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APPLICATIONS OF LIQUID ORGANIC FERTILIZER AZOLLA AND NITROGEN FERTILIZER TOWARDS RESULTS AND QUALITY OF SPINACH *(AMARANTHUS SP.)*

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Abstract. The nitrate content in spinach comes from the chemical nitrogen fertilizer used, while Azolla concentration contains a lot of nitrogen, so use of Azolla can replace nitrogen fertilizer and reduce nitrate content of spinach. This study aims to determine effect of Azolla concentration and nitrogen fertilizer on the growth and yield. The research used factorial CRD, Factor I: Azolla consentration consisting of: A0 = 0 ml/l, A1 = 10 m/l, A2 = 20 ml/l. Factor II: Urea of: U1 = 50 kg/ha, U2 = 100 kg/ha, U3 = 150 kg/ha, U4 = 200 kg/ha. The parameters: Plant height, Number of leaves, Wet and dry weight. The result is azolla concentration of 20 ml/lt of water was significantly different and better than without the application of azolla, both on observing plant height at 21 dap, the wet weight of stems and leaves and the dry weight of stems and leaves. The application of azolla had no significant effect on plant height at ages 7 and 14 DAP, and the number of leaves at age 7, 14 and 21 DAP, root base weight and root dry weight. The application of nitrogen fertilizer did not significantly affect all observed parameters.

Keywords: Azolla, nitrogen, nitrate, quality, spinach.

1. INTRODUCTION

Azolla has a high nitrogen nutrient content that is 4.87% because azolla symbiosis with Anabaena azollae has two kinds of vegetative and heterotic cells. In heterosis cells contain enzyme nitrogenase which will fix air N2 through ATP derived from the circulation of photophosphorylation of water nail plants [1]. Nitrogenation enzymes can convert N2 to ammonia (NH4 +) which is then transported to the host plant and the results of nitrogen fixation are converted to amino acids, besides that the water nail plants have the ability to fix CO2 and carry out photosynthesis, in addition to being used for their own photosynthetic needs produced together with acid amino will be transported to the symbionts Anabaena azollae [2], [3].

Azolla can be given to plants in the form of azolla liquid organic fertilizer (LOF). Providing azolla as a LOF will accelerate nutrient absorption because it has a lower C / N ratio (9-13). Provision of LOF azolla in plants or in planting media can be directly used by plants without having to wait for the decomposition process.

Spinach is a type of green vegetable that has many benefits for health and body growth, especially for children and pregnant women. Inside the leaves of spinach there is quite a lot of protein, calcium minerals, iron and vitamins that humans need. Therefore spinach is used as one of the ingredients in the food supplement industry [4], [5].

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As one of the raw materials for the food industry, the quality standard of spinach is a top priority that must be considered both external (physical) and internal (chemical) quality, including the nitrate content it contains. Spinach is a type of plant that is classified as having a high nitrate content of 3500 mg NO3 / kg of material. Nitrates that are consumed by humans exceeding the threshold will be very dangerous because nitrates in the stomach turn into nitrites which can cause methaemoglobinemia, which causes hemoglobin to be unable to carry oxygen (O2). Another problem that arises is that nitrates in the stomach react with amines to nitrosamines which can stimulate cancer. World Health Organization (WHO) sets the maximum limit of nitrates for adults is 220 mg / day. While the largest consumption of nitrates is taken from vegetables which is around 70% [6].

Urea is a source of nitrogen that is needed by spinach. Urea provides a source of N in the form of $NH4^+$ after being changed from CO (NH2) 2 to (NH4) 2CO3 through the hydrolysis process with the help of urease enzymes in the soil. One of the negative effects of Urea fertilizer is the opportunity as one of the determinants of vegetable nitrate levels. Whereas ammonium when it is in excess in the plants will be very poisonous.

The problem that arises from the description above is that spinach is an important commodity because of its nutritional value but includes vegetables that have high nitrate content. The nitrate content in spinach can come from the nitrogen fertilizer used, while Azolla compost is an organic fertilizer that contains a lot of nitrogen, it is hoped that Azolla compost can replace the use of urea fertilizer so that it can reduce the nitrate content in spinach.

This study aims to determine the effect of azolla and nitrogen fertilizer liquid organic fertilizer on the growth, yield and quality (nitrate content) of spinach, In order to obtain high quality spinach production both physically and chemically, especially with nitrate content low.

The results of previous studies on the effect of Azolla organic compost doses and nitrogen fertilizer on the growth, yield and quality (nitrate content) of spinach (Amaranthus sp.), Can be concluded as follows: 1) Azolla has a better effect on height and number of plant leaves at ages 7, 14 and 21 days after planting, 2) Azolla has a better effect on the wet weight and dry weight of roots, stems and leaves and plant weight per pot, the higher the azolla the better the effect, 3) Nitrogen fertilizer does not affect the observed growth parameters, 4) Nitrogen fertilizer increases nitrate content in plants, 5) Azolla can reduce nitrate content in plants [7].

2. METHODS

a. Place and Time of Research. This research plan was carried out for 8 months in the experimental garden, the Jember Polytechnic soil and Biosain laboratory and the biomolecular laboratory of the Faculty of Agriculture, University of Jember.
b. Tools and Materials. The tools used are container / seedbed, bucket, ruler, sieve, measuring cup, water hose, stove, scales, scissors, electric oven. The ingredients used are spinach seeds (*Amaranthus sp.*), Azolla liquid organic fertilizer, urea fertilizer (46% N) and SP36 (36%).
c. This research design uses factorial randomized block design (RBD) with two treatment factors and is repeated three times. Factor I: Azolla Liquid Organic Fertilizer (LOF), consisting of: A0 = No Azolla LOF, A1 = LOF azolla 10 ml / liter, A2 = LOF Azolla 20 ml / liter. Factor II: Urea fertilizer dose consists of: U1 = Urea Fertilizer Dosage 50 kg / ha or 0.21 gram per pot, U2 = Urea Fertilizer Dosage 100 kg / ha or 0.42 gram per pot, U3 = Urea Fertilizer Dose 150 kg / ha or 0.63 gram per pot, U4 = Urea Fertilizer Dose 200 kg / ha or 0.84 gram per pot.
d. Observed parameters include: a) Plant height, b) Number of leaves, c) Plant wet weight (roots, leaves and stems), d) Plant dry weight (roots, leaves and stems), e) Plant weight per pot, f) Analysis of Soil before and after research, g) Analysis of Nitrate content in plant tissue, h) Analysis of Protein content in plant tissue
e. Research is carried out with the following stages of activity: 1) Preparation of Tools and Materials, 2) Nursery, 3) Preparation of Planting Media, 4) Planting, 5) Provision of Azolla Liquid Organic Fertilizer, 6) Fertilizing, 7) Irrigation , 8) Control of Plant-disturbing Organisms, 9) Harvesting
f. Observation of Growth and Results

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1) Plant Height, observation of plant height is carried out when the plants are 7, 14, 21 days after planting. Measurements were made starting from the base of the stem (ground level) until the growing point.
2) Number of Leaves, observing the number of leaves carried out when the plants are 7, 14, 21 days after planting.
3) Wet Weight and Dry Weight For wet weights and dry weights separated between leaves, stems and roots, weighing is done using electric scales. After obtaining wet weight data, the sample was dried in an oven with a temperature of 80 ^{0}C for 48 hours (until constant).
4) Soil Analysis before and after research. Before planting, soil analysis is carried out to determine the content of the elements in the soil, especially N, then after the research is done, the analysis is carried out again.
5) Determination of Nitrate Content In plant tissue, nitrate content is measured according to the method of Cataldo et al (1975). Extracts of plant tissue as much as 50 µl from 1 gram of extracted dry tissue samples were put in tubes plus 200 µl 5% (W / V) salicylic acid in H2SO4 p.a. After incubation at room temperature for 20 minutes 5 ml was added. 2N NaOH slowly. Furthermore absorbance was measured by a spectrophotometer at a wavelength of 410 nm. Nitrate concentration is calculated by comparing the standard nitrate curve.
6) Determination of Protein Content of plant tissue, protein content of leaf tissue is measured using the Bradford method (Deutscher, 1990) 1 gr of dried grained tissue sample is made a suspension. 1ml of suspension is added to 1 ml of Bradford solution, then absorbance is measured at a wavelength of 595 nm . The results of the reading were compared to the standard Bovine Serum Albumin (BSA) 1mg / ml to determine the content of dissolved protein.

3. RESULT AND DISCUSSION

Results of observations and variance in research data Application of azolla liquid organic fertilizer (LOF) and nitrogen fertilizer on yield and quality of spinach *(Amaranthus sp.)*, Which contains: Plant height and number of leaves can be used in Table 1.

Tabel 1. Daftar sidik ragam Aplikasi pupuk organik cair azolla dan pupuk nitrogen terhadap tinggi tanaman dan jumlah daun, berat basah dan berat kering batang dan daun, berat basah dan berat kering akar bayam.

Sources of Diversity [2)]	Plant height 7 dat [3)]	Plant height 14 DAP	Plant height 21 DAP	Number of leaves 7 DAP	Number of leaves 14 DAP	Number of leaves 21 DAP	Wet weight of stems and leaves (gr)	Root wet weight (gr)	Dry weight of stems and leaves (gr)	Root dry weight (gr)
Treatment	ns	ns	x	ns	ns	ns	x	ns	x	ns
A	ns	ns	x	ns	ns	ns	x	ns	xx	ns
U	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
A x U	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

[2)] A : Azolla, U : Urea
[3)] DAP = The Day After Planting

Table 1 above can be seen that the application of azolla liquid organic fertilizer is significantly different in the observation of plant height at age 21 DAP, the wet weight of the stems and leaves, and very significantly different on the dry weight of the stems and leaves, but not significantly different in plant height at 7 and 14 DAP, and the number of leaves at 7, 14 and 21 DAP, root base weight and root dry weight. The application of nitrogen fertilizer did not significantly affect all observed parameters.

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LSD test 5% application of azolla liquid organic fertilizer to plant height at the age of 21 DAP, the wet weight of stems and leaves, and the dry weight of stems and leaves can be seen in Table 2.

Table 2. Results of LSD test 5% for azolla liquid organic fertilizer application on plant height at 21 DAP, stem and leaf wet weight, and stem and leaf dry weight.

Treatment	Plant height 21 dap		Wet weight of stems and leaves (gr		Dry weight of stems and leaves (gr)	
A0	19,58	b	23,44	b	4,35	b
A1	22,37	ab	24,38	ab	4,93	ab
A2	23,50	a	25,16	a	5,58	a
LSD 5%	2,87		1,09		0,64	

[4)] Numbers followed by lowercase letters indicate different non significance

Table 2 shows that at the observation of plant height aged 21 DAP, the application of azolla liquid organic fertilizer with a concentration of 20 ml / lt of water was significantly different or better than without the application of azolla liquid fertilizer, but the concentration of 10 ml / lt was not significantly different from without the application of fertilizer liquid azolla.

Observation of azolla wet and dry weight showed that the application of azolla liquid organic fertilizer with a concentration of 20 ml / lt of water was significantly different or better than without the application of azolla liquid fertilizer, but the concentration of 10 ml / lt was not significantly different from without the application of azolla liquid fertilizer. The concentration of 20 ml / lt was not significantly different from the concentration of 10 ml / lt.

Application of azolla liquid fertilizer into the planting medium can be directly or sprayed on the plants can be used plants without having to wait for the decomposition process [11]. Nutrient content in azolla liquid fertilizer, especially nitrogen, by spraying on the stem and leaves of these nutrients can be absorbed directly by spinach plants so as to increase plant growth.

4. CONCLUSION

Research on Application of azolla liquid organic fertilizer (LOF) and nitrogen fertilizer on yield and quality of spinach (Amaranthus sp.), Can be concluded as follows:

a. Application of azolla liquid organic fertilizer with a concentration of 20 ml / lt of water was significantly different and better than without the application of azolla liquid fertilizer, both on observing plant height at 21 dap, the wet weight of stems and leaves and the dry weight of stems and leaves.
b. The application of azolla liquid organic fertilizer had no significant effect on plant height at ages 7 and 14 DAP, and the number of leaves at age 7, 14 and 21 DAP, root base weight and root dry weight.
c. The application of nitrogen fertilizer did not significantly affect all observed parameters.

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