

Bacterial and fungal diseases of potatoes in Finland

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Abstract. Six bacterial and 18 fungal diseases are reviewed. Six and 28, respectively, of their causal organisms are presented. The occurrence and economic effects of these diseases are estimated.

Index words: potato, bacterial diseases, fungal diseases

Introduction

Potato is cultivated in Finland in a climatically extreme area where yield variation is high. Potatoes are usually grown in sandy soils thus often exposed to drought. The growing period is hardly 100 days (from May to September), while in Lapland it is far shorter often being limited by night frosts. The brief harvesting period lasting from two to three weeks is frequently quite cold with average temperatures of not more than 10°C. The basic problem confronting modern, highly mechanized production is the harvesting of unripened tubers in extremely cold weather, when many tubers are scuffed and wounded. The storage period is long, even ten to eleven months.

Disease control has been mostly based on varietal resistance, and the knowledge required often obtained by variety trials. Chem-

ical control was not common prior to the 1970s, when greater specialization in potato production by farmers took place.

Bacterial diseases

Blackleg and soft rot (*Erwinia carotovora* subsp. *atroseptica* and *E. carotovora* subsp. *carotovora*). The extent of *E. carotovora* contamination in 71 commercial seed potato stocks was investigated in 1981—1983. *E. carotovora* was detected in 82 % of the stocks, and the average levels of contamination in the three years were 73, 28, and 10 %, respectively (HARJU 1985). Recontamination by *E. carotovora* was found after the second year of yield cultivation when pathogen-free seed potato stocks were investigated during four years' multiplication. *E. caroto-*

vora subsp. *atroseptica* was the predominant soft rot organism isolated from tubers, and it was always associated with blackleg stems. Serotyping of *Eca* isolates indicated that in addition to serogroup I, three other serogroups exist (HARJU and KANKILA 1987).

Bacterial ring rot (*Corynebacterium sepedonicum*) was first found at the end of the 1960s. SEPPÄNEN and HEINÄMIES (1972) identified the pathogen and mapped the incidence of disease based on 542 tuber samples, 321 tubers on average, from seed stocks collected from different parts of the country. The disease occurred quite commonly in Oestrobothnia but only sporadically in other parts of the country. The degree of infection was low, on average one to two per cent. In subsequent official inspections the situation has not improved with regard to the exportation of potatoes (RAUTAPÄÄ and VIRTANEN 1985).

Pink eye (*Pseudomonas fluorescens*) occurs in abundance on tubers grown in light soils in wet conditions. External symptoms may be confused with those of tuber blight (SEPPÄNEN 1981 a, 1982 d).

Common scab (*Streptomyces scabies*) and **russet scab** (*Streptomyces* sp.) also occur to a certain extent every year, the latter mainly affects Bintje. Their occurrence is the consequence of warm and dry weather during the first half of July, and yearly variation is wide. The use of varietal resistance to common scab has been the only means of controlling it, and results of screenings have been reported by ROIVAINEN (1938), YLIMÄKI (1951 b, 1960 a), JAMALAINEN and SEPPÄNEN (1965), VARIS (1965, 1970, 1975), JOY (1980), HÄKKINEN (1981), and MUSTONEN (1985). Attention has been paid to scab resistance in potato breeding, which has resulted in the fairly resistant cultivar Pito and Hankkijan Tuomas. Trials to control common scab with PCNB-preparate were carried out by YLIMÄKI and HÄNNINEN (1957), YLIMÄKI (1958), but the treatment was too expensive for general use. HEINÄMIES and SEPPÄNEN (1971) attempted to study the morphological,

physiological, and pathogenic properties of the potato scab organism.

Fungal diseases during the season

Late blight and tuber blight (*Phytophthora infestans*). Late blight was the most important fungal disease of potato until the 1970s. Its great annual fluctuation was ascertained long ago (GROTFELT 1910), and the question of the efficacy of chemical control as a complement to varietal resistance is still a problem.

RAINIO (1937) attempted to estimate the occurrence and economic impact of these diseases by employing information collected from different parts of the country over a number of years. His results confirmed that in some years the diseases are quite common causing great losses, while in other years there is hardly any blight in the whole country. Corresponding results have been reported by SIMOJOKI (1963), YLLÖ (1963), and SEPPÄNEN (1971) based on blight observations in variety trials carried out over many years. SEPPÄNEN (1971) analyzed material based on observations made from variety trials over more than 30 years in different parts of the country. He concluded that in southern Finland leaf blight occurred nearly every year, in four years out of five on average, but the incidence of a severe blight epidemic was only one year out of three and less northwards. The lowering of tuber yield due to premature defoliation was estimated to be less than 10 % on average, even in southern Finland, and that of tuber blight lesser still. The only study dealing with the fungus itself has been conducted by MÄKELÄ (1966) on the overwintering of the fungus and other factors influencing the rise of epidemics. After the severe late blight epidemic in 1953, POHJAKALLIO (1954) compared the pathogenicity of some isolates from different parts of the country.

The control of late and tuber blights has mainly been based on varietal resistance, which has been considered a fairly important property for the use of a cultivar (KOSKINEN

1932, SAULI et al. 1935, MEURMAN 1936, VALLE et al. 1938, ROIVAINEN 1939, HUTTUNEN et al. 1946, BRUMMER 1950, LINJA-AHO 1955, VARIS 1960, 1965, 1970, 1975, YLLÖ 1963, SEPPÄNEN 1967, 1971, JOY 1980, HÄKKINEN 1981, MUSTONEN 1985). SEPPÄNEN (1967, 1971) introduced the term 'relative resistance to late blight', i.e. the resistance of a given cultivar to late blight compared with its earliness. In Finnish potato breeding consideration has also been given to resistance to late blight, and such cultivars as Jaakko, Veto, and Hankkijan Tuomas, are notably resistant in relation to their earliness. Interest in chemical control had been slight though the results of screenings using different preparates were promising (JAMALAINEN 1933, YLIMÄKI 1951, 1953, 1954, 1956, 1960, 1961). The use of chemical control to complement varietal resistance was not common until the 1970s, when the mean area under potato cultivation of a single farm increased (SEPPÄNEN 1977). Nowadays chemical control ranging from one to three treatments is a common procedure most often employing the systemic metalaxyl + mancozeb preparate, usually complemented with mangan preparates (SEPPÄNEN 1987). Vine killing is often used to control the tuber blight.

Potato wart (*Synchytrium endobioticum*). Potato wart was first found in 1924, probably as a result of the importation of potatoes in 1921—1924 (LIRO 1927, RAINIO 1928). Since then, it has been encountered in numerous localities mainly in southern Finland. In field plots there has hardly been a single finding, but the disease has been found in home gardens (HILLI 1932, LEHTOLA 1944, OLLILA 1949, YLIMÄKI 1950, 1955, AURA 1962, 1971). HILLI (1932) conducted a larger study on the distribution of the disease in Finland and abroad.

In potato breeding wart resistance is required of all new cultivars, therefore resistant cultivars are generally recommended to growers.

This disease was widely known prior to this first finding. Trials to obtain good, wart-

resistant cultivars were started and resistant cultivars were strongly recommended to growers. As early as 1925, a law was enacted prohibiting the growing of susceptible cultivars in localities where potato wart had been identified.

Together all the above precautions have been effective in the prevention of this disease.

Stem canker (*Rhizoctonia solani*) is quite common but seldom causes significant losses. SEPPÄNEN (1985) studied its incidence in five fields cultivated with potatoes as a monoculture for 15—25 years. Seed tubers of three susceptible cultivars treated with thiazobenzazole (ULV) were planted as usual. Plant samples were collected about one month later and analyzed. As the presence of stem canker was either negligible or absent, it was concluded that monoculture is not associated with the disease.

White collar caused by the same fungus is common but considered insignificant in the potato.

Black scurf and **Rhizoctonia scab** (*Rhizoctonia solani*) are rather common but seldom the cause of poor quality in table potatoes (SEPPÄNEN 1972). However, they may have a significant role as carriers of the fungus into the next season. According to tests screening fungicides for seed dressing, varying yield increases have been obtained, and the treatment is therefore recommended (SEPPÄNEN 1974, PIETILÄ 1987).

Powdery scab (*Spongospora subterranea*) occurs nearly every year in slight amounts but is not significant (SEPPÄNEN 1972).

Early blight (*Alternaria solani*) is rather common in certain cultivars during warm seasons but without importance.

Verticillium wilt (*Verticillium albo-atrum*) is rare and has been found only in a few farms in southern Finland (SEPPÄNEN 1983 e).

Stalk break (*Sclerotinia sclerotiorum*) is considered uncommon. However, in 1986, as a consequence of a wet and cold late season, it occurred generally in some locali-

ties, even causing economic losses (SEPPÄNEN 1986).

Storage diseases

D r y r o t s (*Fusarium* sp.) and **G a n g r e n e** (*Phoma exigua* var. *exigua* and *P. e.* var. *foveata*) are the most common storage diseases. JAMALAINEN (1943 a, 1943 b, 1944) isolated eight *Fusarium* species from potato tubers, but at that time dry rots were insignificant compared with tuber blight (OLLILA 1947). As late as the beginning of 1970s, SEPPÄNEN (1972) determined tuber blight to be the most common cause of decay in tubers in packaged table potatoes. In some samples of Bintje grown from stocks originating from recently imported seed stocks, the causal agents of gangrene were isolated and identified. In 1975, about nine thousand tons of seed potatoes were imported, and at the same time storage diseases, dry rots and gangrene, also appeared. This created considerable problems under Finnish growing conditions, where the scuffing and wounding of tubers had been until then the main problems. The causal organisms were later isolated and identified (14 *Fusarium* and 2 *Phoma* species), some characteristics of the fungi were clarified and the importance of the diseases as well as the resistance of our cultivars to them were estimated (SEPPÄNEN 1980 a, 1980 b, 1981 b, 1981 c, 1981 d, 1982 a, 1982 b, 1982 c, 1983 a, 1983 b, 1983 c, 1983 d). In the 1980s there were fewer problems due to dry rots and gangrene. One reason for this is the activities of the Seed Potato Center founded in 1976 (PIETARINEN and SEPPÄNEN 1981).

S i l v e r s c u r f (*Helminthosporium solani*) and **s k i n s p o t** (*Polyscytatum pustulans*) are quite common storage diseases (SEPPÄNEN 1972), especially after wet late

seasons and harvesting conditions, but hardly ever cause significant economic losses. The only method of control recommended is that of drying the tubers as soon as possible after harvest.

P i n k r o t (*Phytophthora erythroseptica*) is rare, the first findings were made by SEPPÄNEN (1971). There have been numerous findings from all over the country since then, but only a couple are of importance.

L e a k o r w a t e r y w o u n d r o t (*Pythium ultimum*) occurs sporadically and may be harmful in some table potato stocks wounded at harvest.

B l a c k d o t (*Colletotrichum atramentarium*) is insignificant (SEPPÄNEN 1972).

Summary

Six bacterial and 18 fungal diseases and their causal organisms 6 and 29, respectively, were presented. Their occurrence and economic importance were roughly estimated.

Potato late blight and tuber blight were the diseases of greatest importance and most difficult to control until the 1970s. Nowadays most farmers use chemical control to assure the quantity and quality of the yield. Since the mid-1970s, *Fusarium* dry rots and gangrene have become the most serious problem. With the aid of developments in seed potato production, and due to the increased knowledge and skill of growers the situation is under control. The bacterial diseases presented here occur every year but seldom cause great crop losses. Black leg and soft rot, as well as common scab must be coped with because the possibilities to control them are limited. The eradication of ring rot appears to be slow and laborious. As to other diseases, more attention ought to be paid to stem canker and black scurf as well as to skin spot. Other diseases are only sporadically harmful.

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Perunan bakteeri- ja sienitaudit Suomessa

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Katsauksessa on esitetty Suomessa todetut 6 bakteeri- ja 18 perunan sienitautia sekä niiden aiheuttajat (6 bakteeria ja 28 sienilajia). Tautien esiintymisrunsaus ja taloudellinen merkitys on arvioitu. Perunan lehtirutto ja mukularutto (aiheuttaja *Phytophthora infestans*) ovat olleet merkitykseltään suurimmat aina 1970-luvulle asti. Tuolloin rutan kemiallinen torjunta yleistyi ammattiviljelijöiden keskuudessa ja nykyisin rutto ei ole aiheuttanut torjuntavaikeuksia.

1970-luvun puolivälissä tuotiin maahamme noin 9000 tonnia siemenperunaa, jonka mukana seurasi runsaasti kuivamädän ja Phomamädän aiheuttajia. Nämä meillä aikaisemmin vain niukasti esiintyneet taudit ovat siitä lähtien olleet taloudellisesti merkittävimmät. Niiden aiheuttajat 14 *Fusarium*-lajia, joista *F. solani* var. *coeruleum* ja *F. avenaceum* ovat yleisimmät, sekä 2 *Phoma*-lajia, on kartoitettu ja niiden tärkeimmät ominaisuudet selvitetty. Siementuotannon kehittämisen ja viljelijäin tiedon ja taidon parantamisen avulla on nämäkin taudit saatu hallintaan.

Bakteeritaudit ovat jokavuotisena kiusana, joskin ne harvoin aiheuttavat suuria menetyksiä. Tyvimädän ja märkämädän (*Erwinia carotovora*) samoin kuin tavallisen perunaruvengin (*Streptomyces scabies*) kanssa on tultava toimeen, sillä keinot niiden torjumiseksi ovat rajalliset. Rengasmädän (*Corynebacterium sepedonicum*) hävittäminen näyttää kestävän odotettua kauemmin. Muista taudeista versolaikku ja seittirupi (*Rhizoctonia solani*) sekä känsärupi (*Polyscytalum pustulans*) vaativat nykyistä enemmän huomiota. Bakteeritaudit punasilmä (*Pseudomonas fluorescens*) ja verkkorupi (*Streptomyces sp.*) sekä sienitaudit perunasyöpä (*Synchytrium endobioticum*), perunaseitti ja kuoriroso (*Rhizoctonia solani*), kuorirokko (*Spongospora subterranea*), perunapolte (*Alternaria solani*), näivetystauti (*Verticillium albo-atrum*), varisiko (liio) (*Sclerotinia sclerotiorum*), harmaa hilse (*Helminthosporium solani*), punamätä (*Phytophthora erythroseptica*) ja sydänmätä (*Pythium ultimum*) ovat vain harvoin taloudellisesti merkittäviä.