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THE EFFECT OF VARIOUS ACTIVE INGREDIENTS OF FUNGICIDES AGAINST *Anthracnose* DISEASE (*Colletotrichum gloeosporioides*) IN CHILI PLANTS (*Capsicum annuum* L.)

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KEYWORDS
Red Chili Plants, Fungicide; Anthracnose and Colletotrichum gloeosporioides.

ABSTRACT
The numerous benefits and uses of chilies have led to a constant increase in demand as the population of Indonesia grows. Anthracnose is a disease that often affects chili peppers and is caused by the fungus *Colletotrichum gloeosporioides*. Farmers typically use fungicides to control anthracnose. Common active ingredients applied for anthracnose control include *Mancozeb*, *Chlorothalonil*, *Propineb*, and copper hydroxide. The research was conducted in the village of Ambit, Waled District, Cirebon Regency, West Java Province. The study took place over three months, from July to September 2023. The research method used a Randomized Group Design (RGD) consisting of five treatments with different active fungicide ingredients and a control (without treatment), repeated five times, resulting in 25 experimental plots. The treatments were A (*Copper hydroxide* active ingredient), B (*Mancozeb* active ingredient), C (*Chlorothalonil* active ingredient), D (*Propineb* active ingredient), E (Control /no fungicide). The fungicide concentration used was 2 ml/liter. The experimental results showed that the various active fungicide treatments had a significant effect on the intensity of anthracnose disease (*Colletotrichum gloeosporioides*) and other diseases like gemini virus. The Chlorothalonil active ingredient showed the lowest intensity of disease anthracnose when compared to the other treatments, even with other active ingredients that were tested. Fungicide treatments had a significant impact on chili yields per plot compared to the control treatment without fungicide. The Chlorothalonil active ingredient treatment yielded higher chili harvest results compared to other treatments, reaching 15.97 kg/plot or 15.97 tons/ha.

INTRODUCTION

Red chili plants are one of the important commodities in Indonesia. Its needs continue to increase along with population growth and rapid economic development. The many benefits and uses of chili cause the demand for chili always increases along with the increasing population in Indonesia (Prasetyo, 2014). The Directorate General of Horticulture of the Ministry of Agriculture (2022), reported that chili production in Indonesia from 2020 to 2021 has decreased. In 2020, national chili production was 2,772,594 tons, while in 2021 it was 2,747,018 tons. The low production of chili is suspected of pest and disease problems in plants (Warisno &; Kres Dahana, 2010). One of the important diseases that attack chili plants is *anthracnose* disease (Putro *et al.*, 2014).

Anthracnose disease is a disease that attacks the chili fruit caused by the fungus *Colletotrichum gloeosporioides.* Colletotrichum gloeosporioides *fungus is a fungus that has a cylindrical spore shape, blunt spore tip, spore size 16.1 x 5.6 um with a growing rate of 12.5 mm per day* (Su et al., 2018). Early symptoms *of anthracnose* of fruit caused by *Colletotrichum gloeosporioides* are characterized by oval, slightly watery patches, forming sunken lesions on the surface of the fruit that will develop into necrosis, and death in tissues

(Patel *et al.* 2005). Efforts that are often made by farmers to control *anthracnose* disease are by using fungicides (Protection *et al.*, 2020). Fungicides are chemical compounds that have a role in controlling plant diseases caused by fungal fungi (Hartini, 2014). Active ingredients commonly applied by farmers in the field for *anthracnose* control include *Mancozeb*, Chlorothalonil, *Propineb (*Suganda *et al. 2001), and Copper Hydroxide* (Widiastuti *et al*., *2011)*.

Mancozeb is a contact fungicide that functions to prevent fungal infections by inhibiting the germination of spores attached to the surface of plants (Djojosumarto, 2008). According to MAFF in Hajijah et al., (2022), *Chlorothalonil* is a nonsystemic fungicide that works to affect enzymes and disrupt metabolic processes, thereby inhibiting spore germination and becoming toxic to fungal membrane cells. *Propineb* is a type of active ingredient that works in contact (contact poison) (Astuti *et al., 2014), used to control fungi / fungi in fruit* (Syarifudin et al., *2021)*. Copper hydroxide is a pesticide known to effectively control *Colletotrichum sp*., which can inhibit fungal growth (Widiastuti *et al.*, 2011). Besides having a role in controlling disease, the use of unwise fungicide active ingredients can cause environmental problems (Suryanto, 2021).

This study aims to determine the interaction of several active ingredients of fungicides against *anthracnose disease (Colletotrichum gloeosporioides)* attacks on chili plants *(Capsicum annuum L.)*.

RESEARCH METHOD

This research was conducted in Ambit Village, Waled District, Cirebon Regency, West Java Province. The implementation time lasts for 3 months (July to September 2023). The method used in this study used Randomized Group Design (RGD). The study consisted of 5 treatments of various active ingredients of fungicides and controls (without fungicides) repeated 5 times so that there were 25 experimental plots. Plot size 1 m x 20 m, distance between plots (gutter width) 50 cm, Length between replicas 50 cm, using plant spacing 40 cm x 50 cm and the number of plants per plot is 48 plants. The treatment uses several fungicide and control active ingredients, with the following design:

A = Active ingredient *Copper hydroxide*
B = Active ingredient *Mancozeb*
C = Active ingredient *Chlorothalonil*
D = Active ingredient *Propineb*
E = Control (without fungicides)

Fungicides are applied by spraying using formulations according to treatment (Deden, *et al*., 2023). Fungicides active ingredients *Copper hydroxide*, *Mancozeb*, *Chlorothalonil, Propineb* are applied using a sprayer with a formulation of 2 ml / liter. Spraying is carried out on chili plants and carried out in the morning. Spraying begins at the age of 28 days after planting with a frequency of once every 1 week then the age of 35, 42, 49, 56 DAP. The observation time is carried out every 1 week after application. The observation method is carried out by calculating the intensity of disease attacks:

$$I = \frac{\sum(n\ x\ v)}{N\ x\ V}\ x\ 100\%$$

I = Intensity of disease
n = Number of plants in each attack category
v = Scale value of each attack category

V = Scale value of the highest attack category
N = Number of plants observed
The attack scale value (v) is determined as follows:
0 = no infection
1 = Attack Intensity 1-20%
2 = Attack Intensity 21-40%
3 = Attack Intensity 41-60%
4 = Attack Intensity 61-80%
5 = Attack Intensity 81-100%

Formula Phytotoxicity :

0= No poisoning , 0 – 5 % abnormal leaf shape or color, and or abnormal plant growth.
1= No poisoning , > 5 - 20 % abnormal leaf shape or color, and or abnormal plant growth.
2= No poisoning , > 20 - 50% abnormal leaf shape or color, and or abnormal plant growth.
3= No poisoning , > 50 – 75% abnormal leaf shape or color, and or abnormal plant growth.
4= No poisoning , > 75% abnormal leaf shape or color, and or abnormal plant growth until the plant dies.

RESULTS AND DISCUSSION

1. Anthracnose *Disease Attack Intensity* (%)

Based on the data from the analysis in table 1. shows that there is an effect of fungicide active ingredient treatment on the intensity of *anthracnose* disease (*Colletotrichum gloeosporioides*).

Table 1. The effect of various active ingredients of fungicides on the intensity of *anthracnose* attacks (*Colletotrichum gloeosporioides)* on red pepper plants aged 34, 41, 48, 55 dan 62 DAP (%).

Fungicide Treatment	Average Intensity of Disease Attacks (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A (*Copper hydroxide*)	1,42 ab	1,33 a	0,15 a	0,23 a	0,12 a
B *(Mankozeb)*	0,41 a	1,42 ab	2,30 ab	1,24 a	0,29 a
C *(Klorotalonil)*	0,52 a	0,36 a	0,22 a	0,31 a	0,32 a
D *(Propineb)*	1,41 ab	0,31 a	1,42 a	1,26 ab	0,14 a
E Control	2,74 b	2,58 b	3,47 b	2,27 b	1,34 b

Remarks : The average value followed by different letters in the same factor and column shows a noticeable difference in the Duncan test.

In (Table 1) shows that the average treatment using active ingredients fungicide has a significant effect when compared to control treatment. The intensity of the attack on the control is greater when compared to the treatment given the active ingredient of the fungicide. From the data above, it shows that treatment with the active ingredient *Chlorothalonil* shows the least attack intensity when compared to other control treatments. So it can be said that the active ingredient *Chlorothalonil* is more potent when compared to other active ingredients to control the intensity of *anthracnose attacks* at all observation ages (34, 41, 48, 55 and 62 DAP). It is suspected that the active ingredient *Chlorothalonil* is able to penetrate the cell wall and cell membrane owned by fungi, enter the cytoplasm and damage the cell and inhibit 50% of the growth of *Colletotrichum gloeosporioides* fungi (Hajijah *et al.*, 2022).

2. Intensity of attacks of other diseases (%)

Based on the data from the analysis (table 2) shows that there is an influence of fungicide active ingredient treatment on the intensity of other disease attacks.

Table 2. The effect of various active ingredients of fungicides against the intensity of attacks of other diseases on red pepper plants aged 34, 41, 48, 55 and 62 DAP (%)

Fungicide Treatment	Average Intensity of Other Disease Attacks (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A (*Copper hydroxide*)	0,38 a	1,63 a	0,36 a	1,07 a	1,90 ab
B *(Mankozeb)*	2,06 ab	0,81 a	1,22 ab	0,18 a	0,98 a
C *(Chlorothalonil)*	1,09 a	0,46 a	0,62 a	0,94 a	1,71 a
D *(Propineb)*	1,58 ab	0,35 a	1,23 ab	0,19 a	1,09 a
E Control	3,24 c	2,42 b	2,78 c	3,00 c	2,55 c

Remarks : The average value followed by different letters in the same factor and column shows a noticeable difference in the Duncan test.

In (Table 2) treatment A (*Copper Hydroxide*), B (*Mancozeb*), C (*Chlorothalonil*), D (*Propineb*) had a significant effect compared to the control treatment (without fungicide). The intensity of jaundice virus disease attack in the control was greater than the treatment of the active ingredient fungicide, treatment with the active ingredient *Propineb* showed the intensity of jaundice virus disease attack gave the best results when compared to other treatments at all observation ages (34, 41, 48, 55 and 62 DAP). This is suspected that *Propineb* is highly effective in suppressing yellow virus due to its ability to inhibit the germination and dispersion of fungal conidia (Tiancang *et al*, 2008).

3. Intensity of pest infestation (%)

Based on the data from the analysis (table 3) shows that there is no effect of fungicide active ingredient treatment on the intensity of pest attacks.

Table 3. The effect of various active ingredients of fungicides on the intensity of pest attacks on red pepper plants aged 34, 41, 48, 55 and 62 DAP (%)

Fungicide Treatment	Average Intensity of pest Attck (%)				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A (*Copper hydroxide*)	0,14 a	0,54 a	0,51 a	0,78 a	0,55 a
B *(Mankozeb)*	0,51 a	0,52 a	0,31 a	0,26 a	0,77 a
C *(Chlorothalonil)*	0,61 a	0,65 a	0,37 a	0,67 a	1,37 a
D *(Propineb)*	1,05 a	0,00 a	1,07 a	0,65 a	0,97 a
E Control	1,72 a	0,93 a	1,05 a	1,52 a	1,48 a

Remarks : The average value followed by the letter is the same in the factor and column and the same shows an unreal difference in the Duncan test.

In (Table 3) shows that the average treatment using active ingredients fungicides does not have a noticeable effect on the intensity of pest attacks. Pests that attack many trust plants are fruit caterpillars (*Heliothis armigera*). The absence of influence on the intensity of pest attacks is thought to be because fungicides function more to control diseases such as fungi, while fruit caterpillar pests will be more effective using insecticide active ingredients.

Insecticides are biocides designed to be toxic to groups of pest organisms (Kaimudin, Sumbono &; Istikomah, 2020).

4. Phytotoxicity

Table 4. Effect of various fungicide active ingredients against phytotoxicity in red chili plants aged 34, 41, 48, 55 and 62 DAP (%)

Fungicide Treatment	Phytotoxicity				
	34 DAP	41 DAP	48 DAP	55 DAP	62 DAP
A (*Copper hydroxide*)	0 a	0 a	0 a	0 a	0 a
B *(Mankozeb)*	0 a	0 a	0 a	0 a	0 a
C *(Chlorothalonil)*	0 a	0 a	0 a	0 a	0 a
D *(Propineb)*	0 a	0 a	0 a	0 a	0 a
E Control	0 a	0 a	0 a	0 a	0 a

Remarks : The average value followed by the letter is the same in the factor and column and the same shows an unreal difference in the Duncan test.

Based on the calculation of the results from (Table 4) it appears that there are no symptoms of poisoning (phytotoxicity) due to the application of the active ingredient fungicide to red chili. So it is concluded that the active ingredients *Mancozeb, Chlorothalonil, Propineb* and copper hydroxide are safe for chili plants at a dose of 2ml / liter. Wati *et al.*, (2021) stated that phytotoxicity is a property that shows the potential for fungicides to cause poisoning effects on plants characterized by abnormal growth after fungicide application.

5. Yiled Harvest Per Plot (Kg)

Based on the data from the analysis (table 5) shows that there is an effect of fungicide active ingredient treatment on the yield of Kg/sample plot.

Table 5. Effect of various fungicide active ingredients on crop yield harvest per plot (Kg).

Fungicide Treatment	Yiled Harvest Per Plot (Kg)
A ((*Copper hydroxide*)	14,16 b
B *(Mankozeb)*	13,08 b
C *(Chlorothalonil)*	15,97 c
D *(Propineb)*	13,47 b
E Control	10,05 a

Remarks : The average value followed by different letters in the same factor and column shows a noticeable difference in the Duncan test.

In (Table 5) shows that the yield of various kinds of fungicide active ingredients has a significant effect when compared to control treatment. The yield of the control sample is smaller when compared to the treatment given the active ingredient fungicide. From the data above, it shows that treatment with the active ingredient *Chlorothalonil* gives the highest yield, which is 15.97 kg / plot or 15.97 tons / ha compared to other active ingredients. In this case, the active ingredient *Chlorothalonil* can increase crop yields because it can control the development of fungi and prevent infection by inhibiting spore germination or fungal mycelia (Djojosumarto, 2008).

CONCLUSION

Treatment of various active ingredients of fungicides has a noticeable effect on the intensity of attacks of anthracnose disease (Colletotrichum gloeosporioides) and other diseases such as yellow virus (gemini virus). The active ingredient chlorothalonil showed the lowest intensity againts anthracnose results up to an observation age of 62 DAP when compared to other treatments even with other active ingredients tested. Fungicide treatment has a significant effect on chili yields per plot when compared to treatment without fungicide control (control). The chlorothalonil active ingredient treatment gave a higher chili yield than other treatments even when compared to all fungicide active ingredients tested, reaching 15.97 kg/plot or 15.97 tons/ha.

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