GLOEOSPORIUM ALBUM AND G, MALICORTICIS ON APPLES IN NOVA SCOTIA[1]

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Abstract

Gloeosporium album and G. malicorticis cause rots on stored apples in Nova Scotia and have been found in cankers on apple trees. Greenhouse inoculations showed that both species can produce cankers on healthy and injured apple trees. Field inoculations with G. album gave negative results but G. malicorticis readily produced cankers on current and one-year old growth of McIntosh apple trees.

Introduction

Gloeosporium album Osterw. (perfect state Pezicula alba Guthrie) has been recognised as an important cause of apple storage rots in Nova Scotia (4, 8). Recently, Gloeosporium malicorticis Cordley (perfect state (Neofabraea malicorticis Jackson), which has not been previously found in Nova Scotia, has been identified as a cause of a rot of stored apples. Both organisms cause rots or stored apples and cankers on apple trees in other areas (1, 3, 5, 6).

Apart from the fruit-rotting phase little was known about the life history of these organisms in Nova Scotia, Therefore, studies were initiated to determine their occurrence and their ability to cause cankers on apple trees. The results obtained are reported in this paper.

Occurrence

In 1959 a storage rot, caused by G. malicorticis, was found on 1.1 percent of the Cortland apples and on a lesser percent of the McIntosh apples being held in storage to determine the effect of orchard fungicides on the development of storage rots (8). In 1960, Russett and Spy apples from three locations were stored at 38°F. for 5 1/2 months after which they were examined for the occurrence of Gloeosporium rots. The rots caused by Gloeosporium spp. appeared to be of two types. One was larger and of the bull' s-eye type. The other was typical of the lenticel type described by Kienholz (7). The two types were kept separate when taking records, The percentage of "bull' s-eye rot" present was calculated on whether or not a fruit was infected, regardless of the number of lesions. Identification of the species present was made from spores or from isolations made on an agar medium. The identification of the cause of lenticel rots was made entirely on agar plates.

The data in Table I shows that G. rnalicorticis and G. album were almost equally responsible for the "bull' s-eye rot" but the former was more commonly the cause of the lenticel type.

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Table 1. Percentage of G. album and G. malicorticis rots of stored apples

'Jariety	Location	No. of Apples	Percent bull's-eye type rots caused by G. album	Percent bull's-eye type rots caused by G. malicorticis	Percent lenticel type rots caused by G. album	Percent lenticel type rots caused by G. malicorticis
Hussett	Kentville	707	1.5	6.2	2.2	54.5
"	Greenwich	311	1.6	12.5	0	28.1
"	Rockland	591	2.8	7.9	0	65.0
Spy	Greenwich	156	25.6	12.1	20.0	75.0
"	Rockland	325	1.8	0.9	23.0	57.8
Average			6.6	7.9	9.0	56.1

In 1957, G. album was isolated from two cankers occurring at the base of dead one-year old wood on McIntosh trees. Similar cankers, dead spurs, and pruning snags were collected from a number of other orchards in 1958 but attempts to isolate G. album from this material were unsuccessful. In 1960, G. album was isolated from cankers on 10 to 15-year old McIntosh trees located in three different orchards. In two of these orchards the trees were very severely cankered and retarded. These cankers were similar in appearance but more advanced than those shown in Figure 1. G. malicorticis was also present in one of them. It is interesting that both of these orchards had received heavy applications of litter from chicken houses which induces very luxuriant growth late in the season.

Development of cankers in the greenhouse on potted trees

On January 21, 1960, dormant one-year old McIntosh apple trees, which had been removed from storage and potted on January 11, were inoculated by making an incision in the bark with a flamed scapel and inserting a pad of fungus mycelium from an agar culture under the flap. The incisions were wrapped with moistened cotton and held in place with cellulose tape. Controls consisted of incisions without inoculum. Two weeks after 'inoculation the cotton was removed.

The treatments, each applied to six trees were as follows:

(a) Held in 40°F storage for eight weeks and then transferred to the greenhouse.
(b) Side branches dipped in hot water (161 to 172°F) for two minutes.
(c) Stems girdled below point of inoculation by removing one turn of a 1/16 inch helically cut band of bark.
(d) Watered to excess by daily applications.
(e) Under-watered with only one weekly application.

Two trees from each treatment were inoculated with a culture of G. album (57-1R), two with the same isolate (57-1Ra) which had recently passed through an apple and two with a culture of G. malicorticis. These isolates had originally been obtained from rotted apples. Two inoculations and one control incision were made on each tree.

Observations were made on the cankers as they developed and on April 21 the cankers were removed from the trees and attempts made to recover the fungus in culture. The number of cankers which developed under the various treatments are given in Table 2. No cankers developed in the controls.

The cankers caused by G. album in the greenhouse were slightly sunken, either brown or light-brown in the center with a dark-brown border. Acervuli were sometimes produced on the surface. The cankers caused by G. malicorticis were very similar and varied from light-brown or tan to dark-brown or almost black, usually zonated with wrinkled bark. Acervuli developed more readily than when the organism was G. album.

The data in Table 2 show that G. album and G. malicorticis can be the primary cause of cankers on young McIntosh apple trees. More inoculations were successful with G. malicorticis than with G. album. The number of trees in each treatment was insufficient to detect any differences between treatments but, apparently, apart from the incisions made at inoculation, abnormal conditions are not needed for the development of cankers.

Field inoculation experiments

Inoculation of fruit and leaf spurs:

On September 25, 1.959, the fruit and leaves were removed from 15 fruit spurs and the leaves from 15 leaf spurs of each of two young McIntosh apple trees. Ten of each of these two types of spurs on one tree were inoculated with G. album and a similar number of each type of spur on the other tree with G. malicorticis. The wounded tips of the spurs were inoculated by brushing them with a spore suspension of the appropriate fungus prepared from acervuli on rotting apples. Immediately following the application of the spores small polythene bags, containing some water, were placed over the spurs and held in place with elastic bands. The five uninoculated fruit and leaf spurs on each tree were similarly bagged. After two weeks the bags were removed, All inoculated and uninoculated fruit and leaf spurs remained healthy.

Branch inoculations:

In September, 1959, and in June, July, August and October, 1960, current and one-year old wood of young McIntosh apple trees were wound-inoculated using the cotton batting and cellulose tape method described previously. Inoculations were also carried out in May, 1960, but at this time only the previous year's growth was inoculated. Ten limbs of each years' growth were inoculated with G. album and ten with G. malicorticis in each month by placing a piece of rotted apple tissue, from an apple infected with the appropriate organism, in a wound incision. In October, 1960, G. rnalicorticis from an agar culture was used instead of the rotted apple tissue. uninoculated wounds were made as before.

No cankers developed in uninoculated wounds or those inoculated with G. album. With G. malicorticis, cankers developed from all inoculations on both current and one-year old wood.

Figure 1. *G. malicorticis* cankers on 1–yr. old wood. Canker on right shows fiddle-string appearance and the one on left shows the start of the fiddle-string appearance.

Table 2. Number of cankers developed on one-year old McIntosh apple trees.

Treatment	Organism		
	G. album	G. album	G. malicorticis
	58-1R	57-1Ra	
Watered daily	1*(1)	2	2 (1)
Watered weekly	1 (1)	1	2 (2)
Eight weeks at 40°F.	2 (1)	0	4 (4)
Hot water	3 (2)	1	3 (1)
Girdled	2 (1)	2 (1)	3

* Out of a total of four inoculations. The number in brackets is the number of cankers from which the organism was isolated.

The average length of the C. malicorticis cankers in mm developing from the 1959 inoculations was as follows:

Date measured	December, 1959	May, 1960
Current year's wood	6.9	8.3
One-year old wood	17.2	20.5

It is obvious that larger cankers developed on the one-year old wood than on the current year's growth and that the cankers increased in size during the winter months. The May examination showed that in a few instances limbs were girdled by the cankers.

The cankers that developed from the 1960 inoculations were measured in May, 1961, and their average length in mm was as follows:

Month inoculated	May	June	July	August	October
Current year's wood	-	10.6	8.6	9.1	13.5
One-year old wood	13.8	16.5	12.4	12.2	15.5

Again the cankers on one-year old wood were larger and by May, 1961, cankers on both types of wood were about the same size regardless of the time of inoculation,

In the early stages of development the cankers in these field experiments were similar to those in the greenhouse but as they developed they became more sunken and usually took on the fiddle-string appearance illustrated in Figure 1. Acervuli of G. malicorticis often appeared on the surface of the cankers one to two months following inoculation but in the advanced stages of canker development acervuli were difficult to find.

Discussion

Apart from their ability to cause apple fruit rots in storage, the role of G. album and G. malicorticis on apple trees in Nova Scotia is not well understood. This study has shown that G. album is present in cankers in the orchard and can cause cankering of healthy and injured apple trees in the greenhouse, Field inoculations with this organism gave negative results. Corke (3) was able to produce cankers by inoculating with G. album in July, August and September but not in other months. Clarkson (2) found G. album to be very prevalent on apple wood following winter injury and considered it to be a saprophyte on dead tissue.

G. malicorticis was also found in cankers in the orchard and cankers were readily produced both in the greenhouse and in the orchard. The importance of this organism in causing cankers of apple trees under natural conditions is not known. Von Arx (1) considered G. malicorticis and G. perennans to be the same species but the perennial cankers caused elsewhere by the latter organism are not present in Nova Scotia.

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