Characterisation of \textit{Pseudomonas syringae} strains associated with a leaf disease of leek in Australia

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\textbf{Abstract}

A necrotic leaf disease of leek (\textit{Allium ampeloprasum} Porrum Group) is reported in Australia for the first time. The fluorescent pseudomonad consistently associated with diseased tissue was identified as \textit{Pseudomonas syringae} by LOPAT tests (+,−,−,−, +), carbon utilisation, bean and lemon inoculations and fatty acid methyl ester analysis. It was confirmed as \textit{P. syringae} pv. \textit{porri} by pathogenicity to leeks, bulb onions, spring onions, shallots and garlic, and by genetic analysis using 16S rDNA PCR, REP, ERIC and BOX PCR, and ISSO PCR. Comparison with reference strains of pv. \textit{porri} from other countries showed similarity to known strains of \textit{pv. porri}. The Australian leek strains were generally uniform in their biochemical reactions although three strains tested varied in their pathogenicity to other \textit{Allium} spp. and varied from published data. All Australian strains shared the same genetic profile with strains from New Zealand, France and California. However, Japanese strains from leek and onion were distinct from the Australian strains and those from New Zealand, France and California. Data strongly support the hypothesis that the pathogen is seed-borne.

\textbf{Introduction}

Leeks (\textit{Allium ampeloprasum} Porrum Group) have become an important component of vegetable production in Australia. Production has expanded over the past 20 years from increased domestic demand and establishment of more export markets in Japan, Hong Kong and Singapore. The leek industry was valued at $17.2 million (Australian) in 2002. The main leek production areas in Australia are the outer metropolitan areas of Melbourne, Adelaide and Perth with smaller plantings in Stanthorpe and Redlands in Queensland. Most seed is imported from Europe, and is grown in speedling (plug) trays in nurseries for up to 100 days before being planted in the field. Leeks are grown all year, except for 1 month in mid-winter, with larger growers planting up to 200,000 seedlings every week in adjacent plantings. Several varieties of leeks are used throughout the year and summer crops are generally irrigated with overhead sprinklers. Leeks are harvested from 4 months after planting in spring and summer to 7 months after planting in autumn and winter crops. Varying rotations are used, from leek on leek for several years, or with up to 5-year rotations with other vegetable crops and cereals.
Pseudomonas syringae was first recorded as a disease of Allium by Goto (1972), who described a leaf spot of onions in Japan, where eye-spot lesions had water-soaked margins and a yellow halo. Lelliot (1952) described a bacterial disease of leeks caused by a pseudomonad, later attributed to a strain of *P. syringae* by Hale (1975). Samson et al. (1981) reported similar symptoms in France and published a description of this pathogen (Samson et al., 1998), naming it *P. syringae* pv. *porri*. This disease has been confirmed as present in New Zealand (Hale, 1975), France (Samson, 1981) and USA (Koike et al., 1999). All reports have described similar symptoms on leek plants, with flower stems having sunken lesions with necrotic centres and olive-green water-soaked edges. Leaf lesions were water-soaked with a yellow halo and which often coalesced into long yellow to light brown streaks and leaf tips withered. Koike et al. (1999) suggested that the bacterium was seedborne and spread through the crop by the treatment of transplants and by overhead irrigation.

A leaf disease with symptoms similar to those described above was observed in 2001 and 2002 in leek seedlings and mature plants in South Australia, Victoria and Western Australia. Symptoms appeared initially as small pale lesions with water-soaked margins which then developed into rusty-brown leaf spots, sometimes with water-soaked, slightly raised margins, occasionally with a yellow halo in some cultivars (Figure 1), or as yellow streaking down the centre or edge of leaves following leaf veination. Disease in seedlings reduced plant vigour and caused death of transplants after 3–4 weeks in the field. Damage to mature plants resulted in extensive death of leaf tissue and curling of leaves if a lesion extended only up one side of the leaf (Figures 2, 3). Lesions could extend from the bulb (Figure 4) to leaf tip. Bacterial ooze from sections of water-soaked tissue suggested a bacterial disease.

This paper reports on the first detection of bacterial blight of leeks in Australia, the characterisation of the causal bacterium, *Pseudomonas syringae* pv. *porri*, and comparison with other strains of the pathogen.

*Figure 1.* Early stage symptoms of bacterial leaf spot of leek.

*Figure 2.* Shepherd’s crook symptoms on leek caused by elongated leaf lesions.