Research Paper :

Antagonism of fungal organisms against *Fusarium oxysporum* f. sp. *carthami*

B.P. KURUNDKAR AND S.B. MAHAJAN

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See end of the article for authors' affiliations

Correspondence to :
B.P. KURUNDKAR
Regional Wheat Rust Research Station, MAHABALESHWAR (M.S.) INDIA
Email : rwrrsm@rediffmail.com

SUMMARY

Wilt of safflower is one of the serious problems for successful cultivation of this crop. The study was conducted to test the efficacy of fungal antagonists isolated from local cultivator's fields against *Fusarium oxysporium* f. sp. *carthami* in laboratory. In all, 25 fungal organisms were tested for their antagonistic effect by dual culture technique. Results indicated that *Aspergillus niger* (Isolate 11 and 1), *Gliocladium virens* and *Aspergillus ustus* had more inhibitory effect than other fungal isolates. Five fungal organisms (*Aspergillus* sp., Black septate mycelium, *Hormiscium* sp., *Trichoderma harzianum* and *Trichoderma viride*) have produced clear zone of inhibition while 10 organisms grew fast and over run the growth of *F. oxysporum* f. sp. *carthami.*

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Safflower is one of the important oilseed crops of India. It is popular amongst the cultivators because of its tolerance to drought, non-preference to specific soil type and ability to yield fairly reasonable with low inputs. However, crop suffers from various biotic stresses resulting in poor yields. Wilt caused by *Fusarium oxysporium* f. sp. *carthami* is one of the serious problems in successful cultivation of the crop resulting in to huge losses even up to 61 % (Anonymous, 2001). Since, the disease is seed and soil borne, is difficult to manage. Earlier workers tried to manage the disease with fertilizers, manure and sulphur application (Wolt and Jones, 1973; Sarhan *et al*., 1982), by soil drenching with fungicides (Chakrabarty and Basuchaudhary, 1977), by soil solarization (Sastri and Chattopadhyay, 1999) but these methods have limited success. The growers are defenseless because of non-availability of resistant varieties for commercial growing.

In the light of this situation, biological management can be good alternative as the bioagents are eco-friendly, cheap and effective in protecting the crop throughout the growth period. Taking into consideration, advantages of antagonistic organisms, present study was planned to evaluate fungal organisms isolated from cultivated fields for their efficacy in inhibiting the growth of *F. oxysporium* f. sp. *carthami* under laboratory condition.

MATERIALS AND METHODS

Rhizosphere samples from different locations of Marathwada region were collected for isolation of antagonistic fungal organisms. Isolation of fungal organisms was carried out by dilution and pour plate method on Potato dextrose agar (PDA), Czapek Dox agar, Lima Bean agar and Soil extract agar media under aseptic condition. Well isolated colonies of fungal organisms were picked by inoculating needle under aseptic conditions and were transferred to plate containing sterilized PDA medium under aseptic conditions. Purification of fungal organisms was carried out by hyphal tip method. These were identified by studying colony characters, growth on PDA, morphology of the mycelium, spore bearing hyphae and spores. After expelling common contaminants, 25 fungal organisms were selected to study their antagonistic effect against *Fusarium oxysporum* f. sp. *carthami* in dual culture on PDA. For this, *F. oxysporum*

f. sp. *carthami* and test organisms were separately inoculated to sterilized Petriplates (90 mm diameter) containing sterilized PDA. A week old growth of these organisms was used for testing in dual culture. A 5 mm disc of the test organism and *F. oxysporum* f. sp. *carthami* were placed at two opposite ends of the Petriplate (10 mm from periphery) and the plates were incubated in an incubator at 25 ± 1 ^{0}C. Control plates were inoculated with *F. oxysporum* f. sp. *carthami* only. There were three replications per treatment. Observations regarding radial growth of *F. oxysporum* f. sp. *carthami* and test organisms were recorded at 7 and 9 days after incubation to study antagonistic effect.

RESULTS AND DISCUSSION

Growth of *F. oxysporum* f. sp. *carthami* and test organisms at 7 and 9 days of incubation period is presented in Tables 1 and 2. At 7 days after incubation, growth of *F. oxysporum* f. sp. *carthami* in *A. niger* (Isolate 11) was followed by *A. niger* (Isolate 1), *A. ustus*, *Fusarium* sp. (Isolate 22) and *Gliocladium virens* which had significantly less growth than control. These isolates were followed by *A. nidulans* (Isolate 7), *A. nidulans* (Isolate 15), *Paecilomyces varioti, Penicillium* sp. (Isolate 5), *Trichoderma viride, Fusarium* sp. (Isolate 21), *Rhizopus* sp. (Isolate 19), *Trichoderma harzianum, Curvularia* sp., *Alternaria* sp., *Aspergillus* sp. and *Penicillium* sp. (Isolate 10) in order of merit, which had less than 50 % growth of *F. oxysporum* f. sp. *carthami* as compared to control.

At 9 days after incubation, growth in *G. virens* was at par with *A. niger* (Isolate 1) and significantly less than all the remaining isolates. It was followed by growth in *A. niger* (Isolate 11) which was at par with growth in *T.*

Table 1 : Growth of *F. oxysporum* f. sp. *carthami* and test organisms on PDA

Sr. No.	Fungal isolates	Growth of *F. oxysporum* f. sp. *carthami* (colony diameter in mm)		Per cent decrease (-) over control		Growth of test organism (colony diameter in mm)	
		Days after incubation					
		7	9	7	9	7	9
1.	*Alternaria* sp.	27.44	39.66	-55.17	-44.48	11.33	14.55
2.	*Aspergillus flavus*	16.22	24.55	-73.50	-65.63	58.66	64.66
3.	*Aspergillus nidulans* (Isolate 7)	18.55	23.33	-69.69	-67.34	62.33	63.33
4.	*Aspergillus nidulans* (Isolate15)	18.55	21.66	-69.69	-69.68	58.00	61.33
5.	*Aspergillus niger* (Isolate 11)	12.10	11.77	-80.23	-83.52	66.11	73.33
6.	*Aspergillus niger* (Isolate 1)	12.77	15.10	-79.14	-78.86	54.99	73.55
7.	*Aspergillus ustus*	13.77	19.33	-77.50	-72.94	49.66	53.33
8.	*Aspergillus* sp.	27.44	39.66	-55.15	-44.48	11.33	14.55
9.	Black septate mycelium	30.21	34.55	-50.65	-51.63	30.10	33.44
10.	*Colletotrichum* sp.	38.22	47.10	-37.56	-34.07	11.33	14.55
11.	*Curvularia* sp.	26.77	38.55	-56.27	-46.03	14.55	16.77
12.	*Fusarium moniliforme*	40.77	50.21	-33.40	-29.71	11.22	13.55
13.	*Fusarium* sp. (Isolate 21)	21.88	42.10	-64.27	-41.06	12.77	17.10
14.	*Fusarium* sp. (Isolate 22)	14.77	19.10	-75.87	-73.26	66.44	68.66
15.	*Gliocladium virens*	15.66	13.11	-74.42	-81.64	52.77	70.10
16.	*Hormiscium* sp.	34.44	44.33	-43.74	-37.94	37.10	40.66
17.	*Mucor* sp.	30.55	33.33	-50.09	-53.34	41.22	50.33
18.	*Paecilomyces varioti*	18.77	23.77	-69.45	-66.72	58.44	65.22
19.	*Penicillium* sp. (Isolate 5)	18.86	24.44	-69.19	-65.78	50.77	54.88
20.	*Penicillium* sp. (Isolate 10)	26.88	29.88	-56.09	-58.17	36.77	45.00
21.	*Rhizopus* sp. (Isolate 2)	40.77	50.21	-33.40	-29.71	11.22	13.55
22.	*Rhizopus* sp. (Isolate 19)	25.77	41.10	-57.90	-42.46	14.10	17.44
23.	*Trichoderma harzianum*	26.10	28.55	-57.36	-60.03	50.77	60.66
24.	*Trichoderma viride*	19.77	16.88	-67.70	-76.37	58.66	64.66
25.	*Trichoderma* sp.	40.88	43.55	-33.22	-39.03	39.33	14.33
	Control	61.22	71.44		-	-	
	S.E. ±	0.84	0.75		0.63	0.66	
	C.D. (P=0.05)	2.33	2.08		1.75	1.68	

viride and significantly less in remaining isolates. Growth in these isolates was followed by growth in *Fusarium* sp. (Isolate 22), *A. nidulans* (Isolate 7), *P. varioti, Penicillium* sp. (Isolate 5), *A. flavus, T. harzianum, Penicillium* sp. (Isolate 10), *Mucor* sp., Black septate mycelium, *Curvularia* sp., *Hormiscium* sp., *Colletotrichum* sp., *F. moniliforme* and *Rhizopus* sp. (Isolate 2). It is seen from results presented in Table 2 that zone of inhibition against *F. oxysporum* f. sp. *carthami* was clearly observed in *Aspergillus* sp., Black septate mycelium, *Hormiscium* sp. and *T. viride*. Maximum zone of inhibition was observed in *T. harzianum* which was followed by Black septate mycelium, *Hormiscium* sp., *T. viride* and *Aspergillus* sp.

Various workers in past studied antagonistic effects of fungal organisms against *Fusarium* sp. in the laboratory. Promising antagonistic organisms include *Gliocladium virens* (Mukhopadhyay *et al*., 1992; Singh *et al*., 1993), *Paecilomyces lilacinus* (Wang – Mingzu *et al*., 1996), *A. niger* and *T. viride* (Sesan, 1987; Gajbe and Langewar, 1991; Naik and Sen, 1993; Gohil and Vala, 1996 and Singh *et al*., 1997). Also, Malathrakis *et al*., 1992, found *Penicillium* sp. antagonistic to *Botrytis cineria*. These findings are on similar line to the observations of present study. Besides, aforesaid fungi, *A. nidulans* (Isolate 7), *A. ustus* and *Fusarium* sp. (Isolate 22) have emerged out to be additional fungi having good inhibitory effect against *F. oxysporum* f. sp. *carthami*.

Table 2 : Zone of inhibition and over run at 9 days after incubation by isolated fungi

Sr. No.	Fungal isolates	Mean zone of inhibition (mm)	Mean over run (mm)
1.	*Alternaria* sp.	-	-
2.	*Aspergillus flavus*	-	3.50
3.	*Aspergillus nidulans* (Isolate 7)	-	5.33
4.	*Aspergillus nidulans* (Isolate 15)	-	3.44
5.	*Aspergillus niger* (Isolate 11)	-	-
6.	*Aspergillus niger* (Isolate 1)	-	-
7.	*Aspergillus ustus*	-	1.33
8.	*Aspergillus* sp.	2.16	-
9.	Black septate mycelium	4.22	-
10.	*Colletotrichum* sp.	-	-
11.	*Curvularia* sp.	-	2.16
12.	*Fusarium moniliforme*	-	-
13.	*Fusarium* sp. (Isolate 21)	-	-
14.	*Fusarium* sp. (Isolate 22)	-	2.33
15.	*Gliocladium virens*	-	3.00
16.	*Hormiscium* sp.	3.66	-
17.	*Mucor* sp.	-	-
18.	*Paecilomyces varioti*	-	-
19.	*Penicillium* sp. (Isolate 5)	-	2.33
20.	*Penicillium* sp. (Isolate 10)	-	3.83
21.	*Rhizopus* sp. (Isolate 2)	-	-
22.	*Rhizopus* sp. (Isolate 19)	-	-
23.	*Trichoderma harzianum*	4.83	-
24.	*Trichoderma viride*	3.44	-
25.	*Trichoderma* sp.	-	2.44

Regarding growth of test organisms at 7 days after incubation, maximum growth was observed in *Fusarium* sp. (Isolate 22), while at 9 days after incubation, maximum growth was observed in *A. niger* (Isolate 1), which was significantly superior than rest of the isolates at these stages. At 7 days after incubation, next promising isolate was *A. niger* (Isolate 11) which was significantly superior than rest of the isolates. It was followed by *G. virens* and *A. nidulans* (Isolate 7), at 7 days after incubation and *G. virens* and *Fusarium* sp. (Isolate 22) at 9 days after incubation. Out of 25 isolates, 10 fungal isolates over grew in colonies of *F. oxysporum* f. sp. *carthami*. This over run varied from 1.33 mm (*A. ustus*) to 5.33 (*A. nidulans*) (Isolate 7). Aforesaid results clearly indicate that ten of the fungal isolates grew rapidly on PDA and put forth great competition to *F. oxysporum* f. sp. *carthami*. *Fusarium* sp., *A. niger, A. nidulans, G. virens* and *A. ustus* have been earlier reported to be fast growing (Gilman, 1959; Domsch *et al*., 1980). Reduction in growth of *F. moniliforme* due to *T. viride* and *Fusarium oxysporum* due to *Penicillium pinophylum* have been earlier reported by Gohil and Vala (1996) and Naik (1989), respectively. Present study had similar results to these findings.

Authors' affiliations:
S.B. MAHAJAN, Regional Wheat Rust Research Station, MAHABALESHWAR (M.S.) INDIA

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