Physiologic Specialization of *Tranzschelia discolor* in Australia

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ABSTRACT

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Inoculation of peach with urediniospores of *Tranzschelia discolor* collected from prune and vice versa demonstrated that physiologic races of the rust exist on peach and prune in Australia. Urediniospores collected from prune were able to infect peach, but the latent period was extended from 13 days to 22–23 days. A similar extension of latent period was observed when prune was inoculated with urediniospores collected from peach. In two tests, it appeared that infection efficiency was decreased in such cross-inoculations. Inoculation of almond with urediniospores from prune resulted in infections that appeared macroscopically as minute flecks. The rust reproduced in these flecks on microsori, each bearing five to 30 urediniospores. The epidemiological and practical significance of physiologic specialization in this rust is discussed.

Additional key words: stone fruit rust

Tranzschelia discolor (Fuckel) Tranz. & Litv. causes rust on cultivated species of stone fruits: European plum (*Prunus domestica* L.), peach and nectarine (*P. persica* L. Batsch), almond (*P. dulcis* (Mill.) Webb), apricot (*P. armeniaca* L.), and Japanese plum (*P. salicina* Lindl.) (17). It is the only species of *Tranzschelia* recorded on *Prunus* species in Australia (18; J. Walker, *personal communication*).

The existence of physiologic races of *T. discolor*, as defined in *Ainsworth & Bisby's Dictionary of the Fungi* (11), has considerable significance for farmers who need to control stone fruit rust and for researchers attempting to devise better control measures. If physiologic races do not exist, as believed by some workers (1,3,4,6,7), then all isolates of the pathogen would be capable of attacking all the main cultivated *Prunus* species. In an orchard of mixed species, the pathogen could spread readily from one species to the next in the same sequence as their foliage develops. A rust outbreak on any one species would constitute a threat to all nearby stone fruits. If, on the other hand, as some evidence suggests (2,5,9,10,12–14,16), physiologic races do occur, an outbreak on one species need not necessarily be a threat to other species nearby. Furthermore, the level of threat from a particular physiologic race would depend on its specificity. A race limited to one *Prunus* species would be a threat only to plantings of that species in the immediate vicinity of an outbreak. Less specific races would obviously pose greater threats.

This paper reports experiments with rust isolates from prune and peach inoculated onto prune, peach, and almond. The study was carried out as part of a program aimed at developing improved measures to control the rust disease of drying prune (*P. domestica* 'd'Ente,' a local selection called d'Agen). Prunes are grown in New South Wales in the Murrumbidgee Irrigation Areas (MIA) and near Young. Rust is a major factor limiting productivity. Other stone fruit species (*P. persica, P. dulcis, P. armeniaca,* and *P. salicina*) are grown in both locations, hence the need for clarification on the question of physiologic races. Peach was selected for the initial studies because it is very commonly grown near prunes; almond was selected because it is often found growing untended and heavily rusted near prune orchards. These species were considered to constitute the greatest risk to prunes should there be no physiologic specialization in *T. discolor*. This is a preliminary report; further work is being carried out with these and the other main *Prunus* species.

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MATERIALS AND METHODS

Plant material. Small stone fruit trees growing in plastic pots 25–30 cm in diameter were used; all were budded trees. The prune trees used were a local selection of *P. domestica* 'd'Ente' known as d'Agen. This is the only cultivar grown in New South Wales for drying. The peach cultivar used was *P. persica* 'Elberta.' Although this cultivar is less frequently damaged in the orchard than the widely grown canning cultivar Golden Queen, it is readily infected when inoculated and was used in this study because potted nursery Golden Queen trees were unavailable. The almond cultivars used were *P. dulcis* 'Brande's Jordan' and 'IXL.'

Rust isolates. Urediniospores of *T. discolor* were collected with a miniature cyclone separator (15) from leaves of infected orchard trees. The separator was washed and rinsed in absolute alcohol between collections to avoid cross-contamination of rust isolates. The prune isolate was obtained from a planting at the Yanco Agricultural Institute; the peach isolate was from a planting of Golden Queen on a commercial farm near Yenda in the MIA. These orchard collections were maintained in controlled-environment glasshouses by repeated inoculations on the respective host species. From time to time, urediniospores were harvested from culture trees, desiccated for 24 hr over silica gel, and stored under liquid nitrogen (8). Experience has shown that *T. discolor* urediniospores can be stored for long periods in this manner without significant loss of infectivity. A heat shock during thawing is not needed. The urediniospores used in 1980 had been stored in liquid nitrogen; those used in 1983 were fresh collections from culture trees.

Inoculation procedures. Urediniospores were suspended in distilled water (100 mg/100 ml) to which the wetting agent polyoxyethylene sorbitan monolaurate (Tween 20) had been added at 0.05 ml/100 ml to aid dispersal. The undersurfaces of the stone fruit leaves were then lightly misted with this suspension by a hand-held pressurized aerosol generator with a freon propellant. Inoculated trees were covered with plastic bags with moistened interior surfaces and held overnight (about 18 hr) in the dark at 20 C in a growth room. The foliage remained damp for this period. Previous work had shown that at 20 C, an 18-hr wet period was more than adequate to achieve heavy infection in a sensitive host (P. F. Kable, *unpublished*). At the end of the wet period, the plastic bags were removed and the trees were dried, then held in a glasshouse or growth room at temperatures ranging from 15 to 25 C. No

moisture was permitted on the foliage after inoculation. This was ensured with drip-irrigation or careful hand watering.

Tests. Four prune trees and four peach trees were inoculated with *T. discolor* urediniospores from prune in April 1980. An additional four prune trees and four peach trees were inoculated with urediniospores from peach. Host leaf age at inoculation was in the range of 150–200 days. The trees were held in a growth room at a constant 20 C and a 12-hr light/12-hr dark cycle. Observations were made regularly for 35 days.

A second test, identical to the first, was carried out in December 1980. Leaf age at inoculation was in the range of 20–70 days.

In January 1983, a prune tree and two almond trees (one Brande's Jordan and one IXL) were inoculated with urediniospores from prune. Leaf age at inoculation was 50–120 days.

RESULTS

The 1980 test clearly showed that N.S.W. collections of urediniospores of *T. discolor* from *P. domestica* (prune) and *P. persica* (peach) are physiologically different (Table 1). Urediniospores collected from prune were nevertheless able to attack peach, and conversely, those from peach were able to attack prune. In these tests, the isolates were separated by their different latent periods on the two hosts. Both had a latent period of about 13 days at 20 C on the hosts from which they were collected. On peach, however, the prune isolate of the rust had a latent period of 22–23 days, whereas the peach rust had a latent period of no less than 22 or more than 39 days on prune. There were also indications that infection efficiencies of the two isolates of the rust were lower on the other *Prunus* species than on the ones from which they were collected. Prune rust caused relatively few infections on peach in one of two tests, whereas peach rust resulted in relatively few lesions on prune in one test.

In the 1983 test, abundant infections resulted from inoculating prune with prune rust. Gray-white flecks of about 0.5 mm in diameter were noted on leaves of both almond cultivars inoculated at the same time with prune rust. These flecks suggested a resistant reaction and were smaller than the normal white spots, which are the first symptoms of infection in susceptible hosts. The unaided eye could not detect rust reproduction in these flecks. Microscopic examination showed, however, that microsori containing paraphyses and from five to 30 urediniospores were present in the flecks (Fig. 1).

DISCUSSION

This study shows that in Australia, physiologic specialization does occur in *T. discolor*, and it has practical significance. When rust isolates from peach or prune were inoculated reciprocally to the other host, infections occurred, but the length of the latent period was increased and infection efficiency appeared to be reduced. These differences would limit the rate of epidemic development of a particular rust race on *Prunus* species that are not its normal host, thus making it uncompetitive with the race or races normally found on those species. This indicates that for the isolates of rust used in this study, rust of prunes does not constitute a threat to nearby peaches and almonds, etc., and vice versa.

However, the capability to infect more than one *Prunus* species has survival value. Infections of a rust race on an uncongenial host may facilitate overwintering. For example, nonalmond races might survive the winter on almond leaves since almonds commonly do not completely defoliate in many climates, whereas most other stone fruits do.

Published cross-inoculation studies and observations on the host range of isolates of *T. discolor* from different *Prunus* species present a confused picture of the level and extent of physiologic specialization (2,5,9,10,12–14,16). This lack of a consistent pattern of specialization makes it difficult to classify forms of *T. discolor* into physiologic races. We consider that more extensive and exact experimentation with *T. discolor* isolates from a range of cultivated *Prunus* species

Table 1. Reactions of two *Prunus* species to inoculation with *Tranzschelia discolor* urediniospores collected from each species

Inoculation date (1980)	Inoculum source species	*Prunus* sp. inoculated	Days to First symptoms[a]	Days to First spores	Infection efficiency
17 Apr.	*P. domestica*	*P. domestica*	11	13	High[b]
	P. domestica	*P. persica*	22	22	High
29 Apr.	*P. persica*	*P. domestica*[c]	...[d]	...	...
	P. persica	*P. persica*	10	13	High
25 Nov.	*P. domestica*	*P. domestica*	10	13	High
	P. domestica	*P. persica*	21–23	23	Low
27 Nov.	*P. persica*	*P. domestica*	...	22–39[e]	Low
	P. persica	*P. persica*	12	14	High

[a] The first symptoms of *T. discolor* infection are small, pale areas delineated by veinlets on the lower surfaces of *Prunus* spp. leaves. These are termed "white spots." Urediniosori subsequently develop on the white spots.
[b] Development of abundant infections on inoculated leaves (> 100 lesions per leaf) indicated a high infection efficiency; relatively few (< 100 lesions per leaf) indicated low infection efficiency.
[c] Observations discontinued after 23 days.
[d] Symptoms were not observed.
[e] Observations not made between 21 and 39 days after inoculation.

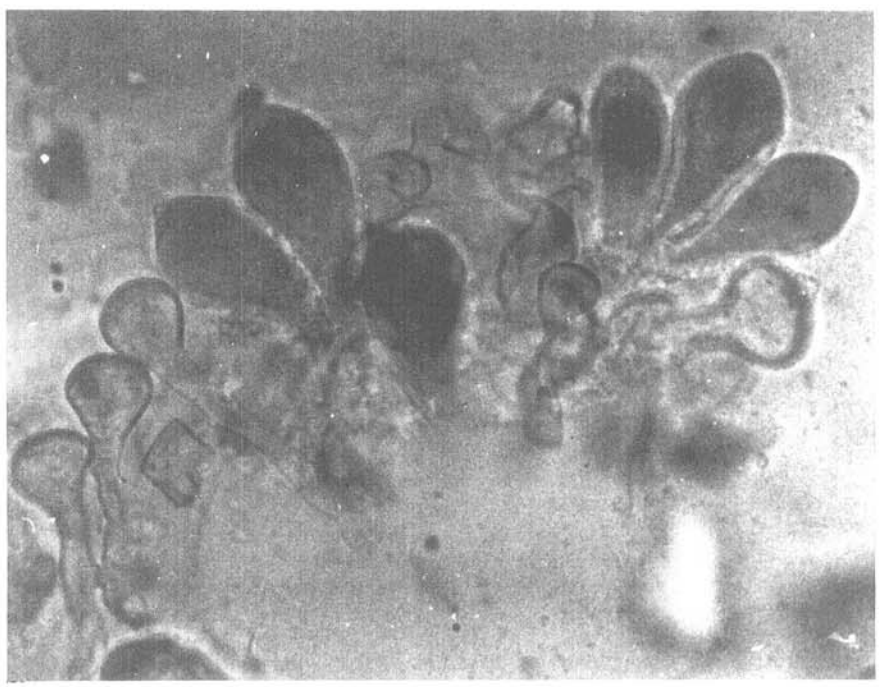

Fig. 1. Urediniospores and capitate paraphyses stripped from a microsorus of *Tranzschelia discolor* (*Prunus domestica* isolate on *P. dulcis* foliage) with adhesive cellulose tape. This method removes all detachable structures with minimal disturbance of their spatial relationships.

from locations around the world is required before *T. discolor* races can be confidently categorized.

Nevertheless, the tentative division of *T. discolor* into forms with affinity to particular *Prunus* species, as proposed recently (2), is justified on practical grounds. Some recognition of the tendency toward specificity between isolate and host of origin in this pathogen will assist farmers in their disease management practices.

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