European Journal of Plant Pathology **100**: 81–84, 1994.

Short communication

Bacterial leaf rot of *Aloe vera* L., caused by *Erwinia chrysanthemi* biovar 3

P.C.A. DE LAAT[1], J.T.W. VERHOEVEN[1] and J.D. JANSE[2]
[1] *Department of Agronomy, Agricultural University, Haarweg 333, 6709 RZ Wageningen, The Netherlands;* [2] *Department of Bacteriology, Plant Protection Service, Geertjesweg 15, 6706 EA Wageningen, The Netherlands*

Accepted 4 November 1993

Key words: fatty acid analysis, pathogenicity, Aruba

Abstract. A severe attack of the bacterium *Erwinia chrysantemi* biovar 3 on the succulent *Aloe vera* on the Carribean island of Aruba is described. Biochemical and pathological characteristics of strains are presented, including results of successful inoculation experiments on *Aloe vera*. This is the first report of the occurrence of *Erwinia chrysanthemi* biovar 3 on *Aloe vera*.

Aloe vera (= *A. barbadensis*) is cultivated for gelproduction on the Caribbean island of Aruba.

Aruba has a dry period from February–October, with day and night temperatures of 35 °C and 28 °C, respectively and a wet period from October–January, having most of the annual 400 mm rainfall. *Aloe*, as a succulent, is able to survive the dry period very well by a physiological process yielding thin, flabby leaves and termination of leaf formation. After some rainfall the plant sucks itself full with water within a few days, showing fresh green leaves.

During field research on Aruba in 1992 with *Aloe vera*, evaluating cultivation methods to incrase gel production, a severe rotting of plants was regularly observed during the wet period. This rotting occurred widespread and was thought to be due to physiological disease caused by strongly changing climatic conditions.

In this article we report the cause of this rotting to be the plant pathogenic bacterium *Erwinia chrysanthemi*, biovar 3.

Symptoms usually occurred 7–10 days after (heavy) rainfall at the bases of outer leaves, showing dark green, water soaked areas (Fig. 1). These dark green areas expanded extremely rapidly under humid conditions, up to 1–2 cm/hour. Sometimes the infection process was accompanied by gas formation showing swelling of the epidermis. Parenchymal tissue was completely changed into a slimy mass, erupting, due to gas formation, from fissures in the epidermis. Non rotting leaf tissue discoloured from light brown to purple. Finally the whole plant was destroyed (Fig. 2). Especially older plants, and in many cases also their roots, were affected.

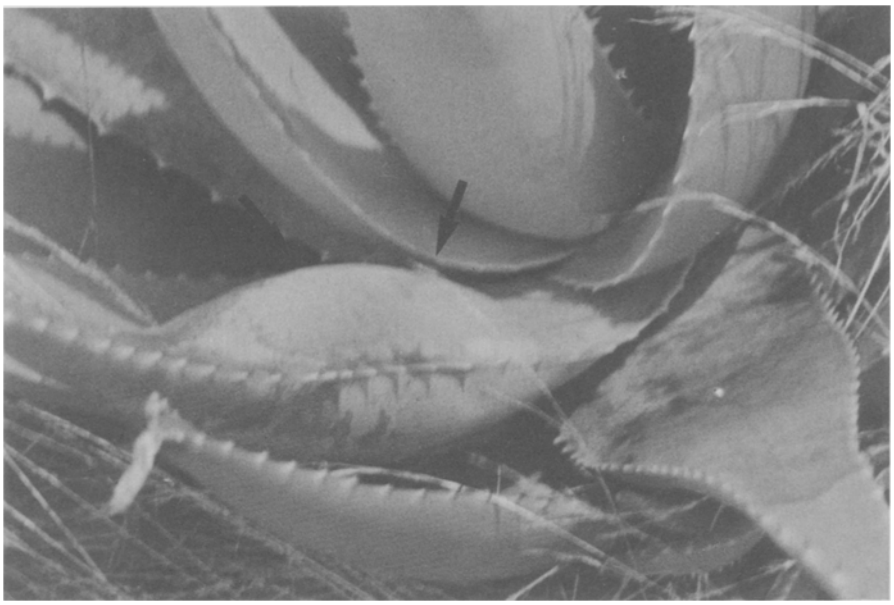

Fig. 1. Aloe vera showing early symptoms caused by *Erwinia chrysanthemi*. Watery rot and swelling (arrow) due to slime pressure of succulent leaves.

Fig. 2. Aloe vera showing progressive disease, plant entirely wilting and slimy.

Bacteria, which were isolated from the borderline of healthy and infected, macerated tissue, were identified according to their phenotypic [Janse and Ruissen, 1988] and serological characteristics as *Erwinia chrysanthemi* biovar 3. Positive characters found for isolates PD 2010, 2097, 2098, 2141–2145 were: facultative anaerobic metabolism of glucose; growth at 37 °C; H_2S and indole production; cellulolytic and pectolytic activity; growth in 5% NaCl; acid formation from lactose, D(-)arabinose, mannitol, melibiose, raffinose; alkali formation from Na-malonate, Cis-aconitate; agglutination with antiserum IPO 7676 prepared against *E. chrysanthemi* strain PD 97 [for preparation method, see Vruggink and Maas Geesteranus, 1975].

Negative characters found were: reaction to Gram-stain; oxidase production; reducing substances in nutrient-sucrose broth; gluconate, arginine hydrolysis; acid production from maltose, inulin, L-proline; alkali formation from α-methylglucoside, 5-ketogluconate, D-tartrate. Analysis of whole cell fatty acids using the Microbial Identification System from Microbial ID, Newark, USA [for method of cell extraction and gaschromatography, see Janse, 1991] yielded patterns equal to those of *Erwinia chysanthemi* biovar 3. Both biochemical tests [see for biovar discrimination Janse and Ruissen, 1988] and fatty acid analysis showed that the wide-host range biovar 3, occurring in many tropical, sub-tropical and greenhouse plants [Janse and Scheepens, 1989] is present in *Aloe*.

Fig. 3. Aloe vera with watersoaked and necrotic leaf after artificial inoculation with *Erwinia chrysanthemi* (strain PD 2010), 24 h after inoculation.

In inoculation experiments with the above mentioned strains on *A. vera* typical symptoms were obtained two days after inoculation (Fig. 3). Five plants/isolate were inoculated. Plants were inoculated by puncturing them with a loop with some growth or a $c \cdot 10^7$ cells $\cdot ml^{-1}$ suspension of a 2-day culture on nutrient agar. Again symptom formation proceeded with a spread of $c \cdot 2$ cm/hour under hot, humid conditions in the open air. Control plants inoculated with a sterile loop or sterile water did not show symptoms.

It appears therefore that *Aloe vera* is a natural host for *Erwinia chrysanthemi* biovar 3. As far as we could determine it is the first time that this bacterium is described from *Aloe*. It is not yet known where the infection starts, but outer leaf traces or roots are possible places of entry. Control of the bacterium will be difficult. Spreading of the bacterium can be avoided by removal of diseased plants and surrounding soil, sterilization of implements and removal of possible weed hosts. Planting in well-drained soil, correct fertilization and optimal cultural practice may help in preventing problems caused by *Erwinia chrysanthemi*.

Acknowledgements

The authors are indebted to Mr T.G. Damian, Division of Agriculture, Husbandry & Fisheries, Aruba, T. Simileer, Landslaboratorium in Aruba, Prof Dr Ir P.C. Struik, Dept. of Agronomy, University of Wageningen, for offering experimental facilities, Ms B.E. Spit for excellent technical assistance.

References

Janse JD (1991) Pathovar discrimination within *Pseudomonas syringae* subsp. *savastanoi* using whole cell fatty acid analysis and pathogenicity as criteria. Systematic and Applied Microbiology 14: 79–84

Janse JD and Ruissen MA (1988) Characterization and classification of *Erwinia chrysanthemi* strains from several hosts in the Netherlands. Phytopathology 78: 800–808

Janse JD and Scheepens T (1989) Further biochemical and serological classification of *Erwinia chrysanthemi* strains. In: Klement Z, ed, Proceedings 7th International Conference on Plant Pathogenic Bacteria, Budapest, Hungary, 1989, pp 775–787

Vruggink H and Maas Geesteranus HP (1975) Serological recognition of *Erwinia carotovora* subsp. *atroseptica*, the causal organism of potato blackleg. Potato Research 18: 546–555