Fan-mould of carnation caused by Phialophora cinerescens[1]

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The fungus, *Phialophora cinerescens* (Wollenw.) van Beyma, was isolated for the first time in Canada. This pathogen causes fan-mould of carnation *(Dianthus caryophyllus* L.) and was obtained from plants in a greenhouse near Norval, Ontario. Inoculations with the pathogen, both by infesting the soil and dipping the roots before planting, produced typical symptoms of the disease in rooted carnation cuttings, but in a much shorter time than that described in the literature.

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Le champignon *Phialophora cinerescens* (Wailenw.) van Beyma a été isolé pour la premiere fois au Canada. Cet agent de la moisissure des oeillets *(Dianthus caryophyllus* L.) a été trouve chez les plants provenant d'une pépinière située près de Norval (Ontario). Les inoculations de ce pathogène dans le sol et le trempage des racines dans une solution pathogene ont donné les symptômes caractéristiques de la maladie chez les oeillets racinés, mais en beaucoup moins de temps que les autres experiences signalées dans la bibliographie.

Phialophora cinerescens (Wollenw.) van Beyma was isolated from carnation ***(Dianthus caryophyllus*** L.) plants growing in a greenhouse near Norval, Ontario. This is the first report of the fungus in Canada. Fan-mould caused by ***P. cinerescens*** has been reported from several European countries (Hellmers 1958, Wickens 1935) and the United States (Nilsson and Dimock 1964). The fungus attacks the plant mainly through the roots and proceeds upward through the vascular system. The movement of the fungus is quite slow and the incubation period is reported to be about 2 months (Hellmers 1958).

The symptoms of the disease vary, but, usually, the most conspicuous symptom is the dry, straw-like appearance of the stems and leaves. Under natural conditions, the disease usually begins in a single plant and gradually spreads to healthy plants, hence the name "fan-mould".

Materials and methods

P. cinerescens, collected and isolated from Ontario grown carnations, was used to inoculate rooted cuttings of the cultivars Scania 3C and U. Conn. Sim # 1. The fungus was grown on potato dextrose agar for 21 days and a suspension of the conidia in distilled water (1.5 million/ml) was prepared. A mixture of pasteurized soil, sand, and peat (2:1:1) was infested with the pathogen by incorporating the suspension at a rate of 100 ml/liter of mixture. The infested mixture was placed in 12-cm plastic pots and 4-week-old rooted cuttings planted therein. A second group of rooted cuttings was immersed for 1 hour (roots only) in the spore suspension and then planted into 12-cm pots containing only the soil-sand-peat mixture.

Additional studies were carried out simulating conditions under which carnations are produced commercially. The soil-sand-peat mixture was used to fill a greenhouse bed and rooted carnation cuttings, previously inoculated by immersing their roots for 1 hour in a spore suspension, were planted into this mixture. This experiment was repeated 3 months later. Greenhouse temperature was maintained at 21°C night and 25°C day, although during the second test (July-September) day temperatures reached 30°C several times. Water soluble 20-20-20 fertilizer was applied at 7-day intervals during the experiments.

Results

In the pot experiments, symptoms first appeared 21 days after inoculation when the plants had been immersed in the spore suspension, and 26 days after inoculation when the plants were grown in infested soil-sand-peat. In both cases, plants were completely necrotic 49 days after inoculation. At this time, the fungus was readily isolated from stem sections from ground level to within 5 cm of the tips of the plants. The pathogen was present in the roots, but the abundance of secondary organisms made isolation difficult.

In the bench experiments, there was no significant difference in disease development between the two tests and, consequently, the data were averaged. Symptoms first appeared 17 days after inoculation and, 42 days later, 90% of the plants (137/150) were severely diseased and 53% of these were completely necrotic. Initial symptoms appeared as a bluish discoloration and wilting of the lower leaves and, 14 days later, 58% of the plants exhibited an average of six leaves with definite

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Table 1. Rate of disease development of carnation plants inoculated with *P. cinerescens* (av. of 2 tests)

Days after inoculation	Disease categories*				
	0	1-7	8-13	14-20	>20
17	118	32	0	0	0
24	98	42	10	0	0
31	63	48	39	0	0
38	27	40	75	8	0
45	0	14	60	68	8
52	0	1	17	86	46
59	0	0	13	64	73

'Based on number of leaves per plant showing symptoms.

wilting and discoloration (Table 1). Thirty-eight days after inoculation, 82% of the plants showed symptoms of varying severity (Fig. 1). Within 45 days of planting, 100% of the plants exhibited typical fan-mould symptoms.

Discussion

The Ontario isolate of P. *cinerescens,* the cause of fan-mould of carnation, appears to require a much shorter incubation period than those described in the literature. Hellmers (1958) reported that lower leaves began wilting 2 months after inoculation and that all plants had completely wilted after 5-6 months. Wickens (1935) reported the incubation period of the fungus between 7 and 17 weeks when the plants were inoculated either by infesting the soil or directly through wounds in the stems. He observed shorter incubation periods when the plants were inoculated during the summer and attributed this to higher temperatures in the greenhouse. Nilsson and Nelson (1964) found that symptoms appeared 25 days after spore suspensions were injected directly into the stems. They observed that die-back of the pathogen in the host occurred at higher temperatures. Nilsson and Dimock (1964) reported that "infected plants may remain symptomless for several months." They found that, where the temperature rose above 80°F (26.7°C), disease development ceased.

The significance of the shorter incubation period of the Ontario isolate has not yet been determined. No differences were observed in length of incubation period or disease development between plants inoculated and grown in March-May when temperatures were maintained between 21 and 25°C and those grown in July-September when, occasionally, the temperatures inadvertently rose to 30°C. The possibility exists, however, that this isolate represents a new, more virulent strain of the fungus. The isolate from Ontario probably originated outside Canada and was brought into the country in infected cuttings. With the importation of rooted carnation cuttings both from the United States and Europe, there is imminent danger of the fungus being introduced into numerous greenhouses in Canada. The eradication of the pathogen from infested soil is very difficult, especially where the plants are grown in bottomless beds in the ground. Control studies are now being carried out at Ottawa.

Literature cited

1. Hellmers, E. 1958. Four wilt diseases of perpetual-flowering carnations in Denmark. Contrib. no. 51, Dep. Plant Pathol., Royal Veterinary and Agric. College, Copenhagen, 150-166.
2. Nilsson, G.I., and A.W. Dirnock. 1964. *Phialophora* wilt of carnations in New York State. Bull. N.Y. State Flower Grower's Inc., no. 223: 5.
3. Nilsson, G.I., and P.V. Nelson. 1964. Nitrogen nutrition and development of *Phialophora cinerescens* in carnation. Phytopathology 54: 1172-1173.
4. Wickens, G.M. 1935. Wilt, stem rot, and die-back of the perpetual-flowering carnation. Ann. Appl. Biol. 22: 630-683.

Figure 1. Carnation plants growing in a greenhouse bed 38 days after inoculation with *P. cinerescens* using the root-dip method.