THE EFFECT OF $Mg(NO_3)_2$COMPOUND FERTILIZERAND N, P, K FERTILIZER ON SOILN-TOTAL, N-PLANT CONTENTS, AND YIELD OF TOMATOES (*Solanum lycopersicum*L.) ON INCEPTISOLS FROM JATINANGOR

ABSTRACT

Inceptisols are one of the soil orders that are quite widely distributed in Indonesia, but the soil fertility level is relatively low. One of the obstacles faced by Inceptisols is the lack of macronutrients. Efforts to increase soil fertility include fertilization. The research aimed to determine the effect of applying compound fertilizer $Mg(NO_3)_2$ combined with N, P, and K fertilizer on N-total content in the soil, N-plant content, and tomato yield on Inceptisols from Jatinangor; and to obtain the best dosage for tomato yields from Inceptisols from Jatinangor. The research was carried out at the Soil Fertility and Plant Nutrition Laboratory Experiment Field and 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 from October to December 2023. The research used a Completely Randomized Block Design (CRBD), which consisted of 6 treatments that were repeated 4 times, namely as follows: A = control; B = 1 dose of N, P, K recommended (200 kg ha^{-1} Urea, 250 kg ha^{-1} SP-36, and 100 kg ha^{-1}KCl); C = 1 dose of Mg $(NO_3)_2$ compound fertilizer; D = ¾ dose of Mg $(NO_3)_2$ compound fertilizer + ¾ recommended dose of N, P, K (150 kg ha^{-1} Urea, 187.5 kg ha^{-1} SP-36, and 75 kg ha^{-1}KCl); E = 1 dose of Mg $(NO_3)_2$compound fertilizer + ¾ recommended dose of N, P, K (150 kg ha^{-1} Urea, 187.5 kg ha^{-1} SP-36, and 75 kg ha^{-1}KCl); and F = 1 ½ doses of Mg $(NO_3)_2$compound fertilizer + ¾ recommended doses of N, P, K (150 kg ha^{-1} Urea, 187.5 kg ha^{-1} SP-36, and 75 kg ha^{-1}KCl). Stages of research activities, namely: land and seed preparation, seeding, planting, applying fertilizer, plant maintenance (watering, weeding, pruning, and pest control), harvesting, data collection, data analysis, and reporting. The research results showed that the application of $Mg(NO_3)_2$ compound fertilizer and N,P,K fertilizer had a significant effect on the N-total content of the soil, N-plant content, yield components, and fruit yield of tomato plants. Treatment of 1 dose of $Mg(NO_3)_2$ compound fertilizer + ¾ recommended dose of N, P, K fertilizer resulted in the highest N-total soil content, N-plant content, and fruit weight per plot, namely respectively 0,34%; 2.01%; and 6.13 kg $plot^{-1}$ while the lowest was produced in treatment A (control), namely 0.13%; 0.99% and 1.40 kg $plot^{-1}$.

Keywords: Compound Fertilizer $Mg(CO_3)_2$; N,P,K Fertilizer, N-total soil, N-plant; Tomatoes, Inceptisols

1. INTRODUCTION

Tomatoes are one of the horticultural commodities that are widely consumed by Indonesian people, market demand for tomatoes continues to increase from year to year along with the increase in population, this has resulted in many farmers in Indonesia developing tomato cultivation (Wiryanta and Bernardinus, 2008). Data on tomato production in Indonesia in 2021 increased from 2020 by 2.71% (Central Statistics Agency, 2021). Household tomato consumption in 2022 was recorded at 687,980 tons, an increase of 1.48% from 2021, namely 677,970 tons (Central Statistics Agency, 2022). If the level of tomato consumption continues to increase without being matched by high productivity, the need for tomatoes will not be met.

To meet the needs for food in general and tomatoes in particular, the agricultural sector is required to increase its production. Increasing crop production can be achieved through various efforts, including the use of superior varieties and expanding planting areas. The Gustavi F1 tomato variety is a hybrid tomato that can adapt to the lowlands. Apart from that, this variety also has a high level of resistance to Gemini Virus and Bacterial Wilt.

Utilizing dry land is one alternative that can be done to increase crop production. One type of soil that is dominant in dry land is Inceptisol. In Indonesia, this land has a wide distribution, namely 70.52

million hectares, which means 40% of the land area in Indonesia (Soil and Agrochemical Research Center, 2003). Furthermore, it was stated by Nursyamsi and Suprihati (2005) that generally,Inceptisols have low productivity, because they have low organic matter content (<5%) and also low availability of nitrogen elements. This can affect the quality of the soil and plants cannot grow optimally (Siswanto &Widowati, 2018).

To overcome the low nitrogen content in Inceptisols by fertilizing, Widyastutik et al., (2022) stated that to achieve balanced and optimal availability of essential nutrients in the soil, it is necessary to carry out balanced fertilization. Providing fertilizer at a dose that is appropriate to the nutritional conditions of the soil will produce high productivity, apart from saving on fertilizer use and also protecting the environment.

The fertilizer used in this research is a combination of magnesium nitrate ($Mg(NO_3)_2$)compound fertilizer and N, P, and K single fertilizer. Mg(NO3)2 compound fertilizer contains macro elements, namely nitrogen (N) at 10% and magnesium (Mg) at 15%. According to Damanhuri et al., (2022), the elements N and Mg are the elements most widely used in the plant growth phase. The element N plays an important role in the formation of leaf chlorophyll which plays a role in photosynthesis, while the element Mg acts as an enzyme activator involved in the photosynthesis process (Wiyantoko et al., 2017).

The research aimed to determine the effect of applying $Mg(CO_3)_2$ compound fertilizer combined with N, P, and K single fertilizer on the N-total content in the soil, N-plant content, and tomato yield on Inceptisols from Jatinangor; and to obtain the best dosage for tomato yields on Inceptisolsfrom Jatinangor.

2. METHODOLOGY

2.1. Place and Time

This research was carried out at the Soil Fertility and Plant Nutrition Laboratory Experiment Field and 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 from October to December 2023.

2.2. Materials and Tools

The materials used are planting media in the form of Inceptisols soil from Jatinangor, Gustafi F1 tomato seeds, a mixture of cocopeat and burnt charcoal as a seeding medium, cow manure, Magnesium Nitrate compound fertilizer, fertilizer Urea, SP-36 and KCl.

The equipment used is laboratory tools for analyzing soil and plants, calipers, analytical scales, seedling trays, shovels, rulers, zip plastic, envelopes, and stationery.

2.3. Experimental Design

The research used a Randomized Group Design (RAK), which consisted of 6 treatments which were repeated 4 times, namely as follows:

A = Control

B = N, P, K recommended doses (200 kg ha^{-1} Urea, 250 kg ha^{-1} SP-36, and 100 kg ha^{-1}KCl)

C = 1 Dose of Mg (NO3)2 compound fertilizer

D = ¾ Compound Fertilizer Dose Mg (NO3)2 + ¾ N, P, K Recommendation (150 kg ha-1 Urea, 187.5 kg ha-1 SP-36, and 75 kg ha-1 KCl)

E = 1 Dose of Mg (NO3)2 + ¾ N, P, K Compound Fertilizer Recommendation (150 kg ha-1 Urea, 187.5 kg ha-1 SP-36, and 75 kg ha-1 KCl)

F = 1 ½ Dose of Mg (NO3)2 + ¾ N, P, K Compound Fertilizer Recommendation (150 kg ha-1 Urea, 187.5 kg ha-1 SP-36, and 75 kg ha-1 KCl).

2.4. Research Activities

Stages of research activities, namely: land and seed preparation, seeding, planting, applying fertilizer, plant maintenance (watering, weeding, pruning, and pest control), harvesting, data collection, data analysis, and reporting.

2.5. Data Collection

The main data collected consisted of total soil N content, plant N content, number of fruit per plant, and fruit diameter. Weight per fruit, and fruit weight per plot. Supporting data is the results of initial soil analysis before treatment.

2.6. Data Analysis

To determine the effect of applying Mg(NO3)2 compound fertilizer and N,P,K fertilizer on total soil N content, plant N content, and tomato plant yield, analysis of variance was used and continued with Duncan's multiple range test at 5% level (Gomez and Gomez, 1995). Data analysis using SPSS software.

3. RESULTS AND DISCUSSION

3.1. Initial Soil Analysis

The soil used in the research was the soil of the Inceptisols order from Jatinangor which had a pH = 6.52 (slightly acidic), C-organic content = 1.57% (low category); N-total = 0.16% (low category), C/N ratio = 10 (low category), CEC = 25.35 cmol. kg-1 (high category), base saturation = 50.39 % (medium category), P_2O_5 (Bray) = 11.10 ppm (low category), K_2O HCl 25 % = 32.20 mg.100 g-1 (medium category), texture Clay is dusty because it is dominated by dust (50%) than clay (46%), and sand (4%). Based on the results of the initial soil analysis, it shows that the Inceptisols on the research land have a low level of fertility so it is necessary to fertilize to increase soil fertility so that tomato plant growth can be optimal.

3.2. Soil N-Total Content

The statistical test results showed that the application of a combination of compound fertilizer $Mg(NO_3)_2$ and single fertilizer N, P, and K had a significant effect on the total N content of the soil. The research results are presented in Table 1.

Table 1. Effect of Mg(NO3)2 Compound Fertilizer and N,P,K Fertilizer on Soil N-total Content in Inceptisols from Jatinangor

Code	Treatments	N-Total Soil (%)
A	Control	0.13 a
B	1 dose N, P, K recommended	0.27 bcd
C	1 dosecompound fertilizer$Mg(NO_3)_2$	0.24 b
D	¾ dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	0.27 bc
E	1 dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	0.34 d
F	1 ½ dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	0.33 cd

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 results of the 5% DMRT test, it shows that the total N content in treatments B, C, D, E, and F is significantly different compared to A (control). The highest total N content was produced in treatment E (0.34%), followed by treatments F (0.33%), B and D (0.27%), C (.24%), and the lowest in treatment A (. 0.13%). The results of the study showed that the application of Mg (CO3)2 compound fertilizer combined with N, P, K (E and F) fertilizer resulted in a higher soil N-total content compared to treatments B, C, and D. This situation was caused by the application N fertilizer from both $Mg(NO_3)_2$ and Urea fertilizers can increase soil N content. As stated by Firmansyah and Sumarni (2013), applying nitrogen fertilizer to the soil, especially from Urea and ZA, can increase the total N content in the soil, but tends to reduce the pH value of the soil or in other words acidify the soil. The low total N content of the

soil at the start of the experiment caused the application of N fertilizer to have a very significant effect on the total N content of the soil. As the dose of N fertilizer increases, the total N content of the soil also increases. Providing high doses of N fertilizer can cause the total N available in the soil to be higher. Furthermore, it was reported by Widiana et al, (2020) that the application of compound NPK fertilizer affected the total N content of the soil, the application of compound fertilizer at 75% of the recommended dose resulted in the highest N-total soil content, but after the dose was increased to 125% and 150% The recommended dose does not increase the total N content of the soil and even tends to reduce the total N content of the soil.

3.3. N-Plant Content

The statistical test results showed that the combination of compound fertilizer $Mg(CO_3)_2$ and single fertilizer N, P, and K had a significant effect on the N-plant content. The research results are presented in Table 2.

Table 2. Effect of $Mg(NO_3)_2$ Compound Fertilizer and N,P,K Fertilizer on N-Plant Content in Inceptisols from Jatinangor

Code	Treatments	N-Plant (%)
A	Control	0.99 a
B	1 dose N, P, K recommended	1.88 bc
C	1 dosecompound fertilizer$Mg(NO_3)_2$	1.82 b
D	¾ dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	1.79 b
E	1 dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	**2.01 c**
F	1 ½ dosecompound fertilizer$Mg(NO_3)_2$ + ¾ dose NPK recommended	1.99 c

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 results of the 5% DMRT test, it shows that the total N content in treatments B, C, D, E, and F is significantly different compared to A (control). The highest plant N content was produced in treatment E (2.01%), followed by treatments F (1.99%), B (1.88%), C (1.82%), D (1.79%), and the lowest was in treatment A (0.99%). The results showed that the application of Mg (CO3)2 compound fertilizer combined with N, P, K (E and F) fertilizer resulted in higher plant N content compared to treatments B, C, and D. The high N content of the plants was related to closely with the total N content in the soil. This is in line with the opinion of Hardjowigeno (2015) that the availability of nutrients in the soil influences plant nutrient levels. The results of the research reported by Subhan, Nurtika, and Gunadi (2009) showed that N uptake in the roots stems, and leaves at 45 days after planting did not show significant differences between treatments, but at 75 and 90 days after planting there were significant differences, on N uptake by tomato plants treated with compound fertilizer. The N content in roots, stems and leaves reached the highest value at a dose of 1,000 kg ha^{-1}. N uptake by tomato plants at 110 days after planting from all compound fertilizer dosage treatments tended to decrease N uptake by plants compared to N uptake at 90 days after planting. Furthermore, it was reported by Widiana (2020) that plant N uptake in the compound NPK fertilizer treatment was significantly different from the control. The compound NPK fertilizer treatment of 75% of the recommended dose had the highest plant N uptake, namely 40.76 mg $plant^{-1}$, while the lowest plant N uptake was in the control treatment, namely 20.31 mg $plant^{-1}$.

The results of the research also show that there is a tendency for F treatment to reduce the N content of plants, this is due to the increasing dose of $Mg(NO_3)_2$ compound fertilizer given causing an imbalance of nutrients in the soil solution and competition for nutrient uptake by plants. As reported by

Qu et al (2023), an excessive supply of Mg fertilizer encourages roots to release phenolic acid and prevents plants from absorbing several nutrients in different vegetable plant genotypes, although it has no effect on Mg absorption by plants.

3.4. Yield of Plant

The statistical test results showed that the application of a combination of compound fertilizer $Mg(NO_3)_2$ and N, P, and K fertilizers had a significant different on the number of fruit per plant, fruit diameter, weight per fruit, and fruit weight per plot. The research results are presented in Table 3.

Table 3. Effect of Mg(NO3)2 Compound Fertilizer and N,P,K Fertilizer on Yield Components and Yield of Tomato Plants on Inceptisols from Jatinangor

	Treatments	Number of Fruit	Fruit Diameter (cm)	Weight per fruit (g)	Fruit Weight per plot (kg)
A	Control	13,73 a	2,67 a	12,90 a	1,40 a
B	1 dose N, P, K recommended	24,38 bc	3,57 b	19,55 b	5,02 bc
C	1 dose compound fertilizer $Mg(NO_3)_2$	19,50 ab	3,60 b	29,80 c	4,22 b
D	¾ dose compound fertilizer $Mg(NO_3)_2$ + ¾ dose NPK recommended	25,55 bc	3,83 b	37,45 d	5,15 bc
E	1 dose compound fertilizer $Mg(NO_3)_2$ + ¾ dose NPK recommended	26,80 c	3,84 b	36,75 d	6,13 c
F	1 ½ dose compound fertilizer $Mg(NO_3)_2$ + ¾ dose NPK recommended	23,98 bc	3,61 b	35,45 cd	4,82 bc

Note: Numbers followed by the same letter are not significantly different according to the DMRT test at the 5% significance level

Based on the results of the 5% DMRT test, the effect of Mg(NO3)2 compound fertilizer combined with N, P, and K fertilizer on the number of fruit per plant, fruit diameter, weight per fruit, and fruit weight per plot generally showed that in treatment B, C, D, E and F are significantly different compared to treatment A (control). Fertilization treatment resulted in a greater number of fruit per plant, larger fruit diameter, greater weight per fruit, and higher fruit weight per plant compared to treatment A (control). Treatment E produced the highest fruit weight per plant, namely 6.13 kg, followed by treatment D (5.15 kg), treatment B (5.02 kg), treatment F (4.82 kg), treatment C (4.22 kg), and the lowest in treatment A (1.40 kg). This is related to the large number of leaves. The number of leaves influences the increase in the rate of absorption of sunlight by the leaves which causes an increase in photosynthate yield (Ross and Salisbury, 1995). To stimulate flower formation, leaves mobilize nitrogen elements which are then distributed to flowers and fruit (Djarwatiningsih et al., 2018). The lowest number of fruit and weight was in the control treatment, namely the average number of fruit was 137.25 and the fruit weight per plot was 1.4 kg.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded, namely:

1. Providing $Mg(NO_3)_2$ compound fertilizer and N,P,K fertilizer has a significant effect on the N-total content of the soil, N-plant content, yield components, and fruit yield of tomato plants.
2. Treatment of 1 dose of $Mg(NO_3)_2$ compound fertilizer + ¾ dose of N, P, K fertilizer produced the highest total N-total content, N-plant content, and fruit weight per plot, namely respectively 0,34%; 2.01%; and 6.13 kg $plot^{-1}$ while the lowest was produced in treatment A (control), namely 0.13%; 0.99% and 1.40 kg $plot^{-1}$.

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