



Nitrogen fertiliser and potato production

This feature article profiles some of the varied effects and challenges associated with using nitrogen (N) fertiliser for potato production.



In the first of two papers examining the use of organic N sources, Rosen & Allan reviewed the scientific literature. Although it is difficult to directly compare organic and conventional fertilisers, because of the confounding effect of other factors within organic production systems, the article concluded that soil quality may be improved, but care must be taken to avoid nitrate leaching from organic fertilisers. With organic nitrogen sources there is sometimes asynchrony with plant nitrogen demands, but under situations of equal nutrient supply, organic fertilisers do not appear to compromise crop yields relative to conventional fertilisers.

In the second paper (Nyiraneza & Snapp), potatoes were grown in soil that was amended with cover crops (fallow or winter rye), poultry manure (0 or 5.6 t/ha) or both, and compared with potatoes grown with conventional N fertiliser and management. Conventional N fertiliser was used to adjust treatments to ensure they all received 224 kg N/ha. Amended treatments had increased tuber yield and N uptake efficiency compared with conventional treatments. In these experiments the organic nitrogen was in apparent synchrony with plant demand, and subsoil measurements of nitrate indicated lower levels in manured than unmanured treatments.

Cambouris et al. describe a very detailed series of trials using different N rates (0-240 kg N/ha) and timing (100, 75, 50, 25 or 0% of N applied at planting with the remainder at hilling) over 3 years at two sites, which differed in the depth to the clayey substratum. Optimal economic returns from tubers were received from rates of 167 to 239 kg N/ha. Split applications of N gave better tuber yields than full applications at either planting or hilling, with best returns from around 50% applied at planting. Optimal N rate and timing were similar at the two sites, but there were differences in quality parameters, such as specific gravity and tuber size (e.g. more large tubers in the deeper soil), which may justify different management practices (e.g. seed piece spacing) on these soils.

In a review of the effects of nutrient management practices on tuber specific gravity, Laboski & Kelling found that excessive rates of N and potassium, along with excessive soil levels of either nutrient, may reduce tuber solids. If soil phosphorus levels are low, addition of this nutrient may improve specific gravity. Another contributing factor to decreased specific gravity was using fertilisers with high salt indices.

A potent potato patent

A patent lodged in Japan describes an alcoholic beverage whose colour is provided by anthocyanins from coloured potato varieties. The pigments and starch are extracted from the potatoes by heat treatment and added to malt, water and a fermentation liquid.

Method for producing colored brewage.

Nagashima et al. (2007)

Patent No. JP2007135544-A.



Shahnazari et al. examined the effects of different irrigation strategies on N in potato crops. Potato crops subjected to partial root-zone drying (70% of water applied in the full irrigation treatment, which was based on 100% of crop evaporative demands), had lower soil residual N content at harvest than the full irrigation treatment in both years of the trial. Compared with the full irrigation treatment, in year 1, leaf N concentration was higher under partial root-zone drying, while in year 2 measurements of vegetative growth were higher for the partial root-zone drying treatments. However, yield was only maintained if the partial root-zone drying treatment was applied in the second half of the growing season.

Exploring the benefits of organic nutrient sources for crop production and soil quality. Rosen & Allan (2007) Horttechnology 17: 422-430.

Integrated management of inorganic and organic nitrogen and efficiency in potato systems. Nyiraneza & Snapp (2007) Soil Science Society of America Journal 71: 1508-1515.

Response to added nitrogen of a continuous potato sequence as related to sand thickness over clay. Cambouris et al. (2007) Canadian J. Plant Science 87: 829-839.

Influence of fertilizer management and soil fertility on tuber specific gravity: a review. Laboski & Kelling (2007) American Journal of Potato Research 84: 283-290.

Nitrogen dynamics in the soil-plant system under deficit and partial root-zone drying irrigation strategies in potatoes. Shahnazari et al. (2008) European Journal of Agronomy 28: 65-73.



Late blight

► **Impact and interaction of nitrogen and *Phytophthora infestans* as yield-limiting and yield-reducing factors in organic potato (*Solanum tuberosum* L.) crops.** Continuing the nitrogen fertiliser theme, this paper summarises results from field trials and on-farm surveys of organic potato producers over a period of 3 years. Data were modelled, and it was found that only 25% of the variation in yield could be explained by the influence of late blight and 48% by nitrogen availability. It was concluded that the effects of late blight on potato yield in organic farms are often over-estimated but there are interactions with N availability, which affects the growing period and the yield potential. Thus, crops under high N status are more likely to be yield-limited due to late blight. *Moeller et al. (2006) Potato Research 49: 281-301.*

► **Microclimate and potential for late blight development in irrigated potato.** A model of late blight was developed for Russet Burbank potatoes over three growing seasons in central Maine, USA. A range of irrigation treatments was investigated, including sprinkler, sub-surface drip and surface drip, but these did not consistently affect microclimatic parameters associated with late blight development. It was concluded that macroclimatic conditions, such as air temperature, relative humidity and rainfall, were more important factors contributing to late blight. *Olanya et al. (2007) Crop Protection 26: 1412-1421.*

► **Late blight – Eucablight – collating and analysing pathogenicity and resistance data on a European scale.** This paper describes the concerted European approach to collecting and analysing research data on host resistance to late blight and characterisation of *Phytophthora infestans* populations. The database currently holds information on over 15,000 isolates from 20 countries. The use of five standard cultivars in host resistance research has helped with data interpretation. *Hansen et al. (2007) Bulletin OEPP/EPPO Bulletin 37: 383-390.*

Storage and Processing

► **Temperature-induced changes in potato processing quality during storage are modulated by tuber maturity.** This trial used three conditioning temperatures (4.5, 6.7 or 9°C for 1 month) and three storage temperatures (4.5, 6.7 or 9°C for 182 days) on three cultivars ('Russet Burbank', 'Ranger Russet' and 'Umatilla Russet') from early- and late-planted crops (grown for 163 or 133 days). Fry colour darkened as conditioning temperature decreased. Conditioning at

higher temperatures increased the tolerance of tubers to lower storage temperatures. Potato processing quality was reduced for early-planted compared with late-planted crops, and late-planted crops had greater tolerance of lower temperatures. There were also differences between cultivars, indicating that the strategies for storing tubers destined for processing must be carefully selected. *Driskill et al. (2007) American Journal of Potato Research 84: 367-383.*

► **Effect of planting and vine-kill timing on sugars, specific gravity and skin set in processing potato cultivars.** In this research, tubers were collected from different regimes of planting and vine-kill dates over 2 years. Greater sugar contents, which result in undesirable fry colour, were found in tubers harvested from later vine-kill dates. The effects of planting date were variable, although earlier dates tended to give lower sugar content. While immature tubers appear to give better processing characteristics, there are other problems with these tubers, such as poor skin set and susceptibility to mechanical damage, dehydration and pathogen infection. *Sabba et al. (2007) American Journal of Potato Research 84: 205-215.*

► **Low temperature post-harvest storage of New Zealand Taewa (Māori potato): Effects on starch physico-chemical and functional characteristics.** The changes in starch during a 6 month storage period (4°C and 80-90% relative humidity) varied considerably between the five cultivars tested (four traditional Māori cultivars and one modern cultivar, Nadine). The types of changes measured during storage included decreases in starch swelling power, solubility and light transmittance, and a shift to smaller starch granule size. Degradation and pitting in the surface of starch granules was seen, along with changes in gelatinisation properties. *Singh et al. (2008) Food Chemistry 106: 583-596.*

91st Annual meeting of the Potato Association of America 12–16 August 2007

► **Antioxidant properties of potato cultivars.** Pigmented potatoes contain high levels of phenolic compounds and anthocyanins that are associated with anticarcinogenic properties. This research studied two potato selections that contained pigmented and non-pigmented sectors in the same tuber. It was shown that the purple sectors contained 3-5 times more total phenolics and higher vitamin C than adjoining non-pigmented sectors. Another cultivar, Rio Grande Russet, contained high (but not undesirable) glycoalkaloid levels, and extracts from that cultivar showed inhibition of some human breast cancer cell lines. These results have encouraged further research with other cell culture lines. *Stushnoff et al. #002.*

► **Breeding for potato nutrition enhancement.** The concentrations of anthocyanins and carotenoids tend to be much higher in coloured sweet potato and wild potato varieties than in standard white potatoes, at

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indicating that cross-breeding and selecting may result in increased levels of these important phytonutrients. Two xanthophylls, lutein and zeaxanthin, are known to be protective components of the human retina and are found in significant amounts in potatoes. Cooking potatoes may alter the levels of anthocyanins and carotenoids, but it does not destroy them. *Brown #005.*

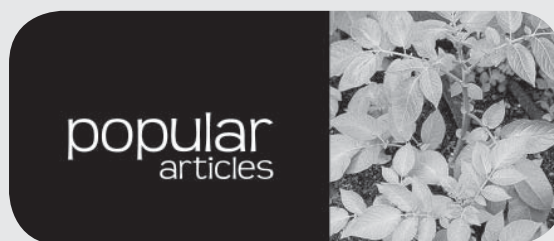
► **Effect of seed-borne Potato Virus Y on performance of Russet Burbank, Russet Norkotah and Shepody potatoes.** By combining healthy and infected seed tubers from the same source in various proportions, seed lots with 0, 2, 10, 20 and 50% infection were created. In three seasons, for three varieties, the negative impact of virus infection level was proportionally the same. Below 10% infection, it is expected that there will be no measurable effect of virus on tuber yield. *Nolte et al. #029.*

► **Variation in *Solanum* species' tuber potassium accumulation and its implications for human nutrition.** High levels of dietary sodium are linked with heart disease in humans. Dietary potassium is regarded as the "sodium antidote" and potatoes are unique in their naturally high potassium levels. Tuber potassium levels were measured in three populations of 25 potato species, and highly significant differences were found. Breeding from species with high potassium levels could have an important effect on human health. *Bamberg et al. #043.*

► **Effect of hairy nightshade in the epidemiology of potato viruses and the biology of aphid vectors.** Hairy nightshade is a very prevalent weed in Idaho, and, being in the Solanaceae family like potatoes, it is susceptible to the same viruses and aphids that infect potatoes. Green peach aphid and potato aphid prefer nightshade over potatoes and they have a 50% higher reproduction rate on the weed. Higher Potato leafroll virus and Potato virus Y levels are found on potatoes grown in paddocks infested with hairy nightshade. Control of this weed is therefore essential, especially in seed potatoes. *Alvarez et al. #080.*

► **Folate in potato tubers: effects of genotype, location, storage, and development.** Folates are essential micronutrients, deficiencies of which have been linked to birth defects. This study showed that folate concentrations ranged from 521 to 1373 ng/g tuber DM, and were found in highest levels in coloured-fleshed potatoes. In addition, skin contained higher concentrations than flesh, folate levels varied with location, and folate content increased during a 7 month storage period. *Goyer et al. #099.*

► **Effect of powdery scab on yield of Umatilla and Shepody potatoes.** Two pot trials used potato seed planted into soil that was inoculated or not with dried, macerated peels from tubers infected with *Spongospora subterranea*. For both cultivars tested, inoculation of soil reduced root weight and increased root necrosis. For Umatilla, inoculation reduced progeny tiller numbers and, in one trial, reduced yield. *Nitzan & Brown #111.*



► **Book: Potato health management. Edition 2**

This is a comprehensive book, comprising 23 chapters that cover how to manage potato health, from seed to storage. Included is information about enhancing potato health by managing the soil microflora; cultivar selection; planting protocols; agronomic information; maintaining tuber health during harvest, storage and post-storage handling; and managing pests and diseases to avoid pesticide resistance. This book is intended for anyone interested in growing potatoes, from commercial growers and consultants to agriculture teachers, students and home gardeners. *Johnson (2008) American Phytopathological Society (APS Press), St. Paul, USA. 261 pp.*

Snippets from www.potatonews.com

Listed below are 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.

► **United States: New class of compostable containers to be made from potato starch.**

The company New Ice Inc., based in Durango, Colorado, has recently been granted patents (U.S. Patent Nos. 6,878,199 and 7,083,673; and European Union Patent No. 1327663) that cover an improved method and materials for manufacturing biodegradable or compostable containers from potato starch. Corresponding patents have also been granted in a number of Eastern European and Asian countries and New Zealand, and further patents are expected in 2008. Initially the containers will be designed for packaging fruit and vegetables, followed by meats and poultry, and they will be able to hold the products in dry, damp or wet conditions. *December 2007: News Headlines.*

► **Don't give blight an inch – BPC.**

The recent season has been particularly bad for potato blight in the UK, and the blight seminars at the British Potato 2007 conference had nearly 500 growers in attendance. They were informed of the current state of changing blight populations, with the new A2 mating types being found in 80% of samples surveyed compared with 67% in 2006. There was no evidence of infections caused by oospores, which can survive in soil for several years, so inoculum is still only surviving between seasons on green material, such as volunteers or on tubers. A2 is a more aggressive, fitter genotype than A1, but currently recommended spray programmes should still give good control in 2008. Aggressiveness relates to the amount of disease caused

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by a particular strain while fitness relates to the ability of the strain to survive into the next generation, and these two characteristics are not necessarily correlated. Vigilance will be the best way to keep blight in check, and it is suggested that growers use the BPC Fight Against Blight and Blightwatch service to assess risk. *December 2007: Feature Articles.*

► **United Kingdom: Handful of dedicated growers key to Anya variety's success.** Anya, a cross between a red-skinned roasting potato (Desirée) and an old variety (Pink Fir Apple), was bred 15 years ago at the Scottish Crop Research Institute. It is grown by only 7 growers and sold on a specialist contract to Sainsbury's, with extended supply being guaranteed by plantings that stretch from Spain to Yorkshire. The variety was recently awarded a silver award in the 'Taste of Britain' seasonal food category, which is judged on a range of criteria, including flavour and quality, innovation, business acumen, environmental record and 'Britishness'. *January 2008: News Headlines.*

► **United Kingdom: Storing potatoes and onions using Restrain System.** This article describes how, starting in 1999, a group of growers in England developed a new storage technique using ethylene gas for anti-sprouting control. The patented Restrain Generator® produces the ethylene gas from pure ethanol (alcohol) using a heated catalyst. Over 130,000 tonnes of potatoes are stored this way. *January 2008: News Headlines.*

► **United Kingdom: Damage to potato crops caused by manure or slurry.** Growers should be careful to avoid growing potato crops after pasture that has been treated with the herbicide aminopyralid. Discoloured and misshapen foliage has even been seen in potato crops planted in areas that have had applications of manure or slurry from animals fed grass treated with the herbicide. *January 2008: News Headlines.*

► **US microwave fries send retail sales soaring in Japan.** This press release from the United States Potato Board describes how the market for microwaveable potato products in Japan has grown 60-70% since the introduction of "Range Potatoes" in December 2006. These frozen crinkle cut potatoes are sold in special boxes designed for use in a microwave. They can be prepared in 3 minutes and have a low oil content. *January 2008: Potato Trends.*

► **Trends in potato storage.** This refers to a comprehensive article by potato storage specialist Michael D. Lewis that can be downloaded from <http://www.colostate.edu/Depts/SLVRC/disease/2007SRMACLewis.pdf>. The article examines the physiological potato defect known as internal sprouts. The article explains why the sprouts occur, including possible physical and chemical interactions, and discusses possible solutions. A series of informative photographs is also presented. *January 2008: Feature Article.*

► **Effect of storage with 30 instead of 100 m³/h per m³ product fan capacity.** Containing an excellent series of tables and calculations, this article is available at <http://www.potatoprocessing.biz/HowTo/StorageEffects.htm>. It describes a simulation study carried out in March 2006 for Tolsma Techniek, storage system specialists, by A&F, a Dutch research institute. The work indicated that a higher ventilation capacity reduced storage losses, and that decreasing fan capacity from 100 to 30 m³/h per m³ product will result in a less optimal temperature control, up to 60% more operating hours and 20 to 30% more weight losses. *January 2008: Feature Article.*



Mana Kai Rangahau