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# PENGARUH INTERVAL ALIRAN NUTRISI TERHADAP PERTUMBUHAN DAN HASIL TANAMAN SELADA (Lactuca sativa) PADA SISTEM DEEP FLOW TECHNIQUE

# EFFECT OF NUTRIENT SOLUTION FLOW INTERVAL ON GROWTH AND YIELD OF LETTUCE (*Lactuca sativa*) GROWN IN HYDROPONICALLY DEEP FLOW TECHNIQUE

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**ABSTRACT**

Lettuce (*Lactuca sativa* L.) is one of the vegetables that are commonly cultivated by using hydroponic systems. Some hydroponic systems require high current expenses in particular for the electricity in order to circulate nutrient solution e.g. in the water culture system – deep flow technique (DFT) -. Electricity costs can be reduced by changing from continuous nutrient flow to intermittent nutrient flow. The aim of this research was to investigate the effect of interval nutrient flow on growth and yield of lettuce. The experiment was conducted in Cirebon from February to April 2018. The experiment was arranged by using randomized complete block design with four treatments: (i) continuous nutrient flow (control), intermittent nutrient flow (nutrient flow during (ii) 15 minutes, (iii) 30 minutes, and (iv) 45 minutes). For each intermittent treatment, the nutrient flow was interrupted for 60 minutes. Each treatment was repeated four times. The result showed nutrient flow interval affected to plant height, shoot diameter, and leaf area at 35 days after planting (DAP). Meanwhile, leaves number, root volume, and fresh weight of harvested crops were not significantly different in all nutrient interval treatments. The highest plant height and shoot diameter were detected in the treatment (ii) nutrient flow during 15 minutes and interruption for 60 minutes, the results were not significantly different to the control – continuous flow treatment. It can be concluded the interval nutrient flow can be used as an alternative of the continuous flow of nutrient solution in hydroponically DFT.

Key Words: DFT, hydroponic, intermittent, lettuce

**ABSTRAK**

Selada (*Lactuca sativa*) merupakan salah satu sayuran yang biasa dibudidayakan secara hidroponik. Beberapa sistem hidroponik membutuhkan biaya besar dalam penggunaannya seperti biaya listrik untuk mengalirkan larutan nutrisi pada sistem Deep Flow Technique (DFT). Biaya listrik tersebut dapat dikurangi dengan mengganti aliran nutrisi yang kontinyu menjadi aliran terputus (intermittent). Tujuan dari penelitian ini adalah untuk mengetahui pengaruh interval aliran terhadap pertumbuhan dan hasil tanaman selada. Penelitian dilaksanakan di Cirebon pada bulan Februari – April 2018. Rancangan yang digunakan dalam penelitian ini adalah Rancangan Acak Kelompok (RAK) satu faktor dengan empat perlakuan. Perlakuan yang dicobakan antara lain (i) aliran kontinyu (kontrol), aliran nutrisi secara terputus (nutrisi mengalir selama (ii) 15 menit, (iii) 30 menit, dan (iv) 45 menit). Setiap perlakuan aliran intermittent, aliran unsur hara diputus selama 60 menit. Setiap perlakuan diulang empat kali. Hasil penelitian menunjukkan bahwa interval aliran unsur hara berpengaruh terhadap tinggi tanaman, diameter tajuk, dan luas daun pada 35 hari setelah tanam (HST). Jumlah daun, volume akar, dan bobot segar tanaman tidak berbeda nyata antar perlakuan. Tinggi tanaman dan diameter tajuk terbesar diperoleh pada perlakuan aliran unsur hara selama 15 menit dan berhenti selama 60 menit. Hasil tersebut tidak berbeda nyata dengan perlakuan kontrol yaitu aliran nutrisi secara kontinyu. Aliran nutrisi secara

intermittent dapat digunakan sebagai alternatif aliran secara kontinyu pada hidroponik dengan sistem DFT.

Kata kunci: DFT, hidroponik, intermittent, selada,

## INTRODUCTION

Lettuce (*Lactuca sativa* L.) is one of the leafy vegetables that have high economic value. This vegetable not only sells in the traditional market but also in the supermarket. Lettuce is consumed with the main food as a salad. Lettuce contains some primary and secondary metabolites such as dietary fiber, amino acids, vitamin B complex, organic acids, and polyunsaturated fatty acids. Lettuce also contains some secondary metabolites such as flavonoid, phenolic acid, lignan, carotenoid, and quinone (Hounsome, Hounsome, Tomos, & Edwards-Jones, 2008).

Lettuce can be cultivated hydroponically. Hydroponic is a technology for growing plants in nutrient solution (Jensen, 1997). The advantages of using hydroponic is it potentially used in the minimum area, efficient use of water and fertilizers, isolation the crop from some problems that caused by soil such as soil pathogen, selling price of vegetables that grown hydroponically is higher than conventional (Jensen, 1997; Roidah, 2015). Hydroponics systems also reduce water loss, increase water use efficiency, and use lands efficiently compared with conventional (AlShrouf, 2017), (Barbosa et al., 2015). The main disadvantages of hydroponic are highly capital costs and energy input (Jensen, 1997).

Deep flow technique (DFT) system is one of type hydroponic system. The nutrient in DFT is monitored, replenished, recirculated, and aerated (Jensen, 1997). Recirculated nutrient solution using a water pump that is driven by energy from electricity. Due to continuous nutrient flow, electricity cost must be high and to reduce the costs, the nutrient flow can be changed from continuous to intermittent flow. The advantage of intermittent nutrient flow is increasing the oxygen around the plant root beside to reduce the electricity cost. Dissolved oxygen (DO) concentration in a recirculating nutrient solution in hydroponic was lower than the minimum DO concentration for lettuce root respiration (Chun & Takakura, 1994). Previous research about the aeration period on growth and yield of *Brassica juncea* (Ningrum, Triyono, & Tusi, 2014) and lettuce (Febriani, Indradewa, & Waluyo, 2013) were conducted. The purpose of this research was to investigate the interval of nutrient flow on growth and yield of lettuce that grown in hydroponically deep flow technique as an alternative of the continuous flow of nutrient solution.

## MATERIALS AND METHODS

The research was conducted in Cirebon, West Java, Indonesia on February – April 2018 which is located on 4 m above sea level. The materials used are lettuce seed var. Butterhead, rockwool, paranet 60%, AB mix nutrients. The tools used are water pipe with

3-inch diameter, water pump, timer, pH meter, UV plastic, and net plot.

The experiments used randomized completely block design and carried out by four treatments of nutrient flow interval i.e., continuous flow nutrient, intermittent flow nutrient for 15, 30, and 45 minutes. For each intermittent treatment, the nutrient flow was interrupted for 60 minutes. The treatment was repeated four times.

Seeds of lettuce were sowed by using rockwool media for 10 days. During the sowing of seeds, there was no adding of nutrient. Lettuce seedlings were replanted to net pot in DFT hydroponics system. AB Mix was used as a source of nutrition in a concentration of 15 $mL.L^{-1}$. The nutrient solution was replenished every week. Lettuce was harvested at 38 DAP.

Parameters observed included plant heigh, number of leaves, shoot diameter at 14, 21, 28, and 35 days after planting (DAP), leaf area, root volume at 35 DAP, and fresh weigh were observed after plants are harvested. The data were analyzed by using ANOVA at 5% and *post hoc* Tukey at 5%.

## RESULTS DAN DISCUSSIONS

### Growth of Lettuce

Height of lettuce at 14, 21, 28, and 35 DAP was affected by nutrient flow interval (Table 1). Nutrient flows during 15 minutes and interrupted for 60 minutes gave the highest plant height at 35 DAP but were ~~did~~ not significantly different with continuous nutrient flow.

Table 1. Effect of nutrient flow interval on plant height of lettuce

| Treatments | Plant Height (cm) | | | |
|---|---|---|---|---|
| | 14 DAP | 21 DAP | 28 DAP | 35 DAP |
| Continuous | 5.74 a | 9.05 ab | 12.87 Ab | 17.37 ab |
| 15 minutes | 5.43 a | 9.95 a | 13.50 A | 19.06 a |
| 30 minutes | 5.31 ab | 9.89 a | 12.21 B | 14.79 c |
| 45 minutes | 4.88 b | 8.72 b | 11.82 B | 16.09 bc |

Note~~s~~: the number followed by the same letter was not significantly different by using Tukey test at 5%.

Nutrient flows for 15 minutes and interrupted for 60 minutes was taller than other treatments because the root got adequate oxygen for root respiration so the nutrient can be absorbed by plant root well. Oxygen concentration in the nutrient solution of deep-water culture is a limiting factor and the plant roots is highly dependent upon the O2 concentration of the immediate root environment (Zeroni, Gale, & Ben-Asher, 1983).

Nutrient flow interval also affected to number of leaves (Table 2). The same condition with plant height, treatment of 15 minutes nutrient flow interval gave the highest number of leaves at 28 DAP and were not significantly different with continuous flow treatment. The continuous aeration on lettuce was reported did not significantly

different with 6, 12, and 24 hours.day$^{-1}$/day of aeration period (Febriani et al., 2013).

Shoot diameter of lettuce with continuous flow of nutrition solution were not significantly different from the other treatments at 35 DAP (Table 3). Shoot diameter was correlated with leaf area and leaf number of lettuce so it was affected by number of leaves.

Table 2. Effect of nutrient flow interval on number of leaves of lettuce

| Treatments | Number of Leaves | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 14 DAP | | 21 DAP | | 28 DAP | | 35 DAP | |
| Continuous | 2.56 | a | 4.38 | b | 6.41 | B | 11.91 | ab |
| 15 minutes | 2.69 | a | 4.78 | ab | 7.97 | A | 12.69 | a |
| 30 minutes | 2.75 | a | 4.97 | a | 7.85 | A | 11.50 | b |
| 45 minutes | 2.44 | a | 4.75 | ab | 7.38 | A | 10.60 | c |

Notes: the number followed by the same letter was not significantly different by using Tukey test at 5%.

Table 3. Effect of nutrient flow interval on shoot diameter of lettuce

| Treatments | Shoot Diameter (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 14 DAP | | 21 DAP | | 28 DAP | | 35 DAP | |
| Continuous | 5.02 | a | 8.69 | b | 16.41 | B | 22.57 | ab |
| 15 minutes | 5.39 | a | 10.77 | a | 18.32 | A | 24.09 | a |
| 30 minutes | 5.43 | a | 10.21 | ab | 17.46 | ab | 21.61 | b |
| 45 minutes | 4.47 | a | 9.38 | ab | 16.66 | B | 23.77 | a |

Notes: the number followed by the same letter was not significantly different by using Tukey test at 5%.

Table 4. Effect of nutrient flow interval on yield of lettuce

| Treatments | Leaf Area (cm$^2$) | | Root Volume (cm$^3$) | | Fresh weight per plant (g) | |
|---|---|---|---|---|---|---|
| Continuous | 204.70 | B | 2.38 | a | 215.63 | a |
| 15 minutes | 403.85 | A | 2.75 | a | 246.88 | a |
| 30 minutes | 294.87 | Ab | 2.63 | a | 314.06 | a |
| 45 minutes | 379.23 | Ab | 3.00 | a | 203.13 | a |

Notes: the number followed by the same letter was not significantly different by using Tukey test at 5%.

**Yield of lettuce**

Leaf area of lettuce was affected by nutrient flow interval. The highest leaf area of lettuce was obtained from 15 minutes flow and were not significantly different from the other intermittent treatment. Meanwhile, root volume and fresh weight per plant were not affected by interval flow treatments.

The treatment of interval flow for 15 minutes gave the highest leaf area of lettuce compared to continuous flow treatment and were not significantly different from another intermittent flow treatment. It showed that the oxygen dissolved in nutrient solution affected to leaf area. The same condition also occurred to lettuce that got some aeration period treatments. Aeration period was not

affected to leaf area of lettuce (Febriani et al., 2013). Root volumes were not significantly different among the treatments, and so do with fresh weight per plant. The result showed that intermittent flow nutrient solution in hydroponically deep flow technique could be used as an alternative to continuous flow due to the same yield that resulted from those treatments.

## CONCLUSIONS

1. The yield of lettuce was not significantly affected by interval flow of nutrient solution.
2. The highest plant height and shoot diameter was detected in the treatment nutrient flow during 15 minutes and interruption for 60 minutes and it was not significantly different to the control – continuous flow treatment
3. The intermittent nutrient flow can be used as an alternative of continuous flow of nutrient solution in hydroponically DFT.

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