Effect of organic liquid fertilizer to increase shallot productivity on the sub-optimal land of Wamena, Indonesia

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Abstract. The lands in Papua are generally the less than ideal for agricultural production, due to the high groundwater and poor nutrient content. Therefore, it is necessary to have a business effort from the locals to produce a traditional technology in plant cultivation; one of them is the shifting cultivation method. The use of organic liquid fertilizer is one of the forms of organic farming implementation that needs to be developed for Wamena farmers, where so far no one has used it. The present study aims to determine the growth response and development of five shallot varieties that are treated by organic liquid fertilizer. The research was conducted on the sub-optimal land of Wamena, Papua, continued in Laboratory of Soil Science and Laboratory of Plant Science, Faculty of Agriculture, University of Halu Oleo, Kendari, from September 2019 to January 2020. The research consisted of two factors; the first factor was five varieties of shallots consisting of Crok, Tiron, Super Biru, Bima and local Wamena variety as comparison. Factor two was the level of concentration of organic liquid fertilizer, which consisted of treatment without organic liquid fertilizer (control), treatment of 150 mL and 250 mL of organic liquid fertilizer. Data results were analyzed by using ANOVA 5% level and continued with the Duncan Multiple Range Test (DMRT) at 5%. The results showed that a specific concentration of organic liquid fertilizer is able to increase growth and yield of shallot. Meanwhile, local Wamena is an adaptive variety in tropical sub-optimal land.

Key Words: agricultural production, high groundwater, poor nutrients, traditional technology, *Allium cepa*.

Introduction. Seeing the contours and conditions of nature in eastern region of Indonesia, it can be said that Papua is worth developing as the eastern organic agricultural center of the East, with the majority of populations that lived as farmers, which have so far implemented the field of cultivation of the fields, and the application of LEISA (Low External Input Sustainable Agriculture), which is known to have a good sustainability of good farmland.

The use of organic liquid fertilizer is one of the forms of organic farming implementation that needs to be developed for Wamena farmers in the field of horticulture. This is due, to the fact that so far no one has used it. The horticulture plants in Indonesia has excellent prospects if are appropriate cultured, has high economic value and there are potential in increasing the welfare of farmers. One of them is shallot, which is one of ten horticultural commodities focused on developing in Indonesia, the target is to ensure sufficient amount that are safe for consumption and is economicaly competitive. Shallots are a superior vegetable commodity that has long been cultivated by farmers intensively. Shallot can be used as cuisine spice (flavor), vegetables (pickles and salads), and processed products (fried shallots). The bulb extract of shallot is currently being studied as traditional medicine (antimicrobial, anticancer, and anti-inflammatory) (Sari et al 2017).

The lands in Papua are generally less than ideal for agricultural production, among others due to high groundwater and poor nutrient content. Therefore, it is necessary to have a traditional technology to produce foodstuffs through a technological transformation that can help farmers to increase the organic content content of the soil associated with sustainable agricultural systems in Wamena, through the inputs that help increase the production of plants by maximizing local potential local wisdom, such as the use of organic liquid fertilizers.

Sub-optimal land may be interpreted as land that has naturally low productivity due to internal factors such as ground holding materials, physical properties, chemical and soil biology and external factors such as rainfall and extreme temperatures (Las et al 2012; Mulyani & Sarwani 2013). Because of the high food requirements and the limited fertile land due to land use change, it is the necessary to use sub-optimal optimal land with suitable crop comodities. However, the sub-optimal land category in question is the new conditions of land and has a high rainfall level as well as low temperatures, so that affects the existing land conditions (Mahanani et al 2020).

The utilization of organic liquid fertilizers is a form of modern organic farming that has not been known by local farmers. Modern organic farming is defined as a farm cultivation system that relies on natural ingredients without using synthetic materials (Mayrowani 2012). The principle of organic farming is based on health, ecological, justice and protection principles. The main objective of organic farming is to provide agricultural products, especially safe food materials for the health of manufacturers and customers and not damaging the environment thus the sustainability of life spared from contamination of hazardous and toxic chemicals (Zaini et al 2016).

Lack of knowledge concerning the use of organic iquid fertilizer as an additional material for the growth and development of plant that are environmentally friendly and safe for health, as well as how to use them, causing obstacles in increasing agricutural production and surrounding areas. One of the obstacle in question, among others, is the lack of knowledge of local communities and agricultural system that are still classified as primitive. So there is no use of any type of organic fertilizer in the organic farming system they apply. Therefore, the problem that needs to be overcome is how to provide knowledge, skills, and experience by proving directly through the implementation of research and apply the use of organic fertilizer (Tuhuteru et al 2019).

The present study was conducted to determine the growth response and development of five shallots varieties on sub-optimal land in Wamena given the treatment of organic liquid fertilizers.

Material and Method. The research was conducted on the sub-optimal land of Wamena, Papua Province, Indonesia continued in Soil and Plant Science Laboratory, Faculty of Agriculture, University of Halu Oleo, Kendari, Indonesia. The study was conducted from September 2019 until January 2020. The experiment was arranged as a random design of two factors with two replications as followed:

Factor 1. Shallot varieties:
- B1. Crok
- B2. Tiron
- B2. Super Biru
- B4. Local Wamena
- B5. Bima

Factor 2. Concentrations the organic liquid fertilizer:
- N0. 0 mL (without organic liquid fertilizer)
- N1. 150 mL organic liquid fertilizer
- N2. 250 mL organic liquid fertilizer

The observations were focused on soil samples (taken before cultivation), plant growth, plant development analysis and plant production concerning plant height (cm), number of leaves (strands) at 7, 21, 35, 49, and 63 days after planting (DAP), leaf area, leaf area Index at 77 DAP, total chlorophyll content at 77 DAP, and production of shallots at 91 DAP.

Soil analysis was performed to obtain the necessary information to see the soil capability that is closely related of to the land productivity. One indicator to see the soil capability is to analyze the chemical properties of the soil sample at the research location. Observations were performed in the Laboratory of Soil Science, of Agriculture, University of Halu Oleo, Kendari, Indonesia. The data analyzed include soil pH (H_20), C content, N available, P available, organic material, CEC (cation exchange capacity), and C/N-ratio.

Analysis of the physiology of shallots to be used as sample was a plant located in the center of the trial plot, not a border plant. The analysis of plants physiology was performed to know the physiological process of plants. This parameter was observed at 77 DAP, which was done destructively to the sample of shallots. The observed parameters include leaf area (LA), leaf area index (LAI), and the total of chlorophyll content. Then, parameters of plant production were observed at the last harvest or on week 13 after planting (91 DAP). The observed parameters were dry weight of bulb (ton ha^{-1}), where the observation was done by the drying process for 3-5 days and the parameter of harvest index.

Statistical analysis. The data results were analyzed using ANOVA (F-test) at significant level of 5%. If the test results indicated a real influence or very real, the tests were to be continued by Duncan's Multiple Range Test (DMRT) at significant level of 5%. Statistical analysis was conducted using an Exel program for Windows 10.

Results and Discussion. The results of the study consist of the results of soil sample analysis which are in the form of land chemical properties before the research was conducted and the results of plant growth analysis, plant physiological properties, and plant production.

The results showed that the organic liquid fertilizer is capable of increasing the productivity of land and shallots. Wherewith treatment on research land is able to improve the land characteristics known to have a pH (H_2O) which is acidic, N content very low, soil organic content very low, known that chemical properties of the land influence on shallots productivity.

The results showed types of land and nutrients status based on the research of analysis of soil chemical properties (Table 1) generally describes the quality of land, where it has a very low N content (0.06%), it is known that N is a macronutrient of plant. Furthermore, based on the results of pH analysis (H_2O) it was showed a neutral state of 5.88 (neutral). Then, the results showed the organic material content of the soil was at medium criteria, with a value of 2.77% (Table 1). Furthermore, the content of soil organic materials from the results of the study was high (4.77%). The available P content was low (7.65%). The CEC content in research location was 2.42 me 100 g^{-1} which is low, while the C/N ratio was 46:16.

Table 1

Result of soil analysis

No.	*Analyzed element*	*Values*
1	pH (H_2O)	5.88
2	C (%)	2.77
3	N (%)	0.06
4	Organic materials (%)	4.77
5	P (ppm)	7.65
6	CEC (CmoL kg^{-1})	2.42
7	C/N-Ratio	46:16

Source: Result of Soil Analysis from The Laboratory of Soil Science, Faculty of Agriculture, University of Halu Oleo Kendari, Indonesia, 2019.

The value of pH (H_2O) in the soil analysis indicates the hydrogen ion amount concentrations (H^+) in the soil. The higher high level of H+ ion in the soil makes the soil increasingly acid (Soewandita 2008). The condition of the soil is due to its young condition (new growing soil). This is supported by Mulyani & Sarwani (2013), which is the sedimentary and essential volume of the old condition with low-level of base saturation of

<50% and with regime humidity of >2,000 mm year^{-1} rainfall. In general, the mastered land has a low level of fertility and low productivity and influence the availability of macro and micronutrients (Soemarno 2013) and to achieve optimum productivity high input is required (Mulyani & Sarwani 2013). It is known that the higher is the pH higher is the content of organic material and higher is the total N content. However, the results showed that before the treatment with organic liquid fertilizer, the content of soil organic materials indicated a medium fertility status. After the organic liquid fertilizer administration the soil biological activity encouraged an enhancement of soil fertility status, both physical and chemical. As the fertility status of the land in determined by its soil organic materials, 2.01–3.00% organic C content idicates medium fertility, and 3.01-5.00% organic C content indicates high fertility (PPT 1995); Rosmarkam & Yuwono (2002) also mentioned that a 2.1-4.2% organic C indicates medium fertility and 4.3-6.0% indicates high fertility; meanwhile, there are also mentioned that high organic C content is considered at 2-4% and excessive at 4-8% (Sutanto 2005).

The content of soil organic material is known to have a linear relationship with total N content. In the conditions, the N content need for the plant will be higher than of other nutrient elements. The amount of N content in the soil is in equilibrium with climate, vegetation factors, topography, physical and chemical properties, human activities and time (Gana 2008). The addition of organic liquid fertilizer is a supply of N in the maintenance process and increased soil fertility. The low availability of N is in the ground causes low soil fertility, so it is a limit factor in both qualitative and quantitative aspect in plant production (Soepardi 1983).

The N element serves to increase plant growth; healthy green leaves (chlorophyll); increase the protein content in the body of the plant; together with the quality of plant-produced leaves and increases protection of microorganisms in the soil that is important for the continuity of weathering materials (Sutedjo 2010). In addition to N, the availability of P in the soil is very closly related to the soil pH (Hanafiah 2008). However, this is not in line with the present research findings. This is caused by the location of the research site in the first planting area, first processed as a land. The low value of P-available is because this element is oxidized by Fe and Al element. Increased available P can occur due to P release from organic materials added, as well as to the indirect influence of organic matter of P those in the soil sorption complex (Rosmarkam & Yuwono 2002). The high content of organic materials before the treatment of liquid organic fertilizers is known to reduce the presence of P by Fe an Al oxide, and also the clay colloids that are in the soil. The availability of P has a low range in pH <4 and >7.2.

P nutrient in the plant serves as a provider and storage of chemical energy for catabolic processes in the plant metabolism. Metabolism of carbohydrate on leaves and removal of sucrose is influenced by inorganic P although indirectly. The process of precipitating sucrose and hexose requires high phosphate energy, therefore inorganic P is required in the leaf cells of the time of carbohydrates preparation (McCray et al 2010).

The content of P and N, at the end, affects the high C/N-Ratio value, which was 46:16 (Table 1). It is known that the C/N ratio is one of the important components of organic materials and can be used to predict the rate of organic materials mineralization. The results showed that the content of the organic matter was high, but did not rule out the possibility of N immobilization (Stevenson 1982). For that, it is necessary to add organic matter to maintain the value of the C/N ratio. This is influenced also by CEC.

The CEC is a soil chemical nature that is closely related to soil fertility. Land with high CEC is able to absorb and provide nutrient elements better than soil with low CEC. Because the nutrients are in colloid cooperation complex, therefore the nutrients are not easily lost by water. The soil with organic material content or with high clay content has higher CEC than soil with low organic material content. Based on the critical fertility criteria (PPT 1995), the soil CEC in the study area was low.

The low value of CEC at the research site indicates that the land was not able to absorb and provide higher level of nutrients. Land with high CEC requires high-dose soil fertilization in order to be available to the plant, therefore when fertilizers are given in a low amount it is less available to the plants, because high quantity is absorbed by the soil and if the CEC is low, the fertilization should not be given once in high quantities because it is easily washed and it would be inefficient (Arthagama 2009). From the results of the analysis of the chemical properties of the organic liquid fertilizer, treatment is known to influence the production of plants. Then when viewed from the results of the research concerning plant growth, interaction between varieties was found in different weeks of observation. The vegetative period of normal shallot will greatly affect the crops (Ambarwati & Yudoyono 2003). This is in accordance with the statement that if vegetative growth is good then the generative growth will also be good because vegetative growth affects the generative period (Subhan 1992). In addition, given of an organic liquid fertilizers according to the plant proper needs will result in better growth (Wijaya 2012). This is indicated by the height parameters of plants and the number of plant leaves.

The growth analysis of the results showed a diversity of varieties responses that are tested to the treatment of the organic liquid fertilizer given (Table 2). At the observations of 7 and 21 DAP show the real estate of the organic liquid fertilizer on the plant hight, namely indicated by the treatment of the 150 mL organic liquid fertilizer combined with Super Biru varieties (9.335 cm) compared with the 150 mL organic liquid fertilizer combined with Bima varieties (4.980 cm). Meanwhile, 21 DAP control of treatment with a combination of local Wamena varieties has a real effect on a combination of 250 mL organic liquid fertilizer treatment with Bima varieties with a value of 12.250 cm. Meanwhile, 35 DAP, observations showed no real effect. Then, on 47 and 63 DAP types of varieties showed a real effect, namely the Crok and Super Biru varieties, showed a mean of 14.88 cm (48 DAP) and 16.62 cm (63 DAP) concerning plant height.

The results of the height parameter of the plant show the variation of organic liquid fertilizer's response to the shallot varieties. This is alleged to occur in cell division activities that occur in the creation of new cells. These new cells require a high quantity of carbohydrates because the walls are made of cellulose and the protoplasm is mostly made of sugar. So, if other factors are favorable the rate of cell division depends on the supply of carbohydrates that is sufficient (Harjadi 1989). In the present study, this is due to the 150 mL organic liquid fertilizer which proved to be the best concentration given to shallots. This points out that the organic liquid fertilizer can increase the absoption of nutrients, especially the N nutrient for vegetative growth of plants. As stated by Prihmantoro (1999), N nutrient are needed for vegetative growth of plants such as leaves, stems and roots.

Furthermore, the treatment with organic liquid fertilizer indicates an interaction of number of leaves parameter on 7, 21, 35, 49, and 63 DAP observation (Table 3), where the results of 7, 21 and 35 DAP showed a combination of control treatment (without organic liquid fertilizer) with Tiron varieties which had a real effect to control treatment with local Wamena varieties (21.000 strands) at 7 DAP, 24.835 strands (21 DAP), 24.335 strands (35 DAP). Meanwhile on 49^{th} and 63^{th} day after planting, treatment of 250 mL organic liquid fertilizer combined with Bima varieties showed real influence (interaction) and not different with the control treatment (without organic liquid fertilizer) combined with local Wamena varieties (26,500 strands) at the 49^{th} day after planting, followed by 28.835 strands (63 DAP).

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Table 2
Plant height of shallot (cm) of Crok, Super Biru, Tiron, local Wamena and Bima varieties

Observation (DAP)	*Variety*	*Organic liquid fertilizer treatment*			*Average*
		0 mL	*150 mL*	*250 mL*	
7	Crok	9.080^{a}	8.580^{abc}	9.000^{ab}	8.8867^{a}
	Tiron	7.415^{abcd}	8.665^{abc}	7.165^{abcd}	8.8617^{a}
	Super Biru	8.500^{abc}	9.335^{a}	8.750^{abc}	6.6950^{bc}
	Local Wamena	6.835^{abcd}	7.000^{abcd}	6.250^{bcd}	7.483^{ab}
	Bima	6.150^{cd}	4.980^{d}	5.300^{d}	5.4767^{c}
	Average	7.5960^{a}	7.7120^{a}	7.2930^{a}	(+)
		CV: 15.075			
21	Crok	9.835^{abcd}	9.085^{abcd}	10.335^{abc}	9.7517^{b}
	Tiron	8.920^{abcd}	10.250^{abc}	8.670^{abcd}	9.2800^{b}
	Super Biru	9.000^{abcd}	9.750^{abcd}	8.330^{bcd}	9.0267^{b}
	Local Wamena	12.250^{a}	11.330^{ab}	11.500^{ab}	11.6933^{a}
	Bima	7.385^{dc}	6.465^{d}	6.265^{d}	6.7050^{c}
	Average	9.4780^{a}	9.3760^{a}	9.0200^{a}	(+)
		CV: 15.934			
35	Crok	10.670^{a}	10.250^{a}	11.585^{a}	10.835^{a}
	Tiron	9.420^{a}	10.500^{a}	8.750^{a}	9.557^{a}
	Super Biru	9.330^{a}	9.585^{a}	9.835^{a}	9.583^{a}
	Local Wamena	12.33^{a}	9.500^{a}	8.915^{a}	10.250^{a}
	Bima	10.580^{a}	13.850^{a}	11.200^{a}	11.887^{a}
	Average	10.467 a	10.737 a	10.057 a	(-)
		CV: 21.787			
49	Crok	15.500^{a}	13.715^{a}	15.450^{a}	14.888^{a}
	Tiron	12.130^{a}	12.550^{a}	10.850^{a}	11.843^{b}
	Super Biru	11.270^{a}	11.835^{a}	12.385^{a}	11.830^{b}
	Local Wamena	14.015^{a}	11.180^{a}	11.135^{a}	12.110^{b}
	Bima	12.735^{a}	15.270^{a}	13.265^{a}	13.757^{b}
	Average	13.1300^{a}	12.9100^{a}	12.6170^{a}	(-)
		CV: 15.699			
63	Crok	17.200^{a}	15.450^{a}	17.235^{a}	16.628^{a}
	Tiron	14.215^{a}	14.735^{a}	12.915^{a}	13.955^{b}
	Super Biru	13.520^{a}	13.735^{a}	14.130^{a}	13.795^{b}
	Local Wamena	15.665^{a}	13.400^{a}	12.980^{a}	14.015^{b}
	Bima	14.780^{a}	17.080^{a}	15.400^{a}	15.753^{ab}
	Average	15.0760^{a}	14.8800^{a}	14.5320^{a}	(-)
		CV: 13.383			

CV - coefficient of variation, DAP – days after planting. The values in the column followed by the same superscript are not significantly different according to Duncan Multiple Range Test with α = 5%; (-): No interaction evidenced between the tested factors; (+): Interaction evidenced between the tested factors.

If in the growth period the plant has a high number of leaves, this can increase production. Wattimena (1987) explains that the auxin will increase the content of organic and inorganic substances in the cell. Furthermore, this substance is converted into protein, nucleic acid, polysaccharides and other complex molecules. The compound will form a network and organs, so the wet and dry weight of the plant increases. This happens because the leaves are the occurrence of the process of photosysnthesis, where the results of photosynthesis in the shallots are stored in the bulb. The more are the leafs, the photosynthesis that is stored in the bulbs will be higher and higher. This is in accordance with Napitupulu & Winarto (2009) who stating that the nutrients plays a role in increasing vegetative and generative growth and influences the increasing of shallots weight. In addition it is supported by Damanik et al (2010) who stated that the nutrient element is needed for the process of photosynthesis and can increase the weight of bulbs. The process of reduced dry weight is suspected to be due to the evaporation of water from bulbs. According to Loveless (1987) mostly the fresh weight of the plants is influenced by the water content of the plant.

Table 3
Number of shallots leaf (strands) of Crok, Super Biru, Tiron, local Wamena and Bima varieties

Observation (DAP)	*Variety*	*Organic liquid fertilizer treatment*			*Average*
		0 mL	*150 mL*	*250 mL*	
7	Crok	16.670^{abc}	19.000^{ab}	15.500^{abc}	17.057^{a}
	Tiron	21.000^{a}	15.665^{abc}	15.665^{abc}	17.443^{a}
	Super Biru	14.165^{abc}	19.835^{a}	13.500^{abc}	15.833^{a}
	Lokal Wamena	5.330^{d}	8.830^{cd}	11.500^{bcd}	8.553^{b}
	Bima	9.500^{cd}	10.000^{cd}	10.835^{cd}	10.112^{b}
	Average	13.333^{a}	14.666^{a}	13.400^{a}	(+)
	CV: 23.955				
21	Crok	16.330^{bcd}	18.670^{abc}	18.665^{abc}	17.888^{ab}
	Tiron	24.835^{a}	17.500^{abcd}	18.670^{abc}	20.335^{a}
	Super Biru	16.000^{bcd}	18.665^{abc}	14.170^{bcd}	16.278^{ab}
	Local of Wamena	11.830^{cd}	15.330^{bcd}	20.670^{ab}	15.943^{b}
	Bima	10.335^{d}	11.500^{cd}	12.330^{cd}	11.388^{c}
	Average	15.866^{a}	16.333^{a}	16.901^{a}	(+)
	CV: 19.151				
35	Crok	17.670^{ab}	20.335^{ab}	18.000^{ab}	18.668^{a}
	Tiron	24.335^{a}	18.670^{ab}	19.835^{ab}	20.947^{a}
	Super Biru	19.170^{ab}	23.165^{a}	16.335^{ab}	19.557^{a}
	Local of Wamena	7.330^{c}	11.830^{bc}	15.500^{abc}	11.553^{b}
	Bima	20.335^{ab}	23.165^{a}	23.165^{a}	22.222^{a}
	Average	17.768^{a}	19.433^{a}	18.567^{a}	(+)
	CV: 20.531				
49	Crok	19.500^{abc}	22.170^{ab}	20.165^{ab}	20.612^{a}
	Tiron	26.335^{a}	20.170^{ab}	22.000^{ab}	22.835^{a}
	Super Biru	21.665^{ab}	26.165^{a}	18.335^{abc}	22.055^{a}
	Local of Wamena	10.665^{c}	14.830^{bc}	18.665^{abc}	14.720^{b}
	Bima	23.000^{ab}	26.330^{a}	26.500^{a}	25.277^{a}
	Average	20.233^{a}	21.933^{a}	21.133^{a}	(+)
	CV : 18.432				
63	Crok	21.170^{abc}	23.665^{ab}	22.330^{ab}	22.388^{a}
	Tiron	27.830^{a}	22.000^{ab}	24.330^{ab}	24.720^{a}
	Super Biru	25.335^{a}	27.665^{a}	20.335^{abc}	24.445^{a}
	Local of Wamena	12.835^{c}	17.170^{bc}	20.330^{abc}	16.778^{b}
	Bima	24.335^{ab}	28.335^{a}	28.835^{a}	27.168^{a}
	Average	22.301^{a}	23.767^{a}	23.232^{a}	(+)
	CV: 15.617				

CV - coefficient of variation, DAP – days after planting. The values in the column followed by the same superscript are not significantly different according to Duncan Multiple Range Test with α = 5%; (+): Interaction evidenced between the tested factors.

In addition, it is known that the genetic factor of each plant is different and it is more dominant in influence plant growth so that the ability to bring up the number of shallot leaves is relatively the same. It is also known that the growth and production of shallots are influencd not only by external but also by internal factors, plant genetics (Putrasamedja 2010). The number of tillers and shallots leafs are more determined by genetic factors (Sumarni & Hidayat 2005) and it is known to be supported by environmental conditions, but depends on plant genetics in capitalizing the environmental support (Allard 1960). The genetic potential of plants, concerning leave numbers, can not be externalized unless the environmental conditions do not provide appropriate/optimal conditions.

Concerning the mean value of the leaves area and leaf area index parameter that have been observed, indicates that each variety clearly have different physiological responses and need different environment to suit the adaptive properties of plants, such as root capabilities in absorbing and translating water on sand or in a casting condition (Sumiyati et al 2018).

These results also affect the number of leaves formed which is one of the expression of plants related to influence of the beneficial treatment or the growing environment, allegedly effect of plant because the shallot with high rate of growth which is thought to influence the increase the number of leaves due to the use of carbohydrates more than to be stored and used in forming bulbs (Tuhuteru et al 2019). Obtaining high yields, it is also supported by sufficient leaf area index value in order to maximize photosynthesis to reach maximum dry weight production. However, this can happen if the environmental conditions are favorable (Table 4). We noted that this is supported by the plant physiological response in addition to the influence on plant growth. According to our observations, the treatment of organic liquid fertilizer has a real effect on plain physiology parameters such as leaf area and leaf area index of shallots on 77 DAP. The present research results demonstrated the real influence of the combination of 250 mL organic liquid fertilizer treatment with local Wamena variety at the extent of the plant leaf area (104.00 cm^{-2} g^{-1}). Meanwhile, the result of the leaf index area parameter showed the real effect of treatment without organic liquid fertilizer with local Wamena variety (0.955 g dm^{-2} $week^{-1}$). In addition, it also affects the plant chlorophyll content (Table 5). The results of this study showed a significant effect on the total of chlorophyll content, which is indicated by the treatment of 250 mL organic liquid fertilizer (0.255 mg g^{-1}).

Table 4

Leaf area (g dm^{-2} $week^{-1}$) and Leaf Area Index (cm^2 g^{-1}) of the Crok, Super Biru, Tiron, local Wamena and Bima shallots varieties

Parameters	*Variety*	*Organic liquid feetilizer treatment*			*Average*
		0 mL	*250 mL*	*150 mL*	
Leaf Area (g dm^{-2} $week^{-1}$)	Crok	49.00^{ab}	85.50^{ab}	91.50^{ab}	75.33^{ab}
	Tiron	43.50^{b}	75.00^{ab}	74.50^{ab}	64.33^{ab}
	Super Biru	78.50^{ab}	59.00^{ab}	68.50^{ab}	68.67^{ab}
	Local Wamena	81.00^{ab}	65.00^{ab}	104.00^{a}	83.33^{a}
	Bima	55.00^{ab}	57.50^{ab}	36.50^{b}	49.67^{b}
	Average	61.40^{a}	68.40^{a}	75.00^{a}	(+)
		CV: 33.805			
Leaf Area Index (cm^2 g^{-1})	Crok	0.545^{bc}	0.910^{ab}	0.885^{ab}	0.780^{a}
	Tiron	0.545^{bc}	0.400^{c}	0.595^{abc}	0.513^{b}
	Super Biru	0.805^{ab}	0.690^{abc}	0.710^{abc}	0.735^{a}
	Local Wamena	0.955^{a}	0.720^{abc}	0.765^{abc}	0.813^{a}
	Bima	$0.785a^{bc}$	0.590^{abc}	0.520^{bc}	0.632^{ab}
	Average	0.727^{a}	0.662^{a}	0.695^{a}	(+)
		CV: 22.869			

CV - coefficient of variation. The values in the column followed by the same superscript are not significantly different according to Duncan Multiple Range Test with α = 5%; (+): Interaction evidenced between the tested factors.

Furthermore, it can also affect the plant chlorophyll content that is the parameter in viewing the green substance that will then be formed into a matter of plants and is required as the basic ingredient of the bulb. In other words, the amount of plant chlorophyll contained in the leaves of plant observed describes the number of photosintat formed. It is suspected that total chlorophyll content is significantly affected by N and hormone content that is in the organic fertilizer in the tight high effect that has an effect on the form of the amount of chlorophyll produced (Table 5). The given organic liquid fertilizer used is known to have the nutrient content of N = 4.15%, P_20_5 = 4.45%, K_2O = 5.66%, Organic C = 9.69%, Fe = 505.5 ppm, Mn= 1931.1%, Cu = 1,179.8%, B = 806.6%, Co = 8.4 ppm, Mo = 2.3 ppm, pH = 5.61, growth regulator (gibberellin, cytokinesis, auxin). The nutrient content of organic liquid fertilizer has a real effect on growth and yield of shallots (Sara et al 2019).

Table 5

Total cholorophyll content (mg g^{-1}) of the of Crok, Super Biru, Tiron, local Wamena and Bima shallot varieties

Variety	*Organic liquid fertilizer treatment*			*Average*
	0 mL	*250 mL*	*150 mL*	
Crok	0.215^{abc}	0.175^{abcd}	0.12^{cd}	0.172^{ab}
Tiron	0.210^{abc}	0.105^{d}	0.160^{abcd}	0.158^{ab}
Super Biru	0.215^{abc}	0.235^{ab}	0.140^{bcd}	0.197^{a}
Local Wamena	0.170^{abcd}	0.100^{d}	0.095^{d}	0.122^{b}
Bima	0.115^{cd}	0.235^{ab}	0.255^{a}	0.202^{a}
Average	0.185^{a}	0.170^{a}	0.155^{a}	(+)
		CV: 25.039		

The nvalues in the column followed by the same superscript are not significantly different according to Duncan Multiple Range Test with α = 5%; (+): Interaction evidenced between the tested factors.

Fertilization using organic liquid fertilizer was reported to be more suitable because the liquid form of fertilizer is easier to be absorbed by roots and can provide nutrients in accordance with the needs of the plant (Putri 2011). This is tought to be related to the ability of organic fertilizers that contain positive microorganisms which can function in addition to being phytohormones, as well as providing nutrition in the area around of plant roots, especially when combined with manure addition. So as to be able growing environmental requirements for microorganisms in colonizing by changing the hard texture of soils into loose to be influential on growth and development of shallots. Ultimately, the liquid fertilizer is able to increase nutrient content around the roots in accordance with the plant needs, and support the absorption of nutrients due to its existence in the plant tissue through a decrease in heavy metal poisoning rates and it is also helpful against pathogens.

The present research results concerning plant production showed real effect indicated by combination of the control treatment (without organic liquid fertilizer) with local Wamena varieties with production achievements of 2.455 ton ha^{-1} and real influential to the treatment of 250 mL organic liquid fertilizer with Bima varieties (0.560 ton ha^{-1}). This is due to the capacity of organic liquid fertilizer to increase the availability and absorption of macro and micro nutrients in shallots, beside the fact that the organic liquid fertilizer also contains growing regulators, resulting in increased plant growth and high bulb production. Natural Nusantara (2004) also reported that organic liquid fertilizer can be used directly by the plantes because the content of nutrients is already in the form of ions ready to be absorbed. Organic liquid fertilizer can stimulate plant growth and is able to increase the overall production. Napitupulu & Winarto (2009) also stated that sufficient nutrients for shallots can increase the weight of the harvesting.

Table 6
Plant production (ton ha^{-1}) of Crok, Super Biru, Tiron, local Wamena and Bima shallot varieties

Variety	*Organic liqid fertilizer treatment*			*Average*
	0 mL	*250 mL*	*150 mL*	
Crok	1.170^{bcd}	0.830^{cd}	1.430^{abcd}	1.143^{b}
Tiron	0.815^{cd}	0.815^{cd}	0.645^{d}	0.758^{b}
Super Biru	1.325^{abcd}	1.150b^{cd}	1.010^{bcd}	1.162^{b}
Local of Wamena	2.455^{a}	2.045^{abc}	2.165^{ab}	2.222^{a}
Bima	0.590^{d}	0.765^{cd}	0.560^{d}	0.638^{b}
Average	1.271^{a}	1.121^{a}	1.162^{a}	(+)
		CV: 45.411		

The values in the column followed by the same superscript are not significantly different according to Duncan Multiple Range Test with α = 5%; (+): Interaction evidenced between the tested factors.

According to Sarief (1995) the organic liquid fertilizer at the right time and concentration can stimulate the root, accelerate the growth of the plant and the absorption of nutrients is better so this way improve the quality and quantity of production. This is in accordance with Sutijo (1986) that during the needs of nutrients, water and light are sufficient to the plant and there so therefore competition between plants the rate of photosynthesis in the growth process is relatively the same. The leave area index plant growth variable can also affect the quality of shallot bulbs.

Plant growth is also supported by environmental factors, others than the number of nutrients available in the soil. The establishment of shallot bulbs will increase in suitable environmental conditions where the lateral shoots will form a new disc, then the armored tape (Samadi & Cahyono 2005). In each plant variety, there is always a difference in genotypes response against various environmental conditions (Handayani & Sri 1991; Jumini et al 2011). This situation causes a growth difference for each shallot variety. It can be said that there is an increase in metabolic processes in local Wamena variety and causes increased formation of carbohydrates, proteins and fat which is known to potentially increase yields of crops such Tiron variety which is known to be adaptive in sandy lands (Tuhuteru et al 2016). For that, local Wamena variety showed to be able to survive in the Wamena region with environmental conditions and weather that is classified in the wet of wet tropical sub-optimal land.

Conclusions. The conclusion obtained from the results of the present study is that the organic liquid fertilizer concentration of 150 mL (N1) is capable to increase the productivity of the shallot plants. Meanwhile, local Wamena is an adaptive variety to wet tropical land.

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