

The Effect of NPK Fertilizer on N Total, N-Uptake, and Shallot Yield (*Allium ascalonicum* L.) on Inceptisols Jatinangor

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Abstract: Shallot (*Allium ascalonicum* L.) is a horticulture commodity that has a lot of benefits also prospective regarding its increasing demand. Each year, shallot productivity in Indonesia is unstable due to nutrient degradation on agricultural land, therefore efforts are needed to increase the productivity of shallot. One of the solution is by using NPK fertilization. This experiment aims to determine the effect of NPK compound fertilizer on N total, N-uptake, and shallot bulb yield. This research conducted at the Soil Chemical and Plant Nutrition Experiments Field, Faculty of Agriculture, Padjadjaran University, Jatinangor, from February to June 2019. The experimental design using Randomized Block Design (RBD) consisted of one control treatment as a comparison, one N, P, K single fertilizer treatment (250 kg ha⁻¹ Urea, 125 kg ha⁻¹ ZA, 200 kg ha⁻¹ SP-36, and 250 kg ha⁻¹ KCl), and eight NPK compound fertilizer treatments of various doses with three replications. The results showed that the NPK compound treatment affected the total N, N uptake, and shallot bulbs yield. Treatment of 75% NPK compound (675 kg ha⁻¹) obtained the highest results of fresh bulbs weight at 41.64 g clump⁻¹ and dry bulbs weight at 25.27 g clump⁻¹.

Keywords: Inceptisols, NPK Compound, N Total, N-uptake, Shallot

1. Introduction

Shallot (*Allium ascalonicum* L.) is an annually horticulture commodity belongs to *Liliaceae* family and can be propagated either generative or vegetative. The benefit of Shallot most used as a complement spices to make cuisine flavorful as well as traditional medical ingredients. Shallot can be produced in almost regions of Indonesia, due to the characteristic of its soil which contains organic, moist, and loose material. In which greatly encourages the development of shallot bulbs that improves the quality of yield [1].

Shallot production in Indonesia is quiet high, yet it is unstable. In 2014, the productivity of Shallot was 10.22 t ha⁻¹, in 2015 was 10.06 t ha⁻¹, in 2016 was 9.67 t ha⁻¹, in 2017 was 9.31 t ha⁻¹, and in 2018 was 9.59 t ha⁻¹ [2]. This issue regarding to shallot productivity can be caused by nutrient degradation on agriculture land, which causes shallot

planting to be carried out in a low level nutrient availability in soil, furthermore it impacted the unstable number of shallot productivity in Indonesia.

One of the factor causing low productivity is due to suboptimal use of Inceptisols in Indonesia. Inceptisols is an ordo of extensive land, the characteristics are: solum is rather thick (1-2 m), black or grey to dark brown colour, crumbly soil structure, acidity level (pH) around 5.0 to 7.0, organic matters less than 20%, and moderate productivity [11]. The fertility rate of inceptisols is relatively low due to acidic pH, surface washability, and contains of high clay. Those characteristic are relevant with the inceptisols in Jatinangor.

In order to minimize this issue regard to low-fertility soil is by applying compound fertilizer. It has advantages compared to single fertilizer. It contains more nutrients and easier practical in its application [3]. Besides, Shallot needs to be well-nutrient to be able to grow and produce optimally. It

shows that using compound fertilizer is a determining factor for shallot to be high cultivated. The addition of NPK fertilizer is possibly increasing the number of leaves, tillers, and dry weight of Shallot. The variety of shallot in this study is Trisula varieties. It has a high number of productivity than others.

The provision of organic and inorganic fertilizer is basically aims to find best the nutrients needed by plant. The soil are generally have insufficient-balance nutrient rate. Fertilizing need to be adjusted regarding the needs of the plant itself [4]. Several studies report that the input of N, P and K for shallot crop varieties can be sourced from the application of fertilizer: urea 250 kg ha⁻¹ + SP-36 300 kg ha⁻¹, KCl 100-200 kg ha⁻¹ [13-15]. Thus, this study aims to determine the effect of NPK compound fertilizer on total-N; N-uptake, and shallot yield bulbs and investigate best doses of NPK compound fertilizer which increase the total-N, N-uptake, and shallot yield on Jatinangor inceptisols.

2. Materials and Methods

2.1. Site Description

A field experiment was conducted on February to June 2019 at the experimental field station of Agriculture Faculty, Universitas Padjajaran. The elevation of the area is approximately 752 m above sea level. Previous study showed that the inceptisols characteristics are pH of 6.32, C-organic of 1.57%, C/N ratio of 10, total N content of 0.16%, total P content of 21.22 mg kg⁻¹, and potential K of 31.88 mg 100g⁻¹. Low to medium cation rate.

2.2. Experimental Design

The study arranged in Randomized Block Design consisted of 10 treatments and 3 replications, there were 30 plots. The treatments were as followed: A = Control; B = singular N, P, K; C = 25% of compound NPK; D = 50% of compound NPK; E = 75% of compound NPK; F = 100% of compound NPK; G = 125% of compound NPK; H = 150% of compound NPK; I = 50% of compound NPK + 50% of singular N, P, K; J = 75% of compound NPK + 75% of singular N, P, K.

2.3. Plant Sampling and Analysis

Plant sampling is carried out when the plant entered the maximum vegetative phase with a sign of flower discharge at the age of 42 DAP (Day after plant). Plant samples were taken by cutting the entire stalk of Shallot from the surface to the tip of the tubers. Steps start from (1) carrying five points of plant sample, (2) weighing, (3) putting in an envelope, (4) drying for approximately seven days. After drying process, (1) blending leaves to smoothness of 0.5 mm, (2) putting in a clear plastic bag, (3) labelling, (4) analyzing N uptake at the laboratory. Soils sampling was taken from different soils in the area around the roots of the plant (rhizosphere) at 42 DAP. It was carried from (1) five samples diagonally of each treatments, (2) compiling, (3) putting approximately 500 g

into clear plastic bag, (4) labelling, (5) analyzing N-total at the laboratory.

2.4. Data Analysis

All data analysis performed by Statistical Package for the Social Sciences (SPSS) software package (version 16). Testing the effect differ average rate using F test method in significance of 95% and Duncan's Multiple Range Test in a difference level of 5%.

3. Results and Discussion

3.1. N Total

N Total soil is the total amount of N contained in the soil. Total N testing was performed by the Kjeldahl method consisting the process of destruction, distillation, and titration. The results of statistical analysis showed that NPK compound fertilizer has a significant effect on total N in the soil.

Table 1. The effect of NPK compound fertilizer towards N total.

Code	Treatment	N Total (%)
A	Control	0,13 a
B	Standard N, P, K fertilizer	0,17 b
C	25% doses of NPK compound fertilizer	0,17 b
D	50% doses of NPK compound fertilizer	0,17 b
E	75% doses of NPK compound fertilizer	0,21 c
F	100% doses of NPK compound fertilizer	0,18 b
G	125% doses of NPK compound fertilizer	0,17 b
H	150% doses of NPK compound fertilizer	0,17 b
I	50% doses of NPK compound fertilizer + 50% doses of singular N, P, K fertilizer	0,17 b
J	75% doses of NPK compound fertilizer + 75% doses of singular N, P, K fertilizer	0,17 b

Note:

Letters of a b and c are explain the different significance. The numbers as followed by the same letters in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

According to the Table 1, it shows that NPK compound fertilizer is possibly increasing the number of N total in the soil. Giving NPK compound fertilizer with high doses causing higher N total in the soil. It happened due to the higher quantity of fertilizer, the more sorption of nutrient. Based on the data, 75% of NPK compound fertilizer treatment produced higher N total than other treatments, average of 0.21%. Compared to control, it showed the lowest rate at the average of 0.13%. While 150% treatment only produced 0.17%, it is not significantly different compared to others. The result shows that the use of uncontrollable inorganic fertilizer is highly possible to reduce productivity and decreasing quality of the soil. The addition of uncontrol fertilizer does not increase the yield, yet it reduces the efficiency of fertilizer itself [5]. Thus capacity of plant should be more considered, in order to achieve shallot on high productivity.

3.2. N-Uptake

N-uptake is an overview of the many nutrients that are

absorbed by the plant, which is obtained by multiplying the dry weight of the nutrient concentration in the plant tissue. Plant tissue analysis results can be useful when having a positive correlation with the response of plants. If the value of plant tissue analysis is low, the plant growth or production would fell.

Conversely, if the value of plant tissue analysis is high means that the plant can exhibit his maximum genetic potential [8]

The analysis result showed that NPK compound fertilizer treatment was significantly different from control treatment toward N uptake. See Table 2 below:

Table 2. The Effect of NPK Compound Fertilizer towards N-Uptake.

Code	Treatment	N-Uptake (mg plant ⁻¹)
A	Control	20,31 a
B	Standard N, P, K fertilizer	34,12 cd
C	25% doses of NPK compound fertilizer	22,15 ab
D	50% doses of NPK compound fertilizer	23,39 ab
E	75% doses of NPK compound fertilizer	40,76 d
F	100% doses of NPK compound fertilizer	36,23 cd
G	125% doses of NPK compound fertilizer	30,92 bc
H	150% doses of NPK compound fertilizer	29,01 abc
I	50% doses of NPK compound fertilizer + 50% doses of singular N, P, K fertilizer	31,24 bc
J	75% doses of NPK compound fertilizer + 75% doses of singular N, P, K fertilizer	24,19 ab

Note:

Letters of a b and c are explain the different significance. The numbers as followed by the same letters in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

Regarding to Table 2, 75% doses of NPK compound fertilizer treatment showed the highest N-uptake of 40.76 mg plant⁻¹. While the lowest result is control treatment, average rate at 20.31 mg plant⁻¹. The 75% NPK compound fertilizer treatment has the highest result, it happened because the capability in absorbing depend on the capacity of each plant [6], in this case, Shallot. Thus, Shallot in Jatinangor inceptisols absorbs N nutrient optimally at the 75% doses of NPK compound.

3.3. The Yield of Shallot

The analysis result showed that NPK compound is significantly affected of weight, both fresh and dried bulb. Based on this study, 75% doses of NPK compound fertilizer treatment achieved highest number of fresh and dried yield, at the average of 41.64 g and 25.27 g. While the control treatment shows the lowest result at the average of 24.20 g and 14.40 g. It happened because there was no addition of NPK fertilizer, hence the plant's nutrient could not be fulfilled. See Table 3 below:

Table 3. The Effect of NPK Compound Fertilizer towards Shallot Yield.

Code	Treatment	Fresh Yield Bulb (g clump ⁻¹)	Dried Yield Bulb (g clump ⁻¹)
A	Control	24,40 a	14,40 a
B	Standard N, P, K fertilizer	35,40 bc	20,40 b
C	25% doses of NPK compound fertilizer	29,87 b	17,60 ab
D	50% doses of NPK compound fertilizer	30,27 bc	18,13 ab
E	75% doses of NPK compound fertilizer	41,64 d	25,27 c
F	100% doses of NPK compound fertilizer	36,00 c	21,20 b
G	125% doses of NPK compound fertilizer	32,87 bc	20,13 b
H	150% doses of NPK compound fertilizer	32,53 bc	19,33 b
I	50% doses of NPK compound fertilizer + 50% doses of singular N, P, K fertilizer	34,07 bc	20,33 b
J	75% doses of NPK compound fertilizer + 75% doses of singular N, P, K fertilizer	30,87 bc	18,87 b

Note:

Letters of a b and c are explain the different significance. The numbers as followed by the same letters in each column are not significantly different according to the Duncan's Multiple Range Test at 5% level.

It showed lower result than Trisula variety bulb number usually achieved, at the average of 39.0-93.3 g. The soil analysis was showed that the soil on the experimental field has a predominantly clay texture. It significantly interfere the growth and development process of tuber enlargement.

According to the table 3, F until J treatment has >75% doses of fertilizer. The excessive fertilizer doses will caused lower result of shallot yield, both fresh and dried yield. It is suspected that the doses was not well-performed, thus it could not make the soil to be optimally nutrient and caused insufficient nutrient balance [7]. If nutrient disruption

happened, it possibly distract the metabolic process. Hence, decreasing the number of yields [9].

Through this study, the best dose of NPK compound fertilizer given to shallot in Jatinangor inceptisols is 75%. This dose gives the highest result on N total, N-uptake, and yield. The high N nutrient greatly affect Shallot's growth. N and P absorption optimizes height, tillers, fresh and dried tuber weight [10]. That expressing the nutrient balance in the soil plays an important role in the synthesis of carbohydrates and protein so that helps enlarge the shallot bulb, which ultimately gained maximum bulb production [14]. In

addition, the spacing combination of 20 x 15 cm + NPK fertilizer application gave the highest number of fresh and dried yield [14]. To be well produce, Shallot require most of the N, P, and K nutrient below the soil. Thus shallot nutrient-need could be fulfilled, grow and produce optimally.

4. Conclusions

Research shows that the total N, N uptake, and yield of shallots that are applied with NPK fertilizer are very significant in Jatnangor inceptisols. this shows that fertilizers have important impacts on the vegetative growth of plants. 75% NPK treatment (675 kg ha⁻¹) obtained the highest yield of fresh tuber weight at 41.64 g of clump⁻¹ and dry tuber weight at 25.27 g of clump⁻¹. Thus, the 75% NPK treatment showed the best results on the Shallots results in the Jatnangor Inceptisols. this proves that in addition to being able to help vegetative growth, NPK fertilization can have a positive impact on generative onion plants and it is best to provide 75% NPK fertilizer.

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