

SYMPTOMS AND PREVALENCE OF TOMATO SPOTTED WILT VIRUS (TSWV) INFECTION IN BANGLADESH

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ABSTRACT

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An attempt was made to study the symptoms of *Tomato Spotted Wilt Virus* (TSWV) and prevalence of its infection on eight tomato varieties namely BARI-T1 (Manik), BARI-T2 (Ratan), BARI-T3, BARI-T7 (Apurba), BARI-T8 (Shila), BARI-T9 (Lalima), BINA-T1 and BINA-T2. The study was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during November 2005 to March 2006. Irrespective of tomato varieties and stages of plant growth, TSWV symptoms were observed on tomato growing on the field remaining some asymptomatic plants. The highest and lowest prevalence of TSWV was recorded in BARI-T2 and BINA-T2, respectively. In all the varieties, virus prevalence was found higher at mid stage followed by late and early stages of infection. Considering TSWV infection BINA-T2 seemed to perform better in comparison to other varieties.

Key word: *Tomato Spotted Wilt Virus*, symptoms, prevalence of infection

INTRODUCTION

Tomato Spotted Wilt Virus (TSWV), transmitted by the thrips (*Frankliniella occidentalis*) is one of the most devastating viral pathogens appeared as a dramatically increasing threat to tomato causing tremendous yield loss throughout the tropics and subtropics. Diseases attributed to TSWV were first reported in Australia in 1915 (Best, 1968). The spheroidal particles of TSWV are of 80-100 nm in diameter (Avila *et al.* 1991). TSWV is under genus *Tospovirus* of the family *Bunyaviridae* (German *et al.* 1992, Murphy *et al.* 1995). TSWV has a host range spanning several hundred species in both monocotyledonous and dicotyledonous plants which include ornamentals and tomato (Moyer *et al.* 1999, Tisserat, 2005). TSWV can infect 35-plant families including the Solanaceae, Asteraceae, Leguminaceae, Brassicaceae, and Bromeliaceae (Momol and Pernezny 2006). TSWV is transmitted from plant to plant by nine species of thrips (Tsuda, 1999, Mound, 1996). Thrips are less than one-quarter inch in length, light green to brown, and are extremely difficult to find on the plants (Tisserat 2005). TSWV is of worldwide importance (Peters *et al.* 1998). This virus is damaging to all floral crops and currently causes the most important disease of these hosts in the USA as well as in temperate and subtropical regions of the world (Pfleger *et al.* 1989, Natalie 2005). Severe yield losses associated with TSWV have been reported in tomato, peanut, tobacco, pepper and potato as well as in some ornamental crops (Culbreath *et al.* 2006, Diffie *et al.* 2006). Although most insecticides have little effect on spotted wilt incidence, use of phorate (Thimet or Phorate) in-furrow at planting has shown consistent suppression of spotted wilt. It has also been found that use of classic herbicide tends to increase severity of spotted wilt (Culbreath *et al.* 2006). Controlling weeds, avoiding contaminated host plants near the vegetable crop, and eliminating thrips in greenhouses and solariums are the best way to manage this problem. Sprays to control thrips have not been successful, probably because viruliferous thrips are constantly being blown into fields from external virus reservoirs (Swift 2006). Cultivar choice has been the most consistent way to suppress TSWV epidemics. In Bangladesh, 16 different viruses including TSWV have so far been recorded (Akanda and Rahman 1993, Akanda *et al.* 1994). But a depth studies on TSWV in Bangladesh have not yet been done. For boost-up the production of tomato, the management of a damaging virus like TSWV is immensely important. Moreover, the cultivation of resistant or tolerant varieties is eco-friendly and effective method of disease management. For the purpose a depth study on different aspects of TSWV is required. The present study illustrated the impact of TSWV symptoms and prevalence of infection with a view to determine the status of eight tomato varieties against the virus.

MATERIALS AND METHODS

The field experiment was conducted at the research farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during November 2005 to March 2006. The soil of the experimental field belongs to Salna series under the Agroecological Zone (AEZ)-28: Madhupur Tract. The texture of the soil was silty clay in surface layer and silty clay loam in subsurface (Rahman *et al.* 1998). The pH of the soil was 6 to 6.5. Eight tomato varieties namely BARI Tomato-1/Manik (BARI-T1), BARI Tomato-2/Ratan (BARI-T2), BARI Tomato-3 (BARI-T3), BARI Tomato-7/Apurba (BARI-T7), BARI Tomato-8/Shila (BARI-T8), BARI Tomato-9/ Lalima (BARI-T9), BINA Tomato-1 (BINA-T1) and BINA Tomato-2 (BINA-T2) were used in the experiment. The seeds of these tomato varieties were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and Plant

pathology Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. After well prepared of the nursery bed the seeds of eight tomato varieties were sown on November 17, 2005. Proper care was taken to ensure good and healthy seedling development. The experimental field was ploughed and leveled to have a good tilth on December 2, 2005. Fertilizer dose was used as N-200 (applied in two splits, one at 21 and other at 35 days after transplanting), P₂O₅-100, K₂O-150, S-20 and B-2 kg/ha as suggested by Rahman *et al.* (1998). Cow dung (5 t/ha) and all the fertilizers except urea were applied during final land preparation. The experiment was laid out following 8x2x3 factorial in Randomized Complete Block Design (RCBD) with 4 replications. The seedlings of eight tomato varieties grown in open nursery bed were carefully uprooted and transplanted in the main field on December 17, 2005. Forty-eight seedlings of each variety were transplanted in 3m x 10m unit plot maintaining 70x70cm² spacing. Intercultural operations were done as and when required. *Tomato spotted wilt virus* (TSWV) was identified on the basis of field symptoms as described by Tisserat (2005), Natalie (2005), Momol and Pernezny (2006), Swift (2006) and Single-Stranded Conformational Polymorphism (SSCP). The prevalence of TSWV was calculated by counting the plants infected every day on the basis of the symptoms caused by the virus. The plants were inspected every day morning to note the appearance and development of the symptoms of TSWV starting from transplantation to last harvest. The tomato plants remained asymptomatic until last harvest was designated as healthy plants. The data on the prevalence of TSWV were collected at three stages of the plant growth. Three growth stages of the plants were categorized as early (transplanting to first flowering), mid (first flowering to first fruiting) and late stage (first harvesting to last harvesting). The disease prevalence was expressed in percentage on the basis of stages as well as total i.e. average of the three stages. The present prevalence was computed using the following formula:

$$\text{Percent of prevalence} = \frac{X_1}{X} \times 100$$

Where,

X₁ = Number of infected plants

X = total number of plants

RESULTS AND DISCUSSION

Symptoms of Tomato Spotted Wilt Virus (TSWV) appeared on tomato growing in the field

The symptoms appeared due to infection of *Tomato spotted wilt virus* (TSWV) in eight different tomato varieties in the field are noted in Table 1 and figure 1-3. Due to infection of TSWV, young plants were shown inward cupping of leaves and turned bronze in color. Leaves developed numerous small dark spots, purple flecks or small necrotic rings. Dark brown and black streaks were observed on the main stem. Infected plants produced less number of twisted flowers. Whitish or yellowish concentric rings were observed on mature fruits. Tips dieback, streaking of the terminal stems, Stunting and plants seemed to be wilted were commonly observed in the TSWV infected field. The type of symptoms and symptom severity were observed to be varied depending on the tomato varieties and time of infection. The symptoms so far noted seemed to be identical and diagnostic for the TSWV infecting tomato as described by Tisserat (2005), Natalie (2005), Momol and Pernezny (2006) and Swift (2006).

Table 1. Symptoms of *Tomato Spotted Wilt Virus* (TSWV) appeared on tomato growing in the field

Plant parts	Symptoms	Remarks
Leaf	Initial symptoms appeared as inward cupping of leaves. Leaves developed off-color which turned bronze cast on the leaves. In some cases leaves exhibited dark purple flecks or small necrotic rings. Development of numerous small dark spots was also common in some cases.	Typical symptoms of TSWV as described by
Stem	Dark brown to black streaks developed on the stems. Stem necrosis was also found as associated symptom.	Tisserat (2005), Natalie (2005),
Flower	In general less number of twisted flowers was yielded by the infected plants.	Momol and
Fruit	Infected plants characteristically produced whitish to yellow concentric rings on the young fruit. Finally fruits showed a bumpy or warty appearance.	Pernezny (2006), and Swift (2006).
Plant	Tips dieback, top necrosis and wilting were observed. Stunting were commonly observed in case of infected plants.	

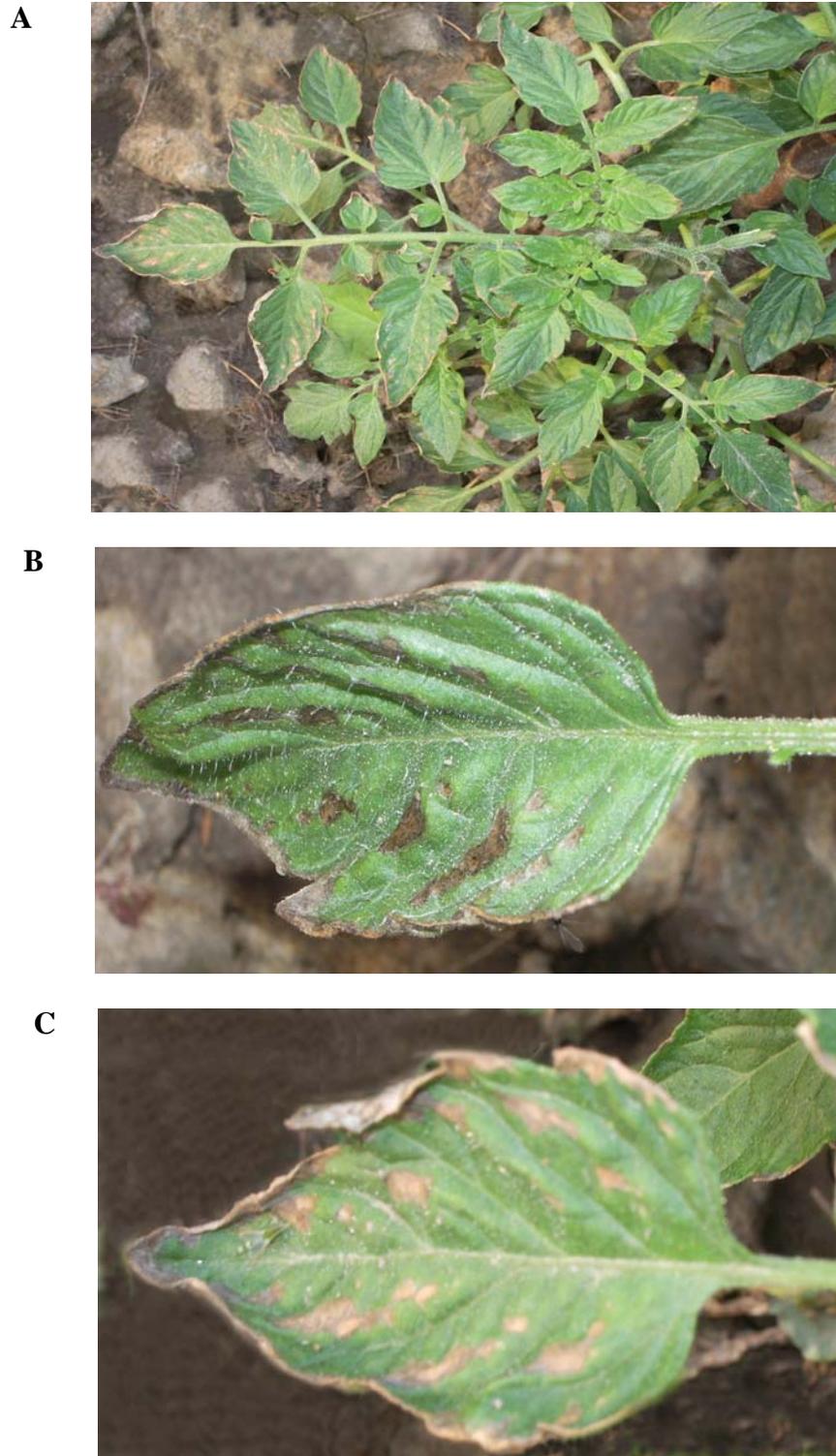


Figure 1.1. A tomato plant showing common symptom of TSWV (A), bronze cast caused by TSWV to young leaf (B), to mature leaf (C).

A



B



Figure 1.2. A tomato plant showing inward cupping as common symptom of TSWV (A), purple flecking of leaf caused by TSWV (B)

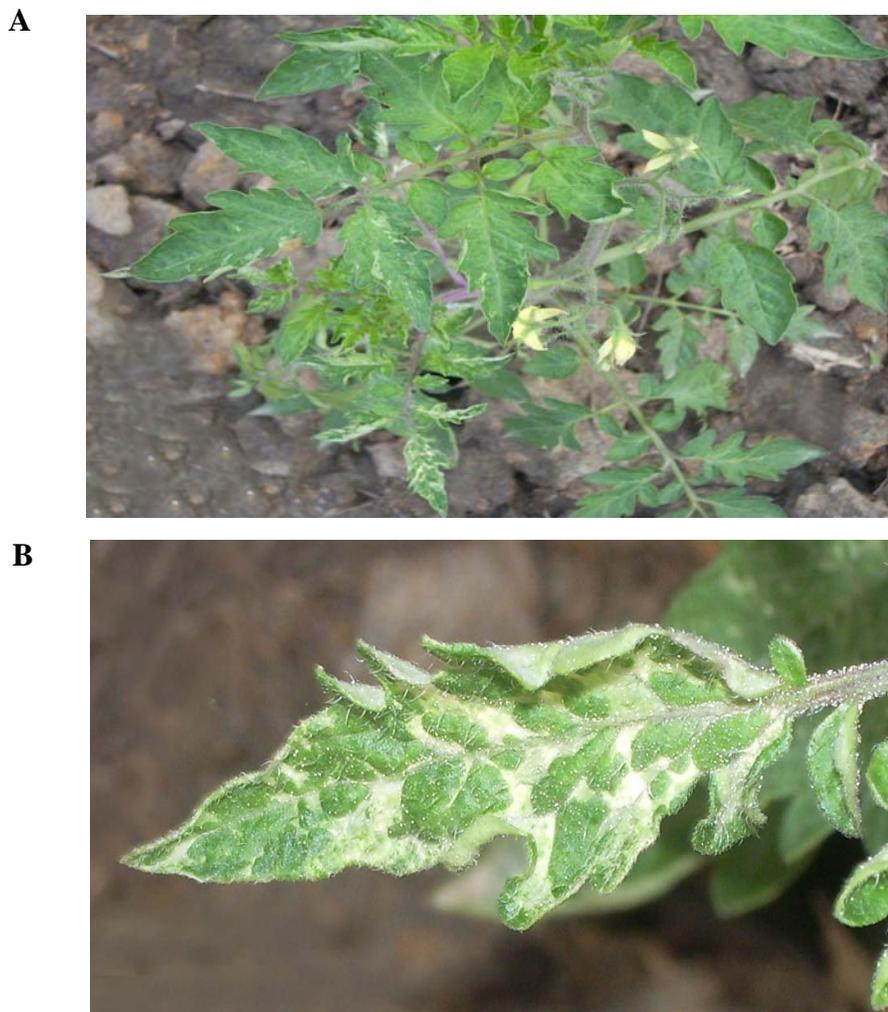


Figure 2. A tomato plant showing uncommonly brilliant symptom of TSWV (A), brilliant rough whitish lesions of TSWV on leaf (B).



Figure 3. A tomato fruit showing typical whitish and yellowish concentric ring spot symptom of TSWV

Prevalence of TSWV infection

The results on prevalence of TSWV infection at three growth stages (Early, mid and late) of eight tomato varieties observed in the experimental field are presented in the figure 4. In all the eight tomato varieties, prevalence of TSWV found higher at mid stage compared to late and early stages of plant growth. The maximum percent of TSWV infected plants was recorded 68% in BARI-T2 and it was minimum (41%) in BINA-T2. BARI-T1 and BARI-T7 showed the same performance (63%) in respect of TSWV prevalence and 51% prevalence was observed in both BARI-T3 and BARI-T8. The rest two varieties BARI-T9 and BINA-T1 showed 52% and 45% infected plants, respectively (Figure 5). The percent of asymptomatic (healthy) plants varied from 32-59% depending on the tomato varieties planted in the field during the study period.

The results of the present study indicated that the tomato variety BINA-T2 performed better against the TSWV infection compared to the others under field condition. The prevalence was found to be varied depending on the tomato varieties (41-68%) and stages of infection (9-33%). Almost such type of results on varietal performance against TSWV in tomato field was obtained by Greenough *et al.* (1990), Tomassoli and Barba (1994), Swift (2006) and Culbreath (2006).

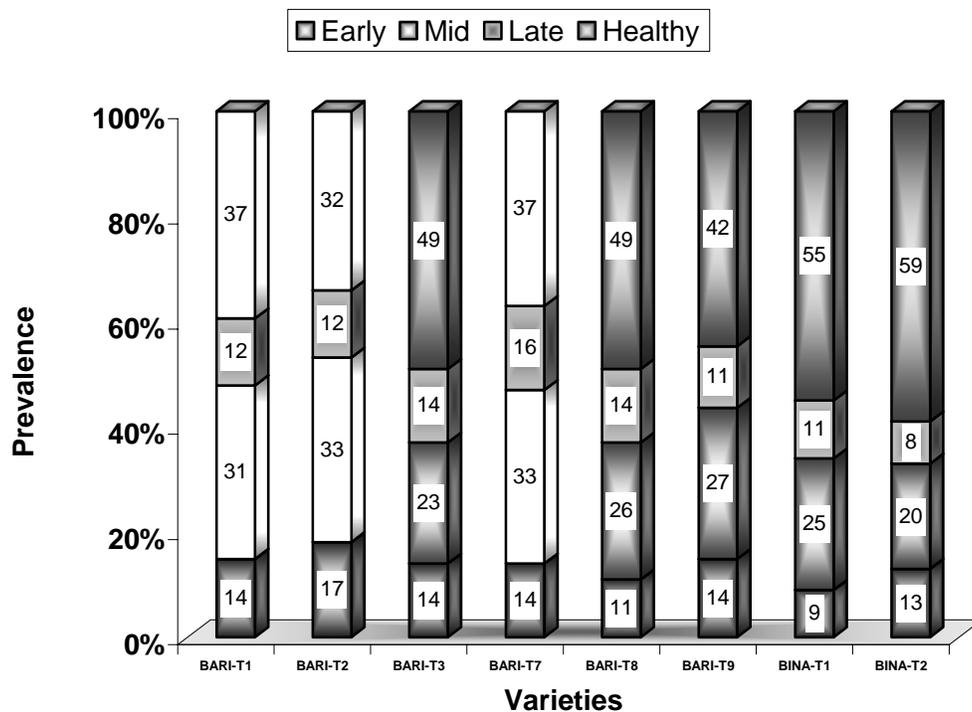


Figure 4. Prevalence of TSWV infection on eight tomato varieties at early, mid and late stages of plant growth

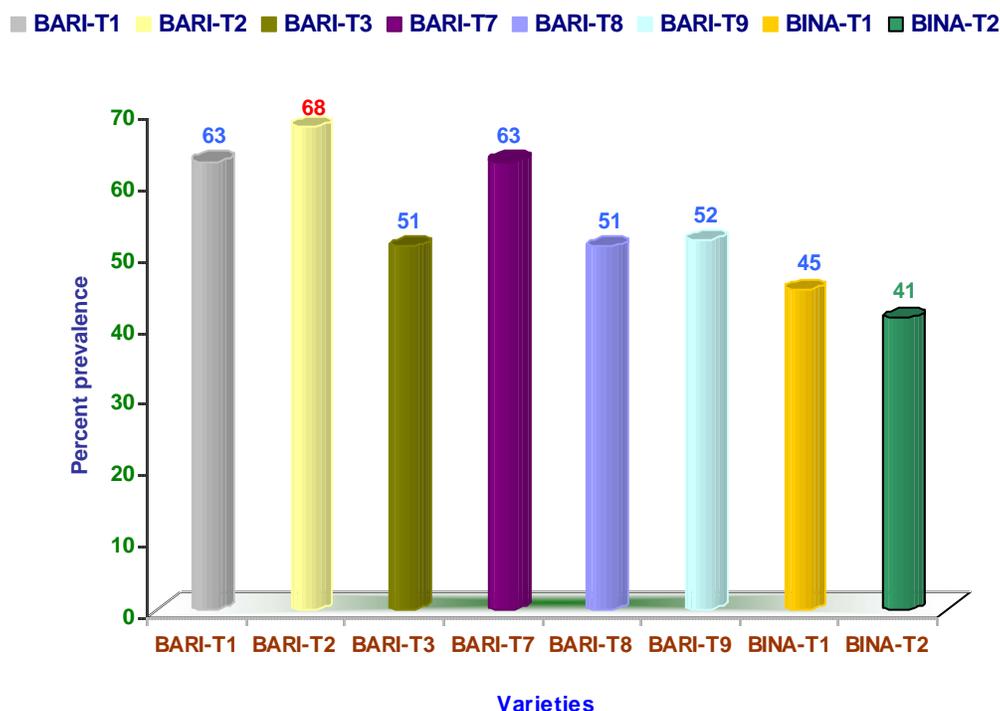


Figure 5. Prevalence of TSWV infection on eight tomato varieties

The experiment demonstrated that different symptoms of TSWV were observed on all of eight tomato varieties at different stages of plant growth. The prevalence of TSWV in eight tomato varieties in the field varied from 9-33% depending on stages of infection viz. early, mid and late stage. The maximum prevalence of the virus was recorded at mid stage followed by late and early stage of infection. On average of the three stages, the highest prevalence was found as 68% on BARI-T2, while the prevalence was ranged from 41-68% depending on the varieties.

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