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OUTBREAK OF BASAL STEM ROT AND WILT DISEASE OF PEPPER IN NORTHERN NIGERIA

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Abstract: A survey was conducted in February of 2004 on the outbreak of stem rot and wilt disease of pepper at the Kitabawa/Danzakara and Ajiwa irrigation sites in Northern Nigeria. Laboratory investigations revealed that it was elicited by *Phytophthora capsici* Leon. The disease caused severe loss in yield and USD 1700.00 to USD 3200.00 loss in revenue/ha. The disease was probably further aggravated by the presence of *Fusarium* sp. as well as ecto- and endoparasitic nematodes. Reasons for outbreak were elucidated and solutions proffered.

Key words: basal stem rot, wilt disease, pepper, *Phytophthora*, nematodes

INTRODUCTION

Pepper is grown worldwide (Bosland and Vatava 2000) and is a major vegetable crop in Nigeria. A high percentage of peppers grown in Nigeria come from the Guinea and Sudan Savanna zones (Kaduna, Kano, Katsina, Kogi, Kwara, Yobe, Zamfara states, etc.) in northern Nigeria. The country obtains an average yield of 1021 kg/ha and is the third largest exporter of pepper (Bosland and Vatava 2000). The crop is grown twice a year: in wet season (June to November) and dry season (December to May). The dry season crop gives higher yield (10 to 15 t/ha) depending on a cultivar, management practice, and date of planting (Uchida and Aragaki 1980; Barksdale et al. 1984; Alao and Alegbejo 1999; Alegbejo and Erinle 1999). The wet season crop yields on the other hand are much less (8 to 10 t/ha) due to diseases, pests and excessive moisture.

The dry season diseases in Nigeria are *Pepper leaf curl virus*, genus *Begomovirus* (PLCV) and basal stem rot and wilt induced by *Phytophthora capsici*. *Phytophthora* is a widespread disease of pepper (Leonian 1922; Alcantara and Bosland 1994; Bosland and Lindsey 1994; Thompson et al. 1994; Chavez et al. 1995, Jianhug et

al. 1998; Ristaino and Johnson 1999). It was first reported in northern Nigeria in 1984 at Ajiwa irrigation site (Erinle 1990). Other limited occurrences were at Kaita or Abdulawa irrigation site, Wudil/Jakarande, Maigana and Birnin Gwari, all in northern Nigeria (Alao and Alegbejo 1999).

A report was delivered to the Director of Institute for Agricultural Research (IAR), Samaru, Zaria, Nigeria informing him of a serious outbreak of wilt disease on pepper at Kitabawa/Danzakara "Fadama" and Ajiwa irrigation sites in northern part of the country. Stems of pepper plants were affected at the level of soil surface, where water-soaked, dark-green lesions developed. They girdled the stem causing plants to wilt and die. Stems were internally discoloured, collapsed, became woody, and irreversible wilt took place. Leaves lost vigour, drooped, but did not fall off from the plant and roots were rotten. External symptoms were not readily seen on fruits but they became desiccated and mummified. Fruits withered but remained attached to the plant. Seeds were brown and shriveled and infested by the fungus. Early infected plants were quickly killed, while laters infected plants showed irreversible wilt. Often, a number of plants in a row or in a roughly circular pattern showed symptoms at the same time. Farmers reported that the disease occurred only at fruiting stage (mid-season when sudden wilt and death occurred). A team of scientists were mandated to visit the site and investigate causal agent(s) of the disease and proffer solutions. This paper reports the investigations carried out on the disease and solutions suggested.

MATERIALS AND METHODS

Survey

Two sites were surveyed in February 2004: Kitabawa/Danzakara fadama irrigation site and Ajiwa irrigation site both in the Sudan Savanna Ecological Zone. Three farms were visited at the Kitabawa/Danzakara fadama irrigation site, four samples per farm were investigated. The farmers were interviewed about crop(s) planted, date of transplanting, time of the disease appearance, cultural practices used, and control measures attempted. Disease incidence, symptoms observed, stage of growth of the crop, type of crop mixture, size of a farm, estimated yield loss and estimated loss in revenue were recorded for each farm. Samples of infected plants and soil in the rhizosphere of infected plants were taken.

At the Ajiwa irrigation site, ten farms were visited and four samples per farm were taken. Similar data and information to those at the first site were also taken. All samples were brought to the diagnostic laboratory of the Department of Crop Protection, Institute for Agricultural Research, Ahmadu Bello University (ABU), Zaria, Nigeria for analysis and diagnosis.

Laboratory Investigations and Diagnosis

In total fifty – two samples were analysed (12 from Kitabawa/Danzakasa and 40 from Ajiwa). Soil samples were plated directly on potato dextrose agar plus streptomycin (PDAS). These were left at room temperature for 24 hours at 25–27°C. On the other hand root, stem, leaf and seed samples of infected plants were incubated in moist chamber for 24 hours, while another portion of plant material was surface sterilized in mercuric chloride solution and plated on PDAS (Hassan

et al. 1994; Larkin et al. 1995). The plates were examined under light microscope after 24 hours. Fungi associated with each plant part were identified.

Nematodes associated with roots and root rhizosphere were determined using a combined method of Cobb's sieving (Cobb 1918) and decanting performed with Baermann trays. The type of nematodes and their population per unit of soil were recorded.

RESULTS

Survey

Infection occurred in February when atmospheric conditions were becoming warm (25–30°C). Eggplant and okra intercropped with pepper at Ajiwa irrigation site were not affected by the disease.

Economic Importance of the Disease

At the Kitabawa/Danzakara irrigation site, Alhaji Bature's farm was sole cropped with "attarugu" pepper. The incidence of the disease was 45%. The one hectare (1 ha) crop was at fruiting stage. Estimated yield loss was 900 (100 kg bags) of fruits. Loss in revenue was ₦ 450 000.00/ha (USD 3 000.00/ha) (Table 1). Mallam Sa'adu's farm area was 1 ha and sole cropped with "attarugu" pepper. It was at fruiting stage. Disease incidence was 48% while yield loss was estimated at 960 (100 kg) bags of fruits, resulting in the loss in revenue of ₦ 480 000.00 (USD 3 200.00/ha) (Table 1). The 0.8 ha farm of Mallam Shaibu was sole cropped with "attarugu" pepper and it was at fruiting stage. Disease incidence was 28%, loss in yield was estimated at 530 (100 kg) bags of fruits, while loss in revenue was estimated at ₦ 265 000.00/ha (USD 1 700.00/ha) (Table 1).

Table 1. Incidence of basal stem rot and wilt of pepper (*Phytophthora capsici*) at Kitabawa/Danzakara fadama irrigation site, Nigeria in February, 2004

Name of farmer	Size of farm [ha]	Disease incidence [%]	Stage of growth	Type of crop mixture	Yield loss [kg]	Loss in revenue/ha [N]
Alh. Bature	1.00	45.00	fruiting	sole attarugu	900 (100 kg bags)	450 000 (USD 3 000)
Mal. Sa'adu	1.00	48.00	fruiting	sole attarugu	960 (100 kg bags)	480 000 (USD 3 200)
Mal. Shaibu	0.8	28.00	fruiting	sole attarugu	530 (100 kg bags)	265 000 (USD 1 700)

100 kg bag of pepper fruit was ₦ 500.00
1 USD = ₦ 150.00

The total area put to "tattasai" pepper production at the Ajiwa irrigation site was about 15 ha. This was owned by 20 farmers. The area was partly sole cropped or intercropped with garden eggplant or okra. Garden eggplant and okra were not infected by the disease. Pepper was at fruiting stage, incidence of the disease was 98%, yield loss was estimated at about ₦ 9,600 (100 kg bags), and loss in revenue was estimated at about ₦ 9.8 million (USD 65 300.00) (Table 2).

Table 2. Incidence of basal stem rot and wilt of pepper (*Phytophthora capsici*) at Ajiwa irrigation site, Nigeria in February, 2004

Name of farmer	Disease incidence [%]	Stage of growth	Type of crop mixture	Size of farm [ha]	Yield loss [kg]	Loss in revenue/ ha [N]
Group of farmers	98.00	fruiting	sole tattasai, pepper/garden eggplant; pepper/okra, etc	15.00	19600 (100 kg bag)	9.80 million

100 kg bag of pepper fruit was ₦ 500.00
1 USD = ₦ 150.00

Laboratory Investigations and Diagnosis

This was done in the Plant Pathology Laboratory of the Institute. The fungi associated with each plant part are indicated in Table 3. *P. capsici* was associated with soil rhizosphere around roots, roots, stems, leaves and seeds of infected pepper plants. In addition *Fusarium* sp. was isolated from stems and leaves while *Rhizopus* sp. was isolated from seeds only (Table 3).

Table 3. Fungi associated with pepper samples collected at Dutsinma and Ajiwa, Katsina state, Nigeria

Plant part	Associated fungi	Frequency of isolation
Soil	*Phytophthora capsici*	all samples
Root	*P. capsici*	
Stem	*P. capsici*, *Fusarium oxysporium*	
Leaf	*Aspergillus flavus*	
Seed	*P. capsici*, *F. oxysporium*,	
	P. capsici, *Rhizopus stolonifer*	

A very high population of nematodes were found in soil rhizosphere of the roots and roots of pepper plants sampled (Table 4). *Meloidogyne incognita* (800 larvae/500 cc of soil; 710 adults/100g of roots), *Helicotylenchus canalis* (570/500 cc of soil), *Scutellonema bradis* (240/500 cc of soil) and *Hoplolaimus indicus* (480/500 cc of soil). *M. incognita* is an endoparasite while the other nematodes are ectoparasites.

Table 4. Nematodes associated with the pepper samples collected at Dutsinma and Ajiwa in Katsina state, Nigeria

Nematode	Population density	Nature	Frequency of isolation
Meloidogyne incognita	710 adults/100 g of roots	endoparasite	all samples
Helicotylenchus canalis	570 adults/500 cc of soil	ectoparasite	
Scutellonema bradis	240 adults/500 cc of soil	ectoparasite	
Hoplolaimus indicus	480 adults/500 cc of soil	ectoparasite	

DISCUSSION

The study indicated that the fungus responsible for basal stem rot and wilt disease of pepper at Kitabawa/Danzakara and Ajiwa irrigation sites is *P. capsici* (Alegbejo and Erinle 1999; Ristaino and Johnson 1999; Anonymous 2003a, b). The fungus is soil-and seed-borne and is known to cause low and delimited pattern of wilted plants as encountered in this study (Peter et al. 1984; Anonymous 2003a, b). The pathogen was probably introduced into virgin soils in the affected areas through infected seeds planted by farmers each year (Café and Dunway 1996; Ristaino and Johnson 1999; Anonymous 2003a, b). This process may contribute to the increase of fungal inoculum each year. Irrigation water will readily move the inoculum from infected plots to healthy ones (Rista et al. 1995; Café et al. 1995). The pathogen is probably temperature-sensitive, hence its occurrence every February of the year (fruiting stage) when atmospheric temperature increases due to gradual cessation of the cold period. It has been reported that favourable conditions for the fungus are wet soils and prolonged wet periods with air temperatures of 24–29°C (Anonymous 2003b). These conditions are met under irrigation at Katsina state as from mid-February each year.

The presence of ecto- and endoparasitic nematodes such as *M. incognita*, *Helicotylenchus* spp., *Sculellonema* spp. and *Hoplolaimus* spp. will create wounds on pepper roots for easy entry of the pathogen (Anandaraj et al. 1996). The presence of *Fusarium* spp. in leaves will also aggravate the disease. Severity of the disease may also increase due to *Fusarium*-nematode interaction.

The following measures are recommended for controlling the disease:

Cultural

Avoid continuous production of pepper on the same piece of land to discourage build-up of the pathogen(s) in the soil. Rotate pepper with non-hosts of the pathogen such as onion, sweet potato, etc. (Ristaino et al. 1997). Avoid poorly drained fields for growing pepper. Plant the crop on a ridge, or better still on raised, dome-shaped beds to provide better soil drainage. Avoid using overhead irrigation. Seedbed hygiene will prevent carrying over the disease from seed beds to the field. Early infected plants should be removed and burnt. Early transplanting (October – early November) may help the crop to escape early infection and thereby reduce severity of the disease.

The use of resistant/tolerant pepper cultivars is useful and cost-effective. Only seeds harvested from healthy plants should be used for planting in the next season. Crop residues should be burnt after harvest.

Chemical

Dress pepper seeds with fungicides such as Apron Plus at the rate of 1:100 (w/w) before sowing (Matheron and Matejka 1995). This will help to control the disease right from seedbed. Spray pepper fields with Benlate at the rate of 30 g in 20 litres of water at weekly intervals right from mid-January. Use poultry manure as fertilizer (Kim et al. 1997). The gas released will fumigate fungi and nematodes. A combination of some of the above control measures (integrated pest management – IPM) will be most effective (Daniel and Falk 1994).

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POLISH SUMMARY

SILNE WYSTĄPIENIE ZGNILIZNY PODSTAWY PĘDÓW I WIĘDNIĘCIA PIEPRZU W PÓŁNOCNEJ NIGERII

W związku z silnym wystąpieniem zgnilizny podstawy pędów oraz więdnięcia pieprzu w nawadnianych rejonach Kitabawa/Danzakara i Ajiwa w Północnej Nigerii w lutym 2004 r. przeprowadzono lustracje polowe. Badania laboratoryjne wykazały, że choroba była wywoływana przez grzyb *Phytophthora capsici* Leon. Spowodowała ona duże straty plonu i straty dochodu z 1 hektara plantacji wynoszące 700,00 USD do 3 200,00 USD. Na zwiększenie nasilenia choroby miała prawdopodobnie wpływ obecność *Fusarium* sp. oraz ekto- i endopasożytniczych nicieni. Choroba rozwijała się silniej w wilgotnym sezonie wegetacyjnym obejmującym miesiące od czerwca do listopada, a słabiej w suchym sezonie wegetacyjnym obejmującym miesiące od grudnia do maja. W pracy podano również zalecenia zwalczania choroby.