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Non-host Crops—Their Effect on *Fusarium oxysporum* f. sp. *carthami*, the Incitant of Safflower Wilt

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Effects of host and non-host crops on *Fusarium oxysporum* f. sp. *carthami*, the incitant of safflower wilt were investigated. Gram, wheat, pea, lentil usually grown with safflower as mixed crop, secreted antifungal compounds inhibitory to the growth of the pathogen. Additionally, gram and wheat in its rhizosphere hosted *Penicillium oxalicum* and *Pseudomonas tumefaciens* which also acted antagonistically and checked the fungal growth significantly.

Key Words: Wilt of safflower, Non-host crop, Rhizosphere

Introduction

Safflower (*Carthamus tinctorius* L.) is cultivated usually as a mixed crop, but the cultivation as a single crop is also common. Earlier investigations (Chakrabarti 1976, Chakrabarti & Basuchaudhary 1978) showed that safflower grown on fallow or singly cropped land suffered from wilt disease incited by *Fusarium oxysporum* Scheld. f. sp. *carthami* Klis. and Hous. more than where it was grown in rotation or mixed with paddy or millets. The difference in the disease incidence between fallow land and land cropped previously to millet or rice was found statistically significant ($p<0.01$). These observations prompted us to determine the effects of non-host crops with which safflower is usually cultivated as a mixed crop, on *F. oxysporum* f. sp. *carthami*.

Materials and Methods

The following experiments have been designed to study the effects of root diffusates, rhizosphere soil and microflora of the host and non-host crops on the growth of the

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pathogen, *F. oxysporum* f. sp. *carthami* (IMI 186541).

Effect of root diffusates

One 10 mm disc of the actively growing pathogen was placed in the vicinity of roots of 5 day old germinating seedlings of safflower (host), gram, wheat, lentil and pea (all non-hosts) separately on 15 ml PDA (potato-dextrose-agar) plate (radius 10 cm), incubated and radial growth of the fungus was measured.

Effect of rhizosphere soil

One 10 mm disc of the pathogen was embedded in the middle of a glass vial containing 20 g of rhizosphere soil of 2 months old gram, wheat, lentil, pea and safflower separately, incubated for 7 days after which the disc was removed, rinsed with sterile distilled water, placed on PDA plate, incubated and the fungal growth was measured.

Pseudomonas tumefaciens and *Penicillium oxalicum* Currie and Thom. (IMI 205866) were dominant microflora in the rhizosphere of wheat and *P. oxalicum* in gram (Chakrabarti, unpublished). Effects of these microorganisms on the growth of the pathogen was also studied.

Effect of Ps. tumefaciens and P. oxalicum

On agar plate *F. oxysporum* f. sp. *carthami* was inoculated in the centre and *Ps. tumefaciens* or *P. oxalicum* a little distant from it on the same plate, incubated and the growth of the pathogen was recorded. The fungal hyphae grown with *Ps. tumefaciens* or *P. oxalicum* after staining with cotton-blue-lactophenol were observed under microscope.

Effect of Ps. tumefaciens and P. oxalicum Diffusates

Three weeks old culture filtrate of *Ps. tumefaciens* or *P. oxalicum* grown on Richard's broth was tested for antagonistic activity against *F. oxysporum* f. sp. *carthami* by agar-cup assay method. One 10 mm cup was made in the centre of the pathogen seeded (5×10^3 5 spores/ml) 15 ml PDA plate into which the culture filtrate was poured. The filtrate was filter-sterilized before pouring into the central cup. Inhibition zone (if any) surrounding the cup was measured.

In all the experiments incubation temperature was maintained at 21 (± 2)°C for 72 hr.

Results

The diameter of the colony (table 1) of *F. oxysporum* f. sp. *carthami* growing in the vicinity of safflower roots was more than that of control (PDA plate without any seedlings) while it was lesser in pea, gram, wheat and lentil.

Table 1 *Effect of root exudates of the host and non-host crops on growth of* Fusarium oxysporum *f. sp.* carthami.

The pathogen near roots of	Diam. of the colony [a,b] in cm
Gram	16.2
Pea	51.3
Wheat	72.9
Lentil	89.2
Safflower	113.5
Control (PDA)	100
C. D. at 5%=0.178	
C. D. at 1%=0.253	

[a] Figures are an average of 3 replications
[b] Figures represent growth in terms of 100% growth in the control

The rhizosphere soil of gram, wheat, lentil and pea checked the growth of the

pathogen. Wheat rhizosphere soil was most effective in checking the growth completely and in gram soil also the growth was very negligible (table 2).

Table 2 *Effect of rhizosphere soil of the host and non-host crops on growth of* F. oxysporum *f. sp.* carthami

Rhizosphere soil of	Diam. of the colony [a, b] (in cm)
Wheat	0
Gram	50.0
Pea	61.1
Lentil	61.1
Safflower	100
C.D. at 5%=0.356	
C.D. at 1%=0.507	

[a] Figures are an average of 3 replications

[b] Figures represent growth in terms of 100% growth in the control

Ps. tumefaciens and *P. oxalicum* exhibited antagonism towards the pathogen suppressing its growth on PDA plate, but the culture filtrate of *P. oxalicum* gave positive while *Ps. tumefaciens* negative reactions of antagonism. The fungal hyphae growing with *P. oxalicum* or *Ps. tumefaciens* showed contracted protoplasm and disorganized cell wall.

Discussion

It is evident from the foregoing results that the diffusates of germinating seedlings of the non-host crops were strongly inhibitory to the growth of the pathogen. Leguminous plants in response to the infection of non-pathogens produced phytoalexin-like compounds which inhibited spore germination and mycelial growth (Smith 1971). *Ps. tumefaciens* and *P. oxalicum* predominant in the wheat and gram rhizosphere also afforded strong resistance to the wilt organism. The control values for *P. oxalicum* may be due to the production of oxalic acid which possess cell damaging property (Johann 1928), while *Ps. tumefaciens* killed the pathogen by causing lysis of the cells. Lysis of *Fusarium* species by *Ps. tumefaciens* was also observed by Novogrudski (1936). Therefore, to check the pathogen population, growing of the non-hosts in rotation or mixed with safflower may be tried.

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