A BACTERIAL DISEASE OF ORNAMENTAL CANNAS CAUSED BY *XANTHOMONAS CAMPESTRIS* PV. *CANNAE* PV. NOV.

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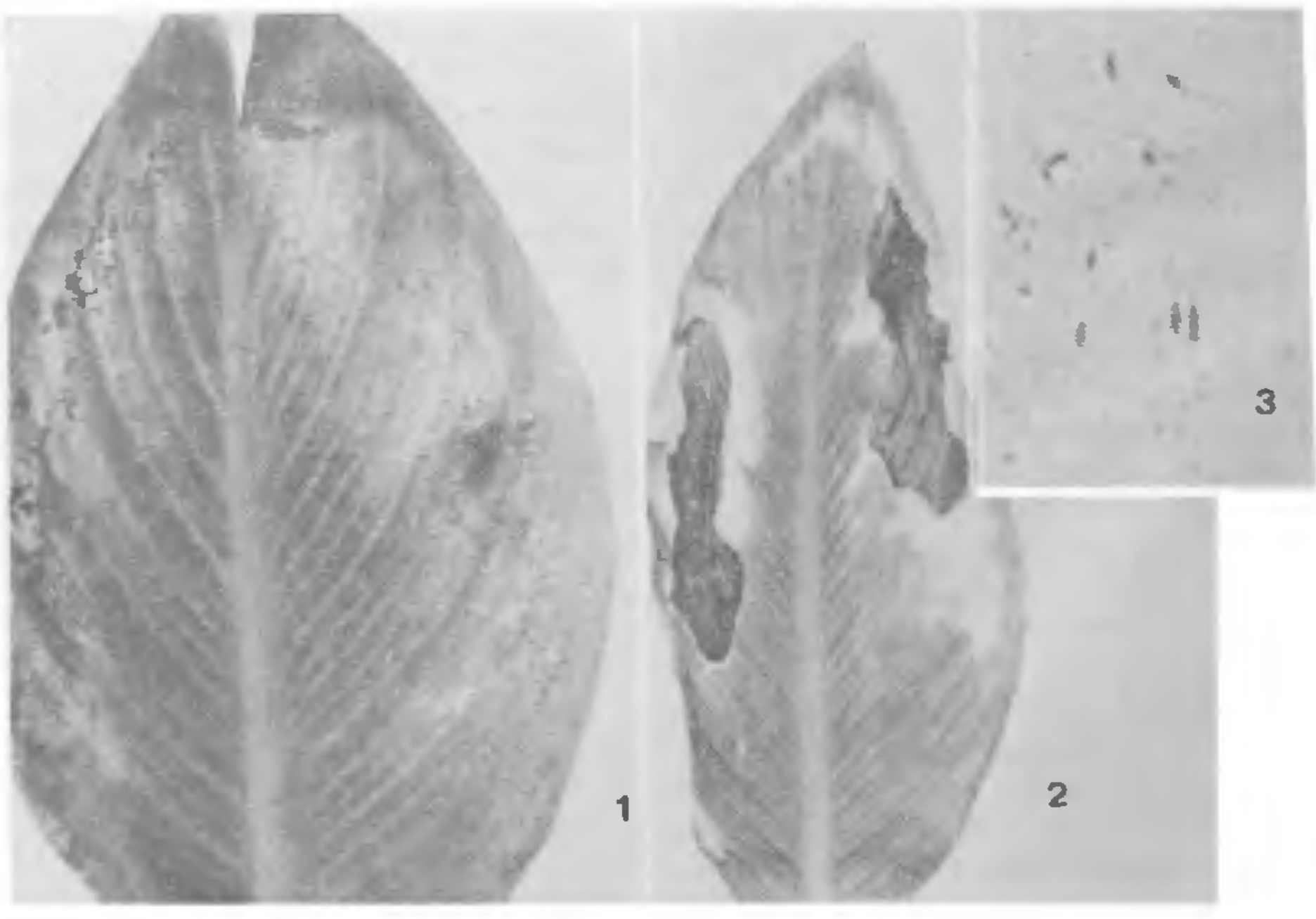
A BACTERIAL leaf spot and leaf blight disease of the ornamental cannas of *Canna* × *generalis* Bailey has been observed since 1980 during the rainy months (July-December) at Madras.

Small yellow spots, about 1 mm dia, each, appear on the young leaves under humid weather. With age, these become necrotic, dark brown, sunken and are usually surrounded by a yellow halo. More extensive damage occurs when several lesions coalesce to form large irregular areas (figure 1). Infection spreading to young unfolding leaves becomes aggressive (figure 2) and often leads to leaf distortion.

Microscopic examination of freshly collected infected leaf tissues revealed masses of rod-shaped bacteria. Isolations made from infected tissues on nutrient agar (NA) readily yielded numerous, small, convex and yellow coloured colonies after 48 hr of incubation at 28°C. Well-separated colonies were selected and purified. Five such single colony isolates were selected from three different cultivars of *C* × *generalis* for further studies.

Young canna plants (four leaf stage) raised from the rhizomes of those cvs from which the bacterial isolates were made, were used to study the pathogenicity of the above five isolates. The inoculum preparation and the method of inoculation were those of Dye[1]. After inoculation, the plants were covered with polythene bags to provide high humidity and incubated in a green house. In 7 days, most of the inoculation points on the young leaves showed the development of progressive lesions which enlarged to 3–8 mm dia in 20 days. Controls did not show any disease development. Bacteria isolated from the lesions were pathogenic on re-inoculation and were comparable to original cultures. Inoculations were also made with isolate 1, in the similar way, into the leaves of the following plants: *Amaranthus caudatus* Linn., *Arachis hypogaea* Willd., *Canna* × *orchiodes* Bailey (cv. 'Queen of Italy'), *Cucumis sativus* Linn., *Curcuma longa* Linn., *Cyamopsis tetragonaloba* Taub., *Lycopersicon esculentum* Mill., *Panicum repens* Linn., *Solanum melongena*



Figures 1–3: 1. A typical bacterial leaf-spot development on *C* × *generalis* leaf (× 0.5). **2.** A very young canna leaf showing fast spreading infection (× 0.4). **3.** Flagellation of the causal bacterium (× 2750).

Linn. and *Vigna catjang* Walp. Detached leaves of the following plants were also inoculated (using the procedure of Dye[1]): *Curcurbita maxima* Dutch., *Dieffenbachia picta* (Lodd.), Schott., *Maranta* sp., *Musa paradisiaca* Linn., *Oryza sativa* Linn., and *Raphanus sativus* Linn. Of all the plants tested, under the given conditions only leaves of *C* × *orchiodes* showed infection with the lesions of ca. 4 mm dia. Others only showed browning reaction at the sites of inoculation.

Cultural, morphological and physiological characters of the five pathogenic isolates were examined by using the procedures of Dye[2]. Colonies were convex, round, bright yellow, smooth and slimy on the four media specified[2]. Isolate 4 produced the most copious slime and growth, however, isolate 5 was slow growing and produced little or no slime. All isolates were found to be small rods, occurring either singly or in pairs. Single rods varied from 0.5–0.7 μm by 1.0–1.9 μm. They were gram-negative, non-sporing and motile with a single polar flagellum (figure 3). The metabolism of glucose was strictly oxidative. Isolates did not grow at 5° or at 40°C and tolerated up to 4% NaCl in the medium. In weakly buffered Dye's basal medium[2], acid was produced from arabinose, xylose, glucose, fructose, galactose, mannose, lactose, sucrose, maltose, trehalose, cellobiose, raffinose, starch, glycerol and mannitol and not from rhamnose, inulin, adonitol, sorbitol, dulcitol, inositol or salicin within 25 days. Isolate 4 produced acid in traces from salicin after 4–5 days.

All isolates utilized acetate, citrate, lactate, malate, propionate and succinate after 2–3 days but not gluconate, oxalate, or tartrate after 30 days. If the medium containing benzoate was heavily inoculated, growth was visible after 7 days. Asparagine did not serve as sole source of C and N. All isolates tolerated tryphenyl tetrazolium chloride at 0.05% and isolates 4 and 5 grew in concentrations up to 0.1% in NA. In methyl red medium, the pH dropped to 5 after 4 days. All isolates were positive in tests for catalase, starch hydrolysis, gelatin liquefaction, Tween 80 lypolysis, proteolytic activity on purple milk (without acid production), and in the production of ammonia from peptone, and H_2S from cysteine HCl, peptone and thiosulphate. Nitrate was not reduced and indole, acetoin and urease were not produced. Tyrosinase activity was positive for isolates 1, 2, 3, weak for 4 and negative for isolate 5.

The isolates of the bacterium pathogenic to canna reported in the present study differ from *Xanthomonas cannae* (Bryan) Savulescu[3]. The characters reported by Savulescu[3]: motility by 1–3 bipolar flagella and reduction of nitrate are not characteristics of xanthomonads[4,5] and further this pathogen is not recognised in the list of Young *et al.*[6], in the Approved Lists[7] or in the ISPP List[8].

The cultural, morphological and biochemical characters of the isolates studied here are similar to those of *X. campestris*[8] (Pammel) Dowson. While being similar to *X. campestris* in *in vitro* bacteriological tests, the bacterium is distinctly pathogenic to cannas in tests reported here. Therefore following the criteria used in the standards[8], we propose the name *Xanthomonas campestris* pv. cannae pv. nov. for this new bacterial pathogen. Isolate 1 is the pathotype and has been deposited in the Plant Disease Division Culture Collection (PDDCC), DSIR Auckland, New Zealand as PDDCC 8306 with isolates (co-types) 2, 3, 4 and 5.

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