# INTEGRATED MANAGEMENT OF *CUCUMBER MOSAIC VIRUS* OF CHILLI (*CAPSICUM ANNUM* L.)

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## ABSTRACT

Rahman, M. S., Jahan, K., Islam, R., Alam, K. M., Karim, M. R. and Rahman, M. M. 2022. Integrated management of cucumber mosaic virus of chilli (*Capsicum annum*). Bangladesh J. Plant Pathol. 38(1&2): 21-26.

Cucumber mosaic virus (CMV) is one of the destructive virus disease causing serious yield and quality loss in chilli worldwide. The experiment was conducted at the research field of Plant Pathology Division, Bangladesh Agricultural Research Institute during two consecutive years to find out the effective management option against CMV of chilli. Six packages with different combinations of seed bed netting, using yellow trap, spraying of Imidacloprid, bio-neem, and paraffin oil were tested against CMV of chilli in field condition. Significant variation of disease incidence and severity was found in different treatment packages. Disease incidence ranged from 10.95 to 38.50 % and the severity varied from 0.93 to 3.50 in different treatment packages. The lowest disease incidence (10.95%) and severity (0.93) was found in treatment package I (Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap in the plot + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population by the yellow trap). The package II (Same as T1 except use Bio-Neem 0.2 % instead of Imidacloprid) also showed lower disease incidence (12%) and severity (1.10). The highest yield (12.24 t/ha) was recorded from package I followed by package II (12.00 t/ha). The reduction of disease incidence was 71.56 % in package I and 68.83 % in package II and thereby increased crop yield by 64.52% and 61.29 %. The package I and package II were considered as the effective management option on the basis of minimum disease incidence, higher yield and marginal benefit cost ratio (1: 4.64 & 1:4.06). These management packages could be used for the management of CMV disease of chilli.

**Key words**: Integrated management, cucumber mosaic virus, chilli, *capsicum annum*

## INTRODUCTION

Chilli (*Capsicum annuum* L.), belongs to the family Solanaceae is an important vegetable and spices crop having immense commercial importance. It is one of the most important crops grown worldwide and cultivated in the Indian sub-continent for vegetable, spices and industrial purposes (Kumar 2012). Chilli, particularly hot peppers, is an important crop in tropical and subtropical Asia, not only because of popular consumption but also their high market value and export potential. Due to worldwide distribution and polyphagous vectors the *Cucumber mosaic virus* (CMV) is one of the most important virus infecting vegetables worldwide (Palukaitis and Garcia-Arenal 2003). Disease, particularly those caused by viruses are considered the major constraints to economic production of peppers and yield losses ranging from 60-100 % in case of early infection (Singh and Cheema 1989, Shukor *et al*. 1989). The CMV is most abundant and appeared as a major devastating virus in the leading chilli growing regions of Himachal Pradesh in India (Biswas *et al*. 2013)).

In Bangladesh CMV is one of the most important viruses which cause serious yield losses in chilli and can reduce fruit yield up to 80% (Rahman 2008). It is spread naturally by aphid in a non-persistent manner. Plant viruses are usually very difficult to control. Spraying of chemical insecticides

is the only option available to the farmers for the management of CMV through vectors control. As the CMV is a non-persistence virus, only insecticidal spray may not control the disease effectively because of very short time is required to transmit the virus and vector is able to transmit virus before their death. Moreover, dependence on a single method is highly vulnerable and sometimes become failure to the management of CMV in chilli (Lepidot *et al.* 2001). Hence, the present study was undertaken to find out a suitable management option against *Cucumber mosaic virus* (CMV) of chilli.

## MATERIALS AND METHODS

The experiment was conducted in the research field of Plant Pathology Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during two consecutive years using randomized completely block design (RBD) with three replications. The unit plot size was 2.5 × 2.5 $m^2$. Six management packages with a control were used as treatment. The management packages were package I : Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap in the plot + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population (aphids) by the yellow trap, package II: Same as package I except spray with 0.2 % Bio-neem instead of Imidacloprid, package III: Same as package I except spray with 2% mineral oil (Paraffin oil), package IV: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + 3 sprays of Imidacloprid 0.1% at 15 days interval starting at 20 days after transplanting, package V: Same as package IV except spray with 0.2 % Bio-neem instead of Imidacloprid, package VI: Same as package IV except spray with 2% mineral oil and package VII: Untreated control. The chilli variety BARI-Marich-1 was used in this experiment. Seedlings were raised in the nursery bed. Five weeks old seedlings were transplanted in the experimental field with a spacing of 50 × 50 cm. Irrigation, drainage, weeding and other intercultural operations were done as and when required. The experimental plots were monitored regularly to observe CMV symptoms. The virus CMV was confirmed by the DAS-ELISA. The diseases incidence was calculated by using the following formula.

$$\text{Disease incidence} = \frac{\text{No. of infected plant}}{\text{Total plants in the plot}} \times 100$$

The severity of *Cucumber mosaic virus* (CMV) was determined according to Monma and Sakata (1997) based on a 0-4 scale as follows:

$$\text{Severity Index} = \frac{\Sigma(\text{Symptom index} \times \text{No. plant of sumptom index})}{\text{Total number of plants}}$$

where the symptom index was as 0 = No Symptom, 1= Mild Mosaic, 2 = Mosaic, 3 = Mosaic & deformed leaf, and 4 = Mosaic and stunted plants.

Data on fresh fruit yield (kg/plot) were recorded and finally converted into fruit yield of chilli into ton $ha^{-1}$. The data were analyzed statistically for analysis of variance (ANOVA) using MSTAT-C program and means were compared according to Duncan's Multiple Range Test (Gomez and Gomez 1984). The percent data were transformed using Arcsine transformation method before statistical analysis.

### Economic analysis

Economic analysis was performed by partial budget technique as described by Rahman *et al*. (2011) following the formulae of economic analysis. Variable Cost = Cost (Taka) that vary in different packages; Gross Return (TR) = Yield in terms of money (@ Taka 20/kg (Yield price); Gross margin = Gross Return–Variable cost; Marginal benefit = Gross margin (packages) – Gross margin (control).
The marginal benefit cost ratio (MBCR) was calculated by the following formula:

$$\text{MBCR (over control)} = \frac{\text{Marginal benefit}}{\text{Variable cost}}$$

## RESULTS AND DISCUSSION

### Incidence and severity of *Cucumber mosaic virus* (CMV) disease of chilli

The incidence and severity of *Cucumber mosaic virus* disease in different management packages varied significantly (Fig. 1). The percent disease incidence ranged from 10.95 to 38.50 % and severity varied from 0.93 to 3.50 in different treatment packages. Incidence of CMV of all the management packages was lower as compared to untreated control. The highest disease incidence (38.50%) was found in control (package VII) and the lowest incidence (10.95 %) was recorded from package I which was statistically similar to package II (12%). The incidence of CMV in other packages ranged from 21

- 29% where package III (21%) and package IV (22.50%)were statistically similar. Similarly, the highest disease severity was found in package VII (control) and significantly lower disease severity of CMV were found in all the management packages over control. The lowest severity was found in package I, which was statistically similar to package II. However, treatments involving netting seedling, 1 spray of Imidacloprid 0.1% or Bio-neem 0.2 % at 5 days before transplanting and 3 sprays of Imidacloprid or Bio-neem at 15 days interval and use sticky yellow trap (package I and package II) were found very much effective as compared to other management packages in respect of disease incidence and severity (Fig. 1). It might be due to better control of CMV vectors (aphids) in the treated plots by netting seedlings and use of sticky yellow trap in the field, the seedlings remain disease free at early stage and spray of insecticides gave better control against CMV. The CMV, an aphid born non-persistent virus, could not be controlled by only insecticides pray as CMV vector required only few seconds to transmit virus from infected to healthy plant. So, the management packages i.e. use of disease-free seedling, sticky yellow trap, and spray insecticide effectively controlled the vectors and reduced the incidence as well as severity of CMV disease in chilli.

**Fresh fruit yield of chilli**

The fruit yield of chilli (BARI Marich-1) in different management packages varied significantly (Table 1). All the management packages gave higher fruit yield of chilli over control. The highest average fresh fruit yield of 7.65 kg/plot or 12.24 t/ha was found in the management package I (Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector aphids by the yellow trap) which was statistically similar the package II (Netting seed bed + 1 spray of Bio-neem 0.2% at 5 days before transplanting + sticky yellow trap + 3 sprays of Bio-neem at 15 days' interval starting after observing the vector aphids by the yellow trap). The lowest fruit yield of 4.65 kg/plot or 7.44 t/ha was found in package VII (Untreated control). The fresh fruit yield of other management packages ranged from 5.00 kg/plot to 6.19 kg/plot or 8.00 t/ha to 9.90 t/ha.

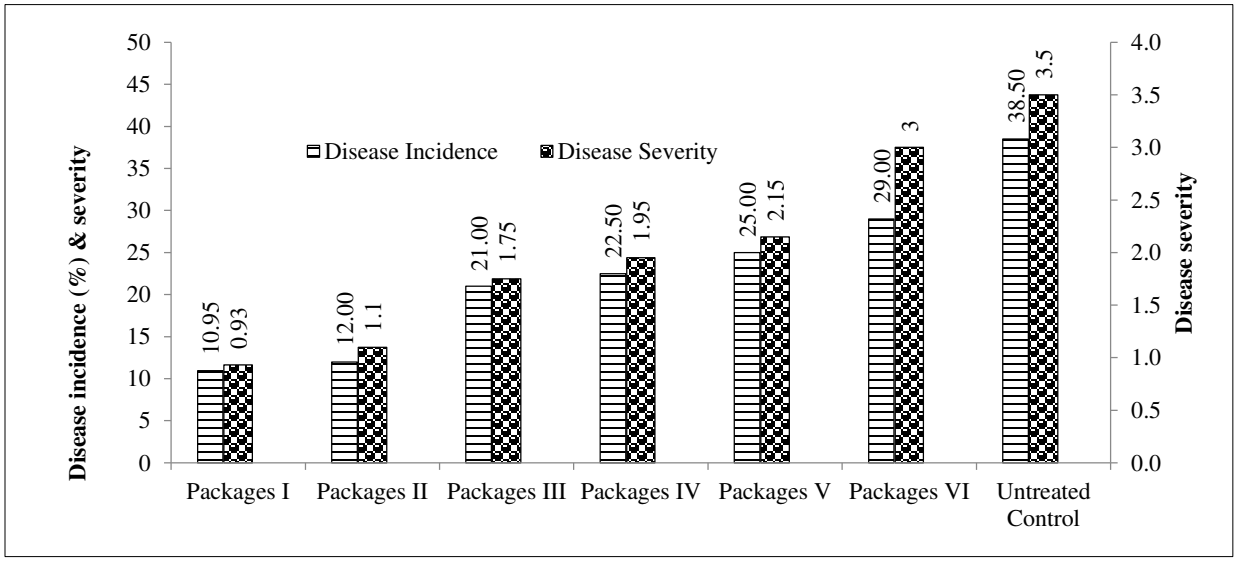


Figure 1. Effect of different management packages on the incidence and severity of CMV disease of chilli

[Package I: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population (aphids) by the yellow trap, Package II: Same as package I except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package III: Same as package I except spray with 2% mineral oil (Paraffin oil), Package IV: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + 3 sprays of Imidacloprid 0.1% at 15 days interval starting at 20 days after transplanting, Package V: Same as package IV except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package VI: Same as package IV except spray with 2% mineral oil, and Package VII: Untreated control].

All the management packages reduced the disease incidence of CMB in chilli and thereby increased fruit yield over control (Table 2). The average disease reduction ranged from 24.68% to 71.56% in different management packages. The highest reduction of disease incidence was 71.56% in management package I which was followed by management package II where disease reduction was 68.83% over control. The average increase of fresh fruit yield of chilli ranged from 7.53% to 64.52% in different management packages. The highest increase of fresh fruit yield over control was recorded as 64.52% in package I which was followed by package II (61.29%). Other management packages reduced disease incidence from 24.68 to 45.45% and increased fresh fruit yield from 7.53 to 33.06%. The average fresh fruit yield of chilli was increased in different management packages might be due to decrease of disease incidence through vector control. These findings were in conformity with the previous findings of Rahman *et al*. (2020).

Table 1. Fruit yield of chilli in different management packages in two consecutive years

| Management packages | Fresh fruit yield of chilli in two consecutive years | | | | | |
|---|---|---|---|---|---|---|
| | Fresh fruit yield (kg/plot) | | | Fresh fruit yield (t/ha) | | |
| | 1st year | 2nd year | Pooled | 1st year | 2nd year | Pooled |
| Package I | 7.70 | 7.60 | 7.65 a | 12.32 | 12.16 | 12.24 a |
| Package II | 7.20 | 7.80 | 7.50 a | 11.52 | 12.48 | 12.00 a |
| Package III | 6.05 | 6.32 | 6.19 b | 9.68 | 10.12 | 9.90 b |
| Package IV | 5.30 | 5.20 | 5.25 c | 8.48 | 8.32 | 8.40 c |
| Package V | 5.10 | 5.25 | 5.18 c | 8.18 | 8.40 | 8.29 c |
| Package VI | 4.85 | 5.15 | 5.00 c | 7.76 | 8.24 | 8.00 c |
| Package VII (Untreated Control) | 4.70 | 4.60 | 4.65 d | 7.52 | 7.36 | 7.44 d |
| CV % | | | 14.75 | | | 13.5 |

Means followed by same letters in row and column are not significantly different at 5% level by DMRT

Table 2. Effect of different treatment packages on disease reduction and fruit yield of chilli

| Treatment packages | Disease Incidence | | | Reduction of disease incidence over control (%) | Yield (t/ha) | Yield increase over control (%) |
|---|---|---|---|---|---|---|
| | 1st year | 2nd year | Pooled | | | |
| Package I | 11.00 | 10.90 | 10.95 e | 71.56 | 12.24 a | 64.52 |
| Package II | 11.50 | 12.50 | 12.00 e | 68.83 | 12.00 a | 61.29 |
| Package III | 23.00 | 19.00 | 21 d | 45.45 | 9.90 b | 33.06 |
| Package IV | 25.00 | 20.00 | 22.50 d | 41.56 | 8.40 c | 12.90 |
| Package V | 23.00 | 27.00 | 25 c | 35.06 | 8.29 c | 11.42 |
| Package VI | 27.00 | 31.00 | 29.00 b | 24.68 | 8.00 c | 07.53 |
| Package VII (Untreated Control) | 37.00 | 40.00 | 38.50 a | - | 7.44 d | - |
| CV % | | | 14.75 | | 13.5 | |

Means followed by same letters in row and column are not significantly different at 5% level by DMRT.

[Package I: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population (aphids) by the yellow trap, Package II: Same as package I except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package III: Same as package I except spray with 2% mineral oil (Paraffin oil), Package IV: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + 3 sprays of Imidacloprid 0.1% at 15 days interval starting at 20 days after transplanting, Package V: Same as package IV except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package VI: Same as package IV except spray with 2% mineral oil, and Package VII: Untreated control].

**Economic analysis**

The management packages of Cucumber Mosaic Virus (CMV) disease of chilli appreciably increased the gross return over control (Table 3 & 4). The gross return was highest in management package I (244800 Tk. $ha^{-1}$) followed by management package II (240000 Tk. $ha^{-1}$). The lowest gross return was obtained from the untreated Control (148800 Tk. $ha^{-1}$). The gross returns of other treatments ranged from 160000 to 198000 Tk. $ha^{-1}$ (Table 3). Marginal analysis pointed out that the management packages I, II & III considerably increase marginal benefit cost ratio (MBCR 4.64, 4.06 & 2.28) over control (Table 4). The highest MBCR was obtained with package I and the lowest with package VI. The results showed that additional investment of Taka 1 in package I over control had additional income of Taka 4.64 followed by package II, III & IV with Tk. 4.06, 2.28, and 1.56, respectively. The cost and return and MBCR from the economic analysis indicated that the management packages I, II, III, & IV were economically viable and maximum gain could be obtained from package I (Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector aphids by the yellow trap).

Table 3. Cost and return in different management packages of CMV disease of chilli

| Packages | *Var. Cost (Tk $ha^{-1}$) | Yield (t $ha^{-1}$) | **Gross return (Tk $ha^{-1}$) |
|---|---|---|---|
| Package I | 17000 | 12.24 | 244800 |
| Package II | 18000 | 12.00 | 240000 |
| Package III | 15000 | 9.90 | 198000 |
| Package IV | 7500 | 8.40 | 168000 |
| Package V | 8000 | 8.29 | 165800 |
| Package VI | 7000 | 8.00 | 160000 |
| Package VII (Untreated Control) | - | 7.44 | 148800 |

* Var. Cost: Cost that vary in different packages; ** Whole Sell rate of green chilli @ TK 20.00/Kg

Table 4. Marginal analysis of different management packages of CMV disease of chilli

| Packages | Gross return (Tk $ha^{-1}$) | Variable Cost (Tk $ha^{-1}$) | Gross margin (Tk $ha^{-1}$) | Marginal benefit (Tk $ha^{-1}$) | MBCR |
|---|---|---|---|---|---|
| Package I | 244800 | 17000 | 227800 | 79000 | 4.64 |
| Package II | 240000 | 18000 | 222000 | 73200 | 4.06 |
| Package III | 198000 | 15000 | 183000 | 34200 | 2.28 |
| Package IV | 168000 | 7500 | 160500 | 11700 | 1.56 |
| Package V | 165800 | 8000 | 157800 | 9000 | 1.13 |
| Package VI | 160000 | 7000 | 153000 | 4200 | 0.60 |
| Package VII (Untreated Control) | 148800 | - | 148800 | - | - |

(MBCR**:** Marginal benefit cost ratio)

[Package I: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population (aphids) by the yellow trap, Package II: Same as package I except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package III: Same as package I except spray with 2% mineral oil (Paraffin oil), Package IV: Net in seed bed + one spray of Imidacloprid 0.1% at 5 days before transplanting + 3 sprays of Imidacloprid 0.1% at 15 days interval starting at 20 days after transplanting, Package V: Same as package IV except spray with 0.2 % Bio-Neem instead of Imidacloprid, Package VI: Same as package IV except spray with 2% mineral oil, and Package VII: Untreated control].

The findings of the present investigation revealed that incidence of Cucumber mosaic virus (CMV) disease of chilli was considerably reduced by the management package, i.e. net in seed bed + one spray of Imidacloprid 0.1% or Bio-neem 0.2 % at 5 days before transplanting + Sticky yellow trap + 3 sprays of Imidacloprid 0.1% or Bio-neem 0.2 % at 15 days interval starting after observing the vector aphids by the yellow trap. The management packages I and II were considered as effective management options on the basis of reduced disease incidence, higher fruit yield and marginal benefit cost ratio. Marginal cost benefit analysis indicated that the two management packages (I & II) were economically viable and cost effective. However, these management packages could be used as effective options for management of CMV disease of chilli in Bangladesh.


## ACKNOWLEDGEMENTS

The author thankfully acknowledges the scientists and stuffs of plant pathology division, BARI for their assistance in data collection and also to SRC for supplying the seeds of BARI Marich-1.


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