UTILIZATION OF FRUIT WASTE LIQUID ORGANIC FERTILIZER IN INCREASING THE PRODUCTIVITY OF WHEATGRASS ON MICROGREENS CULTIVATION

Chatlynbi T. Br. Pandjaitan [*], Eko H. A. Juwaningsih, Rido Djara

Kupang State Agricultural Polytechnic, Jl. Prof. Dr. Herman Yohanes, Lasiana-Kupang. 81011, Kupang, Indonesia.

Corresponding author. Email:
chatlynbipandjaitan@gmail.com

ABSTRACT

Wheat grass microgreens can be consumed in the form of juice (Wheatgrass Juice = WGJ) which is an extract from mature sprouts of wheat seeds harvested during vegetative development at the age of 7-10 days. Wheatgrass microgreens are rich in chlorophyll, minerals, antioxidants vitamins, amino acids various enzymes, phenolic and flavonoids. Fruit waste has high potential to be used as a source Liquid Organic Fertilizer (LOF) so soil fertility can be improved with the and minimize the adverse effects of chemical fertilizer and the risk of pathogenic micro-organisms contamination from animal-waste based fertilizer. The research method was carried out on a quantitative base by applying several concentrations of fruit waste LOF to wheat grass microgreens. This experiment

was designed using a Randomized Block Design with 6 treatments and 4 replications. The treatments of concentration of LOF application were 0, 5, 10, 15, 20 and 25 ml/l. The observed data were further analyzed using Tukey's test at a test level of 0.05 using the SPSS program. The results of this study showed the fruit waste LOF treatment (20mL/L of fruit waste LOF) gave the best results for the parameters of plant height, vitamin C and plant chlorophyll.

Keywords: Wheat grass, microgreens, Liquid Organic Fertilizer, fruit waste

1. Introduction

Microgreens are immature vegetable greens harvested around 7–14 days post-planting or when after new cotyledonary leaves are developed and classified as functional food due to bioactive compound contained in mircrogreens has been examined in many research studies gives benefit to health. Bioactive compound found in microgreens has been examined in many research studies (Zhang *et al*., 2021).The level of phytonutrients contained in mircrogreens such as vitamins, minerals and phytochemicals differs according to the growth stage of the plant and usually the level of phytonutrients will decrease from seedling (sprouts and microgreens) to fully developed stage ((Brazaitytė *et al*., 2015). Generally, in the cultivation of microgreens, the harvesting process is only done once but there are some plants can be harvested more than once so that it

provides advantages to the cultivation process, such as time, energy and production facilities such as seeds used will be more economical. One of these plants is wheatgrass.

Wheat grass can be consumed in the form of juice (Wheatgrass Juice = WGJ) which is an extract from mature sprouts of wheat seeds harvested during vegetative development at the age of 7-10 days (Huda, *et al*., 2017) if it is harvested later and the taste of wheatgrass will be very bitter (Syafi and Palupi, 2018). Wheatgrass microgreens are rich in chlorophyll, minerals such as magnesium, selenium, zinc, chromium, iron, calcium, phosphorus, potassium, boron and molybdenum. Antioxidants such as beta-carotene (provitamin A), vitamin E, vitamin C, and vitamin B complex, amino acids such as aspartic acid, glutamic acid, arginine, alanine and serine, various enzymes that play a role in pharmacological effects such as protease, amylase, lipase, cytochrome oxidase, transhydrogenase, superoxide dismutase (SOD) and rich in phenolics and flavonoids (Arifiansyah *et al*., 2020). The level of vitamin C in Wheatgrass microgreens reaches 5.9-6.2 mg higher than oranges (Irmayanti *et al*., 2015 and Nuroula *et al*., 2019). Due the its phytonutrient properties wheatgrass microgreens can be consumed and is useful for preventing various preventive and curative diseases such

as diabetes mellitus, anemia, arthritis, cancer, thalassemia, asthma, allergies, colitis, obesity, high blood pressure, dyslipidemia and eczema. also plays a role in detoxifying the body (Irmayanti *et al*., 2015).

Consumption of wheatgrass microgreens has a positive effect on the cancer treatment process. Wheatgrass has the potential to reduce negative effects from chemotherapy and does not cause side effects such as those caused by chemical drugs. Therefore wheatgrass can be used as an affordable and non-toxic alternative supplement for patients with chemotherapy because it can reduce the level of inflammatory proteins, prevent decreased HB levels and platelet counts in breast cancer patients, inhibit the growth of carcinoma cancer cells and is positive for invivo immunomodulatory and in-vitro anti-cancer bioactivity (Avisar *et al*., 2020a; Avisar *et al*., 2020b; Rani *et al*., 2019; Gore *et al*., 2018).

Fertilizer is one of the main sources of nutrients for plants. In microgreen growth process, fertilization aims to spur early vegetative growth but organic materials such as animal manures used as an essential source for plant nutrients and a soil conditioner for microgreen cultivation may contain a variety of different pathogenic microorganisms, eg. bacteria, including *Escherichia coli*, *Salmonella spp*., *Listeria sp*, *Campylobacter* spp, parasitic protozoa including *Giardia*

lamblia and *Cryptosporidium parvum* and viruses which are dangerous for human health especially fresh consumed leafy greens for instance microgreens could be the foremost transmitting vehicles of pathogenic microorganisms (Yao *et al*., 2015 and Adegoke *et al*., 2016). Based on the limited availability of acceptable sources of fertilizers in organic production, the application of plant based fertilizer such as Fruit waste liquid organic fertilizer (LOF) made from fruit waste such as rotten fruit of apple, pear, papaya, banana coconut fiber enriched natural NPK (gamal leaf, banana stump, coconut water) could provide options for the production of microgreens.

Fruit waste has high potential to be used as a source Liquid Organic Fertilizer (LOF). Soil fertility can be improved with the nutrient properties contained in fruit waste and can minimize the adverse effects of chemical fertilizer and the risk of pathogenic microorganisms contamination (Nisa and Aisyah, 2016). Pineapple peel contains 81.72% water, 20.87% crude fiber, 17.53% carbohydrate, 4.41% protein, 0.02% fat, 0.48% ash, 1.66% wet fiber and 13.65% reducing sugar. LOF made from pineapple peel at a concentration of 20% can increase stem height and leaves number of water spinach (Parintak, 2018). Coconut fiber can be used as an organic fertilizer especially the liquid type, because it contains

macro and micro nutrients which include water 53.83%, N 0.28% ppm, P 0.1 ppm, K 6.726 ppm, Ca 140 ppm, and Mg 170 ppm. LOF made from coconut fiber can significantly increase the uptake of the element Potassium ((Sabri, 2017 and Wijaya *et al*., 2017). Banana pits contain microbes that decompose organic matter which located in the outer and inner banana pits. Baccilus sp., Aeromonas sp., and Aspergillus nigger are microbes that have been identified in the mole in banana pseudostem (Ibrahim and Tanaiyo, 2018). Banana peel waste has many contents such as, protein and phosphorus, besides that it also contains micro elements Ca, Mg, N, Na, Zn (Rahmawati *et al*., 2017). Fruit waste based LOF at concentration 20 ml/liter can increase the growth and yield of crop lettuce plants on the number of leaves (35.6), wet weight (289.82 g/plant) and dry weight (11.100 g/plant) (Juwaningsih, *et al*., 2018). Also it can increase the growth and yield of local Sabu shallots in terms of number of tillers, number of bulbs and bulb weight (Juwaningsih *et al*., 2019) and improve vegetative growth of grape and dragon fruit cuttings such as the number and length of shoots and the number and length of roots (Juwaningsih *et al*., 2020). This research further explores the non-animal based organic fertilizer source suitable for the growth and development of wheatgrass microgreens. This can provide a theoretical basis and

technical support for the production of organic wheatgrass microgreens.

2. Research Methodology

The experiment was carried out at the Experimental base of Kupang State Agricultural Polytechnic (10° 9′ 2,13″ S, 123° 40′ 17,87″ E, 108.8 m above sea level) in Kupang, East Nusa Tenggara Province from March to April 2023).

The tools used in this study were hand tractors, hoes, sickles, hand sprayers, plastic buckets, meters, and stationery. The tools used are hoes, machetes, paddles, meters, ovens, analytical scales, millimeter paper, spectrophotometer and measuring flasks while the materials used: wheat seeds, fruit waste LOF made from pineapple, apple, pear, banana fruit, papaya, coconut fiber, plus natural NPK from gamal leaves, banana stump and coconut water.

This experiment used the Randomized Block Design (RBD) experimental method consisting of six treatments. The treatments of concentration of LOF application were 0, 5, 10, 15, 20 and 25 ml/l. Each treatment was repeated four times so that the total treatment was 24 experimental units.

Twenty four plastic trays, each 324 x 284 and 50 mm high, filled with a mixture of (1 : 1) soil and sand,

were tightly arranged on a were arranged on a bench and placed outdoors. In each pot, 600 wheatgrass seeds were sown in 24 rows with no spacing in the rows. LOF application in accordance with the 6 tested treatments was applied when the plants were 1 day after sown (das) at twice (07.00 h and 16.00 h) daily. The LOF application method was by dissolving LOF based on tested treatments in water until it is completely mixed evenly then applied to the plants by spraying on the seedling trays.

The data obtained were analyzed using SPSS software. Before being tested with one way ANOVA at the 5% level, the data were tested for normality and homogeneity with the condition that the significance level was > 0.05. The data from the significantly different ANOVA test results were then tested for Tukey Test with a level of 5%.

3. Results

Measurement of plant height is an important parameter because it indicates plant growth affected by the environment or the treatment applied whether suppresses or promotes plant growth. The effect of Fruit waste LOF on wheat grass height measured 3 times at 3, 6 and 9 DAS is presented in Table 1.

Table 1. Wheat grass microgreens height at 3,6 and 9 DAS at various fruit waste LOF concentrations

Treatment (Fruit waste LOF concentration)	Plant Height (cm)					
	3 das		6 das		9 das	
Control (0 ml/l)	3.59	a	4.45	a	5.37	a
5 ml/ l	4.24	ab	5.14	b	6.70	b
10 ml/ l	4.55	b	5.45	b	7.10	bc
15 ml/ l	4.75	b	5.65	b	7.59	cd
20 ml/ l	4.87	b	5.74	b	7.96	d
25 ml/ l	4.36	b	5.28	b	7.30	bcd

Remarks: Mean followed by the same letter at the same columns is not significantly different ($P < 0.05$); das = day after sown

The results revealed that there was significant difference in weight grass height at 3 times of measurements. This experiment found that plant height growth was relatively same in the first and second measurement (3 and 6 das).The differences in plant height were detected in the third measurement where the concentration of fruit waste LOF at 20 ml/l showed the best wheat grass height. The best wheat grass height also can be seen at 3 and 6 das measurements but not significantly different compared to other treatments.

The effect of Fruit waste LOF on chlorophyll content, vitamin C and water content of wheat grass microgreens is presented in Table 2. It shows that various level of concentration treatment of fruit waste LOF affected observed parameters: chlorophyll content, vitamin C and water content of wheatgrass microgreens. Fruit waste LOF at concentration 20 ml/l showed the highest and significantly different compared to other level concentration fruit waste LOF for chlorophyll content parameter. For vitamin c parameter, fruit waste LOF at concentration 20 ml/l showed the highest and significantly different compared to other level concentration (control, 5 and 10 ml/l). However, the result shows on water content parameter where different level of fruit waste LOF shows no significant different between treatments.

Table 2. chlorophyll content of wheat grass height at various fruit waste LOF concentrations

Treatment (LOF concentration)	chlorophyll content (mg/L)		Vitamin C (mg/100 g)		Water content (%)	
Control (0 ml/l)	10.19	a	351.25	a	82.50	a
5 ml/ l	10.26	a	394.28	ab	82.63	a
10 ml/ l	9.73	a	446.25	ab	82.63	a
15 ml/ l	10.34	a	521.38	bc	81.25	a
20 ml/ l	11.90	b	599.00	c	82.25	a
25 ml/ l	10.41	a	491.00	bc	82.38	a

Remarks: Mean followed by the same letter at the same columns is not significantly different ($P < 0.05$); das = day after sown

Discussion

Plant height is important for agriculture, because plant height determines the mechanical stability of many crop plants and a crucial component of a plant species' ecological strategy. It is central to a species' carbon gain strategy, because height is a major determinant of a plant's ability to compete for light, and because of correlations between plant height and traits such as leaf mass fraction, leaf area ratio, leaf nitrogen per area, leaf mass per area and canopy area (Falster and Westoby 2003). Plant height is also an important part of a coordinated suite of life-history traits including seed mass, time to reproduction, longevity and the number of seeds a plant can produce per year (Moles and Leishman 2008).

Table 1 shows that there was no significant difference in wheatgrass microgreens height growth in the first measurement at 3 das except for control treatment. This could be due to the age of the plants and the possibility that POC has not been completely absorbed by the plants. In the 6 and 9 das, there was a significant height difference in tested treatments. Plants treated with 20 ml/l concentration became plants with the highest average growth among the others. It was observed that the increase in fruit waste LOF concentration provided an increase in wheatgrass

microgreens height, being significant by the Tukey test at the 5% probability level. Where the application of fruit waste LOF with concentration of 20ml/l showed a mean wheatgrass microgreens height value of 4.87 cm, 5.74 cm and 7.96 cm at 3, 6 and 9 das (Table 1).

The results of the variable plant height showed the beneficial effect of the use of fruit waste LOF in the initial development of wheatgrass microgreens. Plant height may be associated with the effect that the fruit waste LOF exerted on the physical-chemical and biological properties of the soil, thus increasing the ability of the soil to provide nutrients indispensable for plant development. Higher concentration of fruit waste LOF means more nutrients applied into plant growth environment. Organic fertilizers preserved nutrients and enhanced organic matter content in soil comparing to mineral ones and can modify soil physicochemical conditions owing to their richness of organic matter and nutrients also, application of organic fertilizers can alter soil characteristics (e.g., pH and microorganisms) and therefore lead to soil richness in available forms of macronutrients (Junior *et al*., 2023).

The results of the research are presented in Table 1 showing that application of fruit waste LOF with a higher concentration of 25 ml/L water gave the lower results to

the plant height parameter at 3, 6 and 9 das. This is presumably the concentration given exceeds the plant nutrient requirement, so that it can affect of plant growth and development. Lower concentration of fertilizer won't affect plant growth and development, while higher concentration that exceed plant requirement can disrupt nutrient balance and can poison plant roots because the higher the concentration given, then nutrients are absorbed in plants becomes saturated so that the process of growth and development of plant organs will be hampered (Novita and Wartono, 2023).

The content of chlorophyll in the leaves affected the photosynthetic reaction. The small amount of chlorophyll resulted in not maximal photosynthetic reactions and could not produce maximum carbohydrate compounds (Nurcahyani *et al*., 2020). The chlorophyll content analysis showed that fruit waste LOF at concentration 20 ml/l had a very significant effect compared to other treatments which showed no significant difference (Table 2).

The chlorophyll content can be interpreted of the health and nutritional status of the plant. All plants require a sufficient supply of macro and micronutrients within their growth medium in order to accomplish their standard physiological functions. The presence of appropriate concentrations nutrients such as nitrogen

(N), phosphorus (P), potassium (K), calcium (Ca), sulfur (S), magnesium (Mg) and iron (Fe) have all been recognized as essential for optimum plant growth. Deficiencies in any of these nutrients can manifest (in addition to other characteristics depending on the nutrient in question) as a reduction in leaf chlorophyll content (Kalaji et al., 2017). The synthesis of chlorophyll depends on mineral nutrition. Mineral nutrition significantly affects the dynamics of leaf surface formation and leaf surface area, which is reflected in the total leaf surface amount, photosynthetic potential, and pure photosynthetic productivity. Of all the macro metabolic elements, the greatest influence on plant development in general and on the leaf surface is nitrogen, whose effects are enhanced by phosphorus and potassium (Kurniawan *et al*., 2021). A depletion in overall leaf chlorophyll content reduces the amount of solar radiation that can be absorbed which in turn limits the efficiency of corresponding photosynthetic processes thus lowering primary photosynthetic production (Kalaji et al., 2017). The measurement of chlorophyll content can present important information relating to the presence of biotic stress factors and also of abiotic issues. Fruit waste LOF mader from materials contains macro and micro nutrient required by plant to grow. Fertilizer treatment is thought to have an influence on the content

of chlorophyll as a bio booster or growing regulatory substance or phytohormones. Other factors that may affect the chlorophyll content are availability of nutrients in the media. Nitrogen is one of the main components of chlorophyll, which is about 60%. Nitrogen is one of the components in protein molecules, purines, pyrimidines, and porphyrins. Fruit waste LOF with the content of N, P, K is able to add nutrients to the soil which can later play a role in increasing the formation of chlorophyll in plants (Pratiwi *et al*., 2022).

Observation results displayed in Table 2 shows that giving fruit waste LOF at a concentration of 20 ml/L of water gave the best results and a positive response to plant production in parameter Vitamin C. It is suspected that the low dose given is appropriate for plants and is more effective in absorbing nutrients, in order to increase plant growth and development, so as to increase growth. This can be seen by increased concentration of fruit waste LOF at 25 ml/l decreased the vitamin c level instead. The application of LOF to plants with a different concentration will affect the size of the nutrient content in the fertilizer, but it is not certain that the larger the dose or concentration applied will further increase plant growth (Novianto and Wartono, 2023).

The results of ANOVA on table 2 shows there is no significance between treatments of fruit waste LOF on

the percentage of water content of micro greens. The highest water content of wheatgrass microgreens is 82.63% and the lowest is 81.25%. Vegetables generally have high water content, which is around 70-95%, but low in fat and protein levels. Water content is the amount of water contained in the material expressed in percent. Water content is also one of the most important characteristics of food, because water can affect appearance, texture, and taste in food. Water content in food ingredients also determines the freshness and durability of the food, high water content results in easy bacteria, molds, and yeast to multiply, so that changes will occur in food ingredients (Widiwurjani *et al*., 2019).

5. Conclusion

The treatment of fruit waste liquid organic fertilizer concentration affects the growth parameters, namely plant height and quality parameters, namely chlorophyll and vitamin c content. Concentration treatment at the level of 20 ml/l showed the best plant height at 3, 6 and 9 days after planting, chlorophyll and vitamin c content but differences in concentration treatment did not show differences in plant water content between treatments.

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