APPLICATION OF POTASSIUM NUTRITION SUPPLY TO SHALLOT PLANTS UNDER SMART K – SPRINKLE FERTIGATION IN DRY LAND

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ABSTRACT

The purpose of this study was to investigate smart k – sprinkle fertigation in dry land with potassium nutrition supply on growth and yield of shallot plants. The study was conducted in the Research Field Department of Agroecotechnology, Faculty of Agriculture, University of Sultan Ageng Tirtayasa, Indonesia from August to November 2020. The experiment was designed in a Randomized Complete Block Design (RCBD) with four replications. Experiment was conducted in six different treatments as K50: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system; K75: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system; K100: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system; K125: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system; K150: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system; Control: conventional fertilizer of 100 $kg.ha^{-1}$ as basal dose recommendation. The results showed that smart K – sprinkle fertigation system revealed to increase shallot plant on growth and yield. Besides, the use of Potassium nutrition of 50 $kg.ha^{-1}$ (K50 treatment) showed the highest value on number of leaves plant weight, and bulbs weight per plant, as well as on the potential yields. So that, further study is recommend to observe the application of smart K – sprinkle fertigation system in combination with other nutrition.

Keywords: potassium, fertilizer, micro sprinkle, onion

INTRODUCTION

In Indonesia, shallot is one of the main vegetables that are very volatile in market price and demand. However, the unbalanced production supply due to lack of cultivation method and field condition such as dry land become a challenge to solve the problem. Dry land in Indonesia is quite extensive, which is around 60.7 million hectares or 88.6% of the land area (Utomo, 2002) where the dry land area in Banten Province reaches 50% of the total land area used for agriculture. Moreover, water is often a limiting factor for plant growth, especially in dry areas (Abdurachman *et al.*, 2008).

One of the technologies developed for cultivating crops on dry land is the fertigation system. Fertigation is a way of providing irrigation water together with providing nutrients for plants that are placed close to plant roots (Poerwanto and Susila, 2014). Sprinkle irrigation improves irrigation efficiency and water use efficiency in onion crops compared to surface irrigation methods (Kumar *et al., 2007*). Rahmi *et al.,* (2016) stated that irrigation treatment with sprinkle produces high yield weights, and is significantly different from conventional irrigation.

Potassium is found in plants in the form of K^+ which plays an important role in the process of respiration, photosynthesis, regulating the water potential of cells and osmosis (Taiz & Zeiger, 2002). Potassium is also able to support plants against drought and winter stress, regulate transpiration, water absorption by roots, resistance to pests and fungal diseases, and support stronger stems (Jasmi, 2016). Therefore, it would be of special interest to conduct the study with objective of investigation smart k – sprinkle fertigation in dry land with potassium nutrition supply to shallot plants.

MATERIALS AND METHOD

Experimental Design

The study was conducted in the Research Field Department of Agroecotechnology, Faculty of Agriculture, University of Sultan Ageng Tirtayasa, Indonesia from August to November 2020. The experiment was designed in a Randomized Complete Block Design (RCBD) with four replications. Experiment was conducted in six different treatments as follow:

K50: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system

K75: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system

K100: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system

K125: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system

K150: Potassium nutrition of 50 $kg.ha^{-1}$ under smart K – sprinkle fertigation system

Control: conventional fertilizer of 100 $kg.ha^{-1}$ as basal dose recommendation.

Plant material and growth conditions

Shallot plants cultivar "Bima Brebes" were grown in the plot field (2 m long × 1 m wide) with 10 cm intervals and

20 cm inter-row spacing of each treatment. The plot field was irrigated depending on the treatment by micro sprinkle fertigation from the nutrition solution tank in the morning (08.00 AM) and afternoon (04.00 PM). The nutrition solution discharge was 0.7 L/second of each treatment with the detail need per day as shown in Table 1.

.**Table 1. Amount of nutrition solution fertigation per day**

Day After Planting (DAP)	Amount of Nutrition Solution Fertigation (L/day)	Operational Duration (second)
0 -10	3,2	18
11 – 20	3,2	18
21 – 30	4,3	24
31 – 40	4,7	27
41 – 50	3,8	22
51 - 60	3,2	18

Analyses of growth and yield

To investigate Smart K – sprinkle fertigation system effects on growth, plant height and number of leaves per plant were counted at 6 weeks after planting (WAP). Plant weight, bulb weight, and number of bulbs per plant were measured on the last day experiment (harvesting day) to observe the yield. Moreover, the potential yield also was analyzed to show the effectiveness of Smart K – sprinkle fertigation system.

Statistical analysis

All data were subjected to analysis of variance (ANOVA). Differences among the treatments were tested for significance using the Duncan Multiple Range Test at $P<0.05$. All statistical analyses were conducted using SPSS 16.0 software (SPSS Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

Figure 1 depicts plant height and number of leaves per plant under different treatments. At 6 WAP as expected as the maximum of vegetative stage (Harahap, 2012), the highest value was on K75 treatment on the plant height, but it was not very significant difference with other treatments unless with K150 treatment. The findings suggest that the plant height at 6 WAP of experiment was not only affected by the nutrition but also other environment aspects such as pest and diseases disorder. Besides, on the number of leaves per plant the highest value was on K50 treatment, and it was significant difference compared with the Control. The evidence from this study demonstrates that this fertigation system has a higher potential to use as effective nutrition than conventional irrigation system. The results are in line with previous study that the fertigation system enhanced growth parameters in shallot plant (Rahmi *et al.*, 2016), princess tree (He *et al.*, 2020), and maize (Wu *et al.*, 2018).

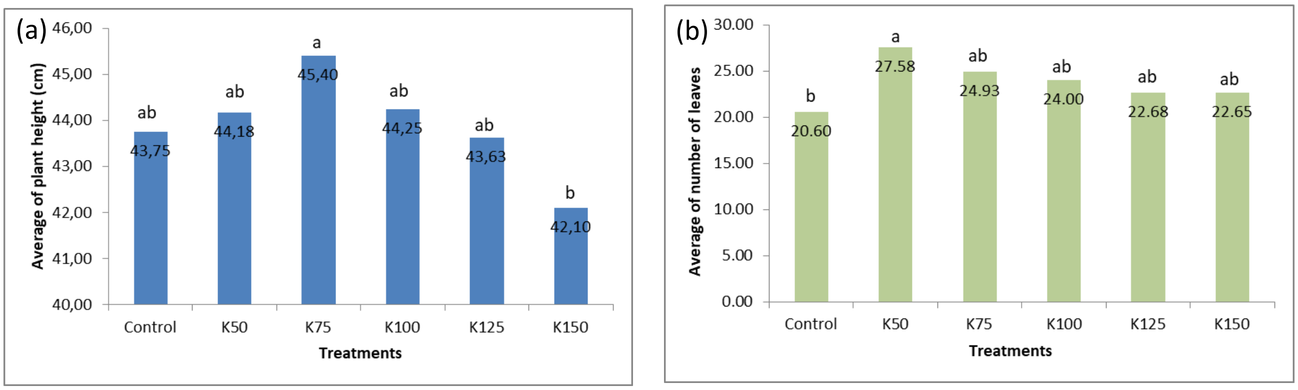

Figure 1. Average of plant height (a) and number of leaves per plant (b) under different treatments on 6 WAP, different letters define the significant difference at $P<0.05$ by Duncan Multiple Range Test.

The result of plant weight and bulb weight are shown in Figure 2. It is apparent from this result that the K50 treatment showed the highest value both on plant weight and bulb weight, and revealed higher result than other fertigation systems. Moreover, the K50 treatment showed significant difference compared with K150 treatments. K fertilizer has a very important role, especially in the formation, breakdown and translocation of starch, synthesis protein, accelerates plant tissue growth and increases starch content in shallot bulbs (Zang *et al.*, 2018; Shehzad *et al.*,2019). The more assimilate ingredients produced, the more they will be translated into shallot bulbs. According to Lakitan (2011), K fertilizer plays a role in increasing photosynthetic activity so that the accumulation of photosynthate can be translated into generative organs, especially shallot bulbs. The results are consistent with findings of previous study by Poornima (2007), which stated that the addition of K fertilizer had a significant effect on the weight of the resulting shallot bulbs.

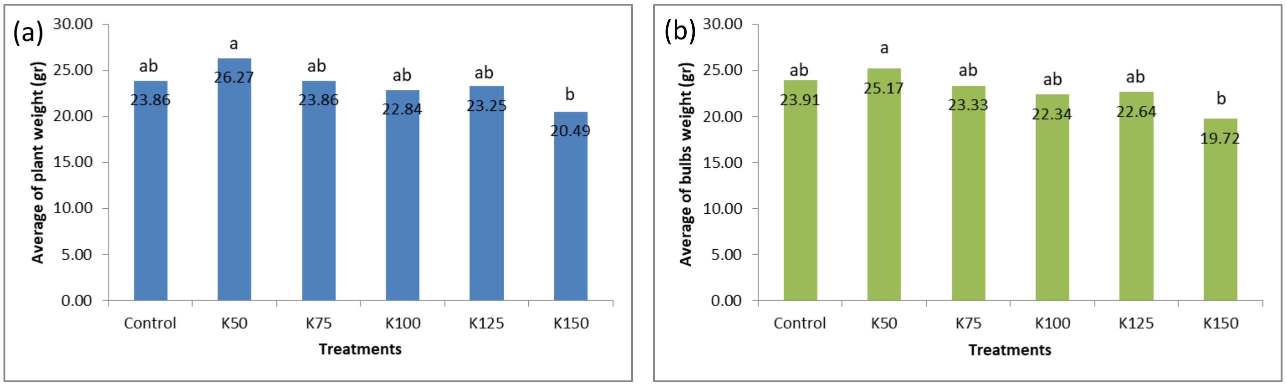

Figure 2. Average of plant weight (a) and average of bulbs weight per plant (b) under different treatments on the last day experiment (harvesting day), different letters define the significant difference at $P<0.05$ by Duncan Multiple Range Test.

The average number of bulbs per plant as marketable yield and the potential yield under different treatments are presented in Figure 3. From the Figure 3, it was clear that the K50 treatments showed the highest value on both parameters. According to Munawar (2011), potassium plays a role in the transport of photosynthetic products (assimilates) from the leaves through the phloem to the tissues of the reproductive organs (fruit, seeds, tubers, etc.) so as to improve the size, color, taste, and fruit skin which are important for storage and transport. Furthermore, Samadi and Cahyono (2005) stated that the formation of shallot bulbs will increase in suitable environmental conditions where the lateral shoots will form new discs, then layered tubers are formed, each growing tuber can produce 2 - 20 new shoots and will grow and develop into tillers, the greater the number of tillers, the greater the number of tubers produced. Therefore, as number of bulbs increase the potential yield also as follow will have an enhance trend.

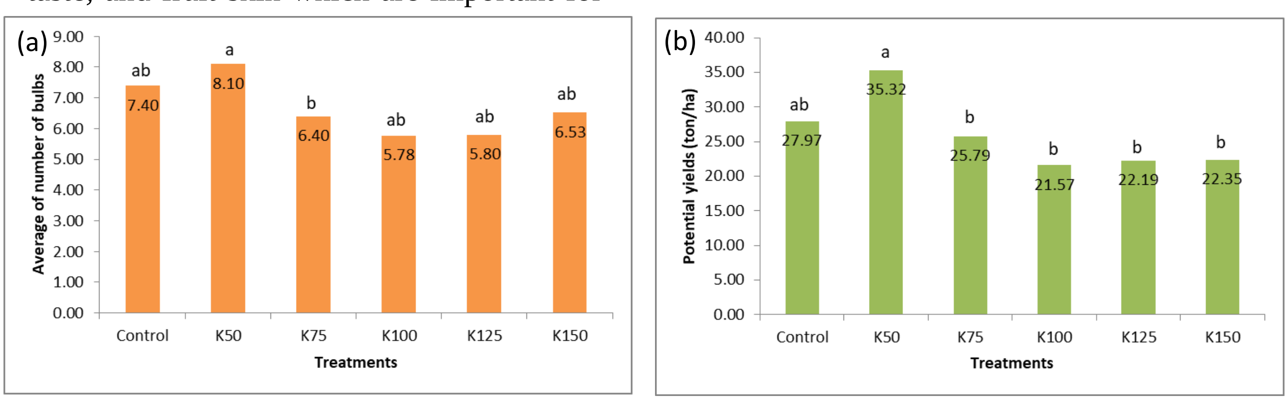

Figure 3. Average of number of bulbs per plant on the last day experiment (harvesting day) (a) and the potential yields (b) under different treatments, different letters define the significant difference at $P<0.05$ by Duncan Multiple Range Test.

CONCLUSION

One of the more significant findings to emerge from this study is that smart K – sprinkle fertigation system revealed to increase shallot plant on growth and yield. Besides, the use of Potassium nutrition of 50 $kg.ha^{-1}$ (K50 treatment) showed the highest value on number of leaves plant weight, and bulbs weight per plant, as well as on the potential yields. So that, further study is recommend to observe the application of smart K – sprinkle fertigation system in combination with other nutrition.

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