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TOMATO LEAF CURL DISEASE DEVELOPMENT AND ITS MANAGEMENT WITH STICKY YELLOW TRAP

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ABSTRACT

Begum F, Jahan N, Muqit A, Doullah MAU (2020) Tomato leaf curl disease development and its management with sticky yellow trap. *Int. J. Expt. Agric.* 10(2), 16-21.

To elucidate the pattern of tomato leaf curl disease development and assess the efficacy sticky yellow trap an experiment was conducted in the nethouse of the Department of Plant Pathology, Sylhet Agricultural University, Syhlet during December 2017 to May 2018. Disease progress pattern varied significantly in control and the plants where trap was used. Disease was first appeared at two weeks after transplanting and reached the highest level after 4 weeks. At the initial stage only upper two leaves were infected and showed disease symptom which covered around 8.7% of the foliage. After two weeks disease incidence rose to 29.8% and after 4 weeks symptoms were observed in the whole plant. Mainly three types of insects: aphid, whitefly and thrips were captured on the trap. Employing of sticky traps delayed leaf curl incidence by two weeks and reduced the disease incidence by 31%. Yield was increased significantly due to application of yellow sticky trap.

Key words: *tomato, leaf curl, sticky trap, whitefly*

INTRODUCTION

Tomato (*Solanum lycopersicum*) is a highly popular vegetable in Bangladesh as well as throughout the world for its high nutritional value and delicacy. Tomato is rich in minerals, essential amino acids, sugar and fiber (Glick *et al*. 2009). In Bangladesh it is mainly cultivated in winter but also being cultivated in a limited scale in summer. The annual production is about 389 thousand metric ton. Total area is 28 thousand hectare. The yield is about 14 ton per hectare (BBS 2018).

However, the yield of tomato is quite low as compared to world average 26.29 t/ha (FAO 2010). Diseases are one of the major constraints of low yield in tomatoes. More than 200 diseases have been reported in tomato out of which 40 are caused by viruses (Martelli and Quacquarelli, 1982). Virus diseases are important because they cause much damage and they are difficult to control. So far 16 different viruses have been recorded on tomato in Bangladesh (Akanda 1994). Tomato leaf curl disease caused by *Tomato leaf curl virus* (ToLCV) is a threatening disease globally (Chakraborty 2008). Though the disease was first reported in 2001 in Bangladesh but most likely it was present since early 90's (Green *et al*. 2001; Hasan *et al*. 2019). Yield loss can be up to 93.95% (Gupta 2000) due to leaf curl disease. Tomato plants can get infected with this disease at any stage of crop growth.

ToLCV belongs to the genus *Begomovirus* (Xie *et al*. 2013). *Begomoviruses* have icosahedral single-stranded DNA (ssDNA) genomes and are transmitted by the sweet potato whitefly (*Bemisia tabaci*) in persistent-circulative non-propagative manner (Ghanim 2014). Tomato leaf curl disease symptoms on infected plants include stunting, curling of leaves and yellowing between the veins, leaf margins curl upward giving cup-shape appearance and flower drop occurs before fruit set (Melzer *et al*. 2009).

Occurrence of whitefly is very common in winter season in Bangladesh. But in recent years the problem has increased manifold. So far, no economic management package or resistant variety is available to combat dissemination of ToLCV by whitefly. Farmers use insecticides to control whitefly for the management of ToLCV. But sole reliance on insecticides causes environmental pollution, pesticide resistance and health hazard. Therefore, it is necessary to search for eco-friendly alternative methods for the management of ToLCV. Non chemical methods have been found effective to manage tomato leaf curl disease (Arooj *et al*. 2017). In Bangladesh, skimmed milk was used for the reduction of incidence and severity of Tomato leaf curl disease (Ali *et al*. 2001). Although there are many reports available on management of the disease, very little information is available on the disease progress pattern and use of sticky traps for its management.

Therefore, the present study was conducted to know the pattern of leaf curl disease development and to assess the efficacy of yellow sticky trap for leaf curl disease management.

MATERIALS AND METHODS

Experimental site

The pot experiment was carried out at the nethouse of Plant Pathology and Seed Science Department, Sylhet Agricultural University, Sylhet during December 2017 to May 2018.

Experimental materials

Tomato variety Ratan (BARI Tomato-2) was used in the experiment. Twelve inch diameter earthen pots were used. Pot mixture was prepared by mixing cowdung, urea and TSP and MOP with soil. Seeds were sown in a

pot in the first week of December 2017. Three week old seedlings were transplanted on first week of January 2018. One seedling was transplanted in each pot. Customized yellow sticky traps were used for insect trapping due to unavailability of commercial yellow sticky traps in the market. To make one sticky paper trap four inch by six inch yellow colored art paper was cut and wrapped with transparent scotch tape so that the sticky part remains outside. This card was tied with a one meter long bamboo stick which was used to support each tomato plant in each pot. The cards were replaced after two weeks. Traps were used in fifteen pots and another fifteen pots were used as control. Irrigation was given with a watering can as and when needed.

Data Collection

Data collection was started at 15 days after transplanting (15DAT) of seedlings. Data were collected once in a week. Data on disease reaction and disease incidence, yield etc were collected in different growth stages.

Disease diagnosis

Leaf curl disease was identified through visual observation of symptoms like upward curling, slight yellowing of leaves, smaller leaflets and stunting of the plants as suggested by Green and Kalloo (1994).

Disease incidence

Disease incidence was calculated with the following formula

$$\text{Disease incidence (\%)} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \text{x} 100$$

Statistical analysis

Fifteen pots were used for each treatment and in each pot contained only one plant. In total thirty pots were used. Paired plot technique was used for comparing the observed data. The data obtained for different characters were statistically analyzed with Microsoft XL.

RESULTS AND DISCUSSION

Disease spread in pot experiment

The spread of tomato leaf curl disease among all the plants in the pot experiment is presented in Fig. 1. Disease started after two weeks of transplanting. The lowest disease incidence (7.5%) was found in 2 weeks after transplanting (2nd week of March) and the highest disease incidence (17.5%) was observed at 6 weeks after transplanting i.e.3rd week of April. In the third and fourth week it was 10% and 15% respectively. There was no further progress till fifth week.

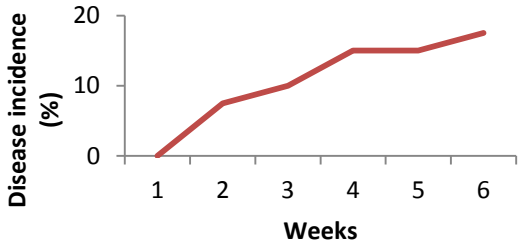

Fig. 1. Progress of leaf curl disease in nethouse from March to April

Disease progress among control plants

The spread of tomato leaf curl disease in control plants at one week interval is presented in Fig. 2. The lowest disease incidence (10%) was found in 2 weeks after transplanting (2nd week of March) and the highest disease incidence (17.5%) was observed after 6 weeks of transplanting (3rd week of April). There was a very slow progress after fourth week. Disease incidence was 13.5, 16.5 and 16.5% respectively in third, fourth and fifth week respectively.

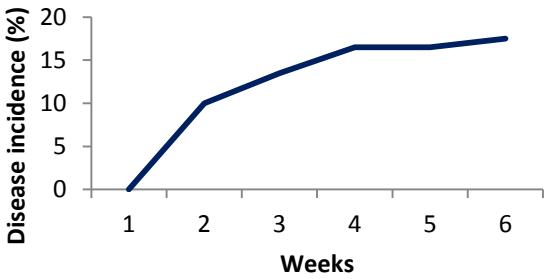

Fig. 2. Leaf curl disease progress in control plants from March to April

Disease spread in sticky trap placed plants

The spread of tomato leaf curl disease in the sticky trap placed plants are shown in Fig. 3. The highest disease incidence was 12% after 6 weeks of transplanting. In control pots the highest disease incidence reached up to 17.5%. That means use of yellow sticky traps could reduce the incidence of tomato leaf curl disease by 31%. In the control plants disease appeared first at 2 weeks after transplanting whereas in the treated plants disease appeared first in 4 weeks after transplanting. There was little progress of the disease after that. The treated plants showed delayed symptoms by 2 weeks compared to non-treated plants. Delayed appearance of disease has profound effect on yield. The more delay in appearance of disease will causeless yield reduction.

Plant's age has effects on the expression of genetic resistance to TYLCV. In an experiment it was found that, all tested varieties suffered a significant yield reduction due to inoculation with TYLCV at 14, 28 or 45 DAS. Plants inoculated at 14 DAS had the highest TYLCV induced yield loss (45.5%) but when inoculated at 28 DAS yield loss was only 22%. (Levy and Lapidot, 2008). In another study, Rahman *et al*. (2006) found that virus prevalence in tomato varied from 42 to 69% depending on early, mid and late stage of infection. Booker *et al*. (2005) studied the effect of *Cowpea severe mosaic viru*s (CPSMV) on the growth and yield of cowpea. They found that inoculation during 12 days after seeding caused 50 to 85% yield loss, at 24 DAS it was 22 to 66% and at 35 DAS it was 2 to 36% depending on cultivar.

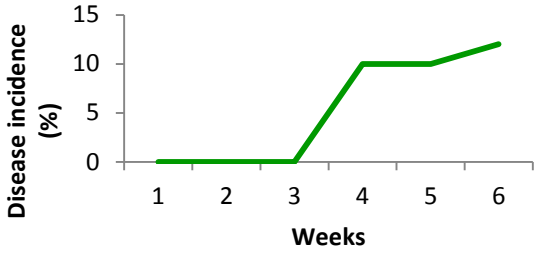

Fig. 3. Progress of leaf curl in plants with yellow sticky trap

Disease symptoms in individual plant

In the present study, four different types of symptoms were observed on the infected plants *viz.* curling, yellowing, reduced leaf size and bushy appearance. Muniyappa (1994) classified symptoms into five categories and designated as group I, II, III, IV and V. Group-I included symptoms of pale-yellow color, vein clearing; upward curling; reduced leaf size, bushy appearance due to shortening of internodes and a greater number of lateral branches. Our present study revealed same symptom as Group-I. Transformation of tomato leaf curl disease symptoms in a single plant is presented in Table 1. Results indicated that after 1 week around 8.7% change was observed with the symptoms. After 2 weeks around 29.8% change occurred, which went up to 55.5% after 3 weeks and around 100% change occurred after 4 weeks of transplanting. Study on TYLCV (*Tomato yellow leaf curl virus*) transmission revealed that about 11-13 days after inoculation viral DNA and coat protein is maximum and symptoms develop about 4-7 days later in the youngest plant tissue. This amount increases further as a result infection gradually spreads to older parts of the plants (Ber *et al*. 1990; Rom *et al*. 1993 and Wage 2007).

Table 1. Transformation of disease symptoms in individual plant

Weeks	Symptoms
1	Top 2 twigs holding around 15 leaves become curled and yellow (8.7%)
2	Around 51 leaves become curl and leaf size becomes reduced (29.8%)
3	Around 95 leaves become curl and leaf size become reduced (55.5%)
4	Around 171 leaves become curl, leaf size become reduced and show bushy appearance (100%)

Disease spread in individual plants

Spread of leaf curl diseases of tomato in individual plants are shown in Fig. 4. *Tomato leaf curl virus* was first found in upper 2 twigs. One week later 12 branches were infected and within 4 weeks it spread to 39 twigs covering the entire plant. As a result, the plant became stunted. Results showed that it takes around 5 weeks to spread the virus to the whole plant after initial symptom.

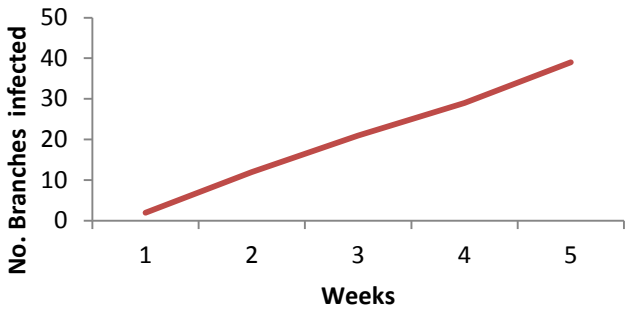

Fig. 4. Spread of leaf curl disease in individual plant

Number of fruits and fruits weight as affected by tomato leaf curl disease

The number of fruits and fruits weight as affected by ToLCD were recorded and presented in Table 2. It was observed that, the number of fruits in diseased plants was 13 and in healthy plant were 59. The reduction percentage of number of fruits was 77.9%.

The total fruit weight in diseased plants was 216g and in healthy plant was 1125g. The reduction percentage of fruit weight was 80.8%.

Table 2. Number of fruits and fruit weight as affected by leaf curl disease

Tomato plants	Number of fruits/plant	Reduction (%)	Fruit weight (g)	Reduction (%)
Diseased	13	77.9%	216	80.8%
Healthy	59		1125	
** (p=0.01)			** (p=0.01)	

Effect of sticky yellow trap on disease incidence and yield

Efficacy of yellow sticky trap on disease incidence and yield of tomato is presented in Table 3. It is noted from the table that the disease incidence was significantly reduced in the treated pots as compared to the untreated control pots. In trap employed plants disease incidence was12% whereas in treated plants it was 17.5%. Though the number of fruits in treated plant (11) was less than the control plant (15), the weight of fruits in treated plant (409g) was higher compared to control (244g) leading to better yield. From the present study, it was observed that use of sticky trap could reduce tomato leaf curl disease incidence by 31.42% and increase tomato yield by 1.7 times. Several authors reported that yellow sticky traps could trap whiteflies and could be used to manage whitefly borne diseases. But they reported that it worked in greenhouse not in the field (Gillespie and Quiring, 1987; Lu *et al*. 2012). Results of the present study are in agreement with their findings.

Table 3. Effect of sticky yellow trap on leaf curl incidence and yield of tomato

Tomato plants	Disease incidence (%)	Reduction (%)	No. fruits/plant	Total fruit wt./plant (g)
Treated	12	31.42	11	409
Control	17.5		15	244
** (p=0.01)			* (p=0.05)	** (p=0.01)

Effect of yellow sticky traps in capturing insects

The effect of yellow trap on insect trapping was promising. Data are shown in Fig 5. Yellow trap was 1st attached in 27th February, 2018. After 1st trapping, 53 Aphid, 6 Whitefly and 26 Thrips were trapped. 2nd attachment of yellow trap was done in 11th March, 2018. After 2nd trapping, 21 Aphid, 17 whitefly and 6 thrips were trapped. Last attachment of yellow trap was done in 28th March, 2018. After last trapping, only 17 Aphids were trapped. The number of insects captured decreased gradually. Higher temperature and reduction of tender foliage might be the reason for reduced number of insects captured in the traps in the later part of crop growth.

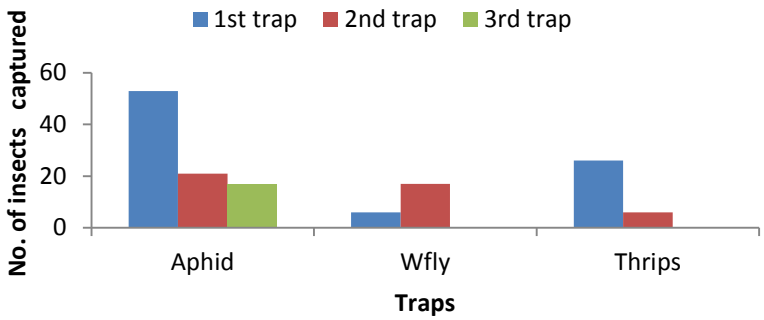

Fig. 5. Effect of sticky trap on insect capture

From the present trial it was found that yellow sticky traps are effective to trap or capture some insects especially aphid, whitefly and thrips which might have caused lower incidence of leaf curl disease. Aphids were more attracted than whitefly or thrips.

CONCLUSION

Tomato leaf curl disease progress pattern indicates that disease starts to appear 2 weeks after transplanting and it takes another 4 weeks to reach up to peak. In case of disease progress in individual plant, it takes 5 weeks to spread the symptom to entire plant after initiation. Results of the present study indicated that sticky yellow traps can be effective to capture whitefly and reduce tomato leaf disease incidence. However it needs to be verified in larger plots in the field in couple of seasons.

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