Pak. J. Bot., 18(2): 329–333, 1986.

CONTROL OF *PHAKOPOSORA GREWIAE* WITH PLANT DIFFUSATES

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Abstract

Water-soluble diffusates of 15 vegetable seeds and 14 spices were tested against urediniospore germination of *Phakopsora grewiae*. Diffusates of turnip, cluster beans, cloves and turmeric showed high inhibition of spore germination. Application of turnip seed diffusate exerted significant effect on the rust appearance. Diffusates of cloves and turmeric gave complete protection and eradication of the rust on detached leaf discs of *Grewia asiatica*.

Introduction

Phakopsora grewiae (Pat. and Har.) Cummins causes severe rust on leaves of *Grewia asiatica* (Khan & Kamal, 1968). Besides reduction in yield of fruit the rusted leaves become fragile and are rejected for cigar making. Whereas indiscriminate use of agricides cause health hazards, attempts are being made to control plant diseases with plant products (Kandasamy *et al*, 1974; Kumar *et al*, 1979; Shukla & Joshi, 1980; Singh *et al*, 1980; Kapoor *et al*, 1981). This paper describes the effect of diffusates of vegetable seeds and spices on urediniospore germination of *P. grewiae* and on rust infection on detached leaf discs of *G. asiatica* L.

Materials and Methods

Urediniospore germination: Twenty g seed samples of 15 vegetables and 14 spices (Table 1) were separately soaked for 24 h in 250 ml conical flasks containing 100 ml distilled water. The barks of cinnamon, rhizomes of ginger and turmeric, and cloves were crushed into small pieces before soaking. The diffusate was passed through Whatman No. 1 filter paper followed by Millipore filter, 0.22 μm pore size. The diffusate was added to autoclaved 1% water agar @ 100,50 and 10 gl^{-1} and poured into Petri dishes. Urediniospore suspension (4×10^4 spores ml^{-1}) from the rusted leaves of *G. asiatica* were prepared following the technique described by Rahber-Bhatti & Shattock (1980). The spores were sprayed on agar plates containing diffusates and incubated at 25°C under constant darkness. After 24 h the plates were observed under microscope (x 10) and germination of urediniospores recorded following the method described by Shattock & Rahber-Bhatti (1983). The urediniospore germination on different diffusates was transformed into inhibition percentage by using the following formula:

$$\text{Inhibition percentage} = \left(1 - \frac{\text{Germination on diffusate}}{\text{Germination on control}}\right) \times 100.$$

The seeds, rhizomes and barks which exhibited 100% inhibition of urediniospores at lowest dilution (10 g^{-1}) their further dilutions of 5, 2.5 and 1.25 gl^{-1} were also tested. ED50 and ED90 values were calculated by probit analysis.

Detached leaf discs: Ten g of turnip seed, cloves and turmeric were separately soaked in 100 ml distilled water in conical flasks and the diffusates were prepared following the method described earlier. Dilutions were made in distilled water @ 10, 5 and 2.5 gl^{-1}. Leaves of *G. asiatica* were washed, surface dried and cut into 15 mm dia. discs. Leaf discs dipped for 5 min in each diffusate were placed on water-saturated cotton wool in Petri dishes and inoculated with suspension of urediniospores using non-gas sprayer (Rahber-Bhatti & Shattock, 1980). Five plates of each treatment and control plates were then sealed with adhesive tape and incubated at 25°C under constant illumination of 2000 lux.

To test the curative effect of the diffusates, similar number of leaf discs was first set up in Petri dishes, inoculated with urediniospores of *P. grewiae* and incubated under the same conditions. Three days after inoculation, the leaf discs were dipped for 5 min in each diffusate. Control leaf discs were dipped in distilled water. The leaf discs of each treatment were then returned to same Petri dishes containing water-saturated cotton wool, sealed with adhesive tape and incubated. Leaf discs were examined 15 days after inoculation. The mean number of uredinia per microscope field (x 10) was calculated by counting the number of uredinia observed in 5 random microscope fields on each leaf disc. The area of leaf disc and that of microscope field was calculated and thus the number of rust pustules per leaf disc was estimated by the formula: $\frac{A}{B} \times C$; where A is area of leaf disc, B is area of microscope field, and C is mean number of uredinia per microscope field.

Results

Urediniospore germination: Most of the vegetable seed diffusates showed strong inhibitory effect on urediniospore germination of *P. grewiae* at 100 gl^{-1} only. Radish seed diffusate completely checked the spore germination at 100 gl^{-1} whereas clusterbean and turnip were effective at 10 and 5 gl^{-1} dilution, respectively.

Except black pepper all other spices inhibited spore germination of the rust fungus at 100 gl^{-1}. Similar effect was found with 50 gl^{-1} diffusate of cumin, white cumin, ajwan, fennel, large cardamom, ginger and cinnamon. At lowest dilution (10 gl^{-1}) of diffusate only cinnamon, cloves and turmeric showed complete inhibition of urediniospore germination. Cloves and turmeric showed inhibition @ 5 gl^{-1}. Turmeric diffusate showed 100%

Table 1. Inhibition of germination of urediniospores of *Phakopsora grewiae* by diffusates of different vegetables and spices on 1% tap water agar (ED50 and ED90 values calculated by probit analysis).

English Name	Latin Name	ED50 (gl^{-1})	ED90 (gl^{-1})
Vegetables:			
Bitter gourd	*Momordica charantia*	116.9 (58.1-163.9)	210.5 (104.6-295.0)
Bottle gourd	*Lagenaria vulgaris*	438.3 (200.0-625.0)	789.1 (360.0-1125.0)
Loofah gourd	*Loofa cylindrica*	68.2 (47.6-96.1)	122.8 (85.7-173.0)
Sponge gourd	*Loofa acutangula*	71.6 (40.9-103.0)	128.9 (73.7-158.5)
Carrot	*Daucus carota*	34.1 (11.9-53.3)	61.5 (21.4-95.9)
Cauliflower	*Brassica oleracea* var. *botrytis*	527.7 (238.0-704.2)	950.0 (428.5-1267.6)
Clusterbeans	*Cyamopsis psoralioides*	27.0 (6.0-50.0)	48.6 (10.8-90.0)
Eggplant or Brinjal	*Solanum melongena*	38.1 (18.5-54.3)	68.7 (33.3-97.8)
Indian squash	*Citrullus vulgaris* var. *fistulosus*	569.5 (217.3-833.3)	1025.1 (391.3-1500.0)
Okra	*Hibiscus esculentus*	497.6 (263.1-714-2)	895.7 (473.6-1285.7)
Onion	*Allium cepa*	104.2 (52.6-135.1)	187.6 (94.7-243.2)
Radish	*Raphanus sativus*	41.9 (15.1-60.6)	75.4 (27.2-109.2)
Spinach	*Spinacia oleracea*	37.3 (15.6-51.0)	67.2 (28.1-91.8)
Tomato	*Lycopersicum esculentum*	45.2 (16.1-64.1)	81.4 (29.0-115.3)
Turnip	*Brassica campestris* var. *rapa*	20.6 (2.6-50.0)	37.2 (4.8-90.0)
Spices:			
Ajwan	*Carum copticum*	26.8 (5.5-50.0)	48.3 (9.9-90.0)
Black pepper	*Piper nigrum*	34.2 (13.7-50.0)	61.6 (24.7-91.5)
Cardamom	*Elettaria cardamomum*	36.6 (23.4-50.0)	65.9 (42.2-90.0)
Larger cardamom	*Amomum subulatum*	27.5 (7.7-50.0)	49.6 (13.9-90.0)
Chillies	*Capsicum frutescens*	27.6 (6.6-50.0)	49.7 (11.9-90.0)
Cinnamon	*Cinnamomum zeylanicum*	20.7 (3.1-50.0)	37.4 (5.7-90.0)
Cloves	*Eugenia caryophyllata*	16.7 (1.2-50.0)	30.1 (2.2-90.0)
Coriander	*Coriandrum sativum*	33.9 (15.6-50.0)	61.1 (28.1-91.2)
Cumin	*Cuminum curvi*	26.9 (5.8-50.0)	48.5 (10.6-90.0)
White cumin	*Cuminum cyminum*	27.5 (7.6-50.0)	49.6 (13.8-90.0)
Fennel	*Foeniculum vulgare*	27.0 (6.2-50.0)	48.7 (11.1-90.0)
Fenugreek	*Trigonella foenum graecum*	28.7 (7.2-50.0)	51.6 (13.1-90.0)
Ginger	*Zingiber officinale*	26.8 (5.5-50.0)	48.3 (9.9-90.0)
Turmeric	*Curcuma longa*	10.6 (0.2-50.0)	19.1 (0.4-90.0)

inhibition in spore germination at 0.625 gl^{-1} dilution. The ED50 and ED90 values of turnip, cloves and turmeric were very low among all vegetables and spices tested (Table 1).

Detached leaf discs: Diffusates of turnip, cloves and turmeric showed significant ($P < 0.001$) effect on sporulation of *P. grewiae* inoculated on detached leaf discs of *G. asiatica.* Protective and curative application of diffusates of cloves and turmeric completely checked infection of the rust. Seed diffusate of turnip protected the leaf discs from the rust

Table 2. Effect of plant diffusates on the infection of leaf discs of *Grewia asiatica* by *Phakopsora grewiae*.

Treatment	Number of uredinia per leaf disc	
	Protective[a]	Curative[b]
Turnip @ 10 gl^{-1}	0	15.45
Cloves @ 5 gl^{-1}	0	0
Turmeric @ 1.25 gl^{-1}	0	0
Control (water-treated)	507.1	490.8

[a]Diffusate applied to leaf discs before inoculation with urediniospores.
[b]Diffusate applied to leaf discs 3 days after inoculation with urediniospores.
All diffusate treatments significantly different from control at $P < 0.001$.

whereas few uredinia appeared when the diffusate was applied 3 days after inoculation (Table 2). Control leaf discs were severely attacked by the rust.

Discussion

Diffusates of most of the vegetables and spices have been for the first time studied to see their antifungal action. It would be evident that vegetables possess varying amounts of active substances which could affect urediniospore germination of the rust fungus *P. grewiae*. Fungitoxic properties in extracts of turnip, kohlrabi (*Brassica oleracea*), beet, cabbage and onion have been reported (Gerretsen & Haagsma, 1951; Maruzzella & Freundlich, 1959; Lapis & Dumancas, 1979; Kumar *et al*, 1979). Except coriander and black pepper all other spices (Table 1) inhibited urediniospore germination of *P. grewiae*. Turmeric and ginger have been tested against *Puccinia recondita* (Sathe & Rahalkar, 1975), *Rhizoctonia solani*, *Sclerotium oryzae* (Naidu & John, 1981) and *Erysiphe polygoni* (Singh & Singh, 1981). Diffusates of cloves, turmeric and turnip gave significant protection and eradication of the rust on detached leaf discs of *G. asiatica*. Similar control of rice blast, bunt of wheat and potato virus X has been achieved with plant extracts (Lapis & Dumancas, 1979; Singh *et al*, 1980; Awasthi & Mukerjee, 1980). It would therefore suggest that diffusates of spices could be employed in the inhibition of urediospore germination of *P. grewiae* on *G. asiatica* and there exists a possibility of extending this work under field conditions.

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(Received for publication 12 April 1986)