DECLINE DISEASES OF FRUIT TREES CAUSED BY BASIDIOMYCETE FUNGI

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Summary

Newly recognised decline diseases in fruit crops are caused by infection of roots with Basidiomycete fungi. Sterile isolates of 7 of these fungi are described using a system of biochemical coding.

INTRODUCTION

IN New Zealand, we have been aware of serious problems caused by endemic insects e.g. grass-grub (*Costelytra zealandica* White); porina caterpillar (*Wiseana* spp.), and two-toothed long-horn borer (*Ambeodontus tristis* F.). Endemic fungi have also been recognised as causing leaf-spot diseases or timber rots in native forests, but only recently one of these endemic fungi (*Peniophora sacrata* G.H. Cunn.) has been shown to cause serious problems in exotic forests and agriculture (Gilmour 1959; Taylor 1969).

The Basidiomycete fungi, which include *P. sacrata*, grow as white strands (rhizomorphs), or wefts of mycelium in soil, leaf-mould, timber or tree-roots. Some Basidiomycetes are mycorrhizal, stimulating growth of *Pinus*, *Nothofagus* and *Leptospermum* spp. Characteristically, most Basidiomycetes growing under natural conditions produce an easily recognisable fruiting-body such as a toadstool, bracket fungus or puff-ball.

DISEASE SYMPTOMS

Basidiomycetes have been implicated in decline disease of fruit-crops and shelter belts in many parts of New Zealand. Main roots of infected trees have cankers on them, which may be up to 6 feet long. This mass of dead, dying and malformed tissue impedes the flow of water and nutrients from the peripheral roots to the leaves, reducing growth rate and cropping. Trees replanted where declining trees have been taken out also become infected so that they grow poorly and never give an economic return.

These diseases occur most commonly in drier areas of the country from the Wairarapa southward, and generally infections take the form of roughly circular and spreading patches of declining trees. Well-drained soils are most seriously affected so that Basidiomycete diseases are most serious on dry ridges of the Moutere and Cashmere Hills, or on well-drained alluvial soils in the Waimea Plain, Motueka Valley, Marlborough Plain, Taieri Valley and Central Otago.

IDENTIFICATION OF BASIDIOMYCETES

Approximately 300 isolates have been obtained from fruit-trees, and another 50 from endemic plants or weeds, but most of these isolates

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remain unidentified because the fruit-bodies necessary for identification are not produced in culture.

Other workers have overcome this problem of identifying sterile Basidiomycete cultures by describing their microscopic features, and matching these descriptions with those of isolates obtained from naturally occurring fruiting-bodies (Nobles 1965; Lombard and Gilbertson 1965). There are some defects to this approach, the chief ones being that it is very time-consuming, and some species cannot be separated by the method.

As an alternative, I have devised a system a coding cultures on two series of biochemical tests, Series A based on those used by bacteriologists and involving reactions produced in media as a result of growth, and Series B using tests which give reactions within 24 hours, most of them using conjugated substrates.

Codes are prepared from the results of approximately 30 tests and isolates are sorted in Groups according to their reaction. Then if the code of an isolate obtained from a diseased root can be matched with that from a fruiting-body, they both belong to the same species.

TABLE 1: BIOCHEMICAL CODING BASIDIOMYCETE CULTURES

Biochemical Test	Biochemical Groups of Fungi						
	I	II	III	IV	V	VI	VII
<i>Series A</i> (Incubated Tests)							
starch	o	d	d	+	o	o	o
rhamnosidase (rutin)	+	+	+	o	o	+	+
lecithinase	+	+	d	+	d	o	+
lipase	+	+	d	o	o	o	+
deoxyribonuclease	+	+	d	d	+	d	+
gelatinase	o	+	o	+	+	+	+
milk	o	+	o	+	+	+	+
cytochrome oxidase	+	+	+	o	o	d	d
reductase	o	o	o	+	+	+	d
vanillin II	o	+	o	o	+	+	o
sodium benzoate	+	o	d	+	+	o	o
caffeic acid	o	o	o	+	+	o	o
ferulic acid I	o	+	+	+	+	+	o
ferulic acid II	o	+	+	o	o	+	o
<i>Series B</i> (Instant Tests)							
esterase (acetate)	+	+	+	d	o	+	+
acid phosphate	+	+	+	d	o	+	+
acid phosphatase+Na fluoride	+	+	+	d	+	o	+
polyphenol oxidase	+	+	d	o	o	+	+
β fucosidase	o	o	d	o	o	d	+
α galactosidase	+	o	+	d	d	+	d
β glucuronidase	o	o	d	+	o	+	o
α mannosidase	+	+	d	d	+	+	+
β mannosidase	+	o	d	+	o	d	d
elastase	o	o	d	o	o	o	+
vanillin I	+	+	+	o	o	+	+

Key + denotes positive
 o denotes negative
 d denotes variable result

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The results in Table I indicate the kind of information which is obtained. Here a total of 36 isolates have been reduced to seven groups, each of which probably represents a single species.

So far there is no evidence that any of these 7 Basidiomycetes is found abroad, and there is a strong evidence that some are endemic. Because we have relatively few isolates of groups I, II, V, VI their distribution and host range are indefinite. However, Table 2 indicates that Group III, VII are found in many areas. Also Group VII has a wide host range whereas the others have a much narrower one.

TABLE 2: DISTRIBUTION AND HOST RANGE OF
BASIDIOMYCETES STUDIED USING BIOCHEMICAL CODING

Group	Isolate	Host	Location	Notes
I	H12	raspberry	Tadmor	Pathogen
	H215	blackberry	Tadmor	
II	H414	chestnut	New Plymouth	
	H415	chestnut	New Plymouth	
	H416	chestnut	New Plymouth	
III	H89	raspberry	Motupiko	Weak Pathogen
	H90	raspberry	Motupiko	
	H201	apple	Appleby	
	H203	apple	Appleby	<i>Collybia</i> sp.
	H204	raspberry	Motupiko	
	H219	raspberry	Greytown	
	H221	raspberry	Greytown	
	H222	raspberry	Greytown	
	H223	raspberry	Greytown	
	H224	raspberry	Greytown	
	H400	raspberry	Wakefield	
	H430	raspberry	Brightwater	
IV	H405	apple	Port Mapua	
	H406	apple	Port Mapua	
	H416	apple	Port Mapua	
	H421	apple	Tasman	
	H422	apple	Tasman	
V	H423	apple	Tasman	
	H449	apple	Millar's Flat	
VI	H464	apricot	Roxburgh	
	H291	apricot	Roxburgh	
VII	H403	apricot	Roxburgh	Pathogen <i>Coprinus</i> sp.
	H217	peach	Cashmere	
	H218	peach	Cashmere	
	H220	raspberry	Greytown	
	H272	cherry	Roxburgh	
	H273	cherry	Roxburgh	
	H275	cherry	Roxburgh	
	H399	raspberry	Wakefield	
	H401	apple	Hastings	
	H402	apple	Hastings	

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CONTROL

(a) *Rotation* is not feasible at the present time because some of these Basidiomycetes have survived for at least 5 years after removal of infected host plants. Moreover, some Basidiomycetes have been found in roots of dog rose (*Rosa canina* L.) and matagouri (*Discaria toumatou* Raoul in Central Otago and blackberry (*Rubus fruticosus* L.) in Nelson. Thus a new planting following such hosts, can become diseased within a short time of planting, and rotation is no real answer to the problem.

(b) *Resistant rootstocks* have been used elsewhere to control soil-borne diseases and some of the 300 apple seedlings screened for resistance to *P. sacrata* should control this fungous disease in the Moutere Hills where *P. sacrata* is the predominant Basidiomycete pathogen. By contrast, several Basidiomycetes are important in root diseases of stone-fruit in Central Otago, so that it would be necessary to select for multiple resistance, for each of the tree crops. This would be a major research programme and under these conditions only soil treatment is feasible.

(c) *Fumigation* is likely to be the most successful soil treatment and in preliminary work in Central Otago, methyl bromide has eradicated 7 Basidiomycetes buried at one m depth. However, no general recommendations can be made yet.

CONCLUSIONS

In New Zealand there is a range of Basidiomycetes which damage roots of fruit trees, and prevent effective replanting. These endemic fungi are important in fruit trees, some of them are present in native forests and I believe that they may be important in planting into exotic forests.

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REFERENCES

- Gilmour, J. W., 1959. A root and stem canker of exotic conifers in New Zealand. *Tech. Pap. Forest Res. Inst. N.Z.* 28: 18pp.
Lombard, F. F.; Gilbertson, R. L., 1965. Studies on some Western Pories with negative or weak oxidase reactions. *Mycologia* 57: 43-76.
Nobles, M. K., 1965. Identification of cultures of wood-inhabiting Hymenomycetes. *Can. J. Bot.* 43: 1097-139.
Taylor, J. B., 1969. Root-canker disease of apples caused by *Peniophora sacrata*. *N.Z. Jl. Bot.* 7: 262-79.