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**Survey of the incidence of black dot of
potatoes**

R F de Boer

Agriculture Victoria



Know-how for Horticulture™

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1. Summary

1.1 Industry Summary

A comprehensive survey of Certified Seed potato growers throughout the State of Victoria, and of ware and processing growers in South Australia, was conducted to determine the incidence and severity of black dot, caused by the fungus *Colletotrichum coccodes*, and other diseases of potato tubers. Samples of tubers, taken at random from consignments of potatoes of different cultivars, were washed and the incidence and severity of tuber skin diseases recorded.

In general, black dot, silver scurf (*Helminthosporium solani*) and black scurf (*Rhizoctonia solani*) were the most common tuber diseases in both Victoria and South Australia. The incidence of other diseases, namely powdery scab (*Spongospora subterranea*), common scab (*Streptomyces scabies*) and eelworm (*Meloidogyne spp.*) were generally low.

Black dot was found to be a common disease of potato tubers grown for seed in Victoria. On average 44% of all tubers tested had black dot. Silver scurf was more prevalent affecting 81% of tubers. The incidence of tubers with black scurf, powdery scab and common scab was relatively low with 28%, 3% and 2% of tubers affected, respectively.

The incidence of black dot in Victoria varied with district. Tubers with black dot were the most common in the Central Highlands (84% tubers affected), least common in the Otway Ranges (4% tubers affected) and intermediate in occurrence in the Gippsland and Kinglake districts (42% and 47% tubers affected, respectively). An analysis of results showed that the incidence of black dot increased by 0.4% for every day that tubers were left in the ground after they had matured and this accounted, in part, for the relatively high level of the disease in Kinglake. High levels of silver scurf were recorded in Kinglake, the Otway Ranges and the Central Highlands (93%, 84%, and 83% respectively) and moderately high levels in Gippsland (63% tubers affected). The incidence of tubers with black scurf did not vary greatly between districts (17-44% tubers affected).

In South Australia, the incidence of both black dot and black scurf averaged 19% tubers affected and 11% of tubers were affected with silver scurf. The incidence of powdery scab and common scab, however, were relatively low (4% and 1% tubers affected, respectively).

Silver scurf, and to a lesser extent black dot, are transmitted on tubers. Research in overseas countries shows that planting seed infected with silver scurf and black dot will result in infection of the progeny tubers. Although not considered to be important in the past, both diseases now increasingly affect income of potato growers because they reduce quality and marketability of tubers, particularly those for the pre-pack washing market. Furthermore, the black dot fungus, unlike the silver scurf fungus, can also damage the roots, stems and stolons of plants causing early death and yield loss in crops. Black dot is, therefore, a potentially more serious disease than silver scurf. There has, for the most part, been no effort to control either disease. This study shows that the management of both black dot and silver scurf will need to become part of routine disease control strategies for seed potato growers.

1.2 Technical Summary

A comprehensive survey of Certified Seed potato growers throughout the State of Victoria, and of ware and processing growers in South Australia, was conducted to determine the incidence and severity of black dot, caused by the fungus *Colletotrichum coccodes*, and of other diseases of potato tubers. Samples of tubers, taken at random from consignments of potatoes of different cultivars (ungraded in the case of seed potatoes), were washed and the incidence and severity of tuber skin diseases recorded. Results were analysed using linear models to examine the effects of *ground-time* (period between maturity and harvest) and *store-time* (period between sampling and assessment), both of which are known to affect levels of black dot and silver scurf, and the effects of location and cultivar on disease incidence and severity.

In general, black dot, silver scurf (*Helminthosporium solani*) and black scurf (*Rhizoctonia solani*) were the most common tuber diseases in both Victoria and South Australia. The incidence of other diseases, namely powdery scab (*Spongospora subterranea*), common scab (*Streptomyces scabies*) and eelworm (*Meloidogyne spp.*) were generally low.

In Victoria, where 33% of Certified Seed Potato Growers were sampled, black dot was found to be a common disease of potato tubers grown for seed with an average of 44% of tubers affected. Silver scurf was more prevalent affecting 81% of tubers sampled. The incidence of tubers with black scurf, powdery scab and common scab was relatively low with 28%, 3% and 2% of tubers affected, respectively.

Tubers with black dot were most common in the Central Highlands of Victoria (84% tubers affected), least common in the Otway Ranges (4% tubers affected) and intermediate in occurrence in the Gippsland and Kinglake districts (42% and 47% tubers affected, respectively). Linear model analysis showed that the incidence of black dot increased by 0.4% for every day that tubers were left in the ground after maturity (*ground-time*). When means were corrected for the effects of *ground-time*, *store-time* and cultivar the incidence of black dot was found to be lower in both Kinglake and the Otway than in the Central Highlands and Gippsland. High levels of silver scurf were recorded in Kinglake, the Otway Ranges and the Central Highlands (93%, 84%, and 83% respectively) and moderately high levels in Gippsland (63% tubers affected). When means were corrected, the incidence of silver scurf was found to be lower in Gippsland and the Central Highlands than in Kinglake and the Otway Ranges. The incidence of tubers with black scurf did not vary greatly between districts (17-44% tubers affected). The model was not able to resolve possible effects of *store-time* on the incidence of black dot and silver scurf, nor the effect of *ground-time* on silver scurf. The cvs. Pontiac and Kennebec were more susceptible to silver scurf than were cvs. Sebago, Coliban and Russet Burbank. Possible differences in cultivar susceptibility to black dot could not be resolved.

In South Australia, the incidence of both black dot and black scurf averaged 19% tubers affected and 11% of tubers were affected with silver scurf. The incidence of powdery scab and common scab, however, were relatively low (4% and 1% tubers affected, respectively). Data from the South Australian survey will also be subjected to linear model analyses when compiled.

Silver scurf, and to a lesser extent black dot, are seed-borne diseases and research in overseas countries has shown that planting infected seed will result in infection of the progeny tubers. Although not considered to be important in the past, both diseases now affect income of potato growers because they reduce the quality and marketability of tubers, particularly for the pre-pack washing market. Furthermore, the black dot fungus, unlike the silver scurf fungus, can damage the roots, stems and stolons of plants causing early death and yield loss in crops. There has, for the most part, been no effort to control either disease. This study shows that the management of both silver scurf and black dot will need to become part of routine disease control strategies for seed potato growers.

2. Recommendations

2.1 Extension

The results of this survey have significant implications for the seed potato growers and their clients. The findings of the survey should be presented to the industry to

- * inform them of the results of the survey
- * inform them of the implications of the results to their industry
- * provide objective information on the potential effects of black dot and silver scurf on yields and quality of potatoes
- * provide information on the current knowledge and gaps in the knowledge on the epidemiology and control of black dot and silver scurf

This can be done in the form of meetings with grower groups, such as Victorian Certified Seed Growers Association, workshops and publications in industry journals and newspapers.

2.2 Future Research

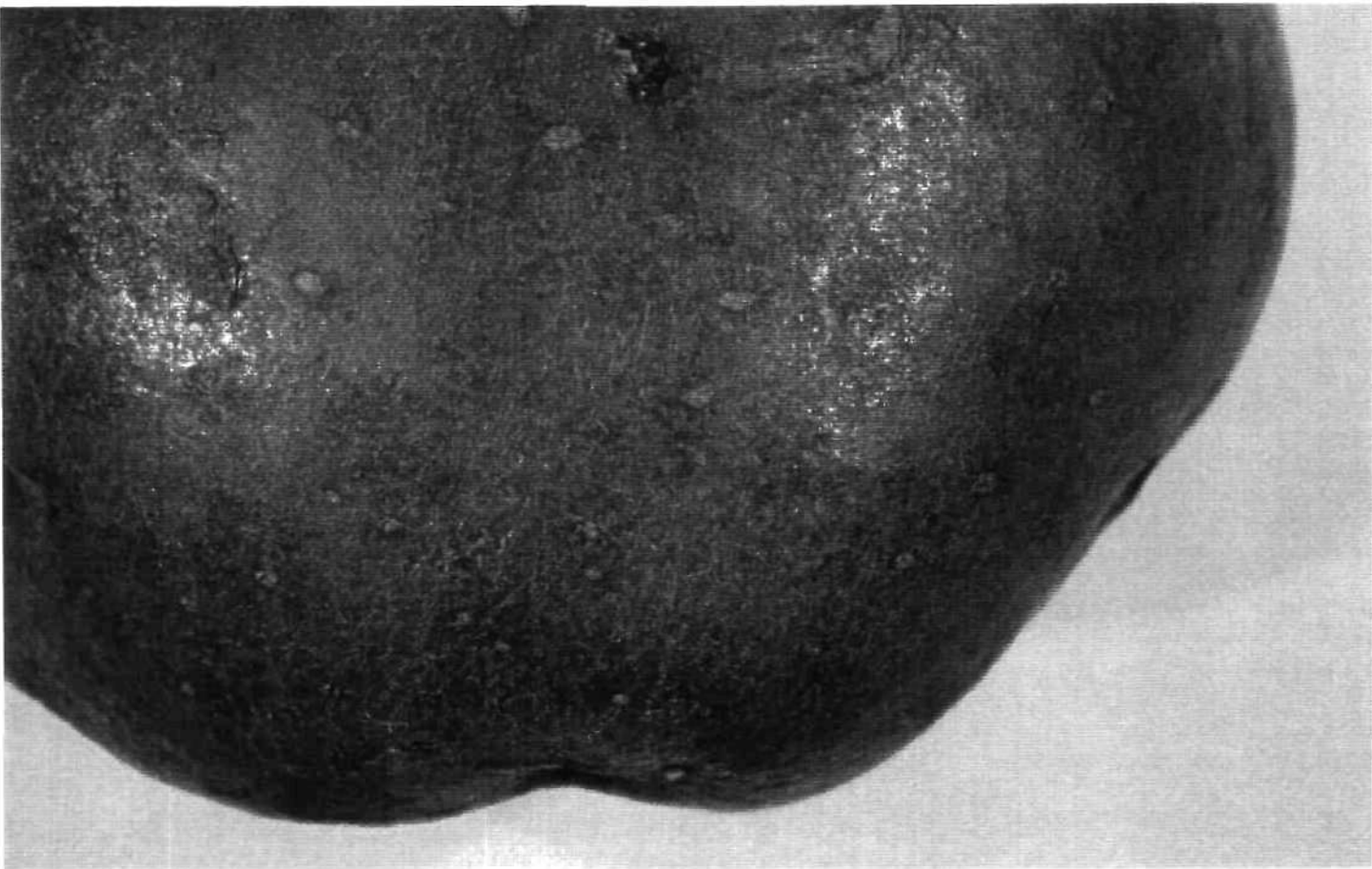
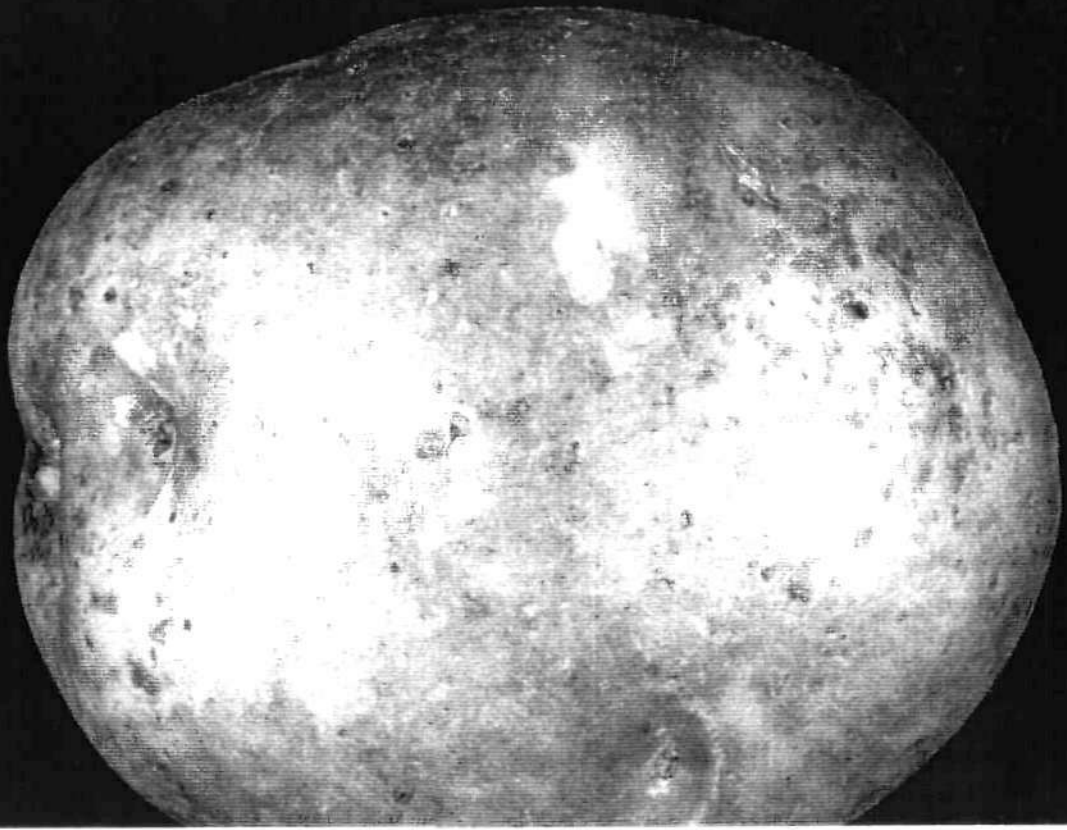
This survey has shown that control strategies are needed for black dot and silver scurf. Current information on the epidemiology and control of both diseases is based on research conducted overseas. There has been very little research in Australia and there is, therefore, no information on the epidemiology of these black dot and silver scurf that is relevant to soils and climatic conditions of the potato growing areas of this country. Furthermore, there are no registered fungicide treatments for the control of black dot and only one for the control of silver scurf.

The industry needs to decide whether resources should be directed to

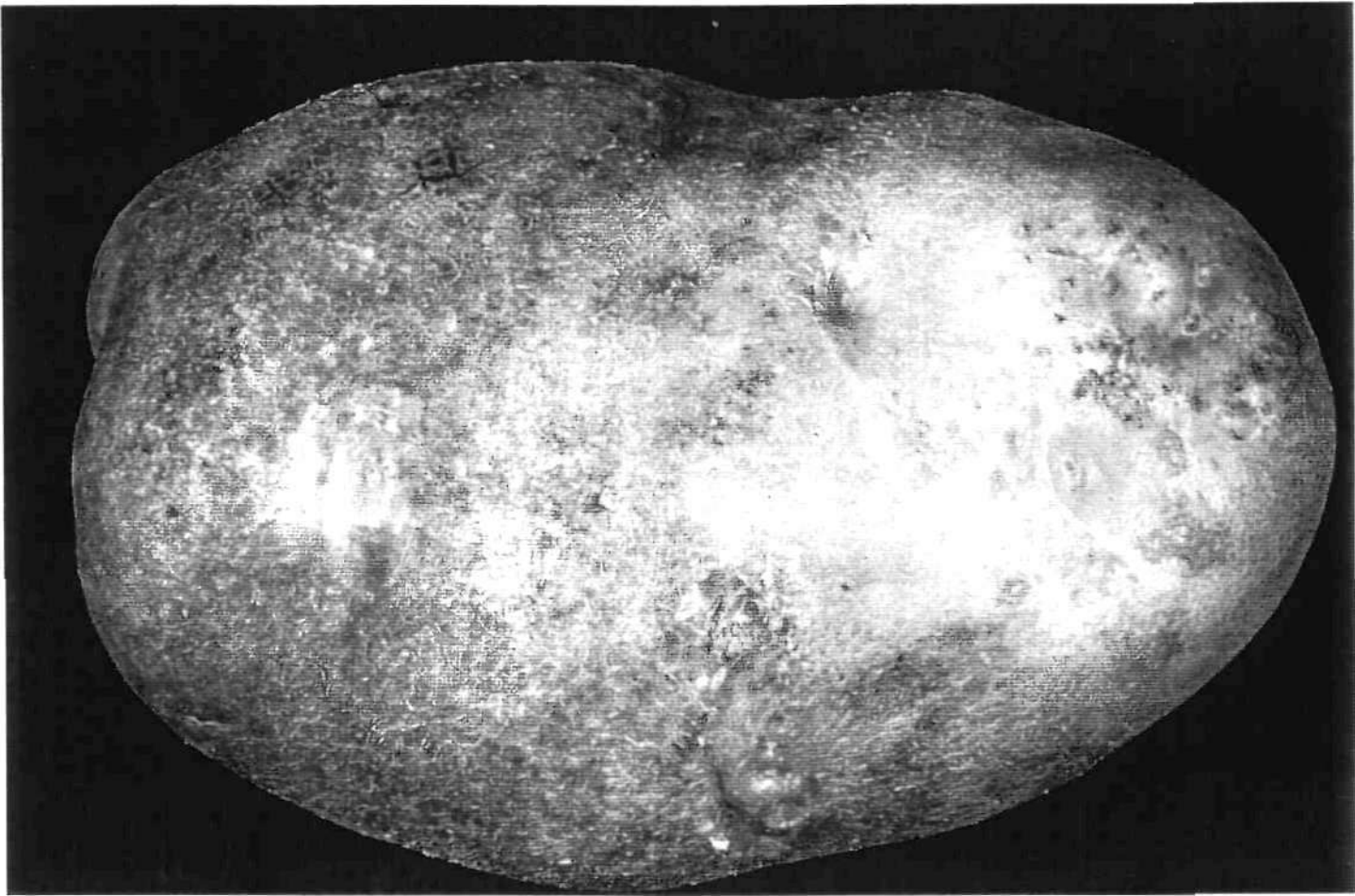
- * study the epidemiology of black dot and silver scurf in Australia
- * evaluate strategies, both cultural and chemical, for the control of black dot and silver scurf on potatoes which are relevant to Australian conditions.

Symptoms of black dot on a white skinned cultivar. Most of the tuber surface is affected - diseased areas have a green tinge. Black dot lesions do not have the characteristic silver sheen of silver scurf lesions.

Symptoms of black dot on a red skinned cultivar (Grey lesions). Microsclerotes (black dots) of *C. coccodes* can be seen in the diseased areas.



Symptoms of black dot on cv. Russet Burbank (Grey shading on the left half (stem end) of the tuber). Microsclerotes of the fungus (black dots) can be seen in the diseased areas.



3. Technical Report

3.1 Introduction

Black dot, caused by the fungus *Colletotrichum coccodes*, can affect the roots, stems, stolons and tubers of the potato plant. The fungus attacks the cortical tissues causing a dry rot (Dillard 1992). Disease symptoms include wilting and premature senescence of plants, reduced number and size of tubers, stem-end rot of tubers and blemishes on the skin (Harrison 1963). Seed and washed table potatoes which have black dot are down-graded in value. Furthermore, studies in the USA have shown that *C. coccodes* can reduce yield of Russet Burbank in the glasshouse and in the field (Barkdoll 1992). The fungus is thought to be part of a disease complex causing premature senescence in Russet Burbank crops (Barkdoll 1992).

The disease was considered widespread in Victoria in the 1960's (Harrison 1963). Over the past two decades it appears to have been of little importance. Recently, however, consignments of high grade washed potatoes were down-graded in South Australia and Victoria because they carried significant levels of black dot. Furthermore, the disease was found on consignments of Victorian Certified Seed Potatoes that had been exported to another state.

Black dot is thought to be favoured by long dry autumn periods which prolong the life of a crop (Harrison 1963). This may explain the why the disease has been noticed in the last few seasons. However, it is possible that black dot has been overlooked and underrated in importance. Symptoms of the disease in the field are, at first glance, similar to those caused by the wilt pathogens (e.g. *Fusarium* wilt) and symptoms on tubers resemble those of other diseases, particularly silver scurf (*Helminthosporium solani*). Wilt symptoms, which occur late in the growing season, could also be confused with natural senescence. Furthermore, overseas studies show that black dot can develop on tubers in storage (Mooi 1959) and, thus, seed may develop symptoms after passing inspection for certification.

The incidence of black dot in Victoria is not known. In Tasmania *C. coccodes* was found to be widespread in senesced potato crops and has been implicated as a cause of premature senescence in Russet Burbank crops in that state (L. Green and P. Aird; pers. comm). Symptoms on tubers are considered to be a problem on high grade washed Coliban ware potatoes grown under centre-pivot irrigation in the sandy soils along the Murray River in South Australia. Victoria is the premier seed producing state in Australia with an output of 30,000 tonnes annually, 60% of which is exported to other states. A good knowledge of the diseases and their incidence in the Seed Scheme is essential if quality is to be maintained or improved.

This study reports on the results of a survey of potato tubers for the incidence of black dot and other diseases in Victoria and South Australia. The Victorian study was confined to Certified Seed Growers since black dot can be transmitted on seed and Victorian growers supply significant quantities of seed to other states. The South Australian study was confined to ware and processing potatoes. New industries in South Australia based on potato production on new ground under centre pivot irrigation have become particularly concerned with the tuber blemishing diseases such as black dot.

The objectives for this project were:

- (a) To determine the incidence and importance of black dot in the Victorian Certified Seed Potato Scheme.
- (b) To determine the incidence and importance of black dot in the major ware production areas along the Murray River in SA.

A third objective of the project, "to compare soil populations of *C. coccodes* with infection of plants in selected Russet Burbank crops in the Central Highlands area of Victoria", was not implemented. A selective media is used routinely for assays of this fungus in the United States (Farley 1972). Attempts at making this media in the initial stages of the project were not successful and it was decided to concentrate resources on the main objectives of the project, namely to survey for the incidence of black dot on tubers.

3.2 Materials and Methods

3.2.1 Survey areas

Two surveys were conducted, one in Victoria and one in South Australia. In Victoria, the survey was confined to Certified Seed Potato growers. Samples of tubers were taken from individual growers sheds in each of the four main growing districts. The districts were Gippsland, which includes the area around Thorpdale and the Koo-wee-rup swamp; Kinglake, north of Melbourne; the central highlands, of which the town of Ballarat is the major centre; and the potato production areas of the Otway Ranges and adjoining plains near Colac. Samples were taken first from Gippsland, since potatoes are harvested the first from this district (February 1993 onwards), and last from the Otway Ranges where harvests are often late (April - August 1993).

Surveys in South Australia were confined to ware and processing potatoes. The districts surveyed include the south-east of the State concerned with the production of processing potatoes, the market gardens area around Virginia in the Adelaide plains, the irrigation areas near Murray Bridge and the production areas in the Adelaide Hills. Samples were taken from the Adelaide Hills, Murray River areas and the South East during winter/summer of 1993 and from the Adelaide Plains area during summer/autumn 1994.

3.2.2 Sampling procedures

Victoria

A sample of tubers (50 or 100) was taken at random from the tops of one half-tonne or one-tonne bins, from one-tonne bulk bags, from bulk carriers or occasionally from 50 kg bags of tubers. In the majority of cases samples were taken from ungraded consignments of tubers destined to be certified as seed grade.

Table 1. Cultivars and numbers of samples in a survey for the incidence and severity of black dot and other diseases of potato tubers in the four main potato growing districts of Victoria in 1992/93

Cultivar	Central Highlands (Ballarat)	Gippsland	Kinglake	Otway Ranges	Total No. of samples
Ballarat Russet Burbank	1 ^A	-	-	-	1
Coliban	3	6	2	4	15
Crystal	-	3	-	-	3
Desiree	-	1	-	1	2
Exton	-	-	2	-	2
Kennebec	4	-	1	1	6
Pontiac	2	5	-	3	10
Russet Burbank	5	-	-	-	5
Sebago	5	7	1	4	17
Sequoia	-	1	-	-	1
Winlock	-	1	-	-	1
Total No. of samples	20	24	6	13	63
No. of seed growers sampled	14	14	5	8	41
Proportion of seed growers sampled (%)	25%	38%	31%	47%	33%

^AFive replicate 100 or 50 tuber samples.

Five replicate samples were taken at random from each consignment which comprised of tubers harvested from an individual paddock. Sample size was 100 tubers from Gippsland and 50 tubers from the other districts. A study of samples from Gippsland showed that the variation in disease incidence and severity in samples of 50 tubers was not significantly greater than in samples of 100 tubers and, therefore, sample size was reduced to 50 for the remaining districts (Central Highlands, Kinglake and the Otway Ranges). Thus, 5 replicate lots of 100 or 50 tubers were sampled from a consignment of a particular cultivar (Table 1).

The cultivars sampled varied from district to district (Table 1). Generally, sampling was restricted to the most extensively cropped cultivars in a particular district. Cultivars marketed as washed potatoes (e.g. cv. Coliban and Pontiac) were also included. Information recorded at sampling included date of sowing and harvest, date of sampling and date of assessment (Appendix).

Samples of tubers were kept in nylon mesh bags and stored at 5°C at the Institute for Horticultural Development, Knoxfield. Before disease assessments were done tubers were washed with a high pressure stream of water to remove adhering soil. The severity of disease on the tuber surface was recorded for each individual tuber on a scale of 0-3 where 0 = healthy, 1 = trace (<5% of tuber surface covered), 2 = moderate (5-30% of tuber surface covered) and 3 = severe (>30% of tuber surface covered). Diseases rated in this way included black dot, silver scurf, black scurf, powdery scab, common root rot and eelworm. Data was recorded on assessment sheets (Appendix).

South Australia

Sampling procedures in South Australia were essentially the same as in Victoria with the exception that samples were often taken from paddocks, from bulk storage on farms or from bulk transport vehicles. Samples of tubers were stored at 5°C before assessment.

3.2.3 Identification of diseases

The diseases recorded in this survey generally have distinctive symptoms. However, black dot and silver scurf are sometimes difficult to distinguish from each other on a tuber surface, especially when symptoms are immature. *Helminthosporium solani* and *Colletotrichum coccodes* readily produced 'fruiting bodies' on tubers in cool storage. Silver scurf was distinguished from black scurf by the prolific production of characteristic conidiophores and conidia on the surface of lesions and these were visible with a hand-lens. Black dot lesions, on the other hand, were characterised by the production of distinctive microsclerotes of *C. coccodes* which were visible with a hand lens. Powdery scab lesions were distinguished from those of common scab, where there was doubt, by the microscopic examination of the contents of pustules.

3.2.4 Calculation of disease incidence and severity

Disease incidence was recorded as the percentage of tubers with a particular disease. Disease severity was recorded as a score which was calculated by weighting the number of tubers in each severity category by 1, 2, or 3 and expressing the sum of

these scores as a proportion of the number of tubers per sample (usually 100 or 50). For example, if, in a sample of 100 tubers, there were 50, 20 and 10 tubers in categories 1, 2, and 3, respectively, the severity score would be calculated as the sum of 50×1 , 20×2 and 10×3 divided by 100, thus giving a score of 1.2 on a scale of 0-3.

3.2.5 Statistical analysis

A Linear Model (multiple regression) was used to examine the effects of location, *ground-time*, *store-time* and cultivar on disease incidence and severity. The terms of the model are presented in Table 2. Published information shows that the incidence and severity of both black dot and silver scurf increases with the time tubers are left in the ground after they mature and with the time in storage (Harrison 1963; Jellis and Taylor 1974, 1977; Mérida *et al.* 1994; Mooi 1959). Both these factors are likely to confound differences in disease incidence and severity between districts and cultivars. The effects of location or cultivar on disease incidence were examined after means were adjusted for the effects *ground-time*, *store-time* and cultivar or location. Cultivars for which there were less than five samples were not included in the model.

The parameter *shed-time* (Table 2) was not tested in this model but will be used in a more thorough examination of the data than that presented here.

Table 2. Description of terms in a linear model used to examine the effects of location, cultivar, *ground-time* and *store-time* on the incidence and severity of tuber diseases in Victoria

Terms	Definition
Location	Central Highlands, Gippsland, Kinglake, Otway Ranges
Cultivar	Coliban, Kennebec, Pontiac, Russet Burbank, Sebago ^A
Ground-time	(Days between planting and harvest) minus <i>Growing Period</i> ^B for each cultivar
Store-time	Days between sampling potatoes and assessing disease incidence and severity
Shed-time ^C	Days between harvest and sampling of tubers

^AOnly cultivars with sample numbers > 2 were tested in the model.

^BAverage number of days between planting and senescence for a cultivar.

^CAlthough this data was recorded, it was not tested in this model.

3.3 Results

3.3.1 Victoria

The incidence and severity (averaged over location and cultivar) of five common diseases detected on seed potato tubers are presented in Fig. 1. All diseases were detected in each of the main potato growing districts of Victoria (Figs. 2 and 3). A sixth disease, caused by the root knot nematode *Meloidogyne spp.*, was rarely seen.

Black dot was detected on an average of 44% of tubers sampled. Overall, black dot and silver scurf were the most common diseases and frequently occurred together on the same tuber and also occurred on all cultivars sampled (Fig. 4). However, the incidence of silver scurf (81% tubers affected) was nearly twice that of black dot (44% of tubers affected) (Fig. 1). Tubers with powdery scab and common scab were relatively uncommon (3% and 2% of tubers affected, respectively) and tubers with black scurf were intermediate in occurrence to those with black dot and powdery scab (28% of tubers affected). The three most common diseases, silver scurf, black dot and black scurf were detected on all cultivars sampled (Figs. 4 and 5).

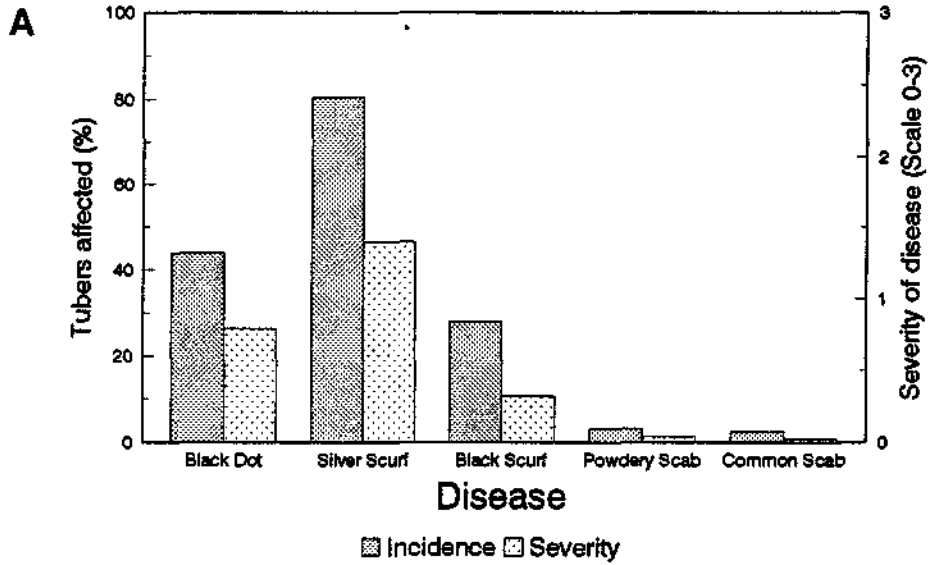
The incidence and severity of black dot were positively correlated with *ground-time*. Regression analysis showed that the incidence and severity increased ($P < 0.05$) by 0.4% and 0.01 units, respectively, for every extra day of *ground-time*. There was no significant ($P > 0.05$) effect of *store-time* on black dot. There were no significant ($P > 0.05$) correlations between either *ground-time* or *store-time* and the incidence and severity of silver scurf.

Both the incidence and severity of black dot varied with location (Fig. 6). Tubers with black dot were most common in the Central Highlands (average of 84% tubers affected), least common in the Otway Ranges (4%) and intermediate in occurrence in the Gippsland and Kinglake areas (42% and 47%, respectively). When taking the effects of cultivar, *ground-time* and *store-time* into account the incidence and severity of black dot were significantly less ($P < 0.05$) in the Otway Ranges and Kinglake than in Gippsland and the Central Highlands (Fig. 6). Similarly, after correcting for *ground-time*, *store-time* and cultivar the incidence of silver scurf was greater ($P < 0.05$) in Kinglake and the Otway Ranges than in Gippsland and the Central Highlands (Fig. 6). A similar trend ($P > 0.05$) occurred with the severity of silver scurf.

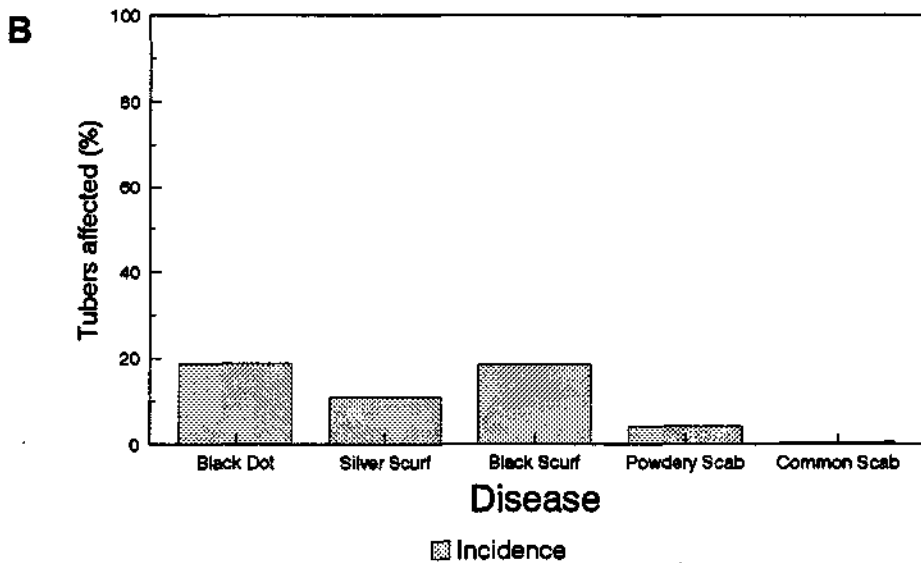
There was no significant ($P > 0.05$) effect of cultivar on the incidence or severity of black dot. The incidence of silver scurf, however, varied with cultivar and more ($P < 0.05$) tubers of cvs. Pontiac and Kennebec were affected with silver scurf than were tubers of cv. Sebago (Fig. 7).

3.3.2 South Australia

The five common tuber diseases were detected on ware and processing potatoes sampled in South Australia (Fig. 1). Tubers with black dot and black scurf were the most common with an average 19% of tubers affected for each disease followed by silver scurf (11% tubers affected). The incidence of powdery scab and common scab were relatively low (average of 4% and 1% of tubers affected). Further analysis of the data is required before conclusions on the relative incidence and severity of the diseases between districts and cultivars can be made.



Victoria: Seed Potatoes



South Australia: ware and processing potatoes

Figure 1. Average incidence and severity of diseases on seed potato tubers in Victoria (A) and incidence of diseases on ware and processing potato tubers in South Australia (B).

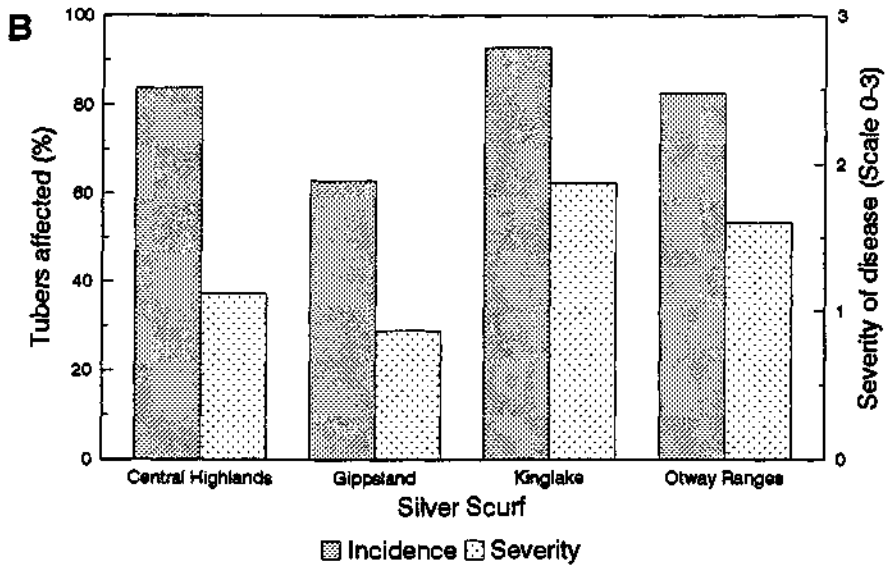
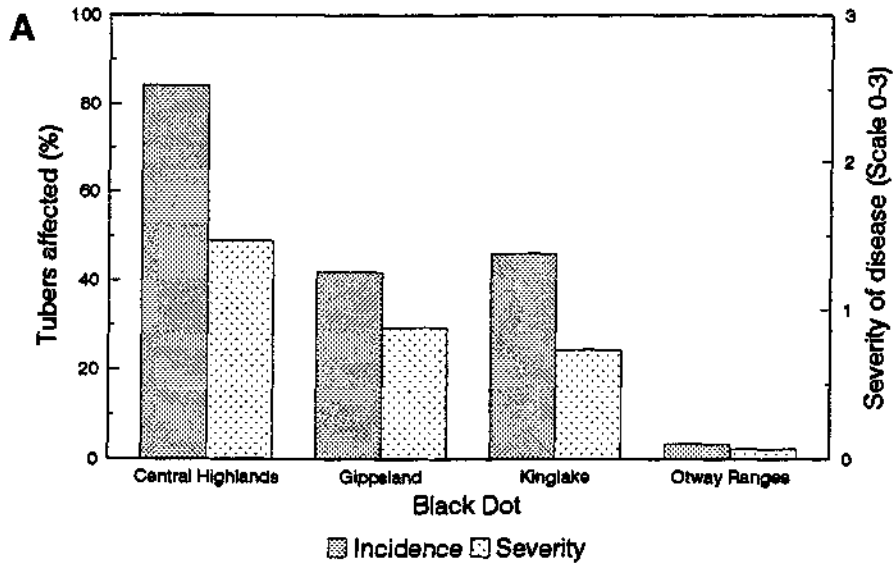


Figure 2. Incidence and severity of black dot and silver scurf on seed potato tubers in the main potato growing districts of Victoria in 1992/93.

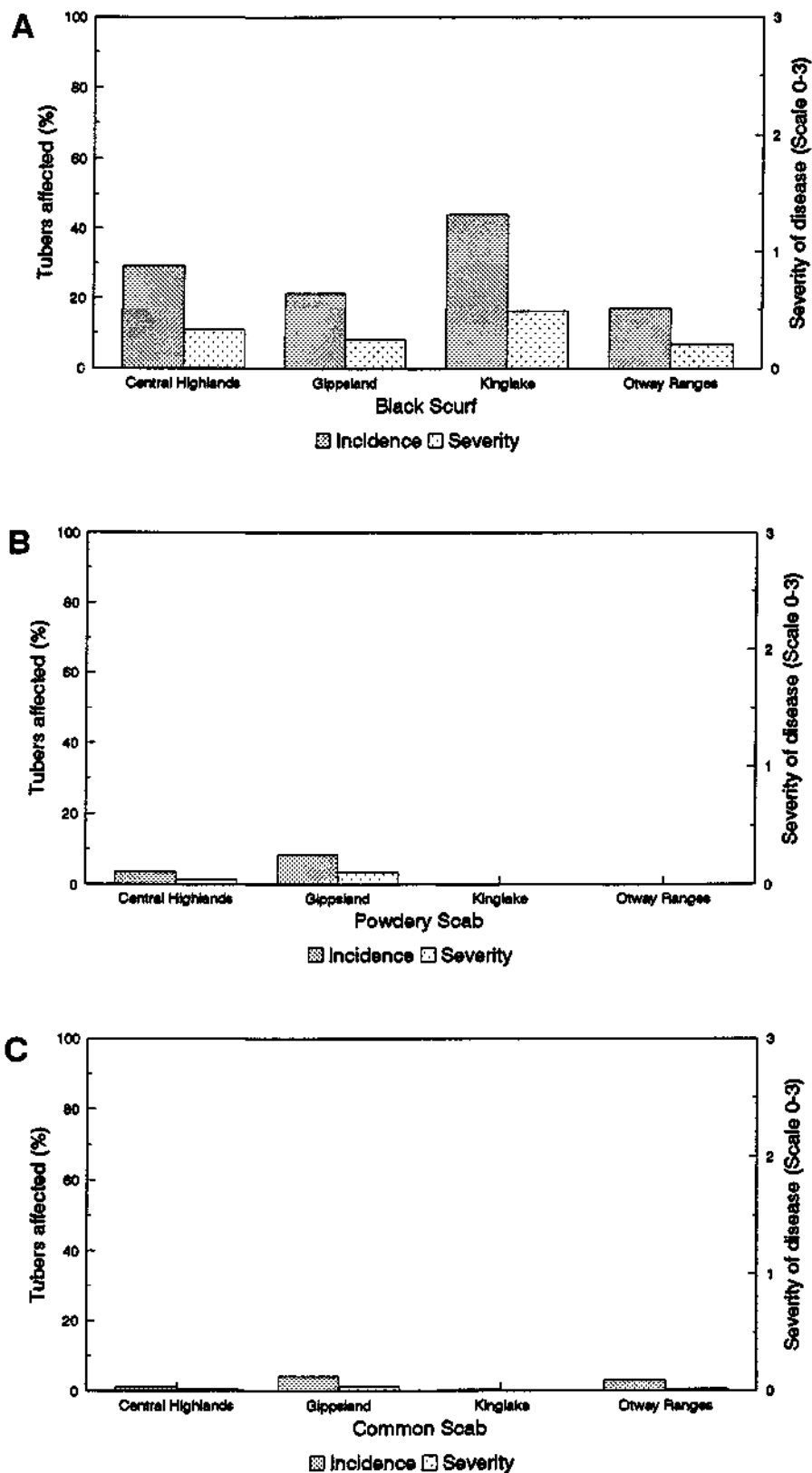


Figure 3. Incidence and severity of black scurf, powdery scab and common scab on seed potato tubers in the main potato growing districts of Victoria in 1992/93.

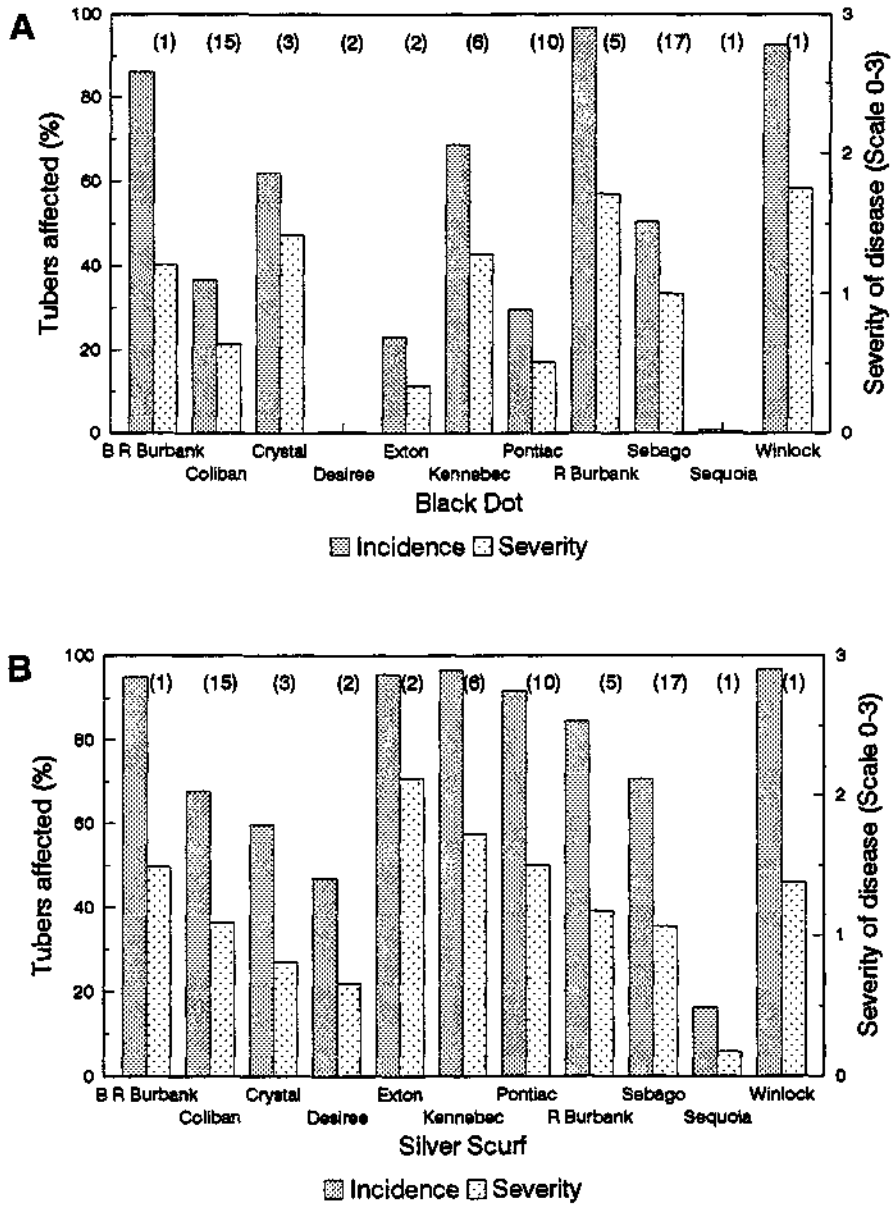


Figure 4. Incidence and severity of black dot and silver scurf on seed potato tubers of different potato cultivars in Victoria in 1992/93 (Number of samples for each cultivar in brackets).

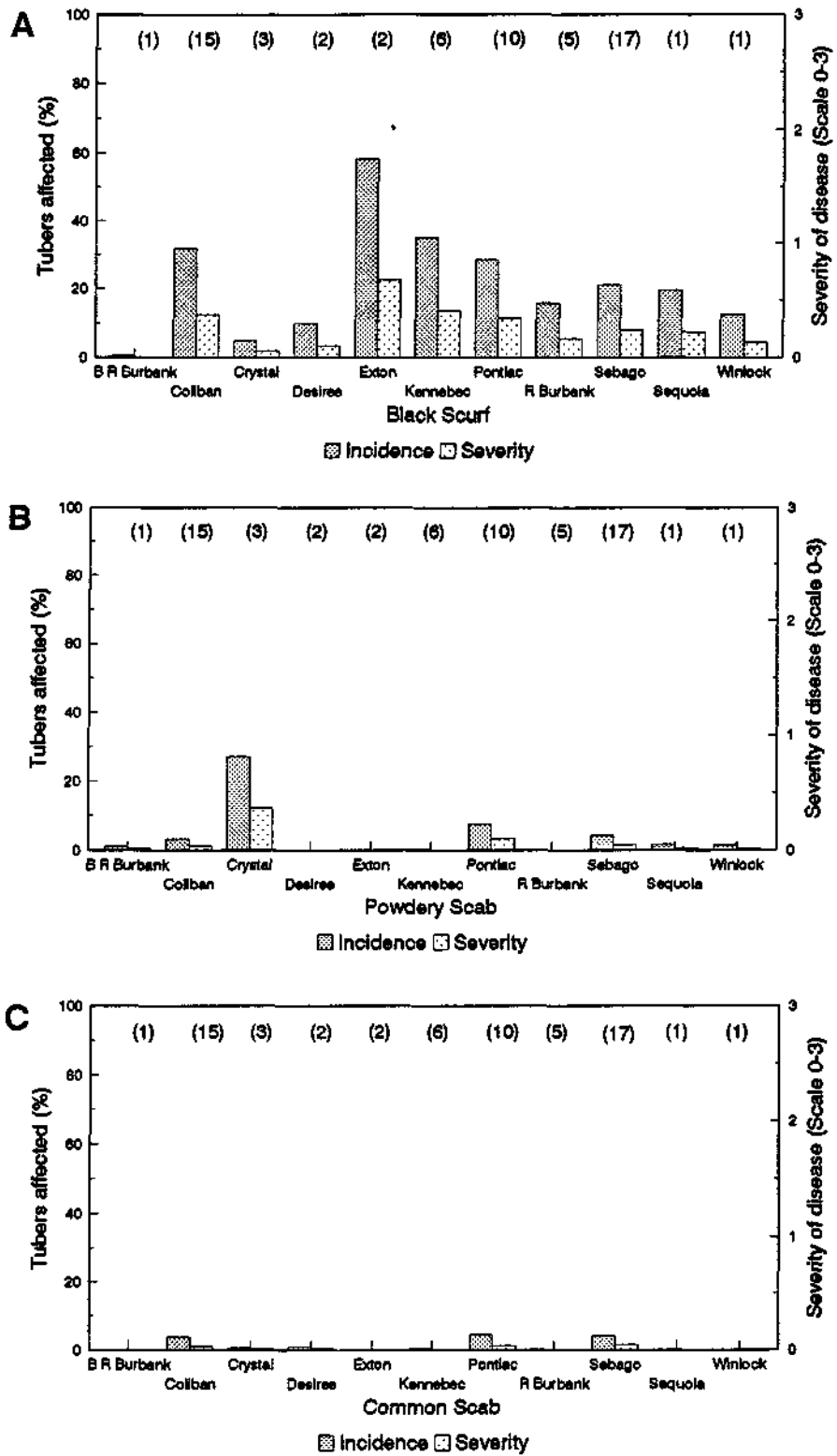


Figure 5. Incidence and severity of black scurf, powdery scab and common scab on seed potato tubers of different potato cultivars in Victoria in 1992/93 (Number of samples for each cultivar in brackets).

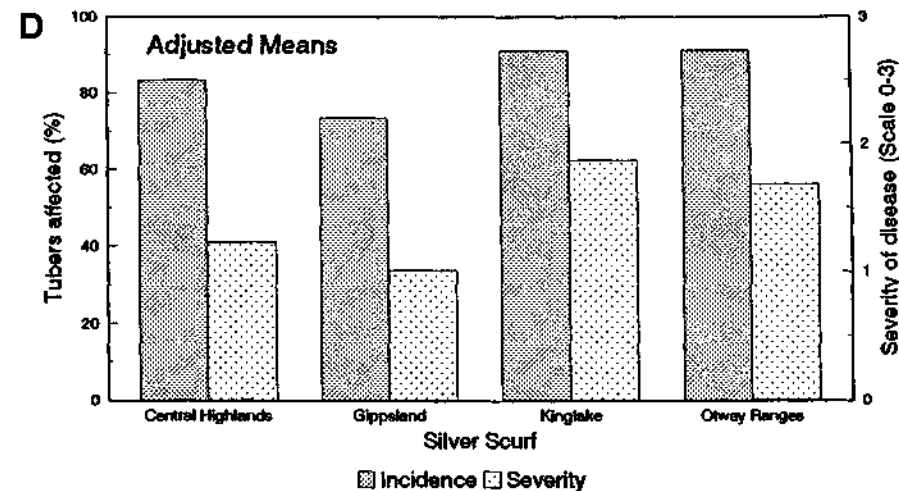
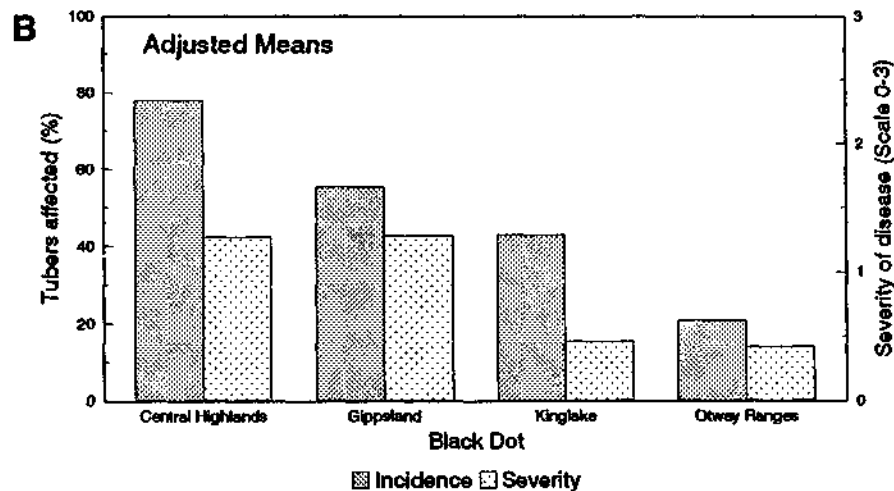
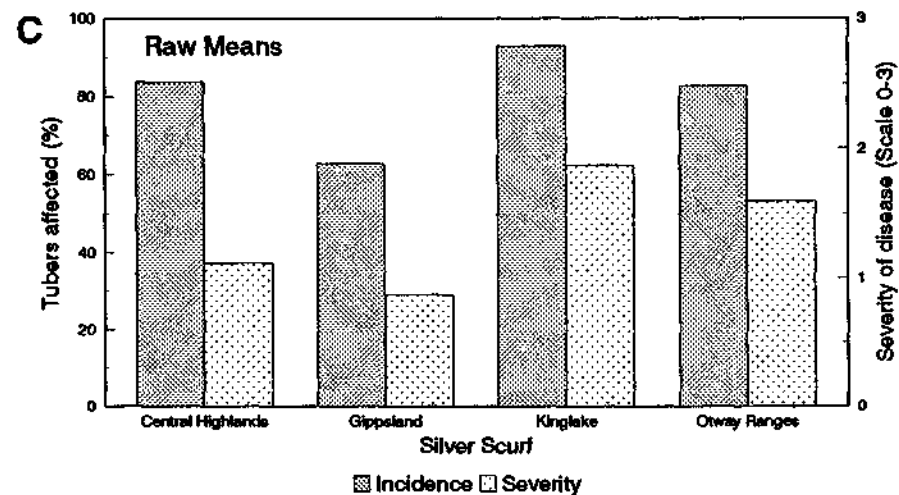
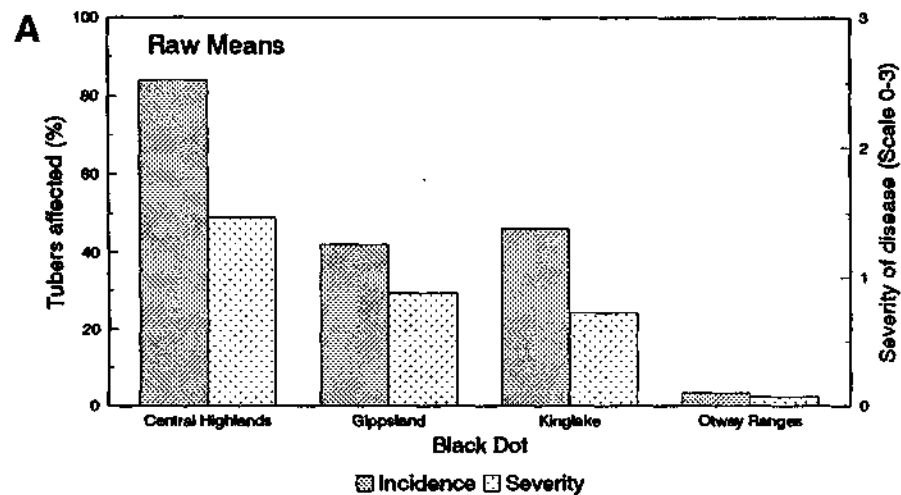


Figure 6. Raw and adjusted means for the incidence and severity of black dot (A and B, respectively) and silver scurf (C and D, respectively) on seed potato tubers in the main potato growing districts in Victoria in 1992/93. Raw means were corrected for *ground-time*, *store-time* and cultivar in multiple regression analyses. (Adjusted means are for statistical comparisons of the relative differences in disease incidence and severity between districts only and should not be used as absolute means).

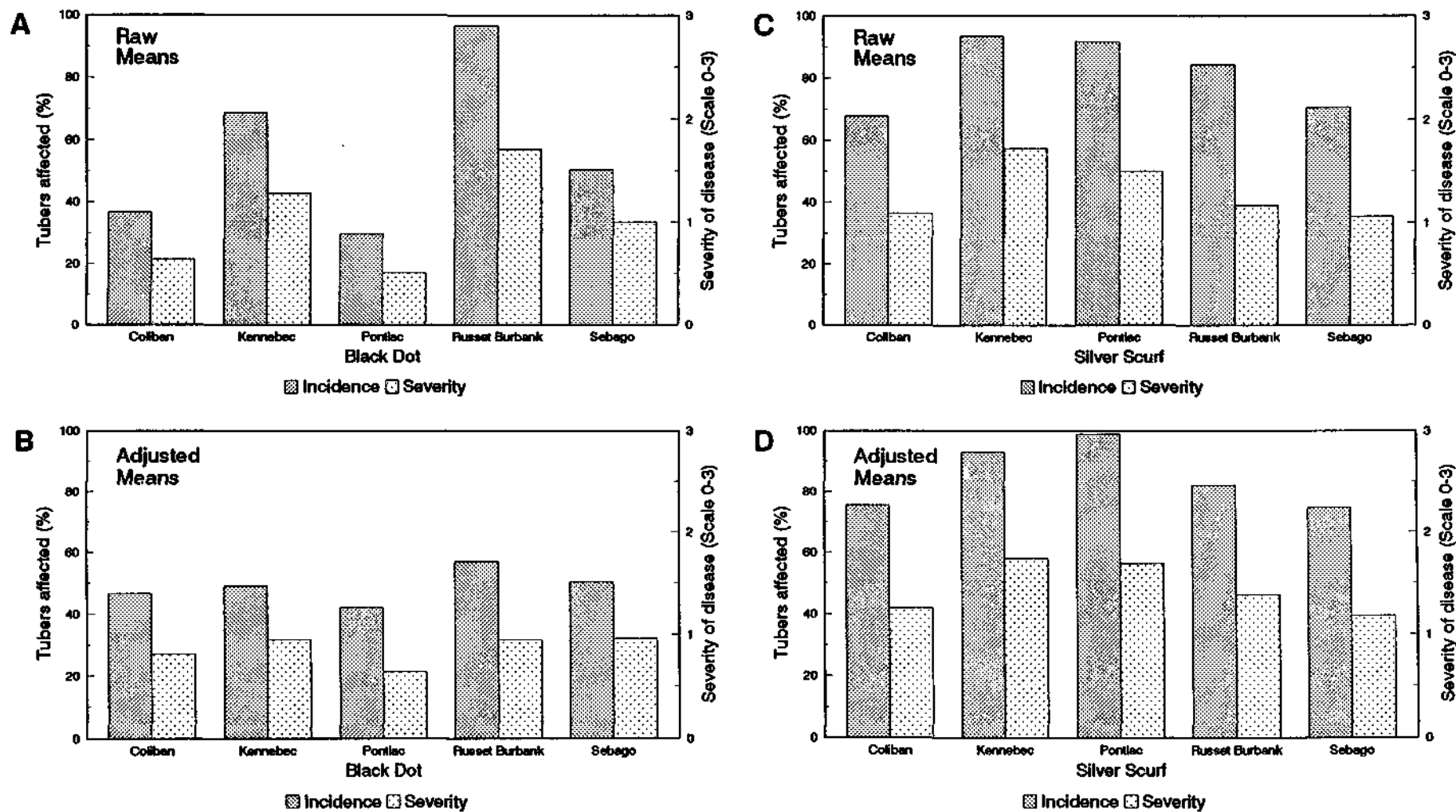


Figure 7. Raw and adjusted means for the incidence and severity of black dot (A and B, respectively) and silver scurf (C and D, respectively) on seed potato tubers of different cultivars tubers in Victoria in 1992/93. Raw means were corrected for *ground-time*, *store-time* and location in multiple regression analyses. (Adjusted means are for statistical comparisons of the relative differences in disease incidence and severity between districts only and should not be used as absolute means).

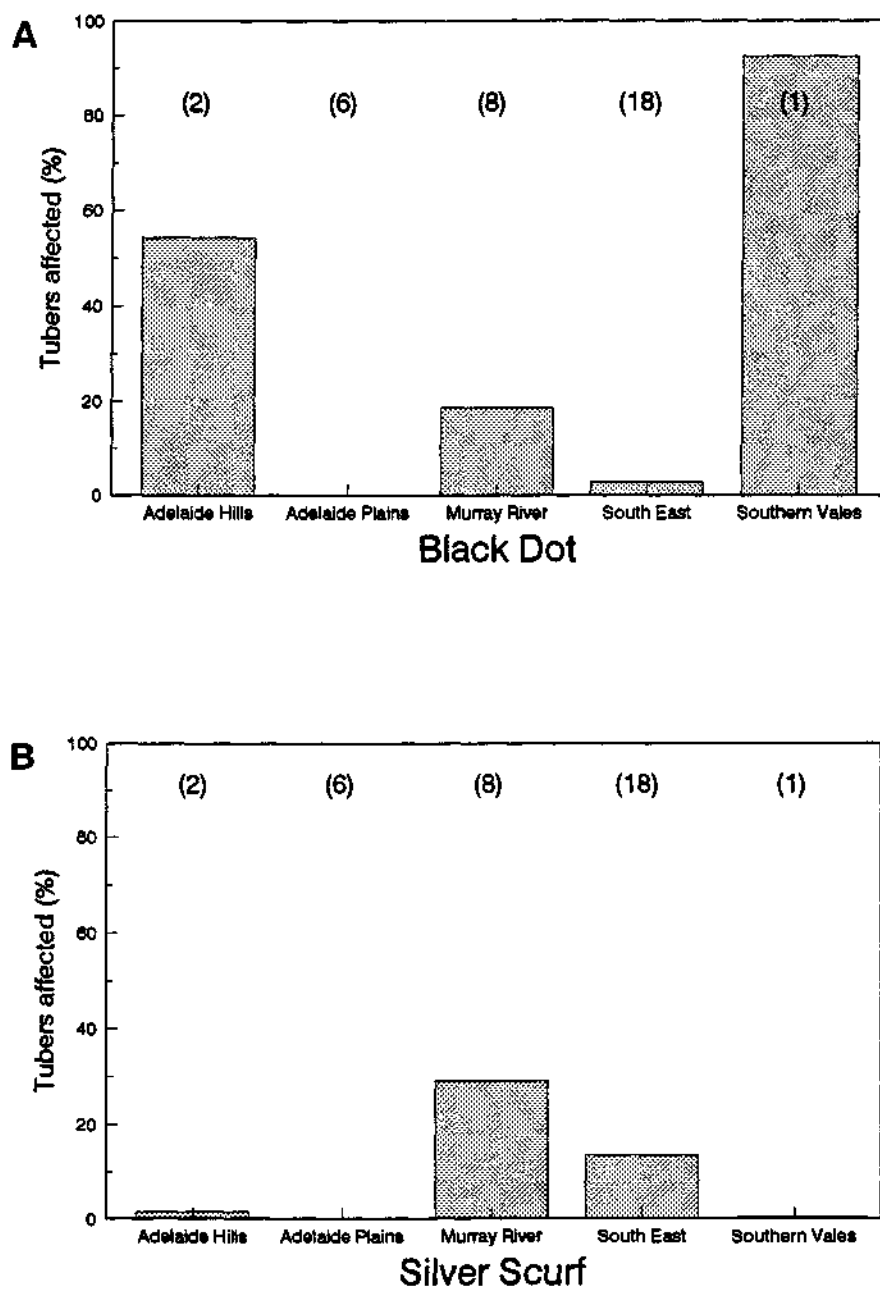


Figure 8. Incidence of black dot and silver scurf on ware and processing potato tubers in the main potato growing districts of South Australia. (Number of samples from each district in brackets).

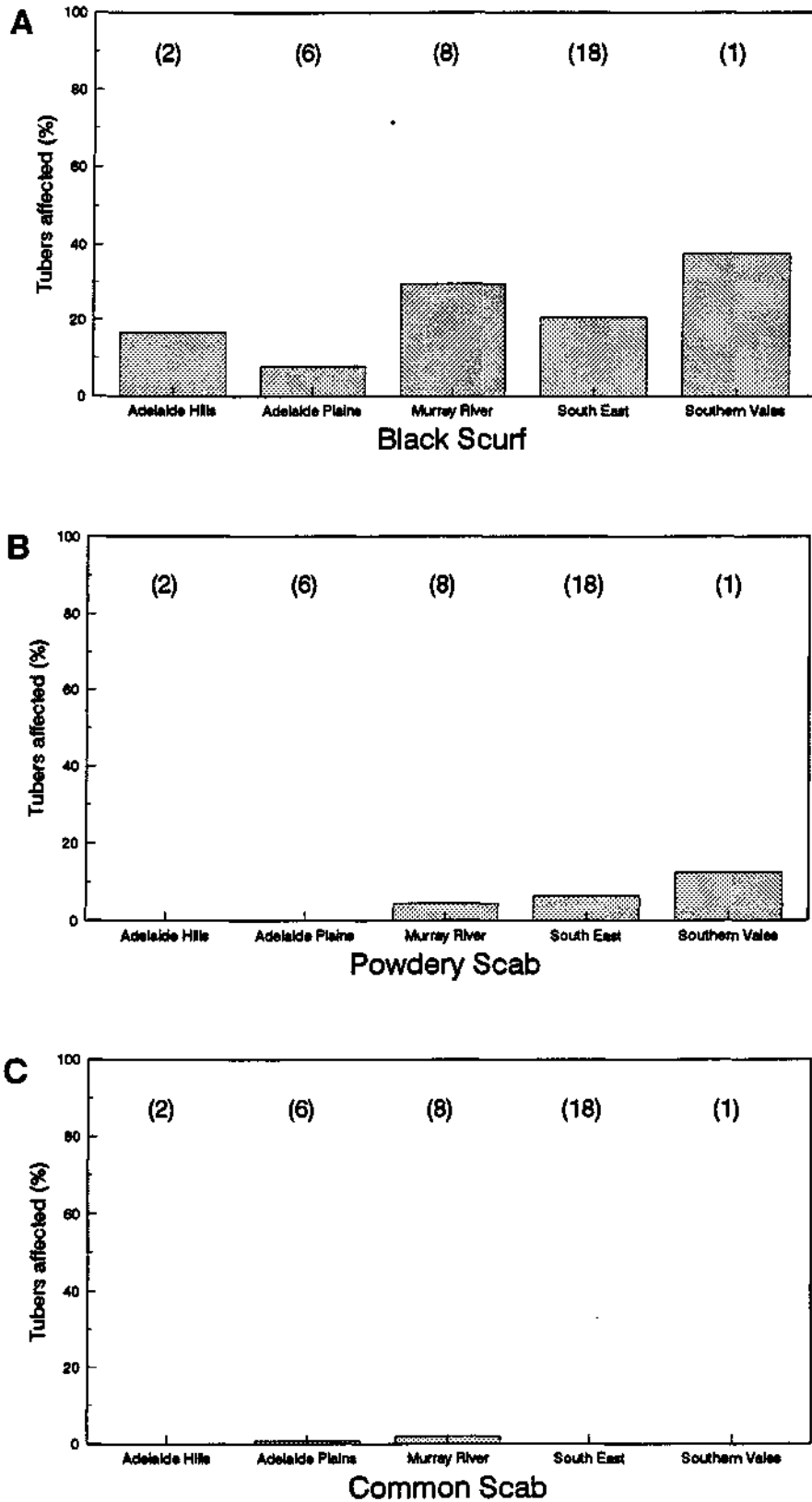


Figure 9. Incidence of black scurf, powdery scab and common scab on ware and processing potato tubers in the main potato growing districts of South Australia. (Number of samples from each district in brackets).

3.4 Discussion

This study has presented detailed information on the incidence and severity of tuber diseases on seed potatoes in Victoria and on ware and processing potatoes in South Australia. The results showed that black dot, silver scurf and black scurf were common diseases of potato tubers in both Victoria and South Australia. Furthermore, silver scurf was found to be the most common disease of seed potatoes in the major potato growing districts in Victoria with an average of 80% of tubers affected. Black dot ranked second as a tuber disease next to silver scurf in Victoria with more than 40% of seed tubers affected.

Both black dot and silver scurf are transmitted on seed tubers (Harrison 1963; Jellis and Taylor 1977; Komm and Stevenson 1978; Lennard 1980; Read and Hide 1984). There are no set tolerances for the incidence and severity of either disease in the Victorian Seed Potato Certification Scheme. Furthermore, neither disease is included in disease management strategies used by seed growers and this could explain, in part at least, the very high incidence of silver scurf on seed potatoes. The implications of the results of this study for seed potato growers are that the industry needs to consider the development of disease management strategies for black dot and silver scurf and to establish standards for these disease on seed potatoes.

The results of this survey were analysed by multiple linear regression. Several overseas studies have shown that there are two important factors that influence the incidence and severity of black dot and silver scurf, namely the period tubers are left in the ground after their skin matures and the time in cool storage (Harrison 1963; Jellis and Taylor 1974, 1977; Mérida *et al.* 1994; Mooi 1959). The incidence and severity of both diseases increases proportionally to the length of time in the ground and in cool storage. Samples were taken from several districts and this necessarily meant that some were stored for long periods (1-8 weeks) before assessment. Although the statistical analysis was able to show a positive correlation between the incidence and severity of black dot and the time tubers were "stored" in the ground this was not the case for silver scurf. Furthermore, the model used was not able to resolve the possible effect of storage time on black dot and silver scurf. The possible effects of cultivar on black dot was also not resolved. A recent study in the United Kingdom showed that potato cultivars vary in their susceptibility to black dot (Read 1991). The model will be refined and further tested before publication of results.

Even after taking into account the various parameters tested in the linear model, the incidence and severity of black dot varied between the different districts in Victoria. The incidence of black dot was found to be less in Kinglake and the Otway Ranges than in the Central Highlands and Gippsland and incidence in the Otways was particularly low. The incidence of silver scurf, on the other hand, was greater in the Otways and Kinglake than in the Central Highlands and Gippsland. The reason for district effects are not known but may be related to climate and soil type. Regional differences in the incidence of black dot have been reported in the United Kingdom (Read 1991).

The effect of *ground-time* on the incidence and severity of black dot found in this study is consistent with published results. Generally, the severity of disease on the roots,

stolons, stems and tubers is reported to increase as the season progresses (Harrison 1963; Johnson and Miliczky 1993; Read and Hide 1988).

This survey reports on disease incidence and severity in one growing season. The incidence of each disease is likely to vary from season to season, as was found in the United Kingdom (Read 1991), and this is probably due to seasonal variation in climate. Harrison (1963) described black dot as a disease that was favoured by long dry autumn periods that prolong the life of the crop.

Very few conclusions can be drawn from the South Australian data at present. The data is being compiled for statistical analyses and will also be tested using linear models.

One objective of the project was to examine populations of *C. coccodes* in Russet Burbank crops in the Central Highlands of Victoria. A selective media is used routinely for assays of this fungus in the United States (Farley 1972). Attempts at making a selective media for *C. coccodes* (Farley 1972) in the initial stages of the project were not successful and it was decided to concentrate resources on the main objectives of the project, namely to survey for the incidence of black dot on tubers. Barkdoll (1992) showed that colonisation of tubers by *C. coccodes* was highly correlated with the number of propagules of the fungus in soil. The fungus was found to be a common organism in potato growing soils in parts of the United States (Barkdoll 1992). It is likely that the fungus is ubiquitous in potato growing soils in Australia. *C. coccodes* occurs readily on the senesced stems in crops of cv. Russet Burbank in the Central Highlands of Victoria and is reported to be widespread in potato growing soils in Tasmania (L. Green; pers. comm.).

Black dot is potentially a more serious disease than silver scurf. *H. solani*, which causes silver scurf, generally only reduces the marketability of tubers, although it is known to reduce early crop growth (Read and hide 1984). *C. coccodes*, however, can significantly damage the growing crop by damaging roots, stems, stolons as well as tubers. Significant damage to crops due to *C. coccodes* has been reported from South Australia this season (T. Wicks; pers. comm.).

Until recently black dot and silver scurf have been largely ignored or overlooked by the potato industry. The epidemiology and management of both diseases has been studied extensively in the United Kingdom and Europe but not in Australia. This study has highlighted the need for basic information on the epidemiology of these diseases in the soils and climates of Australian potato growing areas and for the need to develop disease control strategies , particularly for seed potatoes.

3.5 References

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Appendices

Forms used to record information in the survey for the incidence and severity of black dot of potatoes in Victoria and South Australia.

Survey for Black Dot of Potatoes, 1993

Grower:		Grower:	
Sampling date:		Sampling date:	
Cultivar:		Cultivar:	
Paddock location:		Paddock location:	
Graded/Ungraded:		Graded/Ungraded:	
Date planted:		Date planted:	
Date harvested:		Date harvested:	
Area planted:		Area planted:	
Area harvested:		Area harvested:	
Yield:		Yield:	
Comments:		Comments:	

Grower:		Grower:	
Sampling date:		Sampling date:	
Cultivar:		Cultivar:	
Paddock location:		Paddock location:	
Graded/Ungraded:		Graded/Ungraded:	
Date planted:		Date planted:	
Date harvested:		Date harvested:	
Area planted:		Area planted:	
Area harvested:		Area harvested:	
Yield:		Yield:	
Comments:		Comments:	

Grower:		Grower:	
Sampling date:		Sampling date:	
Cultivar:		Cultivar:	
Paddock location:		Paddock location:	
Graded/Ungraded:		Graded/Ungraded:	
Date planted:		Date planted:	
Date harvested:		Date harvested:	
Area planted:		Area planted:	
Area harvested:		Area harvested:	
Yield:		Yield:	
Comments:		Comments:	

Survey for the incidence of Black Dot of Potato, 1993.

Grower:														Ref. No.						
Cultivar:							Crop location:							Date sampled:						
Planting date:							Harvest date:							Area planted:						
Area harvested:							# Bins:							Assessment date:						
#	BD	SS	BS	PS	CS	DE	#	BD	SS	BS	PS	CS	DE	#	BD	SS	BS	PS	CS	DE
1							36							71						
2							37							72						
3							38							73						
4							39							74						
5							40							75						
6							41							76						
7							42							77						
8							43							78						
9							44							79						
10							45							80						
11							46							81						
12							47							82						
13							48							83						
14							49							84						
15							50							85						
16							51							86						
17							52							87						
18							53							88						
19							54							89						
20							55							90						
21							56							91						
22							57							92						
23							58							93						
24							59							94						
25							60							95						
26							61							96						
27							62							97						
28							63							98						
29							64							99						
30							65							100						
31							66													
32							67													
33							68													
34							69													
35							70													

Comments:

BD = Black Dot, SS = Silver Scurf, BS = Black Scurf, PS = Powdery Scab, CS = Common Scab, DE = Dimple end, EW = Eel Worm
 Severity ratings: 0, no apparent disease; 1, <5%; 2, 5-30%; 3, >30% of tuber surface covered with disease symptom.
 Record Dimple End (associated with Rhizoctonia) as + or -. Record Eel worm in Comments space.