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TRUE SHALLOT SEED PRODUCTION OF LOWLAND SHALLOT (BIRU LANCOR VARIETIES) UNDER THE APPLICATION OF SEAWEED EXTRACT AND N FERTILIZER

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ABSTRACT

The major problem on the improving shallot production is due to availability of quality tuber seeds required by farmers in sufficient quantities. One effort that can be done in order to fulfill the seed production is to use TSS or True Seed of Shallot technology. For this reason, efforts are needed to improve nitrogen fertilizer efficiency following the application of seaweed extract along with different source of N fertilization. The research was carried out in the village of Sidomulyo, Batu, with an altitude of 923 m asl with planting material from seed growers in Probolinggo who have experienced on shallot seed production with seed a dormancy period of approximately 2 months. Seaweed Extract (RL) uses *Citorin* and ammonium nitrate using Calcium Ammonium Nitrate Fertilizer. For seeds to be planted, vernalization is carried out by inserting seeds into the refrigerator at $\pm 10^{\circ}\text{C}$ for 3-4 weeks. The study began in September 2018 and ends in January 2019. The study used a Factorial Randomized Group Design of 1 factor, namely the dose of Ammonium Nitrate with several concentrations of seaweed extract (RL). The dose of Ammonium Nitrate consists of 0% (0 kg / ha), 50% (from the total N dose of 178 kg / ha and 100% (as much as 178 kg / ha). The dosage of N 178 kg per hectare comes from the calculation of N content in doses recommendation is NPK 600 kg / ha (NPK fertilizer contains 15% N), ZA 200 kg / ha (ZA fertilizer contains N 26%), Urea 100 kg/ha (urea fertilizer containing N 46%), and KCl 150 kg/ha Seaweed extract with a concentration of 0 ppm, 120 ppm, 240 ppm, 360 ppm and 480 ppm. Thus the treatment is as follows: (1) Control = 0% N and 0 ppm RL; (2) N1 RL 120 ppm (50% dose N and 120 ppm RL); (3) N1 RL 240 ppm (50% N and 240 ppm RL); (4) N1 RL 360 ppm (50% dose N and 360 ppm RL); (5) N1 RL 480 ppm (50% dose N and 480 ppm RL); (6) N2 RL 120 ppm (100% N and 120 ppm RL) (7) N2 RL 240 ppm (100% N and 240 ppm RL) (8) N2 RL 360 ppm (100% N and 360 ppm RL); (9) N2 RL 480 ppm (100% dose N and 480 ppm RL). The variables observed were plant height, number of leaves, number of tillers and number of tubers per plant, 50% bloom time, number and height of stem, root dry weight, canopy dry weight, number of flowers per stem, number of kernels per stem, percentage of flowers being kernels, weight of 1 seed, seed weight per 1000 m², mini tuber production. Data from the observations were analyzed using ANOVA and if there was a significant effect followed by LSD at the level of 5% to see the differences between treatments.

KEY WORDS

Ammonium nitrate, flowering, vernalization, shallot seed, seaweed extract.

The production of new national shallot bulb seeds can meet 15-16% of the total demand (Director General of Horticulture, 2010). Data for red onion production in Indonesia in 2013 was recorded at 1.010.733 tons, with an import volume of 124.544,25 tons resulting in an average requirement of 2.07 kg person⁻¹ year⁻¹. In 2017, the need for shallots tuber is projected to increase to 1.244.278 ton, which could divided into several segments: (1) consumption at 994,378 ton, (2) 104,900 ton for seeds, (3) 40.000 ton for industry and (5)

105.000 ton for fulfilling exports. When the average productivity of shallots is projected to reach 10.22 tons ha⁻¹, then in 2017 there will be around 121.749 ha of harvested area. Referring to the 2012 harvest area, which was equal to 99.519 ha, the fulfillment of the demand for shallots in 2017 requires an additional expansion of the harvested area of around 22.230 ha. An additional area of 22.230 ha requires additional tuber seeds (1.5 ton ha⁻¹) of 33.345 tons so that the total need for 2017 tuber seeds should be in the range of 138.245 ton. However, the quality tuber seeds needed by farmers are not sufficient in quantity and those availability at the market, due to achieving rapid grow of the shallot production it is required to optimize seed tuber production (Hilman et al., 2014; Rosliani et al., 2016).

The availability of tuber seeds is predicted to only be able to meet 75.87%. If the tuber demand are replaced with TSS (*True Shallot Seed*) (5 kg/ha) then the requirement for this in 2017 is 111 ton (processed BPS data, 2014). Red shallot (*Allium ascalonicum* L.) is one of the important vegetable species which is a national superior commodity (Rosliani et al., 2013; Fritsch and Fiesen, 2002; Sopha et al., 2014). As a result, farmers meet the needs of seeds by producing their own seeds. The use of seeds themselves which is carried out continuously can cause a decrease in productivity and is prone to root tuber diseases such as *Fusarium* and *Colletotrichum* (Sumarni and Rosliani, 2010; Rosliani, 2013). Some other problems faced in the production and use of tuber seeds are more expensive especially when the tuber seed stock is limited, requires greater storage space, higher transportation costs due to volume, and tuber seed production ratio is lower than seed production ratio. The average tuber production ratio is 1: 10 while the seed production ratio can reach 1: 200. The onion seed dormancy period is 2-3 months and if stored for a longer period (> 3 months) there will be a decrease in quality. The advantage of using tuber seeds is that they do not require pollination and complicated technology to replant because the bulb size is quite large (Sumarni and Rosliani, 2010; Rosliani, 2013).

In order to meet the demand of shallot seeds, use the TSS method or botanical seeds. TSS seeds that are an alternative to tuber seeds have several advantages, among others, are healthier seeds, have a higher seed production ratio than tuber production and have a longer dormancy period of more than 2 years (Rosliani et al., 2016). TSS production still faces several challenges, among others, the percentage of flowering and seed formation is still low. Therefore the production of red onion TSS is a very interesting study material because TSS can be an alternative to meet the demand of seeds at the farmer level, thus opening opportunities in efforts to increase national shallot production. Khokar (2014) stated that flowering stimulation in shallots in TSS seed production is influenced by many factors starting from the vernalization process, bulb size, environmental conditions after planting and varieties.. Biostimulants are known as ingredients and/or microorganisms that can increase absorption of nutrient absorption by rooting plants, especially nitrogen. At present the use of biostimulant seaweed extract on shallots is still limited. Farmers generally use GA₃. Seaweed extract has several advantages compared to GA₃ because in addition to containing gibberelin there is also a cytokinin which, among others, functions to accelerate flowering and increase uniformity of flowering time in addition to its function in increasing fertilizer efficiency. Research on the nutrient requirements of Nitrogen, especially Ammonium Nitrate (NH₄NO₃) in TSS production is still not widely used. The aim of the study was to study the potential of ammonium nitrate and seaweed nitrogen in shallot seed production.

The Ministry of Agriculture has issued a package of TSS production technology consisting of components of site selection technology, vernalization, fertilization, and the application of GA₃ and BAP biostimulants (Rosliani et al., 2016) The solution to increase the percentage of seed formation is by using the vernalization technique. Regarding the vernalization technology component, research that looks at the mechanism of shallot seed production through vernalization techniques is still very limited (Wu et al., 2016). The use of 10°C vernalization temperatures in the highlands in Bima varieties has provided information that TSS production can reach 8.12 grams per 12 plants (Hilman et al., 2014). Besides that the fertilizer component is an important strategy in increasing shallot production. However, irrational use of N and carried out continuously will cause an imbalance of nutrients in the soil and degradation of soil fertility which has an impact on decreasing yields. Biostimulant

applications such as the application of Growth Regulating Substances (ZPT) and growth stimulants such as Benzyl Amino Purine (BAP) and Giberellic Acid (GA_3) are also important components that influence TSS production. It's just that a number of previous studies have shown that the effect of the application of GA_3 growth regulators is still varied or unstable, increasing the productivity of shallots. The results of the study (Rosliani et al., 2016) showed no interaction between varieties (Pancasona and Mentas) and the way GA_3 was applied to plant growth, flowering and TSS yield of shallots.

In view of this, the improvement of TSS seed production technology components is a very interesting study material, among others studies on tuber vernalization aspects (storage of tubers at low temperatures), application of N sources in the form of ammonium, nitrate and ammonium nitrate for N availability evaluation. the use of biostimulant using alternative ingredients such as seaweed extract (*Eucheima spinosum*) so that it can be seen the effectiveness in increasing productivity of the results of onion TSS. The objective of this study was to evaluate the response of shallot varieties to the type and dose of biostimulant and the dosage and source of N fertilizer as a component of TSS production technology in increasing the speed of flowering initiation and yield of TSS seed varieties of specific location, namely Blue Lancor variety.

METHODS OF RESEARCH

The study was conducted in Sidomulyo Village, Batu City with an altitude of 923 m above sea level. The study was performed in a plastic house (greenhouse) starting at September 2018 to January 2019. This location was approximately 30 miles from the central city of Malang, with geograhic position at 7°51'12.29" S and 112°31'25.62" E.

The research will be carried out using onion seeds which previously have been vernalized at 10°C for 2-4 weeks. Plastic houses (greenhouses) are made with an area of approximately 150-300 m². Silver black (SB) plastic mulch is used to cover beds, biostimulants in the form of seaweed extract (using Citorin), Calcium Ammonium Nitrate fertilizer as a source of Ammonium Nitrate, SP-36 as a source of P and KCl for K. N,P, and K fertilizers are given in 2 periods, starting from the planting period to optimal vegetative growth and the period of flowering formation to harvest. Fertilizer is being applied according to the recommendation level, which were equal to 600 kg ha⁻¹ NPK, 200 kg ha⁻¹ Urea and 100 kg ha⁻¹ ZA (Ministry of Agriculture, 2014). The second period, fertilizer was given in the form of Ammonium nitrate, SP-36 and KCl equivalent to a dose of 100 kg ha⁻¹ NPK and boron as much as 3 kg ha⁻¹. Pesticides was used for controlling plant pest organisms, manure or petroganics were applied for fulfilling basic fertilizers. Boron fertilizer as much as 3 kg ha⁻¹ and additional SP-36, KCl, and Ammonium nitrate fertilizer as much as 100 kg ha⁻¹ to support flower growth. The supporting equipment for research were used including ruler, raffia, measuring cup, micro pipette, analytic scales, minimum-maximum thermometer, hand sprayer and oven, pollinator insects that help pollinate and tray processes for harvesting and bamboo stick to support flower stalks (*belalo*) during flowering to seed harvest.

The study was used Randomized Complete Block Design (RCBD), whereas the application of Nitrogen Ammonium Nitrate under the combination of Seaweed Extract (RL) and this were repeated 3 times. The list of treatments is given in Table 1.

Table 1 – The detail information of each treatments

Code	Treatments combination	Remarks
(A0)	Control	0 % N dosage (equal to = 0 kg N ha ⁻¹) + 0 ppm RL
(A1)	N1 RL 120 ppm	50% N dosage (equal to = 89 kg N ha ⁻¹) + 120 ppm RL
(A2)	N1 RL 240 ppm	50% N dosage (equal to = 89 kg N ha ⁻¹) + 240 ppm RL
(A3)	N1 RL 360 ppm	50% N dosage (equal to = 89 kg N ha ⁻¹) + 360 ppm RL
(A4)	N1 RL 480 ppm	50% N dosage (equal to = 178 kg N ha ⁻¹) + 480 ppm RL
(A5)	N2 RL 120 ppm	100% N dosage (equal to = 178 kg N ha ⁻¹) + 120 ppm RL
(A6)	N2 RL 240 ppm	100% N dosage (equal to = 178 kg N ha ⁻¹) + 240 ppm RL
(A7)	N2 RL 360 ppm	100% dosis N (equal to = 178 kg N ha ⁻¹) + 360 ppm RL
(A8)	N2 RL 480 ppm	100% dosis N (equal to =178 kg N ha ⁻¹) + 480 ppm RL

The use of UV plastic shade on plastic housing or greenhouse was carried out during the research in an effort to minimize crop failure. The structure UV plastic shade uses a bamboo frame and the shape of a semi-circular roof with a circle peak height of approximately 4 meters and a height of the right and left side of the shade of 2 meters. Around the house the plastic is installed with paranet to control pest and disease outbreak.

The study used experimental plots in the form of beds with a size of approximately 2 m x 1 m. The distance between beds in the replication is 30 cm and the distance between beds between replications is 50 cm. The land is processed perfectly by hoeing and leveling the soil surface. After that, manure is given at a dose of 20 tons per hectare or approximately 0.5 kg per bed.

Silver black plastic mulch is installed along the beds by installing wooden pegs around the beds. Installation of mulch is done a week before planting. Mulch used is with a width of 120 cm plastic size x length of the bed.

Planting holes are made by heating iron rings by burning wood charcoal on top. This tool is specifically designed for making planting holes above plastic mulch. Making a planting hole by observing the spacing of 15 x 20 cm, which is 15 cm between lines and 20 cm in distance so that there are approximately 5 x 10 plants = 50 plants per bed.

Planting is done on seeds that have been vernalized for 2-4 weeks at 10°C. Before being planted, first the seed bulbs are sprayed with a 2 ml per liter biostimulant solution according to the concentration of the treatment then dried. After that the bulb seeds are cut 1/3 the end for the bulbs ready to be planted. Planting by making a planting hole 1-2 cm deep and the tubers covered with a mixture of soil and manure.

Watering is done twice a day in the morning before sunrise and evening or according to land conditions and weather in the field. Watering uses a stringy so that it does not damage the tuber seeds and the seeds are not thrown from the planting hole.

In the rainy season, it is estimated that more diseases attack the onion plants compared to pests. The main disease is fusarium which can cause plants to not grow normally and must be eradicated so as not to spread to other plants around it. Pest and disease control is controlled by the application of pesticides as recommended. To prevent severe attacks, monitoring is carried out every day morning and evening together with watering activities.

Fertilization with a distance of 5 cm from the base of the plant. After that watering is done. P and K fertilizers are in accordance with the recommended dosage which is equivalent to 600 kg NPK ha⁻¹, 200 kg ha⁻¹ Urea, and 100 kg ha⁻¹ KCl. Fertilization is done twice, namely when the plants are 15 and 30 days after planting. When the plants are out, SP-36, KCl, and Ammonium nitrate fertilizers are added at a dose of 100 kg / ha for plant maintenance in supplying the nutritional needs of plants starting from flowering to harvesting seeds. The time of application of additional fertilizers according to the conditions of the plants in the field, carried out up to 5 times at 10-day intervals and added boron with a dose of 3 kg ha⁻¹ to help improve the ability of plants in seed formation.

Mounting the support to support the erection of the umbel or the main flower stem that appears. In 1 clump of plants usually grow 2-3 tubers. If no attachment is installed, the umbel will break or collapse and die. Installation is done when the plants are 35-40 days after planting.

Biostimulant is applied when the plant is approaching the tuber formation phase and the flower has not yet come out. This phase is estimated when the plants are 25-45 days after planting. Biostimulant application 3 times at 7 days interval. The spray volume is 300 liters per hectare so that the volume of spray per plant is 1.2 milliliters.

Insect pollinator intervention to help pollinate the shallot seed production. Insect pollinators use the intervention of green flies (*Calliphora vomitoria*)

Harvesting of seeds is done when plants start 88 days after planting and are harvested three times until the plants are 99 days after planting with harvest intervals 3-4 days depending on plant conditions and weather on the land. Mini bulbs are tubers produced by shallots after the seeds are harvested.

Measurement were made in the vegetative phase, generative planting. Variables and time of observation are as follows:

Observations were made by calculating the number of flower stalks that appeared with flowers that had been fully bloomed in all plants in each treatment plot. Observations were made at 63 HST.

It is done by calculating the shallot seed weight produced. Observations were made by weighing the seeds produced in all kernels in each treatment plot. Observations are made at harvest time, after finishing processing the seeds. The stages are as follows: the harvested flowers are dried, separated from the stover, and manually extracted seeds in the kernel, then weighed using a scale.

Observations were carried out by weighing the harvested tubers which at the same time as the shallot seed harvest, collecting from the tubers weight produced per plot of the treatments.

Root dry weight and above ground biomass dry weight were carried out by destructive sampling and weighing the harvested their fresh weight before placing into the oven overnight at 60°C to derive dry weight for the next following days measurement.

The data obtained were analyzed by ANOVA and if there was a significant effect followed by Fisher LSD analysis (5%) to find out the differences between treatments.

RESULTS OF STUDY

The results the analysis of variance showed that the treatment had a significant effect on time of flower with 75% of flower in full blooming period and stalk height per plant ($P < 0.05$) but not significantly effected on the number of stalk observed at 63 DAP (days after planted) (Table 2).

Table 2 – The time flower appears with 75% of flowers in full blooming period, the number and height of flower stalks 63 HST due to the application of seaweed extract and ammonium nitrate fertilizer

Treatment	Time of flower appear with 75% of flower in full blooming period (DAP)	Height of stalk (cm) 63 HST	Number of stalk 63 DAP (stalk per seed bed)
Control	50,67 ab	52,17 b	10,67
N1 RL 120 ppm	50,33 a	54,19 ab	12,33
N1 RL 240 ppm	50,67 ab	49,37 a	10,67
N1 RL 360 ppm	52,67 abc	56,50 c	13,67
N1 RL 480 ppm	53,00 abc	54,17 bc	12,00
N2 RL 120 ppm	54,00 bc	51,35 ab	12,67
N2 RL 240 ppm	54,33 c	53,40 bc	14,33
N2 RL 360 ppm	55,33 c	52,94 b	15,00
N2 RL 480 ppm	54,67 c	49,43 a	12,33
CV (%)	3,80	9,1	16,60
LSD	3,484	3,448	3,632
Probability	(*)	(*)	(ns)

Note: The numbers accompanied by the same letters in each column show no significant differences at LSD (5%); N1 = 96 kg ha⁻¹ N-NH₄.NO₃; N2 = 178 kg ha⁻¹ N-NH₄.NO₃, RL = seaweed extract, (*) = significant, ns: not significant at $P < 0.05$.

The growing time required for flower being appeared with a 75% of flower in full blooming period at control treatment was 50.67 DAP, which was not significantly different to those N1 treatment at all RL concentrations (120, 240, 360 and 480 ppm), except for N2 treatment. This meant that the application of higher dose of 178 kg ha⁻¹ N-NH₄.NO₃ (N2) exaggerating time for shallot for producing flower slower than low dose application. In addition, the treatment of control was not significantly different to all N1 treatment (lower dose of N fertilizer).

In term of flower stalk height, the greatest was obtained from the treatment of N1 RL 360 ppm, which is not significantly different to N1 RL 480 ppm and N2 RL 240 ppm treatments. In comparison to control, generally the height of the stalk at the N1 dose

treatment increased with the addition of RL concentrations except at 480 ppm but on the contrary, at the higher N2 dose the stalk height decreased with increasing RL concentration so that N2 480 ppm treatment produced the lowest stalk height. The treatment of N1 RL 240 ppm producing the lowest height of stalk which was not significantly different to N1 RL 120 ppm, N2 RL 120 ppm and N2 RL 480 ppm.

The results of the variance analysis showed that the treatment had no effect on the variable number of flowers per flower and the percentage of flowers into capsules ($P < 0.05$) but it was significantly affected the variable number of capsules per stalk (Table 3).

Table 3 – Amount of flower, number of capsules and percentage of flower amount to be capsules due to application of seaweed extract and ammonium nitrate

Treatment	Average amount of flowers (flower/stalk)	Number of capsules (capsule/stalk)	Percentage of flower amount to be capsules (%)
Kontrol	59,67	6,60 a	15,42
N1 RL 120 ppm	57,00	9,87 a	20,11
N1 RL 240 ppm	65,58	12,00 bc	27,05
N1 RL 360 ppm	75,00	10,29 ab	17,49
N1 RL 480 ppm	73,58	12,75 bc	23,56
N2 RL 120 ppm	63,67	13,76 c	27,51
N2 RL 240 ppm	73,25	15,57 cd	29,14
N2 RL 360 ppm	89,67	16,69 d	25,18
N2 RL 480 ppm	67,83	15,57 cd	33,76
CV (%)	22,6	15,52	27,4
LSD	27,17	4,317	11,57
Probability	ns	(*)	ns

Note: The numbers accompanied by the same letters in each column show no significant differences at LSD (5%); N1 = 96 kg ha⁻¹ N-NH₄.NO₃; N2 = 178 kg ha⁻¹ N-NH₄.NO₃, RL = seaweed extract, (*) = significant, ns: not significant at $P < 0.05$.

The highest number of capsules per stalk was found in the treatment of N2 RL 360 ppm as many as 16.69 capsules per stalks in which it was significantly different to controls which only able to produce capsules as much as 6.60 capsules per stalks. However there was no significantly different on the number of capsules per stalk between N2 RL 360 ppm and lower application of RL (N2 RL 240 ppm) or even higher (N2 RL 480 ppm). The average number of capsules per stalk at lower N fertilizer (N1) under various concentrations of RL was contributed to the increasing of those value by 70.15% compared to controls. In addition, the application of higher dose of N fertilizer (N2) at all concentrations of RL (120, 240, 360 and 480) was resulting in the raising of an average number of capsules per stalk by 133%. The number of capsule per stalk in the treatment of N2 at various concentrations of RL (120, 240, 360, and 480 ppm) was higher than that those treatment of N1.

Table 4 – Weight per 1 seed, seed weight per 1000 m², tuber weight per plot size of 2 m² due to application of seaweed extract and ammonium nitrate

Treatment	Seed weight		Tuber weight per plot (g per 2 m ²)
	(mg per seed)	(g per 1000m ²)	
control	1,79	578,67 a	32.00 a
N1 RL 120 ppm	1,28	663,33 b	50.33 bc
N1 RL 240 ppm	1,33	680,67 bc	60.00 e
N1 RL 360 ppm	1,65	921,67 d	61.00 f
N1 RL 480 ppm	1,69	729,67 c	57.67 e
N2 RL 120 ppm	1,78	903,17 d	45.33 b
N2 RL 240 ppm	1,17	687,67 bc	56.33 de
N2 RL 360 ppm	1,15	983,33 e	53.33 cd
N2 RL 480 ppm	1,27	895,67 d	57.33 de
CV (%)	23,9	28,4	15,73
LSD	0,6026	507,1	4,77
Probability	ns	(*)	(*)

The results of the variance analysis showed that the treatment did not significantly influence the weight per 1 seed but it was significantly affected the seed weight in each 1,000 m² and tuber weight (Table 4).

In general, seed weight in all treatment were significantly higher than those of control ($P < 0.05$). The lowest seed weight per 1,000 m² is in the control (578.67 grams), whilst the highest was found under the treatment of N2 RL 360 ppm (983.33 grams). Among the treatments, N2 RL 360 ppm produced highest seed weight (983,33 g per 1000 m²), in which those value are almost twice than the control, and it was significantly different to other treatment, before it was drop to 895,67 g per 1000 m² at the treatment of N2 RL 480 ppm. The average seed weight in treatment N1 (at all concentrations of RL 120, 240, 360, 480 ppm) was 748.84 g in which it was lower than those average seed weight of N2 (at all concentrations of RL 120, 240, 360, 480 ppm), reached 867.46 g. This means that there was an increasing on seed weight by 29.41% and 49.90% compare to control treatment, respectively.

In contrast, in term of tuber weight, the highest was detected under N1 RL 240 ppm treatments (60 g per 2 m²) which was not significantly different to the treatment of N1 RL 480 ppm, N2 RL 240 ppm and N2 RL 480 ppm, producing tuber weight at 57.67, 56.33 and 57.33 g per 2 m², respectively.

The average tuber weight produced in the N1 treatment at all RL concentrations was 58.00 g while for the N2 treatment in all concentrations produced an average tuber weight at of 53.08 g per 2 m². This accounted for the increasing of tuber weight at 81.25% for low fertilizer dose (N1) and 65.88% for high dose N fertilizer (N2) treatment.

The results of analysis of variance showed that the treatment significantly affected the root dry weight and aboveground biomass dry weight $P < 0.05$ (Table 5). The lowest root dry weight were found in control (0.09 g/plant) and the highest was treated with N1 RL 480 ppm (0.28 g/plant) which was not significantly different to N1 RL 120 ppm. The higher dose of fertilizer (N2) did not influence root dry weight since there was no significantly different to all RL concentrations (120, 240, 360 and 480 ppm).

Table 5 – Root dry weight and aboveground biomass dry weight due to application of seaweed extract and ammonium nitrate fertilizer

Treatment	Root dry weight (g/plant)	Aboveground biomass dry weight (g/plant)
Control	0,09 a	0,81 a
N1 RL 120 ppm	0,24 cd	1,67 bc
N1 RL 240 ppm	0,16 ac	1,15 ab
N1 RL 360 ppm	0,14 ab	1,33 abc
N1 RL 480 ppm	0,28 d	1,87 c
N2 RL 120 ppm	0,15 ab	1,35 abc
N2 RL 240 ppm	0,20 bc	1,35 abc
N2 RL 360 ppm	0,20 bc	1,68 bc
N2 RL 480 ppm	0,19 bc	1,70 bc
CV (%)	22,10	23,90
LSD	0,07010	0,5931
Probability	(*)	(*)

Note: The numbers accompanied by the same letters in each column show no significant differences at LSD (5%); N1 = 96 kg ha⁻¹ N-NH₄.NO₃; N2 = 178 kg ha⁻¹ N-NH₄.NO₃, RL = seaweed extract, () = significant, ns: not significant at $P < 0.05$.*

Generally, the additional of N fertilizer increase root dry weight and above ground biomass at the range of 20 to 100 % in all treatments compare to control, eventhough there were no clear evidence that under higher concentration of N fertilizer (N2) was given better result. The lowest aboveground biomaas weight was detected in the control which is not significantly different to N1 RL 240 ppm, N1 RL 360 ppm, N2 RL 120 ppm and N2 RL 240 ppm. The treatment of low N fertilizer (N1) and high N fertilizer (N2) at all concentrations of RL caused an average increasing in dry weight by 85.80% and 87% respectively. The dry weight of the aboveground biomass has the similar pattern to root dry weight affected by those treatment.

DISCUSSION OF RESULTS

Related to the time the flower stalk to be appeared, Rosliani et al. (2016) have conducted in-depth research related to the flowering phase of shallots for seed production. The results of the study showed that flowering time with 75% of flower in full blooming occurred at 62-66 DAP while in this study the flowering time were found at 50.33 - 54.67 DAP, which meant the period was coming earlier. Harvesting time in Rosliani et al. (2016) up to 107 days, whilst on this experiment were reduced to 99 days. This is due to the effect of treatment which adding seaweed extract, therefore the period of flowering was changes. In addition there was also a differences on the locataion, which from the climatic, geographic and also evelation perspective was different. The difference of shallot flowering to be appeared with 75% of flower in full blooming period between low dose fertilizer application (N1) and high dose fertilizer application (N2) was due to a shortage of N in the plant, therefore under N1 or even in control becomes flowering faster. The results of this study in line with Gebretsadik and Dechassa (2018) explain that nitrates or nitrogen at lower doses encourage flowering while nitrates or nitrogen at high doses delay flowering. Likewise with the results of the study of Kant et al. (2011), Castro Marin et al. (2011), and Yuan et al (2016) that nitrogen lower than the optimal dose will encourage flowering while nitrogen at higher doses will extend the period vegetative period of plants (Gebretsadikdan Dechassa, 2018). There are differences in the response of plants to flowering due to nitrogen treatment because nitrogen is an important macronutrient for plants, and regulates many aspects of plant growth and development. Nitrogen has been reported to regulate flowering (Lin and Tsay, 2017). It was also explained that only nitrogen was found to have an effect other than the plant height, it also affected the number of plant days to flowering and seed yield (Abdissa et al., 2011). However, the results of this study are different from some of the studies conducted by Castro Marín et al. (2011), Yuan et al., 2016) which explained that plants grown at low N levels will experience slower flowering. In term of number of capsule per stalk which is the lowest to be found in control is also being affected by the low N supply to this treatment. The increasing number of capsule per talk were between 70 to 133 % under the treatment of low application of N fertilizer (N1) and high dose N fertilizr (N2), respectively. This research is in line with (Gustfson, 2010) that the fruit and seed resistance is higher in plants with higher nitrogen doses because nitrogen can increase phospor and potassium uptake coupled with research conducted by Du Jurdin (2015) that the addition of biostimulants increases the effectiveness absorption of nutrients by roots to N, P and K. In this research research, ammonium nitrate was used, where nitrate itself is a common form of nitrogen and influences plant regulation in various aspects of plant development. Nitrates provide nutrients and are reported to affect the growth of seeds, roots and leaves, root architecture, flowering time, branch formation, and plant aging, and affect crop yields (Crawford and Forde, 2002; Guiboileau et al., 2012; Stitt, 1999; Vidal et al., 2014). Meanwhile, flowering is the transition between the vegetative phase and plant reproductive growth so that this flowering period is a critical period in the role of future generations of plant sustainability and is very influential on fertility or the ability to support plant growth (Srikanth and Schmid, 2011).

In this study, flowering and seeding occurred in the rainy season at the end of November 2018. According to Rosliani et al. (2016) that during the rainy season pollinating insect activity decrease when compared to its activities in the dry season, especially in *Apis serana* and *Vespidae* insects. The emergence of 75% of flowers in full blooming period of all treatments were 52.85 days which is between December (weeks 3-4), in which by this period it rains frequently, whereas the average amount of rainfall in December is at 4.84 mm. According to Rosliani et al. (2005) the planting time affects flowering and seed production. The dry season is the right time for flowering and onion seed production (Rosliani et al., 2005). Furthermore, as stated by Rosliani et al. (2016) which mentioned that the production of shallots seeds should produced during the dry season because at that time, besides the high activity of pollinating insects, there was also a low attack of pests and diseases. This could be potentially reducing seed yields. On this experiment, the main diseases were

fusarium and caterpillar (*Agrotis* sp.). To anticipate the disease attack, prevention and control of disturbing organisms has been carried out regularly once a week with the application of fungicides and insecticides in accordance with the recommendations. The main pests that arise when plant growth are controlled by the *Furadan* application. To anticipate rain water exposure at the study site, plastic houses were used because of planting shallots to ensure that the treatment was not washed away by rainwater. Thus, plants can carry out vegetative growth until they succeed in entering the generative period and seed formation.

Instead of genetic and endogenous factors of the plant itself such varieties Rikanth and Schmid (2011) stated that flowering time can be influenced by various environmental factors. To increase yield, research needs to be done by under a higher altitude. This study was conducted at an altitude of 923 m above sea level while according to (Rosliani et al. 2016) that the production of optimal shallot seeds is cultivated at altitudes above 1,000 m above sea level. This is because flowering onions requires a low temperature of 7-12°C to induce flowering and 12-18°C to increase the size and time of flowering. The novelties of this study was the success in producing lower altitude of shallot (Biru Lancor varieties) seeds under various different treatments to detect the different level of N fertilizer and seaweed extract.

Observation to the weight of 100 seeds is very influential on overall seed yield. The higher the weight of 100 seeds, the higher the yield of seeds produced per unit area. However, there is no significant effect from all treatments in this study. Lack of water during seed filling or seeding phase can reduce yields as a result of reduced seed size (Akil et al., 2007). Adding to this, total seed yields were calculated per 1000 m² area. The results of the seeds in this study showed that the average seed yield on N1 was 748,835 g while the average yield on N2 was 867.46 g in which those values are significantly different compared to control treatment. Average seed yields of seeds per 1000 m² can reach 11.529 g (Rosliani et al., 2018), which meant higher than those values compared to the seed yield in this study. The differences may be due to the difference in shallot varieties and those geographical positions. The effect of the addition of seaweed extract as biostimulant successfully increases the seed yield in the area in 1000 m². The results of this study are in line with the research conducted by Du Jurdin (2015) on soybean plants which suggested that biostimulant had a significant effect on the number of crop pods, number of seeds per pod, number of branches, seed harvest. This is due to an increase in the absorption of N, P and K (Rathore, 2015).

The observation of tubers weight at 99 DAP showed that the lowest results were in the control (32 grams per plot size 2 m²) which was significantly different from all other treatments. The average tuber weight produced in the N1 treatment at all RL concentrations were at 58.00 grams while the N2 treatment in all concentrations produced a tuber average of 53.08. When compared with the control, tuber weight of N1 at all concentrations increased by 81.25% while in N2 treatment the increase was only 65.88%. The results of this study are in line with the research conducted by Gebretsadik and Dechassa (2018) that the lower the nitrogen, the higher the formation of tubers were produced.

The lowest dry weight of shoots and roots were detected in the control, which is equal to 0.81 g and 0.09 g per plant which were significantly different from all other treatments particularly when it was compared to those of N2 treatment (high application of N fertilizer). When it was compared to controls, the treatment of N1 at all RL concentrations caused an average increasing of dry weight at 85.80% while treatment N2 at all concentrations resulted in an average increase in higher dry weight at 87.65%. This variable is closely related to plant height which has a pattern that is almost the same where the treatment of N2 doses produces a higher plant height compared to treatment N1. The dry weight of roots and leaves was measured at tuber harvesting 56 DAP. At the time of harvest, root and canopy formation is under maximum condition. Bertoni (1992) states that the dry weight of plant roots increases rapidly until the beginning of tuber formation and then slows down during the bulb enlargement phase.

Bertoni's (1992) study provides information that the dry weight of leaves and roots is known to be almost the same in all treatments of nitrate levels but the levels of nitrate in roots are known to increase significantly until near harvesting period. This result is along with

the Jurdin et al. (2015) statement who also reported that at harvest time the absorption of nitrate in roots is known to be high. The addition of biostimulant applications to nitrogen treatment increases the efficiency of absorption of nutrients including the mobilization and uptake of nutrients from the soil, transportation, storage and assimilation. The absorption of nutrients in these plants is also influenced by the density of plant roots. The results of this study indicate that crown and accrual dry weight were highest in the N2 RL 480 treatment but were not different from the other treatments. In biostimulants, there are cytokinins, gibberellins and auxins. According to Aryanti (2012) that auxin increases the content of organic and inorganic substances in cells. These substances are converted into proteins, nucleic acids, Polysaccharides, and other molecular complexes. These compounds will form tissues and organs so that the wet weight and dry weight increase. Auxin can also increase plant osmosis pressure and softened cell walls which can increase water absorption and nutrients.

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