AGRIWAR JOURNAL
MASTER OF AGRICULTURAL SCIENCE WARMADEWA UNIVERSITY
**E-ISSN**: 2808-1137, **P-ISSN**: 2808-1323
Vol. 1, No. 2, Dec 2021, Page 37-43
DOI: https://doi.org/10.22225/aj.1.2.4218.37-43

# Effectiveness of Coal-Based Organic Fertilizer and Cow Manure on Yield Quality of Several Tomato Varieties (*Lycopersicum esculentum* L.)

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**Abstract**
*Tomato is an important vegetable crop and has been widely cultivated as a garden plant or commercially. The purpose of this study was to measure the effectiveness of organic fertilizer based on coal and cow dung based on several tomato varieties. This study used a factorial randomized design with two factors, namely the type of fertilizer consisting of "Saputra" coal fertilizer (BB), "Bio Alam Asri" manure (BA) and without organic fertilizer (B0); and the other factor is the tomato variety factor (V), namely Servo F1 (VS), Gustavi F1(VG), and Fortuna 23 (VF). Based on the results of the study, it was found that the treatment of BB and BA, in general, had a significant effect on vegetative growth and generative yields including fruit quality in the three tomato varieties tested. The highest number and fresh weight of tomatoes per plant were obtained in the treatment of BB, namely 44.00 fruits and 3.00 kg, higher than BA fertilizer, namely 39.11 fruit and 2.62 kg, and B0 namely 34.00 pieces and 2.20 kg. The highest number and fresh weight of tomatoes per plant were obtained in VS varieties, namely, 42.33 fruits and 2.74 kg, followed by VG varieties at 40.11 fruits and 2.71 kg and the lowest was VF at 34.67 fruit and 2.38 kg. The highest vitamin C content of fresh fruit was obtained in the BB treatment, which was an average of 36.75 mg/100g, higher than the treatment with BA fertilizer and B0, which were 32.81 mg/100g and 31.07mg/100g.*

**Keywords**: *Tomato varieties; coal fertilizer; cow manure.*

## 1. Introduction

Tomato is an important vegetable crop and has been widely cultivated as a garden plant or commercially, which can be cultivated inland and in greenhouses. Tomatoes play an important role in fulfilling community nutrition. Tomato fruit contains many substances that are useful for the human body [1, 2, 3].

Efforts to increase the production and quality of tomatoes continue to be made, including the use of various types of fertilizers. Recently, the use of organic fertilizers has been increased to reduce the use of inorganic fertilizers [4, 5, 6]. The discovery of new coal-based fertilizers has begun to be developed to improve the quality of agricultural land, especially to restore various nutrients and soil minerals [7]. Likewise, the fertilizers produced by the community of farmers or breeders from livestock waste and crop residue, one of which is the fertilizer produced by a group of farmers in the Klungkung Regency of Bali which is labeled "Bio Alam Asri" fertilizer [8, 9]. Based on the foregoing, a study was conducted on the effectiveness of coal-based fertilizers compared with cow dung-based fertilizers on the production and quality of tomatoes.

## 2. Materials and Methods

This research was carried out at the Experimental Garden (greenhouse) located in Pancasari Village, Buleleng regency, Bali, and the Laboratory of the Agrotechnology Study Program, Faculty of Agriculture, Warmadewa University from January to November 2021.

The research was conducted by the experimental method, with the experimental design used being a factorial randomized block design with 3 replications. There are two factors studied, namely, the first factor is the type of fertilizer (B) which consists of 3 levels (types) of fertilizer, namely: BB (Coal Fertilizer), BA (Bio Alam Asri Fertilizer), and B0 (without organic fertilizer). While the second factor is Variety (V) which consists of 3 levels, namely: VS (F1 Servo variety), VG (Gustavi F1 variety), and VF (Fortuna 23 variety). The study used polybags with a distance between blocks of 50 cm and between polybags in one block of 50 cm.

**Table 1.** Saputra Coal fertilizer laboratory test results

| No | Parameter | Value | Unit | Metode |
|---|---|---|---|---|
| 1. | pH $H_2O$ | 5.1 | - | Potensiometri / pH meter |
| 2. | Kadar Air | 24.63 | % | Gravimetri |
| 3. | Bahan Ikutan | 0.0 | % | Gravimetri |
| 4. | C-Organik | 30.87 | % | Gravimetri |
| 5. | N-Total | 2.05 | % | Kjeldahl/Destilasi |
| 6. | C/N Ratio | 15 | - | - |
| 7. | $P_2o_5^-$ Total | 0.89 | % | $HNO_3$/Spektrofometri |
| 8. | $K_2O$ Total | 1.55 | % | $HNO_3$/F-AAS |
| 9. | Fe - tersedia | 134 | ppm | EDTA/ F-AAS |
| 10. | Mn - total | 252 | ppm | $HNO_3$/F-AAS |
| 11. | Zn - total | 84 | ppm | $HNO_3$/F-AAS |
| 12. | Pb - total | 5.7 | ppm | $HNO_3$/F-AAS |
| 13. | Cd - total | 1.3 | ppm | $HNO_3$/F-AAS |
| 14. | As - total | td | ppm | $HNO_3$/F-AAS |
| 15. | Hg - total | td | ppm | $HNO_3$/F-AAS |
| 16. | La - total | td | ppm | $HNO_3$/MP-AES |
| 17. | Ce - total | td | ppm | $HNO_3$/MP-AES |

Source: Test Results from the Testing Laboratory of Soil Research Institute, Bogor Agricultural Research and Development Institute..

**Table 2.** The results of the laboratory analysis of organic fertilizer "Bio Alam Asri" are as follows

| Parameter | Value | Unit |
|---|---|---|
| pH | 8.19 | |
| Kadar air | 29.16 | % |
| C-Organik | 25.18 | % |
| N-total | 1.49 | % |
| C/N Ratio | 16.89 | |
| $P_2O_5$ | 2.01 | % |
| $K_2O$ | 1.99 | % |
| Fe-total | 6.257 | ppm |
| Fe-available | 153.5 | ppm |
| Mn total | 679.8 | ppm |
| Zn total | 6.43 | ppm |
| Bakteri penambat N | $2 \times 10^6$ | |
| Bakteri pelarut P | $7 \times 10^2$ | |
| E-coli | negative | |
| Salmonella | negative | |

The preparation of the planting media was adjusted to the size of the media volume in polybags, which was 15 kg in volume, and filled with planting media including organic fertilizer used according to the recommended dose of treatment. Preparation of planting material begins


DOI: https://doi.org/10.22225/aj.1.2.4218.37-43

with seed preparation, where the seeds are first soaked in warm water for 10 minutes. Furthermore, the seeds are planted in a nursery that has been filled with a mixture of soil and 2:1 manure. One seed is planted in each nursery hole, then shaded to avoid direct sunlight and rain. Seedlings that already have 4 leaves or are 30 days old are ready to be transferred to the field. Planting is done in the afternoon by prying the seeds without damaging the roots. Seedlings are planted in polybags arranged with a spacing of 50cm x 50cm. Coal fertilizer is given the day before planting at a dose of 300 g/plant. Bio Alam Asri organic fertilizer is given at the same time when preparing the planting media at a dose of 300 g/plant. Watering is done in the morning and evening.

## 3. Results and Discussion

### 3.1. Results

The results of statistical analysis obtained the significance of the effectiveness of Coal Fertilizer and Natural Bio Fertilizer Asri on all observed variables are presented in Table 3.

**Table 3.** The Significance of the Effectiveness of Coal Fertilizer and "Bio Alam Asri" Fertilizer on all observed variables

| No. | Variables | Treatment | | |
|---|---|---|---|---|
| | | B | V | B x V |
| 1. | Maximum plant height (cm) | ** | ns | ** |
| 2. | The age of the plant starting to flower (dap) | ns | ns | ns |
| 3. | The age of the plant starting to bear fruit (dap) | * | ns | ns |
| 4. | Age of harvest (dap) | ns | ns | ns |
| 5. | Number of fruit per plant | ** | ** | ** |
| 6. | Fresh weight of fruit per plant (g) | ** | ** | ** |
| 7. | Fruit water content (%) | ** | ns | * |
| 8. | Total Titrated Acid Level (%) | ** | ** | ** |
| 9. | Fruit Flavonoid Level (mg/100 g) | ** | ** | ** |
| 10. | Vitamin C content (mg/100 g) | ** | ** | ** |

* = significant (P<0,05), ** = very significant P(<0,01), ns = no significant (P>0,05)

The treatment of Coal organic fertilizer and Bio Alam Asri in general significantly affected the vegetative growth and generative yield of the three tomato varieties tested, especially on the parameters of plant height (cm), age of plant beginning to flower (dap), age of plant starting to bear fruit (dap) and age of started harvesting on organic fertilizer (B) and tomato varieties (V) including several components of fruit quality such as average fruit moisture content (%), total titrated acid (%), fruit flavonoid content (mg/100 g), and fruit content. vitamin C (mg/100 g). Only on some parameters such as the age of plants starting to flower, starting to bear fruit, and at the time of the first harvest were relatively the same or not significantly different (Table 4, Table 5, and Table 6).

**Table 4.** Average plant height (cm), age of plant beginning to flower (dap), Age of plant starting to bear fruit (dap), and Age of harvesting in organic fertilizer treatment (B) and tomato varieties (V)

| Treatment | Plant height (cm) | The age of the plant starting to flower (dap) | The age of the plant starting to bear fruit (dap) | Age of harvest (dap) |
|---|---|---|---|---|
| Organic fertilizer (B) | | | | |
| Coal Fertilizer (BB) | 146.80 a | 35.22 a | 49.22 a | 96.44 a |
| Manure "Bio Alam Asri" (BA) | 142.45 b | 35.44 a | 49.11 a | 96.33 a |
| No fertilizer (B0) | 142.26 b | 35.78 a | 50.33 b | 96.89 a |


DOI: https://doi.org/10.22225/aj.1.2.4218.37-43

| | | | | |
|---|---|---|---|---|
| LSD 0,05 | 2.35 | 0.86 | 1.68 | 0.93 |
| Variety | | | | |
| Servo F1 (VS) | 143.39 a | 35.44 a | 49.67 a | 96.56 a |
| Gustavi F1 (VG) | 143.58 a | 35.33 a | 49.56 a | 96.56 a |
| Fortuna 23 (VF) | 144.52 a | 35.67 a | 49.44 a | 96.56 a |
| LSD 0,05 | 2.35 | 0.86 | 1.68 | 0.93 |

*The average value followed by the same letter in the same treatment and the same column means that it is not significantly different in the 5% LSD test.

**Table 5.** The average number of fruit per plant, the weight of fresh fruit per plant (kg), and fruit moisture content (%) in the treatment of organic fertilizer (B) and tomato varieties (V)

| Treatment | Number of fruit per plant | Fresh weight of fruit per plant (kg) | Fruit water content (%) |
|---|---|---|---|
| Organic fertilizer (B) | | | |
| Coal Fertilizer (BB) | 44.00 a | 3.00 a | 94.43 ab |
| Manure "Bio Alam Asri" (BA) | 39.11 b | 2.62 b | 94.06 b |
| No fertilizer (B0) | 34.00 c | 2.20 c | 94.45 a |
| LSD 0.05 | 2.00 | 0.14 | 0.38 |
| Variety | | | |
| Servo F1 (VS) | 42.33 a | 2.74 a | 94.40 a |
| Gustavi F1 (VG) | 40.11 b | 2.71 a | 94.35 a |
| Fortuna 23 (VF) | 34.67 c | 2.38 b | 94.19 a |
| LSD 0.05 | 2.00 | 0.14 | 0.38 |

*The average value followed by the same letter in the same treatment and the same column means that it is not significantly different in the 5% LSD test.

**Table 6.** Average Total Titrated Acid Content, Fruit Flavonoid Content, and Vitamin C Content in the treatment of organic fertilizer (B) and tomato varieties (V)

| Treatment | Total Titrated Acid Level (%) | Fruit Flavonoid Level (mg/100 g) | Vitamin C content (mg/100 g) |
|---|---|---|---|
| Organic fertilizer (B) | | | |
| Coal Fertilizer (BB) | 23.33 b* | 30.92 c | 36.75 a |
| Manure "Bio Alam Asri" (BA) | 30.88 a | 36.09 b | 32.81 b |
| No fertilizer (B0) | 22.96 b | 52.91 a | 31.07 c |
| LSD 0.05 | 1.62 | 1.49 | 0.91 |
| Variety | | | |
| Servo F1 (VS) | 23.26 b | 40.47 a | 27.39 c |
| Gustavi F1 (VG) | 30.47 a | 40.46 a | 30.16 b |
| Fortuna 23 (VF) | 23.46 b | 38.98 b | 43.07 a |
| LSD 0.05 | 1.62 | 1.49 | 0.91 |

*The average value followed by the same letter in the same treatment and the same column means that it is not significantly different in the 5% LSD test.

### 3.2. Discussion

As described above, the treatment of Coal and Bio Alam Asri organic fertilizers, in general, had a significant effect on the vegetative growth and generative yield of the three tomato varieties tested, especially on the parameters of the average plant height (cm), on the organic fertilizer (B) and Tomato variety (V) includes several components of fruit quality such as average fruit moisture content (%), total titrated acid (%), fruit flavonoid content (mg/100 g), and vitamin C content (mg/100 g). Only on several parameters such as the age of the plants starting to flower, starting to bear fruit, and at the time of the first harvest, they were relatively the same or not


DOI: https://doi.org/10.22225/aj.1.2.4218.37-43

significantly different. This indicates that the treatment of organic fertilizers, both coal-based and from cattle farm waste is quite effective in increasing the growth and development of tomato plants in the three varieties tested [10, 11, 12, 13]. This effectiveness is evidence that the nutrient content of the two fertilizers is quite good. Especially coal-based fertilizers which, from the results of laboratory analysis, obtained nutrients, both macro and micro, which are quite effective in increasing the fertility of the growing media. The highest number and fresh weight of tomatoes per plant were obtained in the treatment of Coal fertilizer, namely 44.00 fruit and 3.00 kg, higher than Bio Alam Asri fertilizer, namely 39.11 fruit and 2.62 kg, and both of these fertilizers were higher. compared to without organic fertilizer, the results obtained were 34.00 pieces and 2.20 kg. This result is also by the results of previous research on several other organic fertilizer treatments [10, 14, 15, 16]. The highest number and fresh weight of tomatoes per plant were obtained in Servo F1 varieties, namely, 42.33 fruits and 2.74 kg, followed by Gustavi F1 varieties at 40.11 fruits and 2.71 kg and the lowest was Fortuna 23 varieties at 34.67 fruit and 2.38 kg. This result is also following the optimum potential yield of each variety tested [17, 18, 19]. The highest vitamin C content of fresh fruit was obtained in the Coal fertilizer treatment, which was an average of 36.75 mg/100g, higher than the treatment with Bio Alam Asri and without organic fertilizer, which was 32.81 mg/100g and 31.07 respectively. mg/100g. This result is also following the results of other organic fertilizer treatments on tomato plants obtained by [10, 20, 21, 22] who found that the water content of apple tomatoes was 94.92% while the vitamin C content in fresh tomatoes of apple tomatoes was 14.21 mg/100 g of material and the damage of vitamin C at a temperature of 50°C was 37.35%. Meanwhile, the levels of protein and fiber after the tomatoes were extracted became 10.9408% and 55.1562%. From this study, one kilogram of apple tomatoes produced 66.7207 mg of lycopene and 50 grams of tomato flour with high protein and fiber content for cereal ingredients [10, 23, 24, 25]. In addition, tomatoes are the second most consumed vegetable in the world after potatoes. Properties including physicochemical (lycopene), total titratable acid (TTA), total soluble solids (TSS) and vitamin C, morphology (fruit shape and size), and color contribute to the overall tomato fruit quality. Cluster analysis based on phenotypic data revealed that the ancient tomato variety clusters were not different whereas the single nucleotide polymorphism data revealed three distinct populations. The content of flavonoid compounds, in addition to vitamin C and other nutritional compounds, between the varieties tested also showed significant and non-significant differences. Information from this study may be useful for tomato breeding programs to select germplasm, improve response to selection, and at the same time increase tomato fruit quality [24, 25].

## 4. Conclusion

Based on the results of the study, the following conclusions can be drawn:

1). The treatment of Coal and Bio Alam Asri organic fertilizers, in general, had a significant effect on vegetative growth and generative yields including fruit quality in the three tomato varieties tested. Only on several parameters such as the age of the plants starting to flower, starting to bear fruit, and the time of the first harvest is relatively the same.
2). The highest number and fresh weight of tomatoes per plant were obtained in the treatment of Coal fertilizer, namely 44.00 fruit and 3.00 kg, higher than Bio Alam Asri fertilizer, namely 39.11 fruit and 2.62 kg, and both of these fertilizers were higher. compared to without organic fertilizer, the results obtained were 34.00 fruit and 2.20 kg.
3). The highest number and fresh weight of tomatoes per plant were obtained in Servo F1 varieties, namely 42.33 fruits and 2.74 kg, followed by Gustavi F1 varieties at 40.11 fruits and 2.71 kg and the lowest was Fortuna 23 varieties at 34.67 fruit and 2.38 kg.
4). The highest vitamin C content of fresh fruit was obtained in the Coal fertilizer treatment, which was an average of 36.75 mg/100g, higher than the treatment with Bio Alam Asri fertilizer and without organic fertilizer, which was 32.81 mg/100g and respectively 31.07 mg/100g.


DOI: https://doi.org/10.22225/aj.1.2.4218.37-43

## Acknowledgments

We would like to express our gratitude to Warmadewa University through the Warmadewa University Research Institute for funding this research so that it can run well.

## Reference

[1] Kusandriyani, Y. (2007). Karakterisasi dan deskripsi plasma nutfah tomat. *Buletin Plasma Nutfah*, 11(2), 55-59.
[2] Cahyono, I. B. (2008). *Tomat, Usaha Tani dan Penanganan Pasca Panen*. Kanisius.
[3] Nazirwan, N., Wahyudi, A., & Dulbar, D. (2014). Karakterisasi koleksi plasma nutfah tomat lokal dan introduksi. *Jurnal Penelitian Pertanian Terapan*, 14(1).
[4] Marliah, A., Hayati, M., & Muliansyah, I. (2012). Pemanfaatan pupuk organik cair terhadap pertumbuhan dan hasil beberapa varietas tomat (*Lycopersicum esculentum* L.). *Jurnal Agrista*, 16(3), 122-128.
[5] Hamidi, A. (2017). *Budidaya Tanaman Tomat*. Aceh: Balai Pengkajian Teknologi Pertanian Aceh.
[6] Darmawan, I. K., Kusnanda, I. K. E., Labantari, N. N. S., Situmeang, Y. P., & Sudita, I. D. N. (2021). Level of Community Participation in Conducting Waste Sorting in Semarapura City. *Agriwar Journal*, 1(1), 1-5.
[7] Chozin, M. A., & Baharudin, R. (2014). Penggunaan kacang hias (Arachis pintoi) sebagai biomulsa pada budidaya tanaman tomat (Lycopersicon esculentum M.). Jurnal Hortikultura Indonesia, 5(3), 168-174.
[8] Pangaribuan, D. H., Yasir, M., & Utami, N. K. (2012). Dampak bokashi kotoran ternak dalam pengurangan pemakaian pupuk anorganik pada budidaya tanaman tomat. *Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy)*, 40(3).
[9] Maharina, K. E., Aini, L. Q., & Wardiyati, T. (2014). Aplikasi agens hayati dan bahan nabati sebagai pengendalian layu bakteri (*Ralstonia solanacearum*) pada budidaya tanaman tomat. *Jurnal Produksi Tanaman*, 1(6).
[10] Petropoulos, S., Fernandes, Â., Xyrafis, E., Polyzos, N., Antoniadis, V., Barros, L., & Ferreira, I. (2020). The Optimization of Nitrogen Fertilization Regulates Crop Performance and Quality of Processing Tomato (*Solanum lycopersicum* L. cv. Heinz 3402). *Agronomy*, 10, 715.
[11] Wei, Z., Du, T., Li, X., Fang, L., & Liu, F. (2018). Interactive Effects of Elevated CO2 and N Fertilization on Yield and Quality of Tomato Grown Under Reduced Irrigation Regimes. *Frontiers in Plant Science*, 9.
[12] Bonetti, B., Waldow, E. C., Trapp, G., Hammerschmidt, M. E., Ferrarini, S. F., Pires, M. J., ... & Aquino, T. F. (2021). Production of zeolitic materials in pilot-scale based on coal ash for phosphate and potassium adsorption in order to obtain fertilizer. *Environmental Science and Pollution Research*, 28(3), 2638-2654.
[13] Flores, C. G., Schneider, H., Marcilio, N. R., Ferret, L., & Oliveira, J. C. P. (2017). Potassic zeolites from Brazilian coal ash for use as a fertilizer in agriculture. *Waste Management*, 70, 263-271.
[14] Zhang, S. Q., Liang, Y. U. A. N., Wei, L. I., Lin, Z. A., Li, Y. T., Hu, S. W., & Zhao, B. Q. (2019). Effects of urea enhanced with different weathered coal-derived humic acid components on maize yield and fate of fertilizer nitrogen. *Journal of Integrative Agriculture*, 18(3), 656-666.
[15] Roussis, I., Kakabouki, I., & Bilalis, D. (2019). Comparison of Growth Indices of Nigella sativa L. under Different Plant Densities and Fertilization. *Emirates Journal of Food and Agriculture*, 231.
[16] Camejo, D., Rodríguez, P., Morales, M. A., Dell'Amico, J. M., Torrecillas, A., & Alarcón, J. J. (2005). High temperature effects on photosynthetic activity of two tomato cultivars with different heat susceptibility. *Journal of plant physiology*, 162(3), 281-289.
[17] Farneselli, M., Tosti, G., Onofri, A., Benincasa, P., Guiducci, M., Pannacci, E., & Tei, F. (2018). Effects of N sources and management strategies on crop growth, yield, and potential N leaching in processing tomato. *European Journal of Agronomy*, 98, 46-54.
[18] Hossain, M.A. (2020). Effect of Organic Fertilizer and Irrigation Intervals on the Yield and Quality of Cherry Tomato (*Solanum lycopersicon* var. cerasiforme). Journal of Horticultural Science, 7, 327-334.
[19] Dewi, A. P. (2018). Penetapan Kadar Vitamin C dengan Spektrofotometri UV-Vis Pada Berbagai Variasi Buah Tomat. *JOPS (Journal of Pharmacy and Science)*, 2(1), 9-13.

[20] Kalbani F.O.S.A. and M. Salem and A. J. Cheruth and S. S. Kurup and A. Senthilkumar, 2016. Effect of some organic fertilizers on growth, yield, and quality of tomato (*Solanum lycopersicum* L.). *J. International Letters of Natural Sciences*. 53 (53) p. 1-9.
[21] Lenucci, M. S., Cadinu, D., Taurino, M., Piro, G., & Dalessandro, G. (2006). Antioxidant composition in cherry and high-pigment tomato cultivars. *Journal of agricultural and food chemistry*, 54(7), 2606-2613.
[22] Ntagkas, N., Woltering, E., Nicole, C., Labrie, C., & Marcelis, L. F. (2019). Light regulation of vitamin C in tomato fruit is mediated through photosynthesis. *Environmental and Experimental Botany*, 158, 180-188.
[23] Baldet, P., Bres, C., Okabe, Y., Mauxion, J. P., Just, D., Bournonville, C., ... & Rothan, C. (2013). Investigating the role of vitamin C in tomato through Tilling identification of ascorbate-deficient tomato mutants. *Plant Biotechnology*, 30(3), 309-314.
[24] Kartika, R. (2016). Pengaruh penambahan Caco3 dan waktu penyimpanan terhadap kadar vitamin c pada proses penghambatan pematangan buah tomat (*Lycopersicum esculentum* Mill). *Jurnal Kimia Mulawarman*, 8(1).
[25] Inculeț, C., Dachi, M., Gafincu, A., Gache, M., Teliban, G.C., & Stoleru, V. (2019). Tomato Production Influenced by Variety, Irrigation, and Organic Fertilization. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca: *Horticulture*, 76, 72.


DOI: https://doi.org/10.22225/aj.1.2.4218.37-43