NOVEL TECHNOLOGIES FROM AROUND THE GLOBE

From Africa to the Netherlands, aeroponics to manure scanning, new innovations are cutting costs and increasing productivity.

Aeroponics: More Disease-Free Seed Potatoes in Less Time for Developing Nations

Disease-free seed potatoes produced in higher quantities and in less time are the result of research into aeroponics, now underway through the International Potato Center (CIP).

Aeroponics refers to the process of growing plants that are suspended in a closed or semi-closed environment, and spraying their dangling roots and lower stems with a nutrient-enhanced water solution. Compared to traditional or hydroponic growing methods, aeroponics reduces water and energy costs.

Victor Otazú, head of CIP's Research Support Unit, says aeroponics was adapted at CIP headquarters in Huancayo, Peru, in 2006. The goal was to simplify a formerly sophisticated technology, first developed by NASA, so that seed potato growers in developing countries would be able to use it.

"With the conventional substrate, we used to get five to eight mini-tubers per plant. With aeroponics, we can get from 30 to 50 per plant," says Otazú. He adds that the cost of growing a tuber using aeroponics is about one-quarter the cost of a conventionally-grown tuber.

"In an initial greenhouse space of 20 by five metres, we can get enough quality potato seed to plant one hectare in the field. From this hectare, we can get 20 metric tonnes of seed—enough to plant 10 hectares the following season. From these 10 hectares, we can have enough seed to plant 100 hectares the following season. So in three generations of seed multiplication, we can provide large amounts of quality seed to small-scale growers in a country such as Kenya," he says.

Due to quarantine problems, Peru can't export field-grown potatoes. However, disease-free seed potatoes grown in greenhouses in the Andes can be exported to other Andean countries.

There are now 11 aeroponic modules in Peru, three in other Latin American countries, and 13 in Africa.

The main disadvantage of aeroponic production is its dependence on electric power to maintain the constant spraying needed to keep the potato plants growing. In some African countries, the power goes off quite often. To solve this problem, CIP researchers are devising another hydroponic technology that does not depend on electricity, Otazú says.

The new technology uses sand as an inert material, along with an elevated tank containing a nutrient solution. Using gravity rather than electricity, the nutrient-laden water flows down to the plants through distribution pipes provided with droppers. The result is good growth and yield of clean tubers. This is a cheaper and simpler system for quality seed potato production.

CIP is using aeroponic research techniques to grow seed potato crops in Latin America and Africa.

Photo courtesy of the International Potato Center

"The yield with this technology is not as high as with aeroponics, but it is much better than with the conventional method," says Otazú. "We are still analyzing costs and other aspects, but because of the simplicity of it, I believe it will get established quickly in developing countries."

Dutch Company Develops Mini-Tuber Production System

Living Foods, a Dutch company based in the Netherlands, has developed an enclosed production system that uses nutrient film technology (NFT) to grow seed potatoes. According to Living Foods, seed production is cheaper and more efficient using the NFT technology. A running water film contains a nutrient mix designed to maximize production.

"The cost of the mini-tubers produced in our system is much lower," says Timo ter Voort of Living Foods. "In Holland, the lowest price of a seed potato grown in field production is about 45 cents, and our price—including all variables like labour, energy, and plant material—is under 20 cents."

Most of the company's NFT systems are being used in Holland, where the average number of tubers grown per plant is 50. According to Ter Voort, testing in Columbia, using potato varieties indigenous to the Andes, resulted in an average of 55 mini-tubers per plant. Operating from April to October in Holland, the system, which is housed in a greenhouse, can produce two crops.

Other benefits include no leaching of fertilizer into groundwater, lower risk of virus infection and bacterial contamination,

Photo courtesy of Living Foods

The cost of producing each mini-tuber is reduced using nutrient film technology to grow seed potatoes, says Ter Voort.

and a smaller crop area is required. According to the company, a 260-square-metre growing area will produce approximately 100,000 mini-tubers and 120,000 in a 160-square-metre area, twice per year.

Biopesticides: Increased Adoption Worldwide

Biopesticides are derived from natural materials, such as animals, plants, bacteria and minerals. Generally less toxic than chemical pesticides, they are commonly used for organic production, but are increasingly being adopted by farmers across Canada and the United States.

Biopesticides fall into three major classes: microbial, which consists of a microorganism—such as a bacterium, fungus, virus or protozoan—as the active ingredient; plant-incorporated protectants, which are produced by plants after genetic material is added; and biochemicals, which are naturally-occurring substances—such as scented plants—which can be used to lure pests into traps.

The popularity of biopesticides is growing throughout the world. Research and Markets' recently released report, "The 2010 Worldwide Biopesticide Market Summary, Volume One" shows that sales of microbial pesticides were $396 million from 2007 to 2008—up 47 per cent from three years earlier. If other types of biopesticides are included, the total sales figure rises to $1 billion, about 2.5 per cent of global pesticide sales from 2007 to 2008. Biopesticide sales are predicted to increase at least 10 per cent by 2020.

According to the Biopesticide Industry Alliance, a U.S.-based industry group, the benefits of using biopesticides include: improved crop quality and yield; reduced toxicity compared with conventional pesticides; compatibility with integrated pest management practices; direct application to harmful pests instead of broad spectrum application, which could kill useful insects; the ability to be used in small amounts; and quick decomposition, which aids farm labour safety and harvest timing.

Lucie Grant, president and director of product development for Florida-based Jet Harvest Solutions, says that preventing pesticide resistance is one of the biggest reasons potato producers are investing in biopesticides. "Resistance management is a major determining factor in using a biopesticide over a pesticide when it comes to potato production. Potatoes are treated post-harvest and stored for many months. During these long storage times, plant pathogens, like fusarium dry rot, can develop resistance to conventional chemical pesticides," says Grant.

Jet Harvest Solutions has developed two bacterial biofungicides for post-harvest disease control. The products are based on two different isolates of the plant pathogen, *Pseudomonas syringae*—one product has been approved for use on potatoes in storage in Canada.

Photo courtesy of Jet Harvest Solutions

Potatoes going into storage are being sprayed with biopesticide to prevent post-harvest decay.

British Study Uses Infrared Scanning to Test Manure Quality

Britain's potato growers, like farmers around the world, face increasing costs for chemical fertilizer. At the same time, livestock producers are seeking markets for their animals' waste. A recent study of new technology for manure analysis shows that using near-infrared reflectance spectroscopy (NIRS) can help potato growers and producers of other field crops to make more efficient use of manure to improve the condition of their soil and save money.

"We have found the NIRS method not only to be faster and cheaper to perform, but also more accurate than conventional wet chemistry methods." Gary Collins

NIRS uses the near-infrared region of the electromagnetic spectrum to measure the intensity of wavelengths to identify particular elements within a sample. The study was conducted by the Department for Food and Rural Affairs, with industry partners including Eurofins, ADAS—formerly known as the Agricultural Development Advisory Service—and the Potato Council.

"Taking cattle farmyard manure nutrients into account can save over £250 [$392 CDN] a hectare in manufactured fertilizer costs," says Gary Collins, the Potato Council's nutrition specialist. "This is based on a 40 tonne per hectare application rate, which would be the maximum application, as we have a total nitrogen limit from organic manures of 250 kilograms per hectare."

As in Canada, commercial laboratories in Britain offer nutrient content analysis for manure, but a survey conducted a few years ago showed that only four to seven per cent of British farmers had any analysis completed on cattle farmyard manure, and just 13 per cent on dairy slurry. According to Ken Smith of ADAS, by not having the manure they use tested, farmers run the risk of being up to 300 per cent wrong on their nitrogen supply calculations. Not only does an excessive nitrogen level in soil harm crops, but there are also negative environmental consequences and possible legal penalties involved.

He attributes the lack of testing to relatively high costs—from £40 to £70 ($63 to $110 CDN) for manures and about £50 ($78 CDN) for slurries—and long turnaround times of up to two weeks for test samples sent through the mail. In comparison, tests using NIRS take about 10 minutes, so results will be available much faster than with the traditional wet chemistry method, and the test cost is expected to drop to £22 ($35 CDN).

"We have found the NIRS method not only to be faster and cheaper to perform, but also more accurate than conventional wet chemistry methods. There is also the added benefit of there being no environmental impact from the disposal of the concentrated acids that are used in conventional testing," says Collins.

NIRS is commonly used to test grain and silage. In order to calibrate the equipment for analysis of manure's nutrients and dry matter, hundreds of samples were collected and analyzed, and the sampling method was developed. Under the terms of the partnership agreement, Eurofins now has exclusive rights for use of the NIRS scanner for manure analysis for a two-year period, which will be followed by a service review by the consortium that owns the intellectual property rights.

At the present time, Canadian potato growers pay about $40 for manure analysis, and testing takes 48-hours. If Eurofins' experience proves successful, NIRS scanning could soon be used by Canadian companies to test manure samples.

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