EFFECT OF LIQUID AND SINGLE COMPOUND NPK FERTILIZER ON SOIL AND PLANT NITROGEN CONTENT AND YIELD OF SWEET CORN (*Zea mays* L. SACCHARATA) IN INCEPTISOLS OF JATINANGOR

ABSTRACT

The main problem in Inceptisols soil is its low fertility level. One of the efforts to overcome this problem is by providing additional nutrients that can be absorbed by the soil through compound NPK fertilization, which supplies available nutrients to optimize soil fertility, thereby improving the quality and quantity of sweet corn plants. This research aims to determine the effect of liquid compound NPK fertilizer and single fertilizer on total soil N content, plant N content, and yields of sweet corn crops; and to obtain a combination of compound NPK inorganic fertilizer and single fertilizer that provides the highest yield of sweet corn on Inceptisols soil from Jatinangor. The experiment was carried out in the experimental garden of the soil chemistry and plant nutrition laboratory, Faculty of Agriculture, Universitas Padjadjaran, Jatinangor, from July 2023 to December 2023. The research design used was a Completely Randomized Block Design (CRBD) consisting of nine treatments and three replications, namely: A (control); B (1 dose NPK fertilizer standard); C (¾ NPK compound + ¾ NPK standard); D (1 NPK compound + ¾ NPK standard); E (1½ NPK compound + ¾ NPK standard); F (½ NPK compound + 1 NPK standard); G (¾ NPK compound + 1 NPK standard); H (1 NPK compound + 1 NPK standard), and I (1½ NPK Compound + 1 NPK standard). The data collected were initial soil yield before treatment, soil N-total content, N-plant content, cob diameter, cob length, husked cob weight, peeled cob weight, and cob weight per plot. Data analysis was carried out using variance analysis and continued with the 5% level Duncan's Mutiple Range Test (DMRT). Data analysis using SPSS software. The research results show that the application of liquid and single compound NPK fertilizer had a significant effect on increasing soil N-total, N-plant content, and yields of sweet corn on Inceptisols soil from Jatinangor; and the combination dose of 1 NPK compound (8 L ha^{-1}) + 1 dose of NPK standard (Urea 300 kg ha^{-1}, TSP 100 kg ha^{-1}, and KCl 50 kg ha^{-1}) provides the best sweet corn crop results on Inceptisols soil from Jatinangor.

Keywords: NPK Fertilizer, Inceptisols of Jatinangor

1. INTRODUCTION

Inceptisols soil is one of the soil orders that is widespread in Indonesia, namely around 70.52 million hectares or 37.5% of Indonesia's total land area. This wide spread of land has potential for the development of agricultural cultivation. However, the use of Inceptisols soil cannot be separated from fertility problems. According to Abdurachman et al. (2008) that Inceptisols soil generally has low fertility, with characteristics of low nitrogen (N), phosphorus (P), potassium (K), organic matter, and slightly acidic pH.

Soil formation and processing, as well as erosion are factors that influence the low fertility of Inceptisols soil (Setiawati et al., 2021). Inceptisols are formed by active leaching and erosion (Soil Survey Staff, 1999). Active leaching and erosion processes can remove basic anions and cations that are important for plants. Therefore, fertilization is one solution that can increase the fertility of Inceptisols soil in Jatinangor, so that plants can grow faster and more fertile.

Fertilization can be done using compound and single inorganic fertilizers. Liquid compound NPK fertilizer can increase the availability of macro nutrients such as N, P and K in the form of a solution that is easily absorbed by plants, making it more efficient (Hardjowigeno, 2003; Pirngadi, 2005). On the other hand, single fertilizers dissolve quickly and can be used according to specific plant nutrient needs, and can reduce nutrient leaching (Anggraini et al., 2019). The combination of these two types of fertilizer is important to achieve nutrient balance because compound NPK fertilizer still requires additional single fertilizer, especially the N nutrient source (Kasno and Rostaman, 2013).

Sweet corn (*Zea mays* L. saccharata) is suitable for growing in various types of soil because of its high adaptability (Nursyamsi et al., 2002). Cultivating sweet corn on marginal land such as Inceptisols land can be a solution to meet domestic sweet corn needs (Sumarno, 2021). Sweet corn production in Indonesia is still relatively low, around 8.13 tonnes of fresh cobs $hectare^{-1}$, even though the potential could reach 14

tonnes hectare^{-1}. Sweet corn imports also increase every year, indicating that domestic production is not yet sufficient to meet demand (Central Statistics Agency, 2021).

Liquid and single compound NPK fertilization is expected to increase Inceptisols soil fertility thereby supporting increased sweet corn productivity in Indonesia. Sweet corn is sensitive to N deficiency which is a limiting factor in production and yield quality (Bautista, 1983). Providing liquid compound NPK fertilizer and urea can increase total N levels in the soil because the N contained is easily dissolved and absorbed by plants (Syafrullah and Palmasari, 2020). Using a combination of fertilizers is an alternative for providing complete macro nutrients because single N, P, K fertilizers which tend to be expensive can be reduced with the addition of compound NPK.

Genetic factors also play a role in the growth of sweet corn. Using superior varieties of sweet corn seeds can increase productivity (Syukur, 2010). Superior varieties have advantages in terms of production, resistance to pests and diseases, and fertilizer response (Adie, 1993).

This research aims to determine the effect of liquid compound NPK fertilizer and single fertilizer on total soil N content, plant N content, and yields of sweet corn crops; and to obtain a combination of compound NPK inorganic fertilizer and single fertilizer that provides the highest yield of sweet corn on Inceptisols soil from Jatinangor.

2. METHODOLOGY

2.1. Time and Location

This experiment was carried out in July-December 2023 at the soil fertility and plant nutrition laboratory experiment field, Faculty of Agriculture, Padjadjaran University, Jatinangor District, Sumedang Regency. Soil and plant analysis was carried out at the soil fertility and plant nutrition laboratory, Department of Soil Science and Land Resources, Faculty of Agriculture, Padjadjaran University, Jatinangor, Sumedang Regency, West Java.

2.2. Materials and Tools

The materials used are Inceptisols mineral soil from Jatinangor as a planting medium, sweet corn seeds of the Secada F1 variety, compound NPK fertilizer, and single inorganic fertilizer (Urea, TSP, and KCl). The tools used consist of laboratory tools for soil and plant analysis, hoes, measuring cups, sprinklers, buckets, treatment signs, plastic samples, calipers, meters and scales.

2.3. Experimental Design

This experiment used a Completely Randomized Block Design (CRBD), which consisted of nine treatments, each treatment repeated three times. The treatment plan is as follows: control (A); 1 Dose NPK fertilizer standard (B); ¾ NPK compound + ¾ NPK standard (C); 1 NPK compound + ¾ NPK standard (D); 1½ NPK compound + ¾ NPK standard (E); ½ NPK compound + 1 NPK standard (F); ¾ NPK compound + 1 NPK standard (G); 1 NPK compound + 1 NPK standard (H); and 1½ NPK Compound + 1 NPK Standard (I)

2.4. Stages of Experiment

Carrying out experiments is a series of activities in the field and in the laboratory. Activities in the field start from preparing planting media, planting, applying fertilizer, maintenance and harvesting. Activities in the laboratory are carried out from initial soil analysis to testing experimental results in the field.

2.5. Data Collection

The data collected were: initial soil yield before treatment, soil N-total content, N-plant content, cob diameter, cob length, husked cob weight, peeled cob weight, and cob weight per plot.

2.6. Data Analysis

Data analysis was carried out using variance analysis and continued with the 5% level DMRT test. Data analysis using SPSS software.

3. RESULTS AND DISCUSSION

3.1 Initial Soil Analysis

The results of the initial soil analysis showed that the Inceptisols soil from Jatinangor used in this experiment had a slightly acidic (pH = 6.29), silty clay texture, moderate C-organic content is moderate (2.09%), N-total N is low (0.2 %), C/N ratio is low (10.63), K-EC is high (0.67 cmol kg^{-1}), Na-EC is low (0.13 cmol kg^{-1}), Ca-EC is medium (8.59 cmol kg^{-1}), Mg-EC high (3.40 cmol kg^{-1}), base saturation is low (24.53%) and Cation Exchange Capacity is moderate (24.6 cmol kg^{-1}). This land has relatively low fertility. It was stated by Sudaryono (2016) that a high CEC indicates more fertile soil, whereas a low CEC indicates infertile soil.

3.2. N-Total Content in Soil

Based on the results of statistical tests that have been carried out, it was found that the combination of compound and single NPK fertilizers had a significant effect on the N-total content of the soil. The results of research on the effect of compound and single NPK fertilization on soil N-total content are presented in Table 1.

Table 1 Effect of compound and single NPK fertilizer applications on soil N-total content

Code	Treatments	N-Total (%)
A	Control	0.18a
B	1 Dose NPK fertilizer standard	0.31b
C	¾ NPK compound + ¾ NPK standard	0.29b
D	1 NPK compound + ¾ NPK standard	0.30b
E	1½ NPK compound + ¾ NPK standard	0.30b
F	½ NPK compound + 1 NPK standard	0.28b
G	¾ NPK compound + 1 NPK standard	0.31b
H	**1 NPK** compound **+ 1 NPK standard**	**0.38c**
I	1½ NPK compound + 1 NPK standad	0.28b

Note: Numbers followed by the same letter do not show significant differences according to Duncan's Multiple Range Test at the 5% level.

Based on the data in Table 1, it shows that the treatment of compound and single NPK fertilizers can increase the total N content of the soil significantly compared to the control which has the lowest N-total value compared to the other treatments. Treatment H (1 NPK compound + 1 NPK standard) produced the highest soil N-total content, namely 0.38%, while the lowest was in the control, namely only 0.18%. This is in accordance with the research results of Bachtiar and Ahmad (2019) that inorganic fertilizers rich in N can increase the N-total content of soil. Furthermore, Firmansyah and Sumarni (2016) and Rastuti et al. (2020) that higher doses of N fertilizer increase the N-total content of the soil and the amount of N entering the soil will be greater.

3.3. N-Plant Content

Based on the results of statistical tests, show that giving a combination of compound and single NPK fertilizers has a significant effect on N-plant content. The results of research on the effect of compound and single NPK fertilization on N-plant content are presented in Table 2.

Table 2. Effect of compound and single NPK fertilizer applications on N-plant content

Code	Treatments	N-Plant (%)
A	Control	1.77a
B	1 Dose NPK fertilizer standard	2.9bcd
C	¾ NPK compound + ¾ NPK standard	2.8bc

D	1 NPK compound + ¾ NPK standard	2.72b
E	1½ NPK compound + ¾ NPK standard	2.98cd
F	½ NPK compound + 1 NPK standard	2.96cd
G	¾ NPK compound + 1 NPK standard	3.04d
H	**1 NPK** compound + **1 NPK standard**	**3.06d**
I	1½ NPK compound + 1 NPK standad	2.9bcd

Note: Numbers followed by the same letter do not show significant differences according to Duncan's Multiple Range Test at the 5% level.

Table 2 shows that the N content of plants in various fertilizer treatments was significantly different compared to the control. The highest N-plant content was produced in the H treatment, namely 3.06%, while the lowest was in the control treatment, namely only 1.77%. This is because the control treatment does not involve adding any additional nutrients or fertilizer to the soil so that the plants only absorb the nutrients available in the soil. Firmansyah and Sumarni (2016) stated that plant N content is influenced by the availability of NO_3^- and NH_4^+ in the soil, which is in line with an increase in soil N-total. The higher the N content due to fertilization in the soil, the higher the N content in plants. In line with Buana et al. (2014) the availability of a lot of N in the soil due to N fertilization can accelerate the synthesis of carbohydrates into proteins and protoplasm which can encourage an increase in N levels in plant tissue which is useful in plant growth.

3.3. Components of Plant Results

Based on the results of statistical tests, show that the application of a combination of compound and single NPK fertilizers has a significant effect on cob length, cob diameter, weight of cobs with husks, weight of cobs without husks, weight of cobs per plot. The results of research on the effect of compound and single NPK fertilization on the yield components and cob yield of sweet corn plants are presented in Table 3.

Table 3. Effect of the combination of compound and single NPK on yield of sweet corn

Code	Treatments	PT (cm)	DT (mm)	BTB (g)	BTK (g)	BTTP (kg)
A	Control	18.7a	48.4a	324,0a	253,9a	4.33a
B	1 Dose NPK fertilizer standard	19.1ab	51.6ab	393.8b	278.1ab	9.24bc
C	¾ NPK compound + ¾ NPK standard	19.2ab	52.6b	418.1bc	298.5ab	9.51bc
D	1 NPK compound + ¾ NPK standard	19.4ab	53.2b	418.2bc	303.3bc	9.14bc
E	1½ NPK compound + ¾ NPK standard	19.8ab	53.1b	467.9c	297.1b	8.21b
F	½ NPK compound + 1 NPK standard	20.1ab	54.9b	463.9c	345.0d	8.89bc
G	¾ NPK compound + 1 NPK standard	19.4ab	53.8b	456.1c	329.8cd	9.99c

H	**1 NPK** compound **+ 1 NPK standard**	**20.4b**	**54.0b**	**456.8c**	**352.9d**	**10.34cd**
I	1½ NPK compound + 1 NPK standad	19.2ab	54.2b	458.8c	357.8d	11.63d

Note: Mean numbers followed by the same letter do not show significant differences based on Duncan's Multiple Range Test at the 5% level. PT = cob length; DT = cob diameter; BTB = weight of husked cobs; BTK = cob weight without husk; and BTPP=cob weight per plot.

Based on the data in Table 3, shows that the application of various combinations of compound and single NPK fertilizers can significantly increase the yield components of sweet corn, namely cob length, cob diameter, husk cob weight, peeled cob weight, and cob weight per plot. The results showed that the H treatment (1 NPK compound + 1 NPK standard) produced the longest cobs (20.4 cm), the largest cob diameter (54.0 mm), the weight of cobs with husks and the heaviest weight of cobs without husks (456, 8 g and 352.9 g), and the highest cob weight per plot (10.34 kg), while the lowest yield components and cob weight per plot were produced in the control treatment, namely only 4.33 kg. It seems that Manis and Pada (2015) stated that the yield components of sweet corn plants can be optimal if there is a complete supply of nutrients, both macro and micro elements, so that they can support the growth and productivity of sweet corn plants. Fauziah et al., (2021) stated that the productivity of sweet corn can increase along with increasing N levels in the soil due to fertilization. High levels of N absorbed by plants can also increase the biomass weight of sweet corn plants in the form of increased cob weight. Purwati and Islami (2019) stated that the P element in fertilizer can provide energy for plant metabolic reactions which produce photosynthate and distribute it too sweet corn seeds thereby increasing the weight of sweet corn; and Herdiyantoro et al., (2022) stated that the availability of the K element in the formation and translocation of carbohydrates which are channeled to seed formation affects the formation of protein in the seeds as well as the size and weight of sweet corn cobs. The results of research reported by Made et al., (2023) show that the combination of application of urea and NPK fertilizer doses can increase the growth and yield of sweet corn plants.

4. CONCLUSION

Based on the results of the research and discussion, it is concluded as follows:

1. Application of liquid and single compound NPK fertilizer had a significant effect on increasing soil N-total, N-plant content, and yields of sweet corn on Inceptisols of Jatinangor.
2. The combination dose of 1 NPK compound (8 L ha^{-1}) + 1 dose of NPK standard (Urea 300 kg ha^{-1}, TSP 100 kg ha^{-1}, and KCl 50 kg ha^{-1}) provides the best sweet corn crop results on Inceptisols of Jatinangor.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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