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# Effect of Vermicompost Organic Fertilizer and Russian Liquid Organic Fertilizer on the Growth and Yield of Hybrid Corn (*Zea mays* L. Saccharata)

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**ABSTRACT**

Corn production in Indonesia decreased from 16.53 million tons in 2022 to 14.77 million tons in 2023, highlighting the need to improve cultivation practices. This study aimed to investigate the effects of vermicompost and Russian liquid organic fertilizer, as well as their interactions, on the growth and yield of corn (Zea mays L.). The experiment used a Randomized Block Design with a factorial arrangement. The first factor was the dose of vermicompost fertilizer (K) at three levels: 0, 5, and 10 tons/ha. The second factor was the dose of Russian liquid organic fertilizer (R) at three levels: 0, 5, and 10 ml/L. The treatments were combined to form nine combinations, each replicated three times, totaling 27 experimental units. Each unit consisted of four rows with 25 plants per row, totaling 100 plants. Results showed that the interaction between vermicompost and Russian liquid fertilizer significantly affected corn yield, with the highest yield of 13.75 tons/ha observed at 10 tons/ha vermicompost combined with 10 ml/L Russian liquid fertilizer. The best growth was also achieved at 10 tons/ha vermicompost, producing a stem diameter of 23.30 mm, plant height of 212.89 cm, 13.22 leaves, and a leaf width of 6.22 cm. Similarly, 10 ml/L Russian liquid fertilizer produced a stem diameter of 22.40 mm, plant height of 204.78 cm, 13.22 leaves, and a leaf width of 6.16 cm. Although some differences were not statistically significant based on the 5% LSD test, both fertilizers demonstrated positive effects on vegetative growth and productivity. These findings indicate that the combined application of vermicompost and Russian liquid organic fertilizer can effectively enhance the growth and yield of corn, offering a sustainable approach to increasing corn production in

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## 1. INTRODUCTION

The growth and yield of maize are influenced by the availability of nutrients in the soil and their absorption by the plants. Vermicompost is an organic fertilizer with a crumbly structure containing organic carbon, nitrogen, phosphorus, and potassium, which are beneficial for supporting plant growth and development (Walida *et al.*, 2021). Raksun *et al.*, 2022) reported that the application of vermicompost media accelerated plant height growth and increased the number of

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leaves in yardlong beans. Numerous studies have been conducted on the effects of vermicompost application on plant growth and production. Mahmud *et al*., (2002) stated that applying 15 tons/ha of vermicompost improved the growth and yield of soybeans. Tarigan *et al*., (2002) reported that the use of vermicompost on sweet corn provided a better response compared to chicken manure. Zulfahrigani (2002) found that the maximum maize yield under conventional tillage was 126.24 g per plant with an optimum vermicompost dosage of 16.72 tons/ha, while under minimum tillage, the yield reached 117.77 g per plant with an optimum dosage of 16.10 tons/ha.

Liquid organic fertilizer is a solution derived from the decomposition of organic materials that contains more than one essential nutrient. Liquid organic fertilizer plays a crucial role in improving soil properties—physically, chemically, and biologically—enhancing vegetative growth, and exerting positive effects on plant development. The application of liquid organic fertilizer can increase soil fertility and improve soil characteristics (Mulyani, 2013). According to Pratama (2020), the benefits of liquid organic fertilizer include improving soil structure, promoting plant growth, and enhancing crop quality. In addition, liquid organic fertilizers contain binding agents that allow the applied solution to be readily absorbed and utilized by plants (Nur *et al*., 2016).

Vermicompost fertilizer is highly compatible when combined with other organic materials, biofertilizers, or sources of organic nutrients (Ekadana, 2019). demonstrated that the combination of vermicompost and several Trichoderma spp. strains significantly increased the growth and yield of peanuts. The improvement in production and growth occurred not only due to the interaction effects but also individually, as both vermicompost dosage and Trichoderma spp. inoculation contributed to better soil conditions, plant growth, and yield. This study aims to determine the effects of vermicompost and Russian liquid organic fertilizer, as well as their interaction, on the growth and yield of maize.

## 2. METHODS

This study employed a Randomized Block Design (RBD) with a factorial pattern. The first factor was the dosage of vermicompost fertilizer (K), consisting of three levels: without fertilizer, 5 tons/ha, and 10 tons/ha. The second factor was the dosage of Russian liquid organic fertilizer (R), also consisting of three levels: without fertilizer, 5 ml/liter of water, and 10 ml/liter of water. The combination of vermicompost fertilizer (K) and Russian liquid organic fertilizer (R) resulted in nine treatment combinations, each replicated three times, producing a total of 27 experimental units. Each experimental unit consisted of four rows, with 25 plants per row, totaling 100 plants per unit.

The observed variables included the number of leaves (leaves), plant height (cm), stem diameter (mm), leaf width (cm), cob weight per hectare (tons/ha), cob diameter (cm), cob length (cm), weight of 10 cobs (kg), weight of 1,000 grains (g), and the number of kernel rows (rows).

The collected data were tabulated and analyzed using analysis of variance (ANOVA). When a significant difference among treatments was detected, the Least Significant Difference (LSD) test at the 5% significance level was applied (Gomes and Gomez, 1980). In cases where significant interactions occurred, the Duncan's Multiple Range Test (DMRT) was conducted at the 5% significance level.

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| Test I | Test II | Test III |
|---|---|---|
| K1R2 | K2R2 | K0R2 |
| K2R2 | K0R0 | K1R0 |
| K0R2 | K2R1 | K1R1 |
| K1R0 | K0R1 | K1R2 |
| K1R1 | K2R0 | K2R2 |
| K0R0 | K0R2 | K0R0 |
| K2R0 | K1R0 | K2R1 |
| K2R1 | K1R1 | K0R1 |
| K0R1 | K1R2 | K2R0 |

Figure 1. Layout of the field experiment

## 3. RESULT AND DISCUSSION

### 3.1 *Interaction Between Vermicompost and Russian Liquid Organic Fertilizer*

The results of the study showed that the interaction between vermicompost and Russian liquid organic fertilizer had a significant effect on the growth and yield of maize, with the best interaction observed at the treatment combination of 10 tons/ha of vermicompost and 10 ml/liter of water of Russian liquid organic fertilizer. The variables that exhibited the best interaction were cob weight per hectare (13.75 tons/ha), cob diameter (5.41 cm), cob length (19.97 cm), weight of 10 cobs (3.60 kg), weight of 1,000 grains (13.75 g), and number of kernel rows per cob (18.83 rows). These results indicate that the interaction between vermicompost and Russian liquid organic fertilizer was able to enhance the growth and yield of maize. According to (Muniappan & Muthukumar T., 2004), this phenomenon is influenced by soil environmental conditions. A growing environment rich in organic matter supports the development of soil biota, which consequently improves the physical, biological, and chemical properties of the soil and enhances nutrient availability.

The increase in maize yield, both in cobs and grains, was attributed to the compatibility between vermicompost and Russian liquid organic fertilizer treatments. Vermicompost, which is derived from pre-processed cow manure, acts as a biological buffer that improves soil physical, chemical, and biological properties, thereby providing a favorable environment for both plants and soil microorganisms. Organic fertilizers decompose more slowly into mineral ions; therefore, when only raw organic matter is applied, the addition of complementary organic fertilizers in liquid form is necessary. The absorption of nutrients through both roots and leaves was optimized in this study, as vermicompost was applied to the soil while the Russian liquid organic fertilizer was applied as a foliar spray. These findings are supported by the results of Ekadana (2019)), who also reported that a vermicompost dosage of 10 tons/ha yielded the best growth and production in peanut plants.

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According to Purwasasmita and Kurnia (2009), liquid organic fertilizer is a fermented solution produced from various organic waste materials such as banana stems, golden apple snails (*Pomacea canaliculata*), urine, vegetable residues, and fruit waste. Liquid organic fertilizers contain macro-nutrients (N, P, K, C, H, O, and S) and micro-nutrients (Ca, Mg, Mo, B, Mn, and Fe), as well as beneficial bacteria that function as organic matter decomposers, growth promoters, and biological control agents against pests and plant diseases. Research by Taffarel (2024) on mustard greens (*Brassica juncea*) demonstrated that the combination of 30 g of vermicompost per plant and 9 ml/L of Russian liquid organic fertilizer produced the best results for all observed parameters, including fresh weight per plant, plant height, number of leaves, fresh weight, and dry weight.

The combination of vermicompost and Russian liquid organic fertilizer also affected the chlorophyll content of maize leaves, with the best treatment observed at 10 tons/ha vermicompost combined with 10 ml/L of liquid fertilizer, yielding a chlorophyll value of 50.74 SPAD. According to Nio and Banyo (2011), chlorophyll is the main pigment responsible for absorbing solar energy. Chlorophyll formation is influenced by water availability and several essential elements such as nitrogen (N), magnesium (Mg), iron (Fe), and manganese (Mn). Additionally, light, even in small quantities, is required for chlorophyll synthesis. Nitrogen is one of the key components of chlorophyll; thus, nitrogen-rich fertilizers are crucial during the seedling phase. A high chlorophyll content, accompanied by greater relative water and nitrogen levels in leaves, enhances photosynthetic efficiency, which in turn promotes the formation of plant organs, as indicated by increased shoot number, plant height, stem diameter, leaf number, and leaf area.

### *3.2 Vermicompost (Kascing)*

The single factor treatment of vermicompost significantly affected the stem diameter variable, with the highest value observed at a dosage of 10 tons/ha, reaching 23.30 mm. Although not statistically significant, the 10 tons/ha vermicompost dosage also produced the highest values for the number of leaves (13.22 leaves), leaf width (6.22 cm), and plant height (212.89 cm). The increase in vermicompost dosage resulted in a positive response to maize growth, as the initial soil analysis indicated a low nutrient content. The application of vermicompost and Russian liquid organic fertilizer improved the nutrient content of the soil, thereby supporting better maize growth and maximizing yield potential.

Fertilization is one of the key components in improving soil fertility. Vermicompost is considered an enhanced organic fertilizer, as it contains both macro- and micronutrients as well as plant growth hormones readily available for plant absorption. According to Mulat (2003), vermicompost typically contains nitrogen (N) 0.63%, phosphorus (P) 0.35%, potassium (K) 0.2%, calcium (Ca) 0.23%, manganese (Mn) 0.003%, magnesium (Mg) 0.26%, copper (Cu) 17.58%, zinc (Zn) 0.007%, iron (Fe) 0.79%, molybdenum (Mo) 14.48%, organic matter 0.21%, cation exchange capacity (CEC) 35.80 me%, water-holding capacity 41.23%, and humic acid 13.88%. To sustain and enhance maize yield, nutrient supplementation through fertilization is essential. Farmers often use chemical fertilizers due to their easy accessibility and practical application; however, continuous use of chemical inputs can negatively affect human health and cause environmental pollution. Therefore, innovative alternatives that enhance soil fertility and promote healthy, high-quality agricultural production are needed. One such sustainable approach is the use of vermicompost (earthworm

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castings). The addition of vermicompost to soil can improve its physical properties (such as structure, permeability, and porosity), chemical properties (by enhancing the soil's capacity to retain macro- and micronutrients, and by increasing pH in acidic soils), and biological properties (by stimulating microbial activity and providing energy sources for nitrogen-fixing and phosphate-solubilizing bacteria) (Kartini, 2000).

The increase in maize grain yield observed in this study can be attributed to treatments that supported metabolic processes within the plants. One of the key metabolic activities involves the utilization of nutrients for growth and development. The formation and filling of maize kernels require sufficient nutrients absorbed by the plant roots. The findings of this study confirmed that the addition of nutrients through fertilization, applied both to the root zone and as foliar spray, enhanced plant growth and yield. The organic fertilizer used in this study originated from cow manure processed by earthworms, producing vermicompost or worm castings (Sembiring *et al*., 2014). Kari *et al*. (2000) further reported that the addition of organic matter can improve the efficiency of phosphorus (P) uptake, enhance soil aggregation, and increase soil friability, all of which favor the development of gynophores and reproductive organs. Moreover, liming can mitigate soil acidity and consequently improve crop productivity.

### 3.3 *Russian Liquid Organic Fertilizer*

The single application of Russian liquid organic fertilizer significantly affected stem diameter, with the highest value observed at a concentration of 10 ml/L, reaching 22.40 mm. Although not statistically significant, the same concentration produced the highest values for the number of leaves (13.22 leaves), leaf width (6.16 cm), and plant height (204.78 cm).

The use of liquid organic fertilizer improves soil fertility while supplying essential nutrients required by plants at all growth stages. It serves as an alternative to enhance nutrient availability, sufficiency, and uptake efficiency, while also improving the physical, chemical, and biological properties of the soil. According to Ambarwati, (2014) nitrogen (N) in liquid organic fertilizer is a critical nutrient for vegetative growth, including stems, leaves, and roots. Adequate nitrogen availability accelerates cell division. This is supported by (Hidayat & Putra, 2014) who reported that the application of various concentrations of liquid fertilizer significantly affected the number of leaves, plant height, and average stem diameter in cocoa plants.

Organic fertilizers are available in solid and liquid forms. Liquid organic fertilizer contains organic compounds, including proteins, amino acids, and other substances that stimulate growth and increase crop yield. Its main advantage is the rapid delivery of nutrients, particularly micronutrients, through foliar application. Nutrients are absorbed via stomata, which are abundant on the underside of leaves. Several studies have shown that liquid organic fertilizer positively affects growth and yield in crops such as chili pepper, including plant height, number of branches, flowering time, fruit number, fruit weight per plant, and total production (Widyawati, 2014).

Taffarel, (2024) reported that the best combination treatment of vermicompost and Russian liquid organic fertilizer for mustard greens (Brassica juncea) was 9 ml/L of liquid fertilizer, which increased plant weight by 182.1% compared to the control, reaching 52.33 g per plant. Nutrients in liquid organic fertilizer, such as nitrogen and iron, are essential for enzyme formation, hormones, and amino compounds that support plant growth. Since atmospheric nitrogen is unavailable to plants, microorganisms such as

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Azotobacter sp. are required to fix nitrogen into a plant-available form. Azotobacter sp. can also produce growth-promoting hormones that stimulate faster and more vigorous plant development (Padnamabha, 2014).

## 4. CONCLUSIONS

Based on the results and discussion, the following conclusions can be drawn:

1. The interaction between vermicompost and Russian liquid organic fertilizer significantly affected corn yields, with the highest yield reaching 13.75 tons/ha.
2. The best vegetative growth and corn yield were observed at a vermicompost dose of 10 tons/ha, resulting in a stem diameter of 23.30 mm, a plant height of 212.89 cm, a leaf number of 13.22, and a leaf width of 6.22 cm. Although these values were higher than the other treatments, the difference was not statistically significant based on a 5% LSD test.
3. The application of Russian liquid organic fertilizer at a concentration of 10 ml/L resulted in the best vegetative growth and yield, with a stem diameter of 22.40 mm, a plant height of 204.78 cm, a leaf number of 13.22, and a leaf width of 6.16 cm. Similarly, this difference was not statistically significant based on a 5% LSD test.

These findings indicate that the combined use of vermicompost and Russian liquid organic fertilizer can effectively enhance corn growth and yield, providing a sustainable approach to increasing corn productivity. These results also demonstrate that optimizing the dosage of each fertilizer is crucial for maximizing crop performance while maintaining soil fertility and plant health.

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