



Soil and cultivation

Five scientific papers that have investigated various aspects of the role of soil and cultivation in potato production systems are summarised in this article. The first (Copas et al.) reports on a small plot experiment and several field trials carried out in central Wisconsin, USA.



The resistance of the soils to penetration was described by cone index profiles, which indicated that there was limited potential for root growth below the compacted soil layer with values > 2.0 MPa. In 2 of the 3 years of research, subsoil tillage below 33 cm reduced cone index values to < 1.0 MPa, although this did not affect total and U.S. no. 1 tuber yields. In addition, none of the quality parameters measured (internal defects and sugar concentration) were affected by subsoil tillage. The paper queries the validity of the wide-scale use of subsoil tillage by growers in this region.

In the second paper (Bernik & Vucajnk), field trials with three types of potato cultivators/ridgers carried out in Slovenia over 3 years on medium textured soil are described. A rotary, power take off (PTO) driven cultivator/ridger created the largest cross-sectional area of the ridge and was the most efficient at crushing soil aggregates in the inter-row space and at ridge shaping. Use of this implement gave a higher total yield of tubers than the other two cultivators/ridgers, which were both drawn implements (one having spring tines on a parallelogram framework and wing ridge heads attached and the other having rigid tines on a parallelogram framework and cogwheel ridge discs attached). While the PTO-driven implement gave better physical properties of the soil, both drawn implements had greater work-rates and required less energy to operate.

The third paper (Pavek & Thornton) summarises experiments over 3 years in the Columbia Basin of Washington State, USA, using two cultivars at planting depths of 10, 15, 20 and 25 cm. Tubers planted close to the surface were more affected by soil temperature extremes, but plant emergence was sometimes delayed for deeper plantings. Although node, stolon and tuber number per stem were affected by planting depth, and 'Russet Burbank' but not 'Umatilla Russet' had increased stem numbers as planting depth decreased, there were no effects on total yield. However, marketable yield and gross income were generally lowest for the 10 cm planting depth, with much of this being due to the increased frequency of green tubers.

The "second bread"

People in Belarus, eastern Europe, eat the most potatoes overall worldwide, consuming 184 kg/year per person – that's nearly half a kilo every day – which is way ahead of Russia, at 140 kg/year.

There are more than 200 traditional potato recipes in Belarus, where potato is known as "the second bread".

Agriculture and Agri-Food Canada has a network of 23 soil monitoring sites to provide baseline data on changes in soil quality and biological productivity of representative Canadian farming systems. The fourth paper (Rees et al.) compares changes in soil parameters between 1990 and 2000 at one site (22-NB) under intensive potato production (a potato-potato-barley rotation) in northwestern New Brunswick. The system of contour tillage with variable grade diversions and grassed waterway resulted in low soil loss and water runoff values. However, heavy fertiliser rates led to increased levels of soil potassium and phosphorus, and soil organic carbon levels and earthworm populations were very low.

Potato Yield and Quality Response to Subsoil Tillage and Compaction. Copas et al. (2009) *Agronomy Journal* 101: 82-90.

The effect of cultivator/ridger type on the physical properties of ridge, power requirement and potato yield. Bernik & Vucajnk (2008) *Irish Journal of Agricultural and Food Research* 47: 53-67.

Planting depth influences potato plant morphology and economic value. Pavek & Thornton (2009) *American Journal of Potato Research* 86: 56-67.

Soil and crop responses to long-term potato production at a benchmark site in northwestern New Brunswick. Rees et al. (2008) *Canadian Journal of Soil Science* 88: 409-422.



Disease control

► **Phosphite compounds reduce disease severity in potato seed tubers and foliage. In the research described in this paper, phosphites (alkali metal salts of phosphorous acid) were used to treat seed tubers and foliage of two potato cultivars, ‘Shepody’ and ‘Kennebec’, and plant resistance to three pathogens was measured.** Treatment of seed tubers gave good protection from *Phytophthora infestans*, intermediate protection from *Fusarium solani* and low protection from *Rhizoctonia solani*. With foliar application, protection against *P. infestans* was also high, with greater protection using calcium phosphite than potassium phosphite in ‘Kennebec’ but the reverse in ‘Shepody’. Other plant physiological responses were measured from some of the phosphite treatments compared with controls, such as earlier emergence, darker green leaf colour and a delay in crop senescence. *Lobato et al. (2008) European Journal of Plant Pathology 122: 349-358.*

► **Efficacy of FIT produce wash and chlorine dioxide on pathogen control in fresh potatoes.** FIT Fruit & Vegetable wash is a natural produce wash that is promoted as removing 99.9% of harmful bacteria from fresh fruit and vegetables, leaving no aftertaste or smell. This paper describes an experiment in a commercial fresh pack potato operation where potatoes were washed in flume water with or without FIT, or sprayed with FIT, 9 ppm chlorine dioxide or a water control. On potato surfaces, neither FIT nor chlorine dioxide gave significant reductions in the micro-organisms tested. However, when deionised water inoculated with micro-organisms was treated with FIT or chlorine dioxide, levels of microorganisms were reduced to below the detection limit. When flume water was treated with FIT or chlorine dioxide, only FIT had a large impact on microorganism levels. *Park et al. (2008) Journal of Food Science 73: M278-M282.*

► **Effectiveness of early-season, single applications of azoxystrobin for the control of potato black dot as evaluated by three assessment methods.** A series of experiments during 2003–2006 examined potato black dot disease after single applications of azoxystrobin made either at planting or at 34, 43

or 60–62 days after planting. The different methods used to assess disease on above- and below-ground stems were: (1) frequency of detecting *Colletotrichum coccodes* from 0.5 cm sections, (2) distance of sclerotium expansion and (3) sclerotium density. All three methods indicated that black dot severity was not reduced by application of azoxystrobin at planting, but application at 60–62 days after planting did reduce all of the disease indicators. Below-ground stems had more disease than the above-ground stems, as indicated by methods (2) and (3) in all years and method (1) in 2 of the 4 years. Tuber yield was not significantly different between any of the azoxystrobin treatments and the control in any year, although post-planting azoxystrobin treatment did reduce the incidence of infected progeny tubers compared with the non-treated control in some years. *Cummings & Johnson (2008) American Journal of Potato Research 85: 422-431.*

► **In vitro suppression of soilborne plant pathogens by coir.** Laboratory experiments showed that coir, the mesocarp pith of coconut, suppressed growth of the soilborne plant pathogens *Phytophthora capsici* and *Fusarium solani*. This only occurred when the coir was not sterilised, indicating that micro-organisms associated with coir were responsible for this effect. One micro-organism isolated from coir, *Aspergillus terreus*, inhibited mycelial growth of various soilborne pathogens by up to 75%. *Hyder et al. (2009) Horttechnology 19: 96-100.*

Processing

► **Review of the sugar end disorder in potato (*Solanum tuberosum* L.).** The sugar end disorder, also referred to as dark ends, jelly ends, translucent ends and/or glassy ends, is a serious quality defect in processing potatoes, causing French fries to become dark at one end, which makes them unacceptable to consumers. A symptom of the most common type of sugar end is relatively low starch and high sugar content in the basal end of the tuber. Factors that may lead to sugar end disorder include high soil temperatures, transitory soil moisture deficits and too little or too much nitrogen fertiliser, particularly if these occur during early tuber bulking. The accumulation of large amounts of sucrose in the basal tissues of the tuber appears to be a response to stress, and this is a result in the change in activity of key carbohydrate metabolising enzymes. Resistance to sugar end disorder is highly heritable. This paper lists research-based crop management recommendations to minimise the potential for development of sugar end disorder. *Thompson et al. (2008) American Journal of Potato Research 85: 375-386.*

► **Validation of a simple, colorimetric, microplate assay using amplex red for the determination of glucose and sucrose in potato tubers and other vegetables.**

A reliable, cost-effective method to rapidly measure sugar concentrations in tuber samples using samples of less than 1 g is reported in this paper.

Bethke & Busse (2008) American Journal of Potato Research 85: 414-421.

► **Natural DNA variation at candidate loci is associated with potato chip colour, tuber starch content, yield and starch yield.**

This paper describes an in-depth analysis of 243 potato varieties and breeding clones to look for genetic markers that correlated with chip quality before and after cold storage, tuber starch content, yield and starch yield.

A number of significant and robust associations of DNA markers with traits were found, especially for chip quality and tuber starch content. Several of these markers were in genes encoding for enzymes that function in starch and sugar metabolism or transport.

Li et al. (2008) TAG Theoretical and Applied Genetics 116: 1167-1181.

► **Effect of processing on slowly digestible starch and resistant starch in potato.**

The proportions of rapidly-digested, slowly-digested and resistant starch were measured in potatoes of the variety Frisia after laboratory-scale treatments had been applied to tubers that were raw, cooked or cooked followed by cold treatment (4°C, 2 days). The treatments included freeze-drying, coarsely mincing, pasting, freezing, and dry-milling after freeze-drying. There was very little rapidly-digested and slowly-digested starch in raw potato, and mechanical treatments did not affect this.

Over 95% of the starch in cooked potato was of the rapidly-digested type, but during cold storage up to half of this was converted to slowly-digested starch.

Tissue disruption after cooking was associated with the formation of resistant starch. Freezing after cooking gave similar results to the prolonged cold treatment, while freeze-drying of the cooked potatoes tended to increase the proportion of resistant starch. These findings provide some guidance on potato processing options to alter the nutritional profile of potato products, since rapidly-digested starch is associated with high glycaemic impact, slowly-digested starch provides sustained energy availability and resistant starch has prebiotic benefits.

Mishra et al. (2008) Starch-Starke 60: 500-507.



Potatoes Postharvest

► The following book has recently been published:

Pringle RT, Clayton RC, Bishop CFH 2009; Potatoes Postharvest. CABI, UK. 432 p.

Written by three well-known UK-based potato experts, the book begins with some plant physiological background information relating to potato storage and then examines harvesting and store loading systems. There are several chapters on various aspects of store design, equipment and the importance of accurately controlling the environment in the store. Towards the end of the book are chapters devoted to seed grading and preparation for planting, packhouse and processing facilities and quality control. The book finishes with a look at marketing and storage costs. This book is aimed at all participants in the potato industry, including researchers and potato growers.

Potato Review

► **Markets: Spud sales up as crunch bites deeper.**

The British Potato Council is taking advantage of price rises in rice and pasta to promote potatoes as a part of inexpensive, tasty and nutritious meals. Despite the recession, or possibly because of it, retail reports are indicating increases in volumes of fresh potatoes and potato products. In addition, McDonalds has seen a recent increase in sales, which is good for McCains who is the supplier of frozen fries. Fish and chip shops in Britain are also indicating greater customer numbers, which is in contrast to the trend in recent years.

Supermarket chains are developing promotions that focus on cheaper food options, and in many cases this involves potatoes. *November, p. 22.*

► **Irrigation: No room for poor water management.**

This article summarises presentations from two irrigation specialists at a seminar in the UK. The speakers described the significant negative effects from under-watering (e.g. poor crop nutrition) as well as over-watering (e.g. shallow rooting, oxygen stress, soil damage and nutrient leaching). Both speakers stressed the need for irrigation scheduling – properly timed applications that started with knowing what the soil moisture content was and then made adjustments according to other factors, such as soil type, irrigation system, crop type and intended market, etc. The importance of keeping good records was also emphasised, as detailed information is needed

to feed back to decision-making in future crops and to negotiate with water regulation authorities. *November, p. 26.*

Potato Country

►Receiving seed in your commercial storage?

Dormancy enhancers keep commercial storages free from CIPC. This short article alerts readers to the possibility that solid CIPC crystals applied in autumn can remain in a seed store for many months and could potentially inhibit sprouting or reduce seed vigour in subsequent seed tubers placed into that storage facility. An alternative to CIPC is the dormancy enhancer 1,4dimethylnaphthalene, which is applied as a fog and does not leave long-term residues. Its effects are temporary and fully reversible, although this does mean it may need to be applied several times during storage of a crop. *December, p. 38.*

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 that are indicated.

►Potatoes score high on newly developed

nutritional scoring system. Scientists from Yale have developed a way to score foods involving a complex mathematical formula that includes the content of a large number of nutritional and anti-nutritional compounds. The "Overall Nutritional Quality Index" (ONQI™), or NuVal Score, is a value between 1 and 100, with a higher number indicating a healthier food. Potatoes scored an excellent 93, which compares well against salmon (87), white rice (57), pasta (50) and apple pie (2). Broccoli topped the list with a score of 100. *December 2008: Feature Article.*

►Potato humidity: A key aspect of storage

management. This summary directs the reader to an excellent article (<http://www.fruitandveg.com/content/view/1961/61/>) about the effects of evaporation on weight loss in potatoes and how to prevent it by maintaining a high relative humidity in the potato store. Not only is potato yield affected by water loss, but dehydrated tubers may have poor quality, inferior texture, discolouration and diminished taste. The article describes how humidity may need to change during various phases of potato storage and in response to temperature, and summarises some of the humidifying devices available for potato storage operations. *December 2008: Feature Article.*

►Effects of the season on seed physiology

and seed performance. This article refers to a paper that was presented at the Idaho Potato Conference (<http://www.kimberly.uidaho.edu/potatoes/2002seedproceedings.pdf>). It investigated the effects of weather, particularly temperature, during the growing season on subsequent performance of the potato seed tubers produced. While extremes of temperature are important, even more influential is the timing of these extreme events in relation to the developing seed tubers. Other factors, such as length of the growing season, cultural practices, soil moisture and plant stress with also affect seed physiology. To some extent these can be modified by storage, with higher temperatures causing the stored seed to mature more quickly. *December 2008: Feature Article.*

►India: Frito-Lay planning pan-India expansion under the contract farming model.

Frito-Lay, the foods business unit of Pepsico, procures half of its potatoes for making chips from contract farming agreements. Currently this is done in eight states across India, but the company is planning to introduce this system across the whole country. Frito-Lay is also involved in cultivar development and seed production in India. *January 2009: News Headline.*

►United States: Burbank acreage continues

decline. Recent results released from a survey of the eight major potato producing states in the USA confirm that plantings of Russet Burbank have again dropped, being replaced by newer russet and specialty potato varieties. *January 2009: News Headline.*

►Fifty potato facts.

A fact sheet about potatoes has been compiled and published by the International Potato Center (CIP) in Lima, Peru. It is available at <http://www.cipotato.org/publications/pdf/004495.pdf>. *January 2009: Feature Article.*

►Updated: Comparison of fungicide products for the control of *P. infestans* in Europe.

This website (<http://www.euroblight.net/Fungicide/FungicideComparison.asp?language=UK>) gives an excellent summary of the effectiveness of fungicide products/co-formulations for the control of *P. infestans* in Europe. The ratings, based on the highest rate registered for Europe, were considered by the Fungicides Sub-Group at the Hamar Late Blight Workshop in 2008. They have been developed from field experiments and experience of product performance when used in commercial conditions. *January 2009: Feature Article.*

