



## Powdery scab

**Powdery scab of potato is caused by the protozoan pathogen *Spongospora subterranea* f.sp. *subterranea*, and has become increasingly important around the world. In addition to its effects as a pathogen, the organism is also a vector of potato mop top virus, which itself can cause substantial damage to potatoes.**



The first paper (Merz) reviews some of the factors that have contributed to the greater incidence of powdery scab, such as intensification of potato production, increasing use of susceptible cultivars, more frequent irrigation and banning of mercury, which was previously used as an efficient seed tuber treatment. While much is known about the biology of the organism that causes powdery scab, there is still a lack of basic knowledge on the etiology and epidemiology of the disease, including an understanding of the survival of the resting structures, mechanisms of infection of potato and alternative hosts, and disease development.

Powdery scab lesions downgrade tuber quality and the disease can severely harm crop productivity. The second paper (Falloon) reviews the methods that have been shown to reduce the incidence and severity of the disease. These include choice of field and crop rotation, detecting the presence of the pathogen, use of resistant cultivars, planting pathogen-free tubers, appropriate pesticide treatments for seed and/or soil, adjustment of soil nutrient status, and use of suitable management practices during crop growth. It is concluded that no single method is likely to give complete control of powdery scab, and effective disease management will depend on implementation of several appropriate methods.

Epidemiological studies require an accurate quantification of the amount of pathogen present in soil. In the third paper (Lees et al.), the authors describe development of a real-time PCR assay that reliably measures *S. subterranea* DNA from sporeballs, zoospores and plasmodia/zoosporangia. The assay was validated with a tomato bait plant technique and was used to study infection levels in potato under various environmental conditions. Under controlled conditions, both the incidence and severity of powdery scab were found to be influenced by temperature, soil type and soil moisture regime. Interestingly, infection and disease development were not affected by the level of pathogen in the soil – even low levels of inoculum were regularly found to result in severe disease symptoms. This indicates that disease risk is likely to be related to the relative conduciveness of

## United States:

Northwest US spud experts hunt for the perfect potato.

During the annual Pacific Northwest Tri-State Potato Tour in October researchers, agronomists, geneticists and potato industry folk trudged through hundreds of potato test plots over 10 days. "At this point, it's basically a beauty contest," said Dan Hane, an Oregon State University research agronomist. "It's not easy being a judge of a potato beauty contest, because there are so many different things that could potentially make a new variety." [www.potatonews.com](http://www.potatonews.com), News Headline: November 2008.

environmental conditions.

An important means of minimising the impacts of powdery scab disease is the use of resistant potato cultivars. The fourth paper (Baldwin et al.) describes an environmentally-controlled greenhouse disease assay that allows the accurate and repeatable assessment of diseased tubers. The assay has a high throughput and has been used to assess levels of tuber disease resistance of potato genotypes for three consecutive Southern Hemisphere growing seasons. The assay evaluates symptoms on tubers to verify resistance, rather than inferring the tuber infection on the basis of root galling or zoosporangial root infection, and has clearly distinguished susceptible and resistant standards. This assay will be a valuable tool for early-generation selection in a plant breeding programme.

**Powdery scab of potato – occurrence, life cycle and epidemiology.** Merz (2008) *American Journal of Potato Research* 85: 241-246.

**Control of powdery scab of potato: Towards integrated disease management.** Falloon (2008) *American Journal of Potato Research* 85: 253-260.

**The identification and detection of *Spongospora subterranea* and factors affecting infection and disease.** Lees et al. (2008) *American Journal of Potato Research* 85: 247-252.

**A greenhouse assay for powdery scab (*Spongospora subterranea* f. sp. *subterranea*) resistance in potato.** Baldwin et al. (2008) *Potato Research* 51: 163-173.



## Potato diseases

### ►Mop-top virus, relationship to its vector.

As mentioned in the feature on powdery scab, *Spongospora subterranea* f. sp. *subterranea* is also a vector of potato mop-top virus. The virus has a narrower distribution than its host, being confined to areas with a cool and humid climate, such as Northern Europe, Northern America, China, Japan and the Andes region. The virus symptoms include spraing (brown-coloured arcs or spots) in the tubers, yellow blotching or chlorotic V-shapes in the leaves and stunting of the stems. The virus is situated inside *Spongospora subterranea* f. sp. *subterranea* spores and is transmitted during pathogen attack. Without the host, the virus cannot naturally infect potatoes and will be eliminated after a few generations when the tubers are planted in clean soil. However, artificial transmission by sap has been carried out in the laboratory. *Kirk (2008) American Journal of Potato Research 85: 261-265.*

►A new “*Candidatus Liberibacter*” species in *Solanum tuberosum* in New Zealand. Symptoms resembling “zebra chip” disease, i.e. necrotic flecking and streaking that became marked when the potatoes were fried, were observed in potato tubers harvested from a breeding trial in South Auckland, New Zealand, in May 2008. Affected plants generally senesced early, with lower mean yield and less tuber dry matter than expected. Large numbers of the psyllid *Bactericera cockerelli* had been observed on the crop. PCR analysis of total DNA from potato tubers indicated the presence of a “*Candidatus Liberibacter*” species previously found in tomato and capsicum in New Zealand. The authors believe this is the first report of a *Liberibacter* associated with the disease in potato. *Liefting et al. (2008) Plant Disease 92: 1474.*

►Disease potential of soil- and tuber-borne inocula of *Colletotrichum coccodes* and black dot severity on potato. This greenhouse study found that plants grown in infested soil had more sclerotia on roots than plants grown from infected tubers in three of four trials. Compared to plants that were not challenged with the pathogen, plants grown in infested soil produced fewer tubers and lower yields. In addition, above a certain threshold of soilborne inoculum, black dot disease severity remained constant. *Nitzan et al. (2008) Plant Disease 92: 1497-1502.*

## Agronomy – fertilisers and mulch

### ►Exchangeable soil calcium may not reliably predict in-season calcium requirements for enhancing potato tuber calcium concentration.

This extensive series of trials was conducted over 11 years at two sites, testing five cultivars with or without in-season Ca applications of 168 kg/ha. While there was some variability between cultivars and seasons, for 38 of the 45 trials tuber Ca concentration increased with Ca application. However, there was no consistent relationship between soil Ca levels and tuber Ca concentration. This is despite a wide range in pre-plant soil Ca, with some soil tests measuring over 1,000 mg/kg (current recommendations are for Ca application only if pre-plant soil exchangeable Ca is below 300 mg/kg). It is suggested that the exchangeable Ca soil test was not a reliable predictor of tuber Ca needs in these soils. *Gunter & Palta (2008) American Journal of Potato Research 85: 324-331.*

►Impact of selenium enrichment on seed potato tubers. This study investigated the effect of selenium enrichment on the growth of sprouts and growth vigour of seed potatoes stored for 2 to 8 months. At high supplementation levels (0.075 and 0.9 mg Se/kg quartz sand) there were some positive effects on sprout growth. However, selenium did not affect the duration of dormancy, the concentration of soluble sugars and starch, the early growth of tubers or the resulting tuber numbers and yield parameters. *Turakainen et al. (2008) Agricultural and Food Science 17: 278-288.*

►Changes in soil temperature, yield and photosynthetic response of potato (*Solanum tuberosum* L.) under coloured plastic mulch. This trial compared potato growth and yield under five different coloured polyethylene mulches with a bare soil control. Yields were much higher than the control for white-on-black, silver-on-black and white polyethylene mulches, while black and brown polyethylene mulches did not differ from the control. It is thought that the excessive soil temperatures generated by the black and brown polyethylene negated any advantages of plastic mulches. *Ibarra-Jimenez et al. (2008) Agrochimica 52: 263-272.*

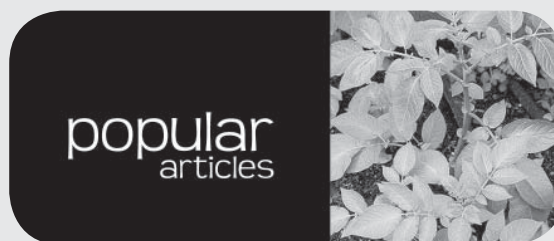
## Nutrition

►Breeding for phytonutrient enhancement of potato. This paper reviews the wide variety of nutrients that are found in potatoes. These include carotenoids, in particular xanthophylls, which are fat soluble, have short half-lives in the human body, and are antioxidants that associate with cell membranes.

Two important xanthophylls found in potatoes are lutein and zeaxanthin, which are components of the human retina. Another important category of phytonutrient found in potatoes is the anthocyanins, which give red to purple coloration to the skin and flesh of potatoes. Anthocyanins are potent antioxidants and have very short half-lives in humans. Potatoes also contain important minerals, such as iron, and are a substantial source of vitamin C. The content of all these phytonutrients varies markedly between varieties and there is considerable scope for selecting breeding lines with high levels of particular compounds. *Brown (2008) American Journal of Potato Research 85: 298-307.*

► **The influence of flesh colour and growing locality on polyphenolic content and antioxidant activity in potatoes.** This paper describes significant differences in total polyphenolic content and antioxidant activity in potato tubers between four yellow-fleshed (Karin, Impala, Ditta and Saturna) and two purple-fleshed (Valfi and Violette) cultivars. The major antioxidants in purple-fleshed cultivars were the anthocyanidins petunidin and malvidin. There were also significant differences in total polyphenolic content and antioxidant activity depending on the environment in which the potatoes were grown. *Lachman et al. (2008) Scientia Horticulturae 117: 109-114.*

► **Antioxidant properties of cultivars and selections from the Colorado potato breeding program.** This study investigated antioxidant properties for over 90 genotypes in the Colorado potato breeding program. Genotypes with red or purple skin and flesh consistently had the highest levels of the antioxidant parameters measured, while baked tubers had lower levels than uncooked, microwave cooked and boiled tubers. Significant variations were seen between years due to environmental effects on these antioxidant parameters. Levels of chlorogenic acid isomers, which have been shown to have in vitro anticarcinogenic properties, were considerably higher in the pigmented cultivars 'Purple Majesty' and 'Mountain Rose' than non-pigmented genotypes. Of the non-pigmented genotypes, 'Rio Grande Russet' had the highest chlorogenic acid and glycolalkaloid content. *Stushnoff et al. (2008) American Journal of Potato Research 85: 267-276.*



## [www.spudman.com](http://www.spudman.com)

► **NEW – Storage technology.** This article describes how potato storage has become very sophisticated, although the basic needs are still the same – getting the tubers into the store at the right time and providing them with the right environment to heal, which really comes down to temperature, humidity and air flow. Three major manufacturers of storage and ventilation systems in the USA have recently released their latest technology for control panels and energy-saving components. The next generation of control panels are very user-friendly, may have simple to use touch screens and are easy to access via the internet – an important feature for many farmers. Energy-saving features include variable frequency drives for fans and microprocessors that operate compressor and condenser units to continually optimise conditions depending on load, air flows and ambient conditions. Some packages can even set the store parameters to match the variety being stored. *July/August 2008, p. 16.*

► **EXPANDING – Chinese markets.** Although China is the largest producer of fresh potatoes in the world, only about 5% of the crop is processed for starch and 1% is used for chips, frozen and dehydrated products. Potato consumption continues to grow rapidly (up to 15% per annum) but there are significant production issues, such as limited natural potato-growing conditions, disease pressure, few suitable varieties, poorly-developed seed certification systems and water supply issues. Thus, there are major opportunities for exporters, of which the USA is the major supplier. *July/August 2008, p. 18.*

► **Seed acre trends.** Figures for the 2008 crop in the USA show that the area of certified seed was approximately the same as the previous year. Russet Burbank was still the major cultivar, with nearly 4x the area sown in the next most popular cultivar, Norland (which included four dark red and red strains). However, both of these cultivars have continued to decline in recent years. Next on the list were Ranger Russet along with Russet Norkotah and seven of its selections. Major increases since last year (17-41%) were seen for the next five cultivars that made up the



top ten, Umatilla Russet, Shepody, Red La Soda, Rio Grande Russet and Atlantic. At #13 and #14 on the list, two cultivars that have only been named for 2 years, Canela Russet and Premier Russet, made big gains with 74% and 146% increases respectively in the area sown for seed. *November/December 2008, p. 18.*

## Snippets from [www.potatonews.com](http://www.potatonews.com)

Listed below is a small selection of the articles that are posted on the Global Potato News website. Please visit the site for further details or follow the links that are indicated.

► **United States: Zebra chip disease in the spotlight at Texas' AgrLife Research.** Zebra chip is a disease that alters sugar levels in the potato so that when fried the sugar caramelizes and turns the chip brown. The chip may have an off taste and will be rejected by consumers because of its appearance. The disease-causing organism is vectored by an insect called the potato psyllid. Apart from the effects seen in the tuber, diseased plants may have curled leaves and stunted growth. The Texas Department of Agriculture has set up a research programme called the Zebra Chip State Initiative, which is initially looking at movement of the psyllid through the potato crop and developing management suggestions on how to help alleviate the problem. *July 2008: News Headline.*

► **Germany: Grimme offers rotary cultivator and potato planter in combination.** This article refers to a new piece of equipment, Grimme's KG 3000 Special rotary cultivator, which can be attached to the extended draw bar of the potato planter. It allows cultivation and planting in one operational pass, leading to less fuel consumption, working hours, wheel tracks and soil compaction. It seems to work under a range of soil conditions, although in very wet conditions it is recommended that the two operations be separated. *July 2008: News Headline.*

► **United Kingdom: Potato 'more nutritious than pasta'.** This press release is part of a campaign launched by farmers to encourage young people to eat more potatoes. People aged 19 to 35 are 27% less likely to cook potatoes, and may be missing out on vital nutrients like iron and potassium. *July 2008: News Headline.*

► **Drought tolerance in potatoes.** Using lines from the International Potato Center in Lima, Peru, which maintains the world's largest collection of tubers, scientists are searching for genes that will give potato varieties the ability to tolerate droughts. They have identified about 2000 genes that are differentially regulated under drought conditions, and many of

these code for proteins that regulate intracellular biochemical processes. Of particular importance are genes that potentially assist with the reinforcement of cell membranes and cuticles. It is hoped that using this information, breeders will be able to select for varieties that can cope with changes in temperature and water availability, parameters that are expected to vary widely as the world is predicted to experience significant climate change events. *July 2008: Feature Article.*

► **Physiologically Induced Heat Stress Posing Problems in Seed Potatoes.** Tests conducted at Michigan State University appear to indicate that seed tubers grown under the severe heat stress experienced during 2007 have aged more rapidly than normal. This has meant that cells do not have sufficient energy for normal processes, such as suberization after cutting, which may affect their ability to resist infection in the field. More details and management recommendations are available from <http://www.potatodiseases.org/pdf/Disease-update-2008-heat-stress-in-SP.pdf>. *Feature Article: July 2008.*

► **United Kingdom: British farmer wins go-ahead for potato waste plant to generate electricity.** In Durham County permission has been given to produce enough electricity to heat 1200 homes from potato waste from a crisp factory. The anaerobic digester will use 1000 tonnes of potatoes, 7000 tonnes of agricultural crops and 2000 tonnes of manure a year. Fertiliser will be a by-product of the process. Although there was widespread support for the proposal, there were some objections on the grounds that the plant would be discordant with the landscape. *August 2008: News Headline.*

► **Australia: Ballarat potato growers reject McCain offer.** In October potato growers in Ballarat refused a price offer from McCain Foods, saying that it did not adequately compensate for rising farm costs. The offer was significantly below that of a major competitor JR Simplot (also known as Birds Eye and Edgell) from Tasmania. *News Headline: October 2008.*

► **Guidelines for preventing and managing insecticide resistance in aphids on potatoes.** The UK's Insecticide Resistance Action Group (IRAG-UK) in association with the Potato Council has produced these guidelines, which apply primarily to the peach-potato aphid (*Myzus persicae*) on potato. They are available from <http://epcinput.files.wordpress.com/2008/07/grower-advice-managing-insecticide-resistance.pdf>. *August 2008: Feature Article.*

