IOP Conference Series:
Earth and
Environmental Science

PAPER • **OPEN ACCESS**

Response of some varieties of corn (*Zea mays* L.) toward applying granular bio-fertilizer on dry land

To cite this article: Ali Ikhwan *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1417** 012001

Response of some varieties of corn (*Zea mays* L.) toward applying granular bio-fertilizer on dry land

Ali Ikhwan, Erny Ishartati, Ferdian Enggar Pamungkas, and Muhammad Rafi Raidiansyah

Agrotechnology, Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang

*Email: aliikhwan64@gmail.com

Abstract. Increasing the yield of corn production on dry land can be done by applying granular biological fertilizers. Rhizobacterial biological fertilizer (Biofertilizer) is a fertilizer that contains microorganisms whose presence can be either singly or in the form of a combination of several types, called a consortium. This research aims to obtain a combination of treatments between varieties and doses of granular biofertilizer. The research was designed using a split plot design with HSD 5%. The main plot uses 4 varieties: *Bisi* 99, *Bisi* 18, *Pertiwi* 6, and *Pertiwi* 3, while the subplots use 3 doses of granular biofertilizer: 50/100/150 g per plant. The research results show a real effect on growth and yield parameters, including plant height, number of leaves, stem diameter, cob location, cob weight, cob length, cob weight without Cornhusk, cob length without Cornhusk, cob diameter, dry weight, 100-grain weight and several corn varieties. In the combination treatment of the *Bisi* 99 variety with 50g granule fertilizer treatment per plant, the best results reached 242.27g per cob (15.98 tons/ha).

Keywords: Biofertilizer, Corn, Dry Land, Granule, Rhizobacteria

1. Introduction

Developing the food crop sector is one of the main strategies as well as encouraging future economic growth. Apart from being a large source of foreign exchange, it is also a source of life for people in Indonesia [1]. Corn is a grain that has strategic and economic value and has growth opportunities because of its position as the main source of carbohydrates and protein after rice and also as a source of feed. Efforts to increase corn production still face various problems so that national corn production cannot meet national needs [2].

The potential for corn productivity in Indonesia could reach 7.0-7.5 tons/ha, but it is still far from expectations, because only 3.3 tons/ha of corn was produced in 2010. The biggest obstacle to corn production is land conversion to non-agricultural use. Malang Regency is one of the districts in East Java Province. According to the Food, Horticulture and Plantation Service, most of the Malang Regency area is agricultural land, and the land area consists of 1.31 percent rice fields (5,888 ha); land/fields/gardens 37.82 percent (121,286 ha); plantation area 7.53 percent (2.12 ha); and forests around 11.30 percent (36,230 ha) [3].

Dry land in the Malang area is recorded as having an area of 10,639 ha and is currently being developed as a center for food crops, especially corn. Even though the dry land is large, corn cultivation in Malang does not provide high yields [4]. Drylands are characterized by low organic matter and total N content [5]. This nitrogen limitation significantly inhibits the growth and grain yield of the maize plant [6]. Even though the dry land is large, corn cultivation in Malang does not provide high yields [4]. One factor that increases production is the use of mineral fertilizers. Continuous use of inorganic fertilizers can damage the soil, deplete nutrients, accumulate chemical residues, and destroy microorganisms in the soil. Therefore, the solution is to use organic fertilizer.

Rhizobacteria biofertilizer (organic fertilizer) is a fertilizer that contains microorganisms either individually or in a combination of several species called consortia. The ability of these microorganisms can stimulate plant growth, fix nitrogen, dissolve phosphate and prevent the growth of plant diseases. Microorganisms such as *Azotobacter* sp, *Hospitalize* sp and *Bacillus* sp produce many plant-stimulating compounds such as auxin and gibberellin. The use of organic materials and biological fertilizers is a solution to overcome low soil fertility and disease attacks on plants [7]. It has also been reported that the use of single or combined bacterial isolates such as Rhizobium leguminosarum, Rhizobium sp2, Bacillus sp, and Burkholderia sp significantly increases soil fertility and crop yields [8]. The characterization of rhizobacteria secondary metabolism has three potential function compounds consisting of osmoprotectant, phytohormone, and organopesticide [9].

2. Materials and Methods

2.1. Study Location and Timing
The research was conducted at the Integrated Laboratory of the Faculty of Agriculture and Animal Husbandry, the University of Muhammadiyah Malang and Tawang Renjeni Village, Turen Subdistrict, Malang Regency, East Java. from 12 September 2022 till 7 January 2020.

2.2. Initial Soil Analysis

The initial soil analysis was carried out by sending the soil sample to *Balai Pengkajian Teknologi Pertanian Jawa Timur* in which stated that the water content is 7.35 %, pH H_2O 6.8 , pH KCL 5.5 , C-Organic 1.20 %, Nitrogen 0.19 %, Available P_2O_5 126 ppm, exchangeable cations K 0,81 cmol(+) Kg^{-1}, Ca 14.48 cmol(+) Kg^{-1}, Mg 2.41 cmol(+) Kg^{-1}, cation exchange capacity (CEC) 15.71 cmol(+) Kg^{-1}.

2.3. Materials

The materials used in this research were isolates containing bacteria (*Raoultella terrigena, Serratia marcescens, Serratia nematodiphila, Enterobacter hormaechei, Enterobacter cancerogenous, Enterobacter cloaceae, Citrobacter murliane, Psedomonas fluorences*) which were collected from Tawang Renjeni Village, 4 varieties of corn plants consisting of the *Bisi* 18 variety, the *Bisi* 99 variety, *Pertiwi* 6 varieties, *Pertiwi* 3 varieties. The reason for using these varieties was because these are the frequent varieties used by the farmer. The 1000-grain weight of each varieties is 303 gr for *Bisi* 18, *Bisi* 99 356 gr, *Pertiwi* 6 332 gr, and *Pertiwi* 3 298.83 gr.

2.4. Research Design

The experimental design used was a split plot experimental design (Split Plot Design) consisting of a main plot and subplots. The main plot as first factor is the plant variety which consists of 4 levels, namely the *Bisi* 18 variety (V1), the *Bisi* 99 variety (V2), the *Pertiwi* 6 variety (V3), the *Pertiwi* 3 variety (V4). And second factor fertilizer dose consisting of no treatment dose (P0) dose of liquid biological fertilizer 50 g/plant (P1) dose of granular biofertilizer 100 g/plant (P2) dose of granular biofertilizer 150 g/plant (P3), Design in repeated 3 times with a population of 18 plants per treatment and 5 observation samples taken randomly.

2.5. Methods

2.5.1. Making Granular *Biological Fertilizer.* Making granule fertilizer by taking samples of bacteria from the root area of the corn soil, then carrying out the dilution and purification stages to obtain 10 bacterial candidates, namely Raoultella terrigena, Serratia marcescens, Serratia nematodiphila, Enterobacter hormaechei, Enterobacter hormaeghel, Enterobacter cancerogenous, Enterobacter cloaceae, Citrobacter murliane, Psedomonas fluorences. Bacterial multiplication from pure bacterial culture is carried out using a fermenter with a capacity of 500 liters, in one application the bacterial multiplication uses a volume of 200 liters of sterile water by adding 400g/200L of red growmore fertilizer, 400g/200L of green growmore, 20L/200L of sugarcane molasses. and added 10 bacterial samples that had been made starter using 200 ml of NB+NaCl media. When all the media has been put into the fermenter, the UV lamp in the fermenter tube is turned on for the sterilization process to minimize contaminants, then stirring is carried out to function as air circulation and mixing of the media so that it is evenly distributed. Stirring is done by opening the stirrer tap and then turning on the stirrer pump. Stirring is carried out during fermentation with a pump machine which lasts for 72 hours with a timer socket set for 2 hours for the pump machine to be on and 1 hour for the pump machine to be off. After the fermentation process is complete, the bacteria are harvested using a harvest pump and then placed into a 30 liter drier. The bacteria used are at a density of $1x10^9$ cfu/ml.

The granuleation process uses a granuleation tool with a diameter of 2.5 m, then the composition used in the granuleation process is with a granuleation machine capacity of 20 kg, consisting of 10 kg of charcoal and 10 kg of manure. granuleation process by inserting bacteria with a density of 1x109 in a sprayer. Insert the solid material into the granule machine then spray the bacteria slowly so that the raw material turns into granules, for the perfect shape to become granules it takes 10 minutes with the characteristics of the granules being perfectly round and the density of the granules being quite hard. After that, dry them without drying them in the hot sun using dry drying.

2.5.2. Land Preparation. Soil processing is carried out using a tractor by removing the soil with the aim of reversing the soil structure and reducing the growth of weeds. Then make beds with a width of 1 meter and a length of 3 meters and a distance between beds of 40 cm and a distance between treatments of 1 meter, then make water channel irrigation. Plotting plants in each bed at 20 cm x 70 cm using raffia rope attached to bamboo.

2.5.3. Planting. Analysis of a 1 Ha land area with a land efficiency of 95% so that the productive land area is 6,000 m2 with a planting distance of 20 cm x 70 cm. Planting distance is an important factor that plays a role in determining the level of competition between plants. 42.000 seeds are needed using 2 planting holes. Seed planting is done using a planter machine, planting corn seeds is done 2 seeds per planting hole. After the seeds enter the planting hole, close it with a hole.

2.5.4. Plant Maintenance. Chemical fertilization is applied when the plants are 21 HST (Day after Planting) and when the plants enter the generative phase at 50 HST (Day After Planting). Granular and liquid biological fertilization is applied a week after the application of chemical fertilizer, namely at 28 HST (Day After Planting) and 57 HST (Day After Planting). The application of liquid and granular biological fertilizer is by pouring then sowing it in the hole with different doses, namely without treatment, 50 g granular biological fertilizer, 100 g granular biological fertilizer, 150 g granular biological fertilizer. Fertilization aims to add nutrients to the soil [10].

Irrigation is carried out after chemical fertilization because it accelerates the dissolution of nutrients for absorption by plants. Irrigation is done by opening the water irrigation gate and then the water is channeled into the land so that all the lava is irrigated. Weeding by hoeing the surface of the soil where weeds or wild plants grow. Weeding aims to obtain quality and quantity of production. Weeding is adjusted to the growth of weeds around the plant by pulling them out by hand [11].

2.5.5. Harvesting. Corn harvesting is carried out on corn plants that are 110 days after transplanting. Corn harvesting is carried out when 90% of the plants show the characteristics of the female flowers having dried, the corn husks are dry, the corn kernels are shiny, dry hard so that they do not make an impression when pressed with a fingernail. The harvesting method is to harvest 5 samples of corn along with the corn husks, after which the harvest is collected into plastic containers that have been labeled per plot.

2.6. Data Analysis
Data analysis was carried out using analysis of variance to determine the variation between treatments. If it is real, it will be further tested using the Honestly Significant Difference (HSD) with a level of 5% to compare the effect between treatments.

3. Results and Discussion
Based on **Figure 1**, Average plant height at the end of observation, treatment V2P2 (*Bisi* 99 + 100g) showed the highest plant height and treatment V1P0 (Control) was the lowest. This research aims to determine the effect of applying granular biological fertilizer at different doses to four varieties of corn plants planted on dry land, namely the *Bisi* 18 (V1), *Bisi* 99 (V2), *Pertiwi* 6 (V3) and *Pertiwi* 3 (V4) varieties. The results of observations of plant height showed that the results had a real influence at the age of 14 DAP, whereas at the age of 21, 28, 35, 42, 49 DAP the effect was very significant, which is presented in **Figure 1**. Plant height at the age of 14 DAT was obtained by the highest average value, namely in the treatment variety *Pertiwi* 3 + 150 g (V4P3) 25.40 cm when compared to the lowest average, namely in the *Bisi* 18 + control (V1P1) treatment, namely 19.00 cm. The effect of giving this treatment at the age of 14 DAT showed that the results were not yet stable between treatments, allegedly because the absorption of nutrients by the plants was not yet optimal.

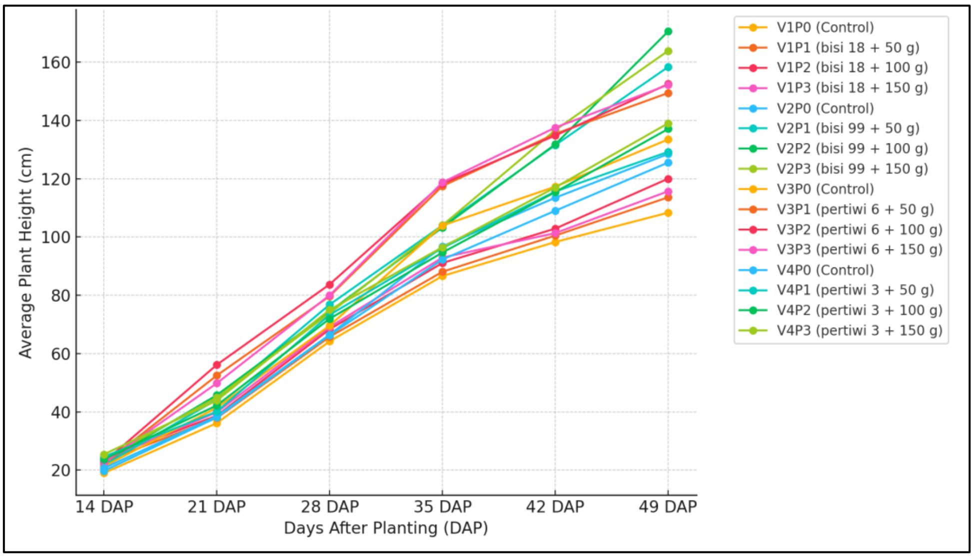

Figure 1. Average plant height over time.

Plant height at the age of 21 DAP to 49 DAP showed very real interaction results (**Figure 1**). The difference in average plant height results each week tended to be stable, where the highest average was in the V3P2 treatment (*Pertiwi* 6 + 100g dose of granular fertilizer /plant) at the age of 21, 28 and 35 DAT, while at the age of 42 DAP and 49 DAP the plant height with the highest average value was the V3P3 and V2P2 treatments. The average plant height with a stable height is in the treatment with a dose of granular fertilizer of 100g/plant for all varieties used. This is thought to be the right and appropriate dose according to the plant's needs, namely that dose, while a dose of 50g/plant is less effective if given because it shows the average results and notations that are significantly different from a dose of 100g/plant. Apart from that, the dose of 150g/plant showed results that tended not to be significantly different from the dose of 100g/plant (**Figure 1**). This indicates that the effect of the dose of 150g/plant did not really affect the results. So, from these results the dose of 100g/plant is very effective and has a good effect on plant height.

Providing biological fertilizer containing the N element needed by plants can make plant roots and stems develop well in absorbing more nutrients, so that they can encourage and accelerate plant height growth [12]. The biofertilizer used contains one of the rhizospheric bacteria which is thought to act as a P phosphate solvent, namely *Serratia nematodiphila*, where corn plants will use the P nutrient for their growth. According to Ulfah [13], it shows that plant height growth is influenced by the *Serratia nematodiphila* bacteria which acts as a phosphate solvent. The initial soil analysis showed the following result: water content is 7.38 %, pH H_2O 6.9, pH KCL 5.8, C-Organic 2.48 %, Nitrogen 0.35 %, Available P_2O_5 46 ppm, exchangeable cations K 1.4 cmol(+) Kg^{-1}, Ca 10.60 cmol(+) Kg^{-1}, Mg 2.40 cmol(+) Kg^{-1}, cation exchange capacity (CEC) 23.71 cmol(+) Kg^{-1}.

Based on **Figure 2**, the number of plant leaves at the end of the observation of the V4P2 (*Pertiwi* 6 + 50g) and V3P1 (*Pertiwi* 6 + 50 g) treatments showed a relatively high number of leaves although it was not significantly different from the V1P2 (*Bisi* 18 + 100 g), V1P3 (*Bisi* 18 + 150 g), V2P2 (*Bisi* 99 + 100 g) and V3P2 (*Pertiwi* 6 + 100 g) treatments. Based on **Figure 3**, the average plant height at the end of the observation, treatments V3P2 (*Pertiwi* 6 + 100g) and V3P3 (*Pertiwi* 6 + 150g) showed the highest plant diameter.

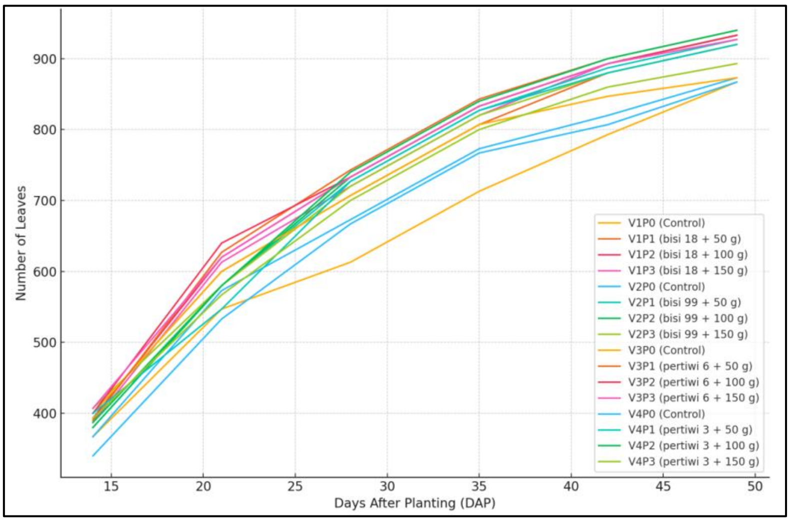

Figure 2. Average number of corn leaves at age 14 to 49 DAP.

The leaf number parameter at 14 DAP showed that the results had a significant effect between corn plant varieties with different doses. The response to the number of leaves of corn plants with the highest mean value was in the *Pertiwi* 6 + 150g (V3P3) variety treatment, while the lowest value was in the *Pertiwi* 3 + control variety treatment (V4P0). At the ages of 21, 28, 35, 42 and 49 DAP, the results showed a very significant effect between the treatments presented in **Figure 2**. The dose of 100g/plant and the dose of 150g/plant were able to increase the mean higher when compared to the mean of the dose of 50g/plant and the control. The absorption of nutrients by plants has an impact on the number of leaves if seen from the results of the analysis of variance calculation. Apart from that, the doses of 100g/plant and 150g/plant also influenced the stem diameter of corn plants, where the control and 50g/plant doses were not significantly different from the 100g/plant dose but were significantly different from 150g/plant.

The stem diameter between plant varieties is not significantly different, this can be seen in the average results presented in **Figure 3.** Providing bacteria in granular fertilizer is able to increase the growth of corn plants, bacteria are able to increase the growth of corn plant roots and have an effect on maximum nutrient absorption of corn plants. This was also explained by Wong-Villarreal [14] that *Pseudomonas aeruginosa* plays a role in stimulating the growth of corn plants and functions as a biofertilizer in soil contaminated with chemicals.

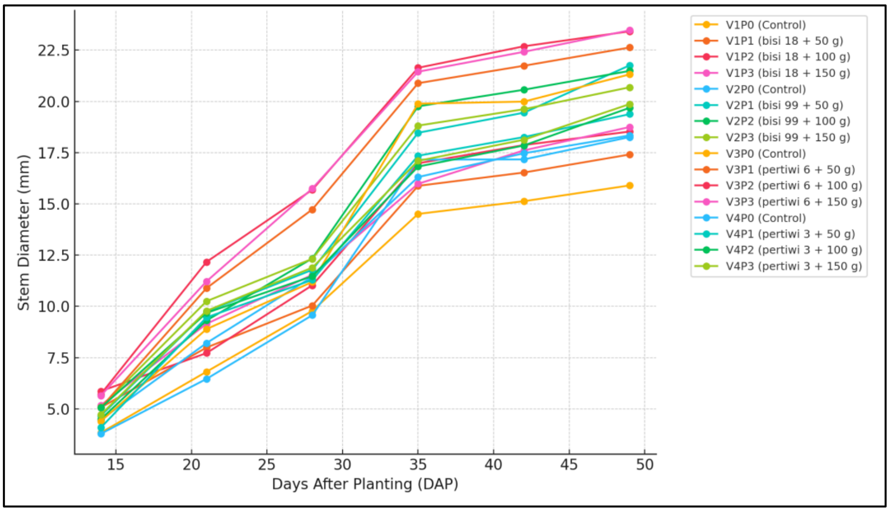

Figure 3. Average corn stem diameter over time for different treatments.

The use of granular biological fertilizer can increase growth and bind potassium nutrients in the soil, resulting in accelerated growth, especially in stem diameter, this is in line with research of Sukmadewi [15] that these bacteria are able to dissolve the nutrient potassium (K) which can bind the nutrient potassium (K) in the soil. In corn plants, K nutrient is needed for plant growth in increasing the formation of plant height and plant stem diameter.

Based on **Table 1**, the average age of male flowering at the end of the observation showed that the *Pertiwi* 3 variety had a relatively high age for male flowering, although it was not significantly different from the *Bisi* 18 and *Bisi* 99 varieties. Meanwhile, the mean value of the control treatment showed a relatively high age for male flowering, although it was not significantly different from the 50g granular fertilizer treatment.

The role of bacteria also influences the generative phase of corn plants, starting from the appearance of flowers, where the granule dose of 150g/plant has a mean value that is not significantly different from the doses of 50g/plant and 100g/plant and is significantly different from the control. This means that administering granular biofertilizer doses at different doses did not show very significant results in the variable observing the appearance of male flowers on corn plants. Apart from that, female flowers appeared, there was no real influence between treatments as seen from **Table 1**.

Based on **Table 1**, the average age of female flowers appearing at the end of the observation, the *Bisi* 18 variety treatment showed the highest number of female flowers appearing, although it was not significantly different from *Pertiwi* 3. Meanwhile, the average value of the control treatment and 100g granular fertilizer showed the number of female flowers appearing relatively high, although it was not significantly different from the 50 g granular fertilizer treatment.

Table 1. Average days of male and female flower emergence.

Treatments	Days of emergence (DAP)	
Varieties	**Male Flowers**	**Female Flowers**
Bisi 18 (V1)	44.08 ± 0.66 ab	46.95 ± 0.59 b
Bisi 99 (V2)	43.77 ± 0.19 ab	45.73 ± 0.66 a
Pertiwi 6 (V3)	43.70 ± 0.91 a	46.52 ± 0.34 b
Pertiwi 3 (V4)	44.20 ± 0.75 b	47.63 ± 0.25 c
HSD 5%	**0.41**	**0.29**
Fertilizer Types		
Control (P0)	44.35 ± 0.49 b	47.23 ± 0.57 b
Granule 50 g (P1)	44.00 ± 0.33 ab	46.73 ± 0.38 ab
Granule 100 g (P2)	43.67 ± 1.04 a	46.52 ± 1.41 b
Granule 150 g (P3)	43.73 ± 0.25 a	46.35 ± 0.16 a
HSD 5%	**0.45**	**0.69**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

Table 2 showed that corn varieties and types of fertilization significantly affected the height of the cob at 56 DAP. The *Bisi* 18 variety (V1) had the highest cob height of 58.50 cm, while *Bisi* 99 (V2) had the lowest height of 0.00 cm. The *Pertiwi* 6 (V3) and *Pertiwi* 3 (V4) varieties each had a height of 1.33 cm and 22.87 cm, respectively. In the fertilization treatment, granule 100 g (P2) produced the highest cob height of 30.10 cm, followed by granule 50 g (P1) with 23.48 cm, while the control (P0) and granule 150 g (P3) each produced 17.27 cm and 11.85 cm.

Table 2. Average value of cob location at age 56 DAP.

Treatments	Cob location
Varieties	
Bisi 18 (V1)	58.50 ± 8.97 c
Bisi 99 (V2)	0.00 ± 2.43 a
Pertiwi 6 (V3)	1.33 ± 2.60 a
Pertiwi 3 (V4)	22.87 ± 1.06 b
HSD 5%	**8.99**
Fertilizer Types	
Control (P0)	17.27 ± 1.07 a
Granule 50 g (P1)	23.48 ± 0.00 ab
Granule 100 g (P2)	30.10 ± 3.77 b
Granule 150 g (P3)	11.85 ± 6.38 a
HSD 5%	**14.05**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

Based on the **Figure 4**, the treatment with the highest cob position was V2P1 which reached 120.00 cm at 98 HST and 123.00 cm at 105 HST, indicating optimal growth. In contrast, the treatment with the lowest cob position was V1P0, which only reached 87.93 cm at 98 HST and 91.80 cm at 105 HST, reflecting the lowest results among the other treatments. This shows that the V2 variety given P1 fertilization gave the highest results, while the V1 variety without fertilization (control) showed the lowest growth.

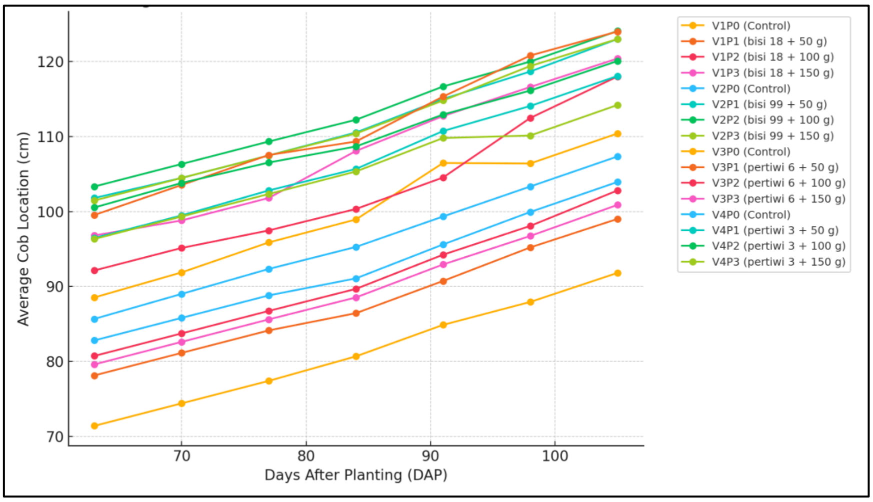

Figure 4. Average cob location over time for different treatments.

Based on **Table 3**, the highest average weight of loose cobs was achieved with the treatment V2P1 (*Bisi* 99 + Granule fertilizer 50 g), producing 270.53 g, indicating the effectiveness of this combination. Other treatments, such as V2P2 (*Bisi* 99 + Granule fertilizer 100 g) and V2P3 (*Bisi* 99 + Granule fertilizer 150 g), also resulted in high yields, but with minimal differences, suggesting that increasing fertilizer beyond 50 g offers diminishing returns. In contrast, the lowest weight was found in the V1P0 treatment (*Bisi* 18 + No treatment) with only 155.85 g, showing the critical role of fertilizer in improving yield. Among the control treatments (no fertilizer), V2P0 (*Bisi* 99) had a higher yield (183.80 g) compared to V1P0 (*Bisi* 18) and V3P0 (*Pertiwi* 6), suggesting that even without fertilization, *Bisi* 99 and *Pertiwi* 6 varieties perform better than *Bisi* 18.

Table 3. Average weight and length value of loose cobs.

Treatments	**Loose Cobs**	
	Weight (g)	**Length (cm)**
V1P0 (*Bisi* 18 + No treatment)	155.85 ± 4.08 a	20.63 ± 0.21 a
V1P1 (*Bisi* 18 + Granule fertilizer 50 g)	180.87 ± 4.26 b	21.27 ± 0.17 b
V1P2 (*Bisi* 18 + Granule fertilizer 100 g)	208.32 ± 0.88 cde	21.97 ± 0.74 c
V1P3 (*Bisi* 18 + Granule fertilizer 150 g)	200.93 ± 0.34 c	22.13 ± 0.58 cd
V2P0 (*Bisi* 99 + No treatment)	183.80 ± 10.61 b	22.65 ± 0.35 de
V2P1 (*Bisi* 99 + Granule fertilizer 50 g)	270.53 ± 0.75 i	26.07 ± 0.10 gh
V2P2 (*Bisi* 99 + Granule fertilizer 100 g)	263.20 ± 4.57 hi	27.09 ± 0.32 j
V2P3 (*Bisi* 99 + Granule fertilizer 150 g)	263.00 ± 10.87 hi	27.02 ± 0.37 ij
V3P0 (*Pertiwi* 6 + No treatment l)	204.73 ± 19.85 cd	25.63 ± 0.12 g
V3P1 (*Pertiwi* 6 + Granule fertilizer 50 g)	220.82 ± 5.27 fg	25.93 ± 0.09 g
V3P2 (*Pertiwi* 6 + Granule fertilizer 100 g)	229.32 ± 0.37 g	26.51 ± 0.12 hi
V3P3 (*Pertiwi* 6 + Granule fertilizer 150 g)	207.07 ± 1.09 cd	26.93 ± 0.41 ij
V4P0 (*Pertiwi* 3 + No treatment)	185.33 ± 1.37 b	21.83 ± 0.45 c
V4P1 (*Pertiwi* 3 + Granule fertilizer 50 g)	254.02 ± 7.12 h	24.23 ± 0.39 f
V4P2 (*Pertiwi* 3 + Granule fertilizer 100 g)	217.60 ± 5.00 ef	23.77 ± 0.40 f
V4P3 (*Pertiwi* 3 + Granule fertilizer 150 g)	213.37 ± 1.95 def	23.10 ± 0.08 e
HSD 5%	**10.17**	**0.52**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

The variable observing the weight of the cob cobs showed that the results had a significant effect between treatments, where the highest average cob weight value was for the *Bisi* 99 variety and the granular biofertilizer dose was 50 g/plant. This is also in line with the results of cob weight without Cornhusks, where the highest average was when using a granular biofertilizer dose of 50 g/plant in the *Bisi* 99 variety. The effect of cob weight was also influenced by the variety used, because plant varieties had different weights. The length of cobs, both with Cornhusks and without Cornhusks, also showed the highest average results, namely at doses of 100g/plant and 50g/plant. According to Mehta [16], corn weight increased with seed treatment by *Pseudomonas fluences* bacteria, giving *Pseudomonas* can also increase fruit length, root weight, root length.

Providing the *Serratia marcescens* consortium bacteria in biological fertilizer can provide nutrients for plants such as nitrogen and increase the availability of phosphate and potassium. Potassium produced by *Serratia marcescens* is needed by plants to increase plant yields such as weight with Cornhusks and weight without cornhusks [17]. The dry weight of corn cobs showed significantly different results between plants, where the highest average dose was 50g/plant in the *Bisi* 99 variety. According to Ahmed [18] stated that *Enterobacter cloceae* bacteria influence the dry weight of corn. The increase in dry weight is thought to be due to Zn used in fertilizer and inoculum applications. *Enterobacter cloaceae* bacteria can dissolve Zn compounds with various nutrients. Based on **Table 3**, the treatment with the highest cob length was V2P2 (*Bisi* 99 + Granule fertilizer 100 g) with a length of 27.09 cm, followed by V2P3 (*Bisi* 99 + Granule fertilizer 150 g) which had a length of 27.02 cm. On the other hand, the treatment with the lowest cob length was V1P0 (*Bisi* 18 + no treatment) with a length of 20.63 cm.

Based on **Table 4**, the highest results were obtained from the V2P1 (*Bisi* 99 + Granule fertilizer 50 g) which is 242.27g, while the lowest results is V1P0 (*Bisi* 18 + No treatment). The provision of granular fertilizer has a positive impact on the length of corn cobs without husks in various varieties (**Table 4**). The *Bisi* 99 variety showed the best response, where treatment with 50 g granular fertilizer (V2P1) produced the highest cob length (18.47 cm), while treatment without fertilizer in the *Bisi* 18 variety (V1P0) produced the lowest length (12.18 cm). Increasing the dose of fertilizer generally increased the length of the cob in all varieties, although there was a slight difference between them. The *Pertiwi* 6 and *Pertiwi* 3 varieties also showed an increase in length with the provision of fertilizer, but not as high as *Bisi* 99. Overall, the application of granular fertilizer proved effective in increasing the length of corn cobs.

Based on **Table 5**, the highest results were obtained from the V4P3 (*Pertiwi* 3 + 150 g granular fertilizer) treatment 52.09 mm, while the lowest results were obtained from V1P0 (*Bisi* 18 + without treatment) 44.12 mm. The application of granular fertilizer consistently increased the cob diameter in all varieties. The *Bisi* 99 variety with 50 g fertilizer also showed a significant increase with a diameter reaching 50.28 mm.

Based on **Table 5**, *t*he highest number of rows is observed in the V2P2 treatment (*Bisi* 99 with 100 g of granule fertilizer), which resulted in an average of 14.80 rows, indicating the most favorable growth conditions. In contrast, the lowest value is recorded in the V3P0 treatment (*Pertiwi* 6 without any fertilizer), with an average of 12.93 rows. These results suggest that the application of granule fertilizer significantly improves the number of rows on corn cobs, with *Bisi* 99 variety showing the best response to the treatment. Based on **Table 5**, the highest percentage is observed in treatment V4P3 (*Pertiwi* 3 with 150 g of granule fertilizer), reaching 98.07%. This suggests that higher fertilizer doses improve cob filling. The lowest value is found in treatment V4P0 (*Pertiwi* 3 without fertilizer), with 89.33%, indicating the significant role of fertilizer in enhancing cob filling.

Based on the results of the analysis, observations of the number of lines and filling tips can provide real influence results. When observing the number of rows, the results were obtained for the treatment that had the highest mean, namely *Pertiwi* 3 + 100g (V4P2) and the lowest mean value was for the *Pertiwi* 6 + control variety treatment (V3P0). Meanwhile, tip filling observations can produce results for varieties with the highest average in the *Pertiwi* 3+150g (V4P3) treatment. Incomplete cob formation results in less full seeds which will affect corn production, which is thought to be caused by a lack of essential nutrients in corn plants. According to Annisa [20], there are other factors that will influence corn production results, namely caused by weeds around the plantation which can cause differences in the number of rows of seeds per cob.

Table 4. Average weight and length value of cobs without husks.

Treatments	**Cobs without husks**	
	Weight (g)	**Length (cm)**
V1P0 (*Bisi* 18 + No treatment)	136.87 ± 0.66 a	12.18 ± 0.34 a
V1P1 (*Bisi* 18 + Granule fertilizer 50 g)	168.73 ± 4.51 c	13.56 ± 0.01 c
V1P2 (*Bisi* 18 + Granule fertilizer 100 g)	180.20 ± 1.07 cd	14.24 ± 0.30 d
V1P3 (*Bisi* 18 + Granule fertilizer 150 g)	176.53 ± 0.41 c	14.78 ± 0.23 ef
V2P0 (*Bisi* 99 + No treatment)	154.73 ± 18.82 b	15.06 ± 0.96 fg
V2P1 (*Bisi* 99 + Granule fertilizer 50 g)	242.27 ± 4.01 g	18.47 ± 0.01 j
V2P2 (*Bisi* 99 + Granule fertilizer 100 g)	239.00 ± 1.07 g	17.99 ± 0.21 j
V2P3 (*Bisi* 99 + Granule fertilizer 150 g)	236.80 ± 0.59 g	18.37 ± 0.01 j
V3P0 (*Pertiwi* 6 + No treatment l)	140.87 ± 11.09 a	12.90 ± 0.67 b
V3P1 (*Pertiwi* 6 + Granule fertilizer 50 g)	195.07 ± 3.85 ef	15.64 ± 0.09 h
V3P2 (*Pertiwi* 6 + Granule fertilizer 100 g)	198.27 ± 3.16 ef	16.44 ± 0.03 i
V3P3 (*Pertiwi* 6 + Granule fertilizer 150 g)	188.20 ± 0.43 de	15.33 ± 0.09 gh
V4P0 (*Pertiwi* 3 + No treatment)	169.40 ± 20.99 c	13.59 ± 1.07 c
V4P1 (*Pertiwi* 3 + Granule fertilizer 50 g)	205.80 ± 6.45 f	14.33 ± 0.25 de
V4P2 (*Pertiwi* 3 + Granule fertilizer 100 g)	199.60 ± 9.26 ef	14.19 ± 0.16 d
V4P3 (*Pertiwi* 3 + Granule fertilizer 150 g)	178.40 ± 0.85 cd	13.27 ± 0.18 bc
HSD 5%	**11.52**	**0.50**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

Based on **Table 6**, the highest value of dry weight is recorded for treatment V2P1 (*Bisi* 99 with 50 g of granule fertilizer), with an average dry weight of 235.60 g. This shows the efficacy of moderate fertilizer application in promoting dry weight gain. The lowest dry weight is noted in treatment V1P0 (*Bisi* 18 without fertilizer), at 139.0 g. Based on **Table 6**, the highest value of 100 grain weight is seen in treatment V4P1 (*Pertiwi* 3 with 50 g of granule fertilizer), at 50.02 g, suggesting that lower fertilizer levels may optimize grain weight in certain varieties. The lowest value is observed in V2P0 (*Bisi* 99 without treatment), at 34.26 g, showing the detrimental effect of no fertilizer on grain weight. Treatments with some level of fertilizer consistently yield heavier grains.

The 100 grains observation variable showed significantly different results between treatments. In the Bisi 18 variety, there were no significant differences between doses, the mean values between treatments and analysis of variance between treatments were not significantly different. The Bisi 99 variety showed significantly different results between the doses given, where a dose of 50g/plant and 100g/plant showed results that were not significantly different but not significantly different with a dose of 150g/plant. The Pertiwi 6 variety from the results of variance analysis calculations shows that there are no real differences between treatments (**Table 9**). where the mean values are different, and the analysis of variance is the same. The Pertiwi 3 variety showed mean results that were not significantly different between treatments. Seed weight depends on several factors, namely the number of endosperm cells and starch granules which are determined in the seed formation phase during the first two weeks after pollination and this also depends on the genetics carried by a variety [19].

Table 5. Average value of cob diameter, number of rows, and cob filling.

Treatments	Cob diameter (mm)	Number of rows	Cob filling (%)
V1P0 (*Bisi* 18 + No treatment)	44.12 ± 0.30 a	13.73 ± 0.09 b	95.37 ± 0.26 c
V1P1 (*Bisi* 18 + Granule fertilizer 50 g)	46.25 ± 0.11 b	14.67 ± 0.09 efg	97.07 ± 0.62 def
V1P2 (*Bisi* 18 + Granule fertilizer 100 g)	47.29 ± 0.37 c	14.53 ± 0.19 def	97.33 ± 0.09 efgh
V1P3 (*Bisi* 18 + Granule fertilizer 150 g)	47.31 ± 0.23 c	14.60 ± 0.16 efg	97.67 ± 0.09 fgh
V2P0 (*Bisi* 99 + No treatment)	44.32 ± 0.92 a	14.07 ± 0.09 c	92.40 ± 1.02 b
V2P1 (*Bisi* 99 + Granule fertilizer 50 g)	50.28 ± 0.08 f	14.40 ± 0.16 de	96.87 ± 0.52 def
V2P2 (*Bisi* 99 + Granule fertilizer 100 g)	49.68 ± 0.02 ef	14.80 ± 0.00 fg	96.73 ± 0.90 de
V2P3 (*Bisi* 99 + Granule fertilizer 150 g)	49.31 ± 0.05 de	14.53 ± 0.19 def	97.87 ± 0.19 gh
V3P0 (*Pertiwi* 6 + No treatment l)	45.62 ± 0.56 b	12.93 ± 0.68 a	89.47 ± 0.52 a
V3P1 (*Pertiwi* 6 + Granule fertilizer 50 g)	48.79 ± 0.16 d	14.47 ± 0.34 de	97.47 ± 0.25 efgh
V3P2 (*Pertiwi* 6 + Granule fertilizer 100 g)	48.80 ± 0.03 d	14.47 ± 0.25 de	96.47 ± 1.18 d
V3P3 (*Pertiwi* 6 + Granule fertilizer 150 g)	49.03 ± 0.03 de	14.07 ± 0.09 c	97.07 ± 0.38 efg
V4P0 (*Pertiwi* 3 + No treatment)	51.87 ± 1.23 g	14.53 ± 0.19 def	89.33 ± 1.00 a
V4P1 (*Pertiwi* 3 + Granule fertilizer 50 g)	54.47 ± 0.16 i	14.27 ± 0.25 cd	97.67 ± 0.19 fgh
V4P2 (*Pertiwi* 3 + Granule fertilizer 100 g)	52.98 ± 0.11 h	14.87 ± 0.09 g	97.87 ± 0.09 gh
V4P3 (*Pertiwi* 3 + Granule fertilizer 150 g)	52.09 ± 0.48 g	14.27 ± 0.25 cd	98.07 ± 0.25 h
HSD 5%	**0.70**	**0.32**	**0.85**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

Table 6. Average value of corn seed dry weight and weight of 100 seeds.

Treatments	Corn seeds	
	Dry Weight (g)	Weight of 100 Seeds (g)
V1P0 (*Bisi* 18 + No treatment)	139.0 ± 0.65 a	35.33 ± 0.89 b
V1P1 (*Bisi* 18 + Granule fertilizer 50 g)	166.40 ± 0.65 c	42.84 ± 0.50 e
V1P2 (*Bisi* 18 + Granule fertilizer 100 g)	175.73 ± 0.25 de	42.46 ± 0.41 e
V1P3 (*Bisi* 18 + Granule fertilizer 150 g)	174.00 ± 1.14 cde	44.17 ± 0.01 f
V2P0 (*Bisi* 99 + No treatment)	157.13 ± 0.81 b	34.26 ± 0.20 a
V2P1 (*Bisi* 99 + Granule fertilizer 50 g)	235.60 ± 1.56 g	41.10 ± 0.03 d
V2P2 (*Bisi* 99 + Granule fertilizer 100 g)	232.33 ± 1.43 g	40.82 ± 0.42 d
V2P3 (*Bisi* 99 + Granule fertilizer 150 g)	227.07 ± 1.36 g	39.89 ± 0.08 c
V3P0 (*Pertiwi* 6 + No treatment l)	137.93 ± 11.08 a	45.55 ± 0.51 g
V3P1 (*Pertiwi* 6 + Granule fertilizer 50 g)	192.00 ± 3.86 f	48.36 ± 0.70 g
V3P2 (*Pertiwi* 6 + Granule fertilizer 100 g)	194.07 ± 2.31 f	48.07 ± 0.36 h
V3P3 (*Pertiwi* 6 + Granule fertilizer 150 g)	181.20 ± 5.38 e	46.36 ± 0.19 hi
V4P0 (*Pertiwi* 3 + No treatment)	166.40 ± 20.99 c	40.99 ± 1.85 d
V4P1 (*Pertiwi* 3 + Granule fertilizer 50 g)	197.73 ± 2.21 f	50.02 ± 0.15 k
V4P2 (*Pertiwi* 3 + Granule fertilizer 100 g)	193.07 ± 7.92 f	49.51 ± 0.15 jk
V4P3 (*Pertiwi* 3 + Granule fertilizer 150 g)	170.40 ± 4.42 cde	49.16 ± 0.55 ij
HSD 5%	**9.19**	**0.81**

Numbers followed by the same letter are not significantly different based on the 5% HSD (Honestly Significant Difference) test.

4. Conclusion

The research findings indicate that the treatment of the *Bisi* 99 variety with a 50 g dosage of granular biological fertilizer produced the best results. It is recommended that the use of this fertilizer be applied at a 50 g dosage for optimal outcomes.

5. Acknowledgement

The journal article was written by Ali Ikhwan, Agrotechnology Study Program, University of Muhammadiyah Malang based on research results "*RESPONSE OF SOME VARIETIES OF CORN (Zea mays L.) TOWARD APPLYING* GRANULAR *BIO-FERTILIZER ON DRY LAND*" which was funded by the National Innovation Research Agency (BRIN) through Program Implementation Research and Innovation for Advanced Indonesia with letter number 41/IV/KS/06/2022. The content is the sole responsibility of the author.

References

[1] D Parhusip *et al* 2020 Peningkatan produksi tanaman jagung melalui pemberian pupuk an-organik fosfat alam *Agrica Ekstensia* **14**(2) 113118

[2] A Wahyudin *et al* 2016 Pertumbuhan dan hasil tanaman jagung (Zea mays L.) toleran her*Bisi*da akibat pemberian berbagai dosis her*Bisi*da kalium glifosat *Kultivasi* **15**(2)

[3] H Kara *et al* 2014 Respon Penawaran Jagung (Zea Mays) Di Kabupaten Malang, Jawa Timur. Putusan Nomer1131/Pid. An/2013/Pn. Jkt. Sel. *Paper Knowledge. Toward a Media History of Documents* **7**(2) 107115

[4] M Ridayanti *et al* 2020 Evaluasi Kesesuaian Lahan Tanaman Jagung Pada Lahan Kering Di Kecamatan Wagir Kabupaten Malang *Jurnal Tanah dan Sumberdaya Lahan* **8**(1) 149160

[5] S X Li *et al* 2009 Nitrogen in dryland soils of China and its management *Advances in Agronomy* **101** 123181.

[6] E Afrida *et al* 2024 Cob and seed characteristics of maize due to nutrient omission techniques *IOP Conf. Ser.: Earth and Environ. Sci.* **1297**(1) 012060

[7] A Kalay *et al* 2020 Utilization of biofertilizers and organic materials on growth and yield of sweet corn (Zea mays saccharata) *Agric* **32**(2) 129138

[8] E Afrida *et al* 2022 Limiting factors of agronomic characteristics for maize through nutrient omission techniques *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* **70**(2) 109118

[9] A Ikhwan *et al* 2023 Characterization of rhizobacteria secondary metabolites on maize (Zea mays) in marginal land *IOP Conf. Ser.: Earth and Environ. Sci.* **1172** 012004

[10] N Amir *et al* 2023 Peningkatan Produksi Jagung Manis (Zea Mays Saccharata Sturt.) Dengan Sistem Olah Tanah Dan Tingkat Pemupukan Kimia Berbeda *Klorofil: Jurnal Penelitian Ilmu-Ilmu Pertanian* **17**(2) 4146

[11] S Puspadewi *et al* 2016 Pengaruh konsentrasi pupuk organik cair (POC) dan dosis pupuk N, P, K terhadap pertumbuhan dan hasil tanaman jagung manis (Zea mays L. var Rugosa Bonaf) kultivar talenta *Kultivasi* **15**(3)

[12] N T Thamrin *et al* 2022 Pengaruh Pupuk Kandang Ayam Terhadap Pertumbuhan Vegetatif Tanaman Jagung (Zea mays L.) *INSOLOGI: Jurnal Sains dan Teknologi* **1**(4) 461467

[13] I Ulfah *et al* 2020 Pengaruh Jenis Bakteri Pelarut Fosfat Terhadap Pertumbuhan Dan Hasil Benih G3 Kentang (Solanum tuberosum L.) Varietas Medians *PASPALUM: Jurnal Ilmiah Pertanian* **8**(2)

[14] A Wong-Villarreal *et al* 2019 Bacteria from Jatropha curcas rhizosphere, degrades aromatic hydrocarbons and promotes growth in Zea mays *Open Agriculture* **4**(1) 641649

[15] D Sukmadewi *et al* 2022 Isolasi Dan Uji Kemampuan Bakteri Pelarut Kalium Dari Tanah Sawah Dengan Sistem Irigasi Subak *Jurnal Agrotek Tropika* **10**(3) 413419

[16] S K Mehta *et al* 2015 Botanicals- An Effective Tool for the Management of Maize Cyst Nematode, Heterodera Zeae on Maize (Zea Mays L.) *Journal of Biopesticides* **8**(2) 6267

[17] A Septiani *et al* 2017 Produksi Enzim Selulase Dari Bakteri Serratia marcescens KE-B6 Dengan Penambahan Sumber Karbon, Nitrogen dan Kalsium Pada Medium Produksi *Bioma: Berkala Ilmiah Biologi* **19**(2) 159163

[18] A A El-Dein *et al* 2016 Isolation and Identification of Zinc Dissolving Bacteria and Their Potential on Growth of Zea Mays *Egyptian Journal of Microbiology* **51**(1) 2943

[19] F Irawan *et al* 2017 Pengaruh umur panen terhadap sifat fisik tepung jagung manis (Zea mays saccharata Sturt) *Jurnal Teknologi Pertanian (Agricultural Technology Journal)* **8**(1)

[20] A N Annisa *et al* 2018 A review of bio-lubricant production from vegetable oils using esterification transesterification process *MATEC Web of Conferences* **156** 06007