

Conference Paper

Study of Pruning Types and Liquid Organic Fertilizer Concentration on Growth and Yield of Pepper (*Capsicum frutescens* L.)

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ABSTRACT

This study aims to determine the best of combination treatment of pruning type and concentration of liquid organic fertilizer (LOF) on the growth and yield of pepper plants whose production is still low and has not yet achieved its production potential which can reach 20 tons/ha. The factorial study with 2 factors was arranged in a completely randomized design (CRD) which was repeated 3 times. The first factor is the type of pruning (P) which consists of 3 levels, namely: P₀ = Not pruned (control), P₁ = Pruning shoot tip, P₂ = Pruning axillary shoot, while the second factor is the concentration of LOF NASA which consists of 3 levels, namely: K₀ = 0 ml/l (control), K₁ = 2 ml/l, and K₂ = 4 ml/l. The results showed that there was a significant interaction between the combination of shoot pruning treatment and LOF NASA concentration on the number of branches and the number of productive branches. The combination of shoot trimming treatment and LOF NASA concentration of 2 ml/l water (P₁K₁) resulted in the best growth of pepper. Meanwhile, the single factor type of shoot tip pruning (P₁) and LOF NASA concentration of 2 ml/l (K₁) produced the best number of fruits and fruit weight of papper compared to other treatments.

Keywords: Concentration, fertilizer, shoot tip, pruning type, organic

Introduction

Pepper (*Capsicum frutescens*, L.) is a horticultural plant from the Solanaceae family whose fruit has a complete combination of color, taste and nutritional value, and is used as a cooking spice and medicinal ingredient (Kouassi et al., 2012). Varieties pepper with medium and high spiciness is used either in fresh or processed form, while those with low spiciness are used for the production of oleoresin or food additives (Sharma, 2008). In general, pepper contains nutrients including fat, protein, carbohydrates, calcium, phosphorus, iron, vitamins A, B1, B2, C, and alkaloid compounds such as capsaicin, oleoresin, flavanoids, and essential oils (Rodrigues & Tam, 2012). Production pepper in Indonesia from 2010 to 2014 showed an increase with a growth of around 8.36% (BPS, 2015). The increase in pepper production based on data for that year is still unable to meet the national demand for pepper so that pepper imports continue to be carried out every year because the average production is still lower than the potential production of pepper of 20 tons/ha (BPS, 2015). One of the reasons for the low production of pepper is the lack of innovation in cultivation technology and the inaccuracy in combining production factors, such as pruning and fertilizing (Saptana, 2011).

Pruning is cutting the branches or shoots of plants to avoid unwanted growth directions. The basis of pruning is closely related to reducing apical shoot dominance and efficient distribution of photosynthate for flowering and fruiting. Pruning the shoot tip (terminal shoots) affects the emergence of new shoots from the main stem as axillary shoots which will grow into main (primary) branches with the growth of many main branches which will have the potential to increase the number of flowers and

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fruit (Najwa, 2014). Pruning the shoots of pepper plants increased the average number of fruits (109.33 fruits per plant) compared to the wiwil treatment (76.67 fruits per plant).

Increasing the number of primary branches on pepper plants requires more certainty of nutrient supply. To ensure the growth and yield of pepper due to the effects of pruning, it is necessary to provide additional fertilizer, either through the soil (as basic fertilizer and secondary fertilizer) or given fertilizer through the leaves by Liquid Organic Fertilizer (LOF) (Sumiati, 1987). The type of liquid organic fertilizer that is often used is NASA which contains macro and micro nutrients, fat, protein, organic acids and growth regulators such as: Auxin, Gibberellins and Cytokinins (Istiqomah et al., 2016). Based on the research results of Yusni (2013) that a NASA LOF concentration of 2 ml/l water produced a red chili fruit weight of 2.18 tons/ha and was significantly different from a NASA LOF concentration of 1 ml/l water which only produced a fruit weight of 1.94 tons/ha.

Material and Methods

The research was conducted on agricultural land at Puspenerbal, Jl. Juanda, Sedati, Sidoarjo from April to July 2020. This research is a factorial study with 2 factors arranged using a Completely Randomized Design (CRD) and repeated 3 times. The first factor was the type of pruning (P) which consisted of 3 levels, namely: P_0 = Not pruned (control), P_1 = Pruned of shoot tip and P_2 = Pruned of axillary shoot. The second factor was the NASA LOF (Liquid Organic Fertilizer) concentration (K) which consisted of 3 levels, namely: K_0 = 0 ml/l water (control), K_1 = 2 ml/l water and K_2 = 4 ml/l water. The combination of treatments from these two factors resulted in 9 treatment combinations and was repeated 3 (three) times, so there were 27 experimental units; Each experimental unit will be observed as many as three pepper plants.



Figure 1. Not Pruning (control) (left), Shoot Tip Pruning (centre) and Shoot Axillary Pruning (right)

Observations were made on the growth and yield variables of pepper which included: plant height, stem diameter, number of branches, number of productive branches, number of fruits and fruit weight per plant.

Results and Discussion

The results of the analysis of the various combinations of pruning types and concentrations of NASA liquid organic fertilizer showed that there was a real interaction with the number of branches and the number of productive branches. Meanwhile, the single factor of pruning type and NASA LOF concentration had a significant effect on plant height, fruit number and fruit weight per plant.

The type of pruning had a significant effect on plant height at the age of 4-7 WAP (Week After Planting), while NASA LOF concentrations had a significant effect on the age of 6-12 WAP. The average value of pepper plant height affected by the type of pruning treatment and the dose of liquid organic fertilizer is presented in Table 1.

Table 1 shows that at the beginning of growth until the pepper plants flower (4 – 7 WAP), pruning shoot tip (P_1) causes the lowest plant height and is significantly different from the control and axillary

shoot pruning. However, along with the growth, at the age of 8 MST onwards the pruning treatment did not show a significant difference in the height of the pepper plants. In the treatment of NASA LOF concentrations it was shown that up to the age of 4 and 5 WAP of pepper, the treatment of NASA LOF concentrations did not show a significant difference to plant height. On the other hand, NASA LOF concentrations of up to 4 ml/l (K_2) produced the highest plant height for pepper and were significantly different than the control but not significantly different with K_1 .

Table 1. The Effect of Pruning Types and NASA LOF Concentration on the Height of Pepper Plants aged 4 - 12 WAP

Treatment	Plant Height (cm) / WAP									
	Pruning	4	5	6	7	8	9	10	11	12
P0 (Control)		15.45 b	22.07 b	27.89 b	32.18 b	46.33	52.48	56.92	60.58	72.89
P1 (Shoot Tip)		14.25 a	20.22 a	26.15 a	30.22 a	44.71	50.89	55.49	59.40	70.57
P2 (Shoot Axillary)		16.54 c	21.89 b	27.95 b	32.37 b	46.16	52.25	57.18	60.67	71.44
RDH 5%		0.99	1.43	1.63	1.83	ns	ns	ns	ns	ns
NASA LOF Concentration										
K0 (Control)		15.10	21.16	26.46 a	30.33 a	44.02 a	50.10 a	54.16 a	57.73 a	70.04 a
K1 (2 ml/l)		15.24	20.80	27.04 ab	32.10 ab	46.46 ab	52.54 ab	57.47 b	61.35 b	72.37 b
K2 4 (ml/l)		15.90	22.23	28.50 b	32.33 b	46.73 b	52.97 b	57.96 b	61.56 b	72.49 b
RDH 5%		ns	ns	1.63	1.83	2.59	2.85	3.26	3.51	2.32

Notes: The mean number followed by the same letter in the same column and treatment is not significantly different in the 5% RDH test. WAP = Week After Planting, RDH = Real Different Honest, ns = Not Significant

The results of analysis of the various combinations of pruning types and concentrations of NASA liquid organic fertilizer on the number of branches of pepper plants showed that there was a very significant interaction at the age of 8-12 MST (Table 2).

Table 2. Average number of pepper branches by the effect of a combination of types of pruning and concentration of NASA liquid organic fertilizer treatment at the age of 8-12 MST.

Treatment	Number of Branch /WAP						
	Pruning	NASA-LOF Concentration	8	9	10	11	12
P0 (control)		K0 (control)	16.56 a	16.67 a	17.11 a	17.78 ab	18.22 a
		K1 (2 ml/l)	17.33 b	17.33 ab	17.44 ab	17.67 a	18.44 ab
		K2 4 (ml/l)	18.00 c	18.00 b	18.00 b	18.33 b	18.78 b
P1 (Shoot tip)		K0 (control)	22.89 f	22.89 e	23.33 e	23.44 e	23.78 e
		K1 (2 ml/l)	27.56 h	27.56 g	27.56 g	27.89 g	28.44 g
		K2 4 (ml/l)	25.22 g	25.22 f	25.22 f	25.78 f	26.33 f
P2 (Shoot Axillary)		K0 (control)	17.00 ab	17.00 a	17.67 ab	18.00 ab	18.67 ab
		K1 (2 ml/l)	21.89 e	21.89 d	21.89 d	22.22 d	22.89 d
		K2 4 (ml/l)	19.22 d	19.33 c	19.11 c	19.78 c	19.00 c
	RDH 5%		0.67	0.71	0.64	0.60	0.38

Notes: The mean number followed by the same letter in the same column is not significantly different in the 5% RDH test. WAP = Week After Planting

In Table 2 it is shown that the combination treatment of the shoot tip pruning type with a NASA liquid organic fertilizer concentration of 2 ml/l (P_1K_1) produced the highest number of branches and was significantly different from the other treatment combinations. There was an increase in the number of pepper branches by the combination of shoot tip pruning treatment and NASA LOF concentration of 2 ml/l (P_1K_1) at 12 WAP of 56.1% compared with control (P_0K_0). Pruning apical shoots earlier (7 DAP), allowing the formation of lateral branches earlier. The results of the analysis of the various combinations treatment of pruning types and concentrations of NASA liquid organic fertilizer on the number of productive branches of pepper plants showed that there was a very significant interaction at the

age of 8-12 WAP. The average value of the number of productive branches of pepper plants by the influence of the type of pruning treatment and the concentration of NASA liquid organic fertilizer is presented in Table 3.

Table 3. Average number of productive branches of pepper by the effect of a combination of pruning types and NASA LOF concentrations at the age of 8-12 MST

Treatment		Number of Productive Branch / WAP				
Pruning	NASA LOF Concentration	8	9	10	11	12
P0 (control)	K0 (control)	12.22 ab	12.44 ab	13.56 a	14.00 a	13.89 a
	K1 (2 ml/l)	12.89 b	13.33 b	13.33 a	13.56 a	14.22 a
	K2 4 (ml/l)	12.56 ab	12.78 ab	13.00 a	13.89 a	14.33 a
P1 (Shoot tip)	K0 (control)	14.22 c	15.33 cd	16.22 b	18.11 c	18.67 c
	K1 (2 ml/l)	13.44 b	14.78 c	16.78 bc	18.00 c	19.56 d
	K2 4 (ml/l)	14.33 c	16.00 d	17.00 b	18.00 c	18.78 c
P2 (Shoot Axillary)	K0 (control)	12.11 a	12.22 a	13.33 a	13.67 a	14.11 a
	K1 (2 ml/l)	12.78 ab	13.11 b	17.22 c	18.44 c	18.82 c
	K2 4 (ml/l)	14.22 c	15.38 d	15.56 b	16.00 b	16.67 b
RDH 5%		0.68	0.71	0.87	0.76	0.63

Notes: The mean number followed by the same letter in the same column is not significantly different in the 5% RDH test. WAP = Week After Planting

Table 3 shows that the combination treatment of pruning shoots with a concentration of liquid organic fertilizer NASA 2 ml/l (P_1K_1) produced the highest number of productive branches, but was not significantly different from the combination treatment of shoot axillary pruning with a concentration of liquid organic fertilizer NASA 2 ml/l (P_2K_1). There was an increase in the number of productive branches of pepper due to the effect of the treatment combination (P_1K_1) at 12 WAP of 40.82% compared with the control (P_0K_0).

The results of analysis of the variance of combination treatments of pruning types and concentrations of NASA liquid organic fertilizer on the number of fruits harvested by pepper showed no significant interaction, while the single factor of pruning type treatment showed a very significant effect, as well as the single factor of NASA liquid organic fertilizer concentration treatment. The average value of the number of fruits harvested of pepper plants by the influence of the type of pruning treatment and the concentration of NASA liquid organic fertilizer is presented in Table 4.

Table 4. Effect of pruning type and NASA liquid organic fertilizer concentration treatment on the amount of fruit harvested pepper plants

Treatments	Number Fruits each Harvest (fruit)			Number Fruits per Plant
	I	II	III	
P0 (Control)	10.19 a	13.63 a	15.74 a	39.56 a
P1 (Shoot tip)	12.48 c	15.89 c	17.96 c	46.33 c
P2 (Shoot Axillary)	11.15 b	14.78 b	16.85 b	42.78 b
RDH 5%	0.91	1.09	1.05	1.14
Concentration LOF NASA				
K0 (Control)	10.56 a	12.96 a	16.19 a	40.70 a
K1 (2 ml/l)	11.59 b	15.15 b	17.04 ab	43.78 b
K2 4 (ml/l)	11.67 b	15.19 b	17.33 b	44.19 b
RDH 5%	0.91	1.09	1.05	1.14

Notes: The mean number followed by the same letter in the same column and treatment is not significantly different in the 5% RDH test. WAP = Week After Planting, RDH = Real Different Honest

Table 4 shows that the shoot-tip pruning treatment (P_1) produced the highest number of pepper fruits per plant and was significantly different from the other pruning types, with an increase in the number of fruits per plant of 17.11% compared to the control. Meanwhile the treatment with the concentration of liquid organic fertilizer NASA 4 ml/l (K_2) produced the highest number of pepper fruits and was significantly different from the control (K_0), but not significantly different from the treatment with the concentration of liquid organic fertilizer NASA 2 ml/l (K_1). There was an increase in the number of fruits per plant by treating the concentration of liquid organic fertilizer NASA 4 ml/l (K_2) by 8.57% compared to the control.

The results of the analysis of the combinations treatment of pruning type and NASA liquid organic fertilizer concentration on fruit weight pepper per harvest and per plant showed no significant interaction, while the pruning type treatment showed a significant effect, as well as the NASA liquid organic fertilizer concentration treatment which had a significant effect. The average value of fruit pepper weight per harvest and per plant by the effect treatment of the type of pruning and the concentration of liquid organic fertilizer is presented in Table 5.

Table 5 shows that the shoot-tip pruning treatment (P_1) produced the highest fruit weight and was significantly different from other pruning types with an increase in fruit weight per plant of 16.14% compared to the control.

Table 5. Effect of pruning type and NASA liquid organic fertilizer concentration treatment on fruit weight per pepper plant

Treatment	Fruit Weight Per Harvest (g)			Fruits Weight/ Plant
	I	II	III	
Pruning				
P0 (Control)	13.15 a	17.67 a	20.15 a	50.97 a
P1 (Shoot-Tip)	14.63 b	20.67 c	23.93 b	59.23 c
P2 (Shoot Axillary)	16.19 b	19.78 b	21.30 a	57.27 b
RDH 5%	1.12	1.40	1.71	10.68
Concentration of LOF NASA				
K0 (Control)	13.33 a	18.52 a	21.00 a	52.85 a
K1 (2 ml/l)	15.30 b	19.44 b	22.00 b	56.74 b
K2 4 (ml/l)	15.33 b	20.15 b	22.37 b	57.85 b
RDH 5%	1.12	1.40	1.71	10.68

Notes: The mean number followed by the same letter in the same column and treatment is not significantly different in the 5% RDH test. RDH = Real Different Honesty

Table 5 shows that the treatment with the concentration of liquid organic fertilizer NASA 4 ml/l (K_2) produced the highest fruit weight of cayenne pepper per plant and was significantly different from the control, but not significantly different from the treatment with the concentration of liquid organic fertilizer NASA 2 ml/l (K_1). There was an increase in fruit weight per plant by treating the concentration of liquid organic fertilizer NASA 4 ml/l (K_2) by 9.46% compared to the control. Giving NASA POC 2 ml/l can produce an increase in the number of flowers and fruit on tomato plants. This is in accordance with the results of the research Yusni (2013) found that the use of NASA LOF 2 cc/l of water showed good results on pepper fruit weight. Furthermore, the absorption of nutrients through the mouth of the leaves (stomata) runs fast, so that plant improvements can be seen quickly. Almost all of the nutrients provided by the leaves can be taken up by plants and are processed more quickly in photosynthesis and translocated quickly to the fruit as a storage for food reserves.

Conclusion

There was a significant interaction in the combination treatment of shoot pruning and NASA LOF concentration on the number of branches and the number of productive branches of pepper plants. The treatment combination shoot tip pruning and concentration liquid organic fertilizers NASA 2 ml/l

(P₁K₁) produced the highest number of branches and productive branches and was significantly different from the other treatment combinations. The single treatment of pruning shoot-tip showed the highest fruit weight per plant of pepper and increased fruit weight per plant by 16.14% compared to the control, while the NASA LOF concentration of 4 ml/l (K₂) produced the highest fruit weight per plant with an increase in fruit weight of 9.46% compared to control, but not significantly different from K₁.

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