Effect of medicinal plants extracts on the incidence of mosaic disease caused by *cucumber mosaic virus* and growth of chili

H Hamidson, N Damiri* and E Angraini

Department of Plant Pests and Diseases, Faculty of Agriculture, Sriwijaya University, Jalan Raya Palembang-Prabumulih, km 32, Ogan Ilir, Indralaya 30662, South Sumatra, Indonesia

*Email: nurhayatidamiri@yahoo.co.id

Abstract. This research was conducted to study the effect of the application of several extracts of medicinal plants on the incidence of mosaic disease caused by *Cucumber Mosaic Virus* infection on the chili (*Capsicum annuum* L.) plantation. A Randomized Block Design with eight treatments including control was used throughout the experiment. Treatments consisted of *Azadiracta indica* (A), *Piper bitle* (B), *Cymbopogon citrates* (C), *Curcuma domestica* (D), *Averroa bilimbi* (E), *Datura stramonium* (F), *Annona Muricata* (G) and control (H). Each treatment consist of three replications. The parameters observed were the incidence of mosaic attack due to CMV, disease severity, plant height, wet and dry weight and production (number of fruits and the weight of total fruits) each plant. Results showed that the application of medicinal plant extracts reduced the disease severity due to CMV. Extracts of *Annona muricata* and *Datura stramonium* were most effective in suppressing disease severity caused by the virus as they significantly different from control and from a number of treatment. The plants medicinal extracts were found to have increased the plant height and total weight of the plant, fruit amount and fruit weight. Extracts of *Curcuma domestica*, *Piper bitle* and *Cymbopogon citrates* were the third highest in fruit amount and weight and significantly different from the control.
Key words*: Medicinal Plants, infection, CMV, Chili.*

1. Introduction

Planting chili in Indonesia often get virus attacks that cause plants to become mosaic, dwarf and disturbed growth and development so that the production also becomes low. Previous research has found that viruses that attack on lowland chili plants are *Tobacco Mosaic Virus* (TMV) and *Cucumber Mosaic Virus* (CMV). In most planting areas chili, CMV is most dominant and obtained as a single virus that attacks chili plants [1]. CMV has a large host either in the form of wild plants or cultivated plants. There are more than 100 plant families consisting of 500 genera and 1300 plant species that may host the CMV [2] and result in 50-100% yield losses [3], [4], [5]. CMV can be transmitted to healthy plants mechanically or via vector. The CMV can result in fruit being misformed and degrading fruit quality so it is not marketable [6], [7].

The control of the disease is done by controlling its vector as well as pests in chili plants, but this way is besides not effective also gives negative impact on human health and environment. Incorrect use of fungicides in both types and doses often causes problems because they can increase production costs and can leave residuals on production [8]. [9].

Utilization of non-hazardous materials such as the use of medicinal plants has begun and been investigating. It was reported by several researchers proved that medicinal plant extracts can be used

as biocontrol agents to control various causes of plant diseases and are able to induce plant resistance [10,11,12,13,14].

2. Material and Methods

The study was conducted on lowland chili cultivation land which was known to be frequently attacked by *Cucumber Mosaic Virus* in Palembang South Sumatra. A Randomized Block Design with 8 treatments of medicinal plant extracts including control was used to conducted the experiment. The treatments consisted of *Azadiracta indica* (A), *Piper bitle* (B), *Cymbopogon citrates* (C), *Curcuma domestica* (D), *Averroa bilimbi* (E), *Datura stramonium* (F), *Annona Muricata* (G) and control (H). Each treatment consisted of 3 replications.

2.1 Preparation of host plant and medicinal plant extract.

Chili seeds were grown until two weeks old and from the seedlings were transplanted to the field that was prepared before.

2.2. The application of medicinal plants Extract.

The application of medicinal plant extracts was done two weeks after the chili seedlings were transferred to the field. The application was carried out by spraying the cultivated land according to the treatment. Spraying done once a week until the first harvest of chili plants. The CMV inoculation was allowed to occur naturally .

2.3 Plant Maintenance.

Plant maintenance includes: watering, weeding and fertilizing. Watering done 1-2 times, a day. Weeding conducted when necessary. Fertilization was done as recommended chili cultivation. Pest control other than CMV's vector was done mechanically. The parameters observed were the incidence of mosaic attack due to CMV, disease severity, plant height, wet and dry weight and production (number of fruits and the weight of total fruits yield) each plant. The analysis of variance (ANOVA), with the Duncan's Multiple Range Test (DMRT) comparison among means [15].

3. Result and Discussion

3.1. Result

3.1.1. Disease occurence. Symptoms of CMV attack begin to appear at week two after application but only on six treatment and control. Symptoms of leafy leave become light green and yellow but still light.

3.1.2. The severity of the disease. The results of analysis of the effect of medicinal plants extract application on the disease severity of CMV on chili plant at the end of the study were presented at Table 1.

Table 1 shows that *Annona muricata* and *Datura stramonium* extracts were most effective in suppressing disease severity caused by the *Cucumber Mosaic Virus* although not significantly different from *Piper bitle* plant extracts, *Cymbopogon citrates*, *Curcuma domestica* and but very different from *Azadiracta indica* and control.

Table 1. Effects of medicinal plants extract application on CMV attack severity on the chili plant in the field.

Treatment	Disease Severity (%)
Control	50.00 a
Azadiracta indica (A)	50.00 a
Piper bitle (B)	15,27 ab
Cymbopogon citrates (C)	12.50 ab
Curcuma domestica (D)	24.98 ab
Averroa bilimbi (E)	16.66 ab
Datura stramonium (F)	8.33 b
Annona muricata (G)	1.42 b

The figures followed by the same letter in the same column mean there is no significantly different at $p \leq 0.05$ DMRT.

3.1.3. Height and weight of plant. Result of analysis of the effect of plant extract application on height and the weight of the plants showed a noticeable difference. Further test results were presented at Table 2.

Table 2. Effects of medicinal plant extract application on height and weight of chili plant.

Treatment	Plant height (cm)	Weight plant (g)	
		Wet	dry
Piper bitle (B)	45.75 a	54.23 a	31.66 a
Averroa bilimbi (E)	48.33 a	50.23 ab	29.36 ab
Annona muricata (G)	49.71 a	47.90 abc	27.53 ab
Curcuma domestica (D)	50.29 a	45,05 abc	24.80 abc
Datura stramonium (F)	48.16 a	43.53 abc	22.60 abc
Cymbopogon citrates (C)	49.44 a	43.06 abc	22.53 abc
Azadiracta indica (A)	50.48 a	35.83 bc	18.33 bc
Control	35.66 b	33.93 bc	15.76 c

The figures followed by the same letter in the same column mean there is no different at $p \leq 0.05$ DMRT.

Table 2 shows that all medicinal plant extract treatments were capable of promoting the growth and development of chili plants. The height of chili plant which is given medicinal plant extract all different with the control. The largest wet weight and dry weight obtained in the *Piper bitle* extract treatment of 54.50 g and 31. 66 g was significantly different from *Azadiracta indica* and control treatment.

*3.1.4. Production***.** Highest chili production was shown by *Curcuma domestica*-treated plants with average amount of 16.33 fruits/plant and average weight of 26.17 g / plant, followed by *Piper bitle* of 15 fruit / plant with weight of 23.97 g/plant. All medicinal plant extract treatments showed a tendency to increase the production of pepper plants, but that was significantly different from the controls shown only by plants extracted by *Curcuma domestica*, *Pipper bitle* and *Cymbopogon citrates* (Table 3).

Table 3. Effect of medicinal plant extract application on chili production in the field.

Treatment	Production/plant	
	Amount of fruit	Weight of fruit (g)
Curcuma domestica (D)	16.33 a	26.17 a
Piper bitle (B)	15.00 ab	23.97 ab
Cymbopogon citrates (C)	14.67 ab	23.23 ab
Datura stramonium (F)	13.00 abc	20.70 abc
Averroa bilimbi (E)	12.67 abc	20.13 abc
Azadiracta indica (A)	11.67 abc	18.03 abc
Annona muricata (G)	7.00 bc	11.23 bc
Control	5.33 c	8.63 c

The figures followed by the same letter in the same column mean there is no different at $p \leq 0.05$ DMRT.

3.2. Discussion

Phytochemicals are non-nutrient plant chemicals that have protective or disease prevention properties. Plants produce these chemicals to protect themselves but recent research proves that many phytochemicals can protect plants against disease. According to [16] and [17], plants produce secondary metabolites of plants, tannins, saponins, steroids, alkaloids and glycosides, lignin, cyanogenic, flavonoids, phenolic in their cells. It was reported that long chain chains (C_6-C_{10}) in plant extracts have been observed to have greater antifungal properties [18].

From the results of this study, there are 3 plant extracts that have the potential to be developed as a vegetable pesticide to control mosaic disease caused by *Cucumber Mosaic Virus*. *Curcuma domestica*, although only able to suppress the severity of CMV disease 50% but increase the growth of chili plant well, this is indicated by the growth and production of chili plants. Suspected phenolic content of this extract is able to suppress the development and replication of viruses in the plant. Curcumin exhibits antibacterial, antifungal and antiviral activity due to its phenolic content. Intervention of phenolic compounds by hydrogen bonding and hydrophobic interactions with microbes can make it more dangerous [19], [20].

Turmeric phamacoligional activity is closely related to curcumonoid consisting of Curcumin (CUR) and two compounds namely demothoxy curcumin (DMC) and Bisdementhoxy cucurmin. CUR interferes with the attachment of viral cells that cause stunted spread of virus in plants. Phenols in plant products are considered potentially toxic to the growth and development of pathogens and thus reduce plant diseases [21]. Phenolic metabolism serves to protect plants from biological and environmental pressures and is therefore synthesized. In response to pathogenic pathogens such as, fungi, virus, bacteria or other pathogenic agents [22].

The number of vectors that was *Aphis gossypii* found highest in control plants and plants treated by *Azadiracta indica* was an average of 40 to 100 Aphids per leaf, while in other treatment was just unde 10 Aphids per leaf. The difference of the number of Aphids was suspected due to the environment influence or location condition, According to [23] nutrient and water are an environmental factor that is crucial because most viruses require a host metabolism active for propagation purposes. Aphids beside as a pest are also a vector for the mosaic virus such as CMV. These insect are able to attack and quikly transmit the virus from infected plants to healthy plants. This vector is capable of transmitting the virus within 5 t0 10 seconds per day and translocating to other plants less than 1 minute [24]

4. Conclusion

Results of the study showed that the application of medicinal plant extracts in this study reduced the disease severity due to CMV. Extracts of *Annona muricata* and *Datura stramonium* were most

effective in suppressing disease severity caused by the virus as they significantly different from control and from a number of treatment. The medicinal plants extracts were found to have increased the plant height and total weight of the plant, fruit amount and fruit weight. Extracts of *Curcuma domestica, Piper bitle* and *Cymbopogon citrates* were the third highest in fruit amount and weight and significantly different with control.

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