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ADDITION ALTERNATIVE NUTRITION ON THREE VARIETIES OF CELERY (*APIUM GRAVEOLENS* L) IN HYDROPONIC FLOATING SYSTEM

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ABSTRACT

The research objectives were to determine the best varieties of celery and nutrient concentration with the addition of Azolla extract for growth and yield of celery and obtain the best combination of varieties and nutrient concentrations for growth and yield celery in the floating hydroponic system. The research was conducted at Screen house number A. 24, and the Laboratory of Agronomy and Horticulture, Faculty of Agriculture, Jenderal Soedirman University, was conducted from January 2020 to April 2020. The research was arranged in a two-factorial randomized block design. The first factors were varieties treatment: Summer variety, Amigo variety, Tall Utah variety. The second factors were the treatment of nutrient concentration: AB mix solution 900 ppm and Azolla extract 60 ml/L, AB mix solution 1100 ppm and Azolla extract 60 ml/L, AB mix solution 1300 ppm and Azolla extract 60 ml/L, AB mix solution 1500 ppm without Azolla extract. The research variables observed were plant height, number of leaves, amount of chlorophyll, fresh root weight, dry root weight, fresh shoot weight, dry shoot weight, root length, and number of stalks. The results showed that the Tall Utah variety and the nutrient concentration of 1300 ppm + 60 ml/L Azolla extract was the best treatment for the growth and yield of celery. The interaction between the two treatments of Tall Utah varieties and nutrient concentrations of 1300 ppm and Azolla extract 60 ml/L showed the best treatment on the variable number of leaves 39.16, total chlorophyll 49.91, fresh root weight 7.57 g, dry root weight 0,73 g, dry shoot weight 2.11 g, root length 9.11 cm, and the number of petioles 8.94 pieces.

Keywords: *Azolla microphylla*, Celery, Hydroponics floating system, Nutrition, and Varieties.

INTRODUCTION

Celery (*Apium graveolens* L.) is one of the vegetables massively consumed in Indonesia. Celery has beneficial as an ingredient, medicine, and cosmetics (Dyah et al., 2012). In addition, celery contains flavonoids as antioxidants that are useful

for healthy, such as saponin, tannin 1%, atsiri oil, phytosterol, kolin, lipase, asparagine, vitamin (A, B dan C), volatile oil, apigenin, and alkaloid (Saputra, 2016). Better quality of celery can be obtained from the excellent practice of planting. Also, it contributes to higher production. One of the planting systems recommended is the hydroponic method. Hydrophonic is a planting method that does not need soil as a planting substrate and can be applied in a small land (Wulansari et al., 2019). Hydrophonic is also managed in a controlled environment, nutrition, and with or without substrate (Susila, 2015). Hydrophonic with floating systems used styrofoam floated on water contained nutrition (Hussain et al., 2015).

Generally, AB Mix is used for hydroponic plant nutrition. However, this nutrition is quite expensive for the local farmers. Therefore, an alternative of nutrition may be needed to minimize the use of AB Mix. The addition of other nutrition will enrich the AB Mix to enhance plant production. One of the sources of potential nutrition is Azolla microphyll since it can chelate the N_2 from the air. Azolla microphylla has been reported to be associated with cyanobacteria blue-green algae (Anabaena azollae), which contributes to supply more nutrition (Surdina et al., 2016).

In addition, the use of a good variety will also contribute to better plant production (Wulandari et al., 2016). In this study, the few seeds from lowland areas were used to adapt to the local environment. To compare with, one seed from the high land was also used.

MATERIALS AND METHODS

The research was conducted at Screen House number A. 24 and Horticultural Agronomy Laboratory, Faculty of Agriculture, Jenderal Soedirman University Jl. DR. Soeparno No.63, Grendeng, Kec. North Purwokerto, Banyumas Regency, was held from January 2020 to April 2020.

The materials used in this study were celery seeds of Summer, Tall Utah and Amigo varieties, water, AB Mix nutrients, *Azolla Microphylla*, and rockwool. The tools used were storage tray, styrofoam, netpot, TDS meter, thermo hygrometer, EC Meter, cutter, pH meter, lux meter, blender, SPAD, filter, scales, measuring cup, ruler, stationery, saw, toothpick, glass measure, bucket, aerator, socket, hose and camera.

The study used a factorial randomized block design which was repeated three times. The factors included were variety and concentration of nutrients. Variety treatment: Summer, Amigo, and Tall Utah varieties. Treatment of nutrient concentration: concentration of AB mix solution 900 ppm and azolla extract 60 ml/L, concentration of AB mix 1100 ppm and azolla extract 60 ml/L, concentration of AB mix 1300 ppm and azolla extract 60 ml/L, concentration of AB mix solution 1500 ppm without azolla extract. Data were analyzed by F test and Tukey HSD test

Observation variables were plant height, number of leaves, amount of chlorophyll, fresh root weight, dry root weight, fresh crown weight, dry crown weight, root length and number of stalks.

RESULTS AND DISCUSSION

Plant height

The nutrient concentration treatment had a very significant effect on the variable height of celery plants. The best treatment was the nutrient concentration of 1,300 ppm with 60 ml/L of Azolla extract, and the maximum plant height was 22.48 cm.

Nutrition is essential the growth of hydroponic plant since it is the most factor related to the plant production. Nutrients, as macro and micronutrients, must be present for plant growth. Each type of nutrient has a different composition (Perwitasari et al., 2012). Nugraha (2015) stated that among the factors that affect hydroponic crop production systems, the nutrient solution is one of the essential

determinants in supporting crop yields and quality.

Number of leaves

The statistical analysis results showed an interaction effect between varieties and nutrient concentrations on leaves in Table 1.

Table 1 shows the results of the highest number of leaves, 39.16 strands at a nutrient concentration of 1,300 ppm added with 60 ml/L Azolla extract and in the Tall Utah variety. The combination treatment of 1,500 ppm nutrient concentration without adding Azolla on Summer, Amigo, and Tall Utah varieties showed fewer leaves than the nutrient concentration of 1,300 ppm; 1,100 ppm; and 900 ppm with the addition of 60 ml/L Azolla extract. The addition of 60 ml/L Azolla extract at the maximum nutrient concentration using the Tall Utah variety can make celery plants grow optimally by looking at the number of leaves. Wijaya (2018) stated a significant effect of the AB mix nutrient solution added with Azolla extract.

Total Chlorophyll

There was an interaction effect between variety and nutrient concentration on the variable number of leaves shown in Table 2.

Table 1. The Combination of the Use Of Varieties And The Concentration Of Nutrients On The Variable Number of Leaves at Harvest.

Treatment	Number of Leaves		
	Varietas		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	23,16 Ab	23,16 Ac	22,61 Aa
1.100 ppm and 60 ml/L Azolla extract	30,66 Ca	32 Cb	39,16 Cc
1.300 ppm and 60 ml/L Azolla extract	26,88 Bc	25,22 Ba	26,44 Bb
1.500 ppm without Azolla extract	29,66 Bc	24 Aa	29,11 Bb

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

Table 2. The Combination of The Use of Varieties and the Concentration of Nutrients on the Variable Amount of Chlorophyll

Treatment	Amount of Chlorophyll		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	41,24 Aa	49,11 Ca	42,54 Ba
1.100 ppm and 60 ml/L Azolla extract	49,41 Bb	44,68 Ab	49,71 Cb
1.300 ppm and 60 ml/L Azolla extract	46,74 Ca	44,37 Ba	43,1 Aa
1.500 ppm without Azolla extract	49,91 Cc	42,46 Aa	47,23 Bb

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

The highest clorohil amount was 49.9 at the nutrient concentration of 900 ppm added with 60 ml/L Azolla extract on Summer variety treatment. Giving the concentration of AB mix 900 ppm had the highest total chlorophyll so that the leaf color was greener than other nutrition concentrations. The provision of 900 ppm AB mix nutrition can provide sufficient nitrogen and magnesium elements to form

chlorophyll. Providing adequate nutrition to plants causes optimal plants in the formation of chlorophyll. In addition to nitrogen, the magnesium microelement group also forms leaf chlorophyll as the core of the chlorophyll molecule, which is an Mg chelate in chloroplasts. Therefore, with the availability of these two elements, more leaf chlorophyll will be formed (Yama, 2019).

Fresh Root Weight

The statistical analysis results showed an interaction effect between varieties and nutrient concentrations on the fresh root weight variable in Table 3.

The heaviest fresh root weight was 7.57 g at a nutrient concentration of 1,300 ppm added with 60 ml/L Azolla extract on Summer variety. It is suspected that at a concentration of 1,300 ppm, the nutrient content in hydroponic nutrition has been well fulfilled, especially the N element, primarily contained in the Azolla extract. Nitrogen nutrient plays a crucial role in supporting the growth of celery plants.

According to Fahmi et al. (2010), his research stated that the addition of nitrogen through fertilization would stimulate root growth and increase root weight. There were very significant results between nutrient concentration and variety treatment because external factors and internal factors can influence plant growth and development. According to Buntoro (2014), external factors are factors caused from outside the plant, which can be environmental factors. Internal factors or factors that come from within the plant can be physiological factors and plant genetics.

Dry Root Weight

The statistical analysis results showed an interaction effect between variety and nutrient concentration on the dry root weight variable, as shown in Table 4

Table 3. The Combination of the Use of Varieties and the Concentration of Nutrients on the Fresh Root Weight Variable.

Treatment	Root Weight		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	3,18 Ab	3,86 Ac	3,08 Aa
1.100 ppm and 60 ml/L Azolla extract	7,57 Cc	4,51 Ba	7,53 Cb
1.300 ppm and 60 ml/L Azolla extract	5,35 Bb	4,65 Ba	6,46 Bc
1.500 ppm without Azolla extract	6,63 Bb	4,73 Ca	6,88 Bc

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

Table 4. The Combination of The Use of Varieties and the Concentration of Nutrients On the Dry Root Weight Variable.

Treatment	Dry Root Weight		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	0,22 Aa	0,36 Ab	0,37 Ac
1.100 ppm and 60 ml/L Azolla extract	0,56 Cb	0,44 Ba	0,7 Bc
1.300 ppm and 60 ml/L Azolla extract	0,37 Ba	0,49 Cb	0,72 Cc
1.500 ppm without Azolla extract	0,65 Cb	0,44 Ba	0,53 Ab

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

The heaviest dry root weight is 0.72 g at a nutrient concentration of 1,100 ppm added with 60 ml/L Azolla extract on Tall Utah variety. The interaction between the two treatments showed that plant growth was not only influenced by genetic factors. Other factors such as the availability of nutrients also supported plant growth well. According to Wawointana (2017), plant growth is influenced by two factors, namely environmental and genetic. Environmental factors can include the availability of nutrients for plants, while genetic factors can be differences in varieties. If these two factors work well, it will produce good plant growth as well or vice versa.

Fresh Head Weight

The treatment of varieties had no significant effect on the variable fresh crown weight of celery plants. It was suspected that one of the causes was environmental influences, namely temperature and light intensity. According to Chabib et al. (2016), differences in plant growth are not only caused by differences in varieties and types. Other factors that can influence are the availability of nutrients in the soil, climate, and environment. Maunte (2018) added that temperature and light intensity are the biggest environmental factors that affect stem elongation. The optimum temperature in stem elongation depends on the type of plant because each plant also has different properties.

The nutrient concentration treatment significantly affected the fresh crown weight of celery plants, presumably because the nutrients for the plants had been fulfilled. Nutrients that affect plant growth are N nutrients. The addition of Azolla makes nutrients have high nitrogen levels. Warganegara et al. (2015) stated that the higher the nitrogen concentration, the higher the growth, as seen in plant height, root length, and fresh plant weight.

Dry Head Weight

The statistical analysis results showed an interaction effect between varieties and nutrient concentrations on the dry crown weight variable, as shown in Table 5.

Table 5. The Combination of the Use of Varieties and the Concentration of Nutrients on the Dry Crown Weight Variable.

Treatment	Dry Crown Weight		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	0,98 Ab	0,97 Aa	1,22 Bc
1.100 ppm and 60 ml/L Azolla extract	1,69 Cb	1,61 Ca	**2,11 Cc**
1.300 ppm and 60 ml/L Azolla extract	1,55 Bc	1,51 Ba	1,52 Bb
1.500 ppm without Azolla extract	1,65 Cb	1,52 Bb	1,19 Aa

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

The heaviest dry crown weight is 2.11 g at a nutrient concentration of 1300 ppm added with 60 ml/l Azolla extract and the Tall Utah variety. Azolla extract is effectively used as an additional nutrient for the cultivation of celery plants. Wijaya (2018) stated a significant effect of the AB mix nutrient solution added with Azolla extract. The combination of nutrient concentration treatment with varieties showed significantly different results. This is because the concentration of nutrients following the needs of the plant is balanced with the use of varieties that can

adapt to the environment, will make the plants grow well, and can affect the yield. Widiyawati (2016) states that a plant's high and low yield depends on the variety used, environmental conditions around the planting area, such as the availability of nutrients.

Root Length

The statistical analysis results showed an interaction effect between varieties and nutrient concentrations on root length variables, as shown in table 6.

The most extended root length is 9.11 cm at a nutrient concentration of 1,300 ppm added with 60 ml/L Azolla extract on Amigo variety. Root length is influenced by the concentration of nutrients as a provider of nutrients and the use of varieties. Following Sumardi and Pudjoarianto (2016), the root system is more controlled by the genetic nature of the plant concerned, but it has also been proven that the plant's root system can be influenced by environmental conditions and the availability of nutrients. Genetic factors fully influence optimal soil physical and chemical conditions, plant root systems. The development of the root branching system will be more stimulated in places where water and nutrients are available.

Number of the petiole

The statistical analysis results showed an interaction effect between variety and nutrient concentration on the variable number of petioles shown in Table 7.

Table 6. The Combination of the Use of Varieties and The Concentration of Nutrients On Root Length Variables.

Treatment	Nutrients on Root Length		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	6,44 Aa	7,77 Bc	7 Bb
1.100 ppm and 60 ml/L Azolla extract	8,5 Cb	9,11 Cc	8,33 Ca
1.300 ppm and 60 ml/L Azolla extract	7,94 Bc	7,22 Ab	6,55 Aa
1.500 ppm without Azolla extract	7,44 Bb	7,77 Bc	7,33 Ba

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

Table 7. The Results of the Combination of The Use of Varieties and The Concentration of Nutrients on The Variable Number of Petioles.

Treatment	number of petioles		
	Variety		
Nutrition concentration	Summer	Amigo	Tall Utah
900 ppm and 60 ml/L Azolla extract	5,77 Aa	6,55 Ab	7,55 Bc
1.100 ppm and 60 ml/L Azolla extract	8,55 Cb	8,11 Ca	8,94 Cc
1.300 ppm and 60 ml/L Azolla extract	6,66 Ba	7 bb	7,88 Bc
1.500 ppm without Azolla extract	8 Bc	7,44 Bb	6,88 Aa

Note: Numbers followed by different capital letters in the same column and different lowercase letters in the same row show significantly different results according to Tukey HSD test at the 5% level.

The highest number of stalks is 8.94 at a nutrient concentration of 1,300 ppm added with 60 ml/L Azolla extract on Tall Utah variety. Using a nutrient concentration of 1,300 with 60 ml/L of Azolla extract proved to get better results on the variable number of petioles than the nutrient concentration of 1,500 ppm without Azolla extract. Sari (2016), the nutrient viscosity of 1,300 ppm optimally has been able to increase the growth and development of celery without increasing the thickness of the nutrients again. However, adding Azolla extract made celery plants grow better than without Azolla extract in this study because Azolla was proven to have a high N content and could support plant growth. Warganegara et al. (2015) stated that the higher the nitrogen concentration is given, the growth will increase.

CONCLUSION

Based on the results of the study, it can be concluded that:

1. The Tall Utah variety was the best variety for growth and yield of celery in a floating raft hydroponic system with an average leaf number of 29.30 leaves, fresh root weight 5.99 g, and dry root weight 0.58 g more than Summer variety and Amigo variety.
2. The best concentration of nutrients for the growth and yield of celery in the floating raft hydroponic system was 1,300 ppm, and 60ml/L Azolla extract with an average value of 33.94 leaves, fresh root weight 6.54 g, dry crown weight 1 .81 g, root length 8.67 cm and the number of leaf stalks 8.54 pieces.
3. The combination of nutrient concentration and variety had a significant effect on the variable number of leaves 39.16 strands, total chlorophyll 49.91, fresh root weight 7.57 g, dry root weight 0.73 g, dry crown weight 2.11 g, length root 9.11 cm, and the number of leaf stalks 8.94 pieces

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