SURVEY OF CHESTNUT NUT-ROT IN NEW ZEALAND

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ABSTRACT

Nut-rot during storage is a serious problem in New Zealand chestnuts and is causing severe economic loss to the industry. During the 1998 season, nut samples of 31 varieties from grower properties and research orchards in the North and South Island were assessed for fungal infection and rotting. The fungus *Phomopsis castanea* was found to be associated with both rotten and healthy nuts in all the North Island samples, although there was a large variation in incidence between varieties and locations. Samples from Rotorua, Bulls and Taupo had lower disease incidence while samples from South Auckland, Waikato, Whangarei, Bay of Plenty and Tauranga had the highest disease incidence. *P. castanea* was not found in growers' samples from the South Island, although it was associated with all six varieties from Lincoln University Orchard. Other fungi isolated from rotten nuts were *Botrytis cinerea* and species belonging to *Penicillium*, *Fusarium* and *Pestalotia*.

Keywords: *Castanea sativa*, *Phomopsis castanea*.

INTRODUCTION

Chestnuts (*Castanea* spp.) have the potential to be a high health, high value export crop for New Zealand growers but nut-rot during storage is an important problem causing considerable economic loss to the industry (Klinac and Forbes 1998). *Phomopsis castanea* has been implicated as a major cause of nut rots, but it is not the only possible causative organism. *P. castanea* was first isolated from New Zealand chestnuts in 1993 (D. Klinac pers. comm.). It causes severe economic losses in the Australian industry, but does not appear to be as severe in the European producing areas (Washington *et al.* 1997). This study attempted to identify the causal organisms, assess the extent of losses and spread of the disease in New Zealand. Previous studies have suggested a lower incidence in the South Island relative to the North Island (McNeil 1996).

METHODS

Nut sampling

Random samples of some important cultivars from the main growing regions across the country were collected between April-June 1998 as part of the AgMardt project No. 9817, "New Zealand Chestnut Nationwide Quality Survey". Nut samples were obtained from 16 growers from the North Island (South Auckland, North Auckland, Waikato, Whangarei, Bay of Plenty, Tauranga, Levin, Rotorua, Taumaranui, Bulls, Gisborne, Hawkes Bay and Taupo) and two growers from the South Island (Canterbury and Queenstown). A range of chestnut cultivars were also examined from the chestnut cultivar collections at Waikato Research Orchard (Rukuhia, 10 km SE of Hamilton) and Lincoln University Orchard (Canterbury). Together, these comprised 63 samples covering most of the chestnut cultivars currently available in New Zealand.

Isolations and nut-rot assessment

All samples were cool-stored (0-5°C) for 12-16 weeks before assessment. Fifteen-twenty apparently healthy nuts from each sample were selected and were cut open in the laminar flow after surface sterilisation. The extent of rotting, rotting symptoms, embryo number and extent of pellicle intrusions were noted. Kernel pieces (about 1 mm³)

immediately beneath the pellicle layer of the stylar and hilum ends of each nut (rotted and healthy) were plated onto Petri plates containing potato dextrose agar (PDA, 39g/litre) and incubated at 20°C. After 4 days of incubation, the fungal colonies developing from the tissue were microscopically identified using standard manuals.

RESULTS

Grower orchards

P. castanea was found to be associated with both rotten and healthy nuts for all the 32 samples tested from the North Island, although there was a large variation between cultivars as well as locations (Table 1).

TABLE 1: Variation in Nut-rot in samples from grower orchards in the North and South Islands.

Location	Cultivar	Rotted-nuts (%)	Predominant fungus ¹ isolated	% <i>P. castanea</i> isolation Stylar end	Hilum end	Total nuts
North Island						
South Auckland 1	1015	93	1	93	93	93
	1005	53	1	80	73	80
South Auckland 2	1015	73	1	73	67	73
	1002	53	1	80	93	100
Waikato	N4	86	1	86	46	93
	K39	0	-	6	13	20
Whangarei	1015	80	1	66	73	73
Bay of Plenty	1015	80	1	60	80	93
	1002	73	1	53	80	87
Tauranga	1002	53	1	73	53	86
	1007	40	1	60	46	60
	1015	40	1	53	40	73
	1005	33	1	53	53	67
Levin	1005	67	2	27	27	40
	1015	27	1	47	60	73
North Auckland	1005	27	1	67	47	80
	1005	26	2	26	33	40
Rotorua 1	1002	20	2	13	26	26
	1015	13	2	20	20	26
	1007	6	2	20	13	26
	1015	6	1	40	40	53
Taumaranui 1	1015	20	1	87	80	100
Taumaranui 2	1015	6	1	40	53	60
	1005	33	1	27	40	47
Bulls	1002	13	1	27	60	67
	1015	13	1	47	67	73
	Tolaga 9	13	1	27	27	40
	1018	6	1	53	47	60
Gisborne	1718	13	2	20	20	27
Hawkes Bay	Puketapu	6	1	40	27	40
Taupo	1005	0	-	20	20	33
	1015	0	-	13	67	80
South Island						
Canterbury	1005	0	-	0	0	0
	1015	0	-	0	0	0
Queenstown	1015	13	3	0	0	0
	1002	0	-	0	0	0

¹1 = *Phomopsis castanea*, 2 = *Penicillium* sp., 3 = *Fusarium* sp.

For example, 73-93% nuts of cultivar 1015 sourced from South Auckland were rotten, whereas no rotting was observed in the same cultivar from Taupo, even though *P. castanea* was isolated from 80% of these nuts. Cultivars 1007 (Rotorua), Puketapu (Hawkes Bay) and 1018 (Bulls) had less than 10% rotten nuts, even though *P. castanea* was isolated from about 25, 40 and 60% of nuts, respectively, from these samples. Cultivar K39 is known to store well and showed no rotting and only 20% *P. castanea* isolation compared to N4 from the same Waikato orchard which is known to store poorly and had 85% rotten nuts and 93% *P. castanea* isolation. *P. castanea* was not isolated from grower samples from the South Island; however *Fusarium* sp., caused some rotting in cultivar 1015 from Queenstown.

Research orchards

From the Waikato Research Orchard, 20 out of the 21 cultivars tested had rotten nuts (the only exception being 1007) and the fungus *P. castanea* was by far the most common species associated with this rotting (Table 2). There was large variation in the percentage of rotten nuts with most in Tanzawa (100%), 1017 (93%) and Eastern Sunrise (60%). Less than 10% rotten nuts were found in the cultivars Disk 1, Disk 4 and Pukekura. *P. castanea* was isolated from all 21 cultivars and incidence ranged from 25-85%.

TABLE 2: Variation in nut-rot within the chestnut cultivar collection at Waikato Research Orchard (Hamilton) and Lincoln University Orchard (Canterbury).

Cultivar	Rotted-nuts (%)	Predominant fungus ¹ isolated	% <i>P. castanea</i> isolation		
			Stylar end	Hilum end	Total nuts
Waikato Research Orchard					
Tanzawa	100	2	25	25	25
1017	93	1	53	53	60
Eastern Sunrise	60	1	46	46	73
651	46	1	66	73	80
605	46	1	40	60	67
1002	40	1	60	50	70
1005	40	1	40	30	60
1008	40	1	40	40	53
1010	40	1	33	40	60
1013	40	1	66	60	86
1714	33	1	33	26	40
1004	23	1	38	31	60
Horton	23	1	38	54	70
1011	20	1	26	33	46
1713	20	1	13	53	66
907	16	1	8	25	25
1015	10	1	20	30	50
Pukekura	9	1	0	36	36
Disk1	8	2	8	33	33
Disk4	8	2	0	25	25
1007	0	-	26	0	26
Lincoln University Orchard					
Long Bay 4	26	2	13	0	13
Herb Farm	26	1	13	20	20
1015	16	1	42	8	50
1005	10	1	40	20	50
Crewenna 1	0	-	20	40	40
Don Whelan	0	-	20	13	26

¹1 = *Phomopsis castanea*, 2 = *Penicillium* sp.

P. castanea was associated with all the six cultivars from the Lincoln University Orchard and contributed to 25% rotting in nuts of cultivars Herb Farm and Long Bay 4. Some rotting was observed in 1015 and 1005, while Crewenna 1 and Don Whelan cultivars were free of disease. Other fungi isolated from rotted nuts were species belonging to *Penicillium*, *Fusarium*, *Pestalotia* and *Botrytis*.

No trends were obvious in relation to *P. castanea* infection of either styler/hilum ends and no correlation was observed between number of pellicle intrusions and rotting severity. The frequency of *P. castanea* isolation was not related to the presence, absence or extent of rotting. Morphological and culture characteristics of *P. castanea* isolates from diseased or healthy nuts and from nuts showing distinctly different symptoms were identical.

DISCUSSION

P. castanea was the most common fungus encountered and by far the most prevalent rot fungus in the North Island grown nuts. However, while storage rots of chestnuts have been reported from around the world, only in the southern hemisphere countries of Australia (Washington *et al.* 1997), Chile (Montealegre and Gonzalez 1986) and New Zealand (Klinac 1998; McNeil 1996) has *P. castanea* previously been reported as a serious problem.

The reasons for this may be partly climatic. Most of the New Zealand locations (Fig. 1) showing the highest incidence of rot were found in the warmer, high rainfall, high humidity areas of the northern North Island and least in the drier areas of the South Island. This would agree with the observation (Ogilvy 1999) that most *Phomopsis* infection seems to occur when it rains during flowering (December-January). Other pre-disposing factors cannot be excluded (eg. tree age, mix of cultivars and pollenisers, orchard management etc.) but were not part of this survey.

FIGURE 1: Map of New Zealand showing chestnut sampling locations.

An interesting observation was that, in multi-embryonic nuts, one embryo might be totally rotten even though the other remained healthy, even after prolonged storage. The pellicle, in such cases, could act as an effective barrier. This may possibly indicate separate infection events or since chestnuts also exhibit xenia, pollination-related genetic differences in the embryos leading to resistance.

Many chestnuts also showed *P. castanea* infection, but still remained free of rot. Why this occurs remains unclear. Further study will be needed to pinpoint the factors responsible for infection of kernels by different fungi and subsequent rot development. With this information, it may then be possible to develop control measures for the disease.

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