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EFFECT OF FOLIAR FERTILIZERS AND FUNGICIDES ON PRODUCTIVITY AND RED GINGER FARMING AFFECTED BY *PHYLLOSTICTA ZINGIBERI* LEAF SPOT DISEASE

Fitria Naimatu Sadiyah[1)]; Annisa Khoiriyah[2)]; Heriyanto[3]
[1,2,3)]Politeknik Pembangunan Pertanian Yogyakarta-Magelang (Polbangtan Yoma),Kementerian Pertanian; Yogyakarta- Magelang Polytechnic in Agricultural Development, Ministry of Agriculture
Email: 1) fitrians00@gmail.com

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ABSTRACT

Phyllosticta zingiberi leaf spot disease causes leaf damage, causing low yields. Control efforts carried out by farmers have yet to yield maximum results, so effective and applicable control techniques are needed, including combining the use of fungicides and foliar fertilizers. The study aimed to determine the effective concentrations of fungicides and foliar fertilizers for controlling leaf spot disease and their effect on Red Ginger productivity and farming. The research was conducted in Argodadi Village, Sedayu District, Bantul Regency, from November 18, 2020, to August 18 2021, in a factorial manner which was arranged in a complete randomized block design consisting of 2 factors with three concentration levels, namely fungicide as much as 0 L/Ha, 6 L/Ha, 12 L /Ha and 0 L/Ha, 10 L/Ha, 20 L/Ha foliar fertilizer. The results showed that applying 6 L/Ha fungicides reduced the intensity of attacks and the percentage of plants affected by leaf spot disease by 56.03% and 65.90%, respectively. While the combination treatment of 12 L/Ha of fungicide and 20 L/Ha of foliar fertilizer was able to increase ginger productivity by increasing plant height, number of tillers, fresh ginger rhizome weight of 0.34 kg/plant and financial benefits in the farming of Rp. 49,180,916 per Ha with an R/C ratio of 1.35.

INTRODUCTION

Ginger is included in the type of rhizome, which has properties that have been studied and cultivated a lot (Gunawan & Rohadi, 2018; Triyono & Sumarmi, 2018). Ginger plants are almost cultivated in all regions in Indonesia. In 2017 the harvested area reached 10,556.01 hectares with a production of 216,586.66 tons, with 71% of this production being produced on the island of Java (BPS, 2017). Thus ginger is the commodity of choice for many farmers because it is considered profitable (Rosadi., et al., 2020 Bangun R.H.BR., 2020), but plant diseases still constrain its cultivation. According to J Merga (2021), leaf spot disease caused by the Pathogen Phyllosticta zingiberi can remove chlorophyll tissue, which can result in a decrease in yield of as much as 13% - 66% depending on the severity. Under high humidity conditions and shaded plants, the incidence and intensity of fungal attacks increase (Hartati et al., 2011). Plants under five months old are highly susceptible to leaf spot disease (Siswanto et al., 2008).

Sedayu Subdistrict, Bantul Regency has an area of 3,126 hectares, including paddy fields and 1,623 hectares of yards used to cultivate rice and secondary crops such as corn, soybeans, tomatoes and chillies. In 2017 the ginger plant area was 5.1 hectares, with productivity reaching 5.17 tons/hectare; this figure is still lower than the yield potential, which can reach 8.0 tons per hectare (Kecamatan Sedayu, 2018)

The low productivity is caused by many factors such as unfavourable weather conditions, lack of water, fertilization not according to the dosage and interference from the Plant Pest Organisms, namely grubs attack with intensity reaching (2.3%), Phyllosticta leaf spot disease (19%), Fusarium fungal wilt (3.2%) and bacterial wilt (1.6%) with sporadic attack areas reaching 1.1 hectares and difficult to control (BPP Sedayu, 2018)

Fungicides are a means in plant cultivation to control disease attacks caused by pathogenic fungi with active ingredients of synthetic chemical compounds and bio fungicides. Furthermore, research on the use of six types of fungicides for controlling anthracnose disease caused by Colletotrichum capsicum on chilli plants showed that a fungicide with the active ingredient copper oxide with a formulation concentration of 2 grams/litre of water could reduce attack intensity by 20.82% (Heriyanto, 2014)

In addition to using fungicides, disease control can be done through proper cultivation. One way of cultivation that is done is balanced fertilization. In addition to optimizing growth, applying foliar fertilizer can reduce the intensity of disease attacks through various physiological mechanisms (Hanadyo et al., 2013). Apart from looking at the effectiveness of using fungicides and foliar fertilizers in controlling leaf spot disease, it is also necessary to look at their financial feasibility. It needs to be done so that this treatment is technically feasible and financially beneficial to farmers so that the

research results can be applied. Based on the description of the problem above, the authors intend to conduct applied research entitled "The Effect of Foliar Fertilizers and Fungicides on Red Ginger Productivity and Farming in Overcoming Phyllosticta Disease".

RESEARCH METHODS

The research was conducted from November 2020 to August 2021 in Argodadi Village, Sedayu District, Bantul Regency. The research was carried out in an area of 500 m2 in yards where Phyllosticta leaf spot disease is endemic

Method of Collecting Data

This study used a factorial field trial method arranged in a completely randomized block design (RAKL) consisting of 2 factors, namely:
a.The first factor (P) was a fungicide consisting of 3 concentration levels

P0: 0 g/liter of water per 500m2 = 0 liter/Ha
P1 : 1.5 g/ liter of water per 500m2 = 6 liter/Ha
P2 : 3 g/ liter of water per 500m2 = 12 liter/Ha

b.The second factor (K) is leaf fertilizer which consists of 3 concentration levels

K0: 0 cc/ liter of water per 500m2 = 0 liter/Ha
K1 : 2.5 cc/ liter of water per 500m2 = 10 liter/Ha
K2 : 5 cc/ liter of water per 500m2 = 20 liter/Ha

So there were nine treatment combinations with four repetitions each to obtain 36 treatment plots.

Data Analysis Method

1. Data Analysis

The results of the observations were then analyzed statistically based on the research design, namely a factorial complete randomized block design; if a significant difference was obtained based on the calculated F value greater than the F table in the analysis of variance, then Duncan's multiple range test was carried out at level 0.05 (Hendriawan A et al. ., 2016) using IBM SPSS Statistics version 20 software.

2. Financial Analysis

Following Saadudin D. et al. (2017) research, Refiana F (2021) and Fadhilah. M. and Rochdiani. D., (2021)., Financial analysis of farming carried out includes costs, income and R/C ratio. In this study, the costs used will be recorded in the form of variable and total fixed costs. Then calculate the profit earned. After getting the benefits from each treatment, it can be compared to which one has

the highest R/C. The treatment with the highest R/C ratio value can be declared as the treatment with the most feasible financial value to apply.

RESULTS AND DISCUSSION

The Effect of Fungicides and Foliar Fertilizers on the Financial Yield of Ginger Plants

Before discussing costs, it is necessary to emphasize the primary data used in the calculation, such as (1) the amount of compost is 0.5 kg per hole; (2) the number of Poska NPK is 0.01 kg per hole; (3) the amount of urea 0.005 kg per hole; (4) spacing of 40x50 cm; (5) The number of beds in 1 Ha is 19, with an average area per bed of 47.70 m2; and (6) foliar fertilizer and fungicide treatment carried out for five months and carried out every two weeks with a dose of 2 tanks.

a. Cost

According to Mandry et al. (2016), farming financing is all costs incurred to finance agricultural activities. From the research that has been done, material costs consist of costs incurred to buy seeds, compost, NPK, and sacks. The details of the use of costs in red ginger farming can be seen in Table 1

Table 1. Details of Material Costs for Red Ginger Farming per Ha

Material Details	Amount	Unit	Unit Price	Cost
Seeds	37.091	Pcs	1.500	55.637.280
Compost	18.545,760	Kg	1.000	18.545.760
NPK	370,915	Kg	4.000	1.483.661
Urea	185,458	Kg	7.000	1.298.203
Bag	40	Pcs	2.000	80.000
			TOTAL	**77.044.904**

Source : Primary Data

In the table above, the highest cost was spent on buying seeds, which was 72.21%, even though judging from the quantity, it was not the largest. Then the second largest portion was used to purchase compost, which was 24.07%, but had the most significant quantity. The following material cost component is the cost of the combined treatment of two doses of fertilizer and fungicide. The details of costs can be seen in Table 2.

Table 2. Details of the Cost of Foliar Fertilizers and Fungicides

Details	Amount per Ha	Unit	Unit Price	Cost Per Dose
Foliar Fertilizer Treatment				
0 cc/L	0	Litre	60.000	-
2,5 cc/L	10	Litre	60.000	600.000
5 cc/L	20	Litre	60.000	1.200.000
Fungicide Treatment				
0 gr/L	0	L	80.000	-
1,5 gr/L	6	L	80.000	480.000
3 gr/L	12	L	80.000	960.000

Source : Primary Data

In Table 2, it can be seen that there were three combinations of treatments for foliar fertilizers with the amount per hectare, namely: 0 cc/litre, ten cc/litre, and 20 cc/litre. While the combination of fungicide treatments, there are 3 doses on a 1-hectare land area: 0 gr/litre, 6 gr/litre, and 12 gr/litre. The highest cost is when using duan fertilizer because it has the most significant quantity, 20 litres.

Table 3 Annual Depreciation Cost

Tools	Amount	Unit	Unit Price	Cost	Age Cost Economic (year)	Value Depreciation per Year
Hoe	10	Pcs	150.000	1.500.000	5	300.000
Fork	10	Pcs	100.000	1.000.000	5	200.000
Sickle	10	Pcs	20.000	200.000	4	50.000
TaIDRaulin	10	Pcs	150.000	1.500.000	2	750.000
Rope	10	Rol	4.000	40.000	1	40.000
Bucket	5	Pcs	40.000	200.000	2	100.000
Small Bucket	5	Pcs	20.000	100.000	2	50.000
Tumbu	20	Pcs	25.000	500.000	1	500.000
			Total			**1.990.000**

Source : Primary Data

In calculating farming, depreciation costs are included per year because cultivation is carried out once a year. While the cost of equipment is not included because it is not an annual plant, so it is sufficient to use only depreciation costs. The annual depreciation fee charged to cultivation costs is IDR 1,990,000

Table 4 Labor Costs

Details	Amount per Ha	Unit	Unit Price	Cost Per Dose
Till the soil and make ditches	40	HOK	80.000	3.200.000
Make Beds	40	HOK	80.000	3.200.000
Planting + application of compost	40	HOK	80.000	3.200.000
Weeding. Hoarding. And the application of chemical fertilizers.	40	HOK	80.000	3.200.000
Foliar fertilization and fungicide	40	HOK	80.000	3.200.000
Sprinkling	20	HOK	80.000	1.600.000
Harvest and post-harvest	60	HOK	80.000	4.800.000
Total				**22.400.000**

Source : Primary Data

In Table 4, you can see the details of the labour costs used to cultivate red ginger. There are seven activities carried out. However, there are activities whose implementation is combined so that the HOK value is also combined in these activities. This occurs in planting activities and compost application due to the provision of compost after the seeds are planted. The most considerable costs are in post-harvest, which is IDR 4,800,000. The implementation of 1 HOK is equivalent to 8 hours. In addition to labour costs, there are also land rental costs. The cost of renting land for 1 Ha is IDR 35,000,000.

Table 5. Total Cost Per Ha in Each Treatment Combination

Cost Per Treatment (IDR per Ha)			Foliar Fertilizer Dosage (litres/Ha)		
			0	**10**	**20**
Fungicide Dosage (liter/Ha)	**Cost per Dose**		**-**	**600.000**	**1.200.000**
	0	-	136.434.904	137.034.904	137.634.904
	6	480.000	136.914.904	137.514.904	138.114.904
	12	960.000	137.394.904	137.994.904	138.594.904

Source : Primary Data

Total costs are the sum of material costs in Table A, combined treatment material costs in Table B, annual depreciation costs in Table C, and labour costs in Table D. The highest costs are in the combination of 12 litres of fungicide doses per Ha and fertilizer and fertilizer doses leaves 20 litres per Ha. Then the second highest cost is the combination of fungicide doses of 12 litres per Ha and foliar fertilizer doses of 10 litres per Ha

b. Productivity

The highest yields were in the combination of using 20 litres of foliar fertilizer per Ha and a fungicide dose of 12 litres per Ha, which was 12.5 tons per Ha. In contrast, the smallest value of the yield is in the combination of 20 litres of foliar fertilizer per Ha and 0 litres of fungicide per Ha. The harvest value without the application of fungicide and foliar fertilizers is even more significant when compared to these results.

Table 6 Average Yield Weight Per Tree in Each Treatment Combination

Average Yield Per Tree (Kg/tree)		**Foliar Fertilizer Dosage (litres/Ha)**		
		0	**10**	**20**
Fungicide Dosage (liter/Ha)	0	0.23	0.22	0.21
	6	0.27	0.27	0.31
	12	0.31	0.33	0.34

Source : Primary Data

Table 7. Yields Per Ha (Kg) for Each Treatment Combination

Yield (Kg/Ha)		**Foliar Fertilizer Dosage (litres/Ha)**		
		0	10	20
Fungicide Dosage (liter/Ha)	0	8.376, 50	8.191, 04	7.727, 40
	6	9.860, 16	10.014, 71	11.312, 91
	12	11.405, 64	12.209, 29	12.518, 39

Source : Primary Data

Table 8. Revenue of Ginger Per Ha in Each Treatment Combination

Revenue Per Ha (IDR/Ha)		**Foliar Fertilizer Dosage (litres/Ha)**		
		0	10	20
Fungicide Dosage (liter/Ha)	0	125.647.524	122.865.660	115.911.000
	6	147.902.436	150.220.656	169.693.704
	12	171.084.636	183.139.380	187.775.820

Source : Primary Data

Ginger revenue per hectare is obtained by multiplying the yield value by the price of red ginger per kilogram. This follows the formula put forward by Soekartawi (2016). Farming profits will be low if production costs are high (Dewi and Qanti SR., 2018). The price of red ginger per kg at the time of harvest is IDR 15,000. The highest acceptance value is in using 20 litres/Ha of foliar fertilizer and 12 litres/Ha of fungicide. In comparison, the smallest acceptance value is in the combination of 20 litres/Ha of foliar fertilizer application and 0 litres/Ha of fungicide. This is proportional to the value of the crop and the costs incurred in the combination.

Table 9. Profits for Each Treatment Combination

Profit Per Ha (IDR/Ha)		Foliar Fertilizer Dosage (litres/Ha)		
		0	10	20
Fungicide Dosage (liter/Ha)	0	(10.787.380)	(14.169.244)	(21.723.904)
	6	10.987.532	12.705.752	31.578.800
	12	33.689.732	45.144.476	49.180.916

Source : Primary Data

Farming profits are obtained after knowing the costs of production, management and capital invested in the business (Misgiantoro., 2017). The benefits obtained in the combination of treatments carried out can be seen in Table 9. The greatest profit value is in using 20 litres/Ha of foliar fertilizer and 12 litres/Ha of fungicide. In comparison, the smallest profit is in the combination treatment of 20 litres/Ha and 0 litres/Ha of fungicide. It is also proportional to the yield of harvest weight, costs, and revenues. The smallest profit here is until a loss condition occurs (because it is a minus value), namely a loss of IDR 21,723,904. Loss conditions are also experienced when the fungicide is not applied.

Table 10. R/C Ratio in Feasibility Analysis of Red Ginger Farming in Each Treatment Combination

R/C per Ha		Foliar Fertilizer Dosage (litres/Ha)		
		0	10	20
Fungicide Dosage (liter/Ha)	0	0.92	0.90	0.84
	6	1.08	1.09	1.23
	12	1.25	1.33	1.35

Source : Primary Data

In analyzing the feasibility of farming, one of the factors that can be measured is the R/C ratio or the ratio between income and costs. According to Suratiyah K (2015), farming is said to be feasible if the R/C value is more than 1; if the value is less than 1, then farming is considered not feasible. In the nine treatment combinations that were carried out, there were three treatment combinations that were not feasible, namely when the fungicide dose was 0 litre/Ha, the foliar fertilizer dose was 0 litre/Ha, 10 litre/Ha, and 20 litre/Ha. At the same time, the other six treatment combinations are still of decent value. From this feasibility value, the combination that is considered the most feasible is when the dose of foliar fertilizer given is 20 litres/Ha and fungicide 12 litres/Ha. The feasibility value is 1.35, meaning that IDR. 1 costs incurred will generate revenue of IDR. 1.35.

In an effort to analyze the feasibility of red ginger farming with special treatment, namely with the addition of foliar fertilizers and fungicides, an analysis of the costs incurred during cultivation is needed. The cost components calculated include material costs, labour costs, land rental costs,

combined treatment material costs and depreciation costs. In accordance with the opinion according to Ahmad FD et al. (2012), that which is included in the cost is the value sacrificed to obtain goods or services that have more benefits in the future.

According to Purwono (2015), the production factors that affect ginger cultivation are the number of seeds, organic fertilizers, chemical fertilizers, and labour. Similar to ginger production costs which have been analyzed, the most significant percentage is the cost of seeds. However, the production costs in this study were allocated for the costs of treating foliar fertilizers and fungicides. The highest cost of fungicide and foliar fertilizer only spent 1.56% of the total production cost, namely from the treatment of 20 litres of foliar fertilizer per Ha and 12 litres of fungicide per Ha.

The highest amount of ginger received per hectare is the application of 20 litres/ha of foliar fertilizer and a fungicide dose of 12 litres/ha. This is because the weight value of the yield per tree at this dosage application is also the largest. However, according to Hapsoh., et al. (2010), the average weight of red ginger rhizome is 0.5-0.7 kg/clump, so the yield from this research can still be increased again to get even greater benefits.

The greatest profit obtained in red ginger farming is found in the treatment of 20 litres/ha of foliar fertilizer and 12 litres/ha of fungicide dose. According to Rufaidah and Erlina (2013), a new business is said to be profitable if the revenue minus costs is more than zero. In this study, only three treatments resulted in losses, namely the treatment of fungicide doses and foliar fertilizers (0.0; 0.10; 1.20) litre/Ha. That means the use of foliar fertilizers is more profitable when combined with the use of fungicide rather than applied separately.

In addition to assessing the benefits, it is also necessary to look at the feasibility of farming that has been carried out to strengthen the analysis that the treatment that has been applied does not only provide benefits in the technical field of cultivation but is also financially feasible. Farming feasibility assessment is done by looking at the value of R/C. In this study, the highest R/C value was the combined dose of 20 litres/Ha of foliar fertilizer and 12 litres/Ha of fungicide, with an R/C value of 1.35. However, this value is still relatively small when compared to the R/C value of ginger farming in Purwono's study (2015), with an R/C value of 3.72 in Karanganyar Regency, As well as research by Hidayat and Rahmat (2019), namely the R/C value (4.1) of ginger farming in South Ogan Komering Ulu Regency (OKU Selatan), South Sumatra.

CONCLUSIONS AND POLICY IMPLICATIONS

Conclusions

The application of a fungicide of 6 L/Ha was effective in reducing the attack intensity and the percentage of plants affected by leaf spot disease by 56.03% and 65.90%, respectively. While the combination treatment of 12 L/Ha of fungicide and 20 L/Ha of foliar fertilizer was able to increase ginger productivity by increasing plant height, number of tillers, fresh ginger rhizome weight of 0.34 kg/plant and financial benefits in the farming of Rp. 49,180,916 per Ha with an R/C ratio of 1.35.

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