chips
a look at what's new in potato information and technology
Horticulture™ New Zealand
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Genotype effects on potato characteristics

This feature article summarises four recent scientific papers that describe how the genetic background of a potato plant can have a major influence on a wide variety of biologically and commercially important characteristics.

Genetic markers can be used in potato improvement programmes to select desired processing traits.

In the first paper (Davis et al.), 49 commercial potato cultivars were assessed in field and greenhouse studies for resistance to two aphid species. Although there were considerable differences between cultivars in their response to each aphid species, these resistances were not significantly correlated. Green peach aphid populations increased slowest on Russet Norkotah and fastest on Red La Soda, while potato aphid populations grew slowest on Aracy and fastest on Irish Cobbler.

The second paper (Wegener & Jansen) demonstrated that the resistance to soft rot caused by *Pectobacterium carotovorum* was greater amongst 10 purple-fleshed potato cultivars than amongst 10 white/yellow-fleshed potato cultivars. The extent of rotting on tuber halves of purple-fleshed cultivars was 29% lower than white/yellow-fleshed cultivars, and this was highly correlated with three components: the presence of anthocyanins, higher concentrations of soluble phenols and elevated polyphenol oxidase activity.

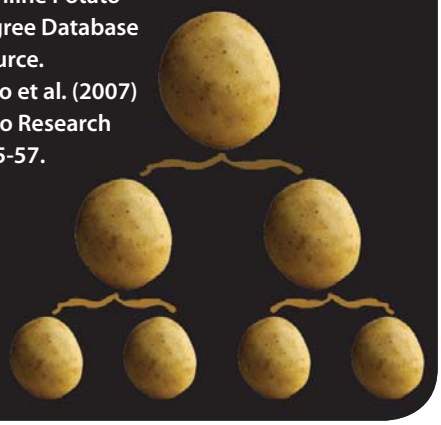
Anti-oxidant compounds were also the subject of the third paper (Reddivari et al.). This study, with 25 genotypes at two Texas locations over 2 years, demonstrated that antioxidant activity, total phenolics, total carotenoids and phenolic composition differed between genotypes, and that the genotype effects were larger than location and year effects. Several genotypes were stable between locations and years, and these would be a good choice as parents in breeding programmes.

The potato processing characteristics of specific gravity and chip colour are the subject of the fourth paper (Andreu et al.). This research used genetic markers to separate 42 genotypes into contrasting groups for each of the two characteristics. These markers explained a significant proportion of the variation in the characteristics and can be used in potato improvement programmes to select breeding lines with the desired processing trait.

The potato family tree!

In the potato version of a family tree, the Laboratory of Plant Breeding at Wageningen University, the Netherlands, has created a Web-accessible interface to allow people to investigate the ancestry of a large number of potato cultivars. Now you can find the great-grandparents of your favourite potato!

An Online Potato Pedigree Database Resource. Berloo et al. (2007) Potato Research 50: 45-57.



Resistance to green peach aphid, *Myzus persicae* (Sulzer), and potato aphid, *Macrosiphum euphorbiae* (Thomas), in potato cultivars. Davis et al. (2007) American Journal of Potato Research 84: 259-269.

Soft-rot resistance of coloured potato cultivars (*Solanum tuberosum* L.): the role of anthocyanins. Wegener & Jansen (2007) Potato Research 50: 31-44.

Genotype, location, and year influence antioxidant activity, carotenoid content, phenolic content, and composition in specialty potatoes. Reddivari et al. (2007) Journal of Agricultural and Food Chemistry 55: 8073-8079.

Genetic markers for processing traits in potato. Andreu et al. (2007) Crop Breeding and Applied Biotechnology 7: 67-73.

Disease control

▶ **Tuber soft rot and concentrations of *Erwinia* spp. in potato-washing plants in South Australia. Over** a 4-year period, potato tubers and water samples from four washing plants in South Australia were collected, and levels of bacterial soft rot infection on tubers and *Erwinia* spp. in wash water determined. An average of 26% of tubers collected from the field developed soft rot, but this increased to 64% or more after tubers had been immersed in water. There was a further increase in incidence and severity of soft rot after tubers were treated to remove adhering soil. The most severe rotting developed when tubers were immersed in water containing high levels of *Erwinia* spp., suggesting that soft rot disease may be reduced by frequently replacing potato wash water with clean water. *Wicks et al. (2007) Australasian Plant Pathology 36: 309-312.*

▶ **Performance of dimethomorph + mancozeb applied to seed potatoes in early management of late blight *(Phytophthora infestans)*.** Due to the systemic action of dimethomorph in this fungicide mixture, healthy seed tubers were protected against *P. infestans* infections and detached foliage was protected against artificial inoculation of *P. infestans*. The experiments were carried out under greenhouse and field conditions (three seasons and two locations) with five cultivars (Kennebec, Shepody, Spunta, Russet Burbank and Ranger Russet). Protective effects were observed up to 30 days after emergence in greenhouse experiments and up to 28 days after emergence under field conditions. Seed treatment with the dimethomorph + mancozeb fungicide mixture can reduce the requirement for spraying early in the season. *Caldiz et al. (2007) Potato Research.*

▶ **In-furrow applications of metalaxyl and phosphite for control of pink rot *(Phytophthora erythroseptica)* of potato in New Brunswick, Canada.** *Phytophthora erythroseptica* inoculum was applied to potato fields, either in-furrow as a vermiculite slurry at planting or as a zoospore drench in soils adjacent to potato plants along with treatments of metalaxyl-m (Ridomil Gold 480EC) and phosphite (Phostrol) applied at planting in-furrow. Metalaxyl-m treatment significantly reduced the mean percentage of diseased tubers (both by numbers and weight) compared with phosphite-treatment, which was similar to inoculated control plots with no fungicide treatment. The cultivar Shepody was significantly more susceptible to pink rot than Russet Burbank in both years of the trial. *Al-Mughrabi et al. (2007) Plant Disease 91: 1305-1309.*

Agronomy – irrigation and soil compaction

▶ **Efficiency of nitrogen fertiliser for potato under fertigation using a nitrogen tracer technique.** Four levels of nitrogen fertiliser (70, 140, 210 or 280 kg N/ha) were applied in five equally split-applications under either fertigation (drip) or furrow irrigation to potatoes grown in autumn or spring on a heavy clay soil in the Hama region of Syria. Regardless of the sowing time, higher marketable tuber yield was obtained by fertigation than furrow irrigation, but the magnitude of the increase was greater in autumn. The response to the different levels of N fertiliser did not differ significantly between the irrigation treatments. Data from the nitrogen tracer indicated that N recovery increased with decreasing levels of N fertiliser and that furrow irrigation resulted in greater movements of nitrate below the rooting zone than drip fertigation. *Janat (2007) Communications in Soil Science and Plant Analysis 38: 2401-2422.*

▶ **Effect of drip tape placement depth and irrigation level on yield of potato.** One of the main challenges with subsurface drip irrigation is determining the optimum installation depth of the drip lateral, as this varies with soil structure, texture and crop root development pattern. This experiment was carried out on a sandy loam soil with cv. Kufri Anand over 3 years and used three irrigation levels (60, 80 and 100% of crop evapotranspiration) and five depths of drip tape placement (0, 5, 10, 15 and 20 cm). Regular tests of flow rates indicated good performance of the irrigation system. When the drip tape was placed at 0 or 5 cm, significant upward movement and loss of water was seen. At deeper placements, the soil surface remained relatively dry. On average, maximum yield was obtained by applying 100% of the crop evapotranspiration (23.6 cm of irrigation water) and by placing the drip tape at 10 cm depth. *Neelam & Rajput (2007) Agricultural Water Management 88: 209-223.*

▶ **Bacterial pathogens recovered from vegetables irrigated by wastewater in Mexico.** Micro-organisms were measured in a range of vegetables, including potatoes, which had been irrigated with untreated waste water in Morocco. There were high levels of enterococci, faecal coliforms and total coliforms, but coagulase-positive *Staphylococcus aureus* was not detected. It was concluded that these vegetables posed a serious health risk to the consumer. *Ibenyassine et al. (2007) Journal of Environmental Health 69: 47-51.*

Nutrition

▶ **Glycemic index - a review and implications for the potato industry.** The glycaemic index (GI) ranks carbohydrate foods according to the degree to which they cause blood glucose to rise after the food is eaten. Foods that cause a rapid rise (high GI) are not recommended for diabetics. The starch in cooked potato is rapidly broken down to glucose, giving a moderate to high GI. However, GI can be influenced by other components of a meal, or even a previous meal. Another indicator is glycaemic load (GL), which takes into account the actual amount of carbohydrate consumed per serving. Because of the high moisture content of potatoes, the GL is generally moderate. GI and GL differ between potato cultivars and can be modified by processing methods. More research is needed to define the GI and GL of potato cultivars and other factors that may affective the levels of these indicators in potatoes. *Lynch et al. (2007) American Journal of Potato Research 84: 179-190.*

▶ **Umami compounds are a determinant of the flavor of potato (*Solanum tuberosum* L.).** Umami, a 100-year-old Japanese concept of flavour, is one of the five individual tastes sensed by receptors on the tongue, together with salty, sweet, bitter and sour. It is an almost savoury taste that is thought to be important for potato flavour. The research described in this paper assessed the levels of some major umami compounds (glutamate, aspartate, GMP and AMP) in boiled potato tubers. The potato cultivars used in the work had previously been assessed for sensory quality. There were strong positive correlations between umami concentrations and flavor attributes and acceptability scores from a trained taste evaluation panel. *Morris et al. (2007) Journal of Agricultural and Food Chemistry 55: 9627-9633.*

▶ **Diagnosis and natural course of allergy to cooked potatoes in children.** Surprisingly some children are allergic to potatoes. In this study, 36 children under 3 years old with positive reactions to screening allergy tests were further investigated, with 17 shown to have a clear potato allergy. The majority of them presented with eczema symptoms but others also showed a range of additional symptoms, including anaphylaxis. Nearly all of these children had previously demonstrated other food allergies and a high proportion of them subsequently developed clinical pollen allergy. By the time the children were 9 years old, most of them had developed tolerance to cooked potato. *Swert et al. (2007) Allergy 62: 750-757.*

Genetic technologies

Listed below are three research articles that review the application of molecular transformation technology for the genetic improvement of potatoes. The first (Chakravarty et al.) describes previous achievements and current trends along with biological and practical requirements. In addition, problems and public concerns are discussed. The second (Ghosh & Jepson) is actually a series of papers that comprise an expert consultation on strategies for assessing the effects of GM crops on the environment. The topics range from experimental design to farm-scale evaluations and include a regulatory paper from New Zealand as well as several papers from South America, one of which looks at the problems of hybridisation between wild and cultivated potato species. The third paper (Rommens) discusses the new technology of intragenics, where the advantages of molecular genetics to introduce new traits into potato varieties can be used without the perceived disadvantages of introducing genetic material from other species.

▶ **Genetic transformation in potato: Approaches and strategies.** *Chakravarty et al. (2007) American Journal of Potato Research 84: 301-311.*

▶ **Genetically modified organisms in crop production and their effects on the environment: methodologies for monitoring and the way ahead.** *Ghosh & Jepson, eds. (2006). Expert consultation: report and selected papers. FAO, Rome, 18-20 January 2005.*

▶ **Intragenic crop improvement**: **Combining the benefits of traditional breeding and genetic engineering.** *Rommens (2007) Journal of Agricultural and Food Chemistry 55: 4281-4288.*

Potato World

▶ **Consequences of water properties often underestimated.** This article describes how the temperature of the mixing water can have a considerable influence on the effectiveness of crop protection chemicals. Hydrogen bonding between individual water molecules gives water its liquid properties. As the temperature of water increases, the hydrogen bonding decreases and the solubility of dissolved chemicals increases. For most crop protection chemicals the ideal temperature is 18-28°C. Above 30°C the high solubility of chemicals can cause crop damage that would not be seen at lower temperatures, and so dose rates should actually be lowered at these high temperatures. *Number 3, 2007, p. 7.*

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.

▶ **Netherlands: Promising perspective for potato proteins.** As part of the process of extracting starch from potatoes, the company Solanic is producing potato protein products. Using a new separation technology that reduces energy and water consumption, the potato juice is turned into a dry, high molecular fraction that mainly comprises the protein Patatin and a low molecular fraction that ends up as a liquid product. The "quality" of the potato proteins, scored on factors such as the amino acid content, digestibility and presence of anti-nutritional factors, is even better than soy protein. Another advantage of potato protein over proteins extracted from other plant foods, such as cereals and legumes, is that the potato protein remains soluble after the extraction process. The potato protein products also have good foaming, emulsifying and bio-functional properties. *June 2007: News Headlines.*

United States: Diet with potatoes associated with reduced risk of developing type 2 diabetes: new study. Researchers at the University of Melbourne and the Cancer Council Victoria, Australia, have found that the risk of developing diabetes is increased with a dietary pattern characterised by meats and fatty foods but reduced by a dietary pattern characterised by a variety of salad and cooked vegetables, including potatoes. In addition, a recent study at Tufts University, USA, has indicated that weight loss can be achieved by a reduced-calorie diet comprising a variety of cooked (but not fried) vegetables, including potatoes, regardless of whether the diet has a high or low glycemic index or glycemic load (http://www.prweb.com/releases/2007Potato/Diabetes/prweb526557.htm).
June 2007: News Headlines.

United Kingdom: Scientists create a new technique to combat potato scab. There are a number of strains of *Streptomyces scabies*, the pathogen that causes potato scab. Recently, DNA tests have been developed to differentiate between the strains, as they may differ in their ability to cause disease. The molecular probes target the thaxtomin biosynthethic genes. Thaxtomin is a protein that breaks down the walls of growing cells, enabling the bacterium to infect any elongating part of the potato plant that is underground. When the bacteria infect potato tubers they produce raised or pitted scab-like lesions. June 2007: News Headlines.

United Kingdom: Potential for potato growers to cut costs. At the "British Potato 2007" conference, speaker Andrew Kneeshaw discussed how growers must concentrate on finding ways to reduce energy consumption in potato stores. With increases in energy costs of up to 60% in the past 2 years, improving general management, maintenance, control systems and store structure, along with making good refrigeration and fan choices, can have a significant impact on profitability. *December 2007: News Headlines.*

Australia: McCain Foods Australia/New Zealand received grant to reduce water use. A government grant of A$635,474 will be used to develop systems to increase the amount of internal water recycling and eliminate water use in certain parts of the food production process. McCain Foods is one of the largest users of the Ballarat water supply and it is expected that the project will help to reduce demand for potable water at McCain by 50%. In addition, the project will provide opportunities for other manufacturing firms in the region to learn about ways to establish water-saving initiatives. *December 2007: News Headlines.*

Australia: South Australian potato growers soon to collectively bargain processor contracts. A draft ruling by the Australian Competition and Consumer Commission will allow potato growers to collectively bargain with McCain Foods and Safries processors. This follows a similar ruling released recently for the Victorian Potato Growers Council, and has the potential to achieve "more efficient outcomes" for South Australian potato growers. *December 2007: News Headlines.*

New Zealand: potato growers invest in future capability. In an exciting initiative that coincides with 2008 being the declared International Year of the Potato by the United Nations, Horticulture New Zealand has launched four new PhD research programmes. The students will work with the country's leading potato and potato disease scientists at Crop & Food Research. One of the projects is embedded in Crop & Food Research's internationally-recognised breeding programme and biotechnology team. The second project will focus on potato water-use efficiency, studying physiological characteristics such as photosynthetic capacity, stomatal resistance and leaf canopy expansion. Another project will investigate the molecular factors controlling potato tuber expansion and eventual tuber size, and work towards the goal of producing gourmet potatoes of specific dimensions. The fourth project will determine the virulence of *Rhizoctonia*, a major pathogen of agricultural crops, responsible for canker and black scurf. The funding demonstrates the commitment of potato growers to developing future capability in their industry and is a great endorsement of the research done by Crop & Food Research. *December 2007: News Headlines.*

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