Onion Twister Disease Caused by *Glomerella cingulata* in Northern Nigeria

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ABSTRACT

EBENEBE, A. C. 1980. Onion twister disease caused by *Glomerella cingulata* in northern Nigeria. Plant Disease 64:1030-1032.

Onion twister disease is characterized by curling, twisting, and chlorosis of the onion leaves, abnormal elongation of the necks, and formation of slender bulbs that decay rapidly when stored. Acervuli of a *Colletotrichum* state of *Glomerella cingulata* were on the necks and leaf blades of some diseased plants. Inoculation tests satisfied Koch's postulates and thus demonstrated for the first time that this fungus is the causal agent of onion twister disease.

Onion twister, a disease of rainy season onion (*Allium cepa* L.), was first reported near Zaria, northern Nigeria, in 1969 (J. H. Green, *unpublished data*). Initially of negligible importance, this disease now poses a serious threat in northern Nigeria where practically all the onions in the country are grown. Yield losses were estimated at 50–100% in several fields.

Although inconspicuous tufts of acervuli of a *Colletotrichum* sp. have been found on the leaf sheaths of some diseased onion plants, *Fusarium oxysporum* Schlecht, *F. solani* (Mart.) Sacc., and other *Fusarium* spp. have frequently been isolated. This led J. H. Green (*unpublished data*) to suggest that onion twister was caused by a *Fusarium* sp. In my studies, symptoms of twister disease did not develop in onion plants inoculated with *Fusarium* spp. isolated from affected plants (2).

In July 1979, when rainfall was unusually heavy and humidity high, acervuli with pinkish masses of conidia of a *Colletotrichum* sp. were conspicuous on the necks and even occurred on the leaf blades (anthracnoselike lesions) of several onion plants. This led to an investigation of the role of *Colletotrichum* sp. in the etiology of onion twister disease.

0191-2917/80/11103003/$03.00/0

MATERIALS AND METHODS

Isolation and preparation of inoculum. Conidia were removed from acervuli on onions collected in the field, streaked on potato-dextrose agar containing 1% streptomycin (PDAS), and incubated at 27 C for 20 hr. Colonies derived from single spores were transferred to fresh PDAS.

The fungus was then cultured for 11 days at 27 C in darkness. Several acervuli, accompanied by pinkish conidial masses, developed beneath a mat of mycelium; abundant conidia were also produced on the aerial hyphae. The mycelial mats, together with the spore masses from 10 petri dishes, were comminuted with 500 ml of sterile distilled water in a sterilized Waring Blendor for 60 sec and filtered through two layers of cheesecloth. The inoculum concentration was adjusted to about 2.5×10^6 conidia per milliliter.

Inoculation. Onion plants (cultivar Round Red) were grown in a heat-sterilized mixture of field soil and sand (3:1, v/v) for 46 days, then transplanted singly into 9-cm plastic pots, and

Fig. 1. Symptoms of onion twister disease occurring naturally on a 12-wk-old onion (cv. Round Red). Note the curling and twisting of leaves and the abnormally elongated neck.

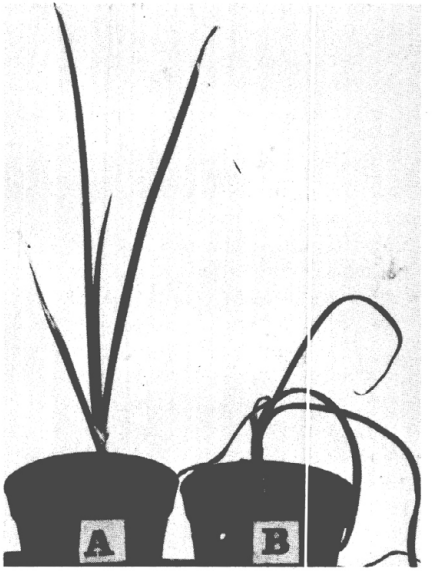

Fig. 2. Eight-week-old onion plants (cv. Round Red): **(A)** Healthy uninoculated plant. **(B)** Plant with leaf and neck malformation 10 days after spray-inoculation with conidia of *Glomerella cingulata*.

inoculated 7 days later. Each treatment included 25 plants; each set of controls consisted of 15 plants.

The onion seedlings were sprayed to wetness with the spore suspension or with sterile distilled water. For soil inoculation, a hole (5 cm deep and 2 cm in diameter) was made in soil in each of 25 plastic pots. Ten milliliters of spore suspension was pipetted into each hole and an onion seedling with washed roots was planted. The control plants received only sterile distilled water.

Incubation. The spray-inoculated plants and their controls were incubated in a humidity chamber at about 100% RH and 26 C and then transferred to a glasshouse where the means were about 28 C and 72% RH. Duration of sunlight was about 12 hr per day; no additional light was supplied to the plants. The soil-inoculated seedlings and their controls were moved directly to a separate glasshouse with similar conditions.

RESULTS

Field symptoms. The most characteristic field symptoms of onion twister disease are curling, twisting, and chlorosis of the leaves and abnormal elongation of the neck (Fig. 1). When disease is advanced, the roots become much more sparse and shorter than those of healthy plants, and the plants may die. Bulbs of affected plants are generally slender. Some bulbs rot before harvest; others decay rapidly when stored.

The disease may occur in foci or affect the entire crop. Often no acervuli or lesions are evident on diseased plants. In other instances, acervuli of a *Colletotrichum* sp. are found on shallow necrotic areas on the leaf sheaths or on well-defined lesions on the leaf blades.

Inoculation. The results of spray-inoculation and soil-inoculation were similar. The first symptom appeared 5 days after inoculation when 60% of the spray-inoculated and 20% of the soil-inoculated seedlings showed curling and twisting. Within 12 days of inoculation, all plants developed symptoms of onion twister disease (Fig. 2). By this time also, 80% of the spray-inoculated plants had sunken oval lesions on the leaf blades and shallow lesions on the leaf sheaths at the necks; these lesions contained clusters of acervuli of *Colletotrichum* sp. (Fig. 3). All control plants were free of symptoms.

Concurrently with these experiments, *Colletotrichum circinans* (Berk.) Vogl. (IMI 215962), isolated from dead leaves and bulb scales of healthy and twister-affected plants, were used to inoculate onion seedlings as already described. No symptoms of twister disease developed.

Reisolation and inoculation. *Colletotrichum* sp. was reisolated from artificially inoculated plants and, after two further inoculations of isolates from the preceding inoculation, yielded symptoms similar to those already described.

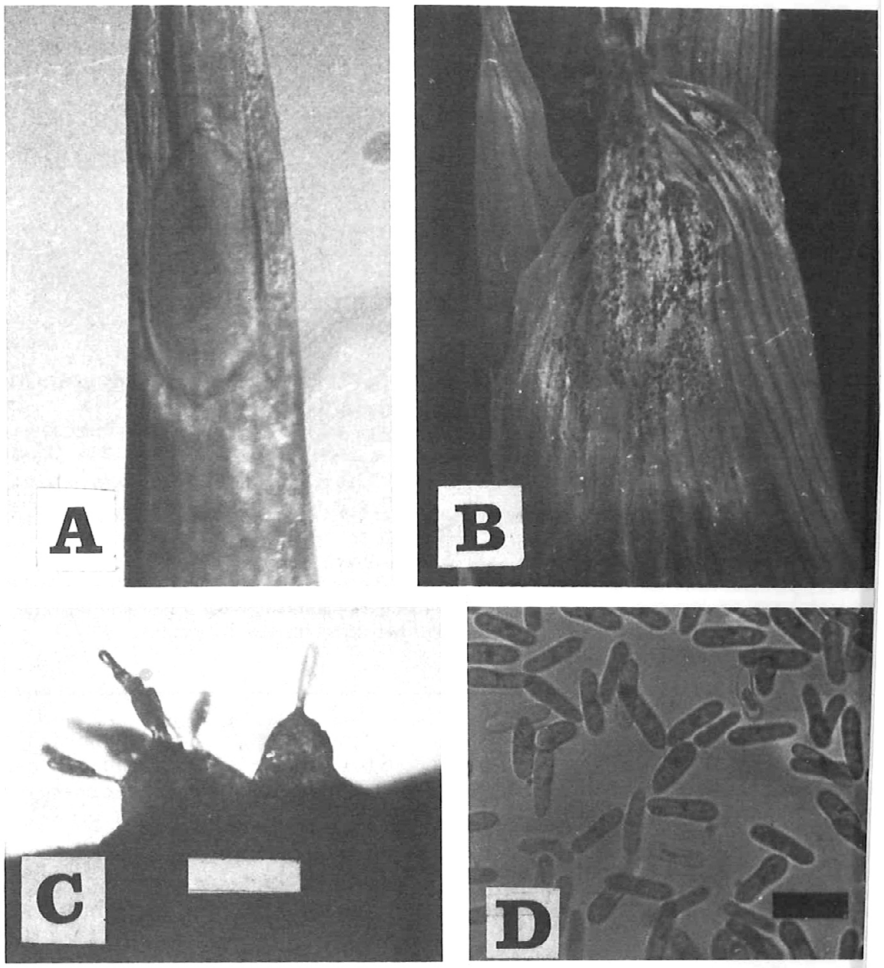

Fig. 3. Onion plants (cv. Round Red) with anthracnose lesions on **(A)** leaf blade and **(B)** leaf sheath. Photomicrographs of **(C)** naturally occurring sporulating acervuli (scale bar = 100 μm) 10 days after spray-inoculation with conidia and of **(D)** conidia of *Glomerella cingulata* (scale bar = 20 μm) grown on potato-dextrose agar.

Identification. The fungus was identified as the *Colletotrichum* state of *Glomerella cingulata* (Stonem.) Spauld & Schrenk (IMI 240970 and IMI 243191). From my findings with regard to conidial shape and dimensions, nature of acervuli and spore masses, and cultural characteristics, this fungus appears to be very similar to a *Colletotrichum* state of *G. cingulata* described by Simmonds (5) and designated *C. gloeosporioides* var. *minor* var. nov.

DISCUSSION

My results show that onion twister disease is incited by a *Colletotrichum* state of *G. cingulata*. This is believed to be the first evidence that *G. cingulata* causes onion twister disease in Nigeria. A disease of onion in Brazil (mal das sete voltas), from symptom description, appears to resemble onion twister and was attributed to *C. gloeosporioides* by Aquino and Da Wanderley (1). Robbs et al (4) suspected *Fusarium oxysporum* f. *cepae* as the causal organism of the disease, however.

Results of spray-inoculation and soil-inoculation suggest that *G. cingulata* can cause onion twister disease via soil infection or aboveground inoculum. Soilborne inoculum could explain why onion twister sometimes occurs in patches. Aboveground conidia disseminated by rain, wind (2,3), and possibly insects (3) could account for the more uniform distribution of diseased plants in many onion fields.

The results of foliar inoculation (Fig. 3) showed that the leaf lesions (anthracnose), observed for the first time on onion plants in northern Nigeria in 1979 by this author, were caused by the same *Colletotrichum* state of *G. cingulata* that is responsible for onion twister. It is possible that onion twister and leaf anthracnose are two phases of the same disease.

ACKNOWLEDGMENTS

I wish to thank the Director, Institute for Agricultural Research, Ahmadu Bello University, Zaria, for financial support and for permission to publish this work; J. E. M. Mordue, Commonwealth Mycological Institute, Kew, for identification of the fungus; I. D. Erinle and A. M. Emechebe for useful suggestions; and M. Wyasi and S. Umoru for technical assistance.

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