Effect of Weed Infestation on the Severity of Phytophthora Blight of Pigeon Pea

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ABSTRACT

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Twenty-six cultivars of pigeon pea (*Cajanus cajan*) were sown in soil infested with *Phytophthora drechsleri* f. sp. *cajani* to determine the effect of weed presence on the severity of Phytophthora blight. Most of the cultivars had high mortality in weeded plots, whereas disease intensity was significantly reduced in weed-infested plots. Apparently, a weed canopy reduced splash dispersal of *P. drechsleri* to aerial plant parts of pigeon pea plants.

Pigeon pea (*Cajanus cajan* (L.) Huth) is highly susceptible to Phytophthora blight caused by *Phytophthora drechsleri* Tucker f. sp. *cajani* Kannaiyan et al from seedling to maturity (5). In India, pigeon pea is sown primarily during June–July, a period that receives maximum rainfall. The disease appears on the aerial parts of plants as stem and foliar blight and causes significant losses under conditions of high relative humidity and temperature during rainy weather (2,3). Because the pathogen survives in the soil, it needs some mechanism for dispersal to the aboveground parts (stem and leaves) of the plants. Some plants with heavy foliage or under high wind velocity may bend near the soil and become infected. However, dispersal occurs mainly through raindrop splash (V. B. Chauhan and U. P. Singh, *unpublished*). As a result, if splash dispersal could be prevented by some means, the probability of infection might be reduced.

Splash-borne infection in apple fruits by *P. syringae* (Kleb.) Kleb. has been reported by Upstone and Gunn (4). Gregory (1) also reported that one of the factors that has promoted increased apple fruit rot caused by *P. syringae* is the practice of maintaining bare soil around the trees with herbicides, thereby replacing the older grass floor, which had a mulching effect. Gregory also reported that the removal of the normal leaf mulch layer around the base of cocoa trees greatly increased the incidence of splash-borne spores of *P. megakarya* Brasier & Griffin. Weeds were considered first as possible interceptors of inoculum of *P. d. cajani* during splash-dispersal events and an experiment was conducted to determine whether weeds would serve as a barrier between the inoculum and plants of pigeon pea. The results of an increase or decrease in Phytophthora blight of pigeon pea by removal and presence of weeds are presented here.

MATERIALS AND METHODS

Twenty-six cultivars, including a susceptible control (ICP-7119) of pigeon pea, were sown in soil known to be infested with *P. d. cajani* during June 1987–1988 and 1988–1989 (Table 1). A factorial experiment with a randomized block design was conducted. Plots (15 × 24.5 m) were divided into four subplots (15 × 5 m) with a space of 1.5 m between

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each plot. One row of the susceptible cultivar was seeded after every five test rows and one row of each other cultivar was planted in each subplot. The seeds were sown at 20-cm intervals in 5-m rows; rows were spaced 0.5 m apart.

There were two treatments, each replicated twice. In the first treatment, hand weeding was done in two subplots at 10-day intervals to keep the plots free from weeds. Weeds (mostly *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., and *Echinochloa* sp.) were allowed to grow in the other two subplots. Total germlings were counted 15 days after sowing. Dead plants were counted after every 15 days for 3 mo after sowing. Total incidence of disease was obtained in weeded and nonweeded fields by calculating the percentage of dead/infected plants as follows: disease incidence = plants infected or dead/total number of plants. Meteorological data were recorded in both seasons (Fig. 1).

RESULTS AND DISCUSSION

Typical blighting symptoms appeared in pigeon pea cultivars after heavy rains. During the months of the studies, the diurnal temperature and relative humidity remained around 25–35 C and 90–100%, respectively (Fig. 1). For most cultivars, there were significantly more blighted plants in weeded plots than nonweeded plots. The weeding interval was almost sufficient to maintain bare ground between rows of pigeon pea. In the nonweeded plots, weeds, mainly *C. dactylon*, *C. rotundus*, and *Echinochloa* sp., covered about 85–90% of the field. *C. dactylon* was partly creeping and partly erect, whereas *C. rotundus* and *Echinochloa* sp. were erect and spreading above the soil surface attaining about 15–45 cm in height.

During 1987–1988 and 1988–1989, maximum plant mortality in ICP-7119 was 64 and 61% in weed-free plots and 24 and 23% in weed-infested plots, respectively. Some cultivars had very little mortality in nonweeded plots in both years (1.4 and 3%). On the contrary, mortality in the same cultivars averaged 43 and 40% in weeded plots (Table 1). This disease is favored by high temperature (30 ± 2 C), high relative humidity (90–100%), and cloudy weather (2,3). These meteorological conditions occurred during the two cropping seasons of the experiments. The results suggest that the weeds inhibited upward dispersal of inoculum by raindrop splash to the aerial parts of the plants and thereby reduced infection. In weed-free fields, the spread of inoculum during heavy and frequent rainfall was unchecked and severe disease resulted. Therefore, we suggest that the yield of pigeon pea might be increased either by mulching the field or by growing dwarf leguminous crops such as mung bean (*Vigna radiata* (L.) R. Wilcz.) and urd bean (*Vigna mungo* (L.) Hepper).

Upstone and Gunn (4) also observed that the apple fruits are contaminated by splash-borne inoculum of *P. syringae* from infested soil during rains at harvest time. The increase in disease intensity was demonstrated by maintaining bare soil around the trees with herbicides. The removal of the normal leaf mulch layer around the base of cocoa trees greatly increased the incidence of splash-borne spores of *P. megakarya* (1). Our results appear to be the first report on the reduction of Phytophthora blight intensity

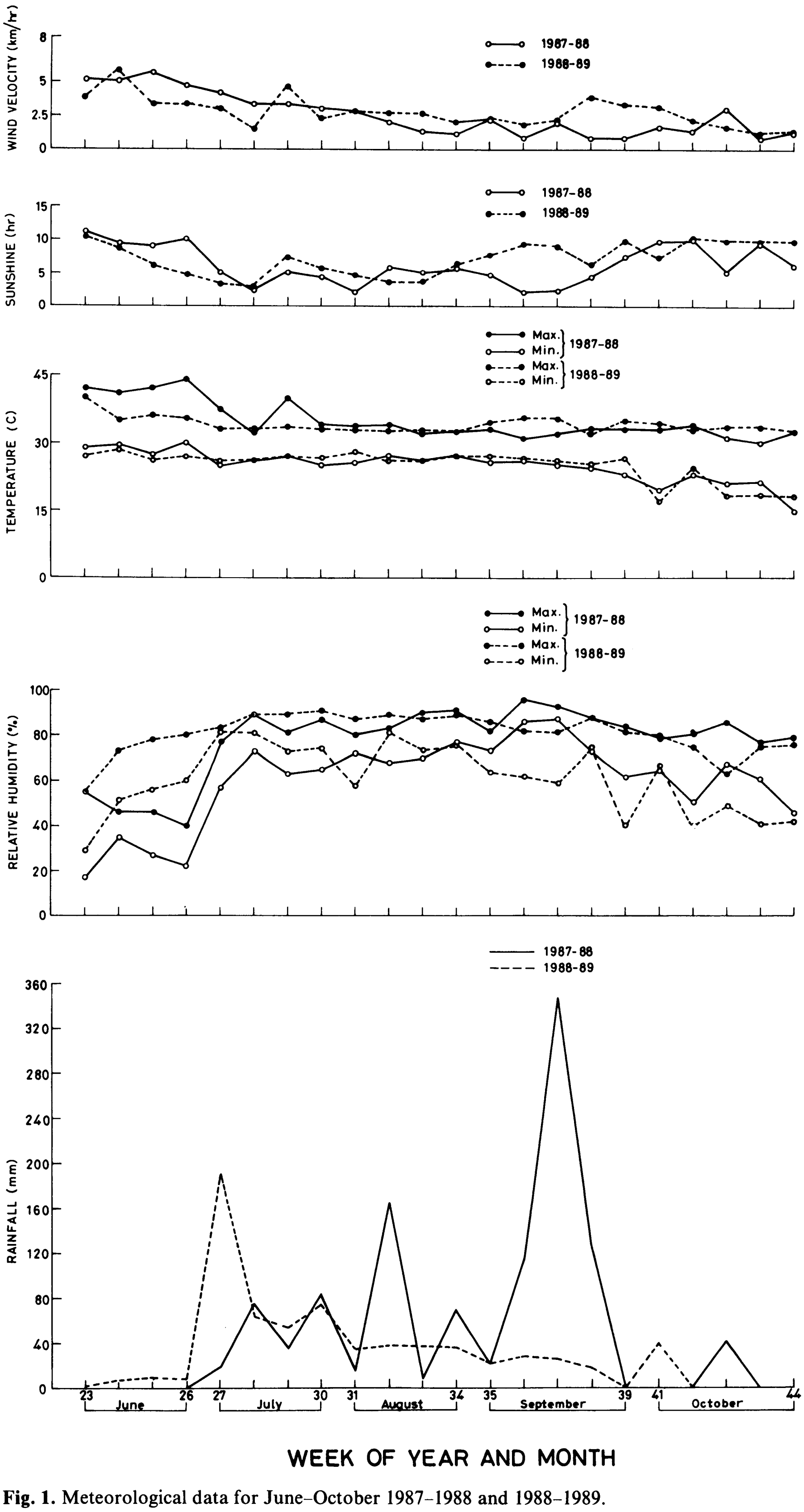

Fig. 1. Meteorological data for June–October 1987–1988 and 1988–1989.

Table 1. Incidence of Phytophthora blight of pigeon pea on 26 cultivars in weeded and nonweeded plots during two growing seasons

	Average mortality (%) of pigeon pea plants			
	1987–1988		1988–1989	
Cultivar	Weeded	Nonweeded	Weeded	Nonweeded
M-82-26	56.5 (48.7)[a]	20.8 (26.8)[a]	50.6 (45.3)[a]	17.2 (24.4)[a]
ICPL-83024	45.3 (42.3)	15.3 (23.0)	37.2 (37.6)	12.5 (20.7)
M-80-110	43.3 (41.2)	16.8 (24.3)	37.2 (37.6)	12.0 (20.2)
Pant A-8507	42.8 (40.9)	1.4 (3.4)	39.5 (38.9)	3.0 (10.3)
ICP-366	41.6 (40.2)	32.7 (34.9)	35.9 (36.8)	19.2 (26.0)
P-855	40.3 (39.4)	5.0 (12.9)	28.6 (32.3)	5.0 (12.9)
ICPL-8398	40.0 (39.2)	11.3 (19.6)	34.4 (35.9)	15.9 (23.5)
Pant A-8505	39.5 (38.9)	1.2 (3.1)	35.4 (36.5)	4.6 (12.4)
Pant A-104	35.7 (36.7)	5.0 (12.9)	28.6 (32.3)	5.0 (12.9)
Pant A-8508	35.5 (36.6)	3.7 (11.1)	28.2 (32.1)	4.8 (12.7)
Pusa Sweet-2	35.1 (36.3)	5.8 (13.9)	28.0 (32.0)	8.4 (16.8)
GAUT 82-55	33.3 (35.2)	16.5 (24.0)	27.6 (31.7)	13.1 (21.2)
DA-108	30.0 (33.4)	3.4 (10.6)	28.4 (32.2)	5.0 (12.9)
Pant A-8514	30.0 (33.4)	5.7 (13.8)	27.1 (31.4)	8.1 (16.5)
GAUT-82-56	28.7 (32.4)	13.8 (21.8)	29.9 (33.2)	16.7 (24.1)
VR-2	28.2 (32.1)	8.0 (16.4)	24.8 (29.8)	11.0 (19.4)
ICPL-186	27.7 (31.8)	20.3 (26.8)	26.0 (30.7)	18.8 (25.7)
MTH-15	26.6 (31.0)	16.6 (24.0)	26.8 (31.2)	16.3 (23.8)
DA-21	25.6 (30.4)	18.6 (25.5)	25.9 (30.6)	14.3 (22.2)
GAUT 82-53	24.9 (29.9)	8.0 (16.4)	25.5 (30.3)	13.7 (12.7)
GAUT 82-91	24.0 (29.3)	11.4 (19.4)	26.8 (31.2)	10.9 (19.3)
Pusa-85	23.2 (28.8)	7.6 (16.0)	20.4 (26.9)	7.6 (16.0)
GAUT-82-137	16.6 (24.0)	8.5 (16.9)	20.3 (26.8)	6.8 (15.1)
GAUT-82-104	20.5 (26.9)	14.0 (22.0)	17.3 (24.6)	12.2 (20.4)
ICPL-83015	10.4 (18.8)	2.5 (4.6)	10.3 (18.6)	2.3 (4.4)
ICP-7119 (susceptible)	64.1 (53.2)	23.0 (28.7)	61.2 (51.5)	22.6 (28.4)
Mean[b]	35.0	18.2	33.0	18.6

[a] Angular transformed values.
[b] LSD ($P = 0.05$): weeded and nonweeded = 0.26; years = 0.26; cultivars = 0.95; year × weeded and nonweeded = 0.37; year × cultivars = 1.34; cultivar × weeded and nonweeded = 1.34; and year × cultivar × weeded and nonweeded = 1.90.

by weeds interfering with inoculum dispersal from soil to susceptible aerial parts of pigeon pea.

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