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# Application of Inorganic Fertilizer With *NanoChisil* and *Nanosilica* on Black Corn Plant Growth (*Zea Mays L.*)

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**Abstract.** Corn is one of the most important sources of carbohydrate and protein in Indonesia, while black corn has not been widely known. One way to increase the growth of black corn plants is to optimize the use of fertilizer, i.e. by a combination of NPK fertilizer with *NanoChisil* or *Nanosilica* fertilizer. *NanoChisil* is a fertilizer with chitosan and silica, while nanosil fertilizer is a fertilizer with silica content. Both of these fertilizers are nano-sized. NPK is a fertilizer with nutrient contents of Nitrogen, Phosphor and Potassium. This study aims to determine the combination effect of NPK fertilizer with *NanoChisil* or *Nanosilica* on the growth of black corn plants. This research used Completely Randomized Design (CRD). The treatments used were P0 control (without fertilization); P1 (25% *NanoChisil* 75% NPK combination); P2 (25% *Nanosilica* 75% NPK combination); P3 (100% *NanoChisil*); P4 (100% *Nanosilica*). The study consisted of 5 treatments with 5 repetitions. The research parameters consist of plant height, number of leaves, wet weight, dry weight, and the stomata amount. The data analysis used is Analysis of Variance (ANOVA) if the difference is evident, the analysis is continued by Duncan Multiple Range Test (DMRT) at 95% significant level. The results showed the use of NPK fertilizer combination with *NanoChisil* and NPK fertilizer with *Nanosilica* have an effect to increase plant height, number of leaves, wet weight, and dry weight. The allocation of 25% *NanoChisil* 75% NPK is most optimal in increasing plant height, number of leaves, wet weight, and dry weight.

**Keywords:** Black Corn, *NanoChisil*, *Nanosilica*, NPK fertilizer, growth

## 1. Introduction

Corn is a source of carbohydrates and also a protein that is important for the people of Indonesia. The main nutritional content of corn according to Suarni dan Widowati (2015), is 72%-73% starch, 8%-11% protein and 1%-3% simple sugar content. In addition, corn has functional food components such as fiber, essential fatty acids, isoflavones, minerals



(Ca, Mg, K, Na, P, Ca and Fe), anthocyanin, beta-carotene (provitamin A), essential amino acid composition, and others.

One of the corn varieties that have not been widely known by the people in Indonesia are black corn or purple corn. Purple corn and black corn are rich in anthocyanin pigments (Jing et al, 2007). One of the factors which driving the increase of corn production in Indonesia is the use of inorganic fertilizers. However, according to Dewanto et al (2013) the use of inorganic fertilizers is always followed by environmental problems, whether biological fertility, soil physical properties, impact on consumers and if used in the long term, it will harm the environment.

The development of environment-friendly technologies is necessary to balance the exploitation of natural resources over the environment through the reduction of the use of artificial fertilizers. One of them is Nano fertilizer, such as *NanoChisil* which is a combination of *NanoChitosan* and *Nanosilica*. The benefits of chitosan in agriculture, among others, is to accelerate the process of nitrogen fixation (Ali et al., 1997). Element of Si can support healthy growth and prevent plants from disease attacks and temperature stress, solar radiation, as well as nutrient deficiency and poisoning (Subagio, 2010).

*NanoChisil* fertilizer is a combination of *NanoChitosan* and *Nanosilica*. *NanoChisil* is in the form of chitosan and silica in nanochromes ( $10^{-9}$ ) making it easier and faster to absorb by plants (Subagio, 2016). *NanoChitosan* is in the form of Chitosan in nanochromes

NPK fertilizer is a compound fertilizer that has three elements which is a combination of single fertilizer N, P, and K. NPK fertilizer in the market is very diverse with different nutrient content (Lingga, 2013).

Chitosan regulates the plant's immune system and causes the excretion of the enzyme (Boonlertnirun *et al*, 2008) More than that, chitosan is not only activates the cells, but also increases the defense ability against diseases and insects.

The function of silicate in the roots, so that the plants could tolerate drought. Silicates are present in the cell wall structure. Grasses, swamp grasses, nettles and horsetails accumulate Si in leaves, silicon serves to strengthen the epidermis and vessels, reduce water shortages and prevent fungal infections.

The objectives of the study were: (a) to know the effect of combination of *NanoChisil* fertilizer with inorganic fertilizer on the plant growth; and (b) To discover the effect of combining *Nanosilica* fertilizer with inorganic fertilizer on the plant growth.

The research benefits are to provide information on the effect of *NanoChisil* and *Nanosilica* fertilizer combined with inorganic fertilizer into the corn plant growth in order to increase the productivity of black corn plants.

## 2. Research Methodology

### 2.1 Time and place

The study was conducted for 2 (two) months, from June to July 2017, starting from the preparation of planting media. The location of research is in Kelurahan Tlogomulyo, Kecamatan Pedurungan, Semarang.

### 2.2 Experimental Design

The experimental design used in this study was Completely Randomized Design (CRD) with 5 treatments, and 3 repetitions. The first treatment (P0) is without fertilization, (P1) 25% *nanochisil* 75% NPK, (P2) 25% *nanosil* 75% NPK, (P3) 100% *nanochisil*, and (P4) 100% *nanosil*.

### 2.3 Implementation

The conducted research activities includes: (1) the preparation of tools and materials; (2) seed preparation which includes the preparation of nursery media, seeding, and removal of seedlings; (2) planting; (3) fertilizer treatment, (4) crop maintenance including: watering, weeding, as well as pest and disease control; (5) data retrieval and analysis; and (7) preparation of reports.

#### *2.4 Data Collection and Analysis*

The collected data were: (1) height of black corn plant at the end of research; (2) the number of leaves performed at the end of the study; (3) leaf color; (4) wet weight and dry weight of corn plants at the end of the research; and (5) the amount of stomata. Data analysis using variance and if the result of variance differ significantly ( $F_{\text{count}} > F_{\text{table}} 5\%$ ) or different very real ( $F_{\text{arithmetic}} > F_{\text{table}} 1\%$ ), then to compare the two average treatment, a further test with the Smallest Real Difference Test (SRDT) of 5% level is done.

### **3. Results**

The research results by combining inorganic fertilizer with nanochisil and nanosil fertilizer on the growth of plant height, number of leaves, leaf color, wet weight, dry weight, and the amount of black corn plant stomata are presented in Table 1.

Tabel 1. Average treatment of plant height, number of leaves, wet weight, dry weight, the amount of stomata and leaf color of black corn plant.

Treatment	Plant Height (cm)	Number of Leaves	Wet Weight (g)	Dry Weight (g)	The Amount of Upper Stomata	The Amount of Lower Stomata	Leaf Color
P0 (Kontrol)	51.6 <sup>a</sup>	6.6 <sup>a</sup>	53.4 <sup>a</sup>	14.8 <sup>a</sup>	23.9	37.1	Light Green
P1 (25% <i>NanoChisil</i> 75% NPK)	93.2 <sup>b</sup>	8.6 <sup>b</sup>	185.6 <sup>c</sup>	42 <sup>b</sup>	26	39.1	Dark Green
P2 (25% <i>NanoSilica</i> 75% NPK)	84.4 <sup>b</sup>	9 <sup>b</sup>	139.6 <sup>b</sup>	41.4 <sup>b</sup>	26.1	38.3	Dark Green
P3 (100% <i>NanoChisil</i> )	52.8 <sup>a</sup>	7 <sup>a</sup>	52 <sup>a</sup>	16 <sup>a</sup>	24.4	38.5	Dark Green
P4 (100% <i>NanoSilica</i> )	48.6 <sup>a</sup>	7 <sup>a</sup>	50.2 <sup>a</sup>	12 <sup>a</sup>	24.5	41.3	Light Green

### 3.1 Plant Height

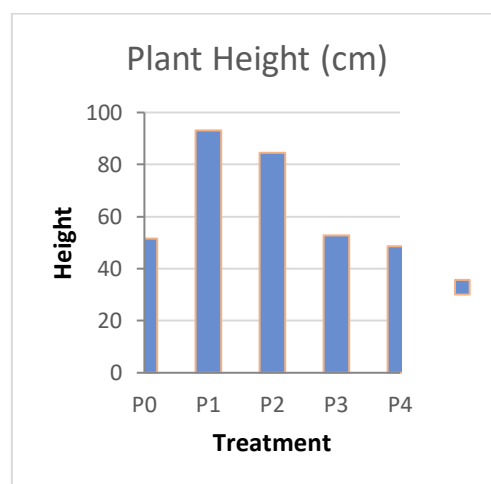


Figure 1. Histogram of Plant Hight

The results showed that the average height of P1 plants (25% NPK 75% nanocisil) and P2 (25% NPK 75% *nanosilica*) were significantly different to P0 (Control), whereas the average height of P3

(100% *nanochisil*) and P4 (100% *nanosil*) did not make a significant difference with plant P0 (Control). The difference of plant height of black corn to control at P1 was 80.62%, at P2 was 63.56%, at P3 was 2.32% and at P4 was -5.81%.

According to Sudarmi (2013), artificial fertilizer can increase the level of macro nutrients in the soil, macro nutrients such as Nitrogen (N), Phosphor (P), and Potassium (K). Furthermore, the use of silica makes plants more upright that leads to a better photosynthesis process which make a good growth on the plant height.

### 3.2 Number of Leaves

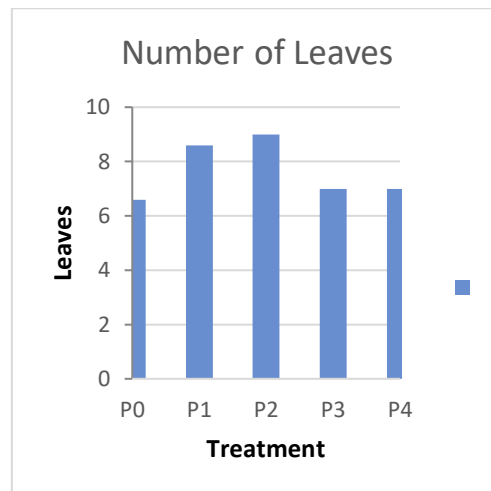


Figure 2. Histogram of Number of Leaves

The results showed the number of leaves of black corn plants with treatment of P1 and P2 was significantly different with P0, P3 and P4. The data of the test results showed the use of NPK fertilizer combination with *NanoChisil* and NPK fertilizer with *NanoSil* resulted in plants with more leaves than control and other treatments. The average result of leaf number in the control treatment (P0) was 6.6 strands, 25% *NanoChisil* 75% NPK (P1) treatment was 8.6 strands, treatment 25% *Nanosilica* 75% NPK (P2) 9 strands, 100% *NanoChisil* (P3) treatment 7 strands, and 100% treatment *Nanosilica* (P4) of 7 strands.

According to Febrian (2011) the leaves are the organs that synthesize food for the needs of plants or as food reserves, the leaves have a chlorophyll that plays a role in the process of photosynthesis, the more leaves the more the photosynthesis process that occurs.

### 3.3 Wet Weight

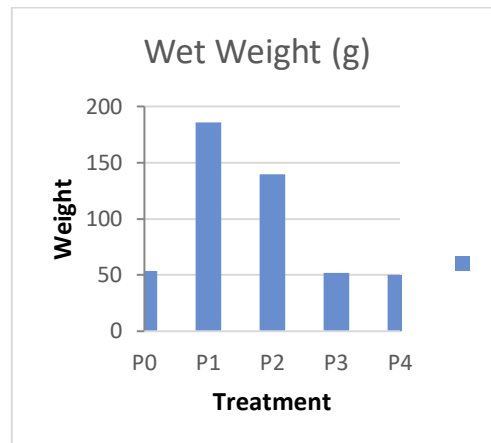


Figure 3. Histogram of the Wet Weight

Based on research data obtained, control treatment, P3 (100% *nanochisil*) and P4 (100% *nanosil*) had wet weight smaller than in plants with P1 and P2 treatment, showed that NPK fertilizer combination with *NanoChisil* or *Nanosilica* had a real influence on wet weight. The difference of average plant with control treatment on P1 plant was 274%, P2 was 161%, P3 was -2.62% and P4 was -5.99%.

NPK fertilizer increase the nutrient content in the soil needed by plants as macro nutrients that support the growth and development of plants. According to Febrian (2011) elements of Nitrogen are required for the formation or growth of vegetative parts of plants such as stems, leaves and roots. Nitrogen element plays an important role in the synthesis and increase the content of chlorophyll so as to affect the increase of photosynthesis results.

Giving fertilizer with too high concentration causes cell division in plants to be ineffective and hampered, which in accordance with the statement Mansfield and Atkinson (1990), which stated that if plants are given nutrients with excessive concentration, it will interfere with the development of cells in it.

### 3.4 Dry Weight

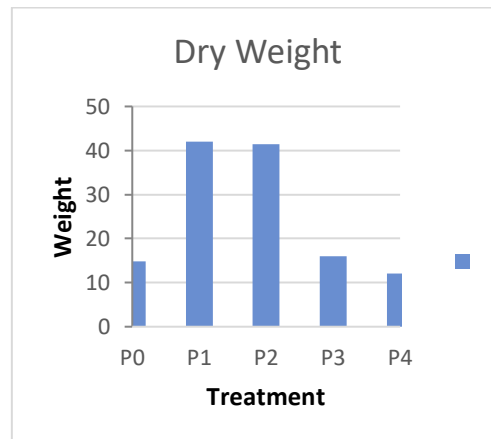


Figure 4. Histogram of Dry Weight

Based on the result of P1 test (25% *nanochisil* and 75% NPK) and P2 (25% nanosil 75% NPL), they have an effect on dry weight and significantly different to the control treatment, P3 (100% *nanochisil*), and P4 (100% nanosil). Plants treated with a combination of NPK with *NanoChisil* or *Nanosilica* have higher dry weight than plants without fertilization or control. The average difference of dry weight of plants with control was at P1 of 183%, P2 of 179%, P3 of 8.1% and at p4 -18%.

According to Sitompul and Guritno (1995), crop production is more accurately expressed by dry weight size than wet weight because wet weight is affected by moisture conditions. According to Gardner et al (1991), dry weight results from the balance between photosynthesis and respiration, photosynthesis results in increased dry weight by taking CO<sub>2</sub> while respiration results in reduced dry weight by releasing CO<sub>2</sub>.

### 3.5 The Amount of Stomata

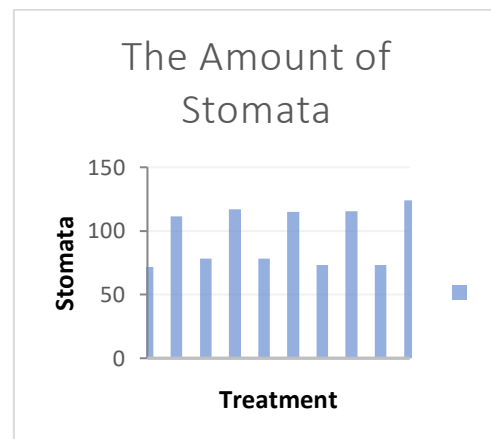


Figure 5. Histogram of the Amount of Stomata

The amount of stomata in the fertilizer treatment did not make any difference to the control plants. The amount of stomata on the upper surface of the leaf has a smaller amount than the lower part of the leaf, according to Muhuria (2007), it is caused by a thick cuticle layer on the adaksial (top) that covers the stomata thus blocking the transpiration process, resulting in stomatal density in the abaxial (bottom) section which greater than the density of the adomal stomata (top), the abjective portion of the leaf is only coated with a thin cuticle or not even covered by the cuticle so as not to inhibit the transpiration process through the stomata.



### 3.6 Leaf Color



Figure 6. Leaf color

The color of the leaves of black corn without fertilization showed the color of light green leaves, whereas in plants treated by the combination of NPK fertilizer with *nanochisil* and NPK fertilizer with nanosil has green leaves, and in plants with 100% *nanochisil* treatment and 100% nanosil has light green leaf. This may be due to the control treatment, P3 and P4 of plants are not getting enough Nitrogen nutrients, because according to Kresnatita et al (2013) N nutrients is function in increasing the amount of chlorophyll, so that if N is available in sufficient quantities, it will increase the rate of photosynthesis, and eventually, the photosynth that formed will be many.

### 4. Conclusion

Based on the research that has been conducted on Black Corn (*Zea mays* L.) with the combination treatment of NPK fertilizer with *NanoChisil* and *Nanosilica* fertilizer it can be concluded that:

1. The addition of NPK fertilizer combination with *NanoChisil* fertilizer has an effect on plant height, number of leaf, wet weight and dry weight of plant but has no effect on the amount of upper and lower stomata.
2. The addition of NPK fertilizer combination with *Nanosilica* fertilizer has an effect on plant height, number of leaf, wet weight and dry weight of plant but has no effect on the amount of upper and lower stomata.

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