

## The First Record of *Echinothrips americanus* Morgan in Slovenia

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In 2001 *Echinothrips americanus* Morgan was first recorded in Slovenia. The thrips was first recorded in Europe in 1989, but did not begin to spread to a greater extent until 1993. This polyphagous pest is believed to cause direct damage, especially on the leaves of its host plants. The present contribution describes genetic structure of *Echinothrips americanus* Morgan rooting in polymorphism of the ITS1-5.8S-ITS2 region of the ribosomal DNA. *Echinothrips americanus* Morgan is less resistant to insecticides and its ability to inhabit new areas is smaller, compared to the Western flower thrips [*Frankliniella occidentalis* (Pergande)]. It can be concluded that its economic importance in the future will not reach that of the latter. We gave a detailed description of the species, its geographic distribution, and deal with its host plants as well as bionomics and its potential natural enemies.

Keywords: *Echinothrips americanus*, first record, economic importance, presentation of the species, Slovenia, Hungary.

The introduction of western flower thrips [*Frankliniella occidentalis* (Pergande)] into Europe in 1983 and above all its very quick spreading over the entire continent has been a phytomedical surprise and challenge, accordingly, much attention has been paid to possible spreading of other potentially harmful species of the Thysanoptera order (Brødsgaard, 1989; Tommasini and Maini, 1995; Vierbergen, 1999; Trdan and Vierbergen, 2001).

After its first record in Europe in 1988 until middle of the nineties, *Thrips palmi* Karny (Loomans and Vierbergen, 1997) was given the most attention, and it remains an object of interest, especially in those districts where it has not been observed yet. It was soon established that – compared to the western flower thrips – this insect is more temperature sensitive and that on the Old continent its economical importance on the cultivated plants could never reach that of the latter. Though its presence has been established in more than 10 European countries (Marullo, 1997), none reports confirming serious economical damage were recorded.

Later on, several other potentially harmful thrips species have been introduced into Europe, one of them being *Echinothrips americanus* Morgan (Vierbergen, 1998).

## Materials and Methods

### *Sampling*

On diverse locations in Slovenia, outdoor monitoring of thrips species on various cultivated plants using classical ways of thrips sampling was performed from April 2000 to September 2001. On August 22, 2001 a female insect was found in the flower of a roseflowering hibiscus (*Hibiscus* spp.) in Šempeter near Nova Gorica (UTM UL98). According to its typical morphological characters it was later identified as *Echinothrips americanus* Morgan species. This was the first recording of this species in Slovenia.

### *Specimen conservation for morphological identification and genetic analyses*

The specimen was kept in a 1.5 ml eppendorf tube in 60% ethanol. This solvent proved to be superior to the 70% ethanol from the very beginning of the genetic analyses (DNA extraction) of various representatives of the Thysanoptera order (Trdan, 2002b). By keeping the specimens in ethanol, the original colour is better preserved, so this short-term conservation is suitable also for the morphological analyses. The tube was kept in the refrigerator, at a temperature of 2–4 °C, until further analysis.

A considerable number of specimens of *Echinothrips americanus* Morgan for genetic analyses was kindly supplied by Bert Vierbergen (Plant Protection Service, Department of Diagnostics, Section of Plant Entomology, Wageningen, The Netherlands).

### *Presentation of the species*

#### *Description*

Females of the *Echinothrips americanus* Morgan species are up 1.6 mm long, males are somewhat shorter (up to 1.3 mm). Imagoes are dark brown to black and have red subintegumental pigment, the colour of larvae and pupae varies from white to pale yellow. The thrips has 8-segmented antennae, the last two segments being the shortest, but on the average they are longer compared to the representatives of the *Frankliniella* genus. The first two segments of the antennae are darker compared to the others, the 3rd segment as well as the lower halves of the 4th and 5th segment are pale yellow, the upper half of the 4th and the 5th segment as well as the 6th, 7th and 8th segments are of dark brown colour. The sense cones on the antennae segments 3 to 6 are simple.

The surfaces of the vertex, pronotum and metanotum are highly sculptured (*Fig. 1*), on the posterior side of pronotum there are two pairs of longer posteroangular setae, between them there is one pair of shorter posteromarginal setae. On the posterior part of the pronotum there are two more or less distinct areas medially where the reticulation is weak. In the central part of the tergites there are two longer parallel setae (*Fig. 2*), on the first pair of the fringed wings they are located only on the first longitudinal vein. Across lateral quaters of each tergite there are sub-reticulate sculpture with conspicuous microtrichia, which are not to be found with the majority of the Thripinae subfamily. There is a complete posteromarginal comb on the 8th segment of the abdomen. The base of the femur, the distal half of tibia as well as the whole of tarsi are yellow, other parts of femur and tibia are brown.



Fig. 1. Highly sculptured surface of the vertex and pronotum

The forewings are mostly darker (pale brown), with a paler base (pale grey), similarly, often not very pronounced pale shoulders appear in the central part of the forewings. Posterior fringe cilia are wavy, while setae on the forewings grow out only from the costa and first longitudinal vein (Fig. 3) (Oetting et al., 1993; Collins, 1998; Mound and Kibby, 1998; Vierbergen, 1998).

*Systematics and morphological relations with some other species already recorded in Slovenia and in Hungary*

*Echinothrips americanus* Morgan is one of the eight already described species of the *Echinothrips* genus, it is economically the most important one (Mound and Kibby, 1998). It is the only representative of this genus which has been found also outside the New World. According to the existing systematics it belongs to the subfamily of Thripinae (family



Fig. 2. Tergites with median pair of setae long and close together

Thripidae, suborder Terebrantia), though the surfaces of vertex, pronotum and metanotum are highly sculptured, which is also a characteristic of the subfamily Panchaetothripinae. This latter includes also *Parthenothrips dracaenae* (Heeger) and *Hercinothrips femoralis* (Reuter), two species which have already been found in Slovenia, the first in 1998 on the ornamental *Dracaena* spp. (Trdan, 2001), and the second only recently (in January 2002) on maize leaves in the laboratory (Trdan, 2002c). Both these thrips have been also found in Hungary (Jenser and Czencz, 1988; Reiderne et al., 1997). From the two thrips species which exhibit a great morphological resemblance to *Echinothrips americanus* Morgan (they look more like it as the majority of the Thripinae subfamily) the latter can be distinguished by a well-developed spinula on the mesothoracic furca and by the capitate apices of the posteroangular setae. It differs from the majority of the subfamily Thripinae also by simple

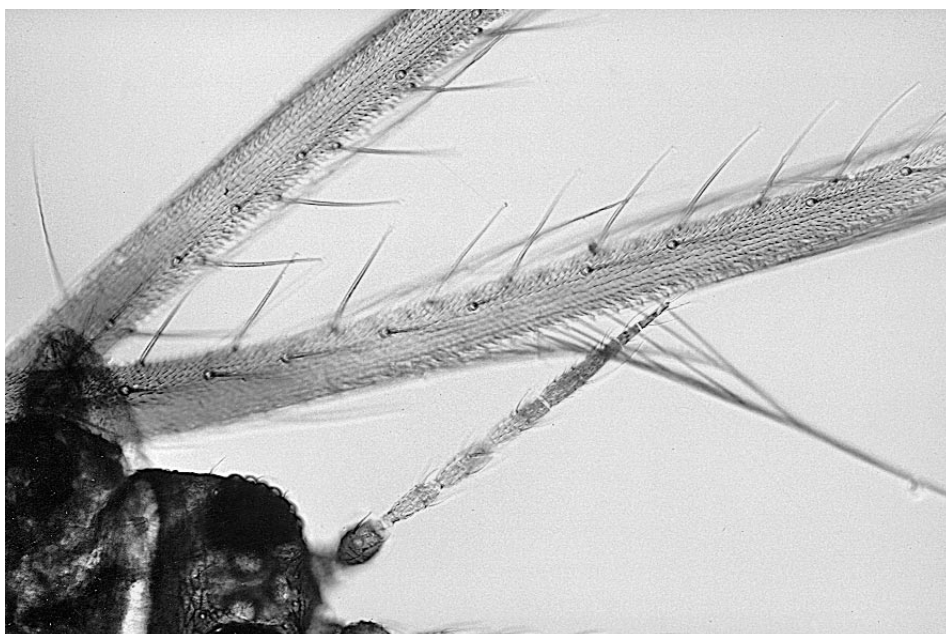


Fig. 3. Forewing setae growing out from the first longitudinal vein

sense cones on the 3rd and 4th segment of the antennae (the 1st segment has forked sense cones). Additionally, microtrichia found laterally on the abdominal tergites are not typical for the Thripini group (one of the 4 groups included into the subfamily Thripinae). Thrips *Parthenothrips dracaenae* (Heeger) and *Hercinothrips femoralis* (Reuter) (as well as the species *Heliothrips haemorrhoidalis* [Bouché], which was first found in Slovenia in 1970 [Janežič, 1991]), have characteristically long last two antennal segments (they are longer compared to the one that precedes them), which is not true for the species *Echinothrips americanus* Morgan.

#### *Genetic structure of Echinothrips americanus Morgan*

The entire genomic DNA of *Echinothrips americanus* Morgan was extracted using a CTAB method (Saghai-Maroo et al., 1984; Kump et al., 1992). The genetic structure was studied on the level of polymorphism of ITS1-5,8S-ITS2 region of the ribosomal DNA, obtained using five restriction enzymes. Protocol is described in detail elsewhere (Trdan, 2002b).

Amplification of ITS1-5,8S-ITS2 region of *Echinothrips americanus* Morgan showed the lengths about 1550 bp.

Further restriction with the Alu I and Rsa I enzymes gave unsatisfactory results. The remaining three restriction enzymes (Hae III, Hinf I, Msp I) did their job and cut the ITS1-5,8S-ITS2 region into several restriction fragments of different lengths (Fig. 4).

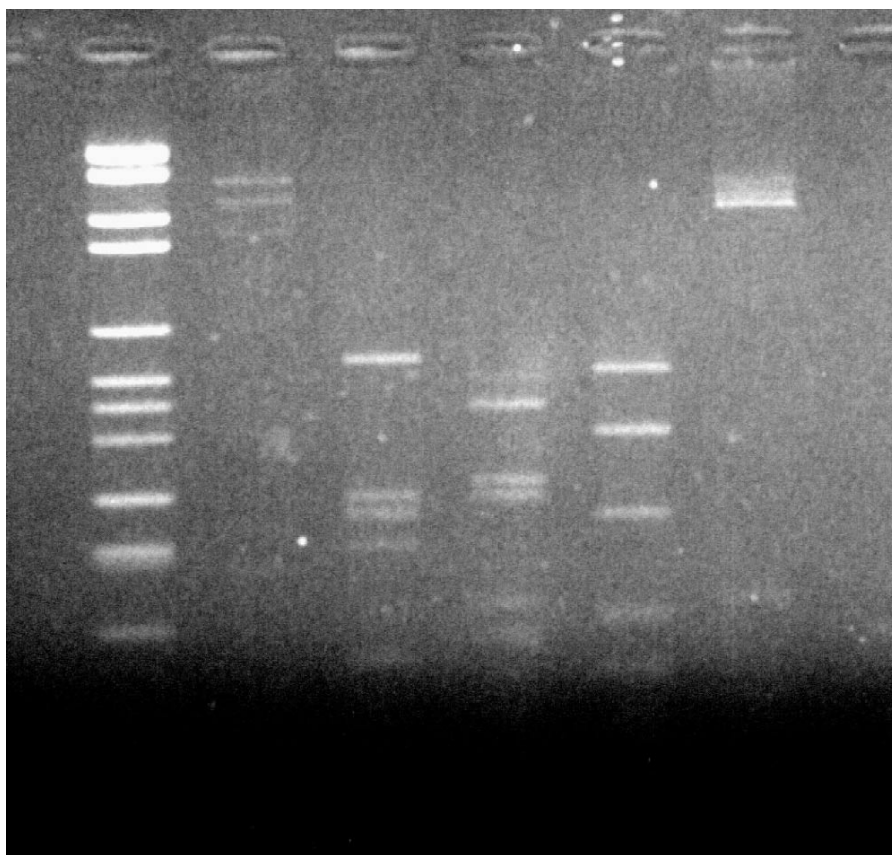


Fig. 4. Restriction patterns of *Echinothrips americanus* Morgan based on restriction of ITS1-5.8S-ITS2 rDNA region with five different restriction enzymes (marker VI; enzymes Alu I, Hae III, Hinf I, Msp I and Rsa I from left to right)

### *Geographic distribution*

*Echinothrips americanus* Morgan is a Nearctic species, first found in the southeast of the USA. Today, in this region the insect is primarily a pest on the ornamentals in the greenhouses, though, under warmer climatic conditions, it can overwinter also in the outdoors, mostly on the weeds in the forests. On the North American continent no records were obtained North to Quebec or West to Iowa (Stannard, 1968), additionally, there are references on its occurrence in California (Morgan, 1913), Mexico (Naime, 1973), Hawaii (Mitchell, 1983) and Bermuda islands (Nakahara and Hilburn, 1989).

The first report of *Echinothrips americanus* Morgan in Europe came from England, where it has been found in 1989, most probably on the ornamentals, which were ment to provide food for exotic insects of the Lepidoptera order. It was only in 1995 when the mass occurrence of this pest took place in the same country, the reports cover 52 introductions

on 39 locations, mostly on the plant material imported from Netherlands (Collins, 1998). The first mass occurrence of the *Echinothrips americanus* Morgan species on the Old continent was reported in 1993 in the Netherlands, where the species was found on the plants belonging to the genera *Synгонium* and *Homalomena* (Cevat and Roosjen, 1994; Vierbergen, 1998). In Europe it has been found also in Italy (Marullo and Pollini, 1999; Scarpelli and Bosio, 1999), in Ireland (Dunne and O'Connor, 1997), in France (Reynaud, 1998), in Sweden (Nedstam, 2001), in Germany (Vierbergen, 1998) and in Austria (EPPO Reporting Service, 2001).

#### *Hostplant range*

The studied insect has a wide hostplant range and is extremely polyphagous. It prefers the plants from the Araceae and Balsaminaceae families, though it has been found on plants belonging to 24 families (Vierbergen, 1998). In the USA the most frequent hosts are those belonging to the genera *Dendranthema*, *Euphorbia*, *Impatiens* and *Medicago* as well as some wooden ornamentals, but the insect is confined to reproduce on at least 40 cultivated and 59 wild-growing different host plant species (Oetting et al., 1993). The most important host plants of *Echinothrips americanus* Morgan in England are those belonging to the genera *Synгонium* and *Dieffenbachia*, in the greenhouses it can also move to plants from the following genera: *Acalypha*, *Dracaena*, *Fatsia*, *Ficus*, *Hibiscus* and *Spathiphyllum* (Collins, 1998; Scarpelli and Bosio, 1999). In the Netherlands this thrips represents an ever increasing threat for the sweet pepper in the greenhouses. Generally speaking, the hostplant range of *Echinothrips americanus* Morgan is more like that of the thrips belonging to the subfamily Panchaetothripinae and less like that of the thrips belonging to the subfamily Thripinae. Considering different plant groups the only ones where this pest has not been found are ferns and needle-leaved trees (Vierbergen, 1997).

#### *Bionomics*

Females deposit eggs singly at random in slits in the leaf tissue. Life cycle gets shorter if the temperature of the surroundings rises. It lasts 33.9 days at 20 °C and 11.4 days at 30 °C (Oetting and Beshear, 1994).

Detection of imagoes (adults) and larvae is relatively straightforward, as the insect lives on the leaf surfaces in both development stages. The insects feed on the upper or on the lower leaf surface, but they are usually more numerous on the lower surface. *Echinothrips americanus* Morgan can sometimes be found also in flowers (Oetting et al., 1993; Oetting and Beshear, 1994; Collins, 1998).

According to observations and studies the species *Echinothrips americanus* Morgan exhibits several advantageous properties which make its staying in the greenhouses (after it has been introduced, usually with plant material) rather longer than growers of ornamental and vegetable crops would like. The insect is polyphagous, it multiplies with facultative arrhenotoky, has a short developmental time and is polyvoltine. The introduction of the so-called opportunistic thrips becomes easier if they exhibit any of the above-mentioned properties (Mound and Teulon, 1995).

### Damage and control

The economic importance of the pest is determined by the damage it causes on the cultivated plants. This results from the sucking of imagoes and larvae. The signs on the leaves are often similar to those caused by sucking of phytophagous mites (Acarina) and are observable as small chlorotic areas. Another typical sign on the leaf surface resulting from the thrips sucking is the so-called silvering, occurrence of silver areas often formed as streaks. The aesthetic appearance of the plants suffers also because of black fecal material on the leaves. Compared with the western flower thrips [*Frankliniella occidentalis* (Pergande)] the direct damage caused *Echinothrips americanus* Morgan, is considerably smaller. There is no evidence that any plant viruses are transmitted because of *Echinothrips americanus* Morgan (Collins, 1998).

Contrary to some other thrips species [*Thrips tabaci* Lindeman, *Frankliniella occidentalis* (Pergande)], which are known to develop a resistance to insecticides rather quickly, *Echinothrips americanus* Morgan is known to be much less resistant and can be relatively easily controlled with most of commonly used insecticides active against this insects (Oetting et al., 1993; Oetting and Beshear, 1994; Reynaud, 1998; Vierbergen, 1998). Reports on successful use of acephate and cyfluthrin came from Italy (Scarpelli and Bosio, 1999), in England heptenophos and malathion were found to be rather effective, while the effect of deltamethrin was not that satisfactory (Macdonald, 1997). This could be an indication of potential resistance of the species against these pyrethroids.

One could come to the conclusion that in the absence of effective predators and parasitoids, in Europe this thrips can become a considerably important pest in greenhouses in a rather short time (Vierbergen, 1998). Among significant potential predators of the *Echinothrips americanus* Morgan bugs of the *Orius* order and mites of the *Amblyseius* order (Macleod, 1997) as well as thrips *Frankliniella vespiformis* (Crawford) (Nedstam, 2001) are most often mentioned.

### Estimation of potential economic importance of *Echinothrips americanus* Morgan in Slovenia and in Hungary

It can be assumed that the first record on *Echinothrips americanus* Morgan in Slovenia was a rather early one, at least if we compare it with *Microcephalothrips abdominalis* (Crawford), which was also recently found in Slovenia (Trdan, 2002a). The occurrence of this latter is considerably greater, so, one can conclude that *Echinothrips americanus* Morgan has not spread in greenhouses to a greater extend. This gives us the opportunity to make the necessary plans and take the measures needed.

According to the experience of growers of ornamental and vegetable crops in other European countries, where these pests have been found, a minor economic importance of *Echinothrips americanus* Morgan can be expected in Slovenia as well as in Hungary. So, it is not at all probable that its importance will be even close to that of *Frankliniella occidentalis* (Pergande), which is very widespread in both countries (Jenser and Tusnadi, 1989; Trdan et al., 1999). This being so, in the strategy against *Echinothrips americanus* Morgan the trying of some alternative pest control methods, which are more environment



friendly, is indicated, in spite of the fact that such methods failed with its more invasive relative *Frankliniella occidentalis* (Pergande) (Fejt and Jarošik, 2000).

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## Literature

- Brødsgaard, H. F. (1989): *Frankliniella occidentalis* (Thysanoptera; Thripidae) – a new pest in Danish glass-houses. A review. Dan. J. Plant Soil Sci. 93, 83–91.
- Cevat, H. and Roosjen, M. (1994): De belangrijkste plaaggeesten van 1993. Vakbl. Bloemisterij 49, 30–34.
- Collins, D. W. (1998): Recent interceptions of *Echinothrips americanus* Morgan (Thysanoptera, Thripidae) imported into England. Entomol. Mon. Mag. 134, 4 p.
- Dunne, R. and O'Connor, J. P. (1997): *Echinothrips americanus* (Thysanoptera: Thripidae) new to Ireland. Ir. Nat.' J. 25, 11–12.
- EPPO Reporting Service (2001): *Echinothrips americanus* ... new geographical records, 2001/021, Paris, EPPO: 2.
- Fejt, R. and Jarošik, V. (2000): Assessment of interactions between the predatory bug *Orius insidiosus* and the predatory mite *Phytoseiulus persimilis* in biological control on greenhouse cucumber. Plant Prot. Sci. 36, 85–90.
- Janežič, F. (1991): Prispevek k poznavanju tripsov ali resarjev (Thysanoptera) na rastlinah v Sloveniji. Zb. Bioteh. fak. Univ. Ljublj., Zv. 57 – Kmet., 169–178.
- Jensér, G. and Czencz, K. (1988): Thysanoptera species occurring frequently on cultivated plants in Hungary. Acta Phytopathol. Entomol. Hung. 23, 285–289.
- Jensér, G. and Tusnadi, C. K. (1989): A nyugati virágtripsz (*Frankliniella occidentalis* Pergande) megjelenése Magyarországon. Növényvédelem 25, 389–393.
- Kump, B., Svetek, S. and Javornik, B. (1992): Isolation of high molecular weight DNA from plant tissues. Res. Rep., Biotech. Fac., Univ. Ljublj., Agric. 59, 63–66.
- Loomans, A. J. M. and Vierbergen, G. (1997): Thrips palmi: a next thrips pest in line to be introduced into Europe? Bull. OILB/SROP 20, 162–168.
- Macdonald, O. (1997): Thripsnet (network on exchange of the information on thrips), pers. comm., Nov 24.
- Macleod, A. (1997): Thripsnet (network on exchange of the information on thrips), pers. comm., Nov 27.
- Marullo, R. (1997): *Thrips palmi*, un importante parassita da quarantena per l'Italia. Inf. Fitopatol. 47, 18–22.
- Marullo, R. and Pollini, A. (1999): *Echinothrips americanus*, un nuovo parassita nelle serre italiane. Inf. Fitopatol. 49, 61–64.
- Mitchell, W. C. (1983): *Echinothrips americanus* Morgan. Proc. Hawaii Ent. Soc. 24, 192.

- Morgan, A. C. (1913): New genera and species of Thysanoptera, with notes on distribution and food plants. Proc. U.S. Nat. Mus. 46, 1–55.
- Mound, L. A. and Kibby, G. (1998): Thysanoptera. An Identification Guide. 2nd Edition. CAB Int., Wallingford, 70 p.
- Mound, L. A. and Teulon, D. A. J. (1995): Thysanoptera as Phytophagous Opportunists. In: Parker, B. L. et al., (eds.): Thrips Biology and Management. Plenum Press, N. Y. and Lond., 3–19.
- Naime, R. M. J. (1973): Notas acerca de algunas especies de trips (Insecta-Thysanoptera), de la entomofauna de Mexico. Revta Soc. Mex. Hist. Nat. 34, 43–53.
- Nakahara, S. and Hilburn, D. J. (1989): Annotated checklist of the Thysanoptera of Bermuda. J. N. Y. Ent. Soc. 97, 251–260.
- Nedstam, B. (2001): Tripsarter i grön innemiljö. Växtskyddsnotiser 65, 6–9.
- Oetting, R. D. and Beshear, R. J. (1994): Biology of the greenhouse pest *Echinothrips americanus* Morgan (Thysanoptera: Thripidae). Zool. (J. Pure Appl. Biol.) 4, 307–315.
- Oetting, R. D., Beshear, R. J., Liu, T.-X., Braman, S. K. and Baker, J. R. (1993): Biology and identification of thrips on greenhouse ornamentals. Univ. Ga., Res. Bull. 414, 20 p.
- Reiderné, S. K., Jenser, G. and Szalay, M. L. (1997): The occurrence of *Cerataphis orchidearum* (Westwood) (Homoptera: Hormaphididae) and *Hercinothrips femoralis* (O. M. Reuter) (Thysanoptera: Thripidae) in Hungarian glasshouses. Növényvédelem 33, 239–241.
- Reynaud, P. (1998): *Echinothrips americanus*. Un nouveau thrips des serres importé en France. Phytoma 507, 36–38.
- Saghai-Marouf, M. A., Soliman, K. M., Jorgensen, R. A. and Allard, R. W. (1984): Ribosomal DNA spacer length polymorphism in barley: Mendelian inheritance, chromosomal location and population dynamics. Prot. Natl. Acad. Sci. 81, 8014–8018.
- Scarpelli, F. and Bosio, G. (1999): *Echinothrips americanus* Morgan, nuovo tisanottero delle serre. L'Inf. Agrar., LV 2, 59–61.
- Stannard, L. J. (1968): The thrips, or Thysanoptera of Illinois. Bull. Ill. Nat. Hist. Surv. 29, 215–552.
- Tommasini, M. G. and Maini, S. (1995): *Frankliniella occidentalis* and other thrips harmful to vegetable and ornamental crops in Europe. In: Biological control of thrips pests, Wagenig. Agric. Univ. Pap. 95, 1–42.
- Trdan, S. (2001): Thrips in Slovenia. In: Thrips, plants, tospoviruses: the millennial review, 7th Int. Symp. Thysanoptera, Reggio Calabria, Jul 02–07. 2001. 7 p.
- Trdan, S., Seljak, G. and Jenser, G. (1999): Cvetlični resar (*Frankliniella occidentalis* Perg.) v Sloveniji. Zb. pred. ref. 4. slov. posvetovanja vars. rastl., Portorož, March 03–04 1999. Maček J. (ed.). Ljubljana, Druš. vars. rastl. Slov., 239–246.
- Trdan, S. (2002a): After the first record of *Microcephalothrips abdominalis* (Crawford) in Slovenia: presentation of the species and evaluation of its potential economic importance. Res. Rep., Biotech. Fac., Univ. Ljubl., Agric. 79, 309–316.
- Trdan, S. (2002b): Evaluation of morphological and genetic variability of populations of economically important thrips species (Thysanoptera) in Slovenia. Dr. diss., Ljubl., Univ. Ljubl., Biotech. Fac., Agron. Dep., 100 p.
- Trdan, S. (2002c): Resar *Hercinothrips femoralis* (Reuter) ugotovljen tudi v Sloveniji. Sodob. kmet. 35, 242–244.
- Trdan, S. and Vierbergen, G. (2001): The risk of introduction of some economically important thrips species (Thysanoptera) to Slovenia. Lec. pap. 5. Slov. conf. plant prot., Čatež ob Savi, March 06–08. 2001. Maček J. (ed.). Ljubl., Plant Prot. Soc. Slov., 303–311.
- Vierbergen, G. (1997): Amerikaanse trips. Nieuwe belager in paprika. Groenten + Fruit/Glasgroenten 7, 12–13.
- Vierbergen, G. (1998): *Echinothrips americanus* Morgan, a new thrips in Dutch greenhouses (Thysanoptera: Thripidae). Proc. sect. Exp. Appl. Entomol. Neth. Entomol. Soc. (N.E.V.) 9, 155–160.
- Vierbergen, G. (1999): Risks of Thysanoptera detected on imported plant products: the Dutch experience. Proc. 6th Int. Symp. Thysanoptera, Antalya, Apr. 27. – May 01. 1998, 157–162.