



Application of Coastal Sediments and Foliar Seaweed Extract and Its Influence to Soil Properties, Growth and Yield of Shallot in Peatland

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ABSTRACT

The high soil acidity and low nutrient content in the peatland may inhibit the growth and yield of shallot and result low productivity. As consequence, the use of peat as a growing medium needs soil fertility improvement. One alternative to improve soil fertility, growth and yield of shallot is by applying coastal sediment and foliar seaweed extract which are easy to obtain and relatively inexpensive in West Kalimantan. This study aimed to investigate soil chemical properties, growth and yield of some shallot variety after the application of coastal sediment and foliar seaweed extract (*Eucheuma cottonii*). A field trial was carried out through the wet period of 2014 in West Kalimantan, Indonesia. The foliar seaweed extract was applied as the foliar fertilizer (0 and 3%), meanwhile the addition of coastal sediment was done at doses of 0 and 40 t/ha. The application of coastal sediment of 40 t/ha improved some chemical properties i.e. pH and the availability of K, Ca, Mg and Na of peat soil. The combination of foliar seaweed extract with 3% and 40 t/ha of coastal sediment increased growth and yield of all shallot variety in peatland compared to using foliar seaweed extract or coastal sediment only.

INTRODUCTION

Shallot (*Allium ascalonium* L.) is an onion like plant that originated from Western Asia. It is one of the most important commercially valuable crops in Indonesia and is consumed as vegetable, spice and traditional medicine (Mahmoudabadi & Nasery, 2009). Some researchers report that shallots contain antioxidants (Lu et al., 2011), antifungal (Teshima et al., 2013), anticancer (Abdelrahman, Mahmoud, El-Sayed, Tanaka, & Tran, 2017). Its consumption will increase every year as the economic and population growth in Indonesia (Astuti, Daryanto, Syaikat, & Daryanto, 2019). One of the efforts to meet the big need of shallots is to increase the area of the shallot planting. In provinces that have large peat soils such as West Kalimantan, the development of shallot cultivation is carried out on peat soils. The estimation of peat soil in Province of West Kalimantan is approximately 117,500 km² in climate type Af (Anshari et al., 2010; Astiani, Burhanuddin, Gusmayanti, Widiastuti, & Taherzadeh, 2018).

Similar to most vegetables, shallot production in peatland requires liming and fertilizers, because the soil has high acidity, macro and micronutrient, and organic acid (Maftu'ah & Nursyamsi, 2019). Furthermore, Nusantara et al. (2018) explain that the low nutrient content in peatlands is caused by leaching during soil tillage and drainage. According to Abat, McLaughlin, Kirby, & Stacey (2012), peat soil has low availability of potassium (K), sulfur (S), zinc (Zn) and copper (Cu). The peat soil properties in West Kalimantan have low fertility that indicated by high soil acidity, low to very low nutrient and naturally accumulate under anaerobic conditions (Sabiham et al., 2012). These conditions supply insufficient nutrient needs of plants, especially base cations such as K, Ca and Mg (Suswati, Sunarminto, Shiddieq, & Indradewa, 2014).

One attempt to improve fertility of peatlands and increase the supply of nutrient for plant is by using ameliorant and biostimulants (Sharma, Fleming, Selby, Rao, & Martin, 2014). The choice of amelioration application to peatland in West

Kalimantan is coastal sediment which is easy to obtain and abundant. Coastal sediment derived from a mixture as the results of erosion on upland which transported by river flow and result of coastal erosion. It is deposited on shoreline beach. Seawater influences the properties of coastal sediment consequence rich in NaCl, CaCO₃ and MgCO₃ (Woodroffe, Farrell, Hall, & Harris, 2017). According to Suswati, Sunarminto, Shiddieq, & Indradewa (2014), in addition, it has high of pH, coastal sediment as well as conceived high alkaline nutrients, so that it will increase the availability of alkaline nutrients (Ca²⁺, Mg²⁺, Na⁺ and K⁺), nutrient uptake and increase the growth of maize in peat soil. Coastal sediment has a pH value of 8, Ca and Mg content separately of 9.75 and 5.82 cmol(+)/kg, and CEC of 22.94 cmol(+)/kg (Sulakhudin, Suswati, & Hatta, 2017). A study by Suswati, Sagiman, & Sulakhudin (2015) stated that the addition of coastal sediment at dose 42 t/ha enhanced the yield of corn. This dose can produce corn of 9.23 t/ha, higher than other treatments which only range between 7.59–5.00 dry grain t/ha.

Seaweeds are biostimulants that make some advantageous effects in crop cultivation (Battacharyya, Babgohari, Rathor, & Prithiviraj, 2015). There were many studies exhibit that spraying seaweed extract could increase the availability of nutrients and yield of several types of flowers, vegetables and fruits such as potatoes, tomatoes, prunes, cherries, almonds and mangoes, wine grape and sugarcane (Arioli, Mattner, & Winberg, 2015; Haider et al., 2012; Singh et al., 2018; Taskos, Stamatiadis, Yvin, & Jamois, 2019). The highest growth, yield and quality of onion plants was obtained from foliar application of seaweed extract (Dogra & Mandradia, 2012). According to Craigie (2011) the application of seaweed extract as fertilizer has the potential to increase crop yields because it contains growth hormones such as abscisic acid, auxin and cytokinin. In addition, its extract also contains growth hormone gibberellin, micronutrients, vitamins and amino acids (Khan et al., 2009; and Wally et al., 2013).

Additionally, the growth of enhancing effects of seaweed extract is also caused by a raise in resistance to biotic and abiotic stresses. The biotic stress are disease and insect attacks, while the abiotic stress are such as nutrient shortage, salinity, dryness, inundation and temperature (Ali, Ramkissoon, Ramsuhag, & Jayaraj, 2016; Guinan et al., 2013; Sharma, Fleming, Selby, Rao, & Martin,

2014). Seaweed liquid fertilizer is a blend of plant growth regulators as well as eco-friendly promoting sustainable productivity and maintaining soil health (Vasantharaja et al., 2019). In this study combined the coastal sediment and the foliar seaweed extract application to improve some peat soil properties, growth and yield of shallot. Thus, this study aimed to appraise the influence of coastal sediments and foliar seaweed extract addition for improving some soil properties and increasing of growth and yield of shallot (*Allium ascalonicum* L.) in peatland. This research hypothesized that the application of coastal sediment and foliar seaweed extract could influence some soil properties, growth and yield of shallot in peatland.

MATERIALS AND METHODS

This research took place on peatland at Siantan Hilir village of Pontianak district, West Kalimantan, Indonesia (0°0'45" N and 109°19'53" E) from March to July 2014. The study location has an average rainfall of 3,000–4,000 mm per year with a daily air temperature of 28°C. The coastal sediments used in this experiment were obtained from Kijing beach at Mempawah district. The coastal sediment consisted of 10.20% sand, 51.85% silt and 37.95% clay with high pH value (8.13) and very high base saturation. Sulakhudin, Suswati, & Hatta (2017) shows that coastal sediment has a base saturation of 82.87%. The contain of potassium and sodium in the coastal sediment was very high, whereas the calcium was high. The total cation exchangeable capacity (CEC) of coastal sediment was low (15.33 cmol(+)/kg) and Magnesium was moderate. The seaweed was collected from the intertidal zone at low tide from the coastal Ladaen, in Anambas archipelago.

Production of Seaweed Extract

Seaweed extract production was carried out using the method of Briceño-Domínguez, Hernández-Carmona, Moyo, Stirk, & van Staden (2014) from of algae *E. cottonii* (*Chlorophyceae*). The collected seaweed was cleaned with sea water to dismiss sand and other cling algae, it was dried under the sun light, was packed and then was sent to the laboratory. The dried seaweed was cut into small pieces, then as much as 200 g was put into distilled water of 1,800 ml and left at room temperature for 12 hours. Then, 1,500 ml of sifted water was added and stirred during the extraction process. It was moved inside in a water bath, and the pH and temperature were set to 8 and 80 °C

respectively. After reaching the desired pH and temperature, the seaweed paste as much as 300 ml was transferred into a glass baker with 15-minute intervals for 2 hours. In the next step, it was diluted by adding half the volume of water from the final volume of the paste (from the early 3,300 ml). Finally, 10% phosphoric acid was added until the extract's pH becomes seven. The filtrate obtained was considered to have a concentration of 100% seaweed extract and to get the concentration of it extract 3% by adding 30 ml of seaweed extract to 1 L of distilled water.

Experimental Design, Field Research, Variable Measured, and Statistical Analysis

Factorial experiments with Randomized Complete Block Design (RCBD) were conducted with three factors, including: 1) foliar seaweed extract (S) at two levels namely: S_0 = zero (control) and S_1 = sprayed with 3% of seaweed extract, 2) coastal sediment (C) at two doses namely: C_0 = without coastal sediment and C_1 = application coastal sediment of 40 t/ha, and variety of shallot (V) namely: V_1 = Bima, V_2 = Moujung and V_3 = Sumenep. Land was prepared conventionally through manual ploughing at the depth of 20 cm and leveling, and then divided into 60 experimental plots of 1 m x 15 m size. The shallot seedlings were transplanted at 25 cm distances on the two sides of each ridge. Maintenance of the crops included watering the plants if there was no rain in 3 days in a row. Pest control and other agriculture practices were applied as commonly recommended for shallot production by Ministry of Agriculture. Seaweed extract testing was carried out in the form of foliar on the leaves thrice by 15 days intervals, beginning from 30 days after transplanting.

Fertilizers were applied in a furrow of 10 cm away from the shallot seedlings. The fertilizers used were Urea (46% of N), SP-36 (36% of P_2O_5), KCl (60% of K_2O) and NPK Phonska at the dose of 300, 200, 300 and 100 kg/ha, respectively. Urea, SP-36 and KCl was applied twice, 1/2 doses was applied 15 days after planting and other 1/2 doses was applied at 15 days after planting, whereas NPK Phonska was applied three times during planting, i.e. each at 15 days, 30 days and 45 days after planting.

Soil analysis was done twice for selected chemical properties, i.e. before experiment and after harvest. The soil samples were compiled to minimize diversity between replications. It was determined using standard procedures by Eviati

& Sulaeman (2009). The growth of shallots was observed in the field including leaves length (cm) and number of leaves and number of tillers. The data generated from the study were analyzed statistically in several stages. First, doing normality test to check whether the data was normal or not. If the data was not normally spread, then transformation test (logarithmic or square root) was done. After normality test, analysis of variance (Anova) test was conducted to analyze differences among treatments, and continued to LSD test if the Anova showed a significant difference. Last, correlation test should be done to analyze the relationship between shallot yield and some soil chemical properties.

RESULTS AND DISCUSSION

Some of the soil chemical properties are presented in Table 1. Based on the soil chemical properties criteria (Eviati & Sulaeman, 2009), the peat soil had a very acidic with pH value of 3.9. According to Melling (2016), the low of pH at peat caused by releasing H^+ ions from dissociated carboxyl groups at organic acid. The peat soil at the study site included hemic, this level of maturity indicated that the peat soil at this location has a moderate level of maturity that is visible from the original material recognized by dark brown color with a thickness of 50-200 cm from the surface. The content of total N was very high, but it was not available for plant growth because N in structural constituent of peat organic matter which showed at the high of C/N ratio (92.98). The organic matter content in this soil was very high (53.00%). The height of the organic matter can be used to store cations in the adsorption complexes.

Table 1 also shows that soil nutrient content is moderate to very high. These nutrients were resulted from residues fertilizing at previous season planting. The land used in the study was farm land that had previously been planted with vegetable crops. From a private communication with farmer, the experiment location was planted vegetables with over doses fertilizers and liming. It was showed by the high of Calcium in this soil (14.70 cmol(+)/kg). The cation exchange capacity (CEC) value was very high (41.26 cmol(+)/kg), it resulted from the high content of functional group in organic acids, such as COOH, OH, etc. The CEC represent the capability to hold and liberate nutrients in soil. The high CEC value in peat soil does not reflect the absence of nutrients K, Ca, Mg and Na, but rather shows the

release of hydrogen ions from the carboxyl group which will cause an increasing in acidity of the peat. Its soil has low of bases saturation (21.74%) which is possible to disturb the balance of nutrients, particularly K, Ca and Mg.

Table 1. Some chemical properties of initial soil on peatland at location of experiment

Soil variable	Value	Criteria ^{*)}
pH-H ₂ O	3.9	Very Acid
C-organic (%)	53.00	Very High
N-total (%)	0.57	Very High
C/N ratio	92.98	Very High
P-Bray I (ppm P ₂ O ₅)	86.1	Very High
K-exchange (cmol(+)/kg)	0.32	Moderate
Ca-exchange (cmol(+)/kg)	14.70	High
Mg-exchange (cmol(+)/kg)	5.99	High
Na-exchange (cmol(+)/kg)	1.82	Very High
CEC (cmol(+)/kg)	41.26	Very High
Base saturation (%)	21.74	Low

Remarks: *) Eviati & Sulaeman (2009)

Effect of Foliar Seaweed Extract and Coastal Sediment Application on Some Soil Properties

Analysis of some soil chemical properties after harvest is presented in Table 2. The value pH of peat soil with coastal sediment application tended to be higher than without provision coastal sediment. The increase in pH of peat soils due to coastal sediment was caused by the binding of hydrogen ions from peat soils to the hydroxide ions from coastal sediment through a neutralization reaction. This application of coastal sediment was not only supposed to achieve soil pH but also to raise the availability of K, Ca, Mg and Na residue in peat soil (Table 2). The more increasing occur to Ca which rised about 2.46 cmol(+)/kg. The addition of Ca in peat soil was expected from coastal sediment. According to Suswati, Sagiman, & Sulakhudin (2015), coastal sediment contains high of Ca about 14.62 cmol(+)/kg.

Table 2 shows that without coastal sediment application the soil tends to have a higher CEC than with the addition of coastal sediment. The mean value of peat soil CEC without coastal sediment was 35.57 cmol(+)/kg, whereas with coastal sediment become 28.54 cmol(+)/kg. The decreasing of CEC was caused by the reduction of negative charge from the functional group organic acid in peat soil

resulted formation of complex compounds between organic acids with cations from coastal sediment, such as Ca²⁺ and Mg²⁺ (Husen, Salma, & Agus, 2014; Nursyamsi, Noor, & Maftu'ah, 2016). This result is in line with Sarifuddin, Nasution, Rauf, & Mulyanto (2018), which reported that giving of seawater can lessen the CEC value of peat soil.

The contents of organic C residue in peat soil with coastal sediment application have a tendency low than without coastal sediment (Tabel 2). This is indicated that addition of coastal sediment of 40 t/ha can be accelerated decomposition of organic matter in peats soil. Soil analysis of C-organic in peat soil after harvest without coastal sediment was 44.56%, whereas with application coastal sediment decline become 33.93%. It means, the application of coastal sediment in peat soil can reduce organic matter about 10.63% compared to no addition of coastal sediment.

Effect of Coastal Sediment and Foliar Seaweed Extract Application on Shallots Growth and Yield

Data presented in Table 3 shows that, the coastal sediment and foliar seaweed extract application significantly affect all studied growth parameters at all variety of shallots. It was an evident that most of the applied coastal sediment and foliar seaweed extract greatly improved leaf length, number of leaf and number of tillers of shallots plants with various significant degrees compared to those of control (without coastal sediment and foliar seaweed extract).

The results proved that the leaf length in all shallots variety significantly increased following the giving of coastal sediment of 40 t/ha. The length of leaves of the Bima, Moujung and Sumenep varieties in the addition of coastal sediment and spraying seaweed extracts were 22.33, 23.17 and 27.22 cm, respectively. The length of leaves in each variety was longer than without giving of coastal sediment and spraying seaweed extract, each of which was only 18.08, 20.55 and 24.57 cm. The highest percentage of increasing parameter of leaf length at Bima variety can be reach 23.51% (Fig. 1). Moreover, the superiority of shallots leaf length by addition of coastal sediment might attribute to improvement of some peat soil properties nutrients uptake. In Table 2, the application of coastal sediment can increase pH and BS of peat soil. These results are in line with Suswati, Sunarminto, Shiddieq, & Indradewa (2014) research findings that the application of coastal sediment increased plant height on maize crops.

Table 2. Effect of foliar seaweed extract and coastal sediment on some peat soil properties

Treatments	pH	C-org	Total-N	P _{-av}	K _{-exc}	Ca _{-exch}	Mg _{-exch}	Na _{-exch}	CEC	BS
		(%)	(%)	(ppm)			(cmol(+)/kg)			
Without coastal sediment										
S ₀ C ₀ V ₁	4.1*	51.04	0.70	197.27	1.18	22.23	5.85	0.62	37.47	31.90
S ₁ C ₀ V ₁	5.6	42.63	0.66	153.77	1.52	43.48	6.49	0.96	33.71	62.23
S ₀ C ₀ V ₂	6.0	39.15	0.72	134.47	1.83	42.96	6.47	1.13	34.46	60.89
S ₁ C ₀ V ₂	6.0	43.79	0.81	70.36	1.12	46.96	6.50	0.79	35.31	62.72
S ₀ C ₀ V ₃	5.1	46.11	0.59	119.24	1.14	32.54	6.64	0.76	37.16	44.22
S ₁ C ₀ V ₃	5.6	44.66	0.78	166.05	1.62	39.16	6.98	1.12	35.31	55.36
Mean	5.38	44.56	0.71	140.19	1.40	37.89	6.49	0.90	35.57	52.89
With coastal sediment										
S ₀ C ₁ V ₁	6.2	32.48	0.53	42.74	1.16	38.83	6.09	2.92	29.18	67.18
S ₁ C ₁ V ₁	5.5	33.93	0.60	123.53	1.24	37.24	5.92	2.54	25.63	73.27
S ₀ C ₁ V ₂	5.6	34.22	0.68	94.37	1.25	38.85	6.06	2.80	27.59	70.99
S ₁ C ₁ V ₂	6.4	31.61	0.61	60.03	1.12	42.30	6.12	2.48	28.81	72.24
S ₀ C ₁ V ₃	6.0	35.38	0.53	81.88	1.30	45.00	6.10	2.30	27.29	80.17
S ₁ C ₁ V ₃	5.6	35.96	0.83	76.89	1.16	39.88	6.55	2.61	32.75	61.31
Mean	5.88	33.93	0.63	79.91	1.20	40.35	6.14	2.61	28.54	70.86

Remarks: C-org = carbon organic, Total-N = total of nitrogen, P_{-av} = available of phosphor, K_{-exc} = potassium exchangeable, Ca_{-exch} = calcium exchangeable, Mg_{-exch} = magnesium exchangeable, Na_{-exch} = sodium exchangeable, CEC = cation exchangeable capacity, BS = base saturation; * = the study did not conducted statistical analysis due to the soil analysis was done from composite soil sample of three replication

Table 3. The effect of coastal sediment and foliar seaweed extract on growth at three varieties of shallots

Treatments	Growth of shallow indicator									
	Leaf length (cm)			Number of leaf (plant)			Number of tiller (plant)			
	Foliar sea-weed	Bima	Moujung	Sumenep	Bima	Moujung	Sumenep	Bima	Moujung	Sumenep
Coastal sediment										
0 t/ha	0	18.08 h	20.55 g	24.57 cde	14.40 f	17.32 e	24.48 abc	4.17 d	5.12 cd	5.72 bc
0 t/ha	3%	22.17 fg	23.27 def	25.42 bc	19.42 d	22.57 c	24.50 abc	5.67 bc	5.84 abc	6.57 ab
40 t/ha	0	22.33 fg	23.17 ef	27.22 ab	19.67 d	22.87 bc	24.73 ab	5.92 abc	6.20 abc	6.70 ab
40 t/ha	3%	25.10 cd	25.33 bc	28.03 a	20.05 d	23.13 abc	25.15 a	5.83 abc	6.28 abc	7.02 a

Remarks: The mean value in one column followed by the same letter showed no significant difference at p < 0.05

The positive effect of spraying seaweed extract at a concentration of 3% significantly increased the leaf length in Bima and Moujung. The leaf length increases 22.62% for Bima variety and 13.24% for Moujung variety, whereas for Sumenep variety only increased 3.46% (Fig. 1). These findings are in line with the results of Dogra & Mandradia (2012) which reported that foliar seaweed extract application in onion was significantly higher from other treatments and control. In addition, the application of seaweed extract also increases higher leaf length in onion on sandy soil (Shafeek, Helmy, & Omar, 2015). The highest leaf length by giving of coastal sediment

of 40 t/ha and foliar seaweed extract is 3% at Sumenep variety (Table 3). This indicated that both treatments had positive effect on leaf length of shallot in peatland.

Table 3 also showed that the number of shallot leaf was significantly increased with the addition of doses 40 t/ha coastal sediment at Bima and Moujung variety, whereas with Sumenep variety was not significant. The increasing percentage of number of leaves in this treatment over untreated control is to the extent of 36.60, 32.04 and 1.02% respectively (Fig. 2). The influence of foliar seaweed extract raised the number of leaves of all shallot

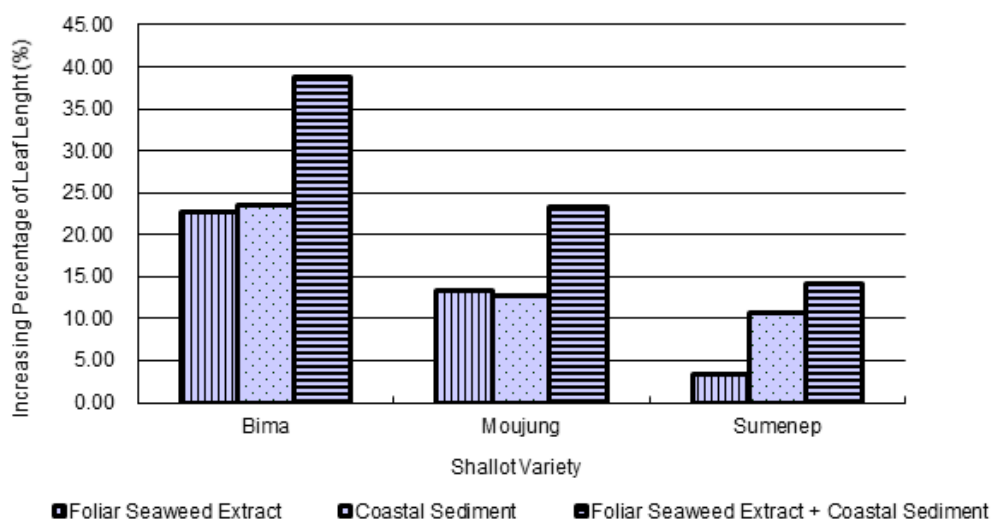


Fig. 1. Increasing percentage of leaf length on some shallot variety at peatland resulted foliar seaweed extract, coastal sediment and both two treatments application

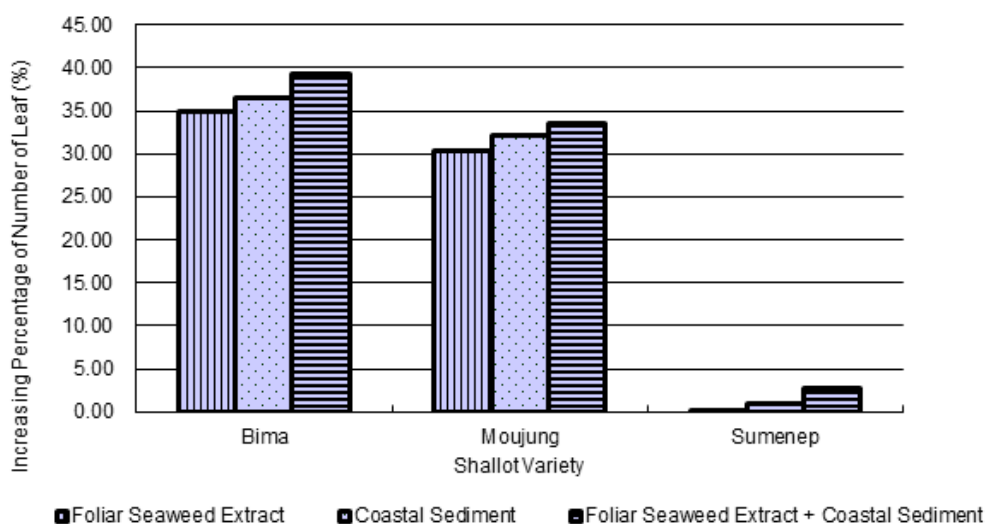


Fig. 2. Increasing percentage of number of leaves on some shallot variety at peatland resulted foliar seaweed extract, coastal sediment and both two treatments application

variety, but this effect on Sumenep variety was not significant. The highest increasing percentage of number of leaves was realized from Bima variety (34.86%) followed by Moujung variety (30.31%) and Sumenep variety (0.08%). These results agree with Babilie, Jbour, & Trabi (2015) which reported an increase in number of leaves on onion plant by foliar spraying with seaweed extract.

The results exhibit that giving of coastal sediment of 40 t/ha and foliar seaweed extract of

3% has significantly achieved the highest values of number of leaves each shallot variety (Fig. 2). Data in Table 3 shows that the number of leaves as a result of the influence of these two factors is higher than the effect of each single factor. In fact, the number of leaves in Moujung variety with foliar seaweed extract and coastal sediment application were 23 and it statistically significant compared to the control (17).

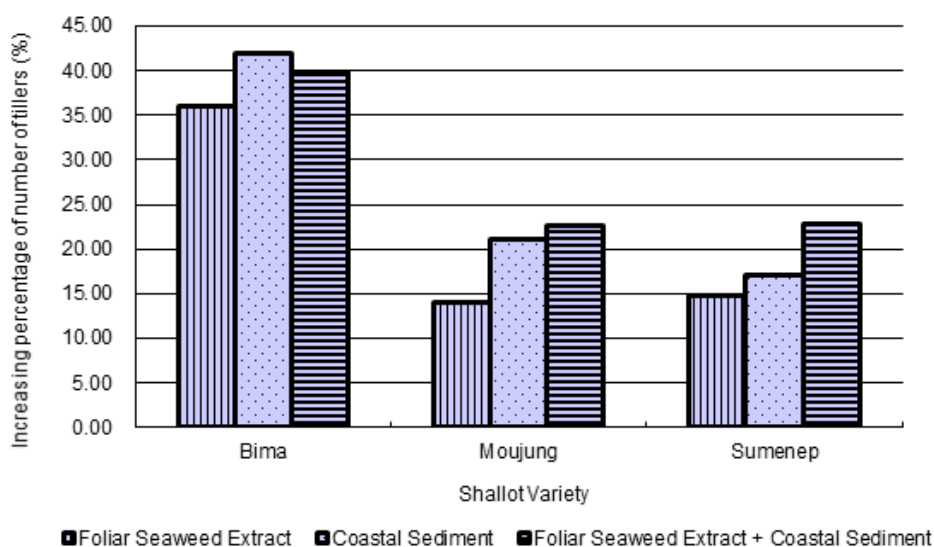


Fig. 3. Increasing percentage of number of tiller on some shallot variety on peatland resulted foliar seaweed extract, coastal sediment and both two treatments application

The obtained data showed that the number of tiller was only significantly higher at foliar seaweed extract, coastal sediment as well as both treatments than at control in Bima variety. In Sumenep variety, the increasing number of tiller with foliar seaweed extract and coastal sediment application (7.02) was only significant than control (5.72). The percentages of increasing number of tiller because of foliar seaweed extract and coastal sediment on each variety of shallot are Bima (39.81%), Moujung (22.66%) and Sumenep (22.23%) (Fig. 3).

The influence of treatments in the present study, either effect of each single factor or both two factor foliar seaweed extract and coastal sediment enhanced the plant growth parameters. Such enhancement in plant growth parameters was due to the improved soil properties that can stimulate root growth so as to increase nutrient absorption from the soil. Moreover, the superiority of shallot plants by spraying seaweed extract may be attributed to the contain of cytokines, phytohormones (indolasetat acid and indolbutiric acid) vitamins, amino acids, and several micro nutrients such as Fe, Cu, Zn, Co, Mo, Mn and Ni (Zodape et al., 2011). Shehata, Abdel-Azem, El-Yazied, & El-Gizawy (2011) explained that the positive effect of spraying seaweed extract was as the result of the interaction of many components in synergy, although the mechanism was not yet known. The application of spraying seaweed extract and providing coastal sediment can be used as one

of the ways to increase the growth and yield of shallots.

Table 4 shows that the yield of shallots increased with the provision of coastal sediment and foliar seaweed extract. Foliar spray of seaweed extracts from *E. cottonii* for 3% tended to increase yield in all shallot varieties, for example in the Sumenep (V_3) variety, the treatment without spraying seaweed extract produced 1.283 t/ha of shallot tubers, while spraying seaweed extract at a dose of 3% was 1.307 t/ha. The results of this study are in line with the research of Vasantharaja et al. (2019) which states that giving of seaweed extract at a dose of 3% by spraying can improve cowpea crop yields. The highest yield was obtained from a combination of giving coastal sediment at a dose of 40 t/ha and spraying seaweed extract at a dose of 3%, as many as 1.917 t/ha. This high yield causes the residues of some nutrients to be lower because plants with high production will absorb more nutrients. There is an inverse relationship between the residues of some nutrients and the yield of shallots. The results of the correlation test between the nutrients P and K with the yield of shallot are negative, namely each with r values for the P and K nutrient of -0.480 and -0.236. This result indicated that the low P and K remaining in the peat soil was due to the high nutrients uptake resulted the increases in shallot yield. Nutrient P has a function as an energy source in the form of ATP which is important in nutrient absorption and

photosynthesis process in shallot (Irianto, Yakup, Harun, & Susilawati, 2017). While potassium has an important function as an activator of several enzymes in metabolism and to maintain turgor of shallot plant cells (Purba, 2014).

The data of nutrient residues in peat soil which is smaller in the treatment of adding coastal sediment than without the application of coastal sediment (Table 4). Nutrient N residue with the provision of coastal sediment was by 0.63%, it was lower than without the addition of coastal sediment by 0.71%. P and K residues in the treatment with the addition of coastal sediment are less than without the giving of coastal sediment (Table 2). The treatment of giving coastal sediment has P and K residues in peat soil of 79.91 ppm and 1.20 cmol(+)/kg, whereas without the addition of coastal sediment was 140.19 ppm and 1.40 cmol(+)/kg, respectively.

Table 4. The effect of coastal sediment and foliar seaweed extract on yield at three varieties of shallots

Yield of shallot (t/ha)			
Without coastal sediment		With coastal sediment	
S ₀ C ₀ V ₁	0.803 h	S ₀ C ₁ V ₁	0.940 g
S ₁ C ₀ V ₁	0.883 gh	S ₁ C ₁ V ₁	1.060 f
S ₀ C ₀ V ₂	1.097 ef	S ₀ C ₁ V ₂	1.180 de
S ₁ C ₀ V ₂	1.160 ef	S ₁ C ₁ V ₂	0.940 g
S ₀ C ₀ V ₃	1.283 cd	S ₀ C ₁ V ₃	1.383 c
S ₁ C ₀ V ₃	1.307 c	S ₁ C ₁ V ₃	1.917 a
Mean	1.089	Mean	1.237

Remarks: The mean value in one column followed by the same letter showed no significant difference at $p < 0.05$

The highest yield of shallots was achieved by treatment of 40 t/ha of coastal sediment and foliar seaweed extract 3% on Sumenep varieties of 1.917 t/ha. When compared to the productivity of shallots in the Province of West Kalimantan in 2018 of 1.2 t/ha (Kementan, 2019). The yield from the treatment was higher. This shows that the cultivation of Sumenep shallot varieties by application of coastal sediment and spraying seaweed extract has the potential to be developed in peatlands.

CONCLUSION

The application of coastal sediments and foliar seaweed extract could improve some soil properties, growth and yield of shallot (*Allium*

ascalonicum L.) in peatland. The improvement of these soil properties is expected to increase the soil fertility to support the growth and yield of shallot. The increasing growth and yield of shallot as shown by enhance of percentage of leaf length, number of leaves, number of tiller and production of bulbs per ha.

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