chips
a look at what's new in potato information and technology
Horticulture™ New Zealand
35
November 2007

Biological control for potatoes

Biological control is about using a living organism to control the growth and development of a pest or disease.

In some situations, the biocontrol agent is a natural enemy of the pest in its native range, but has been left behind when the pest moves to a new area. The biocontrol agent may just need to be introduced and will continue to control the pest. In other cases, the biocontrol agent is present at low levels in the pest population, but ongoing applications of the biocontrol agent may be needed to prevent the pest causing economic damage to a crop.

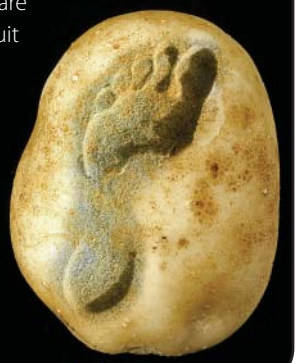
Silver scurf disease. Photo from Ontario Ministry Agriculture and Food (Dr Eugenia Banks)

Three scientific papers describing various biocontrol agents for pests and diseases of potatoes are featured in this issue of Chips. In the first paper (Keasar & Sadeh), a parasitoid (*Copidosoma koehleri*) that controls potato tuber moth in the field in some countries was tested to see whether it could reduce moth populations in storage. During an 8-week storage period, tubers with controlled initial levels of moth infestation received 1-2 releases of adult parasitoids. For potatoes stored indoors, populations of the parasitoids increased and tuber moth populations were significantly reduced. However, tuber moth infestation still reached 100% in both parasitoid-treated and untreated controls. In tubers stored outdoors, parasitised moths were rarely recovered, and infestation levels did not differ between treated and untreated heaps.

In the second paper (Slininger et al.), 18 patented bacterial strains were tested for their ability to suppress late blight disease caused by *Phytophthora infestans* (US-8, mating type A2) in wounded potato tubers. Disease suppression was evaluated after tubers were stored for 1 week at 15°C and 90% relative humidity. Late blight was reduced by up to 60% and four strains were selected for further testing. Suspensions of *P. infestans* were sprayed onto unwounded potatoes, followed by the bacterial treatments alone and in combination. The potatoes were stored for 4 weeks at 7.2°C and 95% relative humidity. All treatments significantly reduced disease, ranging from 35–86% in the first year to 35–91% in the second year. Best control was achieved with the four strain mixture followed by individual treatments of two *Pseudomonas fluorescens* strains. These bacterial strains had also previously shown suppression of dry rot and sprouting, indicating that they have excellent potential in post-harvest treatment of stored potatoes.

What's the carbon footprint of a potato?

A recent article on the BBC website describes how Walkers Crisps has begun labelling its bags of cheese and onion potato crisps with the environmental costs of production. To make a 33.5 g bag of crisps, 75 g of greenhouse gases were emitted, with agricultural processes accounting for 33 g. Nine more companies, including Cadbury's in the UK, are expected to follow suit by labelling their products with carbon footprint figures.



The third paper (Johnson) evaluated suppression of silver scurf disease, caused by *Helminthosporium solani*, by the biological control agent 'Serenade ASO™'. Over 2 years Serenade ASO reduced both the incidence and the severity of silver scurf under low disease pressure and delayed the onset of silver scurf until 5 months of storage. At high disease pressure, only the severity of silver scurf was reduced by Serenade ASO.

The parasitoid *Copidosoma koehleri* provides limited control of the potato tuber moth, *Phthorimaea operculella*, in stored potatoes. *Keasar & Sadeh (2007) Biological Control 42: 55-60.*

Biological control of post-harvest late blight of potatoes. *Slininger et al. (2007) Biocontrol Science and Technology 17: 647-663.*

Evaluation of a biological agent for control of *Helminthosporium solani*. *Johnson (2007) Plant Pathology Journal (Faisalabad) 6: 99-101.*

Disease control

▶ **Application of some natural compounds for management of potato late and early blights.** A series of greenhouse and field experiments investigated antioxidants (mannitol, oxalic acid, citric acid and ascorbic acid), spermine, ornithine and antitranspirants (bio-Film, nu-Film and kaolin) as control agents for the foliar pathogens *Phytophthora infestans* (late blight) and *Alternaria solani* (early blight). In the field, applications of these compounds at the 3-4-leaf and the 10-leaf growth stages on Sponta potatoes decreased disease severity, the overall level of disease, and sporulation. The leaves of potatoes sprayed with some of the compounds had higher levels of chlorophyll-a, chlorophyll-b and carotenoid pigment than untreated leaves, and total tuber yield was increased by some compounds, in particular spermine. *Haggag & El-Khair (2007) Journal of Food, Agriculture & Environment 5: 157-163.*

▶ **Effect of strobilurin fungicides on control of early blight (*Alternaria solani*) and yield of potatoes grown under two N fertility regimes.** Field trials were carried out over 2 years in Prince Edward Island, Canada. The two strobilurin analogs tested, azoxystrobin and pyraclostrobin, were linked to higher total tuber yield for Russet Burbank in 2003 and Shepody in 2004 compared with plots receiving no fungicides. However, no early blight was recorded in 2003, indicating that the response to the fungicides may have been due to physiological and developmental alterations. In 2004, early blight was severe and was suppressed by the fungicides in both cultivars and at both high and low nitrogen fertility regimes. There was no significant difference in total tuber yield between N fertility treatments, although the high N rate decreased disease in Russet Burbank control plots in 2004. *MacDonald et al. (2007) Phytoprotection 88: 9-15.*

▶ **Seed treatment application-timing options for control of Fusarium decay and sprout rot of cut seed pieces.** Cut potato seedpieces were inoculated with *Fusarium sambucinum*, the causative agent of seedpiece decay and rotting of sprouts. Ten, 5 or 2 days prior to planting, seedpieces were treated with a commercially formulated mixture of fludioxonil plus mancozeb (Maxim MZ) or left untreated. The fungicide treatment at all three time-points significantly reduced the percentage of diseased sprouts per seedpiece and seedpiece decay, indicating that this can provide effective control of the disease. *Wharton et al. (2007) American Journal of Potato Research 84: 237-244.*

Agronomy – irrigation and soil compaction

▶ **Water dynamics in drip and overhead sprinkler irrigated potato hills and development of dry zones.** Time domain reflectometry (TDR) probes were installed into potato hills and water content was monitored every 15 minutes at various positions in the potato hill under drip and sprinkler irrigation regimes. Water content values within the centre of the potato hill, where there is the highest root density, were generally greater under drip than sprinkler irrigation. Concurrently, water content values were lower in the furrow of drip than sprinkler irrigation. The difference between the two irrigation regimes in water content in the centre of the hill became more prominent as the growing season progressed. *Cooley et al. (2007) Hydrological Processes 21: 2390-2399.*

▶ **Response of potato tuber yield components to gel-polymer soil amendments and irrigation regimes.** Field experiments were carried out at the Hatfield Experimental Farm of the University of Pretoria, South Africa, to investigate pure and fertiliser-fused gel-polymer formulations at four levels of soil moisture. Although fusing the fertiliser to the gel polymer did not improve potato tuber yields compared with standard fertiliser application, using the pure gel polymer did improve total and marketable tuber yield. Marketable tuber number and yield decreased as soil moisture depletion increased, and the incidence of common scab was inversely related to the irrigation frequency. *Eiasu et al. (2007) New Zealand Journal of Crop and Horticultural Science 35: 25-31.*

▶ **Effects of soil compaction in potato crops.** The timing of planting of potato crops in spring means that there is potential for compaction in many soils. The use of powered cultivators to produce a fine seedbed increases the risk of soil compaction, and is both time and energy inefficient. A series of experiments in the UK showed that soil compaction had a range of physiological effects on potato crops, resulting in reduced tuber yields. Measurements established a relationship between rate of root penetration and soil resistance, and a survey of 602 commercial fields indicated that two-thirds had soil resistance values that would severely restrict root growth. This shallow root depth would lead to inefficient water and nutrient utilisation. It is suggested that there may be major yield advantages of delaying planting until the soil is dry to reduce losses caused by soil compaction. *Stalham et al. (2007) Journal of Agricultural Science 145: 295-312.*

Nutrition

▶ **Determination of folate concentrations in diverse potato germplasm using a trienzyme extraction and a microbiological assay.** Folate is an important dietary nutrient and deficiency can lead to birth defects. This study examined total folate concentrations of potato tubers from 67 cultivars, advanced breeding lines, or wild species. Highest folate concentrations tended to be found in coloured potatoes, and in general, folate content increased over a 7 month storage period. *Goyer & Navarre (2007) Journal of Agricultural and Food Chemistry 55: 3523-3528.*

▶ **Metabolic engineering of carotenoid levels for improvement of plants as food**. Carotenoids are important in human health for normal vision and for preventing degenerative diseases and cancer. These coloured compounds are not produced by mammals and need to be included in the diet. Most major crops, including rice, wheat and potato, have low levels of carotenoids and efforts have been made to increase than through genetic modifications. More recently, potatoes with 'golden tubers' have been produced that contain very high levels of carotenoids. *Diretto et al. (2007) CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 2: 10 p.*

▶ **The effects of low-dose gamma irradiation and storage time on carotenoids, antioxidant activity, and phenolics in the potato cultivar Atlantic.** Low-dose ionising irradiation is being considered to prevent shrinkage and sprouting of stored potatoes. Tubers were subjected to different levels of irradiation and stored at 20°C for 0, 10, 20, 75 or 110 days. The patterns of change in nutrient concentration during storage differed between nutrients, with some increasing and others decreasing. However, in general the effects of storage on nutrient content were much greater than the effects of low-dose gamma irradiation. *Blessington et al. (2007) American Journal of Potato Research 84: 125-131.*

Processing

▶ **Nutrient cycling in the vegetable processing industry: utilization of potato by-products.** There is a huge amount of biological waste from potato processing and cull potatoes. In the past, solid waste and cull potatoes have been put into landfills or disposed of on agricultural land as a fertiliser, and liquid waste can be applied to agricultural land under strict environmental controls. However, recent research has shown that potato processing waste can be used as a high-quality animal feed, particularly in beef feedlots, replacing maize and barley without negative effects on growth or meat quality. In fact, efficiency of animal growth per unit diet intake even improved with diets of up to 80% potato processing waste. *Charmley et al. (2006) Canadian Journal of Soil Science 86: 621-629.*

▶ **Treating potato processing wastewater.** This paper discusses a number of ways of treating potato processing effluent. The detailed analyses include consideration of the composition of the effluent and the financial benefits of efficient treatment processes. Included in the paper are case studies that illustrate the issues raised. *Koen & Clayton (2007) Food Review 34: 36-39.*

▶ **Development of sorting system based on potato starch content using visible and near-infrared spectroscopy.** The starch content of potato tubers has a major influence on their taste, method of cooking and processing options, and can vary widely under different growing conditions. This research examined the non-destructive determination of starch content using visible and near-infrared spectroscopy, by passing tubers under a sensor on a conveyor system. The accuracy of prediction of starch content was very high, and this technique has potential for use in packing houses. *Komiyama et al. (2007) Journal of the Japanese Society for Food Science and Technology 54: 304-309.*

Potato Review

▶ **Fungicides:** Euroblight ratings help spray choice. In the UK, a group of independent scientists meets with representatives from the crop protection industry every year to assess products for their effectiveness against blight. The Euroblight ratings (www.euroblight.net) are given for the effectiveness and characteristics of blight fungicides and assist growers with choosing the right fungicide for their situation. It is emphasised that label information must still be read and complied with. *July 2007, pp. 12-13.*

▶ **Machinery:** Padco design breaks with tradition. Two potato growers in Essex, UK, have developed a radical new harvester. Working with an engineering company, the Psix was built to harvest six rows planted by their three-row planter but can still handle a two-row system. The problem of road width was overcome by pivoting the two digger units into a vertical position for transport. The front wheels are mounted on swing arms, while the engine is rear-mounted and the driver has an unobstructed view from the front. The harvester will be able to handle 1000 tonnes/day. *July 2007, pp. 22-23.*

▶▶

▶ **Environment:** Some growers get a buzz out of potatoes. Sainsbury's is encouraging its fresh produce growers to participate in Operation Bumblebee, a project initiated by Syngenta in the UK to establish habitats with plentiful supplies of pollen and nectar for insects. In just over 2 years, bumblebees have increased by 200%, butterflies by over 230% and spiders by 120%, through sowing specially designated areas with special seed mixtures that include clovers, treefoil and sainfoin. Little productive land is lost since awkward corners, difficult-to-irrigate areas and compacted soil spots can be used, while the benefits to crops that require pollination are huge. *July 2007, pp. 28-29.*

▶ **Stewardship:** Wild flowers, beetle banks and potatoes. A similar scheme to Operation Bumblebee is being run by ADAS on behalf of "Natural England". The principle of environmental stewardship is being applied to balance agricultural productivity with conservation and protection of the environment. Hedgerows are being planted and natural wetlands being re-created, while buffer strips, grass margins and fertiliser-free headlands are used along with fallow crops in the arable rotation. *July 2007, pp. 32-33.*

▶ **Storage:** Hidden losses are revealed to cut costs. As electricity prices rise in the UK (and elsewhere in the world) there is increasing focus on energy losses from potato stores. Unlike leaky irrigation, energy losses cannot be seen and are often ignored. However, a potential saving of £11 million is possible by implementing some basic measures. An infra-red or thermal imaging camera can show where energy is being lost. Particularly important are doors and louvres, but insulation in the roof can also be very significant. Equipment such as variable speed drives for fans offer considerable savings if used properly. *July 2007, pp. 42-43.*

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 shown.

▶ **Australia: MOU signed to enhance Australian potato industry's future.** A historic Memorandum of Understanding was signed on 24 September 2007 between AUSVEG and the Potato Processors Association of Australian, as a commitment to work together for the betterment of the Australian potato industry. This is considered to be a big step forward in delivering improved benefits for growers and processors. *September 2007: News Headlines.*

▶ **Scotland: Chinese import market offers opportunities for Scottish potato growers.** Four companies have met the requirements for propagation, packaging, storage and transportation of Scottish seed potato mini tubers to China. This is a major breakthrough, as China has operated a universal ban on the importation of seed potatoes for many years. Several large potato-producing countries, including The Netherlands, Canada and the USA, have previously attempted to negotiate access for their seed potatoes, but so far no commercial quantities have been exported. *September 2007: News Headlines.*

▶ **United Kingdom: Grimme unveils new generation of potato planters.** Grimme, a firm specialising in potato machinery, has recently released a new series of planters and harvesters. The four-row GL44T planter uses ridged belts to accurately deliver seed to each planting downpipe, with a conveyor belt running in the opposite direction to avoid pile-ups. The machine also has an automatic levelling system to allow precise spacing even on slopes. In addition, fertiliser placement and liquid seed treatment options are also available. The new generation 490 hp four-row Tectron self-propelled harvester has features to improve lifting of soil and tubers, along with wheels that take some of the load off the front axle and help to reduce soil compaction. *September 2007: News Headlines.*

▶ **United States: USPB moves forward with 'new generation' of potato nutrition messaging.** Using consumer focus group testing, a potato industry working group has developed four creative ideas that will be developed into advertising aimed at reversing the decline in consumption of fresh potatoes. After further testing, a strategy to release the messaging will be developed. *September 2007: News Headlines.*

▶ **Nematode, PVY shows why battle to protect crops is never-ending.** This article (http://www.ars.usda.gov/is/AR/archive/aug07/potatoes0807.htm) explains why research into pests and diseases of potatoes needs to be ongoing. Twenty years ago, it seemed as if the golden or potato cyst nematode (*Globodera rostochiensis*) and potato virus Y (PVY) were under control. However, recently a new race of the nematode has been found to attack previously resistant potato varieties, while symptomless carriers of PVY have allowed that disease to re-emerge. New tools are needed to rapidly identify the resistant nematode, as is a survey of the genetic diversity and distribution of PVY strains. *September 2007: Feature Article.*

Interesting fact

▶ Potato production in Canada and the United States totals approximately $30x10^6$ tonnes/year: that's about 5 kilos each for everyone on the planet.

Horticulture™ New Zealand

CROP & FOOD RESEARCH
Mana Kai Rangahau

Chips is a no-frills summary of global R&D in the potato industry. We also provide you with access to full copies of all available papers for private study. To request copies, please email library@crop.cri.nz Produced for Horticulture New Zealand and Ausveg by Crop & Food Research. Visit www.hortnz.co.nz