



Drought stress

This feature highlights six articles that examine drought stress in potatoes and irrigation techniques to maximise water use efficiency.

The first article (*Iwama*) reviewed potato root systems, presenting some very interesting information. For example, most potato roots are found in the top 30 cm of soil although some extend to a depth of 100 cm. In addition, the total root length throughout the soil profile can reach about 10–20 km below an area of 1 m². Total root mass can differ widely between cultivars, breeding lines and wild relatives, but is generally consistent across different environmental conditions, such as soil types, fertiliser rates and planting densities. The paper goes on to discuss how this understanding of root systems can be used to develop tests that can be used to select new drought tolerant cultivars.

In another paper (*Hudak et al.*), three potato genotypes differing in drought tolerance were tested in the laboratory for the activity of two enzymes, peroxidase (POD) and polyphenol oxidase (PPO), and the total phenol content. These biochemical parameters differed between the genotypes and the degree of water stress so could potentially be used as markers for drought-tolerance.

Recently a new irrigation technique called alternate partial root drying (PRD) has been investigated. This is where half of the root zone is irrigated while the other half is allowed to dry out, and then the irrigation is reversed. This paper (*Brocic et al.*) reports experiments conducted during 2007 and 2008 that compared PRD with full irrigation, which was scheduled on evapotranspiration and soil water. In both seasons, PRD improved water-use efficiency and increased tuber quality, as measured by starch content, compared to full irrigation. The PRD technique was also tested in a field experiment in China (*Li et al.*). No difference was seen in crop yield between PRD and full irrigation, but there was a significant improvement in both water use efficiency and nitrogen use efficiency for potatoes under PRD.

The fifth paper (*Cooley et al.*) investigated a method to overcome the dry zone that often occurs when potatoes are grown in a ridge and furrow system under sprinkler irrigation. While trickle irrigation has been shown to improve this problem, the authors proposed that a more cost- and labour-effective solution could be using a surfactant to change soil water surface tension and promote more uniform water distribution into hills. Potatoes were planted along with surfactant

Price volatility of Idaho fresh potatoes:

1987-2007. This study analysed the prices of Idaho fresh potatoes before the United Fresh Potato Growers of Idaho cooperative was formed and since it has been operating. There is statistically significant evidence that the volatility of fresh potato prices has been reduced since the formation of the cooperative. Although the mean price for fresh potatoes has been slightly higher during the cooperative period relative to the pre-cooperative period, this difference was not statistically significant. *Muthusamy et al. (2008)*

American Journal of Potato Research 85: 438-444.

at 9.35 litres/ha. Soil water content was measured using time domain reflectometry probes, and soil nitrate levels at a depth of 1 m were monitored by collecting leachate. Trials carried out in 1998, 1999 and 2003–2005 showed that the application of surfactant increased water movement into the dry portion of potato hills and in many cases decreased nitrate levels in leachate.

In the final paper featured here (*King et al.*), a chemical application system was assembled using mini-sprinklers and common commercial irrigation system components, and installed on a 4-span centre-pivot irrigation system. Field testing demonstrated that spatially variable chemical applications could be effectively and uniformly applied. This was done concurrently and independently of the spatially variable water application.

Physiology of the potato: new insights into root system and repercussions for crop management.

Iwama (2008) Potato Research 51: 333-353.

Influence of osmotic stress on biochemical properties in potato.

Hudak et al. (2009) Acta Horticulturae 812: 237-240.

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Potato diseases

In this issue of Chips, most of the scientific papers featured in the Research Summaries section have investigated biological or cultural control options and inoculum source for a range of potato diseases.

► **Crop rotation with brassicas reduces *Phytophthora* populations in potato soil.** This paper reports results from three growing seasons using five rotational crops (potato, pasture, brassica, cereal and squash) to suppress soil-borne diseases. Metalaxyl fungicide did not affect soil levels of *Phytophthora* and *Pythium* spp., but *Phytophthora* spp. and other fungi were significantly reduced by the presence of BQ Mulch (a brassica crop) in potato and cereal rotations. Cheah et al. (2008) *New Zealand Plant Protection* 61: 256-260.

► **Suppression of *Phytophthora infestans* in potatoes by foliar application of food nutrients and compost tea.** In two separate trials involving three potato cultivars, the incidence and severity of late blight was reduced by up to 35% by the application of compost tea and a range of other nutrients, including seaweed extract, whey and potassium bicarbonate. While these treatments do not reach the level of control given by manzate fungicide (up to 99%), they are a relatively cheap, environmentally safe alternative that can be used to help manage fungicide resistance. Al-Mughrabi (2007) *Australian Journal of Basic and Applied Sciences* 1: 785-792.

► **Biological control of black scurf and dry rot of potato.** Two major potato pathogens, *Rhizoctonia solani* and *Fusarium sambucinum*, were suppressed under greenhouse conditions by a number of potential fungal and bacterial biocontrol agents, with the most effective being *Trichoderma harzianum*, *Epicoccum* sp., *Streptomyces endus* and an actinomycetes isolate, particularly the first two. In general, the effects were similar to those of tolclofos-methyl fungicide, which increased emergence, chlorophyll content of potato leaf, potato tuber yield and reduced black scurf and dry rot severity. El-Kot (2008) *Egyptian Journal of Phytopathology* 36: 45-56.

► **Pathogenicity to potato tubers of *Fusarium* spp. isolated from potato, cereal and forage crops.** Three potato cultivars were artificially inoculated with isolates of *Fusarium* spp. obtained from various crops in Prince Edward Island, Canada, from 2002 to 2004. All

isolates from potato crops were strongly pathogenic, while isolates from cereal crops were pathogenic (*F. graminearum*), weakly pathogenic (*F. sporotrichioides*) or non-pathogenic (*F. poae*). There was similar variability with isolates from alfalfa and clover crops, which ranged from non-pathogenic to pathogenic. Thus, crop rotation may not remove all *Fusarium* spp. pathogenic to potatoes. Peters et al. (2008) *American Journal of Potato Research* 85: 367-374.

► **Biological control of the potato dry rot caused by *Fusarium* species using PGPR strains.** This study tested 17 plant growth promoting rhizobacteria (PGPR) strains for activity against three *Fusarium* species causing dry rot disease. All strains had inhibitory effects on at least one species in Petri dish experiments. The strongest antagonism was observed with *Burkholderia cepacia* strain OSU-7, which was effective on all three *Fusarium* species. This biocontrol agent was also effective on tubers of two potato cultivars, 'Agrida' and 'Granola', under storage conditions. Recep et al. (2009) *Biological Control* 50: 194-198.

► **Aggressiveness of *Streptomyces* on four potato cultivars and implications for common scab resistance breeding.** Recently it has been shown that various *Streptomyces* isolates cause common scab disease and these vary in their distribution and aggressiveness. This paper investigated the interactions between *Streptomyces* isolates and different potato cultivars. The research indicated that other factors outside the pathogen and potato genotype also affect the development of the disease. It was concluded that further understanding of these factors will enable more accurate and reproducible phenotyping, which is required to understand the genetic basis of resistance to common scab. Wanner & Haynes (2009) *American Journal of Potato Research* 86: 335-346.

► **Enhanced resistance to common scab of potato through somatic cell selection in cv. 'Iwa' with the phytotoxin thaxtomin A.** The phytotoxin thaxtomin is produced by pathogenic strains of *Streptomyces* and is a factor in the development of common scab disease. This study selected potato cells that survived in the presence of the chemical and grew these into 39 separate plants. In glasshouse trials, the variants were significantly more resistant to common scab disease than the unselected parent cultivar, 'Iwa', and tuber yields were equivalent. Wilson et al. (2009) *Plant Pathology* 58: 137-144.

► **Deposition of ascospores of *Sclerotinia sclerotiorum* in and near potato fields and impact on the efficacy of a biocontrol agent in the Columbia Basin.** This study indicated that ascospores of *Sclerotinia sclerotiorum* originating from outside potato fields are likely to play an important role in initiating white mould infections. This means that the

effectiveness of the biocontrol agent *Coniothyrium minitans* (Intercept) will be compromised since it is targeted at reducing inoculum of apothecia of *S. sclerotiorum* from **within** the potato field. Hammond et al. (2008) *American Journal of Potato Research* 85: 353-360.

► **Biochemical and genetic diversity of pectolytic enterobacteria causing soft rot disease of potatoes in New Zealand.**

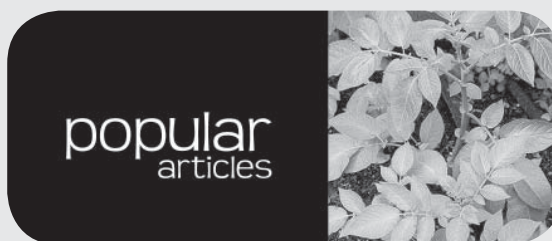
Eighty-nine micro-organisms associated with soft rot of potatoes in New Zealand were characterised by physiological, biochemical and genetic analyses. The majority were classified as the standard pathogens, *Pectobacterium carotovorum* subspecies *carotovorum* and *Pectobacterium atrosepticum*. However, some highly virulent, atypical strains were isolated, and this suggested that novel species or subspecies, including *Pectobacterium wasabiae*, may be responsible for soft rot of potatoes. Pitman et al. (2008) *Australasian Plant Pathology* 37: 559-568.

► **In vitro tests of resistance to soft rot *Erwiniae* on potato tubers.**

This paper describes a method that can be used for quickly screening breeding materials and cultivars for resistance to different *Erwinia* species and strains. Tuber discs from 13 potato genotypes were inoculated with the bacterial suspension and incubated at 26°C for 24-26 hours. Decayed tissues were then washed away and the remaining weight of healthy tissues was measured and used to estimate the degree of resistance. Hudak et al. (2009) *Acta Horticulturae* 812: 103-106.

► **Partial replacing of concentrate feed mixture by potato processing waste in sheep rations.**

In a two detailed studies, the intake and digestibility of concentrate feed mixture substituted with various levels of potato peel waste were measured in the laboratory and in sheep. Crude protein content was similar between the concentrate feed and the potato peel, while the potato peel had a lower crude fibre content. There was no difference in animal intake of the diets, but the total amount of digestible nutrients and crude protein decreased as the level of potato peel waste in the diet increased. However, the level of volatile fatty acids increased with increasing potato peel waste. Thus it was concluded that potato peel waste can successfully replace up to 50% of concentrate feed mixture in sheep diets. Tawila et al. (2008) *American-Eurasian Journal of Agricultural and Environmental Science* 4: 156-164.



www.freshcut.com

► **Measuring sustainability.** This article describes how a group of about 40 companies in the USA is developing a verifiable sustainability index for the produce industry. Incorporating all stakeholders, including non-governmental organisations, suppliers, trade associations and buyers, the index is not focusing on practices but rather is selecting parameters that can be quantified as indicators of sustainability. *January 2009, p. 16.*

► **Produce traceability starts NOW.** The produce industry in North America is developing a "Produce Traceability Initiative" in response to some recent food contamination scares. While currently voluntary, the plan is to get everybody involved in the food supply chain to join the initiative. A series of seven milestones has been developed, with the first one being for companies to obtain their prefix code. This is the initial step in creating a 14 digit "global trade item number" (GTIN) that will be placed on all cases of produce. A case is the smallest unit of labelling envisaged at this stage since the value of labelling individual items has not yet been demonstrated. *January 2009, p. 17.*

Snippets from 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 indicated.

► **Australia: Pest control bugs Australian growers.** Australian growers are disappointed that supermarkets are not labelling produce that has been produced with integrated pest management (IPM) practices. Even worse is the "no live insects" policy, which includes beneficial predators such as ladybirds that are used to control pests like aphids. Both IPM and beneficial insects are an indication of farmers' efforts to cut chemical application drastically by adopting ecological control methods. The supermarkets blame consumers, saying they do not find live insects on produce acceptable. *May 2009, News Headlines.*



► **Effects of size of normal seed tubers and growth regulator application on dormancy, sprout behaviour, growth vigour and quality of normal seed tubers of different potato cultivars.** This item reports on a paper from the first issue of volume 1 of the Research Journal of Seed Science, which was published in 2008 (pp. 41-50). The paper describes an experiment that found higher sprout numbers from 55-65 mm than smaller tubers, and from tubers treated with 5 mg/litre of gibberellic acid. There were also considerable cultivar effects on sprouting and growth vigour parameters. *May 2009, Research.*

► **Got Pink Rot? Get Phosphorous Acid for Harvest.** The August issue of "the SPUDVINE" (www.extension.uidaho.edu/bingham/Aug%202009.pdf), a newsletter produced by the University of Idaho Extension System, discussed the use of a postharvest treatment to prevent healthy tubers becoming infected with the pink rot and late blight pathogens. An application of phosphorous acid as the tubers are transferred into storage is highly recommended for susceptible cultivars (such as 'Russet Norkotah', 'Premier Russet' and 'Western Russet'), tubers harvested from low-lying areas or where infection is suspected. The newsletter discusses recommended phosphorous acid application rates and techniques, and also considers the interaction of pink rot, late blight and Pythium leak disease with other storage diseases, such as soft rot. *September 2009, Feature Article.*

► **Psyllid and Liberibacter workshop proceedings.** A workshop involving a number of international researchers was held in Christchurch, New Zealand, in March 2009 to discuss the psyllid, zebra chip, Liberibacter, and the new phytoplasma. The proceedings of this workshop is available from the Potatoes New Zealand website (www.potatoesnz.co.nz/research.html). *September 2009, Feature Article.*

► **Canada: From potato peel to biogas.** This article describes how waste from the Cavendish Farms' potato processing facilities located in Prince Edward Island, Canada, has been diverted from a landfill into powering the company's boilers. The biogas facility can process 100,000 tonnes of potato waste per annum and will reduce the company's overall carbon footprint by 30-35%. This comes from reducing the fossil fuels previously used to power the plant along with decreased resources for trucking waste potato product to disposal sites. The greenhouse gas emission reduction will be equivalent to taking 7300 cars of the road for 1 year. The biogas process also produces an organic, natural fertiliser that can be applied to potato fields. *October 2009, News Headline.*

► **Dutch wingsprayer possible solution in fight against 'Zebra chips' in New Zealand.** New Zealand potato growers recently visited Dutch potato grower Toon van der Heijden to see his wingsprayer in action. The technique has been developed through the 'Clean water for Brabant' project in Holland and produces a very fine droplet spray to enable application of pesticides with minimum dosage and emissions to the environment. The main target for the equipment, which is expected to be shipped to New Zealand soon, is the insects responsible for vectoring the pathogen that causes zebra chip disease. The disease has only very recently been found in New Zealand and it will be important to kill all of the insect vectors within the potato crop. *October 2009, News Headline.*

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Partial root drying: new approach for potato irrigation. *Brocic et al. (2009) Cereal Research Communications 37: 229-232.*

Effect of alternate partial root-zone irrigation on nitrogen and water use efficiency of potato. *Li et al. (2009) Transactions of the Chinese Society of Agricultural Engineering 25: 92-95.*

Surfactant use to improve soil water distribution and reduce nitrate leaching in potatoes. *Cooley et al. (2009) Soil Science 174: 321-329.*

Center-pivot irrigation system for independent site-specific management of water and chemical application. *King et al. (2009) Applied Engineering in Agriculture 25: 187-198.*

