

# Biological Control of *Botrytis cinerea* on Apple

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## ABSTRACT

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Biological control of dry eye rot of apple caused by *Botrytis cinerea* was obtained by spraying the flowers with a conidial suspension of the antagonistic fungus *Trichoderma harzianum*.

Biological control of several fungal plant diseases has been possible in small-scale experiments, but there are only a few examples of control of natural infection in the field. Some pathogens successfully controlled are *Agrobacterium radiobacter* var. *tumefaciens*, crown gall on stone fruit and roses (3), *Heterobasidium annosum* Fr. (Syn. *Fomes annosus* Fr.) on pine stumps (*Pinus sylvestris*) (4), *Stereum purpureum* Pers. ex Fr. on pear trees (*Pyrus communis*) (2), *Sclerotium rolfsii* Sacc. on peanut (*Arachis hypogaea*) (1), and *Botrytis cinerea* Pers. ex Fr. on strawberries (*Fragaria ananassa*) (5).

In 1975 the infection of apple fruit (*Malus sylvestris*) by *B. cinerea* was reduced after artificially inoculating the flowers before treatment with conidia of *Trichoderma pseudokoningii* Rifai (8). No reduction in natural infection by *B. cinerea* was, however, achieved with a similar treatment (8). This limited success in control may have been due to low temperature in the flowering period when infection is initiated (7), since the *T. pseudokoningii* isolate was unable to grow below 9 C, and the mean minimum and maximum temperature were 7.7 and 13.3 C, respectively. We therefore selected other antagonistic isolates

capable of growth at lower temperatures (6) and one of these, *T. harzianum*, was used in an attempt to control the dry eye rot fungus on apple.

## MATERIALS AND METHODS

Experiments were conducted in 1978 and 1979 at Ullensvang Research Station, Norway. In 1978 there was less than 1% infected apples, so the effect of the treatment could not be assessed. In 1979 the trees were sprayed in the flowering period either on 5 June with fungicides or on 7, 10, and 12 June with a conidial suspension of *T. harzianum* 107. No rain fell during the flowering period except small amounts (2.3 mm) on 8 and 9 June.

The conidial spore suspension was prepared as follows: *T. harzianum* was grown 7-10 days on a 3 mm film of 2% malt agar in bottles at 20 C in natural daylight. The conidial spores were shaken with water, filtered, and diluted to 10<sup>7</sup> spores/ml in a medium containing 0.1% malt extract with or without 0.01% Tween 80.

The apple trees were 9 years old and of the cultivar Red Gravenstein on the rootstock M 26. There were five replicates of each treatment with one tree in each replicate. The sprays were applied to runoff, the fungicide at high volume (3 L per tree) and the spore suspension (2 L per tree) with a hand-operated sprayer.

The number of apples with and without dry eye rot symptoms on the tree and on prematurely fallen fruit on the ground was recorded 3 wk before harvest and at harvest.

## RESULTS AND DISCUSSION

All treatments, except dichlofluanid alone, reduced the disease (Table 1). The reason for the failure of dichlofluanid to control the disease in this and other orchards in 1979 is unknown. This chemical is considered to be one of the standard fungicides for control of *B. cinerea* on apples in Norway. Dichlofluanid with benomyl and *T. harzianum* in 0.1% malt extract significantly reduced the infection, whereas *T. harzianum* in 0.1% malt extract and 0.01% Tween 80 was less effective.

As these experiments show, biological control agents can be used to reduce fruit rot on apples. As far as we are aware, this is the first report of biological control of natural infection of fruit rot under field conditions. Further work, however, is necessary to demonstrate that biological control can be used commercially against dry eye rot on apple in the future.

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Table 1. Effect of biological and chemical control on the frequency of dry eye rot on apple

Treatment	Apple yield (kg/tree)	Fruit rot (%)	
		6 Sept.	28 Sept. <sup>a</sup>
Control	23	1.8	10.7
Dichlofluanid 0.075%	23	2.5	10.2
Dichlofluanid 0.038% + benomyl 0.015%	24	0.9	4.1
<i>Trichoderma harzianum</i> in 0.1% malt extract	22	0.9	6.3
<i>T. harzianum</i> in 0.1% malt extract and 0.01% Tween 80	25	1.1	7.7
LSD 0.05		1.2	3.3

<sup>a</sup> Date of harvest.