

## EFFECT OF TOMATO YELLOW LEAF CURL VIRUS (TYLCV) ON PLANT GROWTH AND YIELD CONTRIBUTING CHARACTERS OF SIXTEEN TOMATO VARIETES

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### Abstract

*Tomato yellow leaf curl virus* (TYLCV) is a common disease of tomato causing severe yield reduction. The present investigation was conducted to find out the effect of TYLCV infection on plant growth, yield and yield contributing characters of sixteen selected tomato varieties under field condition. Incidence of TYLCV varied from 16.00% to 29.00% on different tomato varieties. The highest incidence was found in variety Mongol and the lowest in Salamat. On those varieties, reduction in plant height, leaf number, branch number, shoot weight and fruit yield due to infection of TYLCV ranged 35.61-60.71, 36.99-53.96, 29.10-59.66, 18.49-44.07 and 55.21-67.02%, respectively. Tropic green (42-85%) was the most affected variety. The hybrid Salamat (35-61%) and Abhiruchi-10 (10-62%) were the least affected varieties, which may be considered for cultivation.

*Key words:* TYLCV incidence, tomato, infection

### Introduction

Tomato is a widely cultivated popular vegetable crop in Bangladesh. It is a good source of vitamins and minerals (Hobson and Davies, 1971). In the country, the area of tomato cultivation was 15,000 hectares with a production of 100,000 metric tons in the year (Anonymous, 2005). *Tomato yellow leaf curl virus* (TYLCV) is one of the most severe diseases of tomatoes in

tropical and subtropical regions (Polston and Anderson, 1997; Lapidot *et al.*, 2001). The disease was first reported from Bangladesh by Akanda (1991). In many tomato growing areas, TYLCV is the limiting factor for production, both in the field and in protected screen houses (Pico *et al.*, 1996) and can cause up to 100% yield loss (Lapidot *et al.* 2001). Rashid *et al.* (2001) screened 32 varieties of tomato

against TYLCV where disease incidence varied from 3 to 100%. Farmers need resistant varieties for effective management of the disease. The most relevant evaluation of resistance level lies in the effect of TYLCV infection on yield and yield contributing characters of tomato (Lapidot *et al.*, 1997). New varieties are periodically introduced into the market. Some of them may be less susceptible to TYLCV compared to others available in the country. The present investigation was conducted to find out the effect of TYLCV infection on yield and yield contributing characters of some tomato varieties.

### Materials and Method

A total 16 tomato varieties namely Abhiruchi-01, Abhiruchi-06, Abhiruchi-10, Bankim, Chuanchu, Winner, Gautum, Mongal, BARI Tomato-2, BARI Tomato-3, BARI Tomato-9, Salamat, Tropic green, Udayan and Diamond were tested in the present investigation. The experiment was conducted in the Research and Development farm of Energy Pac Agro Limited, Gazipur.

Seeds were sown in the nursery bed at 15<sup>th</sup> October and transplanted at 9<sup>th</sup> November in 2009. Seedlings of each variety were raised in a well-drained open nursery bed. The main field was prepared following standard method and recommended doses of manure and

fertilizers were applied. After final land privation the field was divided into 48 equal plots (3 m x 2 m) maintaining plot to plot distance of 0.5 m and block to block distance of 1.0 m. Twenty five days old and apparently healthy seedlings were planted maintaining 70 cm and 0.5 m plant to plant distances. The plants of all varieties were checked every day in the morning between 9:00-11:00 is to record incidence of TYLCV. Occurrence of TYLCV infected plants were identified based on visible symptoms of the disease as described by Akanda (1991), Alam (1995) and Gupta (2000). Data on incidence of the disease was collected from seedling stage to harvesting stage. The incidence of TYLCV was expressed in percentage which was calculated on the basis of the formula shown below:

$$\frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Ten plants were randomly selected from each unit plot and samples of healthy and infected leaves were collected from those plants to determine chlorophyll content. Chlorophyll content of was determined using SPAD machine (Minolta Model-502).

At harvesting stage, data on plant growth and yield contributing characters were recorded. After final harvest, fruit yield was also recorded. All parameters of healthy and infected

plants of each variety were collected and percent reduction over healthy plants was computed using the following the formula:

% Reduction =  $\frac{A-A_i}{A} \times 100$ , where A = any parameter of healthy plant, A<sub>i</sub> = any parameter of infected plants.

The experiment was laid out following randomized complete block design with three replications. Collected data were analyzed statistically using MSTAT\_C software.

### Results and Discussion

**Incidence of TYLCV:** Infected plants showed the characteristic symptoms of the TYLCV disease as upward curling, cupping with or without marginal

chlorosis, smaller leaflets and general stunting of plants. Similar symptoms were recorded by Akanda (1999). The lowest incidence of the disease of 15% was observed on Salamat, which was statistically similar to Abhiruchi-6, Abhiruchi-10, Abhiruchi-11, Bankim, BARI Tomato-2, BARI Tomato-9 and Raksha. The highest incidence of 29% was recorded from variety Mongol which was statistically similar to Gautam and Tropic green (Figure 1). Disease incidence varied with varieties perhaps due to varying inherent potentialities against the disease.

**Reduction in plant height:** A significant variation in percent reduction of plant height was observed among the varieties due to infection with TYLCV.

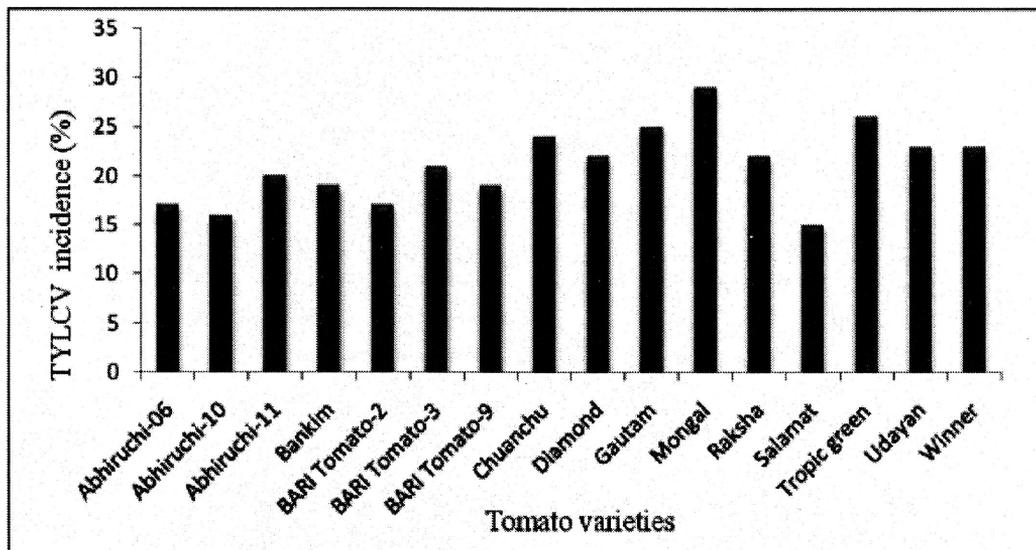


Figure 1: Incidence of TYLCV under field condition

The variation in height ranged 35.61-60.71%. The highest reduction was recorded from Gautam followed by Mongol, Chuanchu, Udayan, and Diamond. The lowest reduction in plant height was found in Salamat, which was followed by Abhiruchi-10, Bankim, Winner, Abhiruchi-11 and Abhiruchi-6 (Table 1). The variation in reduction of plant height might be due to differences in severity of virus infection and the inherent properties of the tomato varieties. Muqit (2006) observed similar variation in plant height due to TYLCV infection in tomato.

**Reduction in leaf number:** The reduction in number of leaves due to TYLCV infection ranged 36.99-53.96% on different tomato varieties. The maximum reduction in number of leaves was found in Tropic green followed by Mongol, Abhiruchi-10 and Diamond. The lowest percent reduction was found in Abhiruchi-6, which was followed by Bankim. In other varieties the reduction in leaf number per plant varied from 41.41 to 46.71 (Table 1).

**Reduction in branch number:** The reduction in number of branches per plant was reduced by 29.10-59.66% due to TYLCV infection depending on tomato varieties. Abhiruchi-10 showed the highest reduction of branch number. It was statistically similar to Winner and Mongol but significantly different

from other varieties. The lowest percent reduction of number of branch was found in BARI Tomato-2, which was statistically similar to Abhiruchi-6 and BARI Tomato-3 (Table 1).

**Reduction in fresh shoot weight:** Infection of TYLCV caused 18.49-44.07% reduction in fresh shoot weight of 16 tomato varieties. Among the variety, Diamond showed the highest reduction of fresh shoot weight followed by Winner, Salamat and Gautam. The minimum reduction was found in Abhiruchi-10, which was statistically similar to BARI Tomato-2. The least percent reduction in shoot weight of Abhiruchi-10 may be due to tolerance to TYLCV (Table 1).

**Reduction in rooting depth:** The reduction of rooting depth due to infection with TYLCV ranged 49.41-73.75% depending on 16 tomato varieties. Tropic green showed the highest reduction, which was statistically similar to Mongol, Winner and Udayan. The minimum reduction was found in Abhiruchi-6 (41.41%), which was statistically similar to Abhiruchi-10, Salamat and Bankim (Table 1).

**Reduction in chlorophyll content:** TYLCV inhibited the production of chlorophyll pigment and destroyed chlorophyll pigment; thereby leaves became yellow in infected plants. The reduction of chlorophyll pigment

Effect of Tomato Yellow Leaf Curl Virus (TYLCV) on Plant Growth and Yield Contributing Characters of Sixteen Tomato Varieties

(SPAD value) ranged 10-42% in different tomato varieties. The highest reduction was found in Tropic green which was significantly different from other varieties. The minimum reduction was found in Abhiruchi-10 (Table 1). TYLCV infection ranged 62.24-83.23% in different tomato varieties. Tropic green showed the highest reduction, which was statistically similar to Udayan, Mongol and Chuanchu. The minimum was found in

**Table 1.** Reduction in different growth parameters and chlorophyll content of sixteen tomato varieties due to infection of TYLCV

| Varieties     | Percentage of reduction over control |                  |                  |                    |               |            |
|---------------|--------------------------------------|------------------|------------------|--------------------|---------------|------------|
|               | Plant height                         | Number of leaves | Number of branch | Fresh shoot weight | Rooting depth | SPAD value |
| Abhruchi-6    | 38.57                                | 36.99            | 59.66            | 39.55              | 49.41         | 21.22      |
| Abhiruchi-10  | 35.72                                | 47.42            | 57.42            | 18.49              | 49.52         | 10.06      |
| Abhiruchi-11  | 37.74                                | 43.78            | 41.43            | 35.08              | 60.75         | 17.86      |
| Bankim        | 36.14                                | 39.42            | 52.00            | 37.16              | 55.45         | 14.70      |
| Chuanchu      | 59.17                                | 42.74            | 39.45            | 38.22              | 66.06         | 25.43      |
| Diamond       | 56.24                                | 46.15            | 34.36            | 44.07              | 64.13         | 21.41      |
| Gautam        | 60.71                                | 42.77            | 37.31            | 40.37              | 64.11         | 21.72      |
| Mongal        | 59.85                                | 51.76            | 38.97            | 38.58              | 67.94         | 22.41      |
| BARI Tomato-2 | 51.37                                | 46.71            | 29.84            | 35.32              | 57.01         | 18.65      |
| BARI Tomato-3 | 48.77                                | 43.63            | 31.44            | 32.49              | 62.14         | 19.94      |
| BARI Tomato-9 | 52.20                                | 45.01            | 34.03            | 37.45              | 61.17         | 20.24      |
| Raksha        | 55.48                                | 41.61            | 39.50            | 37.77              | 63.49         | 18.70      |
| Salamat       | 35.61                                | 41.41            | 43.50            | 40.27              | 58.13         | 17.94      |
| Tropic green  | 55.30                                | 53.96            | 29.10            | 37.94              | 73.75         | 42.24      |
| Udayan        | 58.41                                | 44.17            | 36.42            | 37.23              | 65.10         | 18.83      |
| Winner        | 36.28                                | 46.68            | 39.15            | 41.40              | 64.52         | 20.88      |

Reduction in number of bunch: The reduction in number of bunch due to Abhiruchi-10, which was not significantly different from Salamat and

Gautam (Table 2).

Reduction in number of flower and fruit: Infected plants produced less number of flowers with light yellow color and smaller sized. The reduction in number of flowers due to TYLCV infection ranged 44.95-56.50% among the varieties. Salamat showed the highest reduction of number of flower,

which was not significantly different from Abhiruchi-6, Abhiruchi-10 and Udayan. The minimum was found in Abhiruchi-11, which was not significantly different from varieties Raksha and Diamond (Table 2). Gupta (2000) has found similar results on number of flowers affected by the infection of TYLCV. The majority (up

**Table 2.** Reduction in different yield contributing parameters and fruit yield of sixteen tomato varieties due to infection of TYLCV

| Varieties     | Percentage of reduction over control |                   |                  |              |             |             |
|---------------|--------------------------------------|-------------------|------------------|--------------|-------------|-------------|
|               | Number of bunch                      | Number of flowers | Number of fruits | fruit length | Fruit girth | Fruit yield |
| Abhruchi-6    | 67.40                                | 56.26             | 62.48            | 46.45        | 50.91       | 60.54       |
| Abhiruchi-10  | 62.24                                | 53.93             | 67.47            | 48.28        | 47.97       | 55.21       |
| Abhiruchi-11  | 66.82                                | 44.95             | 69.17            | 51.31        | 69.96       | 64.91       |
| Bankim        | 67.71                                | 52.72             | 63.23            | 51.06        | 58.41       | 60.78       |
| Chuanchu      | 71.76                                | 50.80             | 76.35            | 64.43        | 75.81       | 66.85       |
| Diamond       | 69.13                                | 47.62             | 69.84            | 56.30        | 70.90       | 62.85       |
| Gautam        | 65.66                                | 49.55             | 70.92            | 47.58        | 70.02       | 64.28       |
| Mongal        | 73.64                                | 50.75             | 77.54            | 73.26        | 82.13       | 67.02       |
| BARI Tomato-2 | 65.94                                | 51.09             | 68.32            | 52.24        | 67.59       | 61.65       |
| BARI Tomato-3 | 66.51                                | 50.80             | 66.21            | 49.43        | 65.72       | 63.17       |
| BARI Tomato-9 | 66.45                                | 48.24             | 67.30            | 48.03        | 68.57       | 64.93       |
| Raksha        | 66.72                                | 45.99             | 68.80            | 50.40        | 69.48       | 65.75       |
| Salamat       | 64.82                                | 56.50             | 61.28            | 46.29        | 39.63       | 58.15       |
| Tropic green  | 83.23                                | 49.56             | 78.21            | 77.65        | 85.44       | 65.83       |
| Udayan        | 71.06                                | 50.25             | 73.55            | 58.23        | 72.79       | 62.78       |
| Winner        | 68.86                                | 53.13             | 70.92            | 61.21        | 71.21       | 64.69       |

to 90%) of flowers abscises after infection, and therefore few fruits are produced (Amro, 2009).

There was a pronounced negative effect of TYLCV infection on the number of fruit per plant. The reduction in number of fruits due to TYLCV infection ranged from 61.28-78.21% depending on tomato varieties. Tropic green showed the highest reduction, which was statistically similar to Udayan, Mongol, Chuanchu and Gautam. The minimum percent reduction in fruit number was found in Salamat, which was not significantly different from Abhiruchi-6 and Bankim (Table 2).

Reduction in fruit length and fruit girth: Fruit length was severely affected by TYLCV infection. The reduction in this parameter due to infection with TYLCV ranged 46.45-77.65%. The highest reduction in fruit length was found in Tropic green, which was statistically similar to Mongol. The minimum reduction in fruit length was found in Salamat, which was not significantly different from Abhiruchi-6, Abhiruchi-10 and Gautam (Table 2). The reduction in fruit girth due to TYLCV infection ranged 39.63-85.44% depending on tomato varieties. Tropic green showed the highest reduction in fruit girth, which was not significantly different from Chuanchu, Diamond, Gautam, Udayan and

Winner. The minimum fruit girth was found in Salamat, which was statistically similar to Abhiruehi-6 and Abhiruchi-10. Results of the present study suggest that fruit girth was less in virus infected plants compared to healthy plants (Table 2).

Reduction in fruit yield: Infection of tomato plants with TYLCV caused 55.21-67.02% reduction in fruit yield depending on tomato varieties. The highest yield reduction was found in Mongal, which was not significantly different from Chuanchu, Abhiruchi-11, Raksha, Diamond, Gautam, Mongol, Tropic green and Winner. The minimum reduction was found in Abhiruchi-10 which was statistically similar to Abhiruchi-10, Bankim, BARI Tomato-2 and Udayan (Table 2).

Findings of the present investigation reveal that the growth and yield contributing characters of tomato were affected by TYLCV infection showing varying degrees of reduction in growth parameter, yield contributing characters and fruit yield. None of the varieties was completely resistant to the virus. However, a few of them showed a considerable level of tolerance against the disease. The hybrid Salamat and Abhiruchi-10 were least affected while Tropic green, Gautam and Mongol were highly affected varieties.

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Effect of Tomato Yellow Leaf Curl Virus (TYLCV) on Plant Growth and Yield Contributing Characters of Sixteen Tomato Varieties

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