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A Taxonomic Study of Cercospora vitis (Lév.) Sacc.,
the Causal Organism of a Leaf Spot Disease on Grapes.

A Thesis presented in partial fulfilment of
the requirements for the degree of
Masterate of Agricultural Science
at Massey University

by

Ian Charles Harvey

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SUMMARY

1. A leaf spot disease of grapes caused by a dematiaceous fungus is described for the first time in New Zealand.
2. Literature on the taxonomy of the causal organism is reviewed and reveals a pleurality of binomials that have been applied to the fungus. The main features in contention are the correct basionym, symptomatology, conidium shape and degree of conidiophore compactness. These were studied in relation to the taxonomy of the causal organism and from results obtained it was finally placed in the genus Cercospora, where the binomial becomes C. vitis; the legitimate specific epithet for the fungus.
3. Cultural studies of the pathogen provided further supporting evidence for placement in the genus Cercospora.
4. An apparatus for photomicrographically recording conidium ontogeny and spore germination patterns of filamentous fungi is described.
5. Classification schemes of the Fungi Imperfecti are reviewed and all were found to have certain shortcomings with respect to the classification of the causal organism. A proposed alternative scheme is outlined.
6. The disease does not become manifest until late in the growing season and hyphal swellings in the stomata (stomatopodia) are found to constitute the form in

which the pathogen persists during a latent infection period. A disease cycle is synthesised from results of glasshouse infection experiments, field observations, and reports from the literature.

PREFACE

There is at present a rapidly increasing area of grape vines being grown in New Zealand. As at the 31st of March, 1969, the Viticultural Advisory Committee of the Department of Agriculture estimated there were 2,200 acres of grape vines in New Zealand, of which 1,750 acres are bearing. It is also estimated that by the end of 1970, the acreage will have increased to 3,000 acres (Thompson, personal communication). There is also a parallel boom in the wine making industry (see table I), with New Zealanders becoming increasingly more conscious of good wines as the number on the market increase and comparisons are made with those produced overseas.*

TABLE I

Wine production and grape vine acreages in
New Zealand.¹

	1961-62	1966-67
Wine put down	1,206,000 gal.	2,298,000 gal.
Vine yard acreage	1,187	1,748

¹Industrial statistics, 1966-67.

Grape vines grow prolifically out of doors in the northern areas of New Zealand and yields per acre are often very high, especially in the Gisborne and Auckland districts.

* See Consumer No. 58, 1969 - published by the Consumer Council, N.Z.

However, although the climate is conducive to vine growth, it is also conducive to disease development, and there are several fungal diseases that currently plague the industry. As the acreage increases, disease problems are likely to be of even greater magnitude.

In the Autumn of 1968, the author received a number of severely spotted grape leaves from a Matamata home garden. The disease was tentatively identified as being caused by the fungus Isariopsis clavispora (B. & C.) Sacc., a pathogen not previously recorded in New Zealand (Dingley, personal communication). There are, however, reports of the disease being present in several overseas countries including North America (Berkeley, 1875; Higgins, 1929; Rhoads, 1926; Schwarze, 1917; Tharp, 1917), South Africa (du Plessis, 1942a, 1942b), India (Munjal and Sethi, 1966) and the Philippines (Roldan, 1938). Examination of vineyards in the Gisborne and Auckland areas in February and April 1969 respectively, failed to reveal the presence of the disease.

A review of the literature revealed that the causal fungus has been given several generic and specific names and further, there is considerable confusion as to the correct binomial that should be applied to the pathogen. Accordingly, studies were initiated into all aspects relative to the correct nomenclature of the causal fungus. Associated with this work, the requirements of proof of pathogenicity (Koch's postulates) were fulfilled, and symptoms were recorded as they occurred both in the field and under glasshouse conditions.

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I INTRODUCTION

There are several organisms capable of causing foliage diseases of grapes, including those inducing powdery mildew, downy mildew, anthracnose and black-rot. Further, there are five fully characterized species of Cercospora reported to attack grape leaves (Chupp 1953), but the organism under study, which has also been placed in the genus Cercospora, is the most prevalent and quite distinct from the others (Appendix I). However, despite its apparent uniqueness, the taxonomy of the causal organism has been the subject of much debate in the literature, as evidenced by the fact that it is currently known under three generic names, namely Cercospora, Isariopsis and Pseudocercospora. Even though several workers have conducted quite detailed taxonomic studies on the causal organism, they have often applied different generic names and specific epithets to the fungus (Higgins, 1929; du Plessis, 1942b; Munjal and Sethi, 1966).

The pleurality of names could have arisen from the fact that the fungus was first described in the 19th century when generic limits were broad and vague. As new genera were erected, limits were reduced and defined more precisely as a consequence of which many fungi had to be reclassified into these genera. Placement was often incorrect because many original descriptions were vague and imperfect. The fungus under study illustrates this point in that it was first placed independently into three genera (Cladosporium, Septonema and Graphium) but because

it demonstrates some unusual and variable morphological characteristics, there arose considerable confusion as to its correct nomenclature. Consequently, the taxonomy of the fungus was studied from two aspects:

- (a) The historic development of the nomenclature.
- (b) Morphological and physiological characteristics appertaining to taxonomy.

To determine the correct taxonomic affinity of the fungus, results from the morphological and physiological studies were compared with reported characteristics of the same fungus and closely related fungi.

The confusion in nomenclature arose during the use of the classification system of the Fungi Imperfecti devised by Saccardo in the 19th century. Since modern taxonomy of this group of fungi is based on different criteria, the current confusion was also studied in relation to these present day concepts.

To enable a comparison to be made with other descriptions of the fungus quoted throughout this thesis, a description of the disease in the field and the causal organism as found in New Zealand is now presented.

Lesions first appearing midway through growing season, 2 to 8 mm in diameter, at first as small irregular black areas on upper surface with no necrosis of host tissue, immarginate; later becoming larger and still irregular to angular with red-brown

centres and dark brown-black margins (Fig. 1). Host tissue slightly yellow, becoming more obvious with age of the lesions; lesions often becoming confluent. On lower leaf surface lesions appear light brown through tomentum, sometimes with dark brown centres. Often causing premature leaf yellowing and defoliation.

Fruiting amphigenous; conidiophores long (150 - 450 x 3 - 6 μ), arising from a stroma, medium olivaceous brown, but dark brown en mass; unbranched, septate, multigeniculate at tips with no obvious spore scars; proliferating by 'sympodial' growth; in dense fascicles of 10 - 50 units, fused to spreading at base, always spreading at apex, sometimes coremoid (Fig. 16).

Conidia medium olivaceous brown, blastospores, 3 - 14 (8) septa, obclavate, phragmospores, with obconically truncate base and tapering obtuse apex, straight to slightly curved, smooth, often guttulate, caducous, 20 - 100 (63) x 3 - 12 (7) μ (Fig. 2).

Habitat: on leaves of Vitis vinifera var. Albany Surprise; from a private garden, Matamata, New Zealand. Herb. P.D.D. 26770 and 26771, Herb. Lev. 4111.

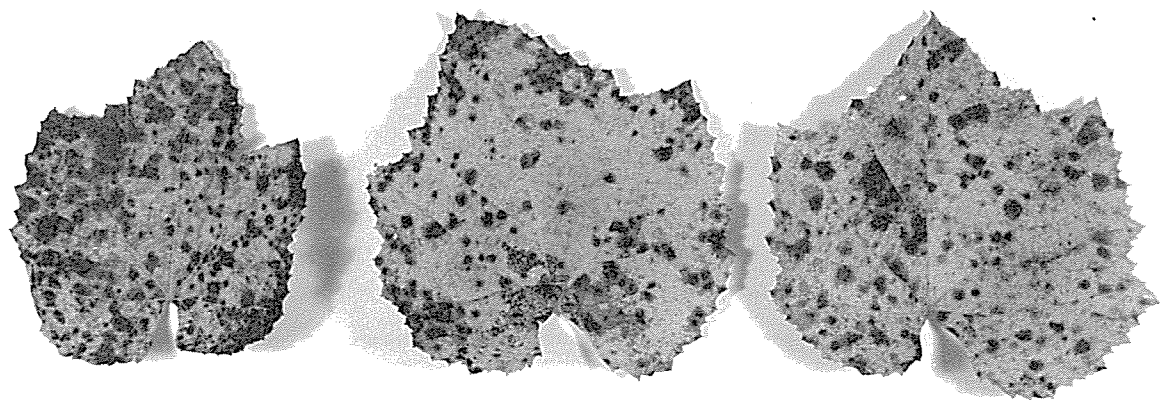
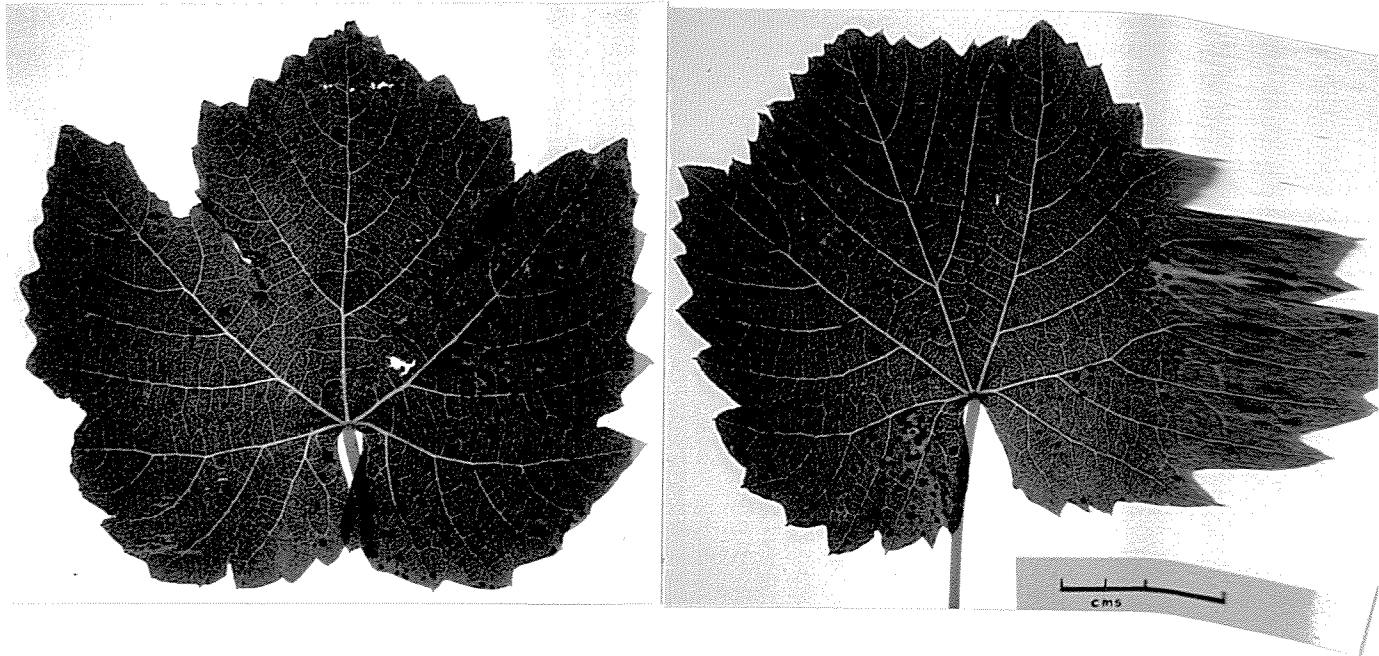


Fig. 1. Field symptoms of the disease on grape leaves (var. Albany Surprise).

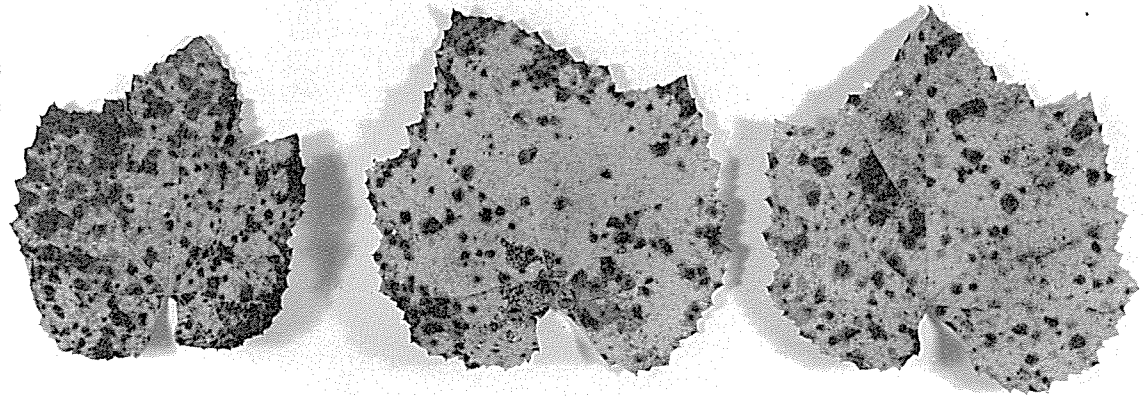
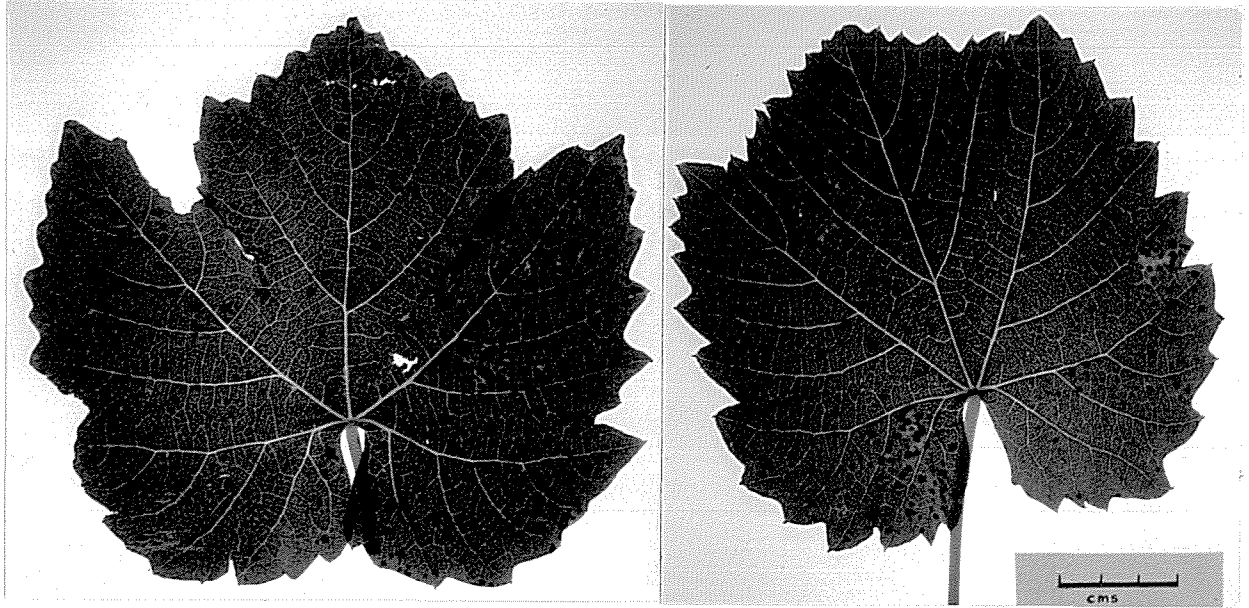


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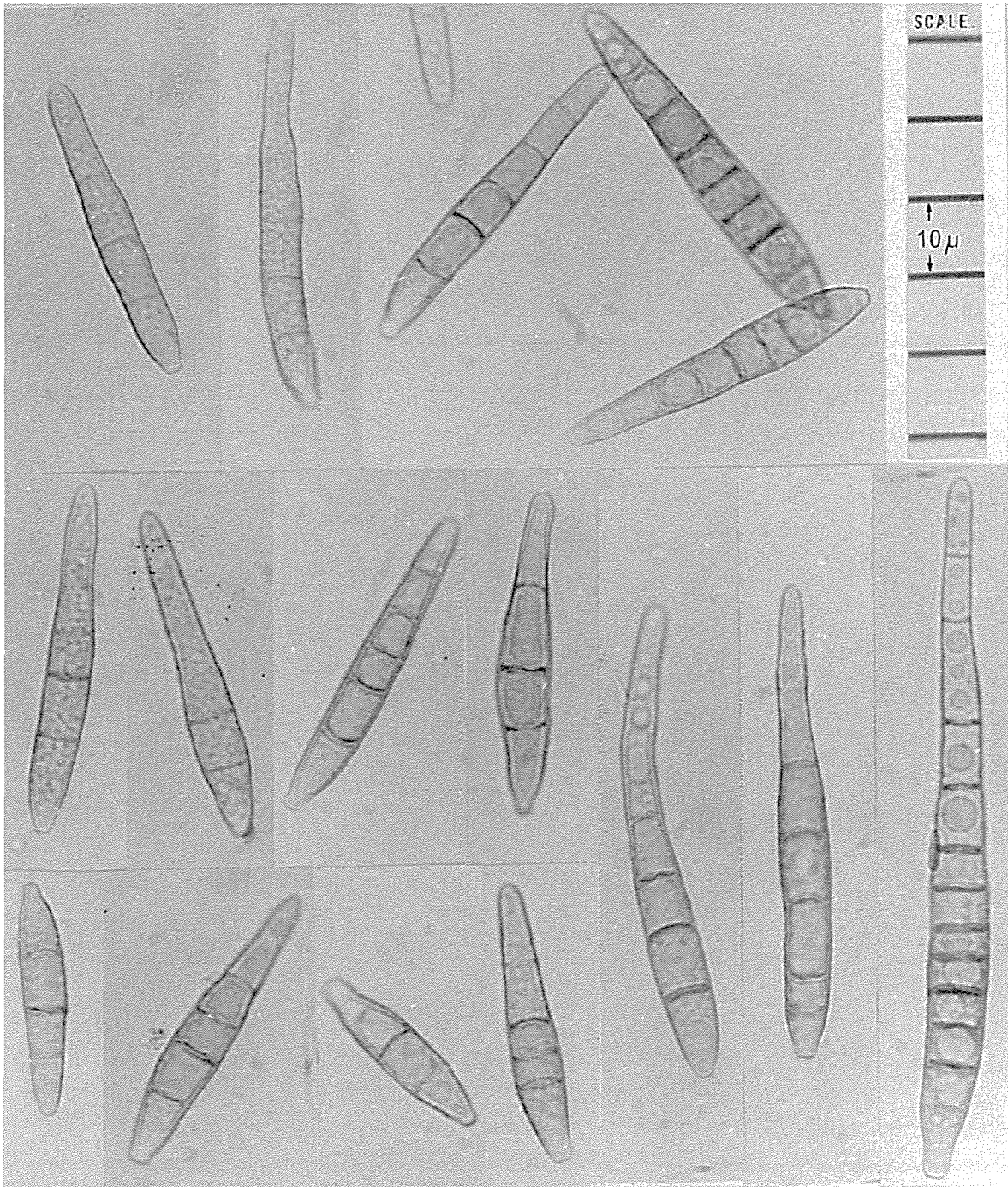


Fig. 2. Conidia of the causal organism from naturally infected field material.