

# The Utilization of Apple Industrial Waste as a Hydroponic Nutrition Material to Increase Economic Value

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**Abstract.** Hydroponic cultivation requires nutrients to support plants' growth and development. One of the efforts is by looking for alternative nutrient resources. Therefore, the goals of this study are 1) To determine the effect of the dose of GN nutrition on the growth and yield of red lettuce (*Lactuca sativa* L var. Red lettuce,) 2) To know the effect of the time interval by adding nutrition to the growth and yield of red lettuce. 3) To determine the effect of the interaction of appropriate nutrition and dose intervals. This research uses factorial randomized block design (RBD) consisting of 2 factors, namely first, giving GN NUTRITION dose; A1 = 5 ml / L; A2 = 6 ml / L A3 = 7 ml / L and second, giving interval; P1 = time interval of 3 days; P2 = time interval of 7 days; P3 = 10 day interval. Observation parameters included 1) Plant height (cm), number of leaves (strands), leaf area (cm), total fresh weight (grams), and fresh consumption weight (grams). The analysis of variance used ANOVA (Analysis Of Variance), while to test the difference between treatments used 5% LSD. The results of this study showed a significant effect on the parameters of leaf counts 28, 35, 42 HST, and leaf area 28 HST. It shows a noticeable influence on plant height at the age of observation 35 dd. It indicates that there is an interaction between the two treatments, namely the parameters of plant height observation with the treatment of the time interval of adding 3-day intervals and 6m / l dose age of observation 7, 21, 35, 42 hst, the number of leaves the time interval of adding 7-day intervals and 7ml doses / l 42 days after observation, and leaf area time interval with ten days interval and 7 ml / l dose at 21, 28, 35, and 42 days of observation.

**Keywords:** GN nutrition, interval, dosage, hydroponics, red lettuce

## INTRODUCTION

Urban farming is an agricultural concept, which refers to all farming activities applied in urban environments, and the results can be consumed directly by residents who live in cities. One

technique proposed is hydroponic planting. With the development of technology, the combination of hydroponic systems controls water, nutrition, and pesticides, which is significantly more efficient (minimalist system) compared to soil culture (especially for short-lived plants). The use of hydroponic systems does not depend on seasons and does not require a vast land compared to soil culture to produce the same unit of productivity [1]. The success of hydroponic vegetable cultivation is determined by the nutrient solution provided. Therefore, all nutritional needs are sought to be available in the right amount and easily absorbed by plants [2].

GN-mix nutrition is a nutrient tested and has a complete nutrient content because it uses the benchmark from Apeldan and Gamborgh 5 Waste Media. Generally, hydroponic plants use compound fertilizers that contain macro and micronutrients. Macro elements function to grow vegetative structure and production, while microelements function as essential supplements for taste, sugar content, sweetness level, color, and plant resistance to disease [3]. Hydroponically cultivated lettuce must get the right nutritional dose of Apelyang Waste [4]. A too low dose of nutrient could result in plant growth being stunted and less stable, while a too high dose could cause the plant to undergo plasmolysis, i.e., cell discharge due to being attracted by more concentrated nutrient solutions [5].

The current research goals are 1) to determine the effect of the dose of GN nutrition on the growth and yield of red lettuce (*Lactuca sativa* L var. Red lettuce), 2) to know the effect of the time interval by adding nutrition to the growth and yield of red lettuce, and 3) to determine the effect of the interaction of appropriate nutrition and dose intervals.

## METHOD

This research used factorial randomized block design, each of which was repeated four times. The combination of all treatments was as follows: P1A1 = 3-day Application interval and Apple Waste Nutrition 5 ml / L of water

- P1A2 = 3-day Application interval and Apple Nutrition 6 ml / L of Water
- P1A3 = 3-day Application interval and Apple Nutrition 7 ml / L of water
- P2A1 = 7-day Application interval and Apple Waste Nutrition 5 ml / L of water
- P2A2 = 7-day Application interval and Apple Waste Nutrition 6 ml / L of water
- P2A3 = 7-day Application interval and Apple Waste Nutrition 7 ml / L of water
- P3A1 = 10-day Application interval and Apple Waste Nutrition 5 ml / L of water
- P3A2 = 10-day Application interval and Apple Nutrition 6 ml / L of water
- P3A3 = 10-day Application interval and Apple Nutrition 7 ml / L of water

Non-destructive observation variables include plant height (cm) and the number of leaves (strands); Non-destructive observations were carried out starting from 7 days after transplanting at 7-day intervals; Observation of harvest includes fresh weight of plants and fresh weight of consumption. Observation variables include (1) Plant height (cm), carried out by measuring plant height from the base on the surface of the media to the longest leaf, (2) The number of leaves (strands), carried out by counting the leaves formed, (3) Leaf area, done by calculating leaf area length times constant, (4) Total fresh weight (grams), carried out by weighing all plants formed in one plant (roots, stems, and leaves), and (5) Consumption of fresh weight (grams), carried out by weighing the plant parts consumed in one plant (stems and leaves).

**RESULT & DISCUSSION**

Based on Table 1, it can be seen that the P3A2 treatment shows the highest results in the observation parameters of height and leaf area while not correlating to the yield component. The component yields showed the highest results in the P1A3 treatment.

Table 1. The Parameter Measurement of plant height (cm), number of leaves (strands), leaf area (cm<sup>2</sup>), total fresh weight (grams) and fresh weight of consumption (grams) measured at harvest

	Plant Height (cm)	Number of Leaf (pieces)	Leaf Area Indeks (cm <sup>2</sup> )	Consumption Weight (gram)	Total Weight (gram)
P1A1	9,38 b	4,62 ab	22,78 ab	11,25	21,67
P1A2	7,94 a	6,12 c	17,23 a	11,09	20,84
P1A3	10,46 bc	5,33 bc	30,35 bc	22,51	34,17
P2A1	8,13 ab	4,69 ab	15,62 a	10,16	15,18
P2A2	9,31 b	5,17 bc	22,58 ab	11,8	25,84
P2A3	7,79 a	4,67 ab	18,75 a	11,25	21,67
P3A1	7,38 a	6,07 bc	18,41 a	11,3	21,85
P3A2	11,39 c	4,33 ab	50,81 c	11,45	22,51
P3A3	10,38 bc	4,75 ab	27,84 b	11,15	20,85

Note: the numbers followed by the same letter and in the same column show no significant differences

based on the LSD Test at the 5% level, hst = Day after Transplanting.

Table 2 shows the highest plant height at 42 days after planting was obtained in the P3A2 treatment, and not different from P1A3 and P3A3 but different from the treatments P1A1, P1A2, P2A1, P2A2, P2A3, and P3A1. P3A1 treatment produced the lowest plant height and did not differ from P1A1, P1A2, P2A1, P2A2, P2A3, and P3A1 but differed from P3A2, P1A3, and P3A3. Meanwhile, at the age of 7 days after planting, the highest average plant height was obtained in the P1A1 treatment and did not differ from P3A3 but differed from the treatment of P1A2, P1A3, P2A1, P2A2, P2A3, P3A1, and P3A2.

Table 2. Plant Height (cm) Red Lettuce Effect of Interaction of Dose Treatment and Addition Intervals on Observation in 7, 21, 35, and 42 DAP

	Plant Height (cm) in observation			
	7	21	35	41
P1A1	4,16 c	7,28 c	8,66 b	9,38 b
P1A2	3,85 b	6,52 ab	7,48 ab	7,94 ab
P1A3	3,21 a	7,14 bc	9,44 bc	10,46 bc
P2A1	2,46 a	6,64 ab	7,25 ab	8,13 ab
P2A2	3,58 ab	7,24 bc	9,46 bc	9,31 b
P2A3	3,81 b	6,27 ab	6,89 ab	7,79 a
P3A1	3,57 ab	6,46 ab	7,08 ab	7,38 a
P3A2	3,43 a	7 c	10,32 c	11,39 c
P3A3	3,92 bc	6,65 ab	6,92 ab	10,38 bc
<b>5%</b>	<b>0,59</b>	<b>1,98</b>	<b>1,41</b>	<b>1,85</b>

Note: the numbers followed by the same letter and in the same column show no significant difference based on the LSD Test at the 5% level, hst = Day after Transplanting.

In the treatment of 21 days after planting, the highest average plant height was obtained in the P1A1 treatment and not different from P2A2 but different from the treatments, P1A2, P1A3, P2A1, P2A3, P3A1, P3A2, and P3A3. While at the age of observation 35 days after planting, the highest average plant height was obtained in the P3A2 treatment and did not differ from the P1A1, and P2A2 treatments, but differed from P1A2, P1A3, P2A1, P2A3, P3A1, and P3A3.

Table 3 shows the highest number of plant leaves at 42 days after planting obtained in the P1A2 treatment and not different from P3A1, but different from the treatments P1A1, P1A3, P2A1, P2A2, P2A3, P3A2, and P3A3. P3A2 treatment produced the lowest number of plant leaves and did not differ from P1A2, P2A1, P2A2, P2A3, P3A1, P3A2, and P3A3 but differed from P1A3 and P2A2.

Table 3. The Average Number of Leaves (strands) Influence Interaction of Dose Treatment and Addition Intervals (P) on Observation Age 42 DAP

Sum of Leaves (Strands) in 41 DAP		
P1A1	4,62	a
P1A2	6,12	c
P1A3	5,33	b
P2A1	4,69	a
P2A2	5,17	b
P2A3	4,67	a
P3A1	6,07	bc
P3A2	4,33	a
P3A3	4,75	ab
<b>5%</b>	<b>1,07</b>	

Note: the numbers followed by the same letter and in the same column show no significant difference based on the LSD Test at the 5% level, hst = Day after Transplanting.

Analysis of variance shows that there is an interaction between the time interval of adding GN Nutrisi with the nutrient dose of Apple Waste to the leaf area of red lettuce (*Lactuca sativa* L var. Red Red lettuce) at the age of 21, 28, 35 and 42. On the other hand, the observation 28 days after planting indicates that the nutrient dosage of Apple Waste did not affect the leaf area of all observations.

Table 4. shows the highest leaf area at 42 days after planting was obtained in the P3A2 treatment and not different from the P1A3 treatment but different from the P1A1, P1A2, P2A1, P2A2, P2A3, P3A1, and P3A3 treatments. Whereas at the age of 21 days after planting, the highest average leaf area was obtained in the P1A2 treatment and was not different from the P2A3 treatment, but different from the P1A1, P1A3, P2A1, P2A2, P3A1, P3A2, and P3A3 treatments.

Table 4. Average Leaf Area (cm<sup>2</sup>) of Red Lettuce Influence Interaction of Treatment (A) and Addition Intervals (P) at Observation Age 21, 28, 35, and 42 DAP

	Number of Leaf Area Index (cm <sup>2</sup> ) at Observation in 21, 28, 35 and 42 DAP							
	21	28	35	42				
P1A1	9,33	b	12,97	ab	19,93	a	22,78	ab
P1A2	10,22	c	13,26	ab	14,09	a	17,23	a
P1A3	5,76	a	23,07	c	23,33	a	30,35	bc
P2A1	7,46	ab	11,93	ab	14,6	a	15,62	a
P2A2	6,53	a	16,47	b	19,55	a	22,58	ab
P2A3	9,91	bc	8,9	a	12,27	a	18,75	a
P3A1	7,78	ab	9,44	a	15,36	a	18,41	a
P3A2	8,71	ab	13,45	ab	38,35	b	50,81	c
P3A3	8,23	b	10,02	a	13,12	a	27,84	bc
<b>5%</b>	<b>1,36</b>		<b>6,87</b>		<b>1,41</b>		<b>1,85</b>	

Note: the numbers followed by the same letter and in the same column show no significant difference

based on the LSD Test at the 5% level, DAP = Day after Transplanting.

At 28 days after planting, the highest average leaf area was obtained in the P1A3 treatment, and different from the P1A1, P1A2, P2A1, P2A2, P2A3, P3A1, P3A2 and P3A3 treatments. In contrast, at the age of 35 days after planting, the highest average leaf area was obtained in the P3A2 treatment and did not differ from P1A1, P1A2, P1A3, P2A1, P2A2, P2A3, P3A1, and P3A3.

Table 5 shows that the plants that were given GN Nurisi fertilizer produced the highest average fresh total weight in treatment P1 and were not significantly different from P2 and P3 whereas the nutrient dosage of Apple Waste showed the highest average acquisition in treatment A3 and was not significantly different from treatment A1 and A2.

Table 5. Average Fresh Total Weight of Red Lettuce Plants (grams) the effect of Dose Treatment and Addition Intervals (P) in 42 days after planting

Total Weight of Plant in (gram) 42 DAP	
Interval of Application	
3 Days	34,07
7 Days	28,14
10 Days	18,88
<b>5%</b>	<b>-</b>
Dosage Level	
5 ml	26,29
6 ml	30,74
7 ml	34,07
<b>5%</b>	<b>0,46</b>

Note: the numbers followed by the same letter and in the same column show no significant difference based on the LSD Test at the 5% level, hst = Day after Transplanting.

Table 6 shows that the plants that were given GN Nurisi fertilizer produced the highest average fresh total weight in treatment P1 and were not significantly different from P2 and P3 while the nutrient dosage of Apple Waste showed the highest average acquisition in treatment A3 and was not significantly different from treatment A1 and A2.

On the first observation, the P1A1 treatment showed a significant acceleration rate of high growth and began to experience a slow rate on the second observation. This was different from the P3A2 treatment which experienced a slow growth rate on observations 1 to 4 and began to show the rate very fast acceleration after the 4th observation to get the highest results. Plant height in the study was influenced by gibberellins and element N produced by GN nutrition and element N contained in the Waste Apelm capable of playing a role in the process of cell extension of red lettuce [6] [7] [8]

Table 6. Average Fresh Weight of Red Lettuce Consumption (grams), the Effect of Dose Treatment, and Additional Intervals (P) 42 days after planting

Consumption Weight of Plant (gram) in 42 DAP	
Interval of Application	
3 Days	15,7
7 Days	13,1
10 Days	13,4
5%	
-	
Dosage Level	
5 ml	13,8
6 ml	13,7
7 ml	15,74
5%	
0,38	

Note: The numbers followed by the same letter and in the same column show no significant difference based on the LSD Test at the 5% level, hst = Day after Transplanting.

Many of the least number of leaves, among others, influenced by nitrogen nutrients contained in the nutrient solution. Because nitrogen is a major component of various important substances in the formation of plant leaves. adequate nitrogen in lettuce plants will accelerate the rate of division and elongation of leaf cells takes place quickly so as to produce a greater number of leaves [9] [10]

At the acceleration of the average leaf area in the P1A3, the treatment acceleration (rate) starts at the 4th observation rises rapidly and is followed by the P3A2 treatment which also rises afterwards. However, when the P1A3 treatment slows down, the acceleration in the P3A2 treatment continues to increase and approaches the end of the research. The results of the research carried out obtained plant leaf area showed that the effect caused by GN nutrition, which is able to produce phytohormones (biostimulants) such as cytokinins that provide stimulation to the expansion of the leaves of lettuce plants and Apelyang Waste nutrients contain nutrients N needed by plants. Macro elements function to grow vegetative structure and production. Microelements function as essential supplements for taste, sugar content, sweetness level, color, and plant resistance to disease disorders [11] [12] [13] In the component of total fresh weight yield which includes root, stem, and leaf weight with P1A3 treatment showed the highest results and still correlated with consumption weight. This happens because the component of weight consumption results, namely the leaves and stems are also components of plants, which are listed in Table.1.

## CONCLUSION

The results of this study showed a significant effect on the parameters of leaf counts of 28, 35, 42 HST, and leaf area of 28 HST. It shows a noticeable influence on plant height at the age of observation 35 dd, which means that there is a real interaction between the two treatments, namely the parameters of plant height observation with the treatment of the time interval of adding 3-day intervals and 6m / 1 dose age of observation 7, 21, 35, 42 hst, the number of leaves the time interval of adding 7-day intervals and 7ml doses / 1 42 days after observation, and leaf area time interval with ten days interval and 7 ml / 1 dose at 21, 28, 35, and 42 days of observation.

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