AGRIWAR JOURNAL
MASTER OF AGRICULTURAL SCIENCE WARMADEWA UNIVERSITY
E-ISSN: 2808-1137, **P-ISSN**: 2808-1323
Vol. 3, **No.** 1, **Jun 2023**, **Page** 36-47
DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

Application of Swallow Fertilizer Combined with NPK Fertilizer on the Growth and Yield of Cucumber Plants

I Putu Adi Masaji*; Yohanes Parlindungan Situmeang; Ni Putu Anom Sulistiawati

Master of Agricultural Science, Postgraduate Program, Warmadewa University, Denpasar, Bali, Indonesia
*Corresponding author: iputuadimasaji38@gmail.com

Abstract
This study aims to determine the dosage of Swallow fertilizer and the dose of NPK fertilizer on the growth and yield of cucumber plants. This study used a randomized block design (RBD) in a factorial pattern with 2 treatment factors, namely: The first factor was swallow fertilizer consisting of 4 treatment levels, namely: without fertilizer, 10 tons ha-1, 20 tons ha-1, 30 tons ha-1, The second factor is NPK fertilizer consisting of 4 treatment levels, namely: without fertilizer, 150 kg ha-1, 300 kg ha-1, and 450 kg ha-1. Treatment of swiftlet fertilizer doses showed a significant to a very significant effect on all variables observed except for fruit dry weight per plant which had no significant effect. The highest yield of fresh fruit weight reached 732.67 g obtained in the swiftlet fertilizer treatment of 30 tons ha-1. NPK fertilizer dose treatment showed a very significant effect on all observed variables except for the variable cucumber flower exit time, cucumber fruit exit time, fruit dry weight per plant, and dry fruit weight per plant had no significant effect. The yield of fresh fruit weight reached 665.57 g obtained in the NPK fertilizer treatment of 150 kg ha-1. The interaction between swiftlet fertilizer dose and NPK fertilizer dose showed results that had a significant to a very significant effect on all variables observed except for the non-significant effect obtained on the cucumber fruit discharge time and fresh fruit weight per plant. Recommendations for swiftlet fertilizer 30 tons ha-1 and NPK fertilizer 150 kg ha-1 can be used to increase cucumber yields.

Keyword: *Organic fertilizer, swallow droppings, NPK fertilizer, cucumber.*

1. Introduction

Cucumber (Cucumis sativus L.) is a type of horticultural plant that is favored by Indonesian people [1]. Cucumber plants originate from the southern Asian continent which is thought to have come from India and its surroundings [2]. A cucumber is a short-lived or annual plant that grows vines like shrubs or shrubs with a plant length of up to 2 meters [3]. Cucumber plants start to bear fruit at the age of 30-45 days after planting [4]. Cucumbers can grow in tropical and subtropical climates [5]. Cucumbers contain various vitamins and nutrients such as protein, carbohydrates, and so on [6]. The constituent of cucumber fruit is more water so cucumber fruit can be classified as a refreshing fruit [7]. Cucumber fruit can be used as an alternative medicine for various diseases, one of which can reduce blood pressure [8]. Providing adequate nutrition to cucumber plants can increase yields and plant growth [9].

Fertilization is an effort to add nutrients to plants that aim to increase plant growth and yield [10]. Fertilizer application to plants greatly helps the soil in providing the nutrients needed by plants in the process of growth and fertilization [11]. Nutrients absorbed by plants are in the form of macronutrients such as nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium, as well as micronutrients such as iron, chloride, manganese, boron, copper, molybdenum, and zinc [12]. Plants require more nutrients nitrogen, phosphorus, and potassium than other elements for plant growth and yield [13]. The provision of plant nutrition can be in the form of organic fertilizers or inorganic fertilizers [14].

Swiftlet manure fertilizer is a fertilizer derived from swallow droppings which contain C-organic 50.46%, N-total 11.24%, C/N 4.49%, phosphorus 1.59%, potassium 2.17%, calcium 0.30%, magnesium 0.01%, pH 7.97 [15]. Fe 347.829 ppm, Zn 1.8464 ppm, and B 1.8533 ppm [16]. Water 28.15%, ash 25.23%, crude fat 0.05%, crude fiber 39.58%, and crude protein 43.96% [17]. Swallow droppings can be used as a source of nutrition for plants [18]. The provision of plant nutrients in the form of organic fertilizers, one of which comes from livestock manure, can improve the quality and activity of soil microbes [19]. Treatment of different doses of swallow fertilizer on the growth and yield of cucumbers showed the heaviest fruit weight results in the treatment of swallow fertilizer doses of 20 tons ha-1 [20].

NPK fertilizer is a synthetic fertilizer that is often used by farmers in general [21]. NPK fertilizer is an inorganic fertilizer that has multiple nutrients such as nitrogen, phosphorus, and potassium [22]. The application of NPK fertilizer of as much as 300 kg ha-1 got the best results on the growth and yield of cucumbers [23]. Inorganic fertilizers such as NPK fertilizers that are used continuously and given to plants in excess, and not accompanied by the application of fertilizers derived from organic matter can cause the soil in the cultivation area to become damaged and the productivity of the land to decrease [24]. The continuous use of chemical fertilizers on agricultural land can result in damaged ecosystems on agricultural land [25]. Given the important role of organic fertilizer derived from swallow droppings combined with NPK fertilizer, a study was conducted to evaluate the effect of swallow fertilizer and NPK fertilizer on cucumber yields.

2. Materials and Methods

This research was conducted in Sidondo II Village, Sigi Biromaru District, Sigi Regency, Central Sulawesi Province. At an altitude of ± 51 meters above sea level. This study used a factorial randomized block design (RBD) consisting of 2 treatment factors. The first factor was the dose of swallow fertilizer which consisted of 4 treatment levels (without fertilizer, 10 tons ha^{-1}, 20 tons ha-1, and 30 tons ha^{-1}). The second factor was the dose of NPK fertilizer which consisted of 4 treatment levels (150 kg ha^{-1}, 300 kg ha^{-1}, and 450 ha^{-1}). Thus, 16 treatment combinations could be obtained and each treatment combination was repeated 3 times so that there were a total of 48 combination treatment plots. Variables observed in this study included: stem length per plant, number of leaves per plant, time of flowering of cucumbers per plant, time of discharge of cucumbers per plant, fruit diameter per plant, fruit length per plant, number of fruits planted, fruit weight per plant, fruit dry weight per plant, fresh body weight per plant, dry fruit weight per plant, and harvest index.

The collected data were analyzed statistically using analysis of variance or variance. When the analysis of variance obtains a significant to very significant effect, then it is continued with the least significant difference test (LSD) at the 5% level for the single treatment, and Duncan's analysis at the 5% level for the interaction effect. Meanwhile, to determine the optimum dose and maximum yield is carried out through a regression test.

3. Results and Discussion

3.1. Results

The results of the statistical analysis of all variables observed in this study are presented in Table 1. Significance of the response or effect of the swallow fertilizer dose (W) and NPK fertilizer dose (N) and their interactions (WxN) on the observed variables.

Swiftlet fertilizer dose treatment (W) showed a significant effect ($P<0.05$) on the variable dry weight per plant, to very significant ($P<0.01$) on the variable stem length per plant, number of leaves per plant, time of flower exit cucumber, time of emergence of cucumber fruit, fruit diameter per plant, fruit length per plant, number of fruit per plant, fresh fruit weight per plant, fresh weight per plant, harvest index, and no significant effect ($P\geq0.05$) on variables fruit dry weight per plant.

Treatment of NPK (N) fertilizer doses showed highly significant results ($P<0.01$) on the variables of stem length per plant, number of leaves per plant, fruit length per plant, number of

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

fruits per plant, fresh fruit weight per plant, fresh fruit weight per plant, harvest index, and had no significant effect (P≥0.05) on the variable stem diameter per plant, cucumber flowering time, cucumber fruit exit time, fruit dry weight per plant, and dry fruit weight per plant.

The interaction between swiftlet fertilizer dose and NPK fertilizer dose (WxN) showed results that had a significant effect (P<0.05) on fruit dry weight variable per plant, so that it had a very significant effect (P<0.01) on stem length variable per plant, number of leaves per plant, the flowering time of cucumber, fruit diameter per plant, fruit length per plant, number of fruits per plant, fresh body weight per plant, dry body weight per plant, harvest index, and no significant effect (P≥0.05) on the variable time of exit of cucumber fruit and fresh fruit weight per plant.

Table 1. The effect of swallow fertilizer doses and NPK fertilizer doses and their interactions with the observed variables

No	Variable	Treatment		
		Swallow Fertilizer (W)	NPK Fertilizer (N)	Interaction (W x N)
	Stem length per plant (cm)	**	**	**
	Number of leaves per plant (strands)	**	**	**
	Cucumber flower exit time (days)	**	ns	**
	Cucumber fruit exit time (days)	**	ns	ns
	Fruit diameter per plant (cm)	**	**	**
	Fruit length per plant (cm)	**	**	**
	Number of fruits per plant (fruit)	**	**	**
	Weight of fresh fruit per plant (g)	**	**	ns
	The dry weight of fruits per plant (g)	ns	ns	*
	Wet pruning weight per plant (g)	**	**	**
	Dry pruning weight per plant (g)	*	ns	**
	Harvest index (%)	**	**	**

* = significance (P<0.05), ** = Very significance (P<0.01), ns = non significance (P≥0.05)

3.1.1. Stem Length per Plant (cm)

The interaction of swiftlet fertilizer with NPK fertilizer (WxN) showed results that had a very significant effect (P<0.01) on plant length growth on day 63 (Table 1). The longest plant stem length reached 310.85 cm obtained from the interaction of swallow fertilizer doses of 20 tons ha^{-1} with no NPK fertilizer, which was significantly different compared to the lowest treatment obtained in the interaction between no swiftlet fertilizer and no NPK fertilizer with the longest plant stem length. obtained reached 88.00 cm (Table 2).

Table 2. The average stem length per cucumber plant is caused by the interaction between swallow fertilizer doses and NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	400 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	88.00 h	124.17 fgh	118.10 gh	107.83 gh
10 ton ha^{-1} (W1)	173.00 ef	226.18 cd	150.40 efg	119.50 gh
20 ton ha^{-1} (W2)	310.85 a	229.48 cd	198.70 de	153.37 efg
30 ton ha^{-1} (W3)	277.20 ab	262.08 bc	197.52 de	224.93 cd

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

3.1.2. Number of Leaves per Plant (strands)

The interaction of swiftlet fertilizer with NPK fertilizer (WxN), proved that the variable number of leaves per plant on the 63rd day of observation had a very significant effect (P<0.01) (Table 1). The highest number of cucumber leaves reached 271.00 in the interaction treatment of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 150 kg ha^{-1}, which was significantly different in the interaction between without swallow fertilizer and NPK fertilizer, with the number of leaves obtained as many as 64. 67 strands (Table 3).

Table 3. The average number of leaves per plant is caused by the influence of the interaction of the dose of swallow fertilizer with the dose of NPK fertilizer.

	NPK Fertilizer			
Treatment	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	400 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	64.67 h	117.00 g	255.83 abc	169.67 f
10 ton ha^{-1} (W1)	115.83 g	204.50 bcd	264.17 ab	240.83 bcd
20 ton ha^{-1} (W2)	146.33 f	221.83 de	230.50 cde	150.50 f
30 ton ha^{-1} (W3)	265.33 ab	271.00 a	208.83 e	155.33 f

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.3. Cucumber flowering time (days)

Swiftlet fertilizer (W) treatment on cucumber plants and the interaction of swallow fertilizer with NPK fertilizer (WxN) produced results that had a very significant effect (P<0.01) on the time of cucumber flower emergence in each treatment, but in the NPK fertilizer treatment (N) indicates an indication of an insignificant effect (P≥0.05) on the time of interest issuance (Table 1). Interaction of swiftlet fertilizer with NPK fertilizer (WxN) on the variable of the fastest time for cucumber flowers to appear, namely the fastest time for flowers to appear on day 16.50 dap, which was obtained as a result of the interaction of 30 tons ha^{-1} swallow fertilizer with 450 kg ha^{-1} NPK fertilizer, which is significantly different from the interaction without swallow fertilizer and NPK fertilizer with the time when cucumber flowers emerge at 24.50 daps (Table 4).

Table 4. The average flowering time per plant is due to the interaction between swallow fertilizer doses and NPK fertilizer doses.

	NPK Fertilizer			
Treatment	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	400 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	24.50 b	26.33 a	26.50 a	26.33 a
10 ton ha^{-1} (W1)	19.67 c	18.17 a	18.00 de	17.67 ef
20 ton ha^{-1} (W2)	19.00 cd	18.17 de	18.33 de	18.17 de
30 ton ha^{-1} (W3)	18.17 de	18.67 cde	18.00 de	16.50 f

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.4. Cucumber Exit Fruit Time

Swiftlet fertilizer treatment at different doses showed results that had a very significant effect (P<0.01) on the time of cucumber discharge per plant but had no significant effect (P≥0.05) on NPK fertilizer treatment and the interaction between swallow fertilizer and NPK fertilizer (Table 1). Treatment of swiftlet fertilizer doses on the observation variable for the fastest time for cucumber fruit discharge per plant on day 14.92 dap, in the treatment of swallow fertilizer doses of 30 tons ha^{-1}, was not significantly different for each swallow fertilizer treatment, but significantly different for the swiftlet fertilizer treatment. without swallowing fertilizer (Table 5).

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

The fastest NPK fertilizer treatment for cucumber fruit discharge time per plant was found in the 150 kg ha^{-1} NPK fertilizer treatment with a fruit discharge time of 17.38 dap and was not significantly different from the treatment without NPK fertilizer (Table 5).

Table 5. Average fruiting time per plant due to the dose of swallow fertilizer with NPK fertilizer

Treatment	Fruit exit fruits time (days)
Swallow Fertilizer	
0 ton ha^{-1} (W0)	23.29 a
10 ton ha^{-1} (W1)	15.42 b
20 ton ha^{-1} (W2)	15.79 b
30 ton ha^{-1} (W3)	14.92 b
LSD 5%	1.10
NPK Fertilizer Dosage	
0 kg ha^{-1} (N0)	17.42 a
150 kg ha^{-1} (N1)	17.21 a
300 kg ha^{-1} (N2)	17.42 a
400 kg ha^{-1} (N3)	17.38 a
LSD 5%	1.10

Note: Numbers followed by the same letter on the same factor means not significantly different on the 5% LSD test.

3.1.5. Fruit Diameter per Plant (cm)

The interaction of swiftlet fertilizer with NPK fertilizer had a very significant effect ($P<0.01$) on the variable fruit diameter per cucumber plant (Table 1). The largest fruit diameter per plant reached 7.40 cm in the interaction of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 450 tons ha^{-1}, which was significantly different from the interaction treatment without swallow fertilizer and NPK fertilizer with a fruit diameter of 5. 39 cm (Table 6).

Table 6. Average cucumber fruit diameter per plant due to the interaction of swiftlet fertilizer doses with NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	5.39 hi	5.08 i	5.90 fg	6.27 e
10 ton ha^{-1} (W1)	5.60 gh	5.80 g	6.98 bc	6.51 de
20 ton ha^{-1} (W2)	6.73 bcd	6.47 de	6.98 bc	6.90 bc
30 ton ha^{-1} (W3)	6.71 cd	7.03 bc	7.05 b	7.40 a

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.6. Fruit Length per Plant (cm)

The interaction of swiftlet fertilizer with NPK fertilizer (WxN) had a very significant effect ($P<0.01$) on cucumber fruit length per plant (Table 1). The longest fruit length variable per plant reached 30.13 cm in the interaction of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 450 tons ha^{-1}, which was significantly different in interactions without swallow fertilizer and without NPK fertilizer with fruit length reaching 20.05 cm (Table 7).

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

Table 7. The average length of cucumber fruit per plant is due to the interaction of swiftlet fertilizer doses with NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	20.05 f	21.78 f	25.50 de	26.12 cde
10 ton ha^{-1} (W1)	22.02 f	24.72 e	27.75 bc	27.22 bcd
20 ton ha^{-1} (W2)	27.30 bcd	27.53 bc	27.43 bc	27.72 bc
30 ton ha^{-1} (W3)	27.92 bc	28.17 bc	28.73 ab	30.13 a

3.1.7. Number of Fruits per Plant (fruit)

The interaction of swiftlet fertilizer with NPK fertilizer showed results that had a very significant effect (P<0.01) on the number of fruits per cucumber plant (Table 1). Based on the results, the highest number of fruits per plant reached 4.23 in the interaction of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 450 tons ha^{-1}, the results were significantly different in the interaction without swallow fertilizer and without NPK fertilizer with the number of fruits only reaching 2.00 pieces (Table 8).

Table 8. The average number of cucumbers per plant is due to the interaction of swallow fertilizer doses with NPK fertilizer doses (WxN).

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	2.00 h	2.90 ef	2.30 gh	2.73 fg
10 ton ha^{-1} (W1)	2.23 h	2.80 ef	2.87 ef	2.83 ef
20 ton ha^{-1} (W2)	2.97 def	3.07 de	3.20 de	3.70 bc
30 ton ha^{-1} (W3)	3.73 bc	3.37 cd	3.97 ab	4.23 a

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.8. Fresh Fruit Weight per Plant (g)

The results of statistical analysis of fresh fruit weight in the treatment of swallow fertilizer and NPK fertilizer doses had a very significant effect (P<0.01) on fresh fruit weight per plant but had no significant effect (P≥0.05) on the interaction between swallow fertilizer and NPK fertilizer (Table 1). The swiftlet fertilizer treatment of the variable fresh weight of cucumber fruit per plant obtained the heaviest cucumber fruit in the swiftlet fertilizer treatment of 30 tons ha^{-1}, with fresh fruit weight reaching 732.67 g and significantly different compared to no swallow fertilizer treatment with a fresh fruit weight yield of 487. 62 g and significantly different from other swiftlet fertilizer dosage treatments. NPK fertilizer treatment on variable fresh fruit weight per plant, the heaviest was obtained in the 150 kg ha^{-1} treatment with 665.57 g fruit weight, and significantly different from the treatment without NPK fertilizer (Table 9).

Table 9. Average fresh fruit weight of cucumber per plant due to the effect of the doses of swallow fertilizer and NPK fertilizer

Treatment	Fruit fresh weight (g)
Swallow Fertilizer	
0 ton ha^{-1} (W0)	487.62 d
10 ton ha^{-1} (W1)	625.22 c
20 ton ha^{-1} (W2)	691.71 b
30 ton ha^{-1} (W3)	732.67 a
LSD 5%	31.37

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

NPK Fertilizer	
0 kg ha^{-1} (N0)	583.82 b
150 kg ha^{-1} (N1)	665.57 a
300 kg ha^{-1} (N2)	648.44 a
450 kg ha^{-1} (N3)	639.39 a
LSD 5%	31.37

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% LSD test.

3.1.9. Fruit Dry Weight per Plant (g)

The treatment of swiftlet fertilizer and NPK fertilizer showed no significant effect (P≥0.05), but the interaction of swallow fertilizer with NPK fertilizer had a significant effect (P<0.05) on fruit dry weight per plant (Table 1). The interaction of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 450 tons ha^{-1} with the heaviest fruit dry weight per plant reached 9.27 g, which was not significantly different in the interaction between no swallow fertilizer and no NPK fertilizer with fruit dry weight per plant reaching 8.73 g (Table 10).

Table 10. The average dry weight of cucumber per plant is due to the interaction between swallow fertilizer doses and NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	8.73 ab	8.14 abc	8.58 abc	8.21 abc
10 ton ha^{-1}(W1)	9.25 ab	8.97 ab	7.20 c	9.22 ab
20 ton ha^{-1} (W2)	8.85 ab	8.08 abc	9.20 ab	7.95 bc
30 ton ha^{-1} (W3)	8.07 abc	8.86 ab	8.01 bc	9.27 a

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.10. Wet Stove Weight per Plant (g)

The interaction of swiftlet fertilizer with NPK fertilizer showed results that had a very significant effect (P<0.01) on the variable wet-frame weight per plant (table 1). The heaviest variable of wet chestnut weight per plant reached 1576.35 g in the interaction of swallow fertilizer 30 tons ha^{-1} with no NPK fertilizer, significantly different from the interaction between no swiftlet fertilizer and no NPK fertilizer with wet stover weight reaching 732.21 g (Table 11).

Table 11. Average wet weight of cucumber per cucumber plant due to the interaction between swallow fertilizer doses and NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	732.21 fghij	898.41 def	769.92 k	864.26 fgh
10 ton ha^{-1} (W1)	871.33 fghi	959.73 hij	982.21 fghi	1063.12 cde
20 ton ha^{-1} (W2)	1244.64 b	1275.63 bc	996.48 ij	1016.31efg
30 ton ha^{-1} (W3)	1576.35 a	1050.14 jk	1135.07 cdef	1141.40 cd

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

3.1.11. Dry Estimated Weight per Plant (g)

The swiftlet fertilizer treatment and the interaction between swallow fertilizer and NPK fertilizer produced results that had a significant (P<0.05) to very significant (P<0.01) effect, but the NPK (N) fertilizer treatment had no significant effect (P>0, 05) on dry matter weight per plant (Table 1). The interaction of swallow fertilizer with NPK obtained the highest dry weight reaching 23.42 g in the interaction of swallow fertilizer 30 tons ha^{-1} with NPK fertilizer 450 kg ha^{-1}, significantly different from the interaction without swallow fertilizer with no NPK fertilizer with dry weight reaching 16.34 g (Table 12).

Table 12. Average dry weight per cucumber plant caused by the interaction of swiftlet fertilizer doses with NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Swallow Fertilizer				
0 ton ha^{-1} (W0)	16.34 bcd	18.98 b	17.99 bcd	18.36 bc
10 ton ha^{-1} (W1)	17.51 bcd	18.48 bc	16.92 bcd	14.85 d
20 ton ha^{-1} (W2)	16.51 bcd	14.98 d	17.30 bcd	15.60 cd
30 ton ha^{-1} (W3)	15.59 cd	15.94 bcd	19.04 b	23.42 a

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.1.12. Harvest Index (%)

The interaction of swiftlet fertilizer with NPK fertilizer had a very significant effect (P<0.01) on the harvest index variable (Table 1). The highest yield index was obtained, reaching 55.59% in the interaction of 30 tons ha^{-1} swallow fertilizer with no NPK fertilizer, significantly different from the interaction without swallow fertilizer and NPK fertilizer with a harvest index of 42.87% (Table 13).

Table 13. The average yield on the harvest index variable is caused by the interaction effect between swallow fertilizer doses and NPK fertilizer doses.

Treatment	NPK Fertilizer			
	0 kg ha^{-1} (N0)	150 kg ha^{-1} (N1)	300 kg ha^{-1} (N2)	450 kg ha^{-1} (N3)
Pupuk Walet				
0 ton ha^{-1} (W0)	42.87 bc	43.65 bc	35.09 def	38.61 cd
10 ton ha^{-1} (W1)	38.12 cd	32.11 def	32.95 def	38.53 cd
20 ton ha^{-1} (W2)	45.37 b	42.91 bc	30.14 fg	34.75 def
30 ton ha^{-1} (W3)	55.59 a	26.13 g	34.85 def	37.10 de

Note: Numbers followed by the same letter on the same factor mean not significantly different on the 5% Duncan Test.

3.2. Discussion

The results showed that the fresh weight of cucumber per plant showed the highest yield in the swiftlet fertilizer treatment of 30 tons ha^{-1} with the heaviest fresh fruit weight reaching 732.67 g, which increased by 50.25% when compared to no swallow fertilizer (W0) weighing 487 .62 g, the NPK fertilizer treatment showed the highest yield in the 150 kg ha^{-1} NPK fertilizer treatment with a cucumber fruit weight of 665.57 g, which increased when compared to no NPK fertilizer with a fresh fruit weight of 583.82 g (Table 9).

The results of the regression analysis of swallow fertilizer dose treatment (W) obtained a linear relationship with the regression line equation: $\hat{Y} = 514.1 + 8.016\ X$, with an R2 of 92.9% (Figure 1). The results of the NPK fertilizer dose regression analysis (N) show a quadratic relationship with the regression line equation: $Y = 589.2 + 0.5537\ X - 0.001009\ X^{-2}$, with R^2 of 84.8%, the

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

optimum dose of NPK fertilizer is 274.38 kg ha^{-1} and the maximum fresh fruit weight yield was 665.16 g (Figure 2).

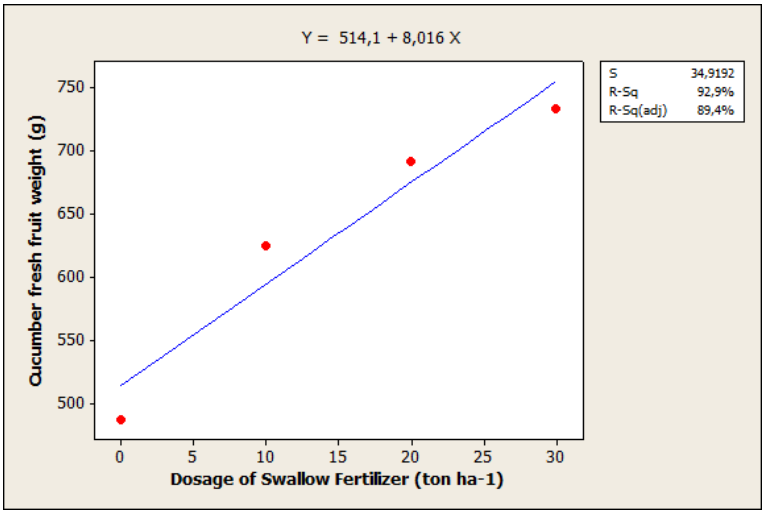

Figure 1. The results of the regression analysis between swallow fertilizer doses

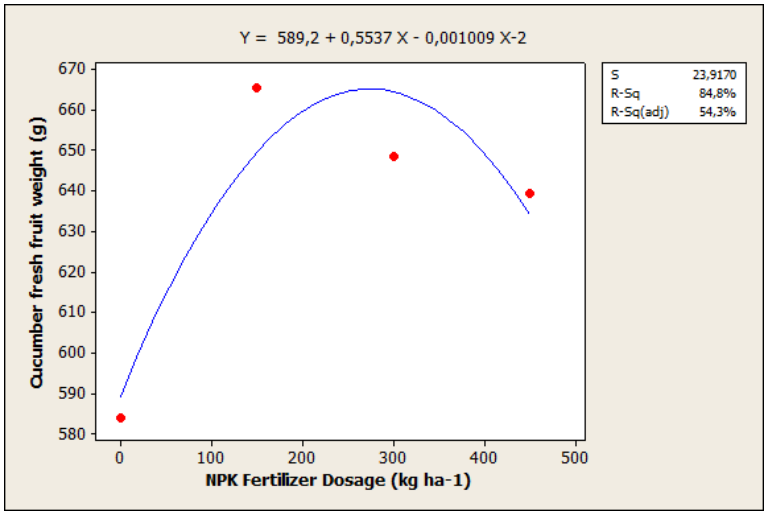

Figure 2. Results of regression analysis of NPK fertilizer

The nutrient content contained in swallow fertilizer and NPK fertilizer can stimulate plant vegetative growth such as plant stem length, stem diameter, number of branches, number of leaves, and fresh weight of the stem, as well as spur generative growth of plants such as fruit diameter, fruit length, number of fruits, weight fruit dryness, and cucumber harvest index. The nutrient content contained in swallow fertilizer and NPK fertilizer also supports the availability of soil N elements and improves the C/N-soil ratio, with the availability of N nutrients and better the C/N-soil ratio caused by the application of swallow fertilizer and NPK so that the soil on where cultivation becomes fertile and vegetative and generative growth of cucumber plants goes well. The good quality of the soil is due to the content of each fertilizer's raw material as a provider of nutrients in supporting plant growth [26].

C/N-soil greatly influences soil quality [27]. The availability of N-soil elements affects the C/N-soil ratio which will make the soil fertile. Fertile soil on cultivated land keeps plants from experiencing a shortage of nutrients throughout growth [26]. The C/N-soil balance affects the microorganisms in the soil, as well as the soil's ability to release the nutrients needed by plants [28]. The organic carbon content in the soil is an indicator of soil fertility [29]. The fertility of plants can be observed in the growth of plant length, stem diameter, number of branches, number

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

of leaves, and sapling weight. Plant length supports plants in channeling nutrients absorbed from the soil through the roots through the xylem tissue which is located inside the plant stem to the leaves and is translocated throughout the plant through the phloem tissue [30].

The large production of cucumber fruit and leaves is supported by the formation of plant branches where there are many cucumbers fruit and leaves on branches that come out of the main stem. Leaves have a role as a kitchen plant or a place for photosynthesis. Photosynthesis is a process of making energy or food substances in plants in the form of glucose so that the leaves can support the formation of fruit in terms of preparing assimilates for the formation, growth, and development of fruit [31]. The diameter of the fruit, the length of the fruit, and the weight of the fruit depend on the ability of the leaves in the process of photosynthesis that occurs in the leaves to produce assimilates in spurring the emergence of flowers, fruit growth and contribute to the formation of good fruit quality.

4. Conclusion

The interaction between swiftlet fertilizer dose and NPK fertilizer dose showed results that had a significant to a very significant effect on all variables observed except for the non-significant effect obtained on the cucumber fruit discharge time and fresh fruit weight per plant. Treatment of swiftlet fertilizer doses showed a significant to a very significant effect on all variables observed except for fruit dry weight per plant which had no significant effect. The highest yield of fresh fruit weight reached 732.67 g obtained in the swiftlet fertilizer treatment of 30 tons ha-1. The results of the regression analysis of the swallow fertilizer dose treatment obtained a linear relationship with the regression line equation: $\hat{Y} = 514.1 + 8.016$ X, with an R2 of 92.9%. NPK fertilizer dose treatment showed a very significant effect on all observed variables except for the variable number of branches per plant, stem diameter, cucumber flower exit time, cucumber fruit exit time, dry weight of fruit per plant, and dry weight per plant had no significant effect. The yield of fresh fruit weight reached 665.57 g obtained in the NPK fertilizer treatment of 150 kg ha-1. The results of the NPK fertilizer dose regression analysis showed a quadratic relationship with the regression line equation: Y = 589.2 + 0.5537 X - 0.001009 X-2, with an R2 of 84.8%, the optimum dose of NPK fertilizer was 274.38 kg ha-1 and the yield of maximum fresh fruit weight was 665.16 g.

Reference

[1] Suwandi, T. R., Azizah, E., & Agustini, Y. (2023). Pengaruh Pemangkasan Cabang Lateral Terhadap Pertumbuhan dan Hasil Tanaman Mentimun (*Cucumis sativus* L.) Varietas Etha 87 F1. Paspalum: Jurnal Ilmiah Pertanian, 11(1), 82-86.

[2] Amin, A. R. (2015). Mengenal budidaya mentimun melalui pemanfaatan media informasi. Jupiter, 14(1).

[3] Fatimah, A. D. (2023). Manfaat Mentimun (*Cucumis Sativus*) Perspektif Islam Untuk Kesehatan. Es-Syajar, 1(1), 81-88.

[4] Somsak Chimma, Saichon Sukyanakij, Siriwan Smithiaporn, Sophida Jiwprasert, & Thanawan Panichphat. (2020). Response of growth and yield of hybrid cucumber to phosphorus fertilizer. Thai Journal of Science and Technology, 9(2), 276-286.

[5] Sabbaha, M. A., Puspitorini, P., Widiatmanta, J., & Wibowo, A. S. (2023). Pengaruh Pemberian Dosis Pupuk Npk Dan Kosentrasi Urin Sapi Terhadap Pertumbuhan Dan Hasil Tanaman Mentimun (*Cucumis Sativus* L.). Grafting: Jurnal Ilmiah Ilmu Pertanian, 13(1), 42-50.

[6] Alfianto, F., & Saputera, A. (2021). Efektifitas Aplikasi Pupuk Kandang Ayam dan Bokashi Kayambang terhadap Pertumbuhan dan Hasil Mentimun (*Cucumis sativus* L.) di Lahan Berpasir. J-Plantasimbiosa, 3(2), 7-1.

[7] Arista, Y. L. V., Khairunissa, A., & Chastelyna, A. J. (2023). Pengaruh Hydrocooling dan Jenis Kemasan Terhadap Kualitas Mentimun (*Curcumis sativus* L.) Selama Penyimpanan. JAGO TOLIS: Jurnal Agrokompleks Tolis, 3(1), 36-44.

[8] Lestari, S., & Nuraeni, D. S. (2015). Pengaruh pemberian jus mentimun terhadap penurunan tekanan darah lansia hipertensi. Jurnal Kesehatan, 6(1), 654-659.

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47

[9] Loan, N. T., & Thiêm, T. T. (2022). Effect of increasing organic fertilizer and reducing chemical fertilizer on growth, yield, and fruit quality of cucumber (*Cucumis sativus* L.). Can Tho University Science Journal, 58(6), 88-97.
[10] Wijaya, R. (2019). Pengaruh Pemberian Kompos Kotoran Burung Walet Dan Pupuk NPK Mutiara 16 16 16 Terhadap Pertumbuhan Bibit Pepaya California (*Carica Papaya* L.) (Doctoral Dissertation).
[11] Ning Chuanchuan, Wang Jianwu, & Cai Kunzheng. (2016). Research progress on the effects of organic fertilizers on soil fertility and soil environmental quality. Journal of Ecological Environment, 25(1), 175.
[12] Mading, Y., Mutiara, D., & Novianti, D. (2021). Respons Pertumbuhan Tanaman Mentimun (*Cucumis Sativus* L.) Terhadap Pemberian Kompos Fermentasi Kotoran Sapi. Indobiosains, 3(1), 9-16.
[13] Priambada, M. N. (2023). Pengaruh Pemberian Pupuk SP36 dan Jarak Tanam Terhadap Produksi Benih Mentimun (*Cucumis sativus* L.) Kode KE021 (Doctoral dissertation, Politeknik Negeri Jember).
[14] Sinaj, S., Charles, R., Baux, A., Dupuis, B., Hiltbrunner, J., Levy, L., ... & Jeangros, B. (2017). fertilization of arable crops. Basics for the fertilization of agricultural crops in Switzerland (GRUD 2017); Richner, W., Sinaj, S., Eds, 1-46.
[15] Kii, F. H. A., Jannah, H., & Mirawati, B. (2018, September). Pengaruh Pupuk Guano Burung Walet Terhadap Pertumbuhan Tanaman Cabai Rawit (*Capsicumfrutescens* L.). In Prosiding Seminar Nasional Lembaga Penelitian Dan Pendidikan (LPP) Mandala (pp. 206-214).
[16] Nasruddin, I., Bayfurqon, F. M., & Rahayu, Y. S. (2021). Efektivitas Pemberian POC Kotoran Burung Walet terhadap Pertumbuhan dan Hasil Tanaman Bawang Merah (*Allium ascalonicum* L.). Ziraa'Ah Majalah Ilmiah Pertanian, 46(2), 198-210.
[17] Hidayat, W., Isroli, I., & Widiastuti, R. E. (2013). Kadar hemoglobin, hematokrit, dan eritosit burung puyuh jantan umur 0-5 minggu yang diberi tambahan kotoran walet dalam ransum. Animal Agriculture Journal, 2(1), 209-216.
[18] Yanto, D. (2019). Pengaruh Pemberian Pupuk Kotoran Burung Walet dan NPK Mutiara 16: 16: 16 Terhadap Pertumbuhan Tanaman Kenaf (*hibiscus Cannabinus* L.) (Doctoral dissertation, Universitas Islam Riau).
[19] Wang Lili, Dong Min, Zhang Lu, & Du Xiangge. (2013). Effects of organic fertilizers with different carbon-nitrogen ratios on soil microbial biomass in organic agriculture. Chinese Journal of Ecological Agriculture, *21*(9), 1073-1077.
[20] Listiawati, I. A., & Rohayeti, I. Y. (2016). Pengaruh Kotoran Walet dan Phonska terhadap Pertumbuhan dan Hasil Mentimun di Tanah Alluvial. Jurnal Sains Mahasiswa Pertanian, 5(1).
[21] Raksun, A., Japa, L., & Mertha, I. G. (2019). Aplikasi pupuk organik dan NPK untuk meningkatkan pertumbuhan vegetatif melon (*Cucumis melo* L.). Jurnal Biologi Tropis, 19(1), 19-24.
[22] Kaya, E. (2018). Pengaruh kompos jerami dan pupuk NPK terhadap N-tersedia tanah, serapan-N, pertumbuhan, dan hasil padi sawah (*Oryza Sativa* L). Agrologia, 2(1).
[23] Sastrawan, M. A., Situmeang, Y. P., & Sunadra, K. (2020). Pengaruh Dosis Pupuk Kompos Kelinci dan NPK Mutiara Terhadap Pertumbuhan dan Hasil Tanaman Mentimun (*Cucumis sativus* L.). Gema Agro, 25(2), 143-149.
[24] Mansyur, F. A. D. L. I. (2016). Tingkat Pengetahuan Petani Terhadap Dampak Negatif Penggunaan Pupuk Anorganik terhadap Produksi Padi di Desa Kalukuang Kecamatan Galesong Kabupaten Takalar.
[25] Taube, F., Schütte, J., & Kluß, C. (2013). Auswirkungen der Berücksichtigung von Gärresten auf den Anfall organischer Dünger in einer novellierten Düngeverordnung–dargestellt am Beispiel Schleswig-Holstein. Berichte über Landwirtschaft-Zeitschrift für Agrarpolitik und Landwirtschaft.
[26] Koryati, T., Purba, D. W., Surjaningsih, D. R., Herawati, J., Sagala, D., Purba, S. R., ... & Aldya, R. F. (2021). Fisiologi tumbuhan. Yayasan Kita Menulis.
[27] Siregar, H. S. (2022). Pengaruh Pertumbuhan Dan Produksi Tanaman Mentimun Jepang (*Cucumis Sativus Var Japanes*) Dengan Pemberian Kotoran Ayam Dan NPK Mutiara. Jurnal Ilmiah Mahasiswa Pertanian [JIMTANI], 2(5).
[28] Rahmi, A., & Biantary, M. P. (2014). Karakteristik sifat kimia tanah dan status kesuburan tanah lahan pekarangan dan lahan usaha tani beberapa kampung di Kabupaten Kutai Barat. Ziraa'ah Majalah Ilmiah Pertanian, 39(1), 30-36.
[29] Phawinee Ongsuwan. (2016). Organic Carbon Accumulation in Rubber Plantation Soils and Oil Palm Plantation Soils: Case Study of Tambon Municipality, Pra Buri District, Ranong Province (Doctoral dissertation, Silpakorn University).

[30] Kusumaningrum, R. (2017). Peranan Xilem Dan Floem Dalam Pertumbuhan Dan Perkembangan Tumbuhan. Jurnal Pendidikan Biologi, 123-130.
[31] Sagala, D., Ningsih, H., Koryati, T., Ramdan, E. P., Indarwati, I., Herawati, J., ... & Septariani, D. N. (2021). Dasar-Dasar Agronomi. Yayasan Kita Menulis.

DOI: https://doi.org/10.22225/aj.3.1.2023.36-47