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Effect Of Azotobacter Sp And Urea Fertilizer (N) On Efficiency (N) Uptake As Well As Tomato Crop Yield

Anatje Lihiang
Department of Biology Education, Faculty of Mathematics of Natural Sciences and Earth, Manado State University
Email: anatjelihiang@unima.ac.id

Abstract

One of the important commodities that are widely consumed to meet nutritional and food needs, especially vegetables, is tomato (*Solanum lycopersium*). The need for tomatoes is increasing both in quantity and quality. But until now the need for vegetables in quantity and quality is difficult to meet using conventional agriculture. For this reason, the application of biological fertilizers that have the potential to reduce the use of inorganic fertilizers and are able to efficiently fertilize, namely the use of *Azotobackter* sp. The ability of these microbes to tether nitrogen from the air largely depends on environmental conditions, especially the availability of organic matter within the rhizosphere, aeration and soil moisture . Nitrogen is a very important plant nutrient. The adequacy of the supply of nitrogen in plants is characterized by the speed of plant growth and dark green leaf color. In the research of Goeswono Soepardi (1983), stated that nitrogen tethering by *Azotobacter* sp is only about 25 kh ha-1 N $^{year-1}$. Meanwhile, the need for nitrogen in tomato plants according to Tisdale *et al* (1985) is 82-120 kg ha-1 N to be able to produce about 30 tons of $^{ha-1}$ fresh tomatoes . This situation shows that to meet the needs of tomato plants for nitrogen, nitrogen fertilization is still needed even though they have received additional nitrogen from *Azotobacter* inoculated sp, that is, by fertilizing urea as a source of N. The objectives of this study are: 1. Effect of *Azotobacter* sp and nitrogen fertilizers on N uptake by plants as well as tomato crop yield, 2. The dose of nitrogen fertilizer on the inoculation of *Azotobacter* sp that gives the highest tomato yield . Based on the results of the research obtained , there was a noticeable increase in N uptake in the administration of *Asotobakter* sp inoculant treatment and accompanied by the application of nitrogen fertilizers than those that were not given *Asotobakter* sp inoculants and nitrogen fertilizers on each treatment. The highest yield of fresh tomatoes was found in the A1N3 treatment with a fresh weight of tomato fruits of 8,969.30 g / plant with a dose of nitrogen fertilizer 90 kg $^{ha-1}$.

Keywords : Asotobacter sp, nitrogen fertilizer, N uptake, tomato fruit

INTRODUCTION

One of the important commodities that are widely consumed to meet nutritional and food needs, especially vegetables, is tomato (Solanum lycopersium). The need for tomatoes is increasing both in quantity and quality. But until now the need for vegetables in quantity and quality is difficult to meet using conventional agriculture (Rosliani and Sumarni, 2005). For thispurpose, the application of biological fertilizers that have the potential to reduce the use of inorganic fertilizers and are able to efficiently fertilize, namely the use of Azotobackter sp, which is a non-symbiotic bacterium as a tether to the N element of air, this microbe is heterotrophic which uses organic compounds as an energy source and develops under aerobic conditions . The ability of these microbes to tether nitrogen from the air largely depends on environmental conditions, especially the availability of organic matter inside the rhizosphere, aeration and soil moisture. Its tethering efficiency is about 10 to 20 mg N g-1 carbohydrates (Subba-Rao, 1992; Paul and Clark, 1989; Shabaev et al,1991). In the research of Goeswono Soepardi (1983), stated that nitrogen tethering by Azotobacter sp is only about 25 kh ha-1 N year-1. Meanwhile, the need for nitrogen in tomato plants according to Tisdale et al (1985) is 82-120 kg ha-1 N to be able to produce about 30 tons of ha-1 fresh tomato . This situation shows that to meet the tomato plant's need for nitrogen, nitrogen fertilization is still needed even though it has received additional nitrogen from Azotobacter sp which is inoculated, y iitu with urea fertilization as a source of N. According to Syaifudin, et al (2013) Urea is a source of nitrogen fertilizer that contains essential elements to support high plant productivity with low production costs and

nitrogen content high. Nitrogen is a very important plant nutrient. The adequacy of the supply of nitrogen in plants is characterized by the speed of plant growth and dark green leaf color. Nitrogen imbalances or too large of these nutrients compared to other elements such as P, K and S can result in lengthening of growth periods and delayed maturity (Tisdale et al , 1985). According to Goeswono Soepardi (1983), of the three main nutrients that are usually applied as fertilizers, the element nitrogen exerts the most striking and rapid influence. In almost all crops, including tomato plants, nitrogen is a part of the use of potassium and phosphorus (Sarief, 1993).

Nitrogen in plants plays a role in the formation of proteins and vegetative growth of plants (Hardjowigeno, 1987). Nitrogen-deficient plants are characterized by the occurrence of slow growth, the plant becomes stunted, the leaves are small and almost yellowish in color , vegetative growth becomes short , and root growth especially the growth of branch roots is stunted. Conversely , excessive nitrogen will lead to longer vegetative growth, succulent plants, and disease sensitivity. (Tisdale et al, 1985; Jones, 1990). According to Marsechner (1986), too high a nitrogen will affect plant morphology, i.e. the extension of the pupus increases and the elongation of the roots is inhibited. This will cause the uptake of nutrients that are not available such as phosphorus to decrease so that there is a decrease in the quality and quantity of tomatoes, and can also cause polusion water, ozone damage in the stratosphere, and acid rain generated by the abundance of NOx (Mengel, 1990). Therefore , research is needed to see the influence of microbes (Azotobacter sp) applied with urea (N) fertilizer on nutrient uptake and plant yields tomatoes. With the purpose of the study, namely:1. Effect of Azotobacter sp and nitrogen fertilizers on N uptake by plants as well as tomato crop yield, 2. The dose of nitrogen fertilizer on the inoculation of Azotobacter sp that gives the highest tomato yield .

Research Methodology

Place and Time

This research was carried out in the laboratory of FMIPA Unima, and green house department of biology education. The implementation time is from February to August 2022.

Materials and Tools

The experimental material consists of soil derived from the experimental garden of the Unima Department of Biology. Urea fertilizer as a treatment (45% N) and inoculant type are Azotobacter sp, tomato seeds, chemicals are used for plant N uptake analysis. In this experiment, laboratory equipment was used for the preparation of Azotobacter sp inoculants, plant analysis, soil sample preparation tools, scales and maintenance tools , watering and pest and plant disease control. For the container of planting media used black polybags , yesng can load soil 10 kg dry air.

METHODS

The treatment in this experiment consisted of applying Azotobacter sp inoculants and nitrogen fertilizer (urea). Ao = No Azotobacter sp inoculant and A1 = Azotobacter sp inoculant is established using the Methot Dilution Plate method. The application of nitrogen fertilizer (urea) consists of four levels, namely: No = no nitrogen fertilizer (0 kg ha-1 N), N1=30 kg ha-1 N, N2= 60 kg ha-1 N , N3= 90 kg ha-1 N.

Trial Design

This experiment was carried out using a randomized design of factorial-patterned k clusters with two factors, *Azotobacter* sp inoculant and nitrogen fertilizer (urea) dose, this experiment was repeated three times So there are 24 experimental units. Observations were made seven weeks after planting (maximum vegetative phase), to see N uptake and tomato crop yield, 24 experimental polybags were used with plants up to fruitful plant.

Response Design

The response to the co-ordination of factors A and B treatment observed in each experimental unit consisted of the following variables: Ntotal plant at seven weeks of age after planting, obtained through multiplication between the concentrations of these elements based on the analysis of N plant tissues according to the wet digestion method using H_2SO_4 and H_2O_2 with Taotal dry weight of plants,

the yield of tomatoes of each plant at the time of harvest (weight of fresh fruit) obtained through weighing the fresh fruit of each plant.

RESULTS AND DISCUSSION

Based on the results of observations, until the second week since the experimental plant still showed uniform growth. Differences due to treatment begin to appear after the plant is two weeks after planting.

Nitrogen Uptake

Table 1. Nitrogen Uptake of Tomato Plants Seven Weeks After Applying inoculants and nitrogen fertilizers.

Treatment	N uptake (mg/plant)
A0N0	229.8262 a
A0N1	230. 7137 a
A0N2	253.3849 b
A0N3	272.4194 c
A1N0	252. 8788 b
A1N1	289.8379 e
A1N2	304.3703 f
A1N3	304.3787 f

Description: The numbers followed by the same small number indicate that they are not significantly different in the 0.05% SKS test.

Interactively inoculant Azotobacter sp with a dose of nitrogen fertilizer, with an unnoticeably increased dose increases the uptake of nitrogen by tomato plants. The effect of applying Asotobacter sp inoculants and nitrogen fertilizers with independently increased doses is significantly meaningful in increasing nitrogen uptake by tomato plants. Administration of Asotobacter sp inoculants increases nitrogen uptake by tomato plants. A noticeable increase in N absorption occurred in the Asotobakter sp inoculant treatment with an absorption value of 252.8788 mg / plant in the A1N0 treatment. This situation indicates the influence of Asotobakter sp inoculants in increasing nitrogen uptake of tomato plants. Asotobakter sp inoculants administered can contribute nitrogen to plants from additional results of air N. In addition, growth hormones synthesized by Asotobakter sp (Toledo et al, 1988) can stimulate root growth. Thus, there is an increase in N uptake in plants inoculated by Asotobakter sp.

An increase in the dose of nitrogen fertilizer (urea) applied causes an increase in nitrogen uptake by tomato plants, A noticeable increase in N uptake occurred in the A0N3 treatment with an absorption value of 272.4194 mg / plant. In the uptake of N plants showed an interaction between the treatment of Asotobacter sp inoculant administration and nitrogen fertilizers (Table 1). The parameters of plant N uptake with the application of Asotobacter sp inoculants and nitrogen fertilizers differed markedly in the treatment that asotobacter sp inoculants or nitrogen fertilizers were not given. The highest plant N absorption was found in the A1N3 treatment with an absorption value of 304.3787 mg / plant. This occurs in connection with the quantitative increase in nitrogen derived from urea fertilizer and Asotobacter sp inoculants as air N tethers. Therefore , plants can raise more nitrogen when compared to without the application of nitrogen fertilizers and Asotobacter sp inoculants . The results of the analysis of N concentrations in upper plant tissues ranged from 4.06% to 5.04 %. This value is still within the range of sufficient criteria for tomato plants, namely 4% to 6% (Jones et al, 1991).

Fresh Tomato Fruit Weights

Interactively inoculant Asotobakter sp with a dose of nitrogen fertilizer with an increased dose is not real means increasing the weight of fresh tomatoes. The effect of applying Asotobakter sp inoculants and nitrogen fertilizers with an increased dose is marked, which means increasing the weight of fresh tomatoes.

Table 2. Weight of Fresh Tomato Fruit Due to Inoculant Administration of Asotobakter sp and nitrogen fertilizers.

Treatment	Fresh Tomato Weights (g/plant)
A0N0	5.924. 15 a
A0N1	5.972.60 A
A0N2	6.0 10.77 A
A0N3	6.862.24 b
A1N0	5.9 93.66 a
A1N1	8.521.84 c
A1N2	8,799.46 s
A1N3	8.969.30 e

Description: The numbers followed by the same small number indicate that there is no real difference in the 0.05% SKS test.

The application of Asotobakter sp inoculants and nitrogen fertilizers noticeably increases the weight yield of fresh tomato fruits. This condition is associated with an increase in growth and absorption of N, so that the need for these nutrients in the generative phase is fulfilled. The increase in fresh tomato fruit yield due to Asotobakter sp inoculants was 23.3%, 26.9%, and 43.8%, respectively.

Inoculants with Asotobakter sp cause increased plant growth. This happens because these bacteria contribute nitrogen to plants from additional results and the synthesis of growth hormones by bacteria that are useful for plant growth. Thus, the uptake of N increases which also results in an increase in the yield of fresh tomatoes.

The application of nitrogen fertilizers noticeably increases the weight of fresh tomato fruits of each plant. This shows that nitrogen is one of the determining nutrients in tomato production. The same thing was expressed by Supriyona and Sutaryo (1992), the increase in nitrogen fertilizer has a focus on the fresh weight of tomatoes. At a dose of nitrogen fertilizer of 90 kg ha-1 N, the yield of tomato fruits is highest compared to other treatments.

The increase in fresh fruits of tomatoes due to the application of nitrogen fertilizers was successively by 24.9%, 48.3% and 39.2% at doses of nitrogen fertilizers of 30, 60 and 90 kg ha-1 N. The optimum dose of the treatment without the Asotobakter sp inoculant occurred at a nitrogen fertilizer dose of 90 kg ha-1 with a fresh tomato fruit yield of 6,872.24 g / plant. The optimum dose of the treatment withoutnitrogen fertilizer occurred in the Asotobacter sp inoculant with a fresh tomato fruit yield of 5,824.15 g / plant. The highest fresh tomato fruit was found in the A1N3 treatment (Azotobakter sp inoculant and 90 kg ha-1 nitrogen fertilizer. This means that the weight yield of fresh tomato fruits due to nitrogen fertilization accompanied by Azotobakter sp inoculants that synergize with each other provides sufficient nitrogen uptake for nutrient needs of tomato plants. The adequacy of the supply of nitrogen in plants is characterized by the speed of plant growth. Nitrogen in plants plays a role in protein formation and plant vegetative growth (Hardjowigeno, 1997; Sarief, 1993). According to Mengel and Kirkby (1987), nitrogen is the basic element for a number of important organic compounds such as amino acids, proteins and nucleic acids.

CONCLUSION

The results showed that Asotobacter sp can increase N uptake in tomato plants, Asotobacter sp inoculant treatment and nitrogen fertilizer interactions occurred in the N absorption meters and fruit yields fresh tomatoes. The highest tomato yield was found in the A1N3 treatment (Asotobacter sp inoculant and 90 kg ha-1 nitrogen fertilizer) of 8,969.30 g/plant. Nitrogen fertilization produces a marked influence on the absorption of n N and the yield of fresh tomato fruits, the increase in the dose of nitrogen fertilizer can be applied to the inoculant Asotobacter sp increase the uptake of N and the yield of fresh tomato fruits.

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