

Survey of Thysanoptera occurring on vegetable crops as potential *Tospovirus* vectors in Mendoza, Argentina

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■ **ABSTRACT.** Tospoviruses severely affect tomato, lettuce and other crops in Argentina, and are thrips transmitted in nature. The epidemiology of tospoviruses is closely related with vector's ecology. The aim of this study was to know the Thysanoptera fauna in and around the tomato ecosystem of the Mendoza province, and to find rearing methods for the more common species. Thrips were collected from 51 host plants and 19 species were identified, five of which [*Bregmatothrips venustus* Hood, *Chirothrips frontalis* Williams, *C. texanus* (Andre), *Frankliniella frumenti* Moulton, and *F. valdiviana* Sakimura & O' Neill] are new records for Mendoza and *Karnyothrips longiceps* (Hood) for Argentina. Three out of the eight species reported to transmit tospoviruses are present in Mendoza: *F. schultzei* (Trybom), *F. occidentalis* (Pergande) and *Thrips tabaci* Lindeman. Rearing methods were developed for eight species: *Aptinothrips rufus* (Haliday), *F. australis* Morgan, *F. frumenti*, *F. gemina* (Bagnall), *F. occidentalis*, *F. schultzei*, *Haplothrips trellesi* Moulton, and *T. tabaci*. Colonies were reared from a single female in a growth room at 25° (± 2) and L 12: D 12.

KEY WORDS: Thysanoptera. *Tospovirus*. Thrips. *Frankliniella schultzei*. *Frankliniella occidentalis*.

■ **RESUMEN.** Relevamiento de Thysanoptera en cultivos hortícolas, como vectores potenciales de *Tospovirus* en Mendoza, Argentina. En la Argentina el tomate, la lechuga y otras hortalizas, son severamente atacadas por virus del género *Tospovirus*. Estos virus, son transmitidos por trips en condiciones naturales. La epidemiología de los tospovirus, está estrechamente relacionada con la ecología de los vectores. El propósito de este trabajo, fue conocer la fauna Thysanoptera en el ecosistema de tomate y su área circundante, en la provincia de Mendoza, y también poner a punto métodos de cría para las especies más abundantes. Se coleccionaron trips en 51 huéspedes y se identificaron 19 especies de tisanópteros, cinco de los cuales [*Bregmatothrips venustus* Hood, *Chirothrips frontalis* Williams, *C. texanus* (Andre), *Frankliniella frumenti* Moulton y *F. valdiviana* Sakimura & O' Neill] son citas nuevas para Mendoza, y una *Karnyothrips longiceps* (Hood) para la Argentina. Ocho especies han sido registradas en la bibliografía mundial como vectoras de tospovirus, de las cuales sólo tres están presentes en Mendoza: *F. schultzei* (Trybom), *F. occidentalis* (Pergande) y *Thrips tabaci* Lindeman. Se ajustaron métodos de cría para ocho de las especies identificadas: *Aptinothrips rufus* (Haliday), *F. australis* Morgan, *F. frumenti*, *F. gemina* (Bagnall), *F. occidentalis*, *F. schultzei*, *Haplothrips trellesi* Moulton y *T. tabaci*. Las colonias se originaron en una sola hembra, en cámara de crecimiento a 25 °C (± 2) con fotoperíodo de 12 horas.

PALABRAS CLAVE: Thysanoptera. *Tospovirus*. Trips. *Frankliniella schultzei*. *Frankliniella occidentalis*.

INTRODUCTION

The transmission of tomato spotted wilt virus (TSWV) by thrips, was established by Pittman in 1927. Since that time at least eight species belonging to the family Thripidae (Order: Thysanoptera) have been reported as vectors of tospoviruses, *Frankliniella fusca* (Hinds) "tobacco thrips", *F. intonsa* (Trybom), *F. occidentalis* (Per-gande) "western flower thrips", *F. schultzei* (Trybom) "common blossom thrips", *Thrips palmi* Karny, *T. setosus* Moulton, *T. tabaci* Lindeman "onion thrips", and *Scirtothrips dorsalis* Hood "chili thrips" (Cho *et al.*, 1989; Hunter *et al.*, 1995; Johnson *et al.*, 1995; De Haan, inéd.). Two of these species, *F. schultzei* and *T. tabaci* have been recorded in Argentina since 1932 (Moulton, 1935). The recently reported *F. occi-dentalis* (De Santis, 1995, 1996; Descamps *et al.*, 1995) is the most efficient vector of TSWV in North America and Europe (Sakimura, 1961a; Paliwal, 1974; Ullman *et al.*, 1989; Lacasa Pla-sencia, 1990; Pitblado *et al.*, 1990; Marchoux *et al.*, 1991; Stobbs *et al.*, 1992).

There is not enough information on tospovirus vectors in Argentina. Only *F. schultzei* has been studied and reported as a vector (Fawcett, 1938; Delle Coste & Zabala, 1946). The Mendoza species of Thysanoptera were updated by De Santis *et al.* (1978), which is the latest report known to the authors.

The objectives of this study were to identify the thrips species present in and around the to-mato ecosystem of Mendoza, to develop rearing methods for those species comnly collected sus-pected or known to be TSWV vectors to assess their role in the epidemiology of TSWV and other tospoviruses, and to update the Thysanoptera fau-na of Mendoza.

MATERIAL AND METHODS

Collection and identification of thrips. Sam-pling of thrips started in August 1991 and ended in 1995. The surveyed area was the tomato grow-ing region of the Mendoza province, located in the middle west of Argentina at 66° 50' to 70° 00' longitude W and 32° 00' to 37° 40' latitude South. Different plants or plant parts, which could harbor thrips (weeds, tomato and others crops) were collected from the field and

brought to the laboratory. The insects were shak-en from flowers and leaves on a white paper, and picked up with a fine-pointed camel's hair brush (Sakimura, 1961b). The thrips were pre-served in small vials containing a mixture of 10 parts 60% ethyl alcohol, 1 part glycerin and 1 part acetic acid (AGA) (Stannard, 1968; Palmer *et al.*, 1989). Permanent mounts. The indivi-duals were dehydrated by gradually increasing the concentrations of ethyl alcohol, and then mounted in balsam. The specimens were iden-tified using keys and descriptions by Moulton (1932,1933a, b, c, d, 1935, 1948), Bailey (1951), De Santis (1967), Mound (1968), Stannard (1968), Mound *et al.* (1976), De Santis *et al.* (1978), Sakimura & O'Neill (1979) and Mound & Marullo (1996).

Fast mounts. The thrips were mounted in Hoyer's medium.

The Thysanoptera studied here are deposited in the Plant Virus Laboratory of the Estación Expe-rimental Agropecuaria Mendoza (INTA), Men-doza, Argentina. Plant species were identified by the Ing. Agr. Oscar Campeggia and they are stored in the herbarium of the same laboratory.

Rearing. The thrips were reared in a growth chamber at 25 °C (±2) and L12:D12. Colonies were started from a single adult female by the fol-lowing methods: Reared on cereal seedlings. Barley, oats, rye and wheat were used. Seeds were placed on moistened filter paper at the bot-tom of a glass vial (15 seeds per vial), and when seedlings were 5 cm high a female was confined in it. The container was covered with transpa-rent PVC film. Two weeks later, the progeny was transferred to a new vial.

Reared on plants grown in clay pots. The thrips were confined with the potted plant in a glass cy-linder covered with PVC film.

Reared in acrylic cages. The cage was an acry-lic cylinder (40 mm long x 20 mm diameter) with both ends closed with Parafilm (Murai & Ishii, 1982; Teulon & Penman, 1986) or PVC film. The thrips were fed on pieces of bean pods, cabbage midribs (Sakimura, 1961b) or pollen and nutrient medium. When pollen was used, a drop of con-centrated apple juice or diluted honey was depo-sited at one end, and covered with stretched Para-film. In pollen cages the eggs of terebratian spe-cies were laid in the nutrient solution between the double Parafilm membrane. When the larvae hatched, they were placed in a new rearing cage.

The rearing containers were arranged in lidded acrylic boxes. Moistened filter paper at the bottom of the box provided adequate moisture.

RESULTS

Identification of Thysanoptera. During the study, 19 species were identified (Table I), five of which [(*Bregmatothrips venustus* Hood, *Chirothrips frontalis* Williams, *C. texanus* (Andre), *Frankliniella frumenti* Moulton, 1948 and *Frankliniella valdiviana* Sakimura & O' Neill 1979) are new records for Mendoza. Another species *Karnyothrips longiceps* (Hood) is a new record for Argentina. The thrips were collected from 51 host plants listed in table I. *Frankliniella valdiviana* was previously misidentified and reported as *F. tympanona* Hood, in Argentina (De Santis *et al.*, 1978). The presence of metascutular campaniform sensilla and the stouter antenna III, a distinct character of *F. valdiviana*, in the specimens labeled as *F. tympanona* in the Museo de La Plata collection, support our conclusion. Four species, *Haplothrips trellesi* Moulton, *H. leucanthemi*, *K. longiceps* and *Leptothrips mali* Fitch, belong in the suborder Tubulifera, the remaining Thysanoptera here studied are classified in the suborder Terebrantia.

Rearing. Eight species were reared with methods previously described (Table II).

Cereal seedlings. *Aptinothrips rufus* (Haliday), *F. frumenti* and *T. tabaci* were satisfactory reared on barley seedlings.

Plants grown in clay pots. *F. schultzei* was raised on lettuce, tomato and *Sonchus oleraceus* L., whereas *T. tabaci* were reared on onion and lettuce.

Acrylic cylinder cages. *F. australis* Morgan, *F. gemina* Bagnall, *F. occidentalis*, *F. schultzei* and *T. tabaci* were reared on pieces of bean pods, *T. tabaci* on cabbage midribs and *F. australis* and *Haplothrips trellesi* on pollen and nutrient solution.

DISCUSSION

During the survey period, three species (*F. occidentalis*, *F. schultzei* and *T. tabaci*) out of eight reported as transmitting tospoviruses were collected. *Thrips tabaci* was the most polyphagous species. It was widely distributed on weeds (includ-

ing grasses) and cultivated plants and found on 39 of 51 host species tested. Although *T. tabaci* is considered a vector in some countries (Lemmetty & Lindqvist, 1993; Sakimura, 1963), there is no evidence that it is a vector in Argentina.

According to De Santis (1970), only the dark form of *F. schultzei* was collected in Argentina. It was considered previously that only this color form was a vector (Sakimura, 1969), but recently, it was shown that the light form can also transmit two tospoviruses with low efficiency (Wijkamp *et al.*, 1995). In the present work, this species was found on leaves and flowers of some cultivated plants and many common weeds.

The western flower thrips were recently recorded on glasshouse crops and alfalfa in Argentina. The first outbreak of *F. occidentalis* appeared at the same time as the first report of TSWV on *Chrysanthemum* in commercial glasshouses of Buenos Aires province (Dal Bó *et al.*, 1995). In Mendoza, this species was detected on *Aster* crops infected with TSWV.

A typical fauna on grasses included seed feeding species on the spikes [*C. frontalis*, *Arorathrips mexicanus* (Crawford) and *C. texanus*] and leaf feeding species (*A. rufus*, *B. venustus* and *F. frumenti*). The most common species were *F. frumenti* (native of South America) and *A. mexicanus*. The predator *K. longiceps* and another possible predator *Stomatothrips bahamondesi* De Santis, were found in low number (two specimens each).

Four flower species, *F. australis*, *F. gemina*, *H. trellesi* and *H. leucanthemi* (Schrank) were captured on flowers and foliage of many weeds and cultivated plants. *Frankliniella valdiviana* and two predators, *Aeolothrips fasciatus* (Linné), *Leptothrips mali* were collected only on flowers.

Drepanothrips reuteri Uzel, found on leaves of grapevine, is considered host-specific to this crop.

The rearing methods described are suitable to obtain colonies from a single female for further studies on virus transmission.

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<i>Frankliniella gemina</i>	<i>Chenopodium album</i> L. "yuyo blanco"	on flowers
	<i>Flaveria bidentis</i> (L) O.K. "fique"	
	<i>Foeniculum vulgare</i> Hill. "hinojo"	
	<i>Hoffmanseggia falcaria</i> Cav. "porotillo"	
	<i>Lactuca sativa</i> L. "lechuga"	
	<i>Lycopersicum esculentum</i>	
	<i>Malva parviflora</i>	
	<i>Matricaria chamomilla</i>	
	<i>Melilotus albus</i>	
	<i>Pitracca cuneato-ovata</i> (Cav). Caro "papilla"	
	<i>Plantago lanceolata</i> L. "llantén"	
	<i>Pyrus communis</i>	
	<i>Raphanus sativus</i>	
	<i>Rapistrum rugosum</i>	
	<i>Sisymbrium irio</i>	
	<i>Solanum eleagnifolium</i> Cav. "quillo"	
	<i>Tessaria absinthioides</i>	
<i>Wedelia glauca</i> (Ort.)Hoffm. "clavel amarillo"		
<i>Medicago sativa</i>	on flowers and leaves	
<i>Eragrostis virescens</i>	occasionally	
<i>Frankliniella occidentalis</i>	<i>Chrysanthemum morifolium</i> Ram. "crisantemo"	on flowers
	<i>Dianthus caryophyllus</i> L. "clavel"	
	<i>Sisymbrium irio</i>	
<i>Frankliniella schultzei</i>	<i>Baccharis</i> sp.	on flowers
	<i>Calendula officinalis</i>	
	<i>Capsicum annuum</i>	
	<i>Chenopodium album</i>	
	<i>Convolvulus arvensis</i> L. "correhuela"	
	<i>Eruca sativa</i>	
	<i>Hofmanseggia falcaria</i>	
	<i>Malva parviflora</i>	
	<i>Medicago sativa</i>	
	<i>Pitracca cuneato-ovata</i>	
	<i>Plantago lanceolata</i>	
	<i>Portulaca oleracea</i> L. "verdolaga"	
	<i>Pyrus communis</i>	
	<i>Rapistrum rugosum</i>	
	<i>Sisymbrium irio</i>	
	<i>Solanum eleagnifolium</i>	
	<i>Anoda cristata</i> (L) Schlecht. "malva cimarrona"	on flowers and leaves
<i>Lycopersicum esculentum</i>		
<i>Lactuca sativa</i>	on leaves	
<i>Sorghum halepense</i>	occasionally	
<i>Frankliniella valdiviana</i>	<i>Baccharis</i> sp.	on flowers
<i>Haplothrips leucanthemi</i>	<i>Lycopersicum esculentum</i>	on flowers
	<i>Plantago lanceolata</i>	
	<i>Sorghum halepense</i>	
<i>Haplothrips trellesi</i>	<i>Amaranthus</i> sp.	on flowers
	<i>Avena</i> sp.	
	<i>Calendula officinalis</i>	
	<i>Chenopodium album</i>	
	<i>Flaveria bidentis</i>	
	<i>Lycopersicum esculentum</i>	

Table II. Methods of rearing for different thrips species

Method	Sustrate	Thysanoptera species
Seedlings of cereals	Barley	<i>Aptinothrips rufus</i>
		<i>Frankliniella frumenti</i>
		<i>Thrips tabaci</i>
Clay pots	Lettuce	<i>Frankliniella schultzei</i>
	Tomato	<i>Frankliniella schultzei</i>
	<i>Sonchus oleraceus</i>	<i>Frankliniella schultzei</i>
	Onion	<i>Thrips tabaci</i>
	Lettuce	<i>Thrips tabaci</i>
Acrylic cylinders	bean pods	<i>Frankliniella australis</i>
	bean pods	<i>Frankliniella gemina</i>
	bean pods	<i>Frankliniella occidentalis</i>
	bean pods	<i>Frankliniella schultzei</i>
	bean pods	<i>Thrips tabaci</i>
	cabbage midribs	<i>Thrips tabaci</i>
	polen + nutr. sol.	<i>Frankliniella australis</i>
		<i>Haplothrips trellesi</i>

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