



## PRODUCTION OF CAULIFLOWER (*Brassica oleracea* var. *Botrytis* L.) DUE TO APPLICATION OF NPK DOSES AND CONCENTRATIONS OF RABBIT LIQUID ORGANIC FERTILIZER

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### Abstract

The community's need for cauliflower commodities is increasing and greater than the rate of food production, which has the potential to increase the food crisis. The purpose of the study was to determine the production of cauliflower plants due to the application of NPK fertilizer and Rabbit Liquid Organic Fertilizer. This study used a Factorial Randomized Group Design (4x4) with 3 replications. The first factor is the dose of NPK fertilizer consisting of 0 gr/plant (M0), 5 gr/plant (M1), 6.25 gr/plant (M2), and 7.5 gr/plant (M3). The second factor is the concentration of Rabbit LOF 0 ml/L (K0), 30 ml/L (K1), 45 ml/L (K2), 60 ml/L (K3). The results of the study are: 1) There is a real interaction in the treatment of NPK fertilizer doses and concentrations of LOF Rabbit effect on total chlorophyll in the leaves; 2) The effect of NPK fertilizer dosage has a real effect on harvest index and a very real effect on plant height and number of leaves; 3) The treatment of LOF Rabbit fertilizer dosage has a significant effect on the parameters of plant height and harvest index.

**Keywords:** *Cauliflower, NPK, LOF Rabbit fertilizer, growth*

### INTRODUCTION

Cauliflower (*Brassica oleracea* var. *Botrytis* L.) is a plant that belongs to the Brassicaceae family. The flower mass part of the plant contains thiocyanate and glucosinolate which function to neutralize harmful substances in the metabolism in the liver. Cauliflower plants are included in the 17 seasonal vegetable commodities exported in 2018. The demand for cauliflower reached 384,250 tons but cauliflower production in 2018 only reached 152,122 tons. The productivity of cauliflower crops reached 204,238 tons in 2020 then decreased in 2021 by 203,385 (BPS, 2022) (BPS, 2022). The productivity of cauliflower plants has not been able to provide the needs according to the consumption of cauliflower in Indonesia which continues to increase every year. This requires efforts to increase the growth of cauliflower plants to meet the needs of the domestic market and outside Indonesia.

The increase in demand for cauliflower is greater than the rate of food production. This will increase the potential for a food crisis in the future. Cultivation of cauliflower plants in polybags can minimize land use because it can be placed in narrow areas or gardens. Plant cultivation with this technique in urban areas can increase food security and independence (Nurjasmi R., et al., 2019). This shortens food access and maintains environmental sustainability because it integrates narrow land with the application of appropriate technology. In addition to using cauliflower varieties that are suitable for the topography of the area, fertilizer application to cauliflower plants needs to be considered so that the plants can adapt and produce maximum production.

Many people use inorganic fertilizers such as NPK fertilizers to increase plant growth quickly. NPK fertilizers are also easy to obtain and more quickly absorbed than using organic fertilizers. Soil quality and productivity will be lower if the use of chemical fertilizers is carried out for a long time so that it affects the growth and quality of plant products due to residues left behind. The combination of the use of inorganic fertilizers such as NPK combined with liquid organic fertilizer (LOF) Rabbit is one of the efforts that can be done. Utilization of potential nutrients in solid and liquid rabbit manure can increase broccoli plant growth including plant height 14 - 42 DAP, number of leaves 14 - 42 DAP, and crown diameter at the age of 42 DAP (Manik F., et al., 2021). The purpose of this study was to determine the production of Bunga Kol plants due to the application of NPK doses and concentrations of Rabbit LOF.

## **METHOD**

This land is located on Jalan Banyu Urip, Gempolkurung Village, Menganti Sub-district, Gresik Regency, East Java Province. The research site has regional characteristics such as a place altitude of approximately 11 meters above sea level with a land slope of 0-8%, air temperature ranging from 24 oC - 33 oC, air humidity between 65% - 96%, average wind speed of 12 - 23 km / hour, and average rainfall of 22.38 mm per day. The type of research was experimental using a 2-factorial RAK experimental design of 4 levels each with 3 replications so that there were 48 units. The first factor is the dose of NPK fertilizer consisting of 4 levels, namely 0 gr/plant, 5 gr/plant, 6.25 gr/plant, and 7.5 gr/plant. The second factor is the concentration of Rabbit LOF 0 ml/L, 30 ml/L, 45 ml/L, 60 ml/L.

Control variables in this study were preparation of planting media, seeding for 21 HSS (Days After Sowing), fertilization, planting, transplanting, watering, pruning lateral shoots, controlling pests and diseases, controlling weeds and harvesting after 58 DAP (Days After Planting). Measurement parameters that included dependent variables in the experiment included plant height 14-35 DAP, number of leaves 14-35 DAP, chlorophyll in leaves, and harvest index. Data for each parameter was then analyzed using the F test at the 5% level. If there is a difference in wararuh at each level, it will be continued with the 5% BNJ test to compare the mean values of all experimental units.

Rabbit LOF is made from the composition of 4 kg of rabbit feces, 8 L of rabbit urine, 1 kg of fish waste flour, 2.5 kg of boiler ash, 1 L of Microorganism Effectiveness 4, 1 L of molasses as molasses, and 1 L of coconut water which is put in a filter bag and soaked in 40 liters of water. All materials for making Rabbit LOF fertilizer were fermented for 21 days. Indicators of successful liquid organic fertilizer include a white layer on the surface, a distinctive smell of fermentation, no bubbles, a brown color and a stable pH ranging from 4-9. Dilution of Rabbit LOF adjusts the treatment level which is then applied by spraying. The dose of Pearl NPK fertilizer was given according to the treatment level 1 day after the application of Rabbit LOF. The application of NPK fertilizer is given in a circular manner.

## RESULTS AND DISCUSSION

### Test of Rabbit Liquid Organic Fertilizer

Laboratory test results showed that Rabbit LOF fertilizer with pH 6.1 and C-Organic 0.48% contained 0.38% N, 0.26% P, 0.54% K, 0.42% Ca, and 0.35% Mg. The parameters of C-Organic and nutrients Nitrogen, Phosphorus, Potassium, Calcium, and Magnesium in LOF Rabbit show values that do not meet the quality standards of liquid organic fertilizer according to the provisions in the Decree of the Minister of Agriculture of the Republic of Indonesia 261/KPTS/SR.310/M/42/2019. The content in LOF Rabbit fertilizer is still able to provide nutrient needs for plant growth. According to Marpaung, A. E., et al. (2019), organic fertilizers in liquid or foliar form containing essential macro and micro nutrients are mostly applied through the leaves. Foliar application of fertilizers is intended to meet the needs of nutrients that cannot be translocated from old tissues to young tissues. Therefore, symptoms of nutrient deficiency in plants will not occur in young plant organs.

### Plant Height

The results of data analysis showed that there was no significant interaction between the dose of NPK fertilizer and the concentration of Rabbit LOF on the height of cauliflower plants. The treatment of NPK fertilizer dosage and Rabbit LOF concentration as a single factor gave a significant effect on plant height. NPK fertilizer used as a treatment has a compound nutrient content including 16% Nitrogen, 16% Phosphorus, 16% Potassium, 0.5% Magnesium, and 6% Calcium. Nutrients absorbed by cauliflower plants are able to meet the needs of photosynthate formation during the photosynthesis process. The average height of cauliflower plants due to the application of NPK fertilizer doses and concentrations of Rabbit LOF is listed in Table 1.

Table 1

Average Plant Height(cm) Effect of Application Pearl NPK Dose and Rabbit LOF Concentration

Treatment	Plant Height (cm)				
	7 DAP	14 DAP	21 DAP	28 DAP	35 DAP
<b>NPK Dosage</b>					
M0 (0 gram)	7,21	9,20 a	11,22 a	13,08 a	16,02 a
M1 (5 gram)	7,46	9,42 ab	11,56 ab	13,64 ab	16,49 ab
M1 (6,25 gram)	7,51	9,60 ab	11,92 b	13,90 b	16,92 b
M3 (7,5 gram)	7,43	9,70 b	11,89 b	14,28 b	17,29 b
BNJ 5%	tn	0,47	0,52	0,78	0,89
<b>LOF of Rabbit Concentration</b>					
K0 (0 ml/L)	7,40	9,24 a	11,39 a	13,24 a	16,21 a
K1 (30 ml/L)	7,29	9,40 ab	11,54 ab	13,64 ab	16,45 ab
K2 (45 ml/L)	7,38	9,50 ab	11,73 ab	13,91 ab	16,86 ab
K3 (60 ml/L)	7,54	9,78 b	11,93 b	14,11 b	17,20 b
BNJ 5%	tn	0,47	0,52	0,78	0,89

Description : If the results of the 5% BNJ further test produce the same letter following the numbers in the column, it shows no significant difference; DAP : Days After Planting, tn : not significantly different

The treatment of NPK fertilizer dose at the M3 level (7.5 gr/plant) was able to give the effect of plant height which was significantly different at the age of 14 DAP and very real at the age of 21 - 35 DAP. There was an increase in plant height at the M3 level treatment (7.5 gr/plant) by 7.34% compared to the control treatment at the M0 level (0 gr/plant). The photosynthate will be transported to plant organs that are actively growing as an energy source for cell division activities in the apical meristem tissue. According to Effendy, I., et al. (2020) the formation of xylem and cell enlargement in the stem organ is the primary growth that occurs in plants resulting in an increase in plant height.

The results of the analysis of variance in Table 1. showed that the effect of the single factor of Rabbit LOF concentration was not significantly different when the plants were 7 DAP. However, there is a tendency to increase the height of cauliflower plants when the concentration of cauliflower fertilizer is getting bigger. The effect of Rabbit LOF concentration as a single factor showed a significantly different effect when the plants were 14 DAP, 21 DAP, 28 DAP and 35 DAP. The highest plant height at 35 DAP due to the single factor of Rabbit LOF concentration was shown at the K3 level (60 ml/L) of 17.20 cm. However, the effect of concentration at this level was significantly different from the K0 (0 ml/L) level of 16.21 cm and not significantly different from the K1 (30 ml/L) and K2 (45 ml/L) levels of 16.45 cm and 16.86 cm, respectively.

Concentration of Rabbit LOF at K3 level of 60 ml/L showed an increase in plant height of 5.76% compared to the control treatment at K0 level (0 ml/L) which resulted in a significantly different effect. This level is able to support the maximum increase in plant height. Nutrients in Rabbit LOF that are absorbed by plants will meet the needs of photosynthate formation in the photosynthesis process. The results of photosynthesis will be transported to parts of plant organs that are actively growing as a source of energy for cell division activities in meristem tissues. Plants that are in the vegetative phase will certainly transport to cells in the meristem tissue, one of which is the apical meristem at the end of the plant stem. According to Nurrudin, A., et al. (2020), all source organs are able to produce optimal photosynthate because of the high chlorophyll content in the leaves. Plant height will affect the widening of the petiole so as to increase the crown diameter of a plant.

### **Number of Leaves**

The results of the analysis showed that the interaction effect of the dose of NPK fertilizer and the concentration of Rabbit LOF on the number of leaves of cauliflower plants did not have a real interaction. NPK fertilizer showed a significant effect while the concentration of Rabbit LOF did not show a significant effect as a single treatment factor. Increasing the dose and concentration of each factor that is getting bigger shows the number of leaves that are getting more. The effect of NPK fertilizer on the number of leaves at each level showed a real difference at the age of 21 DAP and very different at the age of 28 DAP and 35 DAP.

Table 2.  
 Average Number of Leaves (Leaflets) Effect of Application Pearl NPK Dose and Rabbit LOF Concentration

Treatment	Number of Leaves (Leaflets)				
	7 DAP	14 DAP	21 DAP	28 DAP	35 DAP
<b>NPK Dosage</b>					
M0 (0 gram)	4,24	5,82	7,26 a	9,57 a	12,10 a
M1 (5 gram)	4,36	6,06	7,57 ab	9,85 ab	12,72 ab
M1 (6,25 gram)	4,32	6,01	7,67 ab	10,29 ab	13,51 bc
M3 (7,5 gram)	4,36	6,17	8,00 b	10,78 b	14,54 c
BNJ 5%	tn	tn	0,62	0,95	1,31
<b>LOF of Rabbit Concentration</b>					
K0 (0 ml/L)	4,25	5,82	7,39	9,85	12,69
K1 (30 ml/L)	4,31	6,03	7,46	10,03	12,99
K2 (45 ml/L)	4,35	6,10	7,82	10,22	13,38
K3 (60 ml/L)	4,38	6,11	7,83	10,39	13,82
BNJ 5%	tn	tn	tn	tn	tn
Description	: If the results of the 5% BNJ further test produce the same letter following the numbers in the column, it shows no significant difference; DAP : Days After Planting, tn : not significantly different.				

The highest number of leaves on cauliflower plants at the age of 35 DAP due to the influence of a single factor of NPK fertilizer dosage was obtained at the M3 level (7.5 gr/plant) of 14.54 strands which was not significantly different from the M2 level (6.25 gr/plant) of 13.51 strands and very significantly different from the M0 (0 gr/plant) and M1 (5 gr/plant) levels which were 12.10 strands and 12.72 strands respectively. Increased plant height is followed by an increase in the number of leaves on cauliflower because the primordia of cauliflower plant leaves grow located on the stem books. The average number of plant leaves on cauliflower due to the application of NPK fertilizer doses and concentrations of Rabbit LOF is listed in Table 2.

The highest number of leaves on cauliflower plants at the age of 35 DAP due to the influence of a single factor of Rabbit LOF concentration was obtained by the K3 (60 ml/L) level of 13.82 leaves. Even so, the effect of concentration at that level was not significantly different from the concentration of Rabbit LOF fertilizer at levels K0 (0 ml/L), K1 (30 ml/L), and K2 (45 ml/L) which were 12.69 strands, 12.99 strands, and 13.38 strands, respectively. The results of the analysis in Table 2. also show that the effect of the single factor of Rabbit LOF concentration is not significantly different at each plant age, but there is a tendency to increase the number of leaves of cauliflower plants when the concentration of cauliflower fertilizer is getting bigger.

The application between the dose of NPK fertilizer and the concentration of Rabbit LOF gives an influence on the number of leaves at different plant ages. This occurs due to differences in energy use in the distribution of photosynthate to plant parts. The formation of new leaves is determined by the number of cells and the enlargement of cell size in tissues that are influenced by nutrients absorbed by plant roots. The number of leaves formed in plants determines the ability to produce

photosynthate during the photosynthesis process. According to Kurniawati, R., et al. (2022), the element nitrogen is an element that plays a role in the precursor of chlorophyll formation. Nitrogen is a nutrient required for the formation of amino acids during the metabolic process. Amino acids have a role as promoters and catalysts to synthesize various enzymes in plant metabolic processes to stimulate the growth of vegetative organs.

### Chlorophyll in Leaves

The results of the analysis showed that there was a very significant difference interaction due to the application of the dose of NPK fertilizer and the concentration of Rabbit LOF on total chlorophyll in the leaves of cauliflower plants. The doses of NPK fertilizer and the concentration of LOF Rabbit as a single factor showed a significantly different effect on total chlorophyll in the leaves of cauliflower plants. Some treatment combinations were able to produce the highest total chlorophyll with responses that were not significantly different from other treatment combinations at lower NPK fertilizer dosage levels. The dose of NPK fertilizer and the concentration of Rabbit LOF showed a very significantly different interaction effect on chlorophyll parameters.

Chlorophyll parameters need to be tested because chlorophyll plays an important role in the photosynthesis process. According to Ermavitalini, D., et al. (2019), the element nitrogen is an element that plays a role in the precursor of chlorophyll formation. Nitrogen from all treatment combinations of NPK fertilizer and Rabbit LOF is absorbed by plants in the form of nitrate which will then be reduced to ammonium with the help of the enzyme nitrate reductase. Ammonium and amino acids combine through the biosynthesis process of glutamate and glutamine. Amino acids are then arranged to form structural proteins such as chloroplasts through the process of transcription and translation. Chlorophyll is one of the pigments in chloroplast cells. Chlorophyll affects the final result of plant growth and development, namely the mass weight of cauliflower which determines the yield power of the plant. Data on the average total chlorophyll of cauliflower plant leaves due to the effect of NPK fertilizer doses and concentrations of Rabbit LOF are listed in Table 3.

Table 3. Average Klorofil Effect of Application Pearl NPK Dose and Rabbit LOF Concentration

Treatment	Average Chlorophyll (mg/L)							
	K0		K1		K2		K3	
M0	30,92	a	33,18	bc	34,55	cde	35,64	ef
M1	32,57	ab	33,91	bcd	35,98	ef	38,93	g
M1	33,53	bc	35,56	def	36,43	f	39,36	g
M3	34,59	cde	35,76	ef	38,54	g	39,65	g
BNJ 5%	M = 0,62		K = 0,62				MK = 1,70	

Description : If the results of the 5% BNJ further test produce the same letter following the numbers in the column, it shows no significant difference

The combination of 7.5 gr/plant NPK fertilizer dose and 60 ml/L Rabbit LOF concentration (M3K3) showed the highest chlorophyll content of 39.65 mg/L. Based on the results of analysis and further tests, the M3K3 treatment combination is followed by the same letter as the combination of 5

gr/plant NPK fertilizer dose and 60 ml/L Rabbit LOF concentration (M1K3). The M1K3 treatment combination produced a chlorophyll content of 38.93 mg/L. This shows that the reduction of NPK dose from M3 to M1 level shows chlorophyll content that is not significantly different when combined with the concentration of LOF Rabbit at K3 level. Therefore, plants with the M1K3 combination treatment will show the same high production potential as plants that receive the M3K3 combination treatment and are more efficient in using NPK fertilizer.

### Harvest Index

The results of the analysis showed a response that did not interact significantly due to the dose of NPK fertilizer and the concentration of Rabbit LOF on the harvest index of cauliflower plants. The treatment of NPK fertilizer dosage and Rabbit LOF concentration as a single factor showed a significantly different effect on the harvest index of cauliflower plants. Increasing the dose and concentration of each factor showed a greater harvest index value. The average harvest index value of cauliflower due to the application of NPK fertilizer dosage and concentration of LOF Rabbit is listed in Table 4.

Table 4. Average Harvest Index Effect of Application Pearl NPK Dose and Rabbit LOF Concentration

Treatment	Harvest Index		
NPK Dosage			
M0 (0 gram)	0,38	a	
M1 (5 gram)	0,44	ab	
M1 (6,25 gram)	0,47	b	
M3 (7,5 gram)	0,50	b	
BNJ 5%	0,07		
LOF Kelinci Concentration			
K0 (0 ml/L)	0,42	a	
K1 (30 ml/L)	0,43	ab	
K2 (45 ml/L)	0,45	ab	
K3 (60 ml/L)	0,49	b	
BNT 5%	0,07		
Description	: DAP (Days After Planting), tn (not significantly different); if the results of the 5% BNT further test produce the same letter following the numbers in the column, it shows no significant difference.		

The need for adequate nutrients causes the assimilate to be translocated to adjust the productive parts of the plant at each phase of growth and development in cauliflower plants. The results of photosynthesis, namely assimilate, will be used to form biomass in each part of the cauliflower plant organs such as leaves, roots, stems and flower masses. According to Kustiani, E., et al. (2021), the distribution of accumulation in each part of the plant organs is shown in the harvest index parameter. The highest harvest index in cauliflower plants due to the effect of a single factor of NPK fertilizer dose was obtained by the M3 treatment (7.5 gr/plant) of 0.50 and based on the results of the 5% BNJ

further test showed an effect that was not significantly different from the M1 treatment (5 gr/plant) of 0.44 and M2 (6.25 gr/plant) of 0.48. The M3 level is able to provide growth and development in plants so that the treatment level produces a high harvest index.

The concentration of Rabbit LOF singly showed a significantly different effect on the harvest index value of cauliflower plants. The concentration level of K3 treatment (60 ml/L) showed the highest harvest index value of 0.49. This value shows the ratio of photosynthate that is mostly translocated to the generative organs such as the mass of cauliflower. A high harvest index value will cause a high yield. These conditions indicate that cauliflower plants produce high flower mass weight with maximum vegetative and generative growth characteristics. According to Pambudi D. R., et al. (2020), the translocation of photosynthate from leaves to all productive parts of the plant is influenced by the availability of potassium elements absorbed by plants.

## CONCLUSION

The treatment of NPK fertilizer dosage of 7.5 grams/plant (M3) had a significant effect on the harvest index parameter; and had a very significant effect on the parameters of plant height and number of leaves. The treatment of 60 ml/L Rabbit LOF Concentration (K3) significantly affected the parameters of plant height and harvest index. There was a real interaction in the combination treatment, namely M3K3 with a dose of 7.5 gr/plant NPK and a concentration of 60 ml/L Rabbit LOF on the parameters of total chlorophyll content in the leaves. The combination treatment of M1K3 gave the same good growth and production parameters as M3K3. The application of the combined treatment of 5 gr/plant NPK dose and 60 ml/L LOF Rabbit (M1K3) is more efficient and able to produce high production.

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