--------|-----------|---------|--------------------------|-------------------------|---------|--------|
| 1    | First land  | 5.41   | 0.16      | 0.36    | 64.25                    | 15.90                   | -       | -      |
| 2    | POP         | -      | 40.00     | 9.09    | -                        | -                       | 0.014   | 0.223  |
Plant height, plant diameter, and a number of leaves show the real improvement in the distribution of 150 g of chicken manure fertilizer (Table 1, 2 and 3). The response of the vegetative plants shows that the addition of nutrients through the distribution of chicken manure fertilizer needs to be done to increase the availability of nutrients of the lands, especially those which are located in the area beneath the palm oil plantation, to increase the growth of papaya plants. Fertilizer plays an important role in regulating the biophysical and biochemical functions of plants. Microbes contained in chicken manure can function to improve the plants. The analysis shows the land from organic fertilizer chicken manure into the papaya plant hike organic element, N, P and K (Table 7, Table 8).

Analysis of variance showed that there was an interaction between ruby papaya and chicken manure fertilizer with a dose of 150 g. there was a real impact on all parameters of the growth of vegetative at the age of 5 months and 6 months after the cultivating. The addition of chicken manure fertilizer on a dose of 200 g didn’t show significant differences from a dose of 150 g. it indicates although the role of organic fertilizers very important in supporting plant growth, the excessive distribution also harms vegetative growth, as shown in the provision of 200 g of chicken manure fertilizer, in this case with the addition of chicken manure fertilizer on s dose of 200 g/ plant show decreasing growth, although unreal.

Nutrient (N) plays an important role to support the growth of the plan. On the growth phase of vegetative plants, sufficient nutrients on the ground can support the growth of papaya plants. P elements play an important role in increasing chloroplasts as the absorber of sunlight for the photosynthesis process. In addition, element p also plays an active role to transfer energy to ions cell. K+ facilitates some response physiology plants, including opening and closing stomata leaves and regulations a membrane[7]. Potassium is the activator of a large number of the enzyme needed for the formation of starch and protein [8].Open and shut it down stomata controlled by K+ through pressure turgor [9].Pressure osmosis which resulted from the accumulation of k+ in the cell also used to propel the cells in the expansion of leaves [10], the process physiology is held optimally. The low content nutrient element in the ground caused the photosynthetic activity of being inferior and similar to become not optimum for supporting plant growth as it is experienced by low the growth of plants without the provision of chicken manure fertilizer.

The growth of palm oil plan and papaya plants of two varieties as side plants after 2 months of cultivating doesn’t show any competition during the growing time. It is shown in table 4. The plant height, number of leaves, and palm oil plant diameter which is planted with polyculture technique with papaya plants as the side plants don’t show the difference growth with those which are planted with monoculture technique. So, it can be concluded that papaya can be intercropped on a 2-month-old palm oil plant. Palm oil plant can be intercropped with corn without affecting the palm oil plant growth

4. Conclusion
The interaction between fruit variety with chicken manure fertilizer distribution shows the real impact on the growth of the plants and papaya fruit production. Ruby papaya growth shows better on the vegetative phase and more productive compared to the Californian variety. The growth of palm oil plants and papaya fruits doesn’t show any competition during the growing time. Papaya plant can be utilized as a side plant for palm oil plant in the intercropping technique, through 150 g – 200 g of chicken manure distribution per plant.
References

[1] Ji C, Cheng K, Nayak D and Pan G 2018 *J. Clean. Prod.* 192 916–23
[2] Zhan S, Wu J, Wang J and Jing M 2020 *Sci. Total Environ.* 709 136278
[3] Liu Y and Chen Y 2006 *Int. J. Sustain. Dev. World Ecol.* 13 295–305
[4] Savci S 2012 *APCBE Procedia* 1 287–92
[5] Jiao W, Chen W, Chang A C and Page A L 2012 A review *Environ. Pollut.* 168 44–53
[6] Adeniyan O N, Ojo A O, Akinbode O A and Adediran J A 2011 *J. Soil Sci. Environ. Manag.* 2 9–13
[7] Kuromori T, Seo M and Shinozaki K 2018 ABA *Trends Plant Sci.* 23 513–22
[8] Tetlow I J, Wait R, Lu Z, Akkasaeng R, Bowsher C G, Esposito S, Kosar-Hashemi B, Morell M K and Emes M J 2004 *Plant Cell* 16 694–708
[9] Franks P J and Farquhar G D 2007 *Plant Physiol.* 143 78–87
[10] Zonia L and Munnik T 2007 *Trends Plant Sci.* 12 90–7