Integrated Chili Management to Control Some Major Diseases in Brebes district, Central Java, Indonesia

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Abstract

Under the sponsorship of the ACIAR-Funded on Chili Integrated Diseases Management project in Central Java, Indonesia; a preliminary participatory trial was executed to evaluate the effect of mulch and bio fungicide to control anthracnose and other important disease in Brebes. Brebes, at the north coast of Java, is one of the most important chili pepper central production in Indonesia, with its major limiting factors for marketable yield are anthracnose, virus diseases and leaf spot. Farmers have to face a difficult problems, where District of Agricultural extension also found the most difficult questions from farmers dealing with these major diseases. Goal of Brebes trial is, to answer farmer problems on diseases for their commercial chili, since chili has a high market price. The trial introduced straw mulch application plus bio-fungicide, mainly to reduce anthracnose incidence. Mulching is a main plot, whereas bio-fungicide versus synthetic chemical fungicide as sub plot treatment. Mulch utilization exhibited delayed and reduced of virus infestation on chili in the field. Percentage of virus infestation showed lower on mulch treatment than no mulch treatment, almost 50% reduced. Mulch utilization did not affect significantly different on aphid population on chili. Bio-fungicide treatment showed non significantly different as well at 38 dap-88 dap; one these virus vector known is aphid.There was no significant different among treatments against leaf spot (Cercospora). Higher yield was achieved by mulch treated plot plus bio fungicide, and good harvest time allow chili price gave benefit to farmers. Chili plants treated by the bio-fungicide showed a similar capacity to produce chili fruit, and produced higher yield than synthetic fungicide treated plots. Mulch treatment could not reduced anthracnose diseases on chili, however, application of bio-fungicide could reduce significantly different for anthracnose disease of chili fruit compared to synthetic fungicide treatment.

INTRODUCTION

In Asia, Indonesia (176,261 ha) is the second largest chili production country after China (602,503 ha) (Ali, 2006), however our chili productivity is very much lower than China (3.14 t/ha compared to 19.13 t/ha). According to Mustafa *et al.* (2006), chili production in Central Java, produced chili only about 12%, East java is 19% and the highest is, West Java 23%.

Chili pepper is one of the most important cash crops providing nutritional and financial benefits to smallholder farm in Indonesia. It enhances food palatability and also rich in Vitamin C (Ali, 2006). Primarily, chili is cultivated in Java and Sumatra. The productivity of chili (3.14 t/ha) has various constraints. Losses to pest and disease infestations (35-90%) are reported to be one of the serious problem faced by farm operators (RRA, 2007).

The availability of commercial cultivars resistant to pests and diseases are still very limited, this may cause farmers mostly rely on pesticides to control pests and diseases.

About 55-61% of Indonesian chili is produced in the Java island, whereas average yield achieved only about 2.1- 4.1 t/ha, Brebes is chili central production lowland area. The Integrated Diseases Management (IDM) project, aimed to improve chili farmers to implement the introduced technology for yield loss reduction; associated with selected disease of chili pepper in Java, which is anthracnose in Brebes.

According to RRA survey of the IDM project, conducted in 2007, synthetic chemical pesticides appeared to be the major method to control pest and disease on chili.

In lowland area mainly, beside diseases, insect problems such *Thrips parvispinus* is a notorius problem on chili (Dibiyantoro, 1994).

Mechanical control measures such as rouging was not practiced by the chili farmers. The intensity of pesticide use depends on farmers finance condition. Frequency of pesticides application varied, between twice a week to every day spraying, may cause resistance of target pests. Generally, the average application interval was 3 days and using the mixture of two up to six pesticides in a cocktail is a common practice to control pest and diseases on chili (Vos *et. al.*, 1994).

A preliminary on-farm field trial was conducted in Brebes, Central Java for a period of six months in 2008. The objective of this trial were :

1. To identify the effect of mulching in Brebes area for lowland chili production, which is not common for Brebes farmers.
2. To apply bio-pesticide as the effort of reducing chemical synthetic pesticide in controlling anthracnose disease, as well other important diseases.
3. To improve farmers participant skill and knowledge in more safety production

METHODS

Preliminary participatory trial was executed in Klampok, Brebes, Central Java, Indonesia. Chili is a relayed crop after shallots in Brebes area, when shallots were 35 days old in the field.

Split Plot Design was used in this trial with following treatment: Main Plot was straw mulch application on the chili bed that consist of 2 level ie (a) No Straw Mulch and (b) Straw Mulch; Sub Plots were bio-fungicide and synthetic fungicide application to control anthracnose diseases on chili that consist of 4 pattern levels of bio-fungicide and synthetic fungicide application ie (A) : *B. subtilis* (as bio fungicide) + *B. subtilis* + *B. subtilis* + *B. subtilis*); (B) Bion M 1/48 WP (synthetic fungicide) + *B. subtilis* + *B. subtilis* + Daconil 75 WP (synthetic fungicide) + *B. subtilis* + *B. subtilis* + Bion M 1/48 WP + *B. subtilis* + *B. subtilis* + Daconil 75 WP; (C) The pattern of fungicide application was the same as B treatment with

additional treatment with three times of micro organic nutrient application during chili plant growth; (D) Farmers culture practice with chemical fungicides.

Plant development, major insect and diseases were recorded every ten days. Diseases incidence was determined by counting number of damages caused by diseases on the fruit from the total harvested fruits of each harvesting time. Fruit was considered damaged if single lesion was found. Diseased and healthy fruit were counted to determine the percentage of the yield that was marketable in each plot. Pest and disease infestation observation include virus incidence, percentage of *Cercospora* intensity, late blight, anthracnose disease and sucking insect pest population.

RESULTS AND DISCUSSION

Performance of vegetative development is provided by Table 1 and Table 2. Seemingly mulch and bio fungicide treatments were not significantly different to plant development.

Table 1. Effect of mulch on plant height development of chili, Klampok, Brebes, Central Java, 2008

Mulch treatments	Average of Plant Height at .... Days After Planting (dap)					
	38	48	58	68	78	88
No Mulch	32,02 a	35,67 a	39,78 a	42,07 a	43,85 a	44,78 a
Mulch	32,63 a	35,92 a	38,78 a	40,19 a	42,46 a	44,04 a

Note: Means followed by the same letters in the same column are not significantly different at 5% of Duncan Multiple Range Test.

Table 2. Effect of bio fungicides on plant height development of chili, Klampok, Brebes, Central Java, 2008

Bio fungicide treatments	Average of Plant Height at .... Days After Planting (dap)					
	38	48	58	68	78	88
A	34,70 a	44,35 a	48,54 a	51,03 a	51,66 a	52,61 a
B	35,14 a	45,85 a	49,58 a	51,16 a	52,36 a	55,06 a
C	35,81 a	46,50 a	49,29 a	51,89 a	52,77 a	53,96 a
D	34,63 a	44,45 a	49,54 a	51,53 a	52,43 a	53,09 a

Note: Means followed by the same letters in the same column are not significantly different at 5% of Duncan Multiple Range Test.

Virus infection on chili was almost found at anywhere, in chili trial area in the field of Klampok (Brebes). Their symptoms was light and heavy mosaic of the leaves, narrow leaves, curling and malformation. Their growth of chili plant was abnormal and stunting. The stunting plant commonly did not produce fruits. Virus incidence of the trial was assumed there was virus introduction from neighboring field, according to aphid monitoring, that was found in the field. Mulch utilization showed significantly effect of virus incidence on chili in the field (Table 3 and Table 4). There were an interaction effect between mulch and bio fungicide

treatment on virus incidence in the field at 88 and 98 days after planting. Meaning, after virus was already exist on chili plant in the field, virus incidence would be accelerated by aphid vector on no mulch, in spite of virus incidence on mulch in combination with bio fungicide for A and C treatments, acceleration of virus incidence could be reduced significantly different. On both bio fungicide treatment (A and C) with mulch utilization, their emerge of virus incidence could be inhibited and reduced. Effect of these bio fungicide treatments assumed might triggered the immunities system of chili plant.

Table 3. Effect of mulch and bio fungicides on virus incidence of chili at 88 days after planting, Klampok, Brebes, Central Java, 2008

Mulch	Bio fungicide			
	A	B	C	D
No Mulch (NM)	39,00 a (A)	25,50 a (B)	24,00 a (B)	26,50 a (B)
Mulch (M)	15,50 b (B)	24,50 a (A)	17,00 b (B)	25,50 a (A)

Table 4. Effect of mulch and bio fungicides on virus incidence of chili at 98 days after planting, Klampok, Brebes, Central Java, 2008

Mulch	Bio fungicide			
	A	B	C	D
NM	51 a (A)	35 a (B)	35,5 a (B)	36,5 a (B)
M	23,5 b (B)	33,5 a (A)	26 b (B)	34 a (A)

It is practically impossible to identify specific chili virus in the field based on symptoms, according to ELISA test, Duriat (1989) described that viruses infecting on chili in Indonesia were PVY, CMY, TEV, TRV, TRSV, PVX, PVM and AMV. Mulch application exhibited reduction of virus infestation on chili in the field. It seem in percentage of virus infestation showed lower (15.50%) on mulch treatment than no mulch treatment (39%).

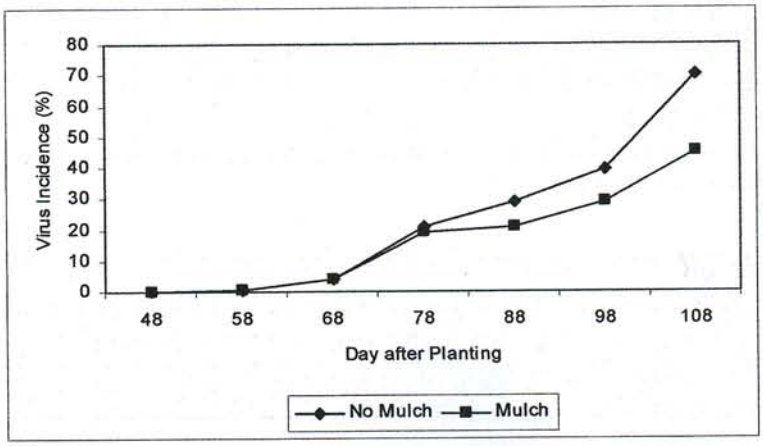

Figure 1. Percentage of virus incidence on chili trial of mulch treatments

Result of insect monitoring on chili in the field found that aphid and Thrips were pre dominantly insect pest on chili, in Brebes. Population of both insects were varied in fluctuation. Effect of mulch treatment on aphid is shown on Table 5. Aphid population on 38 and 48 days after planting was high, but after 48 days after planting, gone lower than at the early observation. Statistically test showed that mulch utilization did not affect significantly different on aphid population on chili.

Table 5. Effect of mulch on aphid population of chili, Klampok, Brebes, Central Java, 2008

Mulch treatments	Average of Aphid Population at .... Days After Planting					
	38	48	58	68	78	88
No Mulch	1,08 a	1,04 a	0,08 a	0,39 a	0,78 a	0,00 a
Mulch	1,19 a	0,81 a	0,00 a	0,38 a	0,18 a	0,00 a

Thrips population also showed variation in fluctuation on every observation. High population of Thrips occurred on 58 and 78 days after planting. According to statistic test showed that mulch effect non significantly different on Thrips population (Table 6). Practically in this trial, mulch treatment in certain case could not reduce Thrips population on chili.

Table 6. Effect of mulch on Thrips population of chili, Klampok, Brebes, Central Java, 2008

Mulch treatments	Average of Thrips Population at .... Days After Planting					
	38	48	58	68	78	88
No Mulch	0,99 a	0,79 a	2,67 a	1,87 a	2,51 a	1,57 a
Mulch	0,89 a	1,04 a	2,31 a	1,99 a	2,17 a	1,23 a

Other major disease emerged on chili was leaf spot (*Cercospora spp.)* with their intensity provided on Table 7. Leaf spot disease appeared before 38 days after planting in low percentage, the symptom was almost found on each plant. The result showed that effect of mulch and bio fungicide (Table 8.) were non significantly different on leaves spot (*Cercospora spp.*), meaning treatments could not reduce leave spot infestation of chili.

Table 7. Effect of mulch on *Cercospora* spots infestation on chili, Klampok, Brebes, Central Java, 2008

Mulch treatments	Average of Cercospora at .... Days After Planting					
	38	48	58	68	78	88
No Mulch	9,43 a	13,45 a	17,78 a	18,30 a	14,78 a	15,23 a
Mulch	8,25 a	12,87 a	14,08 a	18,05 a	16,50 a	13,40 a

Table 8. Effect of bio fungicides on *Cercospora* spots infestation on chili, Klampok, Brebes, Central Java, 2008

Bio-fungicide treatments	Average of Cercospora at .... Days After Planting					
	38	48	58	68	78	88
A	12,60 a	11,45 a	16,75 a	18,00 a	16,85 a	14,30 a
B	8,75 a	13,00 a	17,55 a	18,60 a	15,55 a	13,30 a
C	7,00 a	14,25 a	13,35 a	17,30 a	12,65 a	13,35 a
D	7,00 a	13,95 a	16,05 a	18,80 a	17,50 a	16,30 a

Other disease that appear on chili was late blight infestation, caused by *Phytophthora capcisi.* Disease intensity of late blight infestation could be seen at Table 9. Whereas bio-fungicide application (Table 10) could not prevent late blight infestation on chili in the field.

Table 9. Effect of bio fungicides on late blight (*Phytophthora*) infestation of chili, Klampok, Brebes, Central Java, 2008

Mulch treatments	Average of *Phytophthora* at .... Days After Planting					
	38	48	58	68	78	88
No Mulch	0,0 a	0,0 a	0,95 a	1,10 a	3,55 a	6,80 a
Mulch	0,0 a	0,0 a	0,75 a	1,65 a	4,55 a	7,85 a

Table 10. Effect of bio fungicides on late blight (*Phytophthora*) infestation of chili, Klampok, Brebes, Central Java, 2008

Biofungicide treatments	Average of at .... Days After Planting					
	38	48	58	68	78	88
A	0,00 a	0,00 a	1,30 a	1,60 a	4,30 a	8,15 a
B	0,00 a	0,00 a	0,60 a	0,80 a	3,70 a	7,40 a
C	0,00 a	0,00 a	0,30 a	0,80 a	2,60 a	4,65 a
D	0,00 a	0,00 a	1,10 a	2,30 a	5,60 a	9,10 a

Mulch utilization did not give the effect significantly different of total production of chili fruits (Fig.2). It was assumed that mulch utilization on chili was conducted in the rainy season. Vos *et al.* (1994) described that mulching was recommended as a component within an ICM program for chili. The overall positive effect of plastic mulch on crop health contributed to improve crop production, although effect of rice straw mulch had variable effect on crop health.

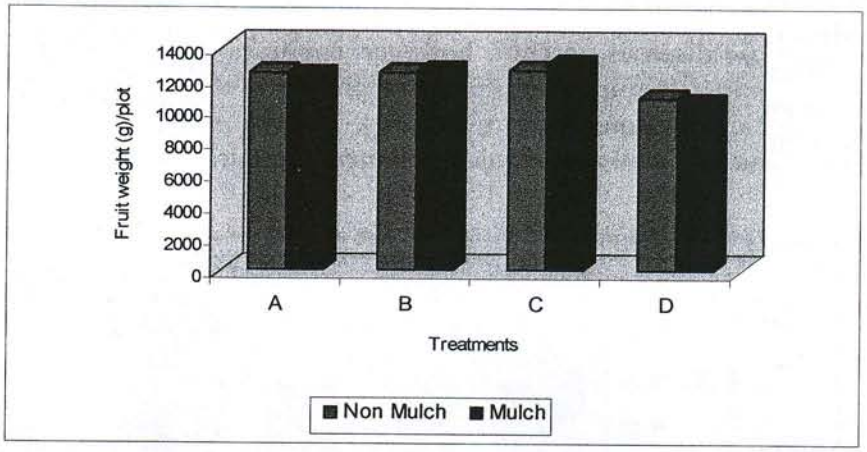

Figure 2. Total fruit weight of chili on bio fungicide and mulch treatments

Table 11. Effect of mulch on fruit harvested on chili, Klampok, Brebes, Central Java, 2008.

Treatments	Harvest of chili fruit/plot	
	Fruit number	Fruit weight (g)
No mulch	1623.60 a	12110.35 a
Mulch	1617.50 a	12177.50 a

Chili plants treated bio fungicide (A,. B and C treatments) showed the same capacity to produce chili fruit. The third of the bio fungicide treatments produced the higher production than synthetic fungicide (D treatment). So in this trial, fungicide synthetic had shown lower production of chili fruit than bio fungicide treatments.

Table 12. Effect of bio fungicides on fruit harvested on chili, Klampok, Brebes, Central Java, 2008.

Bio fungicide treatments	Harvest of chili fruit/plot	
	Fruit number	Fruit weight (g)
A	1650,5 a	12383,6 a
B	1664,0 a	12568,8 a
C	1690,7 a	12852,1 a
D	1477,0 b	10771,2 b

The case of anthracnose infestation on chili fruits, bio fungicide treatments showed lower anthracnose infestation than synthetic fungicide. The synthetic one may not reduce anthracnose infestation on chili fruit. In this case, bio fungicide spraying could be one of alternative to control anthracnose diseases on chili and could be used to prevent the anthracnose disease on chili. There was an assumption on the possibility of sensitivity modification of anthracnose fungus against synthetic fungicide that applied by the farmers on chili in the fields. The fungus of anthracnose in the field was insensitive more to fungicides sprayed by the farmer in the field.

Fruit rot caused by anthracnose was main problem disease in central production of chili. Anthracnose disease always almost found on chili every

season, in the dry as well as in a wet season in Brebes. Mulch treatment could not reduce anthracnose diseases on chili, however, application of bio fungicide could reduce significantly different for anthracnose disease of chili fruit compared with synthetic fungicide treatment (D treatment), it was shown with the higher percentage of mulch as well as no mulch treatments (Figure 3).

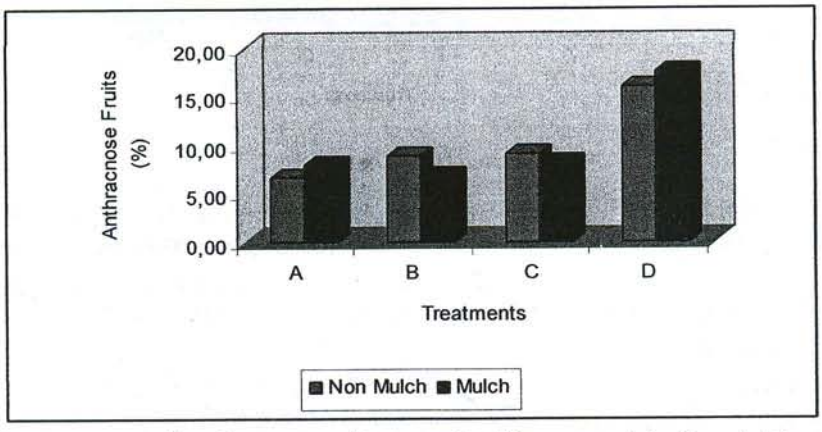

Figure 3. Percentage of anthracnose diseases incidence on bio fungicide and mulch treatments

Table 13. Effect of bio fungicides on marketable and anthracnose fruit on chili, Klampok, Brebes, Central Java, 2008.

Bio fungicide treatments	Harvest of chili fruit/plot	
	Marketable fruits (%)	Anthracnose fruits (%)
A	89,87 a	7,30 a
B	89,29 a	7,90 a
C	88,72 a	8,67 a
D	77,57 b	16,75 b

Amount of healthy fruits (marketable) were 89.87%, 89.29%, 88.72% and 77.57% respectively for A, B, C dan D treatments (Table 13). On chili plant applied bio fungicide treatment produce the higher healthy chili fruit than chili plant treated synthetic fungicide continuously. The third of biofungicide treatments produce no significant different for percentage of diseases fruits. Their reduction of fruit anthracnose diseases on chili plant treated with biofungicide was assumed that *Bacillus subtilis* (an active ingredient of biofungicide) could trigered immunity system of chili plant against anthracnose diseases on chili. This phenomenon was the same case on *Arabidopsis* to be resistant to *Pseudomonas syringae* (Ryals *et. al.*, 1996).

Chili fruits harvested also infected with fruit rot caused by *Bactrocera spp* (fruit fly). Fruit fly was also major constraint on chili. Chili fruit infected with fruit fly become rotten and it will be unmarketable.

Table 14. Effect of mulch treatment on fruit fly infestation of chili fruit, Klampok, Brebes, Central Java, 2008

Mulch treatments	Fruits infected with fruit fly (%)	Bio fungicides treatments	Fruits infected with fruit fly (%)
No mulch	3.33 a	A	2.42 a
		B	2.61 a
Mulch	2.73 a	C	2.29 a
		D	4.79 b

Mulch did not have effect to reduce fruit fly infestation on chili in the field.
The third of bio fungicide treatments (C) reduced fruit fly infestation on chili in the field. Reduction of fruit fly infestation caused by the third of bio fungicide application was significantly different compared with synthetic fungicide treatment continuously.

CONCLUSIONS

- Bio fungicide treatments A (*B. subtilis* + *B. subtilis* + *B. subtilis* + *B. subtilis)*; B (Bion + *B. subtilis* + *B. subtilis* + Daconil) and C (Bion + *B. subtilis* + *B. subtilis* + Daconil + micro organic nutrient application as much as 3 times) could reduce anthracnose disease and fruit fly infestation on chili fruit.
- Bio fungicide (A, B and C) treatments could produce higher marketable fruit weight than synthetic fungicide (D) treatment.
- Straw mulch treatment could reduce virus incidence on chili in the field.

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