ISBN 978-602-344-252-2

Application effect of cow manure growth and yield of shallot in inceptisols

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ABSTRACT

Intensive inorganic fertilization without applying organic materials enhances nutrient depletion. Application of cow manure is nessasary to improve soil fertility including Inceptisols. The experiment was conducted in sreen house of IAERI at Jakenan, Pati, Central Java province to determine appropriate dose of cow manure in providing better growth and yield of shallot cultivated in Inceptisols. Experiment was conducted from December 2014 till May 2015 using a randomized complete design (RCD) with 7 treatments (control, cow manure 5 , 10 , 15, 20, 25 and 30 tons/ha respectively) and 4 replications was applied which is The results showed more high application of cow manure will increase the leaf growth and more hight bulbs yield. The best yield show on treatment 30 t/ha cow manure based on the weight of the bulb yield. Manure application increase soil pH from 5.5 to 6.4. Economically dose of 20 tons cow manure per ha was the most efficient in terms of cost and bulb production.

Keywords: *cow manure, shallot, inceptisol, plant height, yield*

INTRODUCTION

Shallot is a horticultural commodity classified as spice vegetables, bulb-shaped, have a distinctive taste and can be used as cooking seasonings both household consumption, and processing industry. This commodity can potentiall be exported because of its high economic value and great opportunities (Puspitasari et al., 2015). Shallots are also used as traditional medicine or ingredients for the food industry which is currently growing rapidly (Putrasamedja et al., 1996).

Shallots can be planted in the lowlands and highlands, namely at an altitude of 0 – 1000 m above sea level (the optimum altitude at 400 m above sea level), climate support includes air temperatures of 25 – 320C (dry climate), rainfall ranges 300 – 2000 mm/year, air humidity of 80 – 90%, open place without shade with ± 70% lighting, radiation more than 14 hours/day because shallots requires long enough sunlight, the blowing wind has a good effect on

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the photosynthesis rate and the formation of tubers on shallots (Latarang et al, 2006).

Shallots can be cultivated in various types of soils. Besides that, shallots grow well on fertile soil, loose, a lots of organic matter content, soil texture of sandy clay, acidity (pH) 5.5 – 6.6, good drainage and aeration (Deptan, 2007 and BPPT, 2007 in Kusumasari et al., 2011). Shallots can be planted on dry land, with varying types of soils from Alluvial, Latosol and Andosol soils. The types of land affect the results and quality of shallots bulbs (Sunarjono, 1995). Latosol soil can be equaled with Inceptisols based on its characteristict soil. Inceptisols are located at an altitude of 10 – 1000 meters, with hilly to mountainous conditions. Inceptisols are red, brown to yellowish., with a pH of 4.5 - 6.5 (acidic to slightly acidic), and contain organic matter around 5% (Deptan, 2007 and BPPT, 2007 in Kusumasari et al., 2011).

Inceptisols are not very fertile because of lacks nutrients. Excessive use of chemical fertilizers without returning organic materials to agricultural land causes nutrients depletion in soil. Therefore it is necessary to restore or increase soil fertility. One of them is by applying manure to provide additional nutrients, beside improving soil physical and biological properties, and increasing water holding capacity. Plant requirements for manure depend on soil fertility and type of manure. However, the average of recommended dosage ranges from 5-20 t/ha (Wahyuni, 2014).

Based on the description above, it is necessary to conduct research on the appropriate dose of manure on growth and yield of shallots. The right dose is expected to provide a satisfying harvest for farmers. The appropriate dose will not be wasted due to lack or excess of manure. This study aims to determine the appropriate dose of manure for growth and yield of shallots.

MATERIALS AND METHODS

This research was conducted in the screen house of Indonesian Agriculture Environment Research Institute, Sidomukti Village, Jaken Sub-District, Pati District, Central Java. Research has been carried out in December 2014 until May 2015.

The material used for the research is shallots variety “fauzi” obtained from agricultural shops in Jakenan, cow manure, inorganic fertilizer (urea, KCl, SP-36, NPK).The dose of NPK fertilizer used is 300 kg/ha, urea 250 kg/ha, KCl 100 kg/ha and SP-36 100 kg/ha. The equipment used for this research was pots, shovel, scales, treatment nameplates, rulers, ballpoints, and notebooks.

The experiment used pots for planting media, each pot was filled with 5 kg of soil assuming that 1 hectare of land has 2.000.000 kg of soil. A part of soil

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samples were analyzed initially some chemical properties in laboratory of IAERI. Some chemical properties analyzed were cation exchange capacity (CEC) and exchangeable cations (acetate ammonium pH 7.0 method), C-organic (Walkly and Black method), N-total (Kheydahl method), P-total (Morgan Wolf method), and K-total (Morgan Wolf method). Soil samples were prepared with air drying, and sieving. Soil samples were sieved with particle size of <2mm and <0.5 mm (Eviati and Sulaiman, 2012).

The experiment used a completely randomized design (CRD) with 7 treatments, namely: control/without manure (B1), manure 5 tons/ha (B2)
manure 10 tons/ha (B3), manure 15 tons/ha (B4), manure 20 tons/ha (B5), manure 25 tons/ha (B6) and manure 30 tons/ha (B7). Each treatment was replicated 4 times so that totals were 28 experimental pots.

The application of inorganic fertilizers is carried out 3 times, namely at 3, 21 and 35 day after planting (DAP). Fertilizers applied at 3 days after planting were a dose of SP-36 ,1/3 part of urea, 1/3 part of KCl and 1/3 part of NPK. At 21 days after planting, fertilizers applied were 1/3 part of urea, 1/3 part of KCl and 1/3 part of NPK.
And the last one, when the plant entered 35 days after planting, the shallots plant was applied 1/3 part of urea, 1/3 part of KCl and 1/3 part of NPK.

Parameters that mesured were plant high, leaf amount, pH, and clumb weight. Measurement of plant height were conducted every 7 days, namely at 7, 14, 21.28, 35, 42, 49, 56 and 63 days after planting. Measurement of acidity level (pH) was every 14 days. Shallots yield is obtained from weighing tubers/clump. Data were analyzed with the SPSS ver. 16 using variance (ANNOVA) with Duncan's advanced test 5%.

RESULT AND DISCUSSION

Inceptisols are relatively less fertile because of poor nutrients. From Table 1, Inceptisols organic C of 0.31%, low of cation exchange capacity (CEC) of 6.60 cmol(+)/kg..

ISBN 978-602-344-252-2

Table 1. Results of soil nutrient analysis of experimental land

Organic Matter	Methods	Value	Criteria
N-total (%)	Kheydahl	0,06	Very Low
C-organik (%)	Walkley & Black	0,31	Very Low
P-total (mg kg^{-1})	Morgan Wolf method	90,22	Very High
K-total (mg kg^{-1})	Morgan Wolf method	237,77	Very High
KTK ($cmol^{(+)}kg^{-1}$)	NH4OAc pH 7	6,60	Low
pH H_2O	electrode (1:5)	6,46	a little acid.

Soil pH from laboratory analysis was 6.6. Soil acidity is a soil reaction, namely acidity or alkalinity which is expressed with a pH value. The pH value indicates the amount of concentration of hydrogen ions (H +) in the soil solution. Soil pH has an important role in determine nutrient status in soil such as nutrient availability solubility of Al and Fe ions and increase of soil microorganisms activity of (Bachtiar *in* Wahyuni, 2014). The C-organic content of the analysis was 0.31% included in the low criteria. The element C is needed in the soil to absorb more contamination of organic compounds in the soil. The total N-value of 0.06% is included in the medium criteria.N-total serves to provide macro nutrients that are indispensable for plant growth and increase soil fertility. Soil fertility is the ability of the soil to provide nutrients in sufficient and balanced quantities for the growth and yield of crops (Wahyuni, 2014).

Cation exchange capacity (CEC) is one of the soil chemical properties that is closely related to nutrient availability for plants and is an indicator of soil fertility. CEC indicates the total number of cations that can be exchanged on the surface of a negatively charged colloid. The CEC of soil for planting media is 6.60 $cmol^{(+)}$/kg..

Soil is a natural growing medium that provides nutrients for plants to grow well. In order for plants to produce optimally, soil quality must be maintained. Mistakes in processing and treating the soil can damage the soil, resulting in decreased crop productivity. Application of organic fertilizer can maintain soil quality. One organic fertilizer that is easily obtained is manure from animals or livestock. Manure requirements for each type of soil and plants are different.

ISBN 978-602-344-252-2

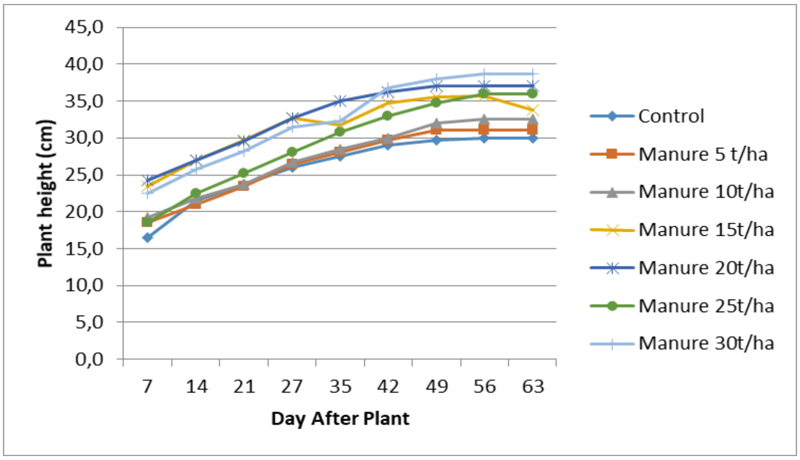

Figure 1. Plant height of shallots in different dose of for manure

From Fig 1, the manure treatment of 20 tons/ha shows the highest plant height from the initial phase of growth up to 35 days after planting. While 30 tons/ha of manure treatment gives the highest plant height from 35 days after planting until harvest. It was seen that the higher the dose of manure tend to give the higher the plant growth.

Application of manure also affects soil pH. Manure can increase soil pH soil so that it is close to neutral pH. Fig 2 shows that application of 30 tons manure per hectar could made the highest pH. Prayudi and Kusumasari (2011) states that the soil conditions used for shallots farming in Brebes Regency generally have low organic matter content because farmers have almost never provided organic fertilizer on their land, while the use of inorganic fertilizers is quite high. This causes a long-term decline in soil fertility. Therefore, the application of organic fertilizer in sufficient quantities as needed will improve the level of soil fertility in supporting optimally shallot plant growth.

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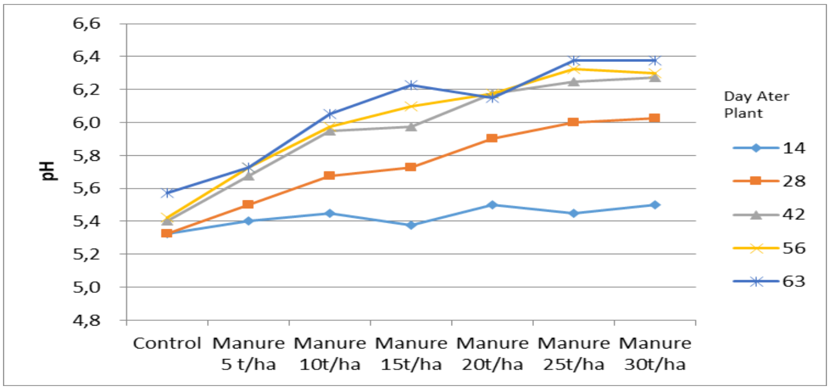


Picture 2. Graph between pH with treatment of manure

Table 2 presents that the highest yield was obtained in the treatment of 30 tons/ha manure. Statistical results show that shallot yield in treatment of was higher significantly than treatment of 0, 5, and 10 tons manure per ha, however, it did not differ significantly with treatment of 15, 20, and 25 tons manure per ha.

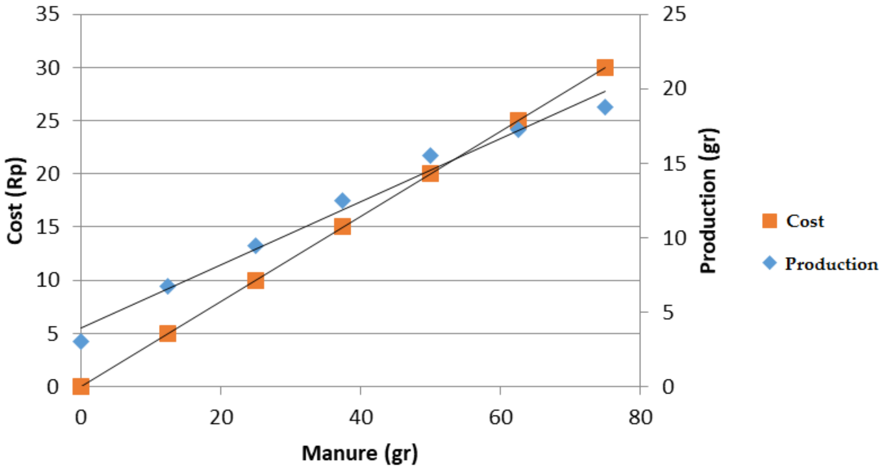
Table 2. Yield of shallots tuber per clump in several dose of manure

Treatment	Yield (g)
Control	3.00^{a}
Manure 5 tons/ha	6.75^{ab}
Manure 10 tons /ha	9.50^{bc}
Manure 15 tons /ha	12.50^{bcd}
Manure 20 tons /ha	15.50^{cd}
Manure 25 tons /ha	17.25^{d}
Manure 30 tons /ha	18.75^{d}

Note : The numbers followed by the same letter in the same column are not different at Duncan's test level $\alpha = 0.05$

Manure is used because it is easily obtained from farmers and is relatively cheap. Researchers tried to see in terms of the economic value of the use of manure to improve the physical properties of Inceptisols. It is assumed that the price of manure among farmers is IDR 400 per kg. Fig 3 shows that the linear line met at the maximum point in the application of 20 tons/ha is the most appropriate and economically efficient dose.

ISBN 978-602-344-252-2



Picture 3. Correlations between manure, production and costs.

Economically, the cost of cultivation (purchase of fertilizer) and the most effective results is on the treatment of 20 t/ha manure. While giving manure more than 20 t / ha gives more tuber yield than the previous dose, but the cost is more.

CONCLUSIONS

Application of 30 ton manure per hectar gives the highest yield of shallots tubers. Economically, 20 t/ ha of manure the most appropriate dose in terms of costs and results.

ACKNOWLEDGEMENS

The author would like to thank Mr. Slamet Rianto for helping actively observe the growth of shallots, measuring plant height, measuring soil pH and harvesting.

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