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Effect of crop sequence on the population of *Fusarium udum* Butl. in soil

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The population of *Fusarium udum*, the causal organism of wilt of pigeon, in inoculated potted soil greatly reduced when the soil was kept fallow. The population was maximum when a susceptible cultivar of pigeonpea was used as the host and the population increased further when pigeonpea was successively grown in the same soil. Appreciable reduction of *F. udum* population in both rhizosphere and rhizophane was obtained with crop sequences of pigeonpea-fallow-chilli, pigeonpea-fallow-tobacco, pigeonpea-chilli-chilli and pigeonpea-tobacco-tobacco. The population was even lesser as compared to when a resistant cultivar of pigeonpea was grown. The percentage of germination of the chlamydospores of *F. udum* in the root exudate of a susceptible cultivar of pigeonpea was more than 3 times than that in a resistant cultivar. The percentage of germination in the root exudates of chilli and tobacco was more or less same as that in the root exudate of a resistant cultivar of pigeonpea. Practically no germination of chlamydospores occurred in tap or distilled water.

Key Words : Pigeonpea wilt, *Fusarium udum*, Crop sequence, Rhizosphere population, Chlamydospore germination, Root exudate

Wilt, caused by *Fusarium udum* Butl., is a serious disease of pigeonpea (*Cajanus cajan* (L.) Millsp.).

Crop rotation has been used as an efficient method for control of pathogenic soil borne fungi having host specificity such as species of *Fusarium*. Reduced wilt incidence in pigeonpea grown after tobacco or sorghum, or one year break has been reported by Bose (1938) and Natarajan *et al.* (1985). The controlling effect on the disease by crop rotation is mainly due to a reduction in the population of the pathogenic fungus in the soil. This paper deals with the results of studies on the effect of different crop sequence on the population of *Fusarium udum* in infested soil in pot culture. The effect of the

root exudates of some crops on the germination of chlamydospores, the dormant survival structures of *F. udum*, was also studied.

MATERIALS AND METHODS

The following host plants were used : Pigeonpea (*Canjanus cajan* L. Millsp.) cv. ICP 2376 (susceptible) and cv. ICP 8863 (resistant), chilli (*Capsicum frutescens* L.) cv. Varuna, jute (*Corchorus olitorius* L.) cv. JRO 632, tobacco (*Nicotiana tabacum* L.) local, gram (*Cicer arietinum* L.) cv. NP 46A and summer squash (*Cucurbita pepo* L.) local.

For soil inoculation an isolate of *F. udum*, multiplied in sterilized sand-maize medium in 250 ml Erlenmeyer flasks for 12 days, was thoroughly mixed with potted soil (sandy loam, pH 6.1) @ 5% of the inoculum. Surface sterilized seeds of different host plants were sown in the inoculated soil (6 seeds per pot).

Each crop in different sequences was allowed to grow in the pots for two months after which the population of *F. udum* in the rhizosphere and rhizoplane of the crop was counted by dilution plate technique (Kaiser and Sen Gupta, 1978) using Papavizas medium (Papavizas, 1976) and the plants removed. The process was repeated with second and third batch of crops using different crop sequences.

For collection of root exudates a folded blotting paper sheet (6.5 cm wide, 1.5 cm high) was placed in a beaker in an upright position with the open side of the fold on the upper side and sterilized in an autoclave. Surface sterilized seeds of different host plants were placed aseptically within the folds of the blotting papers moistened with sterile distilled water and the beakers were covered. After the required period, the seedlings grown in the folded blotting papers were taken out and discarded. The blotting papers, which absorbed the exudates secreted by the roots of different crop plants, were taken out and macerated in a morter and pestle with 70% ethanol. The extract was squeezed through two folds of bandage cloth and centrifuges at 1500 rpm for 5 minutes. The supernatent liquid was collected and stored as test fluid (root exudate) at 4 C for future use.

Abundant chlamydospores were produced by the isolate of *F. udum* when grown in 30 ml potato dextrose broth in 150 ml Erlenmeyer flasks for 15 days at 25 C. The mycelial mats containing the chlamydospores were collected by filtering through folded bandage cloth, washed thrice in sterile distilled water and blended in a waring blender for half minute with sterile distilled water for separation of the chlamydospores. A dilution having 10-12 chlamydospores under the low power of microscope was prepared. A drop of the test solution (root

exudate) was placed in a goove of a double gooved slide. The test solution was allowed to dry up and to this a drop of chlamydospore suspension was added. The slides were then placed in moist chambers prepared by lining petri dishes with moistened filter papers and incubated at 25°C for 24 hours. The number of chlamydospores germinated was counted under a microscope.

RESULTS AND DISCUSSION

The influence of host plants on the population of pathogenic soil borne *Fusarium* spp. has been demonstrated by several workers (Abawi, 1971 ; Abawi and Lorbeer, 1972 ; Banihoshemi and de Zeenw, 1973). In the present study the population of *F. udum* in soil (rhizosphere and rhizoplane) was maximum when a susceptible cultivar of pigeonpea was used as the host and the population increased further when the crop was successively grown in the same soil. The population was much lesser when a resistant cultivar was grown (Table 1).

Table 1. Effect of crop sequences on the population of *F. udum* in inoculated soil

Crops and crop sequences	No. of Fusarium propagules (x 10^3)[1]	
	Rhizosphere	Rhizoplane
1. Pigeonpea (IOP 2376)	19.6	15.6
2. Pigeonpea (IOP 8863)	10.3	6.6
3. Fallow/Fallow Fallow		14.0,3.6/3.0
4. Pigeonpea (ICP 11286) followed by :		
a) Fallow/Pigeonpea	4.6/15.6	4.3/12.6
b) Fallow/Chilli	4.6/4.0	4.3/2.3
c) Fallow/Mustard	4.6/4.3	4.3/3.3
d) Fallow Jute	4.6/10.0	4.3/6.6
e) Fallow Tobacco	4.6/3.0	4.3/2.3
f) Fallow/Gram	4.6/11.6	4.3/9.6
g) Fallow Summer squash	4.6/10.0	4.3,8.0
h) Chilli/Pigeonpea	7.3/14.6	5.3,9.6
i) Mustard/Pigeonpea	7.3/13.0	5.6/10 6
j) Jute-Pigeonpea	11.0/17.3	9.6/11.0
k) Tobacco/Pigeonpea	6.0/9.3	5.0 6.3
l) Gram Pigeonpea	12.3/17.6	8.6,11.3
m) Summer squash Pigeonpea	11.3,15.3	8.3/11.6
n) Chilli/Chilli	7.3,3.6	5.0,2.6
o) Mustard Mustard	7.6/5.0	5.6 4.0
p) Jute/Jute	11.0,7.0	9.6 7.0
q) Tobacco/Tobacco	6.0 3.0	5.0 2.3
r) Gram Gram	12.3/11.3	10.6 8.6
s) Summer squash/Summer squash	11.0/8.6	9.3 6.6
t) Pigeonpea/Pigeonpea	20.3/22.0	14.6/15.6

[1] Mean of three replications

Keeping the pots fallow for two months after a crop of pigeonpea greatly reduced the population of *F. udum* in the soil. When crops other than pigeonpea were grown in inoculated soil following a first crop of pigeonpea, the population of *F. udum* reduced to a varied extent. Appreciable reduction of *F. udum* population was obtained with crop sequences of pigeonpea-fallow-chilli, pigeonpea-fallow-tobacco, pigeonpea-chilli-chilli and pigeonpea-tobacco-tobacco. Studies on rhizosphere population might, thus, be helpful in the selection of crops for rotational purpose in the control of fusarial wilt diseases.

Table 2. Effect of root exudates of different crops on the germination of chlamydospores of *F. udum*

Crop	Germination of chlamydospores (%) ± SE	
	Seedling age (days)	
	7	15
Pigeonpea (ICP 8863)	26.54 ± 1.19 (31.01)	29.66 ± 6.07 (32.67)
Pigeonpea (ICP 2376)	83.64 ± 2.37 (66.31)	88.79 ± 1.03 (70.48)
Chilli	27.20 ± 1.27 (31.41)	30.75 ± 6.88 (31.45)
Mustard	31.03 ± 10.55 (33.04)	34.25 ± 5.54 (36.88)
Jute	37.68 (40.32)	39.25 ± 4.36 (45.27)
Tobacco	24.76 ± 2.72 (30.07)	27.82 ± 8.43 (33.62)
Gram	49.68 ± 3.46 (52.56)	56.78 ± 4.28 (61.52)
Summer squash	48.66 ± 5.43 (52.21)	56.19 ± 5.23 (59.12)
Control : Distilled water	0.92 ± 0.03 (2.77)	—
C.D. P=0.05	19.96	17.75

[1]Figures in parenthesis are transformed angular values

Several workers have demonstrated perennation of pathogenic *Fusaria* in soil as chlamydospores (Cook, 1978 ; Nash *et. al.*, 1961 ; Trujillo and Snyder, 1963). The chlamydospores, however, require some nutrition for their germination, which is mainly provided by the root exudates of different crops. In the present study, chlamydospores of *F. udum* failed to germinate in distilled water (Table 2). Differential growth response and chlamydospore germination of *Fusarium* spp. in the root exudates of resistant and susceptible cultivars of a crop has earlier been demonstrated by Howre and Nene (1984) and

Satyaprasad and Ramarao (1983). In the present study the percentage of germination of *F. udum* chlamydospores in the root exudate of susceptible cultivar of pigeonpea was found to be more than 3 times than that in a resistant cultivar. The percentage of chlamydospore germination in the root exudates of chilli and tobacco was more or less same as that in the root exudate of the resistant cultivar of pigeonpea. The chlamydospore germination percentage in the root exudates of gram and summer squash was significantly higher as compared to those in pigeonpea (resistant), chilli, mustard, and tobacco. A positive correlation could be drawn between the results presented in Table 1 showing population of *F. udum* in the rhizosphere and rhizoplane of different crops and the results presented in Table 2 showing the effect of root exudates of different crops on the germination of chlamydospores of *F. udum*.

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