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Application of MKP Fertilizer (Mono Kalium Phospate) And Solid Organic Fertilizer Rabbit on the Growth and Production of Chilli (Capsicum Frutescens L.)

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capsicum frutescens;
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Abstract

This study aims to obtain the formulation of Mono Potassium Phosphate (MKP) fertilizer and fermented rabbit solid manure at the most appropriate dose for the growth and production of chili plants. This research is a factorial experiment with a randomized block block design (RAK) with 2 factors being tried. In the first factor, MKP fertilizer consists of 3 levels: M 1 = 2 g.l-1 water, M 2 = 4 g.l-1 water, M 3 = 6 g.l-1 water,. The second factor is the dose of rabbit solid fertilizer with 3 levels: P 1 = 10 tons ha-1, P 2 = 20 tons ha-1, P 3 = 30 tons ha-1. The interaction between the application of MKP fertilizer (M) and fermented rabbit solid manure (P) had no significant effect (P□0.05) on all observed variables. The highest production per hectare of MKP fertilizer treatment was obtained at a dose of 6 g.l-1 water of 6.32 tons, significantly different from doses of 2 g.l-1 water and 4 g.l-1 water with a value of 5.36 tons and 5.43 tons, respectively. The treatment of rabbit solid fertilizer dose of 30 tons ha-1 gave the highest value in production per hectare, namely 6.10 tons which was significantly different at a dose of 10 tons ha-1 with a value of 5.45 tons and not significantly different at a dose of 20 tons ha-1 with value 5.56 tons.

Contents

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1 Introduction

Chili is one type of horticultural plant that is very important for the life of the Indonesian people. It is proven that from year to year market demand is still high when conditions are normal. Currently, the availability of chili in the market is still influenced by many things, including low production levels, environmental conditions in production centers and natural disasters, increasing demand. The high demand for chili in the community where its availability in the market has not been able to meet demand, both for large chili (Capsicum annuum L) and small chili (Capsicum frutescens L) provides an opportunity to meet this demand through increased application of plant cultivation technology (Zhu et al., 2005; Sanatombi & Sharma, 2007). One of the application of cultivation techniques is through fertilization which can be sourced from organic and inorganic materials. The many kinds of inorganic fertilizers in the market cause the selection of fertilizers for fertilizing plants to grow and produce high yields must be appropriate. Fertilizers generally contain nutrients N, P and K and are needed by plants. Sobir & Siregar (2014), state that the main nutrients that must be available for plant growth and development are elements of N, P, K. Inorganic fertilizers will be able to provide faster availability when compared to organic fertilizers in an effort to increase production, one of which is MKP fertilizer. (Mono Potassium Phosphate). Patricia (2020), stated that the Phosphate (P) content of 52% and Potassium (K) as much as 34% in MKP fertilizer has the potential to be given to chili plants. With the benefits provided by MKP fertilizer, it encourages farmers to tend to use high doses. Inappropriate selection of the type, timing and method of application of inorganic fertilizers will have an impact on the physical, chemical and biological properties of the soil which are less favorable. Excessive use of inorganic fertilizers will have a negative impact on crop productivity, damage the soil and have an unfavorable impact on the environment if carried out continuously. Giving organic fertilizer is one of the efforts that can be done so that soil damage can be reduced. The Warmadewa University Strategic Plan with an ecotourism-minded vision must be supported by mastery and appropriate technology in the agricultural sector, including the use of MKP fertilizers and solid organic fertilizers (Gupta et al., 2022; El-Shabasy et al., 2019).

The number of types of solid organic fertilizers on the market causes the distribution of chili plants to contain nutrients that can contribute to the soil. Kusuma et al. (2016) stated that organic matter is useful as a nutrient provider for plants that can increase production and is also useful in improving the physical, chemical and biological properties of the soil. Rabbit droppings, one of the sources of organic fertilizer from rabbit cultivation, will generate solid waste and if it is not treated it will pollute the environment. Rabbit manure is one source that can be used as solid organic fertilizer and if the fermentation process is carried out it will be a source of nutrients for plants. Sajimin et al. (2005), stated that rabbit manure is very potential to be used as organic fertilizer because it contains higher nutrients than other livestock manure raw materials, namely C/N: (10–12%), P (2,20–2, 76%), K (1.86%), and Ca (2.08%). Provision of solid rabbit fertilizer with the right dose must be efficient and effective. Solid rabbit manure, which contains high levels of nutrients when compared to other manures, may not necessarily respond well to chili plants (Rodríguez-Calzada et al., 2019; Schweiggert et al., 2006).

The response will be different if the type of solid rabbit fertilizer given has not been fermented and has been fermented. Sitompul et al. (2014), stated that the content of nutrients such as N, P, and K contained in rabbit manure was quite high. Nitrogen is the main nutrient for plant growth, which is generally needed for the formation or growth of plant vegetative parts such as leaves, stems and roots. Phosphorus plays a role in various physiological processes in plants such as photosynthesis and respiration. Potassium plays a role in the activity of various enzymes that are essential in photosynthetic reactions. By applying a dose of solid organic fertilizer, rabbits will be able to make a positive contribution to MKP fertilizer in maintaining environmental balance (Muhammad et al., 2021; Ma et al., 2020). From the explanation above, the problem formulation is

obtained 1). How does MKP fertilizer play a role in the right dose., 2). How does rabbit solid organic fertilizer play a role at the right dose, 3). How does chili plant respond to the interaction of the right combination of MKP fertilizer and rabbit solid organic fertilizer on the growth and production of chili plants (Thyagaraju, 2016; Lakra & Kumar, 2016).

2 Methodology

This research is a field experiment located in Subak Rapuan Mas Ubud, Gianyar which takes place from January to August 2022. This study is a factorial experiment with a Basic Randomized Block Design (RAK) with 2 factors being tried. In the first factor, MKP fertilizer consists of 3 levels: M 1 = 2 g.l-1 water, M2 = 4 g.l-1 water, M 3 = 6 g.l-1 water. The second factor is the dose of rabbit solid fertilizer with 3 levels: P 1 = 10 tons ha-1, P 2 = 20 tons ha-1, P 3 = 30 tons ha-1. From this experiment, 9 combination treatments will be obtained and will be repeated 3 times so that a total of 27 combination treatments will be obtained. MKP fertilizer treatment was given with kocor 1 week after planting and fermented rabbit solid fertilizer was given 1 week before planting along with tillage. Plant maintenance includes watering, weeding and controlling pests and diseases. Harvesting is done in stages according to harvest criteria. The variables observed were plant height, number of leaves, number of flowers, number of fruit, wet and dry weight of fruit, wet and dry weight of stover, production per hectare. The data were statistically analyzed using diversity analysis (Yániz et al., 2005; Fernández-Rodríguez et al., 2021).

3 Results and Discussions

The results of statistical analysis on the variables observed in this study and the results of the significance of "Application of MKP Fertilizer (Mono Potassium Phosphate) and Rabbit Solid Organic Fertilizer on the Growth and Production of Chili Plants *(Capsicum frutescens L.)*" and their interactions (M x P) are presented in the table 1.

Table 1
Significance "Application of MKP Fertilizer (Mono Potassium Phosphate) and Rabbit Solid Organic Fertilizer on the Growth and Production of Chili Plants (Capsicum frutescens L.)

No	Variabel	Treatment		
		MKP Fertilizer (M)	Rabbit Solid Fertilizer (P)	Interaction (M x P)
1	Maximum plant height (cm)	ns	ns	ns
2	Maximum number of leaves per plant (strands)	**	ns	ns
3	Number of flowers per plant (bud)	**	ns	ns
4	Number of fruit per plant (fruit)	**	*	ns
5	Fresh weight of fruit per plant (g)	**	*	ns
6	Oven dry weight of fruit per plant (g)	ns	ns	ns
7	Fresh weight of stover per plant (g)	ns	ns	ns
8	Dry weight of oven stove per plant (g)	ns	ns	ns
9	Production per hectare (tons)	**	**	ns

Information: ns = no significant effect (P≥0.05)
** = very significant effect (P<0.01)
* = significant effect (P<0.05)

Table 1 shows that the interaction between the application of MKP fertilizer (M) and fermented rabbit solid manure (P) had no significant effect (P0.05) on all observed variables. Treatment with additional MKP fertilizer had a very significant effect (P<0.01) on the variables of maximum number of leaves, number of flowers formed, number of fruit per plant, fresh weight of fruit per plant and production per hectare. The treatment of giving rabbit manure had a significant effect (P<0.05) on the variable number of fruit per plant, fresh weight of fruit per plant and a very significant effect (P<0.01) on the variable production per hectare.

Table 2
Average maximum plant height, maximum number of leaves per plant, number of flowers per plant, number of fruit per plant, fresh weight of fruit per plant in the treatment of MKP (M) and rabbit solid fertilizer (P)

Treatment	Plant height (cm)	Number of leaves per plant (strands)	Number of flowers per plant (bud)	Number of fruit per plant (fruit)	Fresh weight of fruit per plant (g)
MKP Fertilizer					
M_1	58.34 a	130.00 a	58.55 a	43,61 a	134.07 a
M_2	57.60 a	140.05 a	74.83 b	46,94 a	135.77 a
M_3	58.67 a	166.55 b	81.05 b	54,89 b	157.94 b
LSD 5%	_-	18.72	14.79	4.79	14.39
Rabbit Solid Fertilizer					
P_1	56.76 a	142.33 a	68.50 a	46,72 a	134.07 a
P_2	57.60 a	144.27 a	68.16 a	46,89 a	135.77 a
P_3	60.25 a	150.00 a	77.77 a	51,83 b	157.94 b
LSD5%	-	-	-	4,79	14.39

Description: The average value followed by the same letter in the treatment and column the same means that it is not significantly different at the 5% LSD test level

Table 3
The average oven-dry weight of fruit per plant, fresh weight of stover per plant, oven-dry weight of stover per plant, production per hectare in the treatment of MKP fertilizer (M) and rabbit solid fertilizer (P)

Treatment	Oven dry weight of fruit per plant (g)	Fresh weight of stover per plant (g)	Dry weight of oven stove per plant (g)	Production per hectare (Tons)
MKP Fertilizer				
M_1	33.41 a	501.11 a	140.04 a	5.36 a
M_2	37.62 a	451.22 a	132.62 a	5.43 a
M_3	38.42 a	372.63 a	108.13 a	6.31 b
LSD 5%	-	-	-	0.58
Rabbit Solid Fertilizer				
P_1	35.53 a	415.47 a	110.22 a	5.45 a
P_2	35.49 a	392.45 a	116.83 a	5.56 ab
P_3	38.43 a	517.04 a	153.74 a	6.10 b
LSD 5%	-	-	-	0.58

Description: The average value followed by the same letter in the treatment and column the same means that it is not significantly different at the 5% LSD test level

The MKP fertilizer treatment of 6 g.l-1 water (M3) gave the highest production per hectare of 6.32 tons or an increase of 17.72% when compared to the lowest application of 2 g.l-1 water (M1) which was 5.36 tons (Table 3). The increase in production per hectare in the M3 treatment was supported by the number of fruits (r=0.974**), fresh fruit weight (r=1.000**) (Table 4). The highest number of harvested fruit per plant and fresh weight of fruit planted was obtained in the treatment of 54.89 fruit, 157.94 g or an increase of 25.87% and 17.80% when compared to M1 of 43.61 fruit and 134.7 g (Table 3). 2). The increase in the number of harvested fruits per plant in M3 was supported by the increase in the number of flowers formed (r=0.757*), the number of leaves (r=0.979**)(Table 4). The highest number of flowers per plant was obtained in the M3 treatment, which was 81.06 buds, an increase of 38.42% when compared to M1 which was 58.56 buds. Aminudin research (2017) found that MKP had an effect on the number of leaves, number of branches, flowers into chili fruit at a dose of 4.5 g liter-1 with the best combination with a spacing of 60 x 50cm. The higher number of flowers will be able to support the increase in the number of fruit formed per plant in M3 (r=0.885**) which is the highest 54.89 fruit, an increase of 25.87% when compared to M1 which is 43.61 fruit **) (Table 2). The high number of flowers and the number of harvested fruits were closely related to the higher number of leaves on M3 which was 166.56 strands formed per plant, an increase of 28.12% and 18.92% when compared to M1 and M2 (Table 2). In this study, it was found that the application of MKP fertilizer with increasing concentration given by watering the soil could increase the number of leaves formed. With the increasing number of leaves on plants due to the role of the content of MKP fertilizer elements, it will support increasing photosynthetic activity because the water status in plant tissue is getting better so that the photosynthate that will be produced is increasing.

MKP with a high enough K content if the K element can be absorbed by plants properly will be able to hold more water. Gardner et al. (1991) stated that plants with sufficient K only lose a little water because K increases the osmotic potential and has a positive effect on stomatal closure. Rahman (2014), stated that the provision of K nutrients in chili plants causes the process of opening and closing leaf stomata to run optimally because the process is controlled by the concentration of K in cells around the stomata. Elemental K acts as a regulator of plant physiological processes such as photosynthesis, accumulation, translocation, transport of carbohydrates, opening and closing of stomata, or regulating the distribution of water in tissues and cells. The results of Pangaribuan et al. (2017) stated that the application of KNO3 fertilizer at a dose of 132 kg ha-1 gave the best results for the best growth, production and absorption of potassium. Photosynthate produced will be able to accumulate into more fruit causing chili plants to produce higher as well. Nurwanto & Sulistyaningsih (2017), found that the single application of potassium fertilizer as much as 2.7 g/plant got the best treatment in determining the fruit quality of cayenne pepper plants. Octaviany & Fuskhah (2020), obtained from the results of his research that the addition of ZK and KNO3 elements at 240 kg K2O/ha has been able to increase the relative growth rate. The higher the fertilizer dose, the higher the tuber's potassium absorption and the slower the tuber formation time.

Table 4
Correlation coefficient values between variables (r) due to the effect of MKP fertilizer dose (M)

	1	2	3	4	5	6	7	8	9
1	1								
2	0.529ns	1							
3	0.050ns	0.874**	1						
4	0.510ns	1.000**	0.885**	1					
5	0.691ns	0.979**	0.757*	0.974**	1				
6	-0.071ns	0.809*	0.993**	0.822*	0.672ns	1			
7	-0.418ns	-0.992**	-0.928**	-0.995**	-0.946**	-0.877*	1		
8	-0.567ns	-0.999**	-0.851*	-0.998**	-0.987**	-0.782*	0.985**	1	
9	0.691ns	0.979**	0.757*	0.974**	1.000**	0.672ns	-0.946**	-0.987**	1
	r(0.05;7;7)=0.754				r(0.01;7;7)=0.874				

Table 5
Correlation coefficient values between variables (r) due to the effect of rabbit solid organic fertilizer dose (P)

	1	2	3	4	5	6	7	8	9
1	1								
2	1.000**	1							
3	0.966**	0.962**	1						
4	0.980**	0.976**	0.998**	1					
5	0.997**	0.996**	0.982**	0.992**	1				
6	0.971**	0.967**	1.000**	0.999**	0.986**	1			
7	0.919**	0.913**	0.990**	0.979**	0.945**	0.987**	1		
8	0.996**	0.994**	0.985**	0.994**	1.000**	0.988**	0.951**	1	
9	0.997**	0.996**	0.982**	0.992**	1.000**	0.986**	0.945**	1.000**	1
	r(0.05;7;7)=0.754				r(0.01;7;7)=0.874				

Information:
1. Plant height (cm), 2. Number of leaves (strands) , 3. Number of flowers formed per plant (bud)
4. Number of fruits formed per plant (fruit), 5. Fresh weight of fruit per plant (g) ,
6. Oven dry weight of fruit per plant (g), 7. Fresh weight of stover per plant (g)
8. Dry weight of oven stove per plant (g), 9. Production per hectare (tons)

The high P content in MKP has a positive impact on the photosynthetic process as indicated by the increase in chili production at higher doses. This is supported by the opinion of Novizan (2002) that phosphorus plays a role in various physiological processes in plants such as photosynthesis and respiration and Potassium plays a role in the activity of various enzymes that are essential in photosynthetic reactions. Liferdi (2010) also stated that phosphorus is needed by plants for the formation of cells in growing root and shoot tissues and for strengthening stems, so that they do not easily fall in natural ecosystems. The application of Mono Potassium Phosphate (MKP) fertilizer from the results of Sopian (2021) research on shallots showed that the treatment of liquid fertilizer had an effect on plant height, number of tubers and tuber weight. Susilawati (2019), stated that the amount of phosphorus (P) in plants was less than nitrogen and potassium. However, in reality, phosphorus is considered the key to the survival of every plant. It was further stated that the function of phosphorus is the formation of flowers, fruits, and seeds; albumin formation; cell division; supports nitrogen performance to accelerate fruit ripening; root development; strengthen the stem; improve overall crop quality; carbohydrate metabolism; form nucleoproteins to construct RNA and DNA; store and transfer energy such as ATP; increase plant resistance to disease

In the treatment of rabbit solid fertilizer (P), the highest production per hectare was obtained at a dose of 30 tons ha-1 treatment, which was 6.10 tons and an increase of 11.92% when compared to P1 which was 5.45 tons (Table 3). The increase in production per hectare in the P3 treatment was supported by an increase in the number of fruit (r=0.992**) and fruit weight per plant (r=1.000**) (Table 5), which was the highest at 51.83 fruit and 152.54 g increased by 10.94 % and 11.96% compared to P1 which was 46.72 pieces and 136.25 g (Table 2). The increasing number of fruits at P3 dose was supported by plant height (r=0.980**), number of leaves(r=0.976**), number of flowers (r=0.998**), fresh weight of stover (r=0.979**), oven-dry weight of the stove (0.994**) (Table 5). The weight per plant increased supported by plant height (r=0.997**), number of leaves (r=0.996**), number of flowers (r=0.982**), number of fruit (r=0.992**), fresh weight stove(r=0.945**), dry weight of stove(r=1.000**). Rabbit solid fertilizer as a source of organic fertilizer given in this study contains very high macro elements N, P, K from the analysis results, namely 2.64%, 877.69 ppm and 675.76 ppm can meet the needs of plants so that metabolism in plants can run well. Sari (2011), mentions that manure that is applied regularly to the soil will contain more organic matter and be able to hold a lot of water so that groundwater is formed which is beneficial for plants, because it will make it easier for plant roots to absorb nutrients for growth. and its development Permatasari & Nurhidayati (2014), stated that in the vegetative and generative growth of plants, nutrients are needed, especially N, P, and K. The N element is needed for the formation of carbohydrates, proteins, fats and other organic compounds. Element P plays a role in the formation of the generative parts of plants. Provision of organic matter such as rabbit manure can

stimulate changes in plant height, stimulate the growth of the root system, and increase leaf growth and leaf number so as to increase the photosynthesis process.

The research results of Khoir (2015), found that the treatment of 100% rabbit compost + 100% NPK resulted in the highest tuber dry weight of 23.07 tons ha^{-1}, while the lowest was in the treatment without rabbit compost and without NPK of 12.26 tons ha^{-1}. Wirajaya et al. (2018), found from the results of his research that the highest fresh fruit weight was obtained in the interaction of giving rabbit manure with pruning the apical part 16 days after planting of 47.67 g and when compared with the combination of no fertilizer application and no pruning 37.80 g. an increase of 26.11%. Likewise, the results of research by Oga & Umekwe (2015), found that the role of NPK in fertilizing watermelon plants can have a significant effect on plant length, number of flowers, number of fruit and number of fruit marketed. The research of Ruminta et al. (2017), found that the results of rabbit manure treatment of 5 tons/ha gave the best independent effect on panicle length, panicle weight per clump and seed weight per plant. Meanwhile, the treatment of manure 5 tons/ha + rabbit urine 7.5 ml/plant gave the best independent effect on the yield of shedding.

4 Conclusion

From the results of this study it can be concluded as follows:

1. The application of MKP (M) fertilizer had a very significant effect (P<0.01) on the variables of maximum number of leaves, number of flowers formed, number of fruit per plant, fresh weight of fruit per plant and production per hectare. Treatment of MKP fertilizer application of 6 g l-1 water gave the highest value of 6.31 tons which was significantly different from 2 g l-1 water and 4 g l-1 water with values of 5.36 tons and 5.56 tons, respectively. on the variable production per hectare. Dosage of 6 g l-1 of water increased the production by 17.72% when compared to the treatment of 2 g l-1 of water and increased by 13.49% when compared to 4 g l-1 of water.
2. The application of rabbit manure had a significant effect (P<0.05) on the variable number of fruit per plant, fresh fruit weight per plant and had a very significant effect (P<0.01) on the variable production per hectare. The treatment of giving rabbit solid fertilizer 30 tons ha-1 gave the highest value of 6.10 tons and was not significantly different from 20 tons ha-1 of 5.56 tons and significantly different from 10 tons ha-1 with a value of 5.45 tons at production observations per hectare. The application of rabbit solid fertilizer at 30 tons ha-1 increased by 11.93% and 9.71%, respectively, when compared to 10 tons ha-1 and 20 tons ha-1.
3. There was no interaction between the application of MKP fertilizer (M) and rabbit solid fertilizer (P) on all observed parameters.

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