Application Of Organic And Inorganic Fertilizer Improving The Quantity And Quality Of Shallot Yield On Dry Land

Sri Anjar Lasmini, Zaenal Kusuma, Mudji Santoso, Abdul Latif Abadi

ABSTRACT: The study aims to assess changes in soil fertility and determine the type of organic fertilizer and the optimal dose of inorganic fertilizers in increasing the quantity and quality of bulb yield on dry land. A split plot design with two factors was used in this research: the first factor as the main plot is a combination of mulch and organic matter consists of two levels, namely: O_1= straw mulch+cow manure, O_2= straw mulch+*Gliricidia* leaves. The second factor as the subplot is inorganic fertilizer consisting of four levels, namely: A_0= Without Fertilizers, A_1= 50kg urea, 100kg SP-36, 75kg KCl, 100kg ZA, A_2= 100kg urea, 100kg SP-36, 150kg KCl, 150kg ZA and A_3= 150kg urea, 200kg SP-36,125kg KCl, 200kg ZA. Of the two factors obtained 8 combined treatment with 3 replications, so there were 24 experimental units. The results showed that treatment of organic fertilizer gliricidia leaves (5t ha-1) and inorganic fertilizer treatment at a dose of 50kg urea, 100kg SP-36, 75kg KCl, 100kg ZA increase the quantity and quality of shallot bulbs compared with other treatments. The results of the soil analysis showed that an increase of soil fertility indicated by enhancement of C-organic level from 0.89% to 2.43%. Improved yield quality and quantity indicated by an increase of total soluble solid bulbs and shallot yield from 6.5t ha^{-1} into 13.91t $ha^{-1.}$

Keywords: Dry land, shallot, organic fertilizer, inorganic fertilizer

I. INTRODUCTION

The development of dry land farming in Central Sulawesi still quite promising. Totally dry land area in Central Sulawesi especially in Palu valley reached up to 79.412.5 ha, whereas 23.221 ha (29.40%) are appropriate for onion cultivation (Badan Pusat Statistik Sulawesi Tengah. 2011; Maskar and Rahardjo, 2008). This suggests that the opportunity for increase shallot production can be obtained through utilization of dry land area. Some constraints in shallot cultivation in dry land is the content of organic matter, and the low of water and nutrients availability. Puslitbangtanak (2004) reported that the main limiting factor in the development of shallot cultivation in Palu is the availability of water, nutrient retention and low organic matter content. An alternative way to overcome the constraints on dry land farming is the use of mulch and fertilizer application. Fertilizer application may be given in the form of organic fertilizers and inorganic fertilizers. Organic fertilizer or organic material is intended to improve the efficiency use of inorganic fertilizers, while inorganic fertilizers are intended to increase the availability of nutrients in the soil, especially macro elements such as N, P, K and S elements. Manure is organic fertilizer that can increase nutrients content in the soil and have a positive influence on the physical and chemical properties of soil and soil microorganisms to encourage their life.

- *Sri Anjar Lasmini: Post Graduate Student at the Faculty of Agriculture, Brawijaya University, Malang, East Java.*
- *Zaenal Kusuma, Mudji Santoso, Abdul Latif Abadi: Lecturer at the Faculty of Agriculture, Brawijaya University, Malang, East Java. Corresponding Author Email: srianjar_lasmini@yahoo.com*

Gliricidia sepium including to the one high-quality source of organic matter which can supply nutrients content as much as 125kg N ha^{-1}, 8kg P ha^{-1} and 80 kg K ha^{-1} if their leaves embedded into the soil (Minardi et al., 2007). The study aims to assess changes in soil fertility and determine the type of organic fertilizer and the optimal dose of inorganic fertilizers in increasing the growth, yield and shallot quality on dry land of Palu valley.

2. MATERIAL AND METHODS

Source of Material

This research conducted at the Sidera village, Biromaru district, Sigi regency, Central Sulawesi with a height of 172 meters above sea level with inceptisol soil type and temperature average is 38^{o}C. Shallot of Lembah Palu variety was used in this research.

Research Methods

This study used a split plot with factorial design which is consisting of two factors. The main plot is a combination of mulch and organic materials in two levels: O_1= straw mulch+manure leaves, and O_2=straw mulch+gliricidia leaves. The subplots consist of four levels of inorganic fertilizers: A_0= Without Fertilizers, A_1= 50kg Urea, 100kg SP-36, 75kg KCl, 100kg ZA, A_2= 100kg Urea, 100kg SP-36, 150kg KCl, 150kg ZA, A_3= 150kg Urea, 200kg SP-36, 125kg KCl, 200kg ZA. Those two factors obtained 8 combination treatment with 3 replication, so there are 24 experimental units. Observation parameters included: (a). changes of physical and chemical soil properties (b). growth components: plant height, leaves number, leaf area, root length and dry weight of root (c). yield components: dry weight of bulb and bulb yield per hectare (d). Shallot quality: total soluble solids and bulbs diameter

Data analysis.

The datas were analyzed using the SAS program for Windows Release 9.1 version. If variance analysis show significantly result, further assessment will be done using HSD with rate of 5 (Gomez and Gomez 1995).

3. RESULTS AND DISCUSSION

1. Changes in physical and chemical soil properties

Chemical analysis of the physical soil properties showed a change before and after treatment. The soil fertility is low before treatment, whereas after treatment the organic levels of C- increased to 2.43%, N-total to 0.62 %, the soil pH of 6.82, porosity and permeability were increase into to 61% and 6.55cm/h respectively and bulk density decreased to 1.15 g/cm $^{-3}$ (Table 1).

Table 1. Results of soil analysis before and after treatment

No	Parameters	Before treatment	After treatment							
			A	B	C	D	E	F	G	H
1.	Bulk density (g.cm^{-3})	1.32	1.26	1.21	1.18	1.23	1.27	1.15	1.17	1.21
2.	Permeability (cm.hour^{-1})	4.46	5.02	5.17	5.23	5.11	4.85	6.55	6.24	5.28
3.	Porosity (%)	49	52	54	56	56	51	61	58	57
4.	pH (H_2O)	5.35	6.42	6.45	6.47	6.37	6.24	6.82	6.76	6.57
5.	C-organic (%)	0.89	1.45	1.89	2.10	1.70	1.59	2.43	2.33	2.05
6.	C/N Ratio (%)	8.13	9.65	10.4	10.9	10.4	10.2	12.8	11.7	9.73
7.	N-total (%)	0.19	0.27	0.35	0.37	0.30	0.29	0.62	0.58	0.53
8.	P-total (HCl)	41.25	24.5	29.3	27.6	23.7	23.5	37.4	33.1	30.2
9.	K_2O (HCl_2)	33.27	37.2	39.1	37.8	38.2	34.9	47.3	46.1	40.5
10.	Sulfur (ppm)	14.00	16.2	16.9	17.3	16.8	15.7	21.6	20.4	17.9
11	Cation exchange capacity (me/100g)	13.27	19.3	22.9	25.7	24.7	19.6	28.7	25.3	25.1

Description : A, B, C, D, E, F, G, H are treatments

According to Atmojo (2008), addition of organic matter into inceptisol soil can increase the soil pH and decrease the Al exchange in the soil. It can also increase the N, P, K, and S content because organic matter can improve absorbtion thereby increase the ability of the soil to hold nutrients from the mineralized by microorganisms .

2. Plant growth response

Observation of growth parameters showed that the treatment of organic fertilizer *Gliricidi*a leaves and inorganic fertilizer with a dose of 50kg urea, 100kg SP-36, 75kg KCl, 100kg ZA (O_2A_1) gave the highest yield (Table 2 and Figure 3). Increased growth has a positive impact in increasing the bulbs dry weight (Figure 1). Increased growth in addition, influenced by genetic factors and the nutrient content that available in the soil. The results of Ibrahim (2010) showed that the addition of fertilizers can increase the number of shallot leaves of 6-11 strands with an average of one leaf per week. According to Abdissa et al. (2011) the proper application of N fertilizer can increase plant height and leaves number approximately 11.5% and 8%. Furthermore, organic fertilizer can increase root length and dry weight of root in the rhizosphere conditions by increasing the population of microorganisms (Shaheen et al., 2007; Ouda and Mahadeen, 2008).

Table 2. Growth response against organic and inorganic fertilizers treatments on shallot

Treatment	height of plant (cm)	number of leaves(strands)	leaf area (cm²)	dry weight of roots (g)	root length (cm)
O_1A_0	22.47a	25.80a	273.14a	1.94a	9.11a
O_1A_1	27.09a	27.33a	497.29b	2.31a	9.64a
O_1A_2	28.47a	31.80ab	558.16c	2.88a	13.23bc
O_1A_3	27.40a	28.23a	453.99b	2.36a	10.06a
O_2A_0	22.40a	23.87a	287.36a	1.36a	10.11a
O_2A_1	**32.40b**	**36.23b**	**632.81d**	**3.54b**	**14.16c**
O_2A_2	26.78a	25.53a	417.12b	2.72a	11.90b
O_2A_3	26.60a	24.80a	337.58a	1.98a	10.82b

Values followed by the same letter in the same row and column are not significantly different at HSD test α 0.05

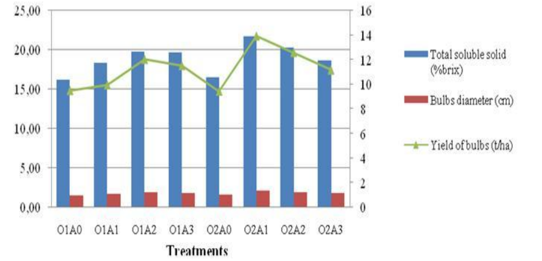

Figure 2. The relationship between the increase in bulb quality of the yield of shallot bulbs

Increasing of plant growth was parallel with the increase of plant dry weight (Figure 1), where the treatment of organic fertilizer *Gliricidia* leaves and inorganic fertilizer capable to create optimal conditions that strongly supports the growth of shallot and produce a high photosynthate. Most of photosynthate translocated for bulb formation, resulting in significantly high dry weight of bulb (Gardner et al. 1991). Application of inorganic fertilizer on a regular basis in sufficient quantities can increase the nutrient content in the soil. The longer the nutrients in the soil on the wane, the deficiency must be added from the outside trough fertilization (Mayun, 2007). Deficiency of N, P, K at the growth stage can lead to reduced root fresh weight (Niedziela, et al. 2008), whereas defficiency of organic fertilizer can lead to soil compactness.

3. Response yield and quality components

Treatment of organic fertilizer in form of *Gliricidia* leaves and inorganic fertilizer with a dose of 50kg urea, 100kg SP-36, 75kg KCl, 100kg ZA capable to increase the dry weight of bulbs, bulb yield, total soluble solids, and the diameter of the bulb (Table.3).

Table 3. Response of yield and quality component of shallot against providing organic and inorganic fertilizer

Treatment	dry weight of bulb (g)	yield (t^{-ha})	total soluble solid (% brix)	bulbs diameter (cm)
O_1A_0	35.48a	9.46a	16.20a	1.55a
O_1A_1	36.31a	9.42a	18.35a	1.82b
O_1A_2	45.03b	12.01b	19.81b	1.98bc
O_1A_3	43.10b	11.49b	19.74b	1.79b
O_2A_0	36.47a	9.40a	16.51a	1.64a
O_2A_1	52.17c	13.91c	21.78c	2.19c
O_2A_2	47.13bc	12.57b	20.36bc	1.92b
O_2A_3	41.80b	11.14b	18.66a	1.67a

Values followed by the same letter in the same row and column are not significantly different at HSD test α 0.05

This quality improvement of shallot bulb due of increased organic and inorganic substances such as carbohydrates, proteins, nitrogen, lipids, phenolic compounds and minerals. This is consistent with the results of Woldetsadik and Workneh (2010) as well as Ali et al. (2007) that the application of inorganic N in the range of 50-100kg especially N ha^{-1} can increase the total soluble solids of bulb. While the results of Yoldas et al. (2011), Akoun (2005), and Jayathilake et al. (2003) showed that the interaction of organic and inorganic fertilizers can increase the diameter of the shallot bulbs. Improved growth and bulb quality gave impact on bulb yield enhancement (Figure 3).

Figure 3. The effect of different treatments on shallot growth and bulb formation

According to Coolong et al. (2004), Sumarni et al. (2012), Sharma et al. (2003), Kumar et al. (2001), and Singh et al. (1997) found that the application of inorganic fertilizer N, P and K with the addition of organic fertilizers can increase nutrient uptake and yield of shallot to 30% .

4 . CONCLUSION

Application of *Gliricidia* leaves of 5t ha^{-1} and inorganic fertilizer at 50kg urea, 100kg SP-36, 75kg KCl, 150kg ZA, can improve the yield up to 13.91 t ha^{-1}, enhance the quality of shallot bulbs, improve the quality of soil, and increase the fertilizer efficiency.

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