

## Predominance of Race 18 of *Xanthomonas campestris* pv. *malvacearum* on Cotton in Australia

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### ABSTRACT

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All of the 67 strains of *Xanthomonas campestris* pv. *malvacearum* collected from commercial cotton crops in New South Wales over a 5-yr period (1983-1988) and in Queensland in one season (1984-1985) were found to be race 18. Races 1-5, 7, 9, and 10 of the blight pathogen which had been recorded on cotton in Australia before 1980 were not detected in this study. The predominance of race 18 has been associated with severe epidemics of bacterial blight on susceptible cotton cultivars and has resulted from the aggressiveness of the pathogen and from the reliance of the Australian cotton industry on a single source of planting seed. New cultivars with resistance to race 18 are now becoming widely grown.

Bacterial blight of cotton (*Gossypium hirsutum* L.) caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye has caused significant losses to growers in Australia (2,3,6). The incidence and severity of bacterial blight on the Deltapine cultivars has been a major

factor in the reduction of the area sown to susceptible cultivars from 100% of the total cotton area in 1984 to 28% in 1988. Locally developed blight-resistant cultivars are now widely grown.

The pathogen, *X. c.* pv. *malvacearum*, was first recorded in Australia in 1923 (12). Brinkerhoff (5) determined that 13 strains of the blight pathogen collected from plants in New South Wales in 1964 were all race 1. In subsequent studies (1,7), race 1 was the only race detected in Australia before 1974 with one exception. According to A. C. Hayward

(personal communication), race 18 was detected on seedlings of cv. Deltapine smooth leaf in quarantine at Kununurra in western Australia in 1966 (1). Races 2-5, 7, 9, 10, and 18 were reported to be present in Australia between 1974 and 1983 (1,7).

The first reported occurrence of race 18 on commercial cotton in Australia was in Queensland in 1974 where nine out of 16 strains collected were race 18 (1,7). Between 1974 and 1977, 12 of the 16 strains collected from New South Wales were race 18 and five of the 14 strains collected from New South Wales and Queensland between 1979 and 1983 were race 18 (1,7).

Hussain and Brinkerhoff (10) reported that race 18 was first identified in Pakistan in 1977 and, according to Hussain (9), it was the dominant race in Pakistan by 1984. Race 18 comprised 75.7% of strains tested and was present at 90.9% of the localities from which samples were collected. Verma and Singh (14) found that 59.3% of the 133 strains of *X. c.* pv. *malvacearum* collected in

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**Table 1.** The reaction<sup>a</sup> of the standard differential cotton cultivars to inoculation with race 1 and race 18 of the bacterial blight pathogen, *Xanthomonas campestris* pv. *malvacearum*

Cultivar	Race 1	Race 18
Acala 44	+	+
Stoneville 2B-S9	+	+
Stoneville 20	-	+
Mebane B-1	-	+
1-10B	-	+
20-3	-	+
101-102B	-	-
Gregg	-	+
Empire B4	-	+
DPxP4	-	+

<sup>a</sup>+ = Susceptible, - = resistant.

India during 1974 were race 18 and that this race was present at more than 83% of the locations tested. The authors described race 18 as being most virulent and aggressive because of its ability to overcome five major bacterial blight resistance genes (10,13). Follin (8) noted that race 18 had become prevalent in the Cameroon and Ivory Coast on cotton cultivars that possessed no genes for resistance to bacterial blight.

The objective of this study was to determine the relative abundance of the various races of the bacterial blight pathogen on cotton in Australia.

## MATERIALS AND METHODS

Leaves infected by *X. c.* pv. *malvacearum* were collected from commercial cotton crops and dried in a plant press before being stored in paper bags in a laboratory drawer at 20–25 C. Schnathorst (11) reported that *X. c.* pv. *malvacearum* was capable of surviving in dried plant material for up to 17 yr. Storage of strains of the pathogen on dried leaves was considered better than storage on artificial media and repeated subculturing. Samples were collected from all cotton production areas of New South Wales during each of the growing seasons between 1983 and 1988. Race identification was generally completed within 12 mo of collecting the strain in the field. Strains from cotton production areas in Queensland were collected during the 1984–1985 season by Melda C. Moffett of the Queensland Department of Primary Industries and were provided as pure cultures on yeast-extract agar slants in McArtney bottles.

Single cell cultures were derived from each collection by repeated single colony

isolation and grown on sucrose peptone agar at 30 C for 3 days before inoculation of the 10 differential cultivars described by Bird (4).

The differential cultivars were grown in a sand, peat moss (1:1) mixture in 10-cm plastic pots with four seedlings in each pot. Four cotyledons of each cultivar (one cotyledon on each seedling) were scratch-inoculated using a sterile cotton swab dipped in a turbid bacterial suspension with fine sterile sand added to aid abrasion. Inoculated seedlings were incubated in a growth chamber at 30 C for a 12-hr day and at 20 C for a 12-hr night and at 85% RH. Light in the growth chamber was provided by 10 Sylvania VHO cool-white fluorescent lamps and six 40W incandescent bulbs that provided 470  $\mu\text{E}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  when measured with a Li-Cor 190SB quantum sensor at pot level. After 10 days, the differential host reactions were assessed as either resistant or susceptible.

A reference culture of race 1 of *X. c.* pv. *malvacearum*, supplied by P. C. Fahy of the NSW Agriculture and Fisheries Biological and Chemical Research Institute, was also tested as a check of the differential cultivars.

## RESULTS AND DISCUSSION

All 67 collections of the blight pathogen were found to be race 18, and none of the other races previously recorded in New South Wales and Queensland were detected in this study (Table 1). The reference culture produced reactions on the differential cultivars that were consistent with race 1 of the pathogen.

All cotton seed for planting in Australia is produced under the supervision of one grower-controlled company called Cotton Seed Distributors Ltd. and is stored, acid-delinted, treated, and dispatched from one facility in northwestern New South Wales. Prior to 1985, precautions to reduce levels of seed infestation by *X. c.* pv. *malvacearum* in commercial cotton planting seed were not considered necessary. However, the use of planting seed infested with *X. c.* pv. *malvacearum* was found to be a major factor contributing to severe epidemics of bacterial blight of cotton in Australia (2,3). Inspections of commercial cotton crops early in the 1984–1985 season indicated that 3.3% of planting seed had been infested with the bacterial blight pathogen (2). The average incidence of bacterial blight on bolls in pure seed crops growing in

Australia's major seed production area during the 1985–1986 season was found to be 30.4% (3). In 1985, Cotton Seed Distributors Ltd. developed an objective to reduce the level of blight infestation in planting seed to less than 0.03% within 5 yr.

The complete dominance of race 18 of *X. c.* pv. *malvacearum* over other races in Australia appears to have developed as a result of the aggressiveness of this race of the pathogen and the efficient dispersal of this race provided by a single source of infested seed for the entire industry in Australia.

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