



Effect of Concentration of Liquid Organic Fertilizer and Arbuscular Mycorrhizal Fungi (CMA) on Growth and Red Bean Plant (*Phaseolus vulgaris* L)

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Abstract. This study aims to determine the interaction between the effect of liquid organic fertilizer concentration and arbuscular mycorrhizal fungi (CMA) on the growth and yield of red bean plants (*Phaseolus vulgaris* L.). The experiment was conducted in Nusaherang Village, Nusaherang District, Kuningan Regency, from July to September 2022. The research method used is the experimental method of Group Random Design (RAK) factorial pattern. The treatment consists of two factors and is repeated three times. The first factor is the concentration of liquid organic fertilizer (P), which consists of three levels, namely: P1 (5 ml / l), P2 (10 ml / l), and P3 (15 ml / l). The second factor of arbuscular mycorrhizal fungi (C) consists of three levels, namely: C1 (5 g / plant), C2 (10 g / plant), and C3 (15 g / plant). The primary observation data is processed using variance analysis; if there is a noticeable effect, the test is continued with the Duncan multiple distance test. The results showed a real interaction between the concentration of liquid organic fertilizer and arbuscular mycorrhizal fungi on plant height aged 21 HST, root length aged 21 HST, number of flowers aged 35 HST, and number of pods per red bean plant. The concentration treatment of liquid organic fertilizer has an independent effect on the number of leaves aged 21 HST. In comparison, the treatment of arbuscular mycorrhizal fungi has an independent effect on the number of leaves aged 21 and 28 HST and the number of seeds per pod. The treatment of liquid organic fertilizer and arbuscular mycorrhizal fungi has the same effect on yield variables, so the average weight of fresh red bean beans per plot is 626 g (0.63 kg) or equivalent to 1.6 tons/ha, assuming 80% of the land is effective.

Keywords: liquid organic fertilizer, arbuscular mycorrhizal fungus, concentration, kidney beans.

INTRODUCTION

Red beans (*Phaseolus vulgaris* L.), or jogo beans, are still beans, but the stems are short and do not propagate (Sunarjono, 2012). Red beans are in great demand by the public because they have good nutritional value and very high economic potential, and the market opportunities are broad, namely for domestic and foreign markets. Therefore, red beans have a massive role in farmers' income, improving community nutrition, state income through exports, developing agribusiness, and expanding employment opportunities (Setianingsih, 2005).

From 2016 to 2020, the harvest area, production, and productivity of red beans in Indonesia experienced fluctuations. This shows that red bean production and productivity in Indonesia is unstable. One of the triggers for instability in red bean crop yields is the technique or method of cultivation, such as inefficient fertilizer application, in terms of the type of fertilizer and the amount of fertilizer applied. This can cause plants to lack nutrients, resulting in low yields. Therefore, appropriate fertilization must be carried out so plants' nutritional needs can be met, such as using organic fertilizer in liquid form (solution) or what is usually called liquid organic fertilizer (POC).

Liquid Organic Fertilizer (POC) stimulates plant growth and contains macro and micronutrients. The benefits of POC are that it can stimulate leaf formation, stimulate cytokinesis in connection with plant growth and development, increase fertilization efficiency, and stimulate lateral growth of shoots or growing points (Widiyazid, 2003). Liquid organic fertilizer does not harm plants because the essential ingredients are natural, so plants easily absorb it (Wahyudi et al., 2021).

The yield of kidney beans will increase if the level of fertilization efficiency and nutrient absorption by the plant is high. Therefore, the use of POC will be more efficient if coupled with the application of Arbuscular Mycorrhizal Fungi (CMA), which are able to improve soil structure and assist in nutrient absorption, thereby increasing plant growth and yield (Pratama et al., 2019).

When applying liquid organic fertilizer, the concentration given needs to be considered because each type of plant has a different level of fertilizer solution needs. Meanwhile, the dose must be considered when applying CMA is the dose used. Accuracy in the use of CMA dosage will optimize how it works. Therefore, it is necessary to research the effect of the concentration of liquid organic fertilizer and Arbuscular Mycorrhizal Fungi (CMA) on the growth and yield of red bean plants (*Phaseolus vulgaris* L.) in order to know the right concentration for POC and the correct dose for CMA.

METHOD

This experiment was conducted in Nusaherang Village, Nusaherang District, Kuningan Regency. It is located at an altitude of 768 meters above sea level (masl) with an average rainfall of the last ten years of 2,615 mm/year. The period for this experiment is July to September 2022. The ingredients used in this experiment were red bean seeds of the Garut Local cultivar, Supremes liquid organic fertilizer, Arbuscular Mycorrhizal Fungi (CMA), and goat manure. At the same time, the tools used in this experiment are stationery, hoes, tugal, nameplates, plot

labels, hand sprayers, digital scales, drills, water hoses, meters, scissors, raffia ropes, cameras, and other tools that support the experiment.

The experimental design used was a factorial pattern Group Randomized Design (RAK) consisting of the first factor of POC concentration and the second factor of CMA.

1. Konsentrasis POC : P1 (5 ml / l), P2 (10 ml / l), P3 (15 ml / l)
2. CMA : C1 (5 g/tanaman), C2 (10 g/tanaman), C3 (15 g/tanaman).

Each treatment was repeated three times, bringing the number of plots in this experiment to 27 maps or 27 experimental units.

DISCUSSION

Plant Height

Based on the results of statistical analysis, it shows that there is a real interaction between the effect of POC and CMA concentration treatment on the height of red bean plants (*Phaseolus vulgaris* L.) aged 21 HST. The results of statistical analysis are listed in Table 1.

Table 1. Effect of POC and CMA Concentrations on Average Height of Red Bean Plants (*Phaseolus vulgaris* L.) At 21 HST

| Plant Height (cm) 21 HST | | | |
|--------------------------|---------|---------|---------|
| Treatment | P1 | P2 | P3 |
| C1 | 25,63 a | 28,12 a | 24,99 a |
| | A | B | A |
| C2 | 27,28 b | 27,25 a | 25,57 a |
| | B | B | A |
| C3 | 27,95 b | 28,31 a | 28,54 b |
| | A | A | A |

Description: The average number followed by the same lowercase letter in the same column and the same capital letter in the same row, did not differ markedly according to the Duncan Multiple Spacing Test at the level of 5%.

Based on Table 1, treatments P1 (POC 5 ml/l) and C2 (CMA 10 g/plant) have shown a significant interaction on plant height at 21 HST. So, treatments P1 and C2 are considered more effective and efficient than other treatments and have the best effect on plant height. This is thought to be because administering POC with a concentration of 5 ml/l can fulfill the plant's nutrient needs, especially nitrogen, thereby influencing the height growth of red bean plants. Nitrogen is a constituent of many compounds, such as amino acids, which are needed to form or grow vegetative parts such as stems, leaves, and roots (Lakitan, 2012). They are giving CMA as much as ten g/plant, which can help plants absorb nutrients using the external hyphae that form.

This is in line with the opinion of Utomo (2010), who states that external mycorrhizal hyphae can help absorb water and nutrient elements used in metabolic processes in the plant body so that they can stimulate plant height growth.

The statistical analysis results showed no interaction and no real influence between the POC and CMA concentration treatments on the height of red bean plants (*Phaseolus vulgaris* L.) aged 28 HST and 35 HST. The results of the statistical analysis are listed in Table 2.

Table 2. Effect of POC and CMA Concentrations on Average Height of Red Bean Plants (*Phaseolus vulgaris* L.) At 28 and 35 HST

| Treatment | Plant Height (cm) | |
|-----------|-------------------|---------|
| | 28 HST | 35 HST |
| P1 | 39,44 a | 49,83 a |
| P2 | 39,98 a | 50,46 a |
| P3 | 38,82 a | 49,15 a |
| C1 | 38,24 a | 48,73 a |
| C2 | 39,48 a | 49,78 a |
| C3 | 40,50 a | 50,94 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 2, POC and CMA concentration treatment showed no significant effect on plant height at 28 HST and 35 HST. This is thought to be because the height growth of plants has reached the maximum limit by meeting their nutrient needs, and plants have switched to the generative phase marked by the emergence of flowers at the age of 26 HST so that the available nutrients are used for plant generative growth. Therefore, at 28 HST and 35 HST, the plant height is relatively the same (not significantly different). This is in line with the opinion of Kristiani et al. (2014), which states that, after entering the fourth to sixth weeks, red bean plants have grown into adult plants with a relatively uniform growing ability.

Number of Leaves

Based on the statistical analysis results, there was no interaction between the treatment of POC and CMA concentrations on the number of leaves of red bean plants at all observation ages. However, there was an independent influence at 21 HST and 28 HST. The results of the statistical analysis are listed in Table 3.

Table 3. The Effect of POC and CMA Concentrations on the Average Number of Leaves of Red Bean Plants (*Phaseolus vulgaris* L.) At Age 21, 28, and 35 HST

| Treatment | Number of leaves | | |
|-----------|------------------|---------|---------|
| | 21 HST | 28 HST | 35 HST |
| P1 | 19,89 b | 42,93 a | 59,04 a |
| P2 | 19,76 b | 41,18 a | 58,76 a |
| P3 | 18,91 a | 40,96 a | 58,24 a |
| C1 | 19,18 a | 40,31 a | 56,67 a |
| C2 | 19,16 a | 40,42 a | 58,24 a |
| C3 | 20,22 b | 44,33 b | 61,13 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 3, at 21 HST, the higher the POC concentrations used, the fewer leaves. P1 treatment has the best effect on the number of leaves, with the highest average number of leaves at 19.89 strands. It is suspected that the POC concentration treatment of 5 ml / l has been able to meet the needs of plant nutrients, especially nitrogen elements, to provide the best leaf growth. According to Ngantung et al. (2018), plants need nitrogen as a nutrient essential in the vegetative phase for forming plant parts, including leaves. POC concentration treatment did not show a noticeable difference at all levels of treatment on the number of leaves aged 28 HST and 35 HST; it is suspected that red bean plants are already at the maximum leaf count growth limit with the fulfillment of sufficient nutrient availability so that it does not give a significant response to the increase in the number of leaves. Sugeng (2005) stated that plant growth is related to the supply of nutrients and water to plants. The relationship shows that plant growth increases to a certain extent, according to the need for sufficient nutrient and water supply.

At the age of 21 HST and 28 HST, the more doses of CMA are used, the more the number of leaves increases. C3 treatment gave the highest number of leaves at the age of 21 HST (20.22 strands) and 28 HST (44.33 strands). This condition shows that the administration of CMA at a dose of 15 g / plant is appropriate in meeting the availability of nutrients plants need at the end of the vegetative phase growth period so that it can symbiosis optimally with rhizobium bacteria to carry out nitrogen fixation. One of the successes of fixation is determined by the availability of sufficient phosphorus content so that the open CMA pores cause water storage to become available and help tether nitrogen from the air and convert it into ammonia, which will be used in the leaf development process (Purwaningsih et al., 2013). CMA treatment did not show significantly different values at all levels of treatment on the average number of leaves of kidney bean plants at the age of 35 HST. This is thought to be because the plant is attacked by leaf rust disease, which begins to appear at the age of 30 HST.

Number of Branches

The results of statistical analysis showed no interaction and no significant effect between the treatment of POC and CMA concentrations on the number of branches of red bean plants (*Phaseolus vulgaris* L.) at the age of 21 HST, 28 HST and 35 HST. The results of statistical analysis are listed in Table 4.

Table 4. Effect of POC and CMA Concentrations on the Average Number of Red Bean Plant Branches (*Phaseolus vulgaris* L.) At Age 21, 28, and 35 HST

| Treatment | Number of Branches | | |
|-----------|--------------------|---------|---------|
| | 21 HST | 28 HST | 35 HST |
| P1 | 7,84 a | 13,96 a | 15,42 a |
| P2 | 7,84 a | 13,73 a | 15,20 a |
| P3 | 7,64 a | 13,44 a | 15,16 a |
| C1 | 7,76 a | 13,38 a | 15,16 a |
| C2 | 7,62 a | 13,40 a | 15,09 a |
| C3 | 7,96 a | 14,36 a | 15,53 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Table 4 shows that the treatment of POC and CMA concentrations did not have a noticeable effect on the number of branches at all observation ages. This is because genetic factors influence the number of branches more than the plant itself, which causes almost the same number of branches. According to Machfud et al. (1996) in Yadi (2020), plant branching is influenced by variety, length of days, planting distance, and soil fertility. In line with what Pratama et al. (2015) stated, the appearance of different plants is strongly influenced by the genetics of the plant itself and its interaction with the environment.

Root Length

The statistical analysis results showed a significant interaction between the effect of POC and CMA concentration treatment on the root length of red bean plants (*Phaseolus vulgaris* L.) aged 21 HST. The results of the statistical analysis are listed in Table 5.

Table 5. Effect of POC and CMA Concentrations on Average Root Length of Red Bean Plant (*Phaseolus vulgaris* L.) At 21 HST

Root Length (cm) 21 HST

| Treatment | P1 | P2 | P3 |
|-----------|---------|----------|---------|
| C1 | 14,33 a | 15,77 ab | 14,60 a |
| | A | A | A |
| C2 | 12,93 a | 19,73 b | 14,87 a |
| | A | B | A |
| C3 | 14,30 a | 14,33 a | 20,83 b |
| | A | A | B |

Description: The average number followed by the same lowercase letter in the same column and the same capital letter in the same row, did not differ markedly according to the Duncan Multiple Spacing Test at the level of 5%.

Based on Table 5, the treatment of P2 (POC 10 ml / l) and C2 (CMA 10 g / plant) has shown a significant interaction with root length of 21 HST. So, P2 and C2 treatments are considered more effective and efficient than other treatments and have the best influence on plant root length. This is thought to be because giving POC with a concentration of 10 ml / l can provide enough nutrients to meet plant nutrient needs, one of which is phosphorus, which plays a role in root length growth. This was stated by Anand et al. (2022): seed growth, root lengthening, and disease tolerance are essential functions of element P. Giving CMA as much as 10 g / plant can help plants absorb the phosphorus nutrients needed. As stated by Musfal (2010), plants infected with CMA can absorb higher P elements than plants that are not infected. The high P uptake by plants infected with CMA is due to CMA hyphae secreting phosphatase enzymes, so P bound in the soil will be dissolved and available to plants.

Based on the results of the statistical analysis, there was no interaction and no significant effect between the treatment of POC and CMA concentrations on the root length of red bean plants (*Phaseolus vulgaris* L.) at the age of 42 HST and 60 HST. The results of the statistical analysis are listed in Table 6.

Table 6. Effect of POC and CMA Concentrations on Average Root Length of Red Bean Plant (*Phaseolus vulgaris* L.) At 42 and 60 HST

| Treatment | Root Length (cm) | |
|-----------|------------------|---------|
| | 42 HST | 60 HST |
| P1 | 27,41 a | 33,42 a |
| P2 | 27,83 a | 33,14 a |
| P3 | 27,39 a | 32,19 a |
| C1 | 25,58 a | 31,39 a |
| C2 | 28,33 a | 33,67 a |
| C3 | 28,72 a | 33,70 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 6, treatment of POC and CMA concentrations has no noticeable effect on root life length of 42 HST and 60 HST. This is thought to be because root length growth has reached the maximum limit by meeting its nutrient needs, and plants have switched to the generative phase characterized by the emergence of flowers at the age of 26 HST so that the available nutrients are used for plant generative growth. According to Surawinata et al. (2017), phosphorus nutrients that have been available to plants function for cell division, fat and albumin formation, fruit, flower, and seed formation, accelerate fruit ripening, stimulate root development, improve plant yield quality and disease resistance so that phosphorus absorbed by plants is more for generative growth rather than used for root length growth.

Number of Interest

The statistical analysis showed no interaction and no significant effect between the treatment of POC and CMA concentrations on the number of red bean plants (*Phaseolus vulgaris* L.) flowers at the age of 28 HST and 42 HST. The results of the statistical analysis are listed in Table 7.

Table 7. Effect of POC and CMA Concentrations on the Average Number of Flowers of Red Bean Plant (*Phaseolus vulgaris* L.) At 28 and 42 HST

| Treatment | Number of Interest | |
|-----------|--------------------|--------|
| | 28 HST | 42 HST |
| P1 | 1,93 a | 0,33 a |
| P2 | 1,56 a | 0,64 a |
| P3 | 1,93 a | 0,49 a |
| C1 | 2,07 a | 0,31 a |
| C2 | 1,67 a | 0,78 a |
| C3 | 1,69 a | 0,38 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 7, the treatment of POC and CMA concentrations did not significantly affect the number of flowers aged 28 HST and 42 HST. This is thought to be because, at the age of 28, HST POC administration has not been able to meet the nutrient needs of plants to optimize flowering at the beginning of the generative phase, especially phosphorus (P). According to Lingga (2001) and Payung dan Lempang (2018), phosphorus plays a role in stimulating fruit

flowering and ripening. CMA is also thought to have not worked optimally to help the absorption of P elements, so the number of flowers that appear at the beginning of the generative period is relatively the same in all treatments. Sukmawati et al. (2014) stated that mycorrhizal fungal infections can increase nutrient absorption by external mycelium by expanding the surface of root absorption or through the results of chemical compounds that cause the release of nutrient bonds in the soil. At the age of 42, HST is the end of the flowering period, so the flowers have begun to turn into pods. Therefore, the number of flowers at the age of 42 HST did not respond significantly to the treatment of POC and CMA concentrations.

Based on the results of statistical analysis, it can be seen that there is a real interaction between the effect of POC and CMA concentration treatment on the number of flowers of red bean plants (*Phaseolus vulgaris* L.) aged 35 HST. The results of the statistical analysis are listed in Table 8.

Table 8. Effect of POC and CMA Concentrations on the Average Number of Flowers of Red Bean Plant (*Phaseolus vulgaris* L.) At 35 HST

| Number of Interest 35 HST | | | |
|---------------------------|--------|--------|--------|
| Treatment | P1 | P2 | P3 |
| C1 | 8,67 a | 8,80 a | 8,73 b |
| | A | A | A |
| C2 | 8,13 a | 7,67 a | 7,00 a |
| | A | A | A |
| C3 | 7,60 a | 7,33 a | 9,67 b |
| | A | A | B |

Description: The average number followed by the same lowercase letter in the same column and the same capital letter in the same row, did not differ markedly according to the Duncan Multiple Spacing Test at the level of 5%.

Based on Table 8, treatment of P3 (POC 15 ml/l) with C3 (CMA 15 g/plant) showed a significant interaction with the number of flowers aged 35 HST and gave the highest number of flowers compared to other treatments. This is thought to be because the provision of POC with the right concentration can meet the needs of plant nutrients to stimulate plant growth, including the number of flowers. Koswara (2009) stated that plants will thrive if they can absorb the available nutrients according to the level of plant needs. One of the nutrients in POC that affects flower formation is element P. CMA administration can help plants absorb nutrients. More excellent water absorption by mycorrhizal plants will also carry nutrients such as N, P, and K to increase plant nutrient uptake (Musfal, 2010).

Number of Pods per Plant

Based on the results of statistical analysis, it can be seen that there is a real interaction between the effect of POC and CMA concentration treatment on the number of pods per red bean plant (*Phaseolus vulgaris* L.). The results of the statistical analysis are listed in Table 9.

Table 9. Effect of POC and CMA Concentrations on Average Number of Pods Per Bean Plant (*Phaseolus vulgaris* L.)

| Number of pods per plant | | | |
|--------------------------|----------|---------|----------|
| Treatment | P1 | P2 | P3 |
| C1 | 14,07 a | 12,33 a | 14,07 ab |
| | A | A | A |
| C2 | 16,47 b | 14,93 b | 12,73 a |
| | B | B | A |
| C3 | 15,00 ab | 15,33 b | 15,73 b |
| | A | A | A |

Description: The average number followed by the same lowercase letter in the same column and the same capital letter in the same row, did not differ markedly according to the Duncan Multiple Spacing Test at the level of 5%.

Based on Table 9, P1 (POC 5 ml/l) and C2 (CMA 10 g/plant) treatments showed a significant interaction with the number of pods per plant and gave the highest number of pods per plant compared to other treatments. This is thought to be because the provision of POC with a concentration of 5 ml / l can meet the nutrient needs of plants, especially phosphorus (P), which affects the formation of pods. As stated by Cahyono (2007), the adequacy of P elements in plants will increase the number and maturation of pods. CMA treatment of 10 g/plant can help provide and absorb the phosphorus plants need. This is by the statement of Sukmawati et al. (2014) that CMA has external hyphae that can increase the availability of P elements in the soil.

Number of Seeds per Pod

Based on the results of the statistical analysis, there is no interaction between POC and CMA concentration treatment. However, CMA treatment has an independent influence on the number of seeds per pod of red bean plants (*Phaseolus vulgaris* L.). The results of the statistical analysis are listed in Table 10.

Table 10. Effect of POC and CMA Concentrations on Average Number of Seeds Per Pod of Red Bean Plant (*Phaseolus vulgaris* L.)

| Treatment | Number of seeds per pod |
|-----------|-------------------------|
| P1 | 4,11 a |
| P2 | 3,91 a |
| P3 | 4,00 a |
| C1 | 3,82 a |
| C2 | 4,16 b |
| C3 | 4,04 ab |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 10, it can be seen that the treatment of POC concentration has no noticeable effect on the number of seeds per pod. This is thought to be because the P content in the soil is high enough that POC does not respond significantly to the number of seeds per pod. According to Supadma et al. (2014), phosphorus plays an essential role in the division and enlargement of seed constituent cells and the success of pollinating flowers into seeds.

CMA treatment markedly affected the number of seeds per pod of kidney bean plants. C2 treatment has the best effect on the number of seeds per pod, with the highest average number of seeds per pod at 4.16 eggs. It is suspected that giving CMA at a dose of 10 g / plant has influenced the development of hyphae in CMA to absorb nutrients, especially P elements that can help seed formation. According to Pratama et al. (2019), phosphorus is one of the constituent nutrients of energy transfer components, nucleic acids, the primary enzyme constituents, stimulates early root growth and growth, accelerates seed growth, and many other metabolic functions. Charisma et al. (2012) stated that mycorrhizal activity can produce organic acids and phosphatase enzymes that can change P elements in the labile zone so that plant roots can absorb them.

Weight of Fresh Seeds Per Plant and Per Plot

Based on the statistical analysis results, there was no interaction and no significant effect between the treatment of POC and CMA concentrations on the weight of fresh kidney beans (*Phaseolus vulgaris* L.) per plant and plot. The results of the statistical analysis are listed in Table 11.

Table 11. Effect of POC and CMA Concentrations on Average Weight of Red Bean Fresh Beans (*Phaseolus vulgaris* L.) Per Plant and Per Plot

| Treatment | Fresh Seed Weights (g) | |
|-----------|------------------------|----------|
| | Per Plant | Per Plot |
| P1 | 20,36 a | 636,87 a |
| P2 | 19,40 a | 635,48 a |
| P3 | 19,52 a | 604,52 a |
| C1 | 18,18 a | 581,11 a |
| C2 | 20,30 a | 706,91 a |
| C3 | 20,80 a | 588,84 a |

Description: The average number followed by the same letter in the same column does not differ markedly according to Duncan's Multiple Spacing Test at 5%.

Based on Table 16, POC and CMA concentration treatment had no noticeable effect on fresh seed weight per plant and plot. This is thought to be due to more dominant genetic factors, such that the administration of POC and CMA does not respond significantly to the weight of fresh beans. According to Machfud et al. (1996) and Yadi (2020), genetic factors show carriers of traits inherited from their elders. In addition, the non-synchronous maturity of the pods is suspected to be the cause, so that by the time of harvest, some pods have begun to dry. This caused the weight of fresh kidney bean beans per plant and plotted not to differ markedly at all treatment levels.

CONCLUSION

1. There was a significant interaction between the effect of POC and CMA concentration treatment on plant height aged 21 HST, root length aged 21 HST, number of flowers aged 35 HST, and number of pods per plant. There was an independent effect on the treatment of POC concentration of 5 ml/l (P1) on the number of leaves aged 21 HST. CMA treatment of 15 g/plant (C3) independently affected the number of leaves aged 21 HST and 28 HST, and CMA treatment of 10 g/plant (C2) independently affected the number of seeds per pod.
2. All POC and CMA concentration treatments have the same effect on yield variables, so the average weight of fresh red bean beans per plot is 626 g (0.63 kg), equivalent to 1.6 tons/ha, assuming 80% effective land.

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