QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 402

BACTERIAL WILT OF GINGER IN QUEENSLAND

By A. C. HAYWARD, B.Sc. Ph.D., MELDA L. MOFFETT, B.Sc., and K. G. PEGG, B.Sc.

SUMMARY

Bacterial wilt (*Pseudomonas solanacearum*) of ginger was recorded in Queensland for the first time. Two types of wilt caused by biotypes 3 and 4 could be distinguished. Seven weeds commonly found in ginger plantings were found infected with biotype 3. The pathogenicity of biotype 4 to a number of hosts was determined and its reaction on ginger was compared with that of biotype 3 and also biotype 2 isolated from potato.

I. INTRODUCTION

A bacterial wilt of ginger (*Zingiber officinale* Rosc.) was recorded in Queensland for the first time in 1965 in the south-eastern district known as the Near North Coast. Ginger is commonly grown there on clay loams with a fairly retentive subsoil. The meagre rainfall of the 1965 season was supplemented by heavy irrigation in an attempt to delay fibre development. The disease spread rapidly under these conditions.

The first symptoms of the disease were a yellowing and wilting of the lower leaves which quickly spread upward until the entire plant became golden brown and wilted. In advanced stages of the disease the base of the pseudostem became watersoaked, readily breaking away from the rhizome. The vascular tissue was discolored a dark brown or black. Externally, infected rhizomes were greyish brown with transparent patches beneath which the tissue was milky white. When the pseudostems and rhizomes were cut transversely, a copious white, milky exudate oozed from the cut edges (Figure 1).

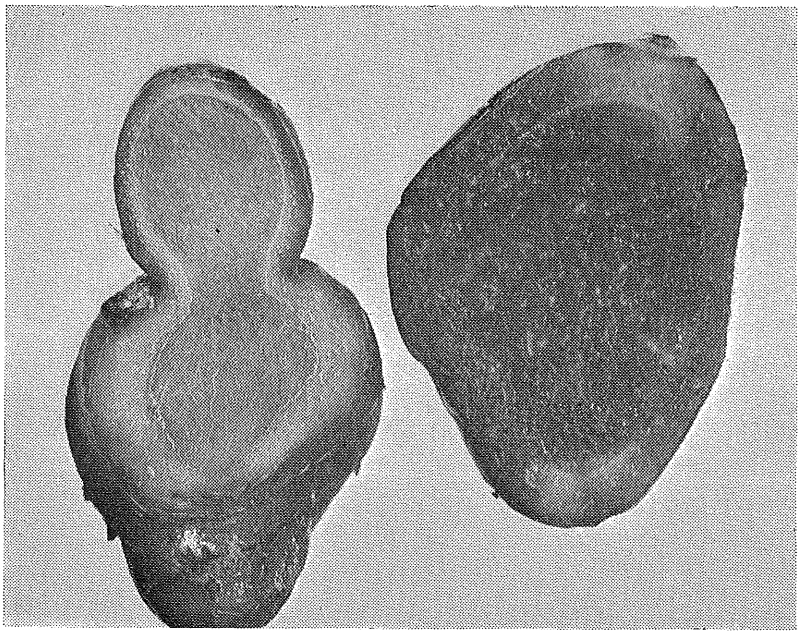

Fig. 1.—Cross sections of ginger rhizomes: right, infected with *P. solanacearum* biotype 4 showing bacterial exudate; left, healthy rhizome.

In the summer of early 1966 this disease was again present in a few localities, but on a number of different farms occasional plants were affected by a much slower wilt. The leaves of these plants turned a dark tan colour before wilting and the bacterial ooze was darker and more gummy than from the rhizomes affected by the fast wilt.

Weeds commonly present in ginger fields were examined for vascular discoloration and wilting. Isolations were carried out from seven such weeds, namely *Xanthium pungens* Wallr., *Rapistrum rugosum* (L.) All., *Solanum nigrum* L., *Bidens pilosa* L., *Solanum auriculatum* Ait., *Dodonaea lanceolata* F. Muell. (an indigenous shrub) and *Crassocephalum crepidioides* (Benth.) S. Moore.

Bacterial wilt of ginger caused by *Pseudomonas solanacearum* (Erw. Smith, 1896) Erw. Smith, 1914 has been reported from Hawaii (Ishii and Aragaki 1963), and from Mauritius and Malaya (Hayward 1964). Although this disease is very serious in tomatoes grown in south-eastern Queensland during the hot wet months of the year, it had not been recorded on ginger prior to 1965. Investigations were commenced to identify the bacteria causing wilting of ginger and causing a wilt and vascular discoloration of the weeds and to make comparisons with the strains of *P. solanacearum* commonly causing wilt of tomato and potato in southern Queensland.

II. METHODS

The characterization of seven isolates from fast-wilting ginger, 12 from slow-wilting ginger and one from each of the weeds listed above was carried out by one of us (A.C.H.) using techniques described previously (Hayward 1964). Also, the characteristics of 12 pathogenic isolates, seven from the fast-wilting ginger, two from tomato and one each from potato, *Xanthium pungens* and *Rapistrum rugosum,* were determined, using techniques described by Moffett (1966). A 2% sucrose peptone medium (Hayward 1960) was used to maintain stock cultures.

Pathogenicity to ginger was determined by two methods. These were root-inoculation and stem-inoculation methods, both described by Winstead and Kelman (1952). All other pathogenicity tests were carried out using the latter method. Inoculum was produced from approximately 3-day-old virulent colonies (Kelman 1954) in 2% sucrose peptone broth.

III. RESULTS

All isolates were identified as *P. solanacearum* but consisted of three biotypes according to the classification put forward by Hayward (1964). All of the isolates from fast wilt of ginger proved to be biotype 4, whereas the isolates from slow wilt of ginger, from tomato and from the weed hosts, all of which were showing symptoms typical of bacterial wilt, were biotype 3. The potato

Fig. 2.—Ginger plants on right inoculated with *P. solanacearum* biotype 4; control plants on left.

isolate was a representative of biotype 2. Recourse to the literature has not brought to light any previous records of bacterial wilt on several of the weed hosts represented in this study. These hosts were *Xanthium pungens* (Noogoora burr), *Crassocephalum crepidioides* (thickhead), *Rapistrum rugosum* (turnip weed), *Dodonaea lanceolata* (hop bush) and *Solanum auriculatum* (wild tobacco). These are apparently new host records.

Following inoculation of ginger plants with the two ginger biotypes, wilting occurred within 14 and 21 days of stem-inoculation and root-inoculation, respectively, with biotype 4 (Figure 2). Biotype 3 induced a very slow browning of the leaves over a period of 6 weeks (Figure 3). The isolates from tomato and potato did not wilt ginger. Isolates of biotype 4 caused wilting in tomato, potato, *Zinnia elegans* Jacq., *Capsicum frutescens* L., *Physalis peruviana* L. and *Solanum melongena* L. in 7-14 days. Peanut, tobacco, sunflower, French bean, *Xanthium pungens* and *Rapistrum rugosum* did not wilt but considerable vascular browning developed in the last four hosts.

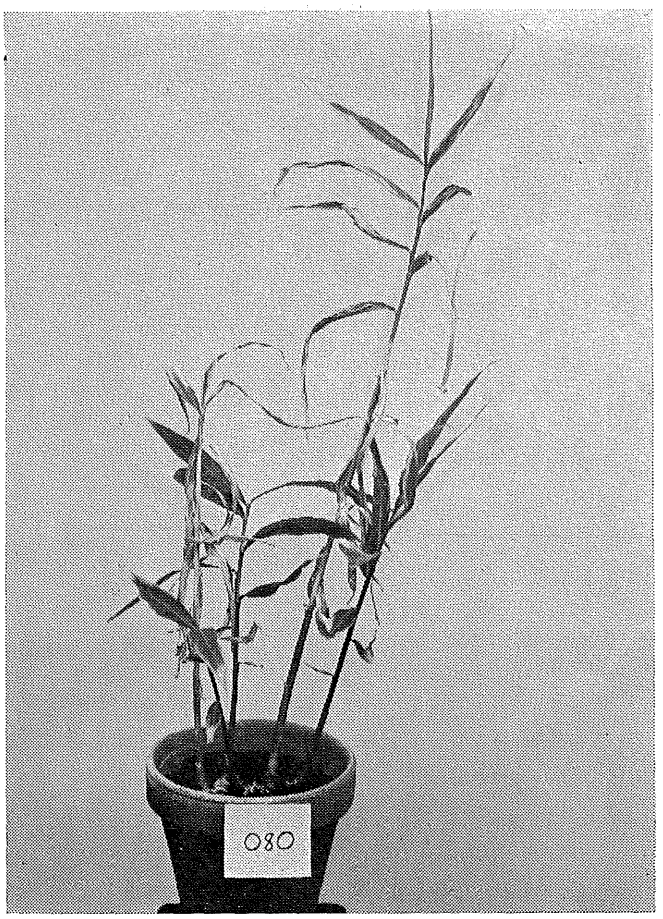

Fig. 3.—Ginger inoculated with *P. solanacearum* biotype 3 isolated from ginger.

IV. DISCUSSION

In Queensland, bacterial wilt of ginger may be caused by either biotype 3 or biotype 4 of *Pseudomonas solanacearum*. A survey of biotypes present in the Near North Coast district, where the observations reported here were made, is continuing and will be reported on elsewhere. From results to date (A. C. Hayward, unpublished data), it is evident that biotype 3 is commonly present in the soil in this district and is responsible for heavy losses in tomato. However, the severe wilt symptoms produced in ginger are due to biotype 4, which at the present time appears to be of restricted distribution. Where this biotype occurs, it spreads through the ginger planting very quickly, killing out large areas. It is evident that this biotype could be a considerable threat to the future of the ginger industry in Queensland. It is of interest that the isolates of the pathogen from bacterial wilt of ginger in Hawaii and Malaya both proved to be biotype 4, although that from Mauritius was biotype 3 (Hayward 1964).

REFERENCES

HAYWARD, A. C. (1960).—A method for characterising *Pseudomonas solanacearum*. *Nature, Lond.* 186:405-6.

HAYWARD, A. C. (1964).—Characteristics of *Pseudomonas solanacearum*. *J. Appl. Bact.* 27:263-77.

ISHII, M., and ARAGAKI, M. (1963).—Ginger wilt caused by *Pseudomonas solanacearum* E. F. Smith. *Pl. Dis. Reptr* 47:710-3.

KELMAN, A. (1954).—The relationship of pathogenicity in *Pseudomonas solanacearum* to colony appearance on a tetrazolium medium. *Phytopathology* 44:693-5.

MOFFETT, MELDA L. (1966).—A new bacterial leaf spot of Antirrhinum seedlings caused by a subspecies of *Pseudomonas fluorescens* Migula, 1895. *Qd J. Agric. Anim. Sci.* 23:121-32.

WINSTEAD, N. N., and KELMAN, A. (1952).—Inoculation techniques for evaluating resistance to *Pseudomonas solanacearum*. *Phytopathology* 42:628-34.

(Received for publication July 27, 1966)

A. C. Hayward is attached to the Microbiology Department, University of Queensland. The other authors are officers of the Plant Pathology Section, Division of Plant Industry, Department of Primary Industries. Miss Moffett is stationed at Brisbane and K. G. Pegg at Nambour.