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NEW OR UNUSUAL RECORDS

Root rot of lavender caused by *Phytophthora nicotianae*

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Lavender (*Lavandula angustifolia*) plants with rotted roots and discoloured vascular systems consistently yielded cultures of fungi that were identified as *Phytophthora nicotianae* van Breda de Haan (= *P. parasitica*). Inoculation experiments using either zoospore suspensions or mycelial fragments were successful in reproducing symptoms originally observed on wilting and dying plants. Lavender is a new host for *P. nicotianae*.

Lavender is a somewhat woody perennial low shrub of the family Labiatae, and is native to southern Europe and northern Africa. It is an aromatic plant long cultivated for its fragrant foliage and flowers.

During the growing season of 1987 many hundreds of potted lavender plants in a Maryland nursery showed symptoms of decline. The plants had been potted in plastic and were sitting on ground covered with black plastic mulch, exposed to the weather. Water from recent rains had pooled in broad, low areas in which the majority of affected plants were sitting. The normally green-blue foliage had turned grey, plants had stopped growing, some had wilted, and others had died. When unpotted, ailing plants were found to have dark brown to black primary roots, few secondary roots, and dark streaks in the vascular tissue of roots that were outwardly healthy. Stems of affected plants also had vascular discolouration or were watersoaked and discoloured a pink-brown throughout.

This is a report of the aetiology of the root rot and wilt of lavender. A preliminary report has been published (Putnam, 1988).

Sections of roots and stems with discoloured vascular tissues were cleaned of soil and soaked in 10% aqueous household bleach for 1 min, rinsed twice in sterile distilled water, and air dried under a laminar flow air hood. Alternatively, root and stem sections were cleaned of soil and washed under cool running water for 10–20 min. The epidermis was removed from stem and root sections, and small pieces (2–3 mm) of tissue from margins of healthy and watersoaked areas, or from sound tissue with vascular discolouration, were placed in Petri dishes containing a medium specific for *Phytophthora* and *Pythium*, PARP (Jeffers & Martin, 1986). The plates were incubated in the dark at 25 °C. After 4 days, coenocytic hyphae with irregular walls were observed. Hyphal tips were removed and transferred to hemp seed agar (HSA) (Tuite, 1969). After 5 days, 4-mm-diameter discs were removed from margins of the colonies with a cork borer and placed in sterile soil extract to stimulate zoospore production. Each plate received five plugs, and plates were incubated under four cool white fluorescent lamps mounted 30 cm above the bench. Sporangia formed within 2 days; zoospore release was stimulated by placing the plates at 4 °C for 1 h. Single zoospores were collected and used to start pure cultures; these were used for identification and inoculation.

Zoosporangia for identification were produced in clarified V-8 $CaCO_3$ broth (Tuite, 1969). Hyphae from single-spore cultures were added to 100 ml of broth and incubated for 3–5 days under light as above. Sexual structures were not produced in single-spore cultures. Mating type determinations were made on HSA using 4-mm-diameter disks from the margins of 3-day-old fresh cultures in the manner of Tsao (1987).

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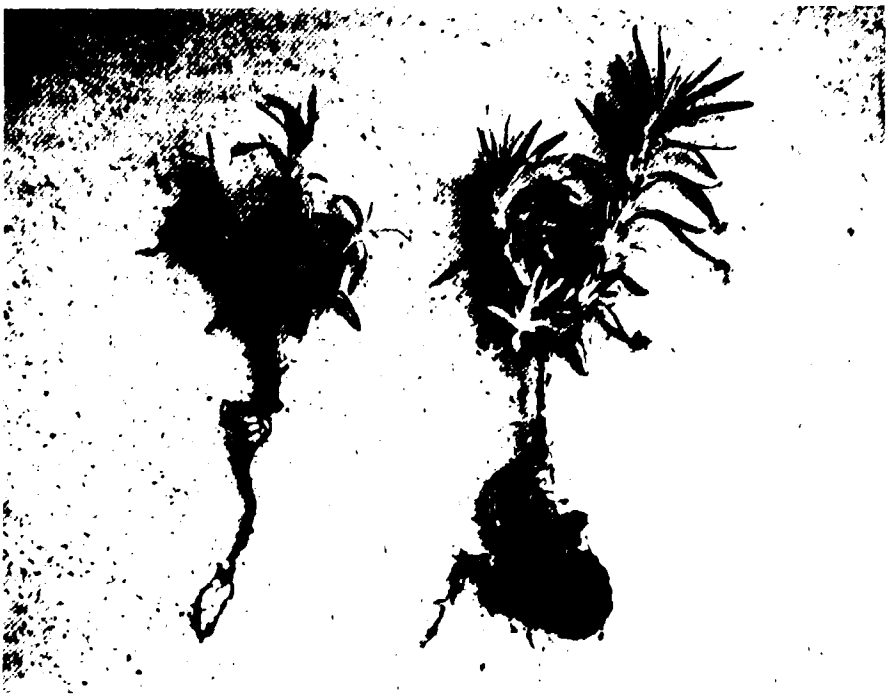

Fig. 1. Rooted lavender cutting inoculated with *P. nicotianae* zoospores (left); lower leaves have died, upper leaves have wilted, and many roots have rotted away. Compare with control plant (right) displaying healthy roots and new growth of foliage.

Inoculation of plant material was made using either zoospores or mycelium from broth cultures. For the former, rooted cuttings were unpotted, washed free of soil, and the roots placed in a zoospore suspension for 30 min. Roots of control plants were suspended in sterile water. All plants were then repotted in a soil-less mix and maintained in a glasshouse for the duration of the experiment. For mycelial inoculations, cultures were grown in bottles containing 100 ml lima bean broth (100 g frozen lima beans boiled for 20 min, filtered through cheesecloth, volume adjusted to 1000 ml, sterilized by autoclaving) for 7–10 days at 25 C. Mycelial mats of three bottles were triturated in a blender for 4–5 s without adding additional liquid; the resulting mycelial fragments composed the inoculum. Inoculations were made by mixing 25 ml of inoculum into soil-less potting mix (approximately 1100 cm^3). Rooted cuttings and 3-year-old lavender plants were then transplanted into the infested potting mix. Control plants were planted in soil treated with lima bean broth only. All pots were maintained in approximately 3 cm standing water for 4 days. For both types of inoculation, five replicate plants were inoculated plus two control plants per experiment; the experiments were performed three times with zoospores and twice with mycelium. For all inoculations, recovery of the pathogen was attempted by placing disinfested stem or root pieces onto PARP as described above.

Colonies composed of coenocytic mycelium were consistently isolated from diseased lavender root and stem tissue. These colonies were identified as *P. nicotianae* van Breda de Haan on the basis of morphological characters. Zoosporangia produced in V-8 $CaCO_3$ broth were as follows: conspicuously papillate, hemispherical at the base, broadly ovoid overall, sympodially produced, not proliferating internally, and non-caducous. Very few sporangia were produced on agar media. Sexual structures formed when lavender isolates were paired with A1 mating types of *P. nicotianae*; such structures were not formed in single-isolate cultures. Oogonia were spherical, with mean diameter of around 30·4 μm ($n = 180$); antheridia were predominantly amphigynous. Gross colony morphology on solid media was patchy and tufted, not regular or petaloid. Confirmation of the identity of a typical isolate from lavender was provided by H. H. Ho (State

University of New York, Department of Biology, New Paltz, New York 12561).

Inoculation of plants using mycelial fragments produced visibly wilting plants (flaccid leaves, stems mostly upright) 6 days after inoculation, with severe wilting, death of lower leaves, discoloration of upper leaves, and death occurring 3–4 days later. Roots were darkened and resembled those found on the diseased nursery plants. Control plants looked healthy, were producing new leaves, and had firm white roots. Isolation from roots and stems of wilted plants yielded only colonies of *P. nicotianae*, whereas isolation from control plants yielded nothing. Similar results were obtained using zoospores as inoculum (Fig. 1).

P. nicotianae has a wide host range, but to our knowledge this is the first report of it attacking common lavender.

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