J. Biol. Control, 15(2): 177-182, 2001

# Effect of edaphic and climatic factors on the mycoherbicidal potential of *Fusarium* spp. against *Parthenium hysterophorus* L.

S. FARKYA, A. K. PANDEY and R. C. RAJAK
Department of Biological Science
Rani Durgawati University
Jabalpur 482 001, M. P., India
E-mail: svg20uk@yahoo.com

**ABSTRACT:** **Factors affecting mycoherbicidal potential of two indigenous *Fusarium* spp. viz. *F. oxysporum* PR # 12 and *F. solani* PR # 13 inciting seedling blight and wilt in plants of *Parthenium hysterophorus* L. were investigated. In preliminary green house experiments, both the pathogens favoured sandy loam soil, 25°C±1°C temperature, 70 per cent soil moisture and 100 per cent relative humidity for maximum seedling mortality. Soil pH 6.0 and 7.0 were favourable for maximum control of this weed by *F. oxysporum* PR # 12 and *F. solani* PR # 13, respectively.**

**KEY WORDS:** *Fusarium oxysporum, F. solani*, mycoherbicidal, *Parthenium*

The biological, technological and economic feasibility of indigenous fungal pathogens are now well realised by commercialization of many of them as potential mycoherbicides (Templeton, 1992; Templeton and Heiny, 1989; TeBeest 1993; Weidemann *et al.*, 1995). Extensive survey of literature clearly indicates that comparatively foliar pathogens have received more importance in mycoherbicide research and development while soil borne pathogens remain the least studied organisms in this novel aspect of applied mycology (Jones and Hancock, 1990). Soil borne pathogens have several advantages over foliar pathogens. They can reduce weed population through decay of seeds before germination or by causing death of seedlings shortly after germination. They may also cause severe root decay, girdling, soil line lesions and internal stem necrosis, resulting in reduced competitive ability and decreased reproductive capacity of infected weeds (Jones and Hancock, 1990). Fusaria are virtually found in all types of soil and distributed worldwide. Many *Fusarium* spp. are currently under evaluation for their mycoherbicidal potential against several weeds (Walker, 1981; Boyette *et al.*, 1984; Boyette & Walker, 1985a,b). In preliminary greenhouse tests conducted on two indigenous species, *Fusarium oxysporum* PR #12 and *F. solani* PR#13 have shown high mycoherbicidal potential against parthenium ragweed (*Parthenium hysterophorus* L.) (Rajak *et al.*, 1990; Pandey *et al.*, 1990; Farkya *et al.*, 1994). Realizing the potential of these soil borne pathogens and profound influence of soil environment on disease development, the present investigation was carried out to determine the impact of various factors on the efficacy of the pathogens.

## MATERIAL AND METHODS

Pathogens were obtained from the mycological culture collection of this Department

of Biological Science, Rani Durgawati University Jabalpur, which were recovered earlier from diseased seedlings of *Parthenium.*

**Green House Conditions**

Seeds of *Parthenium* weed were collected and planted evenly in 20cm diam. earthern pots. Green house temperature was 25° ± 1°C with 80 – 85 per cent relative humidity & approximately 12h day length. The inoculum concentration in whole experiment used was $5.5 \times 10^4$ macroconidia / ml. The dew duration was 16h and plants were inoculated in cotyledonary stage. Control plants in each treatment were sprayed with surfactant and water only. Seedlings were observed daily for 14 days.

**Inoculum preparations**

Conidia of test fungi were harvested by flooding Petri-dishes of seven days old cultures grown on Potato–Dextrose–Agar (PDA) medium with sterile distilled water. The inoculum was adjusted to $5.5 \times 10^4$ spores/ml using haemocytometer. Surfactant, Tween–80 was added @ 0.05 ml/150ml spore suspension. Medium was prepared in accordance with Agarwal and Hasija (1986).

**Treatments**

**Soil Texture**: To study the effect of soil texture, air dried field soil was passed through a 80 mesh sieve to remove all sand particles. Percentage of silt and clay was determined by mechanical analysis (Singh, 1989). Five different textural groups *viz.*, clay (100%), silty clay soil, loam soil, sandy loam soil and loamy sand soil were artificially made as suggested by Singh (1989).

Seedlings of *Parthenium* raised in plastic pots containing soil of different textures were used for bioassay. 10–15 days old 15 to 20 seedlings per pot were sprayed to run off using an atomizer and placed in environmental test chamber (Remi) for 24 h (28°C±1°C, 100% RH) and then moved to a greenhouse for observation.

**Temperature:** To study the effect of post application air temperature, inoculated seedlings were kept at 15, 20, 25, 30 and 35°C in environmental test chamber. Relative humidity ranged from 90– 95per cent. The soil used was loamy sand.

**Soil moisture and relative humidity:** Effect of soil moisture and disease incidence was determined following method of Roth and Richer (1943) and Bateman (1961). Polythene bags of (10×10cm) filled with soil at various levels and placed over a constant water level to obtain different soil moisture content in surface layer of soil, were used. Similarly, a set of inoculated pots in four replicate were kept in environmental test chamber at different humidity to study its effect on disease severity.

**Soil pH:** Acid washed sandy soil was adjusted to different pH with 0.1M citrate phosphate buffer and seedlings were raised in soil having different pH values. These pots were inoculated and kept in environmental test chamber at 25°±1°C temperature. The seedlings of control pots were sprayed with distilled water and Tween-80.

**Statistical Analysis**

Whole experiment was repeated thrice and all treatments in each experiment were replicated four times. The data were analyzed statistically and difference between treatment means was evaluated by Duncan's multiple range tests.

## RESULTS AND DISCUSSION

**Soil texture**

Maximum seedling mortality was recorded in sandy loam soil followed by loamy sand soil, loam soil, silty clay soil and clay soil by both the pathogens (Fig. 1). Clay soil did not support disease development. Degree of porosity influence growth and parasitism of both the pathogens. Sandy loam soil is better drained, holds less water, dry faster and may favour multiplication and survival of *Fusarium* spp. (Boyette *et al.*, 1984; Saxena and Khare, 1988)

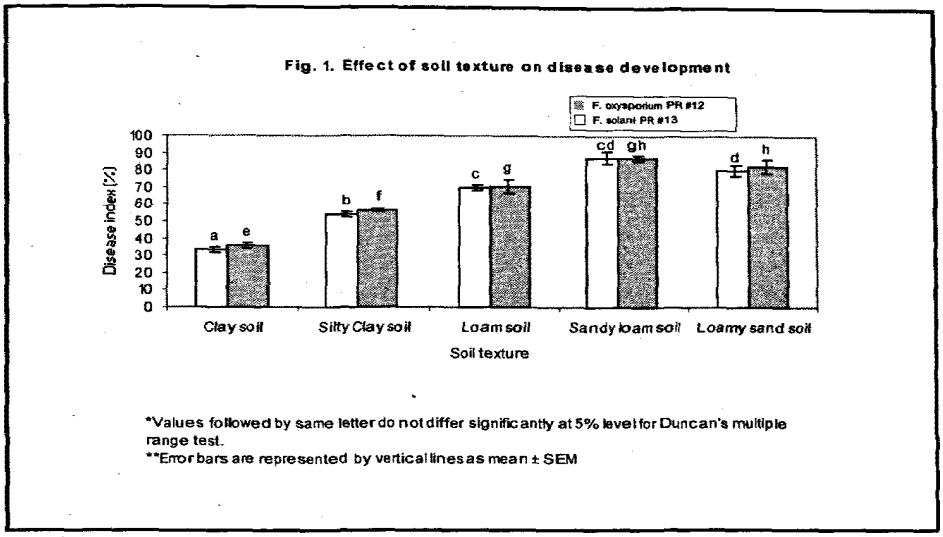



Fig. 1. Effect of soil texture on disease development

*Values followed by same letter do not differ significantly at 5% level for Duncan's multiple range test.
**Error bars are represented by vertical lines as mean ± SEM

## Temperature

Seedlings were infected by two pathogens at 25°±1°C temperature followed by 30°±1°C (Fig. 2). Increase or decrease in temperature from optimum resulted in drastic decline in seedling mortality. Similar results were obtained earlier for *F. lateritium*, the biocontrol agent of *Abutilon theophrasti* and *Sida spinosa* (Boyette & Walker, 1985 a,b).

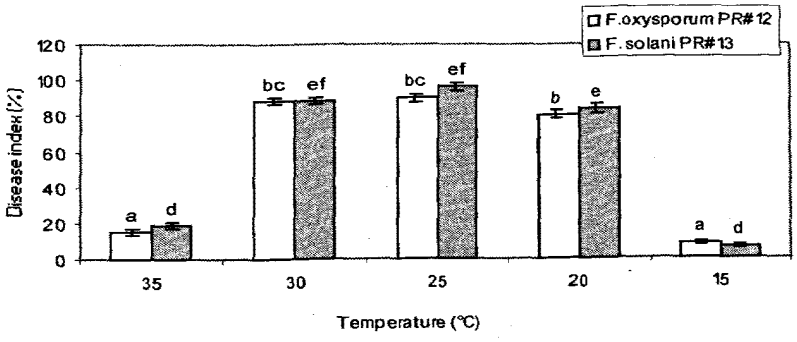


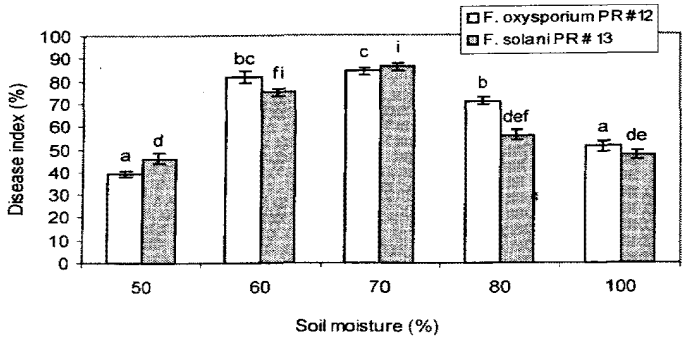

Fig. 2. Effect of temperature on control of P. hysterophorus L by F. oxysporum PR#12 and F. solani PR#13 in green house

*Values followed by same letter do not differ significantly at 5% level for Duncan's multiple range test.
** Errors bars are represented by vertical lines as mean ±SEM.

**Soil moisture and Relative humidity**

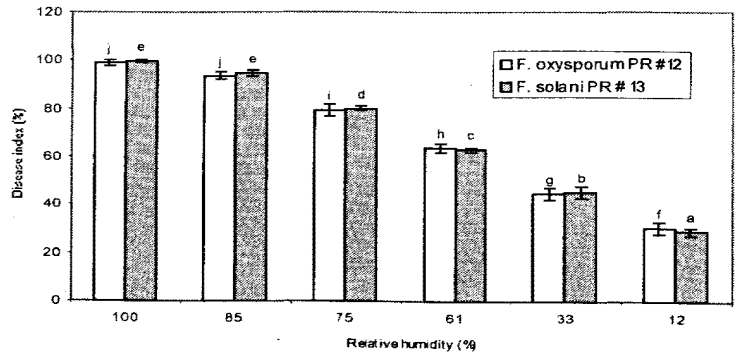
Maximum seedling mortality was observed at 70 per cent of soil moisture contents followed by 60 and 80 per cent (Fig.3) and relative humidity 100 per cent followed by 85, 75, 61, 33 and 12 per cent (Fig.4). Less soil moisture influence the soil aeration and concentration of salts in soil as well as it also affect availability of oxygen to microorganisms (Mehrotra, 1980). High humidity avails moisture for germination of spores for infection (Mehrotra, 1980).

**Fig. 3. Effect of soil moisture on disease development**

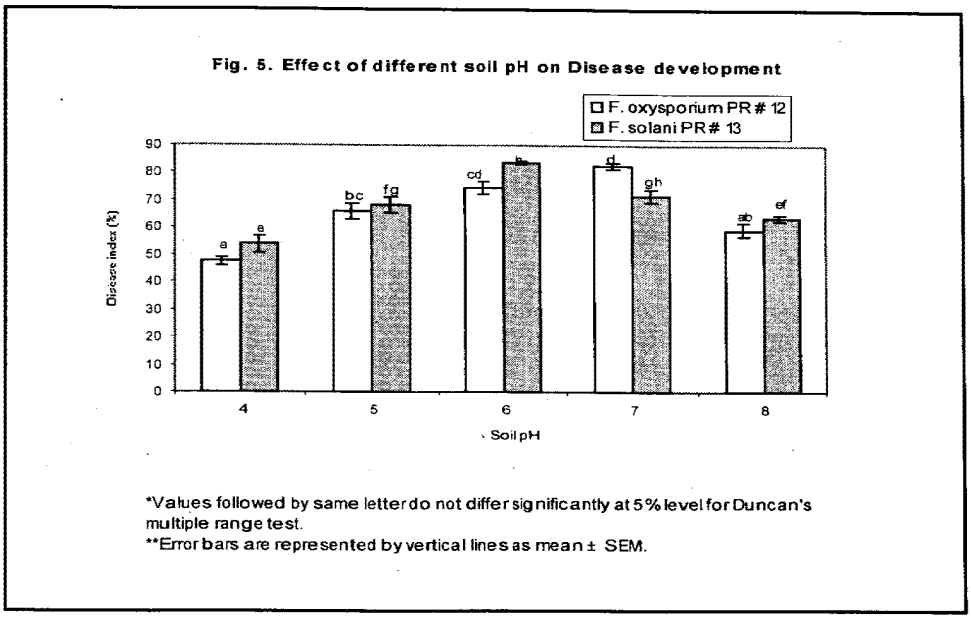



*Values followed by same letter do not differ significantly at 5% level for Duncan's multiple range test.
** Errors bars are represented by vertical lines as mean ± SEM.

**Fig. 4. Effect of Relative humidity on disease development**




*Values followed by same letter do not differ significantly at 5% level for Duncan's multiple range test.
** Errors bars are represented by vertical lines as mean ± SEM.




**Soil pH**

Maximum seedling mortality was observed at either neutral (7.0) or slightly acidic pH (6.0) (Fig. 5) in case of *F. oxysporum* PR #12 and *F. solani* PR #13, respectively. Slight increase or decrease in pH from optimum resulted in decreased seedling mortality. Neutral or alkaline soils favoured disease severity. Climatic parameters that favour rapid infection and disease development together with the knowledge of the climate in geographic region where the weed grows are of great significance in accurate assessment of the mycoherbicide potential of a particular fungal pathogen.

Result presented in this study revealed that both the test fungi may cause a lot of damage under controlled environmental conditions and further research is needed in field conditions for possible development of *F. oxysporum* PR #12 & *F. solani* PR #13 as mycoherbicides against *Parthenium hysterophorus* L.

## ACKNOWLEDGEMENTS

Financial support provided by Council of Scientific & Industrial Research (9/97(46)/96–EMR – I) is thankfully acknowledged.

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