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THE EFFECT OF AMELIORANTS AND SYNTHETIC FERTILISERS ON THE GROWTH OF SEVERAL VARIETIES OF ONIONS AFFECTED BY SALINITY

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Abstract

The study was conducted in Deli Serdang Regency at an altitude of +13 msal, starting in May-August 2024. Demand for shallots is very high, so expansion of shallot cultivation to marginal lands such as saline soils is necessary. The purpose of this study was to examine the effect of ameliorants and synthetic fertilisers on the growth of several shallot varieties. The study used a split split plot design consisting of three factors, namely: First factor (S): S0 (saline soil + topsoil); S1 (saline soil + sawdust compost); S2 (saline soil + sawdust charcoal). The second factor was synthetic fertiliser (P): P1 (0.37 g/polybag (375 kg/ha)); P2 (0.75 g/polybag (750 kg/ha)); P3 (1.125 g/polybag (1,125 kg/ha). The third factor was variety (V): V1 (Bima Brebes); V2 (Batu Ijo); V3 (Sembrani), which was repeated three times. The observation data were analysed using the F test with a 5% DMRT follow-up test. The results showed that the use of the Bima Brebes variety produced the highest percentage of red onion bulb growth potential with a value of 99%, which was significantly different from the Sembrani variety (81%) and not significantly different from the Batu Ijo variety (92%). The Sembrani variety (V3) and the effectiveness of synthetic fertiliser doses can help red onion plants adapt to salinity, either with or without the aid of ameliorants.

Key word: Ameliorant, Synthetic_Fertilizer, Onion, Allium_ ascalonicum, Varietie

INTRODUCTION

Red onions have long been cultivated intensively by farmers as a staple vegetable, providing a source of income and employment opportunities that contribute significantly to regional economic development. As a result, red onion cultivation businesses have spread widely across almost all provinces in Indonesia (Simangunsong et al., 2017). Based on Susenas data for the 2005-2019 period, national shallot consumption has tended to increase, averaging 2.73 kg/capita/year over the last five years. Meanwhile, according to the Food Security Agency, the average increase in national shallot consumption over the last five years was 4.07% per year (Directorate General of Horticulture, 2020). Domestic shallot production has not been able to meet consumer demand due to suboptimal farming systems, poor and suboptimal land conditions, and the use of seeds of declining quality. Shallot productivity can be increased through several efforts, one of which is the utilisation of suboptimal land and the selection of appropriate, high-quality seeds (Nugroho et al., 2017). Agricultural development is shifting to suboptimal land such as saline soil due to the reduction of fertile agricultural land. Soil becomes saline due to seawater intrusion, irrigation water containing salt, or high evaporation and low rainfall, causing salts to rise to the root zone (Kusmiati et al., 2014). Indonesia is estimated to have a total area of 444,300 ha of saline land, with 304,000 ha classified as moderately saline and 140,300 ha as saline (Rahman in Yamika et al., 2016). Soil is categorised as saline if the electrical conductivity of the saturated soil extract is > 4 dSm-1. The adverse effects of salinity on plants are related to high water osmotic pressure, an imbalance between Na and K, Ca, Mg ions, and a decrease in N and P uptake. High Na+ concentrations in soil solutions suppress nutrient ion activity and cause extreme Na+/Ca2+ or Na+/K+ ratios, which can interfere with Ca and K ion uptake (Grattan and Grieve, 1999).

Plant development in saline soils can be achieved by adding soil conditioners and planting salt-tolerant varieties. Soil conditioners can improve soil fertility and quality by improving the physical and chemical conditions of the soil. Changes that occur in the chemical properties of saline soil include a decrease in cation exchange capacity (CEC), an increase in base saturation (BS), an increase in pH, an increase in nutrients, and a reduction in toxic compounds. Meanwhile, changes in physical properties include an improvement in soil structure (Suratman, 2013). Several researchers have reported the effectiveness of ameliorants in increasing crop yields on saline soils. Shaaban et al. (2013) ameliorated saline soils using manure, gypsum, humic acid, and combinations thereof. This is what prompted the author to conduct a study on the effect of applying ameliorants and adding synthetic fertilisers on the growth of several varieties of shallots.

LITERATURE REVIEW

Red onion, family Alliaceae, is an economically important species that is widely cultivated throughout the world, especially in Asia and Europe. According to Zulkarnain (2013), the classification of red onions is as follows: Kingdom: Plantae, Division: Spermatophyta, Subdivision: Angiospermae, Class: Monocotyledonae, Order: Asparagales, Family: Liliaceae Genus: Allium, Species: Allium ascalonicum L. Red onions can grow in various environmental conditions. To obtain optimal results, red onions require good environmental conditions, adequate light, water, and nutrients. One of the obstacles in increasing red onion production is the use of varieties. Varieties are one of the determining factors in the success of plant growth and yield. According to Kartinaty et al. (2018), in order to develop plants, in addition to considering the agroecosystem, the use of varieties must also be taken into account, because not all varieties are adaptable to the development area. Apart from using good quality seeds, the selection of varieties that can be grown in various environments must also be considered in increasing red onion production.

Seeds are a key component in shallot cultivation, and farmers have traditionally relied on and become accustomed to using bulb seeds. Currently, there has been a development in shallot seed technology using seeds or True Shallot Seeds (TSS), which have several advantages, including seed health, lower distribution costs, and lower costs. There are several superior shallot varieties, such as Bima Brebes, Super Philip, Tajuk, Katumi, Manjung, Sanren, Betanis, Pikatan, Bauji, Lembah Palu, Tinombo, Palasa, Super Putih, Super Trisula, Batu Ijo, Trisula, TSS Pancasona, and Tuk-Tuk, which are cultivated by communities in several regions in Indonesia. Salinity appears to affect two plant processes: water relations and ionic relations. During initial exposure to salinity, plants experience water stress, which in turn reduces leaf expansion. During long-term exposure to salinity, plants experience ionic stress, which can cause premature ageing of mature leaves. Salinity has three potential effects on plants: it reduces water potential, causes direct toxicity from each Na and Cl absorbed, and can cause disruption to the absorption of essential nutrients (Barus et al., 2013).

Sawdust contains chemical components such as cellulose, hemicellulose, lignin and extractive substances (Sari and Damardi, 2016). Sawdust is quite suitable for use as compost raw material, although not all of its components can be completely broken down. The finer the particle size of the sawdust, the better its water absorption and odour. The fertilisation commonly practised by most farmers today, especially for N, P, and K, is to use single fertilisers applied without considering the balance of nutrient composition or the fertilisers required by the plants (Hariyadi et al., 2019). When applied, the use of compound NPK fertilisers is more practical than single fertilisers (Sutrisna and Surdianto, 2014). Fertilisation with NPK Mutiara 16-16-16 affects the height of plants, yield per plant, and yield per plot of shallots (Rambe et al., 2019).

METHOD

The study was conducted at the Experimental Garden of the Faculty of Agriculture, University of Muhammadiyah North Sumatra, Percut Sei Tuan District, Deli Serdang Regency, at an altitude of +13 metres above sea level with flat topography. The research was conducted using a split-split plot design consisting of three factors. The first factor as the main plot was saline soil with the addition of sawdust ameliorant (S) (Zuhroh et al., 2013), consisting of three types, namely: S0 (saline soil + topsoil (1:1)); S1 (saline soil + sawdust compost (1:1)); S2 (saline soil + sawdust charcoal (1:1)). The second factor as the subplot was synthetic fertiliser using NPK fertiliser (P) (Hendarto et al., 2021) consisting of three levels, namely: P1 (0.375 g/polybag (375 kg/ha)); P2 (0.75 g/polybag (750 kg/ha)); P3 (1.125 g/polybag (1,125 kg/ha). The third factor as plot children was Variety (V), consisting of 3 types, namely: V1 (Bima Brebes); V2 (Batu Ijo); V3 (Sembrani), which were repeated 3 times. The number of samples per treatment was 3 plants, with a total of 243 sample plants out of 405 plants overall.

The observation data were analysed using the F-test. If the statistical test yielded significant results, the testing was continued with the DMRT (Duncan's Multiple Range Test). The observation variables were calculated by measuring the growth potential and height of the red onion bulbs.

1. Growth Potential (%)

Growth potential is calculated based on the percentage of shallot bulbs that show growth potential (GP), calculated on day 7 using the following formula:

$$GP = \frac{\sum \text{Growth}}{\sum \text{Bulbs planted}} \times 100\%$$

2. Plant Height (cm)

Plant height measurements were taken on sample plants after 3, 5 and 7 weeks after planting until bulb growth stopped. Plant height was measured from the base of the plant to the tip of the highest leaf using a tape measure.

RESULTS AND DISCUSSION

1. Growth Potential (%)

Observations show that there is a significant effect of variety on the growth potential of shallots affected by salinity (Table 1).

Table 1. Effect of Saline Soil with the Addition of Ameliorants and Synthetic Fertilisers on Growth Potential in Several Varieties of Shallot Tubers.

Treatment	Varieties			Average
	Bima Brebes	Batu Ijo	Sembrani	
		……%.....		
S0P1	100	100	87	96
S0P2	100	87	80	89
S0P3	100	87	73	87
S1P1	93	87	87	89
S1P2	100	87	80	89
S1P3	100	93	80	91
S2P1	100	100	73	91
S2P2	100	87	87	91
S2P3	93	100	80	91
Average	99 B	92B	81A	

Numbers followed by the same letter in the same row are not significantly different at the 5% Duncan level. Notes: S0 (Saline soil + Topsoil (1:1)); S1 (Saline soil + Sawdust compost (1:1)); S2 (Saline soil + Sawdust charcoal (1:1)); P1 (0.375 g/polybag (375 kg/ha)); P2 (0.75 g/polybag (750 kg/ha)); P3 (1.125 g/polybag (1,125 kg/ha)).

The use of the Bima Brebes variety produced the highest percentage of red onion bulb growth potential, with a value of 99%, which was significantly different from the Sembrani variety (81%) and not significantly different from the Batu Ijo variety (92%). This is because the Bima Brebes (V1), Batu Ijo (V2) and Sembrani (V3) varieties can adapt to saline soil with added ameliorants. Growth potential is one way of measuring the quality of varieties used as planting material. According to the Ministry of Agriculture, Directorate General of Food Crops, Directorate of Seed (2019), growth potential testing is carried out by observing the growth of new shoots of shallot bulbs under appropriate conditions over a certain period of time to obtain a growth potential value in percentage terms. One of the shallot varieties that showed the best plant growth results when planted in saline soil + topsoil and given 0.75 g of NPK fertiliser per polybag was the Sembrani variety. This is because plant growth is influenced by planting materials, the environment and the season at the planting location. According to Hidayat et al (2011), shallot clones and growth types affect plant height. Several genetic and environmental factors are closely related and cannot be separated from one another. The length of a variety's leaves is influenced by the environment

and season at the planting location. If the environmental factors are suitable for plant growth, plants with optimal appearance will be produced.

2. Plant Height (cm)

Based on observations of the use of ameliorants and synthetic fertilisers on several varieties of shallots affected by salinity, there was a significant effect on plant height (Table 2).

Table 2. Effect of Saline Soil with the Addition of Ameliorants and NPK Fertilisers on Plant Height in Several Varieties of Shallots.

Treatment	Varieties		
	Bima Brebes	Batu Ijo	Sembrani
	……..cm……		
S0P1	26.56C	23.33D	29.83B
S0P2	25.11C	24.78C	33.33A
S0P3	23.67CD	23.56D	28.78BC
S1P1	19.22E	22.00DE	28.89B
S1P2	20.44E	22.56D	23.94C
S1P3	19.00E	20.28E	24.06C
S2P1	22.89D	22.56D	29.67B
S2P2	23.38D	25.50C	26.44C
S2P3	25.44C	22.83D	31.56AB

Numbers followed by the same letter in the same row are not significantly different at the 5% Duncan level. Notes: S0 (Saline soil + Topsoil (1:1)); S1 (Saline soil + Sawdust compost (1:1)); S2 (Saline soil + Sawdust charcoal (1:1)); P1 (0.375 g/polybag (375 kg/ha)); P2 (0.75 g/polybag (750 kg/ha)); P3 (1.125 g/polybag (1,125 kg/ha)).

The combination of treatments that produced the highest interaction value was S0P2V3, namely 33.33 cm, which was not significantly different from the S2P3V3 treatment. This shows how prominent the effect of using the Sembrani variety (V3) and the effectiveness of synthetic fertiliser doses are in helping shallots adapt to salinity, both with and without the use of ameliorants. According to Hidayat et al. (2011), onion clones and growth types influence plant height. Several genetic and environmental factors are closely related and cannot be separated from one another. The length of a variety's leaves is influenced by the environment and season at the planting location. If the environmental factors are suitable for plant growth, plants with optimal appearance will be produced. Fahri et al. (2021) stated that variety differences will determine how well the plants adapt to environmental stress. Red onion plants grown in saline soil but with the addition of soil conditioners and NPK fertiliser can still grow, develop and photosynthesise well. According to Sujinah and Ali (2016), plants can develop various resistance mechanisms in response to salinity stress, including photosynthesis, osmoregulation and antioxidant enzymes produced by the plant. Therefore, based on the ability of plants to grow in saline conditions, plants are classified into two types, namely glycophytes and halophytes. Glycophytes are plants that do not tolerate very high salinity, while halophytes are plants that are resistant to high salinity conditions. Based on the opinion of Lu et al. (2015), salinity can induce changes in plant gene expression to adapt to stressful environments.

CONCLUSION

The use of the Bima Brebes variety produced the highest percentage of red onion bulb growth potential with a value of 99%, which was significantly different from the Sembrani variety (81%) and not significantly different from the Batu Ijo variety (92%). The Sembrani (V3) variety and the effectiveness of synthetic fertiliser doses can help shallot plants adapt to salinity, either with or without the aid of ameliorants.

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