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Wilt incidence in sole and sorghum intercropped pigeonpea at different inoculum densities of *Fusarium udum*

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Abstract : Disease incidence in a wilt tolerant pigeonpea cultivar C 11 in sole and sorghum intercropped system at varied densities of *Fusarium udum* in Alfisol and Vertisol fields was studied at ICRISAT Asia Center, Patancheru, India during 1992 rainy season. A significant (P = 0.01) reduction in wilt incidence was observed in both the soils in sorghum intercropped pigeonpea compared to sole pigeonpea only at higher inoculum densities (1725-4960 colony forming units (CFU) g^{-1} soil) but not at lower densities (220-1070 CFU g^{-1} soil). Wilt incidence at the highest inoculum density (4960 CFUg^{-1} soil) tested in the Vertisol was 57 per cent in sole pigeonpea compared to 39 per cent in sorghum-intercropped pigeonpea. In the Alfisol, wilt incidence at the highest inoculum density (4150 CFU g^{-1} soil) tested was 66% in sole pigeonpea compared to 46% in sorghum intercropped pigeonpea.

Keywords : Pigeonpea, *Cajanus cajan,* sorghum, wilt, *Fusarium udum*, sole crop, intercrop, Alfisol, Vertisol, inoculum density

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important grain legume crop of rainfed agriculture in the semi-arid tropics of Asia, eastern and southern Africa and central America. Traditionally, it is commonly intercropped with a variety of other crops, but in the recent years there has been a trend towards growing pigeonpea as a sole crop because of better prices being paid for the grain and the availability of short-duration cultivars. Among the diseases affecting pigeonpea pruduction, wilt caused by *Fusarium udum* Butler is the most important. It is particularly serious in south Asia and eastern and southern Africa, in which regions it is estimated to cause annual yield losses worth US$ 36.3 and 5.2 millions respectively (Kannaiyan *et al.*, 1984).

One way of effectively managing wilt disease is to grow resistant cultivars. Intensive efforts are underway to develop high-yielding and wilt resistant cultivars of pigeonpea in India and eastern and southern Africa (Reddy *et al.,* 1990). Another important approach by which soil borne diseases such as pigeonpea wilt could be managed is by adoption of suitable cultural practices. There are a few reports indicating the influence of cropping systems on pigeonpea wilt. Bose (1938) observed reduced wilt incidence in pigeonpea grown after

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tobacco. Reduction in wilt incidence was also observed when pigeonpea was grown either mixed or intercropped with sorghum (Dey, 1948; Gupta, 1961; Natarajan *et al.*, 1985) and *Crotolaria medicaginea* (Upadhyay and Bharat Rai, 1981). During disease surveys in India, Kannaiyan *et al.* (1984) observed low wilt incidence in fields of pigeonpea intercropped with sorghum. All the earlier studies, however, were conducted in normal fields or wilt sick-plots without information on the *F. udum* populations in the soils at sowing. It is logical to expect that the effects of mixed or intercrops on pigeonpea wilt will vary with initial *F. udum* population in soil. Hence, a field experiment was conducted to examine the effects of intercropping of sorghum with pigeonpea on wilt incidence in soils with different initial *F. udum* population densities.

MATERIALS AND METHODS

The experiment was conducted on Alfisol and Vertisol fusarium wilt sick plots at ICRISAT Asia Center, Patancheru, Andhra Pradesh, India during the 1992 rainy season. The sick plots used for the experiment were developed during the period 1975 to 1977 by growing wilt susceptible pigeonpea lines such as ICP 6997 and incorporating wilted plants into soil (Nene *et al.*, 1981). Sickness of the plots was subsequently maintained by interplanting susceptible lines (1:2 or 1:4) with germplasm accessions and breeding material being screened for resistance.

In order to develop different gradients of *F. udum* inoculum in the original wilt sick plots, a solarization technique was used (Chauhan *et al.*, 1988). Plots of 72 m^2 (18m × 4m) in the sick plots were subjected to 10, 20, 30, 40, 50 and 60 days of solarization during April and May 1992 to obtain differential killing of *F. udum*. The main plots were laid along the natural slope of the field (1 per cent slope) and separated by a two metre path to avoid any possible contamination between the plots of different *Fusarium* populations. These were not replicated. Each of these plots were divided into four sub-plots (18 m^2). Two plots were sown randomly with sole pigeonpea and two with pigeonpea intercropped with sorghum and considered as replicates. The inter- and intra- row plant spacings were 60 and 20 cm respectively. RBD was used for data analysis.

The population of *F. udum* in different main plots were estimated after solarization. Soil samples from subplots were not analysed for *F. udum* population. The composite soil samples collected from each main plot (10 sub-samples drawn from each plot from 10 cm depth) were air dried, ground using a mortar and pestle, passed through a 40 mesh (1.4 mm) sieve and stored in plastic envelopes at 25°C until required. All samples were processed for estimation of *F. udum* population within two weeks of collection using a malachite green medium (Singh and Chaube, 1970). One hundred mg of soil was sprinkled on five 90 mm diameter petri dishes and incubated on laboratory benches at 20-30°C. *Fusarium udum* colonies were counted after five days. Four replications were kept for each samples.

The experiments were sown on 10 June 1992. In the intercropped system, 2 rows of sorghum were alternated with one row of pigeonpea. A moderately wilt susceptible medium-duration pigeonpea cultivar C 11 was used in the experiment. The sorghum used was CSH 9. The trial was conducted under rainfed conditions (annual rainfall 704 mm). A basal dose of 40 kg of N and 20 kg P_2O_5 ha^{-1} was applied to all the plots. A top dressing of urea was applied to the sorghum at the rate of 40 kg N ha^{-1} 30 days after sowing. Wilt incidence was monitored at monthly intervals till the end of the season (December).

RESULTS AND DISCUSSION

F. udum populations in different treatments at sowing ranged from 220 to 4960 colony forming units (CFU) g^{-1} soil in the Vertisol (Table 1) and from 105 to 4150 CFU g^{-1} soil in the Alfisol (Table 2). Wilt incidence in the Vertisol ranged from 3 to 57 percent in sole pigeonpea plots and from 4 to 39 percent in the sorghum-intercropped plots (Table 2). With higher initial levels of in-

Table 1 : Wilt incidence in sole and sorghum intercropped pigeonpea (cv. C 11) grown in a Vertisol field with different initial inoculum densities of *Fusarium udum* at ICRISAT Asia Center, Patancheru, India 1992-93 rainy season

Initial *F. udum* population (CFU g^{-1}) soil	Pigeonpea plants wilted (%)	
	Sole pigeonpea	Sorghum intercropped pigeonpea
4960	57 (49)[1]	39 (39)
3765	40 (39)	27 (31)
1725	32 (34)	16 (23)
1070	13 (21)	13 (21)
920	10 (19)	9 (17)
630	5 (13)	5 (13)
220	3 (10)	4 (12)
	5%	1%
CD Inoculum load	5.3 (3.1)	7.8 (4.6)
CD Cropping system	2.9 (1.8)	4.3 (2.8)
CV (%)	16	8

[1]Figures in parentheses are angular transformed values.

oculum (1725-4960 CFU g^{-1} soil), wilt incidence in sorghum- intercropped pigeonpea plots was significantly (P=0.01) lower than in sole pigeonpea plots. At lower initial levels of inoculum (220-1070 CFU g^{-1} soil), the differences in wilt incidence in between sole and sorghum intercropped pigeonpea were, however, not significant, indicating an interaction between *F. udum* populations and cropping systems. The results of the experiment in the Alfisol field (Table 2) showed similar trends.

The results of the study are in conformity with studies that indicated that intercropping of sorghum with pigeonpea reduced wilt incidence in pigeonpea (Dey, 1948; Gupta, 1961). The use in the present study of a moderately wilt-susceptible variety C 11 and of different initial *F. udum* populations provide more insight into the effects of sorghum-pigeonpea intercropping on wilt incidence. The maximum difference in wilt incidence in the sole and sorghum intercropped pigeonpeas observed in the present study in a moderately susceptible cultivar was 20%. Natarajan *et al.* (1985) reported 24% wilt in susceptible pigeonpea genotypes intercropped with sorghum compared to 85% in the sole pigeonpea crop. The results of the present and past studies on sorghum-pigeonpea intercropping indicate that sorghum intercropping alone cannot reduce wilt incidence below the economic threshold levels of 20% (Naik and Reddy, 1993) either in susceptible or moderately susceptible cultivars when there are high populations of *F. udum* in the soil (>3240 CFU g^{-1} soil).

The reduced wilt incidence in sorghum intercropped pigeonpea has been attributed to fungitoxic exudates secreted by sorghum roots. Rangaswami and Balasubramanian (1963) reported that sorghum roots secreted hydrocyanic acid, and the spores of *Fusarium moniliforme* (Sheld.) when treated with sorghum root exudates showed de-

Table 2 : Wilt incidence in sole and sorghum intercropped pigeonpea (cv. C 11) grown in an Alfisol field with different initial inoculum densities of *F. udum* at ICRISAT Asia Center, Patancheru, India, 1992 rainy season

Initial *F. udum* population (CFU g^{-1})	Pigeonpea plants wilted (%)	
	Sole pigeonpea	Sorghum-intercropped pigeonpea
4150	66 (54)[1]	46 (43)
3240	41 (40)	30 (33)
1375	24 (29)	17 (25)
1030	12 (20)	8 (17)
830	9 (17)	8 (16)
310	5 (13)	0
105	3 (9)	2 (9)
	5%	1%
CD Inoculum load	8.3 (6.6)	12.3 (11.0)
CD Cropping system	2.4 (2.3)	3.6 (3.4)
CV (%)	13.9	11.2

[1]Figures in parentheses are angular transformed values.

layed germination. They also found that in early stages of plant growth, this fungus was not capable of establishing itself in the rhizosphere of the sorghum genotypes. Odunfa (1978) also suspected the presence of antifungal substances in sorghum root exudates when he obtained scanty mycelial growth of four species of *Fusarium* when treated with these exudates. It is also possible that sorghum roots encourage soil microflora that are antagonistic to *F. udum.*

It was logical to expect sorghum intercropped pigeonpea to be more effective in suppressing *F. udum* population and reducing wilt incidence at lower population levels than at higher levels. But the results were other way round. The reasons for lack of suppressive effect of sorghum intercropped pigeonpea at lower levels of *F. udum* are not clear. But the results of the study clearly point out the need for integrated management of pigeonpea wilt. Though cultural practices such as intercropping may help in reducing *F. udum* population, on its own it will not be able to manage the disease. Thus, there is a need to investigate the integrated effect of cultural practices such as inter/mixed cropping, and crop rotations and resistant/tolerant cultivars on *F. udum* population for effective management of the disease.

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