

# A taxonomic revision of the genus *Tranzschelia* (Uredinales)

## Final Report

A project supported by the Studienstiftung Mykologie, Köln  
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**Abstract:** The taxonomic work started in 2 May 2005 in the State Museum of Natural History Karlsruhe, Germany in the laboratory of and supervised by Dr. Markus Scholler. During almost 5.5 months, ending 12 Oct. 2005, 352 specimens belonging to different herbaria from Asia, Europe and the USA were studied. The material studied was of two kinds: rust species on Prunoideae (Rosaceae) and rust species on Ranunculaceae. On the basis of this work, one new species, *Tranzschelia arasbaranica*, has been described. Further species are waiting to be described. The preliminary host range for several species of *Tranzschelia* was determined. The *Tranzschelia* spp. were studied morphometrically and documented, using a digital camera. Germination of teliospores of *T. discolor* was induced on different agar media. The uredinial state of *T. pruni-spinosae* differs from that of *T. discolor* in having larger, thick-walled paraphyses, especially at the apex and smaller urediniospores with different morphology. The morphological investigations are part of a study toward a monograph and a molecular phylogeny of the genus *Tranzschelia*.

## Introduction

The genus *Tranzschelia* (Urediniomycetes, Uredinales) contains about 15 species, all of which are native of the northern hemisphere (Cummins & Hiratsuka, 2003). The species are either microcyclic on Ranunculaceae or heteroecious on Ranunculaceae spp. (aecial hosts) and Rosaceae (*Prunus* s.l. spp., telial hosts). The main morphological feature is the two-celled echinulate or verrucose, pigmented teliospores that tend to adhere basally in groups.

Recently, López-Franco & Hennen (1990) studied the American species of the genus. Their study is based mainly on morphological features of the teliospore size and surface. A taxonomic revision of the old-world species, however, is still required. Two complexes, the *Tranzschelia anemones* and the *Tr. pruni-spinosae* complex, are in particular need of a major revision. The *Tr. anemones* complex includes microcyclic species on various Ranunculaceae spp. (*Anemone*, *Pulsatilla*, *Thalictrum*). The *Tr. pruni-spinosae* complex consists of taxa with similar morphology, all of which (facultatively?) switch from *Anemone* spp. to *Prunus* spp. In both complexes, there are several morphologically similar but biologically distinct species, which can hardly be delimited by spore morphology using light microscopy only. The long-term goal is to produce a worldwide biosystematic monograph of the genus *Tranzschelia*, a monograph that organizes the data into the classical form of species descriptions, circumscribes the variability of each taxon, provides insight into their ecology by giving host and geographic ranges, includes keys and illustrations to aid in identification, and presents phylogenetic ideas based on cladistic analyses of morphologic and molecular data. Such monographs are the most important products

of biosystematic research because they are essential for other scientists who require basic biological information about a species. These monographs organize data into a logical framework into which new information can be placed and from which predictions and identifications can be made.

### Material and methods

The specimens from the following herbaria: B, BPI, E, K, KR, M, PUR, STU, Z, IRAN, and different private herbaria have been studied. Newly collected specimens from Central Europe and Iran were also studied. Spores from dried specimens were mounted mostly in lactic acid in glycerol and examined with a Leitz microscope at a magnification of  $\times 400$  or  $\times 1000$ . Specimens were photographed using a Canon Power Shot A80 digital camera. Fifty spores per specimen were randomly selected and measured. For a germination test, teliospores of the specimens of *Tranzschelia discolor* collected on 27.10.2004, were scratched from the leaves with tweezers and sprinkled on agar media (R2A agar and water agar) in Petri dishes. Half of the Petri dishes were kept in a north sided room receiving some sun light in the morning and half in the dark, also at room temperature. Germination was observed every two hours and twice a day after 24 hours.

### Results

A) Nineteen taxa were recognized as follows:

A1) *Tranzschelia* species on Prunoideae (Rosaceae)

**1. *Tranzschelia microcerasi*** Tranzschel & M.A. Litv.

Host range (on the basis of herbarium and newly collected material): *Amygdalus* sp., *Prunus jacquemonti*.

**2. *Tranzschelia iranica*** M. Abbasi & Gjaerum

Host range: *Cerasus microcarpa* subsp. *tortuosa*, *Prunus microcarpa*, *Amygdalus elaeagnifolia*, *A. communis*.

**3. *Tranzschelia discolor*** (Fuckel) Tranzschel & M.A. Litv.

Host range: 0+I on, *Anemone caroliniana*, *A. coronaria*, *A. fulgens*, *A. hortensis*, II+III on *Persica simonii*, *Prunus amygdalus*, *Pr. armeniaca*, *Pr. cerasifera*, *Pr. domestica*, *Pr. domestica* subsp. *insititia*, *Pr. fenzliana*, *Pr. persica*, *Pr. pumila*, *Prunus* sp., *Pr. spinosa*.

NOTE: Several authors did not pay attention to differences between *T. discolor* and *T. pruni-spinosae* and put all specimens of rusts on stone-fruit trees under the name *T. pruni-spinosae*. The study of many herbarium materials showed that several specimens under the name *T. pruni-spinosae* belong in fact to *T. discolor*. For this reason, the distribution of *T. pruni-spinosae* is much more restricted than accepted before.

Dunegan (1938) and Laundon (1975) mentioned that the packets of Fuckel's exsiccati Fungi rhenani 2121 studied by them, did not contain *Puccinia discolor* (= *T. discolor*), but Tranzschel & Litvinov (1938) and López-Franco & Hennen (1990) showed that Fungi rhenani 2121 in herb. LE contained leaves of *P. insititia* with a rust matching *T. discolor* (= *P. discolor*). We also found a good result with Fungi rhenani 2121 in herb. B, an isotype of *T. discolor* (= *P. discolor*). While the type locality for *T. discolor* was only mentioned as "Europe" by López-Franco & Hennen (1990), we found that the type specimen was collected from Eltville at Hessen (Germany).

**4. *Tranzschelia pruni-spinosae*** (Pers.) Dietel

Host range: 0+I on *Anemone ranunculoides*, *A. nemorosa*, II+III on *Prunus armeniaca*, *Pr. spinosa*, *Pr. cerasifera*, *Pr. cerasifera* subsp. *caspiaca*, *Pr. domestica*, *Pr. domestica* subsp. *insititia*, *Pr. pumila* var. *depressa*, *Pr. pissardii*, *Pr. myrobalanus*, *Prunus* sp.

**5. *Tranzschelia* aff. *pruni-spinosae***

Host range: *Prunus grayana* (Japan).

NOTE: The specimens of *T. pruni-spinosae* on *P. grayana* were different from other Asian and European populations of *T. pruni-spinosae* in having longer urediniospores with mostly 2 equatorial germ pores. These Japanese specimens might be considered as a new variety.

**6. *Tranzschelia pruni-spinosae* var. *americana* López-Franco & J.F. Hennen**

Host range: *Prunus americana*, *Pr. nigra*.

**7. *Tranzschelia japonica* Tranzschel & M.A. Litv.**

Lectotype designated here: On *Prunus mume*, Japan, Morioka, Pref. Iwate, 29.9.1904, G. Yamada (BPI 113643), (II)+III.

Host range: *Prunus mume*, *Pr. salicina*, *Pr. anzu*, *Prunus* sp.

NOTE: This species has non-fasciculate teliospores with two similar cells, like *T. pruni-spinosae*, but it differs from that species in having teliospores with a thicker wall and larger spines. The specimens BPI 113408 and BPI 113643 were mentioned by Tranzschel & Litvinov (1939) and one of them (BPI 113643) is designated as lectotype here.

**8. *Tranzschelia ornata* López-Franco & J.F. Hennen**

Host range: 0+I on *Anemone quinquefolia*, *A. berlandieri*, II+III On *Prunus americana*, *Prunus* sp., *Pr. orthosepsls*, *Pr. besseyi*, *Pr. mexicana*.

**9. *Tranzschelia arthurii* Tranzschel & M.A. Litv.**

Host range: 0+I on *Hepatica acutiloba*, *H. nobilis* var. *acuta*, *H. nobilis*, II+III on *Prunus virginiana*, *Pr. serotina*.

**10. *Tranzschelia* sp. 1.**

Host range: *Prunus serotina* subsp. *capuli* (Mexico, Ecuador, Colombia).

NOTE: When López-Franco & Hennen (1990) studied the genus *Tranzschelia* in the Americas, they put all *Tranzschelia* specimens on *P. serotina* subsp. *capuli* under *T. arthurii*. Our revision of *Tranzschelia* specimens on *P. serotina* subsp. *capuli*, collected in Southern Mexico and the North of South America (Colombia, Ecuador) showed that all these specimens were different from *T. arthurii*. A comparison of the above-mentioned specimens with *T. arthurii* (paratype PUR 49609) revealed that *T. arthurii* has larger teliospores with a thinner, light brown wall; moreover the teliospores in *T. arthurii* were deeply constricted at the septum. There is no doubt that specimens on *P. serotina* ssp. *capuli* should be considered as a new species.

**11. *Tranzschelia* sp 2.**

Host range: *Prunus nakaii*, *Pr. humilis* (S. Korea and China)

NOTE: This species is a fasciculate species close to *T. hyrcanica*, but differs from it in having smaller teliospores with smaller echinuli.

**12. *Tranzschelia arasbaranica* M. Abbasi & M. Scholler, Sydowia 57 (2): 149-153.**

Host range: *Cerasus mahaleb*.

NOTE: The species was described on the basis of two specimens collected from the NW of Iran. We also found this species on specimens of the same host collected in Greece.

**13. *Tranzschelia asiatica* Y. Ono**

Host range: 0+I on *Hepatica nobilis* var. *japonica*, II+III on *Prunus grayana*.

A2) *Tranzschelia* species on Ranunculaceae:

**14. *Tranzschelia pulsatillae* Dietel**

Host range: *Pulsatilla cernua*, *P. chinensis*, *P. hirsutissima*, *P. halleri*, *P. montana*, *P. palustris*, *P. patens* var. *wolfgangiana*, *P. pratensis*, *P. pratensis* subsp. *nigricans* (= *P. nigricans*), *Pulsatilla* sp., *P. vernalis*, *P. vulgaris*.

**15. *Tranzschelia fusca* (Pers.) Dietel**

Host range: *Anemone trifolia*, *A. nemorosa*, *A. ranunculoides*, *A. sylvestris*, *Anemone* sp.

**16. *Tranzschelia* sp. 3**

Host range: *Anemone multifida* var. *tetonensis*, *A. nemorosa*, *A. parviflora*, *A. lithophila*, *A. piperi*, *A. quinquefolia* (all species are from USA).

NOTE: A comparison of American specimens of *Anemone* rusts with European specimens (from all over Europe) showed that the *Anemone* rusts from USA differ from the European ones in having lighter and thinner teliospore walls and smaller and widely spaced conical warts. The teliospore cells do not separate readily in *Tranzschelia* on *Anemone* in the USA, but in *Anemone* rusts from Europe (*T. fusca*) they readily break at the septum.

**17. *Tranzschelia thalictri* (Chevall.) Dietel**

Host range: *Thalictrum exaltatum*, *Th. flavum*, *Th. minus*, *Th. aquilegiifolium*, *Th. polycarpum*, *Th. simplex*, *Th. simplex* subsp. *galioides*, *Thalictrum* sp.

**18. *Tranzschelia* sp. 4**

Host range: *Anemone altaica* (from Japan)

NOTE: The closest species to the above rust is *T. cohaesa*; the new taxon, however, differs from *T. cohaesa* in having variable teliospores and a different type of infection.

**19. *Tranzschelia viornae* (Arthur) Arthur**

Host range: *Clematis pitcheri*.

B) Separation of *T. discolor* from *T. pruni-spinosae* by morphology of the uredinial state.

Some authors have mentioned that *T. discolor* and *T. pruni-spinosae* cannot be distinguished when only the uredinial state is present. We found that the uredinial state of *T. pruni-spinosae* differs from *T. discolor* in having larger, thick-walled paraphyses, particularly at the apex, and smaller urediniospores with a different morphology. We studied several specimens of *T. pruni-spinosae* from around the world; on all of them we found mostly the telial state with a few uredinia; in many cases uredinia were absent. Moreover, all specimens studied with only uredinia (collected from different continents), belonged to *T. discolor*. This means that the uredinial state of *T. pruni-spinosae* exists only for a short period and is replaced by telia very soon. We assume that the uredinial state does not play a role in distribution of *T. pruni-spinosae*.

C) Germination experiments with teliospores of *T. discolor*.

Germination was seen of teliospores in all Petri dishes in daylight condition. No germination occurred in teliospores kept in complete darkness.

### Future studies

This project has been worked out and the proposal was written by Dr. M. Scholler, the project leader. Besides organizational and technical work (loan requests from public

and personal herbaria, sending specimens for molecular work, providing and ordering literature, archiving specimens in herbarium KR, correspondence....) he also contributed to the practical/scientific part of the project by writing a preliminary nomenclator, developing the method for germination experiments, making line drawings of the germinated basidia, collecting fresh material in Germany and Italy for germination and molecular studies, identifying and translating labels etc. Molecular-phylogenetic studies were carried out by the third participant of the project, Dr. Cathie Aime (Beltsville, USA), who sequenced 37 specimens, 27 of which are from herbaria IRAN & KR. Whereas this molecular study is almost finished and will soon be published, the nomenclatural, morphological and chorological aspects need further intense studies. Morphological studies will be focused on urediniospores and aeciospores. So far, only teliospores are adequately documented. Also, additional material from Asia (Russia) has to be ordered and studied. Morphology will be documented mainly by SEM photographs which will be carried out at the Forschungszentrum Karlsruhe. Distribution maps of species will be made using the data of a 10000 reprint collection of the late Wolfgang Brandenburger. The present state of the monographic study will be presented by M. Scholler at the meeting of the Deutsche Gesellschaft für Mykologie in 2006.