Summary

Western flower thrips *(Frankliniella occidentalis)* is not only serious pest of vegetables and flowers, but also economically important as a vector of several species of Tospovirus, such as *Tomato spotted wilt virus* (TSWV). TSWV rapidly spread throughout Japan in the late 1990s and became one of the most serious pathogen of vegetables and ornamental crops grown in greenhouses. In this study, I revealed the infection source of TSWV in the winter fields and solved the relationship between virus and hosts to establish a management system of TSWV infesting green pepper in spring to autumn.

1. During winter season, results of field surveys in Bungo-ohno, Oita prefecture, revealed that weeds in greenhouses were sometimes infected with TSWV but the infection rate was extremely low, suggesting that weeds were not important as overwintering hosts of TSWV in greenhouse. On the other hands, TSWV was frequently detected from green pepper fruits left in greenhouses and in the field until they rotted. Moreover, percentages of viruliferous *F. occidentalis* were extremely high and not significantly different between weeds and green pepper fruits. I concluded that TSWV-infected green pepper fruits left in greenhouses or fields are the major source of infection.

2. I investigated the efficiencies of TSWV transmission ability of *F. occidentalis*, which were collected in green pepper and Eustoma grandiflroum fields, and *F. intonsa*, which were collected in green pepper and strawberry fields in Oita prefecture. Six populations of *F. occidentalis*, showed different transmission efficiencies (minimum 15.6%, maximum 62.0%), and three populations of *F. intonsa*, collected in green pepper and strawberry fields showed transmitted the virus with a high efficiency (54.7 to 65.8%). These findings suggest that *F. occidentalis* and *F. intonsa* populations with high TSWV-transmission efficiencies may play some roles in severe epidemics of TSWV in Oita prefecture fields.

3. I examined acquisition and transmission rates of TSWV in *F. occidentalis* which were fed with eight TSWV-infected weed species. When the first instar larvae were given TSWV-infected leaves of *Cerastium glomeratum, Solanum nigrum, Stellaria media* and *Galinsoga ciliata*, the acquisition rates of adult thrips were 85.4%, 73.6%, 72.6% and 35.6%, and the transmission rates were 76.4%, 60.9%, 61.3% and 29.9%, respectively. On the other hand, the acquisition and transmission rates were less than 10% when *F. occidentalis* were fed with *Lamium amplexicaule*, *Stellaria neglecta*, *Veronica persica* and *Vicia angustifolia*. These results suggest that the potential as TSWV-acquisition sources by *F. occidentalis* is different among weed species, and the thrips can be transmitters easily by acquiring the virus from some weed species efficiently.

4. The acquisition efficiency of *F. occidentalis* was investigated using TSWV-infected *Datura stramonium* with various infection levels. The amount of TSWV in the leaves was estimated using DAS-ELISA and qRT-PCR. The ELISA value (A_{405}) and the qRT-PCR value in leaf disks were logarithmically correlated. The percentage of viruliferous thrips almost reached the maximal value when the ELISA value and the qRT-PCR value of a leaf piece fed to the thrips measured more than 1.0 (abs) and 1.29×102 (ng TSWV nucleocapsid protein/cm^2 leaf), respectively. A few viruliferous thrips were obtained when the values were less than the threshold.

5. I examined the stability of the antigenic activity of TSWV in viruliferous *F. occidentalis* trapped on sticky traps. When the sticky trap were kept at 5° C, the DAS-ELISA value of the thrips' bodies declined very slowly. When sticky traps were kept at 15° C or higher, the value gradually

decreased in the 5 days after they were trapped, but the decrease of the value slowed thereafter. When the temperature was equal to or less than 25° C, the 95% confidence interval for both males and females was significantly higher than that of the healthy ones until 20 days after they were trapped. Similarly, the quantities of TSWV RNA in viruliferous thrips captured on a sticky trap were measured. The quantity rapidly decreased as the time passed after being trapped. The mean value halved in a day, but the reduction slowed 3 days after being trapped or later.

6. I investigated effectiveness of some insecticides using five populations of *F. occidentalis*, which were collected in green pepper fields and two populations, which were collected in Eustoma grandiflroum fields, respectively. Spinosad was toxic with almost 100% of corrected mortality. On the other hands, most pyrethroids and chloronicotinyls group were less toxic to F. occidentalis generally. In organophosphate, PAP was toxic with almost more than 85.0% of corrected mortality, but acephate and DDVP (50.0%) were showed remarkable differences, between less than 10% to around 90%, respectively. Similarly emamectin bebzoate and chlorfenapyr were showed remarkable differences. Sensitivity ratio (R/S ratio) to emamectin benzoate, chlorfenapyr and spinosad were 2.1 to 5.4, 3.5 to 14.8, and 0.9 to 3.2, respectively. These result showed that *F. occidentalis* collected in Oita prefecture, acquired resistance for emamectin benzoate and chlorfenapyr.

7. The effect of control on the population of *F. occidentalis* and *F. intonsa* released by predatory mite, *Amblyseius swirskii* Athias-Henriot was investigated on spring-autumn pepper greenhouses. In case once time released plot 50,000 *A. swirskii* per 10 are, at the end of May or the beginning of June, *A. swirskii* well-inhabited 120 days after. The density of adult *F.occidentalis* and two larvae of thrips species become lower in the released plot than that of control plot for 120 days after. On the other hand, the density of adult *F.intonsa* was not different between the released plot and the control. The temperature conditions during the investigation (average:23.7 to 25.0℃, max:37.2 to 42.6 ℃, mim:5.6 to 12.8℃) did not affect for the colonizing success of *A. swirskii* on these greenhouses. I concluded that *A. swirski*i can be useful to control for *F.occidentalis* on greenhouse of spring-autumn green pepper.

写真１　ミカンキイロアザミウマ成虫と２齢幼虫と卵

写真２　ミカンキイロアザミウマ食害によるピーマンの被害

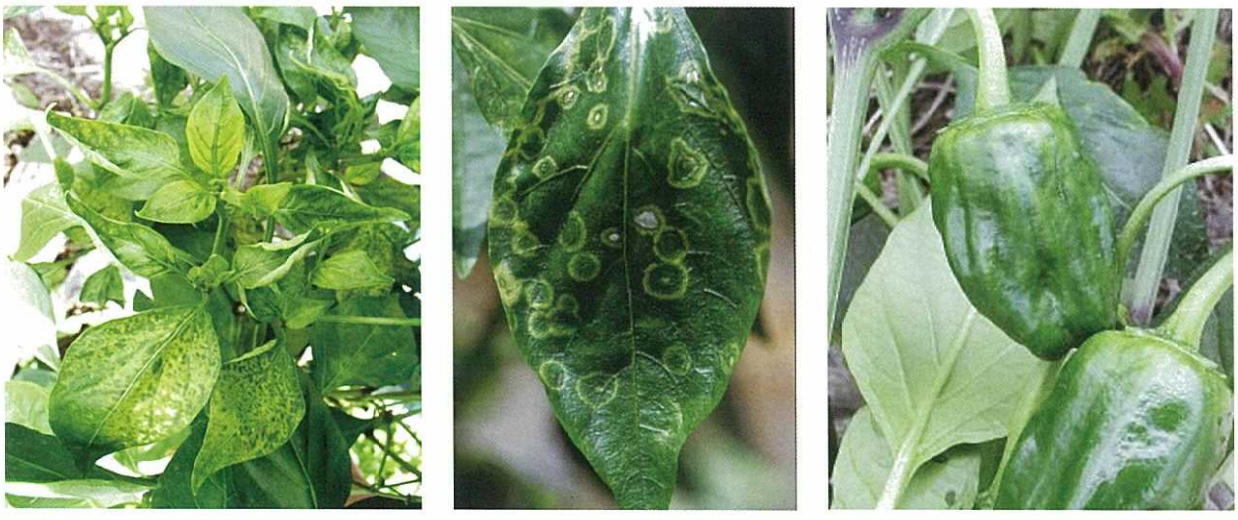
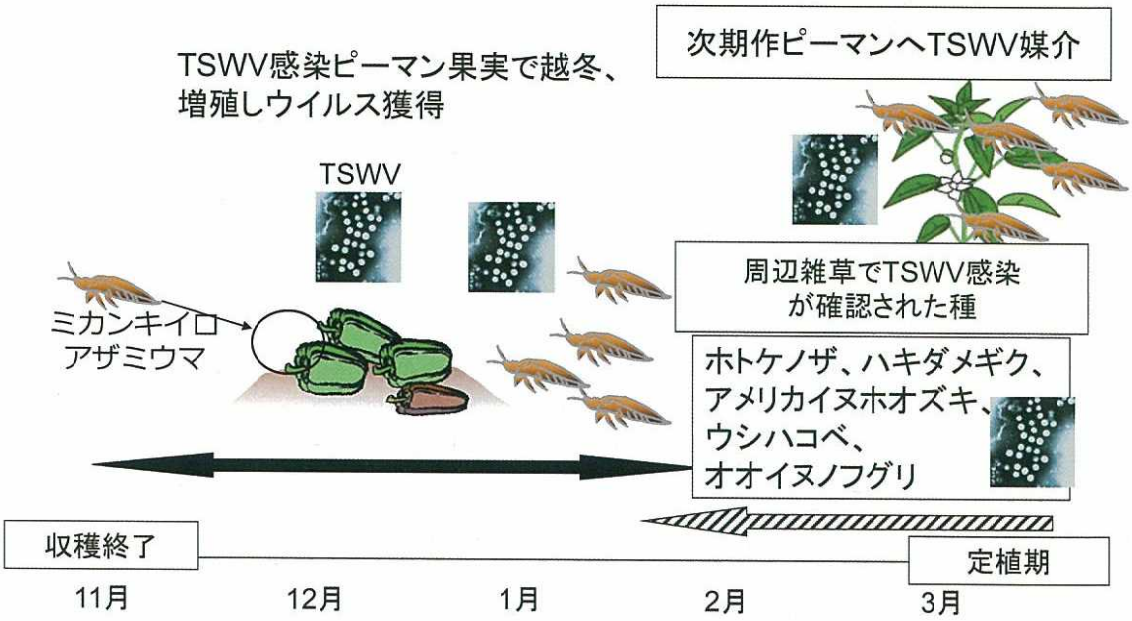


写真３　TSWVに感染したピーマンの症状

写真４　圃場内に放置されていた果実残渣（左）と果実残渣に
生息していたミカンキイロアザミウマ成幼虫（右）



第１図　大分県のピーマン圃場でのトマト黄化えそウイルス（TSWV）伝染環

マイクロチューブ内でアザミウマ成虫に24時間摂食させた後に
水面に浮かべて48時間経過したリーフディスク.
黒褐色のえそ斑点を形成したディスクがTSWV陽性.

写真５　ペチュニアリーフディスク法検定

写真６　TSWVに感染した雑草の病徴

写真７　青色粘着板に付けたミカンキイロアザミウマ
雌成虫（上４頭）と雄成虫（下３頭）

写真８　スワルスキーカブリダニの放飼実演（左）
静置されたピーマン葉上の資材（中央）
空ボトルを支柱に刺し処理完了の目印（右）

写真９　ピーマン花に集まるスワルスキーカブリダニ（左）
葉裏に生息するスワルスキーカブリダニ（中央）
ピーマン葉裏の毛耳に生息する雌成虫と産下された卵（右）

写真10　作付け修了後に残渣を放置した圃場（左）
指導後は残渣を除去し圃場内を耕耘（右）

写真11　TSWV対策会議（豊後大野市 2002年）（左）
集落単位での現地研修会（竹田市 2007年）（中央）
ピーマン定植後のウイルスチェック（竹田市 2006年）（右）