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Incidence of black shank (*Phytophthora nicotianae* var. *nicotianae*) in north Queensland tobacco crops between 1969 and 1974

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Summary

Black shank (*Phytophthora nicotianae* var. *nicotianae*) was first observed in Queensland tobacco crops in 1969. In that year its presence was confirmed at 49 sites scattered through the tobacco growing districts of the Atherton Tableland. Due to its almost simultaneous appearance at such a large number of sites, it is unlikely that the causal organism was newly introduced. Rather, it is probable that the disease did not become apparent until the commercial release in 1969 of the two new susceptible cultivars, Sirone and Hicks Q46.

During six tobacco seasons (1969–1974) we recorded the severity of the disease in reported outbreaks. At individual sites, the percentage of infected plants was as high as 68%. The majority of recordings (80%) were made in cv. Sirone. The mean severity was also high in this cultivar.

The disease incidence fluctuated yearly but showed no signs of increasing as may have been expected. On the contrary, recordings in the last three seasons were far less than in the first (12 cf. 93). This may have been due to a district trend towards earlier planting and consequently less favourable, lower soil temperatures during the growing season.

1. Introduction

Black shank (*Phytophthora nicotianae* B. de Haan var. *nicotianae*) is a root and basal rot of tobacco (*Nicotiana tabacum* L.) It is currently regarded as one of the two most important diseases of tobacco in North America (Stavely 1977) and has been recorded in Africa, Asia, South America and Europe. Until 1969, the disease had not been observed in Australia.

The tobacco producing districts of Australia lie in the eastern states of Queensland, New South Wales and Victoria. Of the total annual production of 16 000 tonnes, 40% is produced on the Atherton Tableland of north Queensland near the towns of Mareeba and Dimbulah. Here, the area planted to tobacco varies, but is approximately 3 500 ha. Smaller producing areas in Queensland are near the towns of Ingham, also in north Queensland, and Bundaberg, Beerwah and Inglewood in south-east Queensland.

Although brown stem rot (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dast.)) had been recorded in tobacco near Beerwah as early as 1932 (Simmonds 1966) the first record of black shank was made at Mareeba in 1969 (O'Brien 1970). In that year the disease occurred over a wide area and there was speculation regarding its long term effects on the industry. For this reason, all reported outbreaks of the disease were inspected and the severity of the disease determined over a period of 6 years (1969–1974).

2. Methods

Following the initial recording of black shank in September 1969, farmers and field advisory officers were asked to report suspected field sightings of the disease during six tobacco seasons (1969–1974). Samples were collected from each site and tissue from the advancing disease margin in the stem pith was transferred to an oatmeal agar medium in petri plates. If *P. nicotianae* var. *nicotianae* was recovered, a field severity rating was made as soon as possible. In each field ten samples, each of 100 consecutive plants in a row, were examined and the presence or absence of disease symptoms recorded. The sampling sites were at positions along the diagonal transects of the field. Since the sampling for severity estimates was usually made at an early stage of crop development, the possibility existed that the severity would become greater as the crop aged. This was investigated in 1971 by re-surveying 18 fields previously inspected. The average crop age was 9 weeks at the first inspection and 15 weeks at the second.

We also considered it probable that some fields affected by black shank would not be reported. To determine whether this was so, we conducted a very detailed examination of 60 fields in the Mareeba district in 1971. In none of the fields had the disease been reported at the time of inspection. If black shank was found, the fields were sampled as described previously.

3. Results

Black shank was recorded from widely separated locations during 1969 (figure 1). The sites were not restricted to a particular soil type or locality. In some cases irrigation water was reticulated from the Tinaroo Dam while in others, irrigation water was pumped from streams. The frequency of recordings and the mean severity varied from season to season (table 1). The most severe infestation was 68% in a crop of cv. Sirone in 1969.

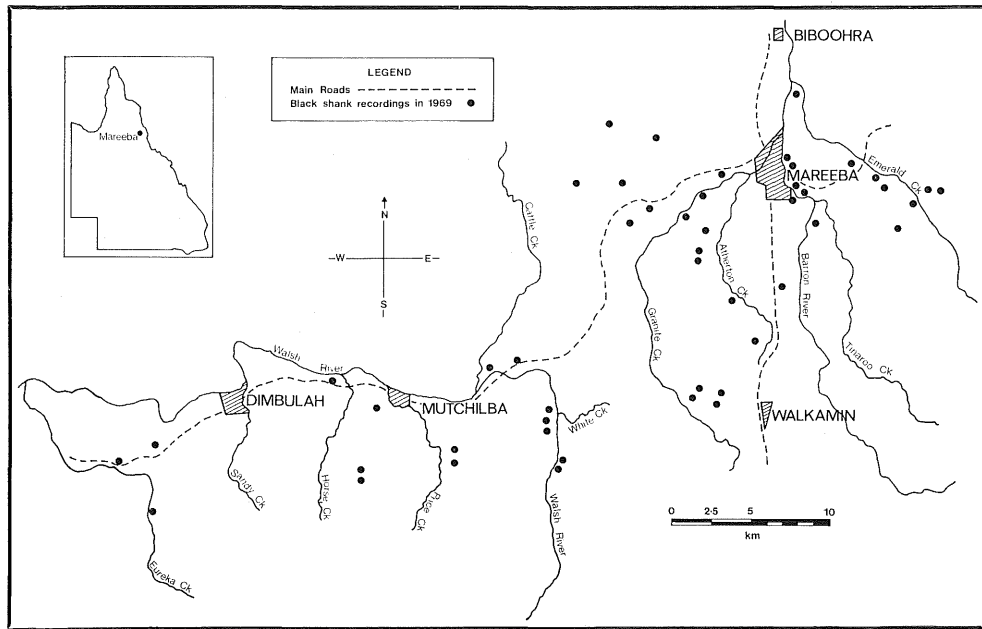


Figure 1. The location of black shank recordings during the 1969 tobacco season.

Table 1. The number of recordings of black shank and the mean % affected plants in tobacco cultivars 1969-1974

Season	Hicks Q34	Hicks Q46	NC95	Sirone	CSIRO 40T	Sirone 2	All cultivars
1969	0	5* (1.1)†	0	44 (9.5)	..	..	49 (8.5)
1970	0	3 (2.1)	0	13 (5.6)	..	..	16 (5.0)
1971	0	3 (0.4)	0	25 (2.6)	..	..	28 (2.4)
1972	0	0	0	0	2 (2.7)	..	2 (2.7)
1973	0	0	0	1 (0.5)	0	..	1 (0.5)
1974	0	0	0	2 (0.6)	1 (1.0)	7 (10.4)	10 (7.5)

* Number of recordings.

† Mean % infected plants.

The period of these observations saw changes in the cultivars being grown in the district. In 1968, Hicks Q34, also known as Departmental Hicks, was the only cultivar registered for sale. In 1969 three new lines were released. Hicks Q46 was registered as a cultivar superior in agronomic qualities to cv. Hicks Q34 (Gordon 1968). Sirone was offered as a blue mould (*Peronospora hyoscyami* de Bary) resistant cultivar and cv. NC 95 was registered on the basis of its resistance to bacterial wilt (*Pseudomonas solanacearum* (Smith 1896) (Smith 1914). A second blue mould resistant cultivar CSIRO-40T was released in 1972 and a third, cv. Sirone-2, in 1973 (Gillham and Harrigan 1977). The approximate proportion of the crop planted to each of these cultivars is indicated in table 2.

Table 2. The commercial popularity of tobacco cultivars in north Queensland 1968-1974

Season	Seed distribution of cultivars as a % of total weight of seed sold					
	Hicks Q34	Hicks Q46	NC95	Sirone	CSIRO 40T	Sirone 2
1968 ..	100	..	..	..	..	..
1969 ..	65	18	2	15	..	..
1970 ..	20	45	5	30	..	..
1971 ..	11	36	4	49	..	..
1972 ..	30	18	5	17	30	..
1973 ..	11	13	3	46	27	..
1974 ..	5	7	3	43	20	22

These figures were derived from seed sales and do not take into account the minor proportion of grower produced seed. It is clear, however, that the popularity of the Hicks cultivars declined while that of the blue mould resistant lines increased, cv. Sirone being the most widely used.

In the check of the survey method carried out in 1971, black shank was present in 15 of the 60 fields. All recordings were in the cultivar Sirone. Twelve of the recordings were at a very low level (<0.1%). The remaining three sites showed severities of 0.2%, 0.2% and 5% respectively. These figures have not been included in table 1.

The mean severity of black shank on the 18 farms revisited in 1971 increased from 2.0% to 8.0% approximately 6 weeks later.

4. Discussion

The annual surveys of farms during the 6 year period showed that *P. nicotianae* var. *nicotianae* is widely distributed in the tobacco growing district of the Atherton Tableland. The data on seasonal incidence in table 1 are not complete since our survey of 60 farms in 1971 showed there were many farms on which the disease occurred at a low level but was not reported. Similarly, a figure for disease severity is difficult to determine since losses increase through the life of a crop. The result of re-surveying 18 fields in 1971 suggests that the percentage of plants affected by black shank late in the season may be four times as large as that shown in table 1.

Although the incidence fluctuated from year to year, there was no overall increase in severity over the six seasons. This is in contrast to the steady increase in disease severity in Georgia reported by Gaines (1960). One possible explanation could be the district trend for the crop to be planted earlier. Crops planted earlier, for example, July rather than August-September, develop under cooler conditions. As evidence of this trend, the gazetted time (Old Govt. Gazettes 9/7/66 and 4/9/71) for first seedbed sowings was changed from 1 June to 1 May in 1971. It is currently 1 April (Old. Govt. Gazette 1/2/75). It has been well documented (Kincaid and Gratz 1935; McCarter 1967) that high soil temperatures favour the disease.

The cultivars which appeared most susceptible to black shank were Sirone and Sirone 2. There were comparatively few recordings in cv. Hicks Q46 and CSIRO-40T and the severities were slight. It is interesting to note that cv. Hicks Q46 was introduced from the U.S.A. where it is known as Broadleaf Hicks (V. J. Hansen personal communication). In that country it is considered susceptible to black shank although not as sensitive as other cultivars such as Virginia Gold. In the field tests reported by Troutman, Henderson and La Prade (1962) a mortality rating of 50% was recorded for cv. Hicks while cv. Virginia Gold sustained 91% mortality. In the development of Sirone the major back cross parent was cv. Virginia Gold (Wark 1970). This may account for the high level of susceptibility indicated in the surveys. Although Sirone 2 was selected from Sirone on the basis of greater resistance to black shank (Gillham and Harrigan 1977), several fields of this cultivar were affected in 1974. Many growers used this line to plant areas where black shank had occurred previously, which may account for the disproportionately high number of recordings in this cultivar. It seems, however, that the resistance in this line is not extremely high.

Before 1969, *P. nicotianae* var. *nicotianae* had not been recorded in Australia. The evidence from the field survey of that year when 49 widely distributed outbreaks were reported, strongly suggests the fungus was not a new introduction. It seems probable that *P. nicotianae* var. *nicotianae* had been present for some time prior to 1969 but did not affect the standard commercial cultivar. We did not have any reported outbreak in this line during the six seasons. The release of black shank susceptible cultivars in 1969 allowed the development and recognition of the disease. In contrast, Gaines (1960) reported the spread of black shank to the flue-cured areas of Georgia; from two farms in 1955, to 75 confirmed reports in 1959. In this case, increases in the number of farms affected were attributed to the introduction of inoculum with infected seedlings and aerial dispersal of sporangia.

Black shank is widespread and has the potential to be damaging. At present, it seems that losses can be kept low by planting early and using a cultivar which is not highly susceptible. Black shank screening should be continued as part of plant breeding programmes developing cultivars for this area.

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