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EPIDEMIOLOGY OF SOFT STEM ROT DISEASE IN COWPEAS GROWN IN OWERRI, IMO STATE, A RAINFOREST AREA OF NIGERIA

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ABSTRACT

Epidemiology of soft stem rot disease of cowpeas grown in Owerri, Imo State, a rainforest area in Nigeria was studied. Ten cultivars of cowpea; IT86D-719, IT89K-288, VITA7, IT86D-715, IT84S-2246-4, IT90K-277-2, TVU14476, TVX3236, IT93K-452-1 and Ife-Brown were planted in the Teaching and Research Farm, Imo State University, Owerri, between May and August, 2006. Plot size of 1 x 3 m each was used with the following planting distances, 25 x 75 cm, 25 x 25 cm, 50 x 50 cm, 50 x 75 cm, and 75 x 75 cm, arranged in a randomized complete block design. Except fertilizer application, other field maintenance practices including weeding and insecticide application were done at 4 weeks after planting. The field was rain fed throughout the duration of the experiment. Observations were made on soil temperature, relative humidity, rainfall, soil moisture, incidence of soft stem rot disease on the cowpea seedlings, number of cowpea seedlings having symptoms of soft stem rot disease, disease lesion diameter in the affected seedlings, and seed yield. It was observed that the 25 x 25 cm and 50 x 50 cm planting distances recorded more disease-infected cowpea seedlings suggesting that overcrowding plant population encourages spread of soft stem rot disease. Incidence of soft stem rot disease was observed on the cowpea seedlings and it was believed to have been facilitated by conducive soil temperature (24.4^{o}C) and soil moisture recorded within the period. Soft stem rot disease attacked virtually all the cultivars; however, the number of affected seedlings was significantly lower in IT86D-715 cultivar than the other cultivars. Also cultivar IT86D-715 recorded the lowest disease lesion diameter, suggesting the cultivar's potential as a tolerant material in the management of soft stem rot disease in cowpeas.
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INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a legume which has become a staple food for majority of people worldwide. In Nigeria, cowpeas are cheap source of protein (Davis *et al*., 1991) having contained up to 25 % protein (Coetzee, 1995) and the crop is an important companion in the cropping systems of the West African sub-region (Quass, 1996). However, cowpea is susceptible to a wide range of pathogens that attack the crop at all stages of its growth, causing diseases such as rots, thus militating against its increased and sustainable yield (Allen, 1973).

Pythium rots are a common crop disease caused by *Pythium* species of which the species, *Pythium aphanidermatum* (Edson) Fitzpat causes soft stem rot disease in cowpeas (Onuorah, 1973; Moorman, 2002). *Pythium* rots are very common problems in fields and greenhouses where the organism kills newly emerged seedlings (Javis, 1992). *Pythium* species are plant pathogens of economic importance in agriculture, and tend to be very generalistic and

unspecific in their host range- that is- they infect a large range of hosts (Owen-Going, 2002). In hydroponic systems inside green houses, where extensive monocultures of plants are maintained, *Pythium* spp cause extensive and devastating root and stem rots (Javis, 1992; Owen-Going, 2002; Owen-Going *et al*., 2003). Development of stem rots in some crops coincides with hot weather when temperature of the crop growth environment is high. *P. aphanidermatum* is widely known to cause severe symptoms of root and stem rots in various crops when root zone temperature is moderate or high (23-27^{o}C) (Bates and Stanghellini, 1984; Gold and Stanghellini, 1985; Martin and Loper, 1999; Owen-Going *et al*., 2003; Thomson *et al*., 1971). It is important to note that effects of temperature on symptom development can differ markedly from those when the pathogen colonizes the tissues symptomlessely during the biotrophic phase. According to Sutton *et al*. (2006), roots of hydroponic peppers and chrysanthemums can be extensively colonized by *P. aphanidermatum* but remain almost symptomless at 16 to 18^{o}C, yet develop severe symptoms within minutes or hours when the temperature is raised to 24-28^{o}C under adequate soil moisture.

An understanding of soft stem rot epidemics is fundamental to the development and refinement of methods and practices to manage the disease in crops. While soft stem rot is almost universal in commercial systems, and in many instances becomes sufficiently severe to cause serious crop losses, it is also true that in many other instances, progress and spread of the disease is comparatively slow and losses are perceived minor (Sutton *et al*., 2006). However, it is clear that a myriad of variables significantly influence the *Pythium* species and soft stem rot development in crops. Important variables range from subtleties such as calcium in the root zone (Hardham, 2000) to elevated temperature and moisture, which can bring about abrupt and explosive increases in root and stem necrosis in large portions of crops (Bates and Stanghellini, 1984; Gold and Stanghellini, 1985; Javis, 1992; Kläring *et al*., 2001; Martin and Loper, 1999; Raftoyannis and Dick, 2002; Thomson *et a*l., 1971). *Pythium* species will cause disease because environmental conditions are favourable, not as a result of the spread of the pathogen into new area. According to Moorman (2002), Onuorah (1973), Parker (2003) and Sutton *et al*. (2006), plants are generally most susceptible to *Pythium* when the conditions are unfavourable for plant growth such as unfavourable temperature, excessive moisture, low light or poor nutrient availability. Each *Pythium* species is favoured by different conditions as *P. aphanidermatum* causes root and stem rots in plants in warm (25-36^{o}C), moist soil (Van der Plaats-Niterinks, 1981). Moist soil is conducive to disease development because the low oxygen level encourages the release of exudates from plants which stimulate the growth of *Pythium* species in the plant tissue (Sutton *et al*., 2006). The present study investigated the epidemiology of soft stem rot disease caused by *Pythium aphanidermatum* in Owerri, Imo State rainforest area of Nigeria.

Materials and Methods:

Materials in this study consisted of ten (10) cowpea cultivars, namely; IT86D-719, IT89K-288, VITA7, IT86D-715, IT84S-2246-4, IT90K-277-2, TVU14476, TVX3236, IT93K-452-1 and Ife-Brown. The land was prepared with tractor and planted in May 2006 on flat beds measuring 1 x 3 m in size each. The cowpea seeds were planted in the prepared beds at the rate of one (1) seed per hole of 3-4 cm depth, by using the following planting distances, 20 x 75 cm, 25 x 25 cm, 50 x 50 cm, 50 x 75 cm, and 75 x 75 cm. The experiment was designed in a Randomized Complete Block and arranged in a split-plot, with five main plots (represented by the planting distances), ten subplots (represented by the 10 cowpea cultivars) and three replications. The sowed cowpea seeds germinated after four days of planting. Water supply to the planted field was through the rainfall which was available throughout the duration of the cowpeas in the field. The field was weeded two times (first one was at 4 weeks after planting, and the second was at 8 weeks after planting), before the maturity of the cowpea seedlings. There was no fertilizer application, however, Dimethoate insecticide was applied to the cowpea seedlings at the rate of 1 l/ha, at 4 weeks after planting. This was aimed at protecting the seedlings from insects attack. Environmental conditions under which the cowpeas were grown were recorded. The major factors monitored were soil temperature (measured with soil thermometer), soil moisture expressed in water (%) by mass. Other environmental components recorded include, relative humidity, rainfall and insolation. Also observations and records were made in the following parameters:-

1. From the date of seed germination to maturity, the seedlings were checked every two days for possible incidence of soft stem rot disease.

2. Disease lesion diameter per cultivar which was determined by measuring the diameter of the lesion caused by the soft stem rot disease on the cowpea seedlings. This was done with a flexible thread and meter rule (graduated in mm) after 7 days of incidence of the disease on the seedlings.

3. Number of seedlings per cultivar having symptoms of soft stem rot disease.

4. Cowpea seed yield per cultivar. Matured pods of the cowpea cultivars were harvested, dried and the seeds processed and weighed with a weight scale graduated in grammes. However, the yield was recorded in kg/ha after converting the values with the following formula;

$$X = \frac{Y_1}{Y_2} \times \frac{10000}{1}$$

Where; X = required yield (kg/ha)

Y_1 = yield /cultivar /plot (kg)
Y_2 = plot size (m^2)
$10000m^2$ = area of a hectare.

Data Analysis

Data collected for the observed parameters were analysed by the analysis of variance procedure, while means were separated by the Duncan Multiple Range Test as used by Onuh and Igwemma (1998).

Results

The prevailing weather components during the duration of the experiment were presented in the Table1.

Table 1: Mean monthly records of prevailing weather components during the growth period of the cowpea cultivars

Months	Rainfall*(mm)	Relative humidity*(%)	Air temp.* ^oC	Soil temp.+ ^oC	Soil moisture+ (water by mass(%))
May	469.8	79	30.5	26.5	14.1
June	500.7	85	28.7	23.0	15.0
July	260.0	88	28.0	23.1	13.4
August	190.5	83	28.8	25.2	13.3

*Values obtained from Nigeria Meteorological Agency (NIMET), 2006.
+Values obtained in the field during the growth of the cowpea seedlings.

Table 2: Mean number of cowpea seedlings having symptoms of soft stem rot disease in the planting distances

Planting distance	Mean* number of affected seedlings
20 x 75 cm	22.7^b
25 x 25 cm	66.3^a
50 x 50 cm	61.7^a
50 x 75 cm	23.0^b
75 x 75 cm	9.7^c

*Means having the same letter are not significantly different at P = 0.05, according to Duncan Multiple Range Test.

There was significant difference in the number of diseased cowpea seedlings observed from the different planting distances used for the experiment. Looking at the Table 2 above, more cowpea seedlings were affected by the soft stem rot disease in the 25 x 25 cm and 50 x 50 cm

planting distances. On the other hand, 75 x 75 cm planting distance recorded the lowest number of soft stem rot affected seedlings.

Table 3: Mean number of seedlings having symptoms of soft stem rot disease in the cowpea cultivars.

Cowpea cultivars	Mean* number of affected seedlings.
IT86D-719	51.0[a]
IT89K-288	53.0[a]
VITA7	50.0[a]
IT86D-715	6.0[e]
IT84S-2246-4	57.0[a]
IT90K-277-2	20.0[d]
TVU14476	22.0[d]
TVX3236	40.0[b]
IT93K-452-1	31.0[c]
Ife-Brown	30.0[c]

*Means having the letter are not significantly different at P = 0.05, according to Duncan Multiple Range Test

There was significant difference among the cowpea cultivars in the mean number of seedlings affected by the soft stem rot disease. From the Table 3, IT86D-719, IT89K-288, VITA7 and IT84S-2246-4 cultivars had the highest seedlings affected by the disease. But IT86D-715 cultivar recorded the lowest number of affected seedlings which was significantly different from the mean number of affected seedlings in the other cultivars.

Table 4: Mean lesion diameter of soft stem rot disease in the affected cowpea cultivars

Cowpea cultivars	Mean* disease lesion diameter (mm).
IT86D-719	26.9[a]
IT89K-288	3.2[de]
VITA7	21.5[b]
IT86D-715	2.6[e]
IT84S-2246-4	6.4[d]
IT90K-277-2	15.3[c]
TVU14476	1.1[e]
TVX3236	28.6[a]
IT93K-452-1	21.1[b]
Ife-Brown	27.6[a]

*Means having the letter are not significantly different at P = 0.05, according to Duncan Multiple Range Test.

Measurements on the disease lesion diameter showed that there was significant difference among the cowpea cultivars. Cultivars, IT86D-719, TVU3236 and Ife-Brown had the highest disease lesion diameter of 26.9, 28.6 and 27.6 mm, respectively. These mean disease lesion diameters were significantly different from the mean disease lesion diameters of the other cultivars (Table 4). On the other hand, cultivars, IT86D-715 and TVU14476 had the lowest mean lesion diameters of 2.6 and 1.1 mm, respectively.

Table 5: Mean seed yield of the cowpea cultivars

Cowpea cultivars	Mean* seed yield (kg/ha).
IT86D-719	60.97[a]
IT89K-288	50.70[a]
VITA7	58.37[a]
IT86D-715	24.13[c]
IT84S-2246-4	12.10[cd]
IT90K-277-2	37.90[b]
TVU14476	55.07[a]
TVX3236	20.93[c]
IT93K-452-1	8.67[d]
Ife-Brown	13.47[cd]

*Means having the letter are not significantly different at P = 0.05, according to Duncan Multiple Range Test

The seed yield as presented in the Table 5 showed that there was significant difference among the cowpea cultivars. Cultivar, IT86D-719 recorded the highest mean seed yield of 60.97 kg/ha, however, it was not significantly different from the mean seed yield of the cultivars, IT89K-288, VITA7 and TVU14476 (Table 5). The least mean seed yield was recorded in the cultivar, IT93K-452-1.

Discussion

The incidence of soft stem rot disease on the cowpea seedlings was an indication of the presence of *Pythium aphanidermatum* in the experimental field. It was possible for the pathogen to infect the cowpea cultivars because of the favourable environmental conditions that prevailed during the growth of the cowpeas. The cowpea cultivars were planted between May and August 2006 which was rainy season months in Nigeria, and the soil maintained an average soil temperature of 24.4^{o}C. The available moisture and favourable temperature contributed to the observed incidence of soft stem rot disease on the cowpea cultivars. This observation was in agreement with Onuorah (1973) and Sutton *et al.* (2006) who reported that *P. aphanidermatum* is capable of initiating disease in plant within minutes or hours when the temperature is raised to up to 24-28^{o}C under adequate soil moisture.

There was significant influence of the planting spaces in the incidence and spread of soft stem rot disease in the cowpea cultivars. The 25 x 25 cm and 50 x 50 cm planting distances recorded more number of diseased cowpea seedlings than the other planting distances. It is believed that, the 25 x 25 cm and 50 x 50 cm planting distances had more cowpea seedlings (more plant density), thus providing the needed environment for the spread of the soft stem rot disease among the cowpea seedlings planted in the plot. This observation gives credence to the work of Raftoyannis and Dick (2002) who reported that overcrowding in plant populations encourages easy infection and spread of plant diseases especially the diseases caused by pythiaceous fungi.

The observation of soft stem rot disease symptoms on almost all the cowpea cultivars used in this study showed that they are susceptible to the soft stem rot disease. However, cultivar, IT86D-715 recorded the least number of affected seedlings than the other cultivars. Also cultivars, TVU14476 and IT86D-715 recorded the least disease lesion diameter. Even though cultivar TVU14476 recorded reasonable number of affected seedlings, the low value of lesion diameter recorded in the cultivars suggested some level of tolerance of these cultivars to the disease. Following the same pattern, cultivars, IT86D-719, TVX3236 and Ife-Brown had the highest number of seedlings affected by the disease. Subsequently, these cultivars, IT86D-719, TVX3236 and Ife-Brown recorded the highest disease lesion diameter which suggested that they are more susceptible to the disease than the other cultivars.

There was significant difference in the seed yield among the cowpea cultivars. However, it could be observed that varietal differences contributed to the yield recorded for the cultivars. This was evidenced by the record of high seed yield in the cowpea cultivars that were more attacked by the soft stem rot disease than the others.
The findings in this study supported that the knowledge and understanding of epidemiology of soft stem rot disease caused by *P. aphanidermatum* provides a valuable platform for rationalizing new research directions and better technologies and practices for managing soft stem rot disease. Cowpea cropping practice should avoid overcrowding plant density to reduce chances of more plants being affected by the soft stem rot disease. It is equally valuable to study this IT86D-715 cowpea cultivar so as to harness its disease tolerance potential for possible cowpea breeding programmes.

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