Fusarium avenaceum, a pathogen of stored broccoli

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Fusarium avenaceum was identified as a new pathogen of broccoli kept in long-term storage at low temperature and controlled atmosphere. The first sign of the disease was growth of a white fluffy mycelium partly covering the inflorescence. Although disease development was very slow at 5°C, breaking the cold chain did cause outbreaks of infection in apparently healthy broccoli. Broccoli stored in ethanol vapour at 13°C; an experimental treatment that slows down yellowing, was also prone to infection by *F. avenaceum*. This disease could be a limiting factor in the long term storage of broccoli, if this storage practice is used commercially.

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Nous avons identifie un nouveau pathogene post-recolte chez le brocoli, le *Fusarium avenaceum*, qui se developpe durant l'entreposage prolonge a basse temperature et sous atmosphere controllee. L'infection se manifeste par l'apparition d'un mycelium blanc soyeux qui couvre partiellement l'inflorescence. La maladie evolue tres lentement a 5 °C. Cependant, lorsque le brocoli est transfere a temperature ambiante, l'infection progresse tres rapidement. *F. awenaceum* s'est developpe egalement chez le brocoli entrepose a 13°C dans une atmosphere d'air contenant des vapeurs d'ethanol, un traitement experimental qui ralentit le jaunissement. Cette maladie peut devenir un facteur limitant de l'entreposage a long terme du brocoli s'il devient en usage sur le plan commercial.

Broccoli is a highly perishable produce and its quality greatly depends on storage conditions. Quality lost during storage is mainly due to yellowing, which can be reduced by using appropriate conditions of controlled or modified atmospheres (Lebermann *et al.*, 1968; Lipton and Harris, 1974). With the extended shelf-life obtained under these conditions, problems such as physiological disorders and post-harvest diseases become more important (Makhlouf *et al.*, 1989). A number of pathogens can develop on broccoli during storage or transit. Fungal pathogens reported in North America are *Sclerotinia sclerotiorum* (Lib.) De Bary, *Botrytis cinerea* Pers., *Cladosporium, Mucor, Alternaria* and Rhizopusspp. (Ceponis *et al.*, 1987; Lipton and Harris, 1974).

Experiments conducted at Laval University laboratory, with locally grown broccoli, and long-term storage, showed the development of white fluffy mycelium repeatedly on florets (Fig. 1). The fungus colonized the broccoli tissues superficially, but covered a large area on the inflorescences, making them unacceptable for marketing. The disease was present on broccoli stored at 5°C for four to six weeks in a controlled atmosphere of nitrogen containing 6% CO_2 and 2% O_2. The same pathogen was also observed on broccoli stored in 0.1% ethanol vapour at 13°C; an experimental treatment which slows down yellowing (unpublished data). In both cases the infected broccoli was still green and otherwise of good quality. At the same time, the control stored in normal air had turned yellow and become unmarketable. Healthy broccoli removed from controlled atmosphere storage and left at room temperature overnight developed white fluffy mycelium.

The fungus, isolated on PDA from infected florets, was identified as *Fusarium avenaceum* (Corda ex Fr.) Sacc. (Nelson *et al.*, 1983). Inoculation with these cultures on florets held in air or ethanol vapour (0.25 and 0.5%) induced the same infection in 48 h at room temperature. Growth of the pathogen was stimulated on florets stored in 0.25% ethanol vapour. The reason for this stimulated growth was not investigated, but an adverse effect of ethanol on the microflora competing with *F. avenaceum* is a possible cause. Infection was very slow on inoculated florets stored at 4°C, only half showed sign of infection after two weeks. However, when these florets were taken to room temperature, they all developed infections. According to Lacey (1989), *F. avenaceum* can grow in a range of temperatures between -3 to 31°C, with an optimum around 25°C. Breaking the cold chain, for even a short time, could bring a sudden outlbreak of symptoms in broccoli that did not show signs of the disease. *F. avenaceum* has been reported to be an occasional pathogen of stored cabbage (Geeson, 1983). Long-term controlled atmosphere of broccoli allows the pathogen to grow, while the produce colour remains green. Adair (1971) studied the effects of controlled atmosphere on the growth and virulence of *F. roseum* on cabbage; which could have been *F. avenaceum*. In low oxygen, virulence was unaffected at 5°C and enhanced at 12°C as compared to air. This pathogen could thus be well adapted for infecting brassicas stored in low oxygen situations.

If long-term controlled atmosphere storage of broccoli is used on a commercial scale, tlhis disease may be a new factor limiting the shelf life of this vegetable.

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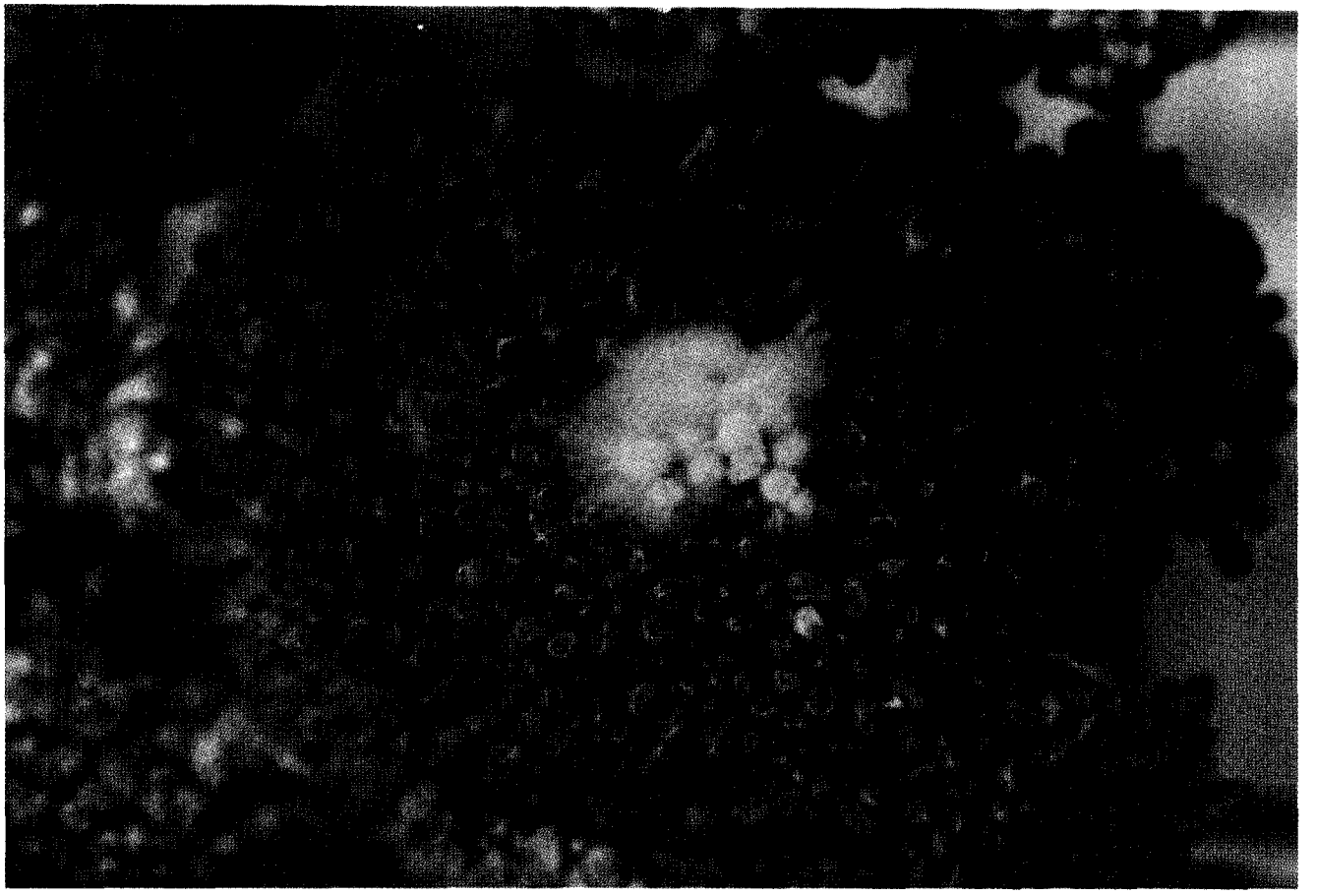

Fig. 1. Inflorescence of broccoli infected by *F.* avenaceum during storage.

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