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Growth and Yield of Watercress (*Nasturtium officinale* R.Br) at The Level and Different Type of Nitrogen Fertilizer

Eko Widaryanto and Yulita Firda N. I. K*)

Department of Agronomy, Faculty of Agriculture, Brawijaya University
Jl. Veteran, Malang 65145 East Java, Indonesia
*)Email: yulita.firda@gmail.com

ABSTRACT

Watercress (*Nasturtium officinale* R.Br) is family of Brassicaceae. Watercress has become favourite of many people in Indonesia especially in Malang and used as medicinal plant. Growth and yield of watercress was affected by nutrient content of Nitrogen. Nitrogen isessensial nutrient needed by plant to growth and to form vegetive organ as leaf, branch and root. This research aims to get best level at different type of fertilizer for growth and yield of watercress by using urban farming methode. The reseach was conducted in CV. Kurnia Kitri Ayu Farm Malang from July until December 2016. The reseach used Complete Randomized Design (CRD) involving four level of dose (1, 2, 3 and 4 g/pot) and two type of different fertilizer (Urea and ZA) with four types of doses and three replicatiosn. The result showed there was an influence between the level and different type of fertilizer. Urea fertilizer on doses 4 g per pot has higher result than others treatment of variant doses of Urea fertilizer and alsoZA fertilizer on doses 4 g per pot has higher result than others treatment of doses ZA fertilizer.The yield data showed if using Urea on doses 4 g per pot increased 50% higher than ZA fertilizer on doses 4 g per pot. The result clearly indicated that 4 g per pot of Urea fertilizer was the best level of doses of different type of fertilizer.

Keywords: Fertilizer, Nitrogen, Urban Farming, Urea, Watercress, ZA.

INTRODUCTION

Public interest will increase as healthy living by consuming lots of healthy vegetables. One type of vegetable is rich in benefits and much-loved is watercress (Nasturtium officinale R.Br), or sometimes referred to jembak is a highland vegetable which can only live in watery land as well as rice, water spinach, and velvetleaf. According Bahramikia and Razieh (2010) states that watercress is used as a medicinal plant in Iran, the leaves of watercress plants used against depuratif, diuretic, expectorant, hypoglycemia, odontalgik, and cancer.

Watercress cultivated with an average yield per year to 6.7 tons (BPS Malang, 2006). The level of consumption of watercress in Malang is also quite high with the number of requests reached 17.6 tons in 2005-2006 (BPS Malang, 2006). This condition nyebabkan me-the watercress production should diting-katkan each year, but the production of watercress is very volatile. This is caused by the lack of optimal care and the lack of land-use for the cultivation of watercress. Therefore, efforts to improve yields and offset in-need market interest in the cultivation of the optimal business such as the addition of nutrients and increase cultivation areas such as yard using urban farming system.

According to Edward (2016), Urban farming is the concept of the transfer of conventional farming to agriculture per-kotaan with the perpetrator and the planting medium that made the difference. Agriculture kon-vensional more oriented to production, whereas urban farming is more oriented to meet personal needs. plant. One of fertilizer that can be used to improve soil fertility is Urea and ZA. The chemical, physical, and biological soil is backing affect growth, yield and quality of crops. Urea (NH_2CONH_2) is able to stimulate vegetative growth and increase the green color of leaves and ZA able to improve the taste and color of the crop. The conversion efficiency of nitrogen increases with increasing level of Nitrogen (Jamilah and Nuryulsen, 2010).

It is expected that through this experiment could obtained good information

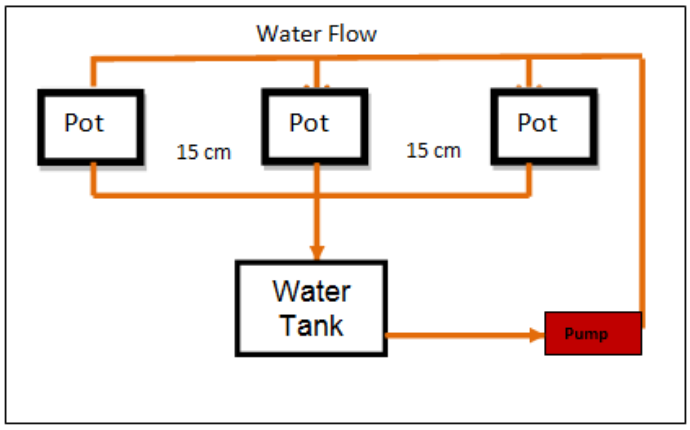
on the use of level and type of fertilizer so that the production of watercress can be improved and the effeciency in using fertilizer.

MATERIAL AND METHODS

The research was conducted on July until Desember 2016at CV. Kurnia Kitri Ayu Farm, Sukun Malang. Tools that were used include shovels, gutters, saws, hoses, pumps, pots, cutter, ruler, oven, analytical scale, calculators, cameras, paper, pen and labels. The materials that were used include watercress seedlings of local varieties and two types of fertilizers, Urea and ZA. All tools and materials were used from cultivation started until harvest time.

This research was using randomized block design witheight treatmentin four levels of doses and three replications. Treatment D1 (Urea 1 g), D2 (Urea 2 g), D3 (Urea 3 g), D4 (Urea 4 g), D5 (ZA g), D6 (ZA 2 g), D7 (ZA 3 g), D8 (ZA 4 g).

Watering on this researh was using water flow system. The steps were including preparation of watercress planting material from cuttings with length 25 cm. Planting media was using 2 kg sandy loam soil. This soil type was chosen because it could adapts to the characteristics of watercress. Planting media then placed on square pipe with height 15 cm and width 10 cm, the next step continued with planting and maintenance (watering, fertilizing, weeding, and pest diseases control). The water flow system is shown in the following figure:



Gambar 1 Water Flow System

Watercress plant data was divided into growth and yield observations. Growth observations were conducted every 7 days at 14-38 days after planting with the parameters observed included plant length (cm), number of leaves (leaf), number of branches, root length (cm), total fresh plant weight (g tan-1), dry plant weight (g tan-1) and crop growth rate (g m-2 minggu1), while yield observationwere conducted at first, second and third harvest times or 42, 84 and 126 days after planting. Observation data were analyzed using analysis of variance (F test) at 5% level. If the test results was significantly different then continued with HSD test at 5% level.

RESULTS AND DISCUSSION

Lenght of Plant

According to the table 1, it can be explained that treatment and level of different types of fertilizers had significantly different results on the length of the plant at 14-38 days after planting. The observation of the plant significantly different from other treatments was treatment with Urea 4 g dose level. One of the factors that influence the growth of watercress plant lenght is element nitrogen in the soil, that the nitrogen requirement must be sufficient for plant growth. According Hardianti (2016), Nitrogen should be available in sufficient quantity so the growth and production of plants will be in optimum condition.

Treatment with Urea fertilizer got

better results than ZA treatment. Urea is immobile and easy to absorb water moisture, it is in accordance with Jian et al. (1986) that one form of nitrogen fertilizer such as Urea that containing N 46%, easily to draws moisture (hygroscopic) and it easily absorbed by plants.

Number of Leaves

Results of analysis of variance the number of leaves at 14-35 DAP observations showed significantly different results. The application of urea at dose of 4 g per plant give the best results compared with other fertilizer type and different doses (Table 2). Nitrogen fertilizer application at the beginning of planting affects the number of leaves produced by the plant. This is in accordance with the statement of the Erawan *et al.* (2013) that Nitrogen is an essential component in the vegetative growth of the plants. Nitrogen serves to promote plant growth, including the growth of leaves, leaf area with green color that consist of chlorophyll, increasing the protein content in the plantklorofil organs and improve the quality of plants (Erawan *et al*., 2013).

Ispandi and Munip (2004) stated the content of nitrogen in fertilizers have a role in stimulating vegetative growth and accelerate the growth of plant tissues, especially the growth number of leaves, tillers and plant height. Leaves as organ of the plant serves as site of photosynthesis system. Absorption nitrogen fromnot arable landwill lower the process of leaves formation and photosynthesis. Nitrogen element is one of the most essential macro nutrient in plant growth.

Table1 Interactions of Fertilizer Types and Doses on Length of Plant at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Lenght of Plants (cm) on ObservationPeriods (DAP)							
	14		21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA	Urea	ZA
1	9.9 ab	7.6 a	13.9 cd	8.5 a	18.1 abc	13.4 a	29.4 c	23.6 a
2	10.7 bc	8.7 ab	15.6 de	10.2 a	20.2 abc	15.5 ab	33.5 cd	25.3 ab
3	13.1 bc	10.5 abc	17.5 de	11.2 b	23.4 bc	18.2 abc	35.8 de	28.2 ab
4	15.5 c	12.8 abc	19.1 e	16.1 d	25.4 c	19.8 abc	39.5 e	33.4 cd
HSD 5%	5.13		3.07		8.71		4.80	
CV (%)	10.76		10.08		14.28		12.83	

Remarks: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data length of plants were the result of growth observation in the first harvest.

Table 2 Interactions of Fertilizer Types and Doses on Number of Leaves at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Number of Leaves (leaf) on Observation Periods (DAP)							
	14		21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA	Urea	ZA
1	10.43 ab	8.83 a	15.91 a	14.5 a	23.4 a	23.1 a	29.2 ab	27.2 a
2	13.18 bc	10.31 ab	17.71 ab	16.4 b	28.5 bc	25.8 ab	34.4 bcd	30.6 abc
3	16.51 cd	13.63 bc	22.15 de	20.1 b	32.3 d	28.0 bc	36.5 cd	33.1 bcd
4	19.38 d	16.66 cd	25.73 e	23.7 c	33.5 d	30.5 cd	38.2 d	36.6 cd
HSD 5%	3.69		5.75		2.98		6.16	
CV (%)	10.76		12.93		14.28		17.24	

Description: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data number of leaves were the result of growth observation in the first harvest.

Table 3 Interactions of Fertilizer Types and Doses on Number of Branches at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Number of BranchesOn Observation Periods (DAP)							
	14		21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA	Urea	ZA
1	3.7 abc	3.2 a	4.1 ab	3.5 a	4.2 ab	3.8 a	5.0 ab	4.5 a
2	4.6 ab	3.5 ab	5.2 ab	4.7 ab	5.3 ab	4.3 ab	5.7 ab	4.8 a
3	5.2 bc	4.3 abc	5.7 b	5.1 ab	6.1 ab	5.4 ab	7.0 ab	5.7 ab
4	5.4 c	5.2 bc	6.7 c	5.8 b	7.1 b	6.4 ab	8.1 b	6.0 ab
HSD 5%	2.18		2.99		2.86		3.21	
CV (%)	22.54		13.60		12.63		12.63	

Remarks: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data number of branches were the result of growth observation in the first harvest.

Table 4 Interactions of Fertilizer Types and Doses on Root Lenght at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Root Lenght (cm) On Observation Periods (DAP)							
	14		21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA	Urea	ZA
1	1.20 ab	0.7 a	2.83 a	2.5 a	3.51 a	3.45 a	5.01 a	4.43 a
2	1.85 bc	1.3 ab	3.14 a	2.6 a	4.30 ab	3.60 ab	6.13 ab	5.85 a
3	2.15 bc	1.9 bc	3.23 a	2.9 a	5.13 ab	4.26 ab	6.88 ab	6.40 ab
4	2.38 c	2.1 bc	3.70 a	3.2 a	6.55 b	4.95 ab	7.65 b	6.96 ab
HSD 5%	0.89		1.45		2.84		2.90	
CV (%)	12.39		11.90		14.19		11.70	

Description: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data of root length was the result of growth observation in the first harvest.

Number of Branches

Data number of branch watercress plants in this study showed that in the observations at 14, 21, 28 and 35 days after planting were significantly different between Urea and ZA fertilizer. Urea fertilizer treatment at dose 4 g per plant was getting more number of branches than other treatments (Table 3). Each treatment increased at every level of observation, but the increase number of branches did not show significant improvement. Nitrogen is an important component in photosynthesis and also it plays an important role in forming protein (Kiswondo, 2011). Therefore, if plants suffer from lack of nitrogen,the vegetative growth will be obstructed.

Root Lenght

Data observations at 14, 28 and 35 days after planting of root length was significant difference, while observation at 21 DAP showed that was not significantly different, because root lenght was not increasing (Table 4). Planting materials were usingcuttings, it formed root fibers that extended. Roots have main function to absorb water and nutrient. According to Endres *et al*. (2010), the growth of root lenghtis very influenced by the availability of water and nutrients in the soil. Katono (2005) explains that the influence of the dosage of Urea can occur because of nitrogen contained in the soil can not be separated from immobilization by clays and other nutrients, therefore nutrients become available to the plants requires consedirable time.

Leaf Area

Leaf area showed that the different types and doses of fertilizer had affected the enhancement in leaf area. Observations 14, 21, 28 and 35 days after planting showed significant differences in the leaf area result (Table 5).

Leaf is where biological point of photosynthesis take a place, which plays an important role in the absorption of sunlight energy, formation of organs of vegetative and generative organs of plants (Bidwel, 2001). The explanation above shows that in increasing leaf area, the higher sunlight absorption, organ formation of vegetative and generative organs will growoptimum. The wider leaf area makethe photosynthesis process becomes optimum and itcan increasethe formation of plant biomass. Nitrogen is an essential component in the process of photosynthesis so that the availability of sufficient nitrogent will be optimize the process of photosynthesis and plant biomass formation. Totok (2004) explained that the lack of nitrogen provides a direct influence on the growth of leaves (leaf area) and photosynthesis of plants.

Crop Growth Rate (g cm^{-2} $week^{-1}$)

The observation of Crop Growth Rate at 21, 28 and 35 days after planting showedsignificant influence on each treatment. Urea with dose of 4 g per pot showed the best value compared with other fertilizers treatment dosage levels (Table 6). The CGR is influenced by the amount of nitrogen at the beginning of growth, it is in line with the research of Gunarto (2002), that CGR watercress for N elements are needed by plants mainly in the vegetative phase and function of N during the vegetative phase is assist in the formation of photosynthesis.Hanolo (1997) stated Nitrogen should be available in sufficient quantity for optimal growth and yield production, therefore nitrogen uptake greatly affect to the plant growth.Leaf is wherephotosynthesis take a place, it plays an important role in the absorption of sunlight energy, formation of organs of vegetative and generative organs (Bidwel, 2001). The explanation above showed that in increasing leaf area, the higher sunlight absorption, organ formation of vegetative and generative organs will grow optimum. The wider leaf area make the photosynthesis process becomes optimum and it can increasethe formation of plant biomass. Nitrogen is an essential component in the process of photosynthesis so that the availability of sufficient nitrogent will be optimize the process of photosynthesis and plant biomass formation. Totok (2004) explained that the lack of nitrogen provides a direct influence on the growth of leaves (leaf area) and photosynthesis of plants.

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Table 5. Interactions ofFertilizer Types and Doses on Leaf Area at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Leaf Area (cm^2 $plant^{-1}$) On Observation Periods (DAP)							
	14		21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA	Urea	ZA
1	11.91 a	9.28 a	18.5 b	10.7 a	23.2 bc	15.25 a	27.25 a	22.45 a
2	14.41 b	12.46 b	19.1 b	12.8 a	28.1 bc	16.67 ab	29.42 ab	24.45 a
3	17.81 b	13.15 b	23.2 c	15.3 b	30.2 c	23.40 bc	32.49 bc	30.90 bc
4	21.65 c	17.27 b	28.6 d	19.5 b	32.8 c	28.13 bc	38.00 c	32.21 bc
HSD 5%	0.89		9.84		15.16		11.67	
CV (%)	12.39		12.47		13.48		10.22	

Remarks : Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data leaf area was the result of growth observation in the first harvest.

Table 6 Interactions of Fertilizer Types and Doses on Crop Growth Rate at Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Crop Growth Rate (g cm^{-2} week^{-1}) On Observation Periods (DAP)					
	21		28		35	
	Urea	ZA	Urea	ZA	Urea	ZA
1	4.63 a	4.50 a	12.16 ab	11.40 a	10.50 a	10.20 a
2	5.44 bc	4.80 ab	15.00 bc	13.03 ab	13.86 abc	12.16 a
3	5.80 d	5.34 bc	18.75 d	14.88 abc	17.80 d	15.04 bc
4	5.90 d	5.67 cd	19.03 d	16.43 c	18.16 d	15.90 cd
HSD 5%	0.63		3.84		2.90	
CV (%)	4.44		22.60		22.41	

Remarks: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data of plant growth rate was the result of growth observation in the first harvest.

Table 7 Fresh weight of accumulated harvest through Interactions ofFertilizer Types and Dosesat Various Observation Periods

Treatment of Fertilizer Dose (g pot^{-1})	Fresh weight of accumulated harvest (g plant^{-1})	
	Urea	ZA
1	70.86 b	60.21 a
2	82.97 c	71.86 b
3	91.82 d	81.91 c
4	102.26 e	92.58 d
HSD 5%	6.98	
CV (%)	18.44	

Description: Numbers followed by the same letter at the same age (column and row) showed no significant different in HSD test at 5% level. DAP :day after planting; CV: coefficient of variation; Data fresh weight of accumulated harvestwas the result ofyield observations at (42, 82 dan 162 DAP)

Hanolo (1997) stated Nitrogen should be available in sufficient quantity for optimal growth and yield production, therefore nitrogen uptake greatly affect to the plant growth.Leaf is wherephotosynthesis take a place, it plays an important role in the absorption of sunlight energy, formation of organs of vegetative and generative organs (Bidwel, 2001). The explanation above showed that in increasing leaf area, the higher sunlight absorption, organ formation of vegetative and generative organs will grow optimum. The wider leaf area make the photosynthesis process becomes optimum and it can increasethe formation of plant biomass. Nitrogen is an essential component in the process of photosynthesis so that the availability of sufficient nitrogent will be optimize the process of photosynthesis and plant biomass formation. Totok (2004) explained that the lack of nitrogen provides a direct influence on the growth of leaves (leaf area) and photosynthesis of plants.

Fresh Weight Of Accumulated Harvest

The fresh weight observation of watercress total yield done at harvest time showed significantly different in the treatment of fertilizer typesand dosage. From the analysis of variance showedurea at dosage of 4 g per pot has the best results compared with the others treatments (Table 7). Fresh weightof accumulated harvest is basically very influenced by the results of other variables such as the number of leaves, leaf area and length of the plant. Fresh weight of the plants affected by the length of plant and the number of leaves. Variable is highly influenced by nitrogen, especially on the formation of vegetative organs. When vegetative organs in the optimum conditions, the result of watercress yield will be high.Nitrogen fertilizer in the early days of planting potential to produce a good crop production, it is consistent with the statement Suryati (2009) that the fertilizer in large numbers in the early planting can back give good results on a per-

plant and crop production.Treatment using Urea fertilizer can result in an increase in the heavier the plant fresh weight, it is similar to the results of research Jian et al. (2017) that administration of urea and ammonium nitrate fertilizer can increase yield significantly better and the weight and size of the fruit.

CONCLUSION

Treatment using ureawith 4 g per pothad the optimum results of growth and yield on watercress plants. Datagrowthobservation showedthat urea fertilizer with dose of 4 g per pot can increase 45% length of the plant, 54% number of leaf, 57% root length, 81% number of branches, 56% leaf area,83% fresh plant weight, 58% dry plant weight, 56% plant growth rate and44% accumulated harvest weight greater thanother different types fertilizer with other different dose levels. Watercress cultivationusing urban farming systems can increase watercress plants production and it has good results at plant growth rate and plants yield.

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