

First Occurrence of Sudden Death Syndrome of Soybean in Brazil

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Abstract

Sudden death syndrome (SDS) of soybean was observed in a field in Brasilia DF, Brazil in the 1992 growing season, which was cool and wet. Initial symptoms consisted of chlorotic spots which became necrotic or developed into chlorotic streaks, and the leaflet veins remained green. *Fusarium solani* with blue pigment was isolated from the diseased plants at a high percentage. Inoculation of the pathogen resulted in the development of typical interveinal chlorotic spots on the leaves and the fungus was reisolated from the diseased roots. Koch's postulates were fulfilled. Common bean was more susceptible than soybean in artificial inoculation test. This is the first report of SDS of soybean in Brazil and first observation in South America.

Discipline: Plant disease

Additional key words: *Fusarium solani*, *Glycine max*, common bean, pathogenicity

Introduction

Soybean (*Glycine max* (L.) Merrill) is one of the most important crops for export in Brazil. During the 1992 growing season, an unknown disease with symptoms consisting of chlorotic spots on the leaves was observed on soybean in the commercial and experimental fields of Brasilia DF, Brazil. The damage associated with the disease was severe in fields without tillage and with continuous cultivation of soybeans. Spatial distribution of the diseased plants was restricted to road sides. This pattern of development in the field suggested the existence of a soil-borne disease. The aim of this study was to determine the etiology of this disease.

Description of symptoms

Initial symptoms of the disease consisted of the appearance of interveinal chlorotic spots on the leaves of soybean plants 1 to 2 weeks before flowering (Plate 1a). After flowering when the plants were at the

R4 to R5 maturity stages⁴⁾, extensive symptoms developed. The chlorotic spots became necrotic or developed into chlorotic streaks, and the leaflet veins remained green (Plate 1b). Severely affected leaflets dropped off, leaving the petioles attached. Root symptoms were characterized by a discoloration of the root system and the taproot showed a deep dark brown color. Vascular discoloration extended on the stem up to several nodes, but the pith remained white. This disease could be differentiated from brown stem rot caused by *Phialophora gregata* (Allington & Chamberlain) W. Gams by the distinct discoloration of the pith. The initial leaf symptoms were similar to those of red crown rot caused by *Calonectria crotalariae* (Loss) Bell & Sobers. Red crown rot differed from this disease by the presence of red perithecia on the stem and microsclerotia in the root.

Materials and methods

Causal fungi were isolated from the taproot of the diseased plants. The roots were washed in running tap water for 30 min and cut into 0.5–1 cm

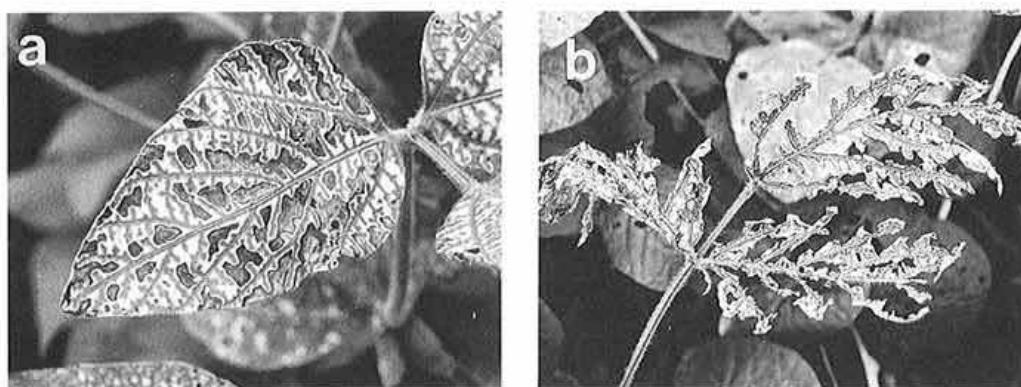


Plate 1. Foliar symptoms in sudden death syndrome of soybean in Brazil
a: Early symptoms, b: Advanced symptoms.

fragments. The tissues were surface-disinfected for 5 s in 70% ethyl alcohol and 2 min in 1.0% sodium hypochlorite, placed on potato dextrose agar (PDA) containing streptomycin sulfate (100 mg/ml), and cultured for 5 to 7 days at 25°C. Single-spore cultures of *Fusarium* sp. that were consistently associated with the disease were used to identify and confirm their pathogenicity. Microscopic observations were carried out using standard procedures for identification of *Fusarium* species as described by Nelson et al⁷⁾. The mycelial growth rates were determined by placing each 9 mm mycelial disc on a PDA plate and incubating it at 0–35°C. Measurements of the radial mycelial growth length were taken every 24 h and the results were expressed by the averages of five isolates (Fig. 1).

A soybean cultivar, Cristalina, which was found to be susceptible to the disease in an experimental field and common bean (*Phaseolus vulgaris* L.) cv. Topcrop, were seeded in 140 ml paper pots. Roots of 14-day-old seedlings were dipped in a 10⁶/ml suspension of macroconidia of isolate SSL-3 at 25°C

for 24 h and transplanted to 1,000 ml pots filled with steam-sterilized soil. All the treatments were replicated in 20 pots per cultivar with one plant per pot. The soil containing 0.4 g N/kg, 1.5 g P₂O₅/kg, and 0.4 g K₂O/kg was kept moist throughout the

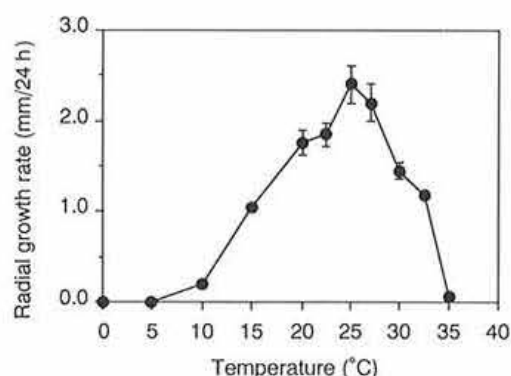


Fig. 1. Mycelial growth rates on PDA of *Fusarium solani* isolated from SDS of soybean in Brazil at various temperatures
Vertical bars represent standard deviation of 5 isolates.

Table 1. Pathogenicity of *Fusarium solani* (SSL-3) isolated from SDS of soybean in Brazil

Host (cv.)	Inoculation	Disease index (0–5)	
		Root ¹⁾	Leaf ²⁾
Soybean (Cristalina)	Inoculated	3.3 b	2.7 b
	Not inoculated	0.0 a	0.0 a
Common bean (Topcrop)	Inoculated	4.2 c	4.3 c
	Not inoculated	0.0 a	0.0 a

Data are means of 20 replicated pots.

Values within a column followed by the same letter are not significantly different at P = 0.05 as determined by Tukey-Kramer's multiple-range test.

1): 0 = No necrosis, 1–5 = Increasingly severe necrosis.

2): 0 = No symptoms, 1 = Symptoms involve 1–20% of leaf area, 5 = 81–100%.

experiment. The pots were transferred to a growth chamber at 20–25°C under natural light conditions. Control plants were transplanted in the same manner but not inoculated (Table 1).

Results and discussion

Fusarium sp. with blue pigment was isolated from the diseased plants at a high percentage of 90% per plant (18/20) and 38% per root fragment (76/200). The fungal colony on PDA showed a cream color later turning blue and agar became reddish-brown. The fungus produced a septate and hyaline mycelium. Its macroconidia on carnation leaf agar were curved, slightly pointed at the apex, mostly 4-septate, rarely 5-septate, 45–62.5 × 4.5–6.0 μm in size and formed on simple or branched conidiophores from monophialides (Plates 2 & 3). Formation of microconidia was uncommon and chlamydospores on water agar were globose (7.0–13.5 μm), with terminal or

intercalary conidia or hyphae. The mycelial growth rates on PDA plates at various temperatures are shown in Fig. 1. The growth of the fungi was slower and optimum temperature ranged between 25.0 and 27.5°C. On the basis of these characters that corresponded to the descriptions by Roy et al.⁸⁾ and Rupe⁹⁾, the fungi were identified as *Fusarium solani* (Mart.) Apple & Wollenweb emend. Snyd. & Hans.

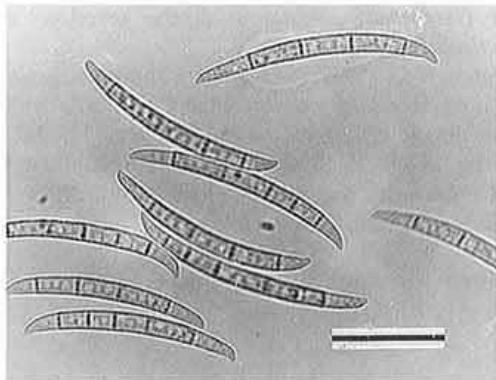


Plate 2. Macroconidia of *Fusarium solani* produced on carnation-leaf agar
Bar = 30 μm.

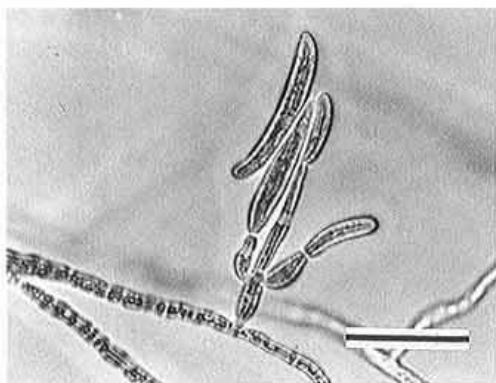


Plate 3. Developing macroconidia formed on conidiophores from monophialides
Bar = 40 μm.



Plate 4. Interveinal chlorosis of soybean leaflet 5 weeks after inoculation

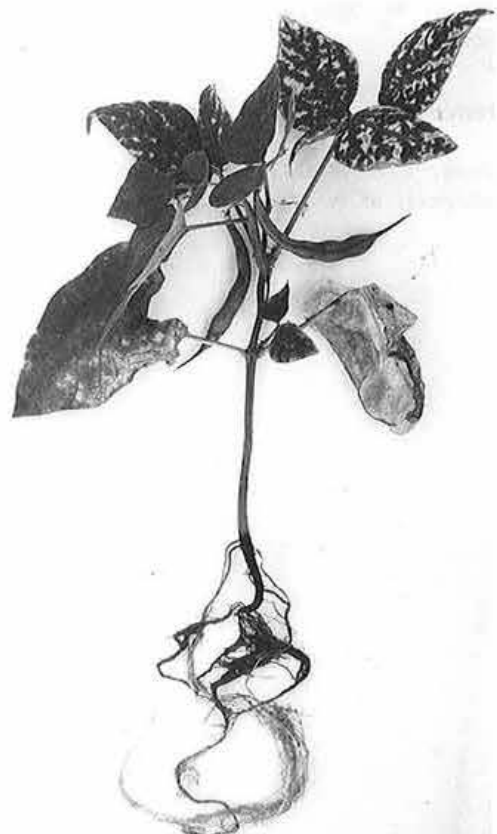


Plate 5. Leaf symptoms and root necrosis of common bean plant 5 weeks after inoculation

form FS-A. Although Abney et al.¹⁾ reported that the teleomorph of *F. solani*, *Nectria haematococca* Berk. & Br., was recovered from SDS of soybean root, we could not verify this observation in the current study.

Interveinal chlorosis on the leaves became evident 5 weeks after artificial inoculation (Plate 4). In contrast, all the control plants remained healthy (Table 1). The fungus was reisolated from the diseased roots but not from leaves. Therefore, Koch's postulates had been fulfilled. The symptoms after artificial inoculation on common bean were more severe than on soybean (Table 1, Plate 5). Although common bean is cultivated widely in Brazil, we did not observe this disease in common bean in the field.

The weather during the 1992 growing season was cool and wet. Such suitable weather conditions⁹⁾ along with soybean monoculture may account for the outbreak of SDS. More attention should be paid to this disease, because SDS is more prominent in fields or areas with high yield potential⁹⁾ and associated with infestation with soybean cyst nematode^{3,6,8)}. SDS of soybean has been reported in USA^{5,8-10)} and Hungary²⁾. This is the first report of SDS in Brazil and first observation in South America.

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