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## The growth and yield of sweet corn (*Zea mays saccharata* Sturt.) with anorganic and organo-bio fertilizer

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# The growth and yield of sweet corn (*Zea mays saccharata* Sturt.) with anorganic and organo-bio fertilizer

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**Abstract.** The field study was conducted to study the growth and yield of sweet corn with different fertilizer at the experimental farm of the Department of Agrotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Indonesia from May to August 2018. The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments and three replication. Treatments include: 300 kg NPK/ha; 300 kg NPK/ha + 1.2 ton Rhizoculant/ha; 150 kg NPK/ha + 2.4 ton Rhizoculant/ha; 150 kg NPK/ha + 1.2 ton Rhizoculant/ha; 2.4 ton Rhizoculant/ha; and 1.2 ton Rhizoculant/ha. Results showed that fertilizer application had a significant effect on plant height, silking time, leaf area, and shoot-root ratio. The application of 300 kg NPK/ha + 1.2-ton Rhizoculant/ha produced higher values of growth and yield attributes rather than other treatments. The application of nutrients through Rhizoculant only was the lowest values of growth and yield attributes.

## 1. Introduction

Sweet corn (*Zea mays* L. *saccharata* Sturt.) also known as sugar corn, is a hybrid of maize (*Zea mays* L.) specifically bred to increase the sugar content. Sweet corn is introduced from the USA. The fruit of the sweet corn plant is the corn kernel. It has a sugary rather than a starchy endosperm and a creamy texture. The low starch level makes the kernel wrinkled rather than plumpy. Sweet corn cannot be regarded as a staple food, but it is consumed fresh as a confection. Sweet corn is a variety of maize with high sugar content. Sweet corn is the result of a naturally occurring recessive mutation in the genes which control the conversion of sugar to starch inside the endosperm of the corn kernel. Unlike field corn varieties, which are harvested when the kernels are dry and mature (dent stage), sweet corn must be picked when immature (milk stage) and prepared and eaten as a vegetable, rather than a grain [1].

Among all types of maize, Sweet corn (*Zea Mays* saccharine) has commercial importance. Many experimental findings revealed that higher crop yield of maize grown for grain could obtain only when the plant get sufficient quantities of nutrients during there lifespan. Hence, the balanced fertilization is very important to get the maximum yield, so it was felt necessary to study the effect of fertilizer levels on growth and yield of sweet corn. Fertilizers, natural or artificial are substances containing chemical elements that improve growth and productiveness of plants. Fertilizers enhance the natural fertility of the soil or replace the chemical elements taken from the soil by previous crops. Current production practices for sweet corn requires a very high level of inputs like fertilizer that causes a significant increase in production cost.



Biofertilizer has been identified as an alternative to substitute chemical fertilizer for increasing soil fertility and plant production. Biofertilizer is a substance containing living microorganisms, which can make important elements available via a biological process [2]. The utilization of biofertilizer has several advantages over chemical fertilizer for agricultural purposes: (i) biofertilizer is considered the safest among many of the chemical fertilizers now in use; (ii) neither toxic substances nor microbes themselves will be accumulated in the food chain; (iii) self-replication of microbes circumvents the need for repeated application [3].

The efficiency and effectiveness of microbes as an active ingredient of biofertilizer is affected by several factors, i.e., soil type, climate condition, and the quality of organic matter [4]. In recent years, biofertilizer has emerged as an important component of the integrated nutrient supply system, and it holds a great promise to improve crop yields through environmentally better nutrient supplies. An organo-biofertilizer “Rhizoculant” containing *Trichoderma* sp., *Aspergillus* sp., *Azotobacter* sp.

This research was conducted to develop a nutrient management strategy on sweet corn by combining organo-biofertilizer (Rhizoculant) with inorganic fertilizer (NPK) at varying rates.

## 2. Materials and Methods

The experiment was conducted at the experimental farm of the Department of Agrotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Medan - Indonesia from May to August 2018. Bonanza F<sub>1</sub> sweet corn variety with 70 days maturity was used in the experiment.

The study laid-out in three equal blocks, equally spaced at one and a half meter (1.5 m) between blocks. Each block was subdivided into six plots, The six treatments were allocated following the randomization procedure for Randomized Complete Block Design (RCBD) which consists of : B0 : 300 kg NPK/ha; B1 : 300 kg NPK/ha + 1.2 ton Rhizoculant/ha; B2 : 150 kg NPK/ha + 2.4 ton Rhizoculant/ha; B3 : 150 kg NPK/ha + 1.2 ton Rhizoculant/ha; B4 : 2.4 ton Rhizoculant/ha; and B5 : 1.2 ton Rhizoculant/ha.

The area was thoroughly prepared before planting. Initial plowing was done and left idle for two weeks to allow weeds to decay and suppress its germination after which second plowing and harrowing at a week interval was done. Soil analysis was also done before planting. One seed per hill was planted at 50 cm x 50 cm plant spacing. Basal application of NPK fertilizer and Rhizoculant was done after planting. The seeds were covered with thin soil, so that there will be direct contact of seeds with the soil for better and uniform germination. Manual weeding was done to prevent the growth of weeds. Crop protection activities were employed by strictly following an integrated pest management approach for corn. Destructive insects and diseases were appropriately applied with pesticide. Clean culture through spot weeding and brushing of weeds surrounding the area was implemented to eliminate the host of insect pest and diseases. Corn cob was harvested at 63, 65, and 70 days after planting.

Parameters gathered were plant height, tasseling and silking time, leaf area, shoot-root ratio and productivity. The statistical differences were tested using an analysis of variance and means were compared used Duncan Multiple Range - test. Figures show significant differences using letter designations. Data points with different letters show significant differences ( $P < 0.05$ ).

## 3. Results and Discussion

### 3.1. Plant Height

The combination of NPK and Rhizoculant fertilizers significantly affected the height of sweet corn plants (Table 1). The highest plant (200.0 cm) was found at 300 kg NPK / ha (B0) which was not significantly different with B1, B2, B3 treatments but significantly different from the application of biofertilizer only (B4 and B5). The lowest plant height (183.6 cm) was found in giving only 2.4 tons of Rhizoculant / ha without NPK (B4). Inorganic fertilizers are known to have the peculiarity of the fast release of their nutrient contents; however organic fertilizers are known to have the characteristic nature of the slow release of nutrients [5].

**Table 1.** Plant height, tasseling and silking time of sweet corn in a combination of inorganic and organo-biofertilizer

Treatment	Plant height (cm)	Tasseling time (days)	Silking time (days)
B0: 300 kg NPK/ha	200.0 a	49.0	50.7 b
B1 : 300 kg NPK/ha + 1.2 ton Rhizoculant/ha	195.3 a	49.0	51.7 b
B2 : 150 kg NPK/ha + 2.4 ton Rhizoculant/ha	196.3 a	49.3	51.0 b
B3: 150 kg NPK/ha + 1.2 ton Rhizoculant/ha	195.0 a	49.0	51.0 b
B4: 2.4-ton Rhizoculant/ha	183.6 b	49.3	53.3 ab
B5: 1.2 ton Rhizoculant/ha	187.3 b	51.0	55.3 a
CV (%)	3.21	1.64	2.99

### 3.2. Tasseling and Silking Time

Time of tasseling and time of silking of sweet corn was presented in Table 1. Time of tasseling not significantly different but the time of silking of sweet corn significantly different by application of varying combinations NPK and Rhizoculant. The earliest time of tasseling (49.0 days) was found in B0, B1, B3 and latest (51.0 days) at B5 (1.2 tons Rhizoculant / ha). The earliest time of silking (50.7 days) was found in treatment B0 (300 kg NPK / ha), which was not significantly different with B1, B2, B3, B4, and significantly different with B5 (1.2 tons Rhizoculant / ha), while the time of silking in B5 it is not significantly different from B4 (2.4 tons Rhizoculant / ha)

Time of tasseling and silking is very determined by various factors, including environmental and genetic factors [6]. One of the factors that affect the flowering of plants according to [7] is soil fertility. Flowering can be successful if soil fertility allows plants to grow and healthy. One that plays a role in flowering is phosphorus. The element P is very necessary for the process of assimilation, respiration and is needed for generative development plants that speed up the flowering process.

### 3.3. Leaf Area

The combination of NPK and Rhizoculant fertilizers significantly affected leaf area of sweet corn (Table 2). The highest leaf area (6523.7 cm<sup>2</sup>) was found at 300 kg NPK / ha (B0) which was not significantly different with B1, B2, B3 but significantly different with B4 and B5. B4 and B5 are not significantly different. The lowest leaf area (4963.7 cm<sup>2</sup>) was found in giving only 1.2 tons of Rhizoculant / ha (B5).

**Table 2.** Leaf area, shoot-root ratio and productivity of sweet corn in a combination of inorganic and organo-biofertilizer

Treatment	Leaf area (cm <sup>2</sup> )	Shoot-root ratio	Productivity (kg/ha)
B0: 300 kg NPK/ha	6523.7 a	7.1 b	15 600.0
B1 : 300 kg NPK/ha + 1.2 ton Rhizoculant/ha	6002.7 ab	7.8 ab	15 939.0
B2 : 150 kg NPK/ha + 2.4 ton Rhizoculant/ha	6332.7 a	5.5 b	14 050.0
B3: 150 kg NPK/ha + 1.2 ton Rhizoculant/ha	6307.0 a	7.2 b	13 657.7
B4: 2.4-ton Rhizoculant/ha	5513.7 bc	8.1 ab	12 033.3
B5: 1.2 ton Rhizoculant/ha	4963.7 c	10.0 a	10 316.7
CV (%)	6.22	17.15	17.04

### 3.4. Shoot-root Ratio

Shoot-root ratio of sweet corn was presented in Table 2. Shoot-root ratio was significantly different by application of varying combinations NPK and Rhizoculant. The highest shoot-root ratio (10.0) occurred in B5 (1.2-ton Rhizoculant/ha), which was not significantly different from treatment B1 and B4. The

lowest shoot-root ratio (5.5) occurs in B2 (150 kg NPK/ha + 2.4-ton Rhizoculant/ha), which is not significantly different from treatment B0, B1, B3 and B4.

### 3.5. Productivity

The productivity of sweet corn was presented in Table 2. The productivity of sweet corn not significantly different by the application of varying combinations NPK and Rhizoculant. Although not significantly different, the highest productivity (15 939.0 kg/ha) was obtained in treatment B1 (300 kg NPK/ha + 1.2 ton Rhizoculant/ha), and the lowest (10 316.7 kg/ha) was in B5 (1.2 ton Rhizoculant/ha). The findings were also similar to [8] who observed that *Azotobacter chroococcum* significantly increased grain yield of maize over no inoculation.

## 4. Conclusion

The application of organo-biofertilizer 'Rhizoculant' as much as 1.2 t/ha combined with inorganic fertilizer (300 kg NPK/ha) increased the productivity of sweet corn.

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