

INTERNATIONAL PEST CONTROL

March/April 2013
Volume 55 Number 2



Public Health ♦ Agriculture ♦ Horticulture ♦ Amenity ♦ Forestry



Locating and controlling stable flies

Keeping birds at bay in
food production

Space spray fundamentals

Developments in
insect detection

Managing pests in food handling facilities

NPTA celebrate twenty
years

China Agrochem show review

Improving local pest
control businesses on
the internet

Improved stink bug trapping methods

Quality control for
stored coffee and
cocoa

Managing metaldehyde

Managing needle
necrosis in Christmas
trees

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Volume 55 Number 2

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Federation of Asian &
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Cover – Improved coverage using small discretely deposited droplets will lay the foundations for more rapid and complete uptake of foliar applied nutrients. Foliar feeding fruit trees along waterways in Thailand (Picture Omex)



David Loughlin, Editor
International Pest
Control Magazine

You may notice a few changes to IPC magazine this issue. Besides aiming to cover all aspects of pest control in print, we have now embraced the digital age and have broadened our reach to include social media. We invite you to search out our various locations on LinkedIn, Twitter and Facebook where we welcome your contributions.

We aim to compliment your other sources of information, so please do make contact as it helps us to stay both current and relevant. We are also pleased to put faces to the names of our team of learned Technical Consultants who contribute to IPC throughout the year. Should you encounter them or myself at various exhibitions and events, do please seek us out to discuss what's new or important in your part of the industry.

It has been a busy news month regarding food security in Europe, with stories often featuring groan-inducing horse meat puns. It is timely therefore to run our feature on pest control in the food industry. As we went to press, news was breaking about legal action being taken after a serious outbreak of salmonella in a US peanut factory in 2009, allegedly linked to poor pest management.

Also provided in this issue are updates on what is new in the semiochemicals industry; how nutrients help in building plant defences and a review of fly control in animal husbandry and in storage environments.

David

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Technical Consultants



Clive Boase runs the Pest Management Consultancy, probably the UK's longest-running urban pest consultancy. "I continue to be amazed by the diversity of urban pest issues. We now work with a broader range of projects and clients than ever before, including pests and construction materials, poultry pest strategies, development of experimental pesticides, bed bugs and the Olympics, strategies for urban housing, invasive species risk assessments, not forgetting training and legal work. This is a very dynamic sector." www.pest-management.com



Rob Fryatt B.Sc. held senior positions within ICI, Zeneca and Sorex and now leads Xenex Associates who provide advice to agrochemical suppliers, pest management companies and other organisations around the globe. Rob has been a Director of the BPCA, Director General of CEPA and chairs the CEN European Committee developing a common pest management service standard. Rob is a frequent invited speaker at industry events and has written regular opinion columns for a number of international industry publications. www.xenexassociates.com



Dr Terry Mabbett is a pest, disease and weed control specialist with forty years of international experience covering research, consultancy and journalism in agriculture, horticulture, forestry, amenity, livestock and public health. His current areas of particular interest are the protection of tropical tree crops and exotic insect pests and plant pathogens of Britain's native, naturalised and forest plantation trees. Drterrymabbett@btinternet.com



Graham Matthews DSc., FSB., FRES. began his career in Africa working on cotton pest management before joining Imperial College. Research and teaching pesticide application at Imperial and overseas has been interspersed with consultancies for international organisations, such as the World Bank. Author of several books, he was formerly an editor of Crop Protection. Retired in 2001 and now Emeritus Professor of Pest Management. www.dropdata.net



Martin Redbond B.Sc. has spent nearly forty years working in the crop protection industry where he has held various sales, marketing, technical and regulatory management positions with multinational companies and in contract research. He is the author of a number of important crop protection reports and has been editor of Crop Protection Monthly for the past eight years. www.crop-protection-monthly.co.uk

New insect to patrol apple orchards

New Zealand pome fruit growers are enhancing their management options for one of the key pests for the top fruit orchard industry, the codling moth, with the release of a new biocontrol agent. Plant & Food Research scientists, with support from Pipfruit New Zealand, have been investigating the potential for *Mastrus ridens*, a small parasitoid wasp, to control the codling moth, *Cydia pomonella*, one of the major pests affecting the New Zealand pome fruit industry.

Following EPA approval, field appraisal will take place over the next few years to measure the effectiveness of the wasp as a long term biological control agent. The first release in commercial orchards, of 1,000 individuals, was made in Hawke's Bay this season.

"Codling moth is a major issue for the industry, with control of the pest costing between \$8 and \$12m each year," says Mike Butcher, Technical Manager of Pipfruit New Zealand. "Whilst the presence of a single moth in a shipment can impact on market access for all New Zealand apple exports to codling moth sensitive markets, the industry is also focused on reducing the use of chemical pesticides.

This ultimately means we must find new ways to control pests, and the introduction of the wasp as a biological control agent is an important new component to our system that currently includes mating disruption, a codling moth specific virus and selective chemistry. This release is an important step in meeting quarantine requirements for our premium markets."

The *Mastrus* female wasp attacks the pupae of codling moths, laying its eggs on the moth larvae. When the wasp larvae hatch, they feed on, and eventually kill, the codling moth larva. They then emerge as adult wasps to disperse and seek new codling moth larvae on which to lay their eggs.

"Biological control agents, such as parasitoid wasps, play an increasingly important role in controlling pests as chemi-

cal interventions are reduced," says scientist John Charles from Plant & Food Research. "This species, which originated in Kazakhstan, has been established in other countries, particularly in the USA, for control of codling moth, and these initial releases in New Zealand will help us to determine how well they survive in our environment and control the pest."

The *Mastrus* wasp was approved for release by the Environmental Protection Agency in June 2012 and thousands have since been reared in captivity.

A video showing the female *Mastrus* wasp laying her eggs can be found at <http://youtu.be/1OF--XpWNlg>. Source: Plant & Food Research Mt Albert, Auckland, New Zealand.

CEPA revises corporate structure

In anticipation of the launch of a European standard for pest management services, CEPA's



Extra-Ordinary General Assembly, which took place in Brussels on 5 February 2013, voted unanimously to approve revised Statutes, clearing the path towards transforming the Confederation into a fully-fledged, Not-for-Profit organisation under Belgian law (ASBL).

Signing the incorporation papers were representatives from CEPA's five biggest national associations (France, Germany, Italy, Spain and the UK) as well as Belgium and the Netherlands, CEPA's original founders.

This represents a major step in the development process of the Confederation, signalling to all stakeholders that CEPA is ready to

tackle the challenges and opportunities that lie ahead when the European Standard for Pest

Management Services, currently under development in collaboration with CEN, the European Committee for Standardisation, will be launched next year.

The Confederation of European Pest Management Associations (CEPA) is based in Brussels and represents the European professional pest management industry. It unites and federates 20 national associations as well as associates from international pest management servicing companies, manufacturers and distributors.

For more information, contact Roland Higgins, Director General roland@cepa-europe.org



CEPA Directors at the incorporation ceremony (from left to right): Francesco Saccone, Rainer Gsell, Brigitte Guillot, Frederic Verwilghen, Bertrand Montmoreau (Chairman of the Board of Directors), Simon Forrester, Martina Flynn, Daniel Lucien, Serge Simon, Alain van Lidth de Jeude and Roland Higgins.

European crop protection industry initiates project to contribute to minimise pesticide residues in food

In November 2011 the crop protection industry took another step toward establishing itself as a valued partner in the pursuit of a more sustainable farming system in Europe. The initiative aims to deliver measurable results in four thematic areas of: safeguarding water, the enhancement of biodiversity, the provision of safe and affordable food and the protection of health. The European Crop Protection Association (ECPA) has recently launched a dedicated project on Residue Management which is part of the food stream.

Improvements have been made within the past years. Year after year, the results of the Annual Report on Pesticide Residues carried out by the European Food Safety Authority (EFSA) are showing this. Exceedances of Maximum Residue Levels (MRLs) have diminished and pesticide residues in general have been declining. MRLs are set 100 fold below residue safety levels so exceedances reported do not mean that the food is unsafe to eat, however all efforts must be undertaken to avoid exceeding the limits.

Nevertheless, there is still a lot to be done. This project falls within ECPA's overall new initiative to develop joint industry projects which contribute towards a fully sustainable European agriculture in a manner that meets consumer expectations.

The residues project aims to contribute towards further minimizing pesticide residues in food and it is hoped that this will ultimately foster consumer trust in food safety. This residues project is being conducted together with the Experimental Station Cajamar Caja Rural "Las Palmerillas", situated in the heart of the Spanish greenhouse production Almería. "A train-the-trainer concept will be developed to understand the steps undertaken that help to improve the management of residues. This will then be shared through a cross-country collaboration with other regions to spread the acquired knowledge" - said Jan Rether, Project lead of the Residues Management Project at ECPA.

"The crop protection industry takes consumers' concerns about residues in food very seriously" - commented

Friedhelm Schmider, Director General of ECPA. "We believe that by undertaking this project we can really help improve the remaining issues regarding residue exceedances in Mediterranean fresh pro-

duce." The first intensive trainings with stakeholders will take place in June 2013 at Las Palmerillas, Spain.

For more info the initiative, visit www.hungry4change.eu

EU may ban some neonicotinoid pesticide uses. Syngenta & Bayer react

The European Union has proposed a two-year ban on imidacloprid, thiamethoxam and clothianidin on crops attractive to honey bees, a move prompted by a European Food Safety Authority (EFSA) report that identified risks to the bees. The Commission also wants to prohibit the sale and use of seeds treated with plant protection products containing these active substances, according to a Jan. 31 proposal at a meeting of the Standing Committee on the Food Chain and Animal Health.

The Commission asked member states to put in place a two-year suspension on clothianidin, imidacloprid and thiamethoxam as granules, seed treatment or sprays on maize, oil seed rape, sunflowers, cotton and cereals (except for winter cereals). The regulation is expected to be implemented by July 1. "These are proportionate measures. We are giving the member states two years to see whether it's working. Then we will see if we need to review the legislation in Europe," the Commission's spokesperson for health and consumer policy, Frederic Vincent, said on Jan. 31 in an article on the Europolitics website.

In its report published Jan. 16, EFSA found that contamination of neonicotinoid-treated crops, neonicotinoid dust exposure, and nectar and pollen exposure contributes to declines in honey bees and weakens their hives. It also identified high risks from exposure to guttation fluid from corn for thiamethoxam.

Herman Fontier, head of the pesticides division of the European Food Safety Authority (EFSA), told a Parliamentary committee that his organisation's recommendation that neonicotinoid pesti-

cides, widely blamed for bee declines around the world, should be kept away from bees, was merely a risk assessment - and it was up to individual EU member states whether or not to act on it.

Syngenta, Bayer React

Switzerland-based Syngenta, which makes thiamethoxam, said it believes the EFSA "found itself under political pressure to produce a hurried and inadequate risk assessment, which even they acknowledge contains a high level of uncertainty." A recent study cited by the company showed that without neonicotinoid seed treatment, crop yields would fall by 40% and cost the EU economy around \$23.1 billion over five years.

"Seed treated with thiamethoxam has been used across millions of hectares of European crops for over ten years. When used properly the technology does not damage bee populations and this is why many EU countries have continued to support its use," Syngenta said.

Bayer CropScience - the principal manufacturer of imidacloprid - called the proposal "draconian" and a "missed opportunity to achieve a fair and proportional solution." Bayer, of Monheim, Germany, requested EU member states "adhere to the principles of proportionality when addressing the Commission's proposal and refer back to solid science before taking any measures." The company added: "Any disproportionate action would jeopardize the competitiveness of European agriculture and finally lead to higher costs for food, feed, fiber and renewable raw materials and have an enormous economic impact throughout the whole food chain."

Bumblebees combine pollination with crop protection

Bert Synaeve*

Bumblebees that are already used in the pollination of crops such as strawberries can also be used to carry microbial pesticide preparations to plants, to control grey mould and other major diseases, which cause huge yield losses annually.

Grey mould is spread through airborne particles, and infects strawberries and raspberries during the flowering period, yet only becomes visible when the fruit ripens or during storage – when it is too late to be controlled.

The new Flying Doctors system from Biobest consists of a patented dispenser system that is available as a fully integrated option to the standard bumblebee hive.

As the bumblebees leave their hive, they walk through a tray of specially formulated microbial fungicide or microbial insecticide preparation, which clings to their legs and body. They then deliver this product directly to each flower they visit. The bumblebees' hairy bodies and buzzing habit when visiting flowers, makes them especially effective as delivery vehicles.



The dispenser can also be used to enhance pollination by placing commercially available pollen in the tray, instead of the microbial fungicide/insecticide. This application can be used in a number of fruit crops, including apples, almonds, kiwi, and cherries.

This replaces labour-intensive spraying or dusting of the pollen, allowing growers to save on pollen bills.

The Flying Doctors system represents pollination combined with crop protection. This simple yet effective method saves labour, requires less volume of product and also helps reduce the risk of pesticide resistance and residue problems, making it a sustainable agricultural solution. Good results have already been obtained under test conditions at the Biobest Green Lab, as well as in commercial crops.

The system brings together all the benefits of bumblebees, such as effective pollination even early in the season and under adverse weather conditions, with crop protection that fits current IPM programmes. It can be used in fruit or vegetable crops, and although the focus is currently on flower-associated diseases such as grey mould and pests like flower thrips; Biobest's R&D team is exploring the potential of this new technology to combat foliar diseases and pests too.

According to Biobest, the launch of a new Western bumblebee species will allow growers in North America and Canada to take advantage of the scheme, with their own local Flying Doctors. Biobest presented the Flying Doctors system at Fruit Logistica, Berlin in February, the world's leading trade fair for the fresh fruit and vegetable business.

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BaitSafe® alternative to conventional methods of surface baiting

Described as ‘the most revolutionary change to bait station design in 20 years’, BaitSafe® manufactured by ‘MakeSafe® Pty Ltd, offers a HACCP certified alternative to conventional methods of traditional surface baiting. When used as an applicator for rodent control, the bait is contained within a lockable unit discouraging vermin from moving to bait stations in open production or storage areas in search of food. It is particularly well adapted to food industry application.

First launched in July 2012 at the FAOPMA Conference in Australia, BaitSafe has since gone on to win the 2012 Australian Food Magazine Award for Food Safety & Innovation in Non-Food. The product can be installed into walls, ceilings, flat roofed areas, eaves and floors, between floors, cupboard bottoms with many more applications allowing the Pest Controller to inspect, monitor and or place bait directly into areas where pests live and breed. In contrast to traditional bait stations, BaitSafe is not exposed to the public therefore eliminating the risk to staff; children or pets coming into contact with any possible bait located behind and because it is an internal station is also good for the environment. The unique design positions BaitSafe as the first product on the market to offer a discreet solution.

Bill Simos, Managing Director of HACCP International’s operations in Asia says. “BaitSafe® is an “out of the box” invention that is simple to use and brings many advantages to controlling rodents and insects in tight spaces”. The device is the only wall and ceiling void bait station for rats, mice, roaches, bedbugs, scorpions and stored product pests currently on the market today. Mr Gary McMahon, CEO and Co-inventor of BaitSafe® added “The Company and its partners are delighted to achieve HACCP International certification but to gain dual rodent and insect approval was the icing on the cake.

To monitor, a pest controller can quickly access the bait using the key, check for evidence of pests and replenish the bait supply if needed. No ladder is required to monitor units that are installed in ceilings, as operators can screw a standard extension or paint pole into the key to

open the unit from floor level, simplifying the maintenance process and removing ‘working at height’ issues.

For more information visit website www.baitsafe.com.au or e-mail info@baitsafe.com.au in Australia or info@pandlsystems.com for the UK, Europe and the US.



HACCP International certifies BASF pest control products for food industry

HACCP International has certified a pest control products manufactured by BASF for use in food premises across the Asia Pacific region. The certification covers the Vector™ branded fly control system products, Roguard® branded rodent bait stations and several insecticide and rodenticide products for pest management professionals.

Pests pose a significant health risk to food premises where insufficient control can lead to infestation and serious consequences to consumer health. In addition, pest control products must be used appropriately in order to avoid introducing a greater risk than those they are designed to control

Those responsible for food safety within a food processing or handling facility must ensure that they, and their pest control service providers, source

solutions that are both effective and food safe. All certified products are evaluated to determine the fitness for purpose in the food industry and the compatibility with the food safety standards and Quality Assurance schemes.

Mr Akihiro Onda, Regional Head of BASF’s Pest Control Solutions business in Asia Pacific, said “It’s important to us that products which are particularly suitable for the food industry are identified as such – helping pest management professionals to help their customers. Protecting the food industry through the development and supply of innovative and accredited products is strategically very important to our business. Not only do we want to provide pest control solutions for the food industry, but we see HACCP certification as an important step in connecting closely with key customers in this significant sector.”

Rimini, Italy pays host to Disinfestando 2013

On 6th and 7th March, one of the Europe’s largest exhibitions for the Pest Control Industry was held in Rimini in the Palacongressi. The ANID organised pest control event provided opportunities for the many visitors and the 40 exhibitors from Italy and abroad, to meet new customers, strengthen ongoing relationships and keep an eye on new market opportunities and competitors.

Starting on the 5th March afternoon with the General Assembly of Members of ANID, the main accompanying

program to Disinfestando provided two days of presentations on topics of interest to all those involved: the new Biocides Regulations; the future of CEN standards on services of pest control; the resistance to anticoagulants in Italy; the experience of the City of Rome in the fight against *Aedes albopictus*, the Asian-Tiger mosquito; the new National Collective Labour Agreement; public procurement; the effectiveness of *Bacillus* spp in controlling mosquito larvae and Waste Management in Pest Control.

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Rogue traders cash in on Chalara ash dieback confusion

Following widespread reports of Chalara ash dieback caused by the fungus *Chalara fraxinea*, unscrupulous operators in SE England, masquerading as professional arborists and tree surgeons, are scaring landowners into felling perfectly safe and healthy common ash trees. As of February 25th 2013, the UK Forestry Commission had confirmed 386 cases of chalara ash dieback disease across the country.

Rogue traders are playing on fears generated by national media reporting of chalara ash dieback at the end of last year. Kent County Council Trading Standards is the latest organisation to warn on this development.

Current information from DEFRA says no-one will be forced to destroy ash trees unless they are young trees on recently planted sites confirmed with chalara ash dieback disease. In these situations the Forestry Commission or another branch of the UK plant health



Plant Health Notices will only be issued for destruction of young ash trees on recently planted sites. Bark lesion shown here. Picture Forestry Commission.

authority will issue a Plant Health Notice. This means that all mature ash trees should (for the moment) be spared. However, this does not take into account any developing issues with public safety for which landowners (tree owners) are clearly responsible.

These escalating threats to perfectly healthy fully grown ash trees from 'cow-boy' operators shows the urgent need for UK plant health authorities to approve the use of microinjection of systemic fungicide into ash trees for their protection. Finding a solution should not prove too difficult. North Americans are dealing with a potentially lethal disease of oak trees called oak wilt caused by a very close relative of chalara ash dieback. Oak wilt is caused by a fungus called *Chalara quercina*. Oak trees in N America are successfully protected (and in some cases cured) of oak wilt disease by microinjection of the systemic fungicide propiconazole. The fungicide is

MI Dengue® from Ecovec named Edison Awards finalist

MI Dengue has been named a 2013 Award Finalist in the Lifestyle and Social Impact category by the US based Edison Awards™. The awards symbolize the persistence and excellence personified by Thomas Alva Edison, inspiring creative minds to remain in the forefront of innovation, creativity and ingenuity in the global economy.

Ecovec is a technology leader in intelligent dengue monitoring solutions. MI Dengue provides an online platform for real-time, city-wide surveillance of mosquitos that transmit the dengue fever virus. The system uses novel low-cost mosquito traps, an *Aedes aegypti* specific attractant, and a mobile software platform to generate real-time maps that allow optimized mosquito control and help

prevent dengue outbreaks. The MI Dengue system has helped to protect more than 18 million people in 60 cities over the past seven years from the dengue virus, and, according to clients, has conserved the amount of insecticide needed to control mosquitos by up to 60%.

"Dengue fever is the fastest spreading neglected tropical disease on the planet, and MI Dengue is an innovative

Pest control software firm celebrates 20 years

Service Pro.net, developers of ServSuite, is celebrating its 20th anniversary this year. The family-owned technology company was started by Richard Deering as an off shoot of his lawn and pest management company. Its first product was a Windows desktop-based software program designed specifically for the family's pest control business.

After selling his lawn and pest control business, Richard and his family

focused on developing Service Pro.net. Its products evolved into web-based programs with over 1400 databases between its two main products. Service Pro.net's latest innovation, ServSuite Mobile, was launched just last year.

What was once a business that had less than ten employees has now grown to a medium-sized operation with close to one hundred employees. The company has expanded its operations to include a larger and stronger sales

team, a marketing team, development department, and a very responsive support department. This growth in operations has lead to the permanent move of the company into their very own office building in Columbus, Ohio.

As part of their 20th anniversary celebration, Service Pro.net is inviting everyone to celebrate with them in person at the 2013 ServSuite University in Nashville, Tennessee. See www.theservicepro.net for details.

injected into the tree trunk by operators working at ground level and subsequently transported acropetally to all aerial parts of the tree in the xylem (water conducting tissue).

Propiconazole is a member of the azole group of fungicides (sub group triazole). By mode of action propiconazole is a Steroid Demethylation (ergosterol biosynthesis) Inhibitor or DMI. The active ingredient stops disease development inside the plant by interfering with sterol biosynthesis in the membranes of fungal cells. There are other triazole fungicides including tebuconazole, used in a similar way to protect against and control oak wilt disease, which could also be used to control Chalara ash dieback disease in the UK. With this technique approved and in place landowners will have the option of protecting trees rather than pre-emptively felling them. Source: Dr Terry Mabbett.



The Ecovec system uses traps to capture mosquitoes. The traps are positioned within the urban area and are checked weekly

solution to put the brakes on the spread of this disease,” said Ecovec director Luis Felipe Ferreira Barroso. “It is a great honor to be recognized for our innovative approach to fighting dengue fever.”

The Edison Awards received over 360 nominations this year. The ballot of nominees is judged by more than 3,000 senior executives and academics. Award winners will be announced April 25, 2013 at the Awards Annual Gala, held in the Grand Ballroom at Navy Pier, Chicago, IL.

Say it with flowers – provided they’re pest free

Each year, U.S. Customs and Border Protection agriculture specialists inspect millions of cut flower imports during the February Valentine season because some of these flowers may carry hitchhiking pests and diseases that could harm the U.S. flower industry. “Agriculture inspections are a crucial part of the inspection process for items entering into the country,” said Kevin Harriger, executive director for the CBP Agriculture Programs Trade and Liaison office. “CBP works to identify a relatively small number of harmful hitchhiking pests amongst the millions of stems entering the country because even a single dangerous pest could cause millions of dollars of damage to our nation’s crops.”

One of the most serious diseases that can be introduced via imported flowers is chrysanthemum white rust. If established in the United States, the disease could decimate the U.S. chrysanthemum industry. Other agricultural pests and diseases capable of destroying our nation’s crops or forests include the Emerald ash borer, the Asian long-horned beetle, citrus canker, and the Khapra beetle.

During the 2012 Valentine’s season from Jan. 1 to Feb. 14, the US CBP processed 842.2 million cut flower stems.

Most of the cut flower shipments are imported from South America, primarily Colombia, with 536.1 million stems or 67 percent, followed by Ecuador with 194 million stems or 23 percent. Miami ranks first among U.S. ports of entry for shipments of cut flower imports, followed by Los Angeles. The quantity of imported cut flowers processed by both ports during the 2012 Valentine’s season increased 5.7 percent compared to the 2011 season.

The imported cut flowers inspection process resulted in a total of 2,439 pest interceptions nationally. Miami intercepted 1,394 pests, followed by Los Angeles with 371 pests. 838 pests (34.4 percent) were intercepted from Colombia and 903 (37 percent) were intercepted from Ecuador. The most common type of insects intercepted in these cut flower imports are *Tetranychus* sp. (mites), *Aphididae* (Aphids), *Agromyzidae* (Miner Flies) and *Noctuidae* (moths).

Source: <http://www.cbp.gov/xp/cgov/about/accomplish/>. The U.S. Customs and Border Protection is the unified border agency within the Department of Homeland Security charged with the management, control and protection of our nation’s borders at and between the official ports of entry.



US demand for animal health products to exceed \$12 billion in 2016

Demand for animal health products in the US is forecast to increase 3.5% annually to \$12.7 billion in 2016. Animal health care is a relatively recession-resistant industry, as health care is regarded as a necessary expense of animal ownership or husbandry. Preventive care will remain a driving factor in sales of animal health products as owners of commercial and companion animals alike recognize the need to maintain good health conditions for their animals.

The large nutritional chemical segment will account for over one-quarter of the growth seen during the forecast period, as these products -- which include amino acids, vitamins, minerals, enzymes, and other products -- remain vital as feed additives and dietary supplements. Consumer interest in natural products will continue to favorably impact the nutritional chemical segment as products such as acidifiers, amino acids, carotenoids, enzymes, herbs, probiotics, and other ingredients with a more "natural" profile are used to replace more controversial additives.

The importance of preventive health care will support growth in parasiticides and vaccines. Parasiticides will remain a prominent feature in the care of pets and livestock, as prevention of and treatment for existing fleas, ticks, and other pests will help reduce occurrences of pest-related health disorders. Furthermore, fears about antibiotic resistance are leading to increased use of diagnostics to treat only animals requiring care, rather than medicating entire herds or flocks, driving above average gains in this product segment.

Livestock and poultry will continue to account for the dominant share of animal health product sales through 2016 due to the sheer size and importance of the US commercial animal segment. However, companion animal applications will remain the fastest growing and will continue to increase their share of demand. Ownership trends favoring higher spending on pet health -- such as on preventive products including parasiticides, and on food and supplements featuring nutritional chemical content

US Animal Health Product Demand (million dollars)

Item	% Annual Growth				
	2006	2011	2016	2006-2011	2011-2016
Animal Health Product Demand	8940	10685	12700	3.6	3.5
Nutritional Chemicals	2840	3450	4030	4.0	3.2
Parasiticides	1868	2172	2550	3.1	3.3
Vaccines	1227	1642	2080	6.0	4.8
Systemic Agents	813	961	1160	3.4	3.8
Other Products	2192	2460	2880	2.3	3.2

-- will encourage ongoing above average sales gains.

These and other trends are presented in *Animal Health Products*, a new study from The Freedonia Group,

Inc., a Cleveland-based industry market research firm. For further details, contact Corinne Gangloff, pr@freedoniagroup.com or through www.freedoniagroup.com.

PestEx 2013 to be the largest ever UK pest exhibition

Following a complete sell-out of exhibition space, BPCA had to work with the exhibition hall to incorporate extra stands to meet exhibitor demand at PestEx 2013, which this year takes place on 10 and 11 of April at the ExCel Centre in London Docklands.

Promising to be the biggest ever UK exhibition, BPCA Chief Executive Simon Forrester commented "Manufacturers from across the globe clearly see PestEx as the place to launch new products, and servicing companies know they can pick up details on all the key innovations, research and best practice. So to meet this demand we have squeezed more stands into our two exhibition halls at ExCeL." Simon added "with the increase in exhibitor numbers, the much anticipated technical and business seminar programmes and the explosion of visitors bookings we've received, PestEx 2013 will well and truly be the largest ever UK exhibition."

Over the two day exhibition there will be a series of business, research and technical seminars, delivered by some of the industry's leading experts. Seminar topics include:

- Sewer Baiting Best Practice
- BioControl: the future of pest control?
- Bait Station Efficacy
- Specification Non-Compliance
- Dry Ice in Pest Control
- Feral Bees: Best Practice
- Waste Management in Pest Control
- Ship/Container Fumigation: Risk Reduction Strategies
- Unravelling Dispersal Behaviour in the Bed bug
- The future for SGAR's
- Rodent Control - getting back to basics

PestEx 2013 will be the ideal place to do business, meet new contacts, explore new products and learn about the latest industry practices and innovations. Find out more at www.bpca.org.uk.





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NPTA: Twenty years and still going strong

J. Barrie Sheard*

2013 can certainly be recorded as a very special year for the National Pest Technician's Association (NPTA).

In May 1993, at a Pest Control training day in Nottingham, a four people decided that it was about time to create a formal body that would speak for and act for the Pest Control Technician, whether that person worked for a local authority, or for a private pest control servicing business.

Thus the Midland Pest Control Association (MPTA) was formed. However, the response from Pest Control Technicians around the United Kingdom, was such that people in the South West, in both Cornwall and Devon and also up in the north, in the counties of Cumbria, Northumberland and also Scotland, were getting in touch to ask, "Can we Join?" Therefore, within a few months it was decided to respond to the interest generated and so the National Pest Control association was formed.

Membership was opened to small and medium sized pest control businesses and there it has stayed for twenty years. Of course the association has moved on, with a set of nine Directors sitting on a Management Board, an official constitution with articles of Association, and becoming a Limited Company.

In June 2012, the Association finally acquired and moved into their very own freehold, purpose built and designed, office premises. Known as NPTA House, at Eastwood in Nottinghamshire (contact details at base of article) it has room for this 20 year old Association to continue to grow and develop. The decision to move and buy had taken well over two years previously, as space at the old NPTA House, at Kinoulton, was becoming tight and the rent was becoming unreasonable.

The new NPTA House has adequate space to enable the association to expand both office wise, and most importantly, to be able to provide a suitable meeting and training room upstairs, which will facilitate the development of the training and educational side of the Association.

The reason for these training needs particularly, is that over the years the NPTA has become well known for developing many especially designed training courses, ranging from "Drainage and pest control", "How to tackle bees and wasps", "Night shooting and the Law", "Everything you need to know about Bats" and very recently, the "New Starters Course". The office move tied in well with the achievement in 2010, from the Royal Society of Health (RSH), to hold Award Courses for their Level 2 Diploma in Pest Management.

The current plan is to make the first floor of NPTA House a fully self contained and equipped training room with all the modern IT facilities. At long last they are able, to provide facilities that no longer tie them into the workings of the main office, with intrusion from telephones and callers and deliveries to the offices.

Space upstairs also enables the NPTA to hold monthly Management Board meetings and work along with major suppliers of pest control and management products in the UK, to pro-



NPTA staff at the annual PestTech exhibition

vide special, one-off training days. One such was the Midlands Training Day held in October 2012 with 41 delegates. The NPTA plans to offer other UK Pest Control Industry Manufacturers and suppliers the same facilities, with the incentive to avoid the costs of expensive hotels or seminar room hire.

The PestTech Exhibition

One of the first major decisions taken at the outset was to organize a pest control exhibition and so PestTech was born. This was first held in 1993 at the Josiah Boots Complex within the Nottingham University complex. Since then the NPTA exhibition has become an annual event at the Motorcycle Museum, Birmingham, UK. November 2013 will see the 21st exhibition.

Every year the number of exhibitors and attendees has grown, from all parts of the UK pest control industry: from manufacturers, suppliers, trainers, researchers, local authority staff, to working pest control technicians with their supervisors and bosses.

The quarterly "Today's Technician" magazine

Also back in 1994, having initially issued a member's news sheet to promote the Association itself, it was felt there was a place to professionally publish a regular NPTA publication. With their membership very much in mind, i.e. the individual men and women who undertake pest control and pest management, the publication had to be entitled "Today's Technician". This is still in print today.

Benefits of NPTA Accreditation

If any spotlight deserves to be shone in the history of the Association, and where the NPTA can and should pat itself on the back, is with NPTA Accreditation. Here the association has created a 'gold' level of membership. This is geared to the current needs of both the general population and the many business customers who provide contract opportunities and who require a twenty-first century "seal of approval". Since the Accreditation launch several years ago, the NPTA are now reaching levels that require bigger and better management, which, having created the space within the new NPTA House, the association is able to provide.

*J. Barrie Sheard FCIEH, Member of the NPTA Management Board.
NPTA House, 12 Farrington Way, Eastwood Link Office Park,
Eastwood, Nottingham NG16 3BF

Despite the current financial situation, within the UK and overseas, sadly causing many businesses, both large and small, to go to the wall, the NPTA are pleased to announce that membership statistics have grown during the last 12 months from just above 850 to nearly 950; a growth of twelve percent.

It needs to be appreciated, that whilst many of these are sole traders or self employed individuals, this figure also now include small to medium sized businesses and companies, from 2, to upwards of 10 and more staff. Long may the NPTA continue to prosper.

Contact: office@npta.org.uk or visit www.npta.org.uk and for PestTech: www.pesttech.org.uk. Interested readers who wish to see a copy of Today's Technician are invited to contact NPTA House for a copy of the latest or earlier issues.

Biopesticide strategic networking event in London

In many European countries today, the systematic use of pesticides is questioned because of the awareness of undesirable negative effects on ecosystems, animal species, and human health. As a consequence of increased regulation of conventional pesticides, biopesticides are seen as the next big opportunity for growth, with a market potential estimated at \$1bn by 2017.

The UK based NRI and the Enterprise Europe Network (EEN) are hosting a networking event to understand new EU Biopesticide Legislation which will limit the number of pesticides farmers can use and increase the importance of Integrated Pest Management (IPM) as an alternative. Rory Hillocks, an expert in IPM from the European Centre for Integrated Pest Management (EUCIPM), based at NRI, will be giving a talk during the event, as well as the IBMA, the Chemical Regulation Directorate, East Malling Research and the Pesticide Action Network, among others.

The meeting is planned to bring together representatives from companies in different parts of the plant protection industry. It will provide an opportunity to hear from a range of pest management stakeholders on IPM and the drivers for change in pest management technologies and practices in European agriculture and horticulture. The EEN will facilitate the networking session to enable participants to make new contacts that might lead to both commercial and technology development partnerships, addressing new markets for biopesticides and other IPM component technologies.

Representatives from over 8 countries are expected to attend the meeting that will include a workshop session to hear and discuss in syndicate new technology/commercial proposals from a number of companies/organisations.

The event will take place on Thursday 11th April 2013 at University of Greenwich, Old Royal Naval College, London, UK. For more information visit www.eucipm.org and the Events page at www.enterprise-europe-network.ec.europa.eu.

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Koppert Biological Systems sets up a base in 'incredible India'

Koppert Biological Systems has taken an important new step within Asia, with the establishment of Koppert India. The company has tapped into a new market full of opportunities with India playing an increasingly prominent role in the export and biological markets in particular. Professional covered greenhouse horticulture is developing strongly in the country of more than 1.2 billion inhabitants.

Managing director Henri Oosthoek refers to India as one of the BRIC countries, a very important and promising market for Koppert. 'There is a huge demand for natural and biological solutions in a market in which the majority of the population is vegetarian.' By taking this step, Koppert is also supporting the efforts of the Indian population to improve food security and safety, public health, and biodiversity within agriculture and horticulture.

Koppert India's operating base is Bangalore, the capital of the state of Karnataka. Here, the climate conditions are favourable for horticulture, and the number of greenhouse projects is increasing rapidly. The sales focus will be primarily on natural



The Koppert team in India is investigating if red spider mites on tea can be controlled by releases of *Neoseiulus californicus* and *Phytoseiulus persimilis* under field conditions.

enemies and microbiological products for greenhouse cultivation of vegetables and flowers. The expectation is that biological crop protection below ground and above ground will become available for the whole of India over the coming years.

In the last week of January 2013 the first predatory mites *Neoseiulus californicus* (Spical) and *Phytoseiulus persimilis* (Spidex) were introduced in tea crops in India. The introduction was part of a trial to find out if a biological solution can solve a large problem; i.e. if the tea red spider mite (*Oligonychus coffeae*), which is a major pest in tea in India, can be controlled by releases of *Neoseiulus californicus* and *Phytoseiulus persimilis* under field conditions.

The total area of tea production in India is about 500,000 ha of which about 2,500 ha is organic. For this trial the Koppert team in India is cooperating with the Upase Tea Research Foundation. The location of the trial is in the region of Valpari and Conor.

The trial is conducted in a completely randomized block design with 4 treatments and 3 replications. Spidex, Spical and a mixture of both will be compared to the current spider mite control practice in organic tea. Introduction of Spical and Spidex is done with the Mini-Airbug. Spider mite and predatory mite numbers will be counted for 3 months after the predatory mite introduction.



Managing Director Henri Oosthoek congratulates manager Udayanarayana Bhat with the establishment of Koppert India in front of the India Gate, the national monument of India.

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Stable flies: Locating, controlling and assessing the damage they cause

Sandra Avant*

Livestock producers may not be able to see the difference between stable flies and other flies at a distance, but they can definitely see the stable flies' effect on their cattle as the animals stop grazing and bunch together to minimize the number of bites they're getting. Stable flies are among the most important arthropod pests of cattle in the United States. Their painful bites can reduce milk production in dairy cows, decrease weight gain in beef cattle, and reduce feed efficiency.

Generally, insecticide sprays are used to help keep stable flies off animals, especially their legs, where the flies mainly bite. But as cattle walk through wet grass or wade through water, the spray washes off—making the treatment ineffective. Management of this pest is further complicated by the fact that larval development sites exist for only a short time, are difficult to find, and can produce huge numbers of the aggravating flies. Scientists at the Agricultural Research Service's Agroecosystem Management Research Unit (AMRU) in Lincoln, Nebraska, are looking at better methods to locate stable fly habitats, finding easier and more efficient ways to control them, and assessing the damage they cause.

A heavy cost for cattle producers
What's the cost of stable fly damage? It's something livestock owners need to know. "If you tell a producer that a site is the source of lots of flies and needs cleaning up, that producer wants to know if it is worth the time and expense," says AMRU entomologist David Taylor. "We wanted to provide a cost-benefit analysis." Taylor and his colleagues developed a model to assess the economic impact of stable flies using four classes of production: dairy, cow/calf, pastured and range stocker, and animals on feed. They found that

each year, stable flies cost the U.S. cattle industry more than \$2.4 billion, making them the most damaging arthropod pest of U.S. cattle.

As their name implies, stable flies have historically been associated with stables and barnyards. But over the last 30 years, they have become a significant pest in pastures too. Research indicates that the problem is partly due to the large bales of hay placed in fields as supplemental feed for cattle during the

winter. "The accumulation of wasted hay, manure, and urine at these feeding sites creates an ideal habitat in the pasture for stable fly larval development," Taylor says. "We identified hay-feeding sites as producing a lot of flies, but we wanted to know how the timing of the flies coming off the sites correlates with adult population levels."

In Nebraska, stable fly populations peak twice a year—in mid-June to July and again in September or October.



On the research farm at the University of Nebraska, ARS entomologist Jerry Zhu checks stable fly captures from a trap baited with his newly designed attractant, or lure, in a cattle feedlot

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Scientists determined that the hay-feeding sites are the primary sources of flies in the June-July peak.

Stopping stable flies before they mature

Cleaning up infested sites has been the main stable fly control method for about 100 years, Taylor says. The problem is that hay-feeding sites are often in remote locations. As for insecticide use, says Taylor, “This kind of habitat has an active microbial community that can break down most traditional insecticides very quickly. You might get a couple of days of control before the effectiveness wears off.”

The team found that using an insect growth regulator to interrupt the development of stable flies can be effective. In one study, Taylor used cyromazine to control immature stable flies. Cyromazine, a commercial product, has been used to control other species of flies, mainly in poultry production. It interferes with molting and inhibits proper development of the insect’s external skeleton.

“We wanted to develop a method where the producer could apply a single treatment and be done,” Taylor says. Scientists found that a single application of granular cyromazine sprinkled on a hay-feeding site reduced the number of adult stable flies emerging by 97 percent.

Treatments took about 10 minutes, cost \$10 per site, and remained effective for 10 to 20 weeks. “It’s something producers can put in a pickup truck and don’t have to mix or spray,” Taylor says. “They can quickly treat sites while doing other chores or checking on cattle.”

A “push and pull” strategy

Identifying the attractants or substances that lure females to a particular site to lay their eggs may help scientists find ways to reduce their populations. “When gravid females—flies with eggs—reach an egg-laying site, we believe they use the olfactory sensors on their antennae to gather information related to nutrition,” says AMRU entomologist Jerry Zhu. “They then make a decision as to whether it is the right area to lay their eggs.” Zhu is using what he calls a “push and pull” strategy to control stable flies. The “push” involves driving stable flies or other filth flies, like house flies and horn flies, away from livestock with a repellent. Plant-based chemicals that are low in toxicity, such as those found in catnip, are being used as experimental treatments.

“Catnip oil and its active compounds—nepetalactones—are powerful repellents against stable flies,” Zhu says. “Catnip is probably the best repellent



Entomologist David Taylor checks a stable fly emergence trap near a hay-feeding site. The trap is used to evaluate the effects of chemical and physical treatments on stable flies

identified, so far, for flies that bite. Catnip oil is also a good larvicide,” meaning it can be used for reducing stable fly larval development, he adds. Zhu and his colleagues developed several sprayable catnip oil formulations for reducing stable fly field populations. Through a cooperative research and development agreement, Zhu partnered with Microtek Laboratories Inc., to test a novel granular catnip product that can deter egg-laying.

The “pull” part of Zhu’s strategy involves developing attractants to lure stable flies into a trapping system that can be combined with a low-toxicity insecticide or a sticky substance. Zhu and Taylor are also working with AMRU entomologist Kristina Friesen, who is studying microbial communities associated with stable fly larval development sites.

“In my mind, the long-term solution to stable fly control is a cultural solution,” Taylor says. “Even though we’re developing strategies such as chemical control, our long-term objective is to provide producers with methods to raise cattle without providing larval developmental sites for flies. That’s the real goal.”



Entomologist David Taylor checks a stable fly emergence trap near a hay-feeding site. The trap is used to evaluate the effects of chemical and physical treatments on stable flies

Keeping birds at bay in food production facilities

Dave Maxwell*

Pest control in the food manufacturing sector is a very broad discipline. Immediate concerns that spring to mind include rats, mice and other rodents as well as insects and invertebrates. However where bird control is concerned, the matter can become emotive. While we know about the dangers of contamination from droppings and the diseases that can be carried by feathered pests, many species are beloved in Britain and even protected under the law. How then can food manufacturers ensure their production lines, warehouses and finished products remain contamination free, while adhering to often strict legislation?

First of all, we must consider the potential dangers of birds gaining access to a food manufacturing facility. In the UK, allowing birds into a food business violates the Food Safety (General Food Hygiene) Regulations 1995 and the reasons for this are varied. Bird droppings not only erode and damage stonework and metals, block ventilation channels and cause a slipping hazard, but also act as a carrier for a variety of dangerous disease organisms. Salmonella, e-coli, campylobacter and listeria are among the hazardous pathogens commonly found in bird droppings, while dry pigeon droppings can carry ornithosis – a cause of pneumonia and respiratory failure which can prove fatal in humans. Birds' feathers and bodies may also contain parasites, presenting a further hazard where birds can gain access to building interiors.

So what are the options for facilities managers? The first thing to consider is the type of bird causing the problem, as not all are considered pest species and are therefore protected under the law. The Wildlife & Countryside Act 1981 is the key piece of legislation covering bird control, and even though it has been partially superseded by the European Bird Directive 1993, its principles remain current in practice.

Although the legislation does list certain species as 'pests' and authorises their destruction by owner/occupiers, it is a condition of the Act that non-lethal methods should be considered first – so live cage trapping, scaring and baiting should all be explored before shooting. However, all nests and eggs are protected and must not be moved or destroyed until young have fledged, and many species must not be exterminated under any circumstances.

If food manufacturers treat avian intruders on a case-by-case, if-and-when basis, hygiene as well as reputation is

constantly at risk. The most common area for bird access is in warehousing, and any pallets contaminated by droppings are likely to be rejected by the customer even if the food packaging is not compromised, meaning large amounts of product heading to landfill. Additionally, many large supermarket customers insist on frequent audits of their suppliers' premises to verify pest control practices on a yearly or six-monthly basis. The risk of losing big customers is a real threat, and leaving bird control to chance is becoming increasingly unsustainable. Investing in



Bird spike systems, aimed at preventing perching and overnight roosting, need to be selected with the target bird in consideration. Gulls can be destructive and can rip apart smaller spike systems with their beak.

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adequate bird proofing is therefore the preferred option in bird control, negating the need for awkward trapping or inhumane destruction of birds by keeping them out in the first place.

A variety of bird proofing systems are available and care must be taken to select the most appropriate method for the bird species likely to present in the area. While a 50mm net is perfectly adequate for deterring pigeons, sparrows could easily negotiate these gaps meaning a smaller net of around 19mm would be more suitable. Similarly, bird spike systems, aimed at preventing perching and overnight roosting, are designed for different types of bird – for example spikes to deter gulls should have longer wires than pigeon spikes, due to gulls' longer legs which allow them to stand astride pigeon spikes. Additionally, the scavenging nature of a gull means they can be destructive and have been known to rip apart smaller spike systems with their beaks, meaning gull spikes must be reinforced.

Selecting a bird proofing system also depends largely on the amount of 'bird pressure' faced by each area. A high pressure area is one where birds roost or nest overnight, and as this is seen as a safe haven for birds, they will go to great efforts to return to these areas, necessitating a heavy duty system such as wire netting.

Medium pressure areas are typically used for daytime perching, which presents an additional problem in that these areas are often used for eating. Birds will catch or pick up their food and carry it to their perch to consume undisturbed, leading to the risk of additional contaminants – especially where the birds feed on live prey. Spikes may be a useful solution here, however care must be taken that larger birds cannot negotiate the spikes for roosting, as droppings can build up and harden over time, creating a platform for the smaller birds which caused the initial problem.

When birds cannot access their favoured roosting or perching locations they are liable to migrate to an alternative nearby location, meaning areas previously thought of as low pressure (only occasionally used) may suddenly

become high or medium pressure. It is therefore important to secure all areas of a building, even if birds are not commonly seen in all areas.

There are many other logistical aspects to consider when installing bird proofing systems. Often, and particularly in old buildings, wall and roof surfaces are irregular and present difficulties in securing nets along curved or angled surfaces, and ensuring all eaves are enclosed. Typically an installation would include one day for surveying the property and then making custom frames to fit. There is also the issue of access control to consider, for example service personnel are likely to need to get between the net and the building to maintain water pipes, air conditioning, lighting or other utilities. To allow for this, zips can be installed, however occasionally the utilities themselves may present a risk to the integrity of the net. One example is a recent case of a steam pipe on an exterior wall, which would have melted an ordinary net and rendered the system inoperable. By attaching a weld mesh to the net before fixing into place, heat was dissipated from the pipe, ensuring the reliability of the net.

Failing to install bird netting and instead choosing to deal with pest birds as and when they gain access to the

facility may at first appear to be the cheaper option, but will soon prove to be a false economy. Products can be spoiled and contracts lost through the contamination of finished produce, and if birds gain access to the production facility itself then manufacturers run the risk of having to scrap entire batches or ingredients stores, as well as losing time and money through a temporary shut-down for cleaning. Staff are also placed at risk of illness and infection if birds have the opportunity to access a food production facility, and the costs involved in engaging a suitably trained provider to assess, trap or exterminate the animal could also be prohibitive.

Bird netting, spikes and other proofing systems should always be installed by trained professionals, accredited by a national association such as the British Pest Control Association (BPCA), to ensure all legislation is followed to the letter and the biology of the birds in question is properly understood. Investing in a suitable, professionally-installed proofing solution is the only way to prevent bird access and contamination, and in the long term delivers cost savings and peace of mind.

For further information visit www.hygiene.co.uk



Bird droppings not only erode and damage stonework and metals, block ventilation channels and cause a slipping hazard, but also act as a carrier for a variety of dangerous disease organisms

Space spray fundamentals

Graham Matthews*

Control of flying insects in a stored product environment is always a challenge. Owners of large warehouses often prefer a non-residual space treatment instead of spraying wall surfaces with a residual insecticide. The aim of a space spray is to control flying insects with very small droplets penetrating between stacks of produce. Control of insects in buildings in this way was a key application method over 80 years ago when natural pyrethrins were atomized into a fine spray using a twin fluid compressed air “paint” sprayer.

A flow of air through the nozzle sheared the spray liquid into sufficiently small droplets that remained airborne long enough to kill any insects active in the treated space. Original hand held devices included the “Flit-gun”, a small hand operated applicator that was eventually replaced by an aerosol can for domestic use.

Post World War II, thermal fogging equipment originated from two sources. In one form, equipment that had been developed to screen warships from attack was adapted to apply insecticides. The Todd Insecticide Fog Applicator (TIFA) is one example of a truck or



Hand carried thermal fog with oil based formulation

trailer mounted fogger with a large heat exchanger that is used to disinfecting ships holds, sewers and for treating grain. Alternatively, hand carried thermal fogging machines, evolved from the pulsejet engine, and were really a development from the V1 rocket engine design.

From the 1950's, space spraying was primarily carried out with thermal fogs. These are produced by vaporising a spray liquid diluted in an oil or diesel at a temperature of about 400°C which condenses as a dense white cloud of droplets. Visibility is reduced by these fogs, which creates short-com-

ings. When they were used outdoors e.g. for mosquito control, traffic accidents sometimes occurred and so interest reverted, especially in the USA, to cold fogs where no heat was involved.

In cold fogging, droplets are formed when the spray liquid is fed into a high speed vortex of air. This technique allows minimum volumes of liquid to be applied. In the USA, some new cold fog machines use a high speed rotary nozzle as these are considered to be less noisy.

The technique is more often referred to as a ULV (ultra-low volume) application. Clearly with ULV fogs, there are considerably fewer droplets per cubic metre of air space, so unlike thermal fogs, visibility is not reduced, although some consider that thermal fogs are more effective, due to the psychological nature of the dense white fog. In both thermal and cold fogs, the aim is to produce droplets smaller than 20µm VMD (volume median diameter) to remain airborne. Large droplets in a space spray are wasting chemical as they sediment rapidly onto the floor or other horizontal surfaces.

The current trend is to use a pesticide formulated with an evaporation retardant and diluted in water to avoid exposing the environment to organic solvents and oils. This means that the initial droplet size is different, as the VMD of water based sprays will generally be double that of a similar space sprays



Killgerm Exodus cold fogger - electrically operated

* IPARC Imperial College, Silwood Park, Ascot.

diluted in kerosene. Thus with a kerosene spray, the VMD might be about 14µm, whereas with a water based formulation, the VMD is likely to be about 25µm.

The dosage applied as a space spray is calculated strictly from the amount of pesticide needed to treat a volume of air. Thus, when treating a warehouse, it is important to know the cubic capacity of the building. Allowance should be made for large stacks of produce contained within the warehouse.

In contrast to residual sprays applied to wall surfaces, the amount of insecticide applied as a space spray is much lower, as it is intended to be applied when the insects are active. Many insect pests are only actively flying for a brief period and this may be in the evening. In this situation, electrically powered, cold fogging equipment, fitted with an auto timer is ideal, as it can be set to operate when the building is not occupied. Insects that are not flying, such as the immature stages, will not be affected, so

Example

If a warehouse is 10m high x 80m long and 40m wide, the volume is 32,000m³.

If there are four stacks of produce 5m high x 30m long and 12m wide = 7,200m³, the space in which insects may be flying is 24,800m³, so if the product is to be applied at 500ml/3,000m³ then 24,800/3000 = 8.26 so 500ml x 8.26 = 4.13 litres of product.

The product label will suggest a dilution rate, so If the amount of product is mixed with 500ml of diluent, then 8.26 litres of liquid are applied with the fogging machine.



sequential sprays to kill emerging adults before they lay eggs is often required when using space sprays alone.

Criticism of indoor space sprays is often due to operators forgetting the

need for sequential treatments, as any impact is short-lived. Similarly outdoor space sprays are not effective in penetrating inside buildings situated alongside a road, as the airflow is insuf-



TIFA vehicle mounted thermal fogger in use around a hotel in Cairo

ficient for small droplets to penetrate inside buildings, even when doors and windows are open.

When treating inside buildings, including glasshouses, it is important that the all openings are firmly closed, as a fog can be sucked out of the space by winds outside the building. Electrical apparatus inside the building must be switched off, especially when using oil based thermal fogs, in case a spark ignites the fog.

Apart from insecticides, other applications include fogs of fungicides in glasshouses and potato sprouting depressants fogged in potato stores. Fogging outside is very dependent on weather conditions and requires 'still' air with an inversion, to prevent fogs lifting away from where the pest is located. Fortunately this is often in the evening and early morning when most mosquito vectors of disease are active.

Safety

When applying a thermal fog, the operator **MUST** remain with the equipment as there is a risk of fire. Unfortunately, a number of users of thermal fogging machines have ignored this clear instruction and lost a store or plastic glasshouse, usually due to the equipment



Thermal fogger that had been left unattended. Part of the building in which it was being used was also badly damaged

running out of fuel and the fogging oil igniting in the hot resonator tube.

As a fog contains very small droplets, the operator must wear appropriate respiratory protective equipment (RPE), namely a face mask, to prevent inhalation of the pesticide.

If the equipment is controlled by a timer, the RPE may be needed when a person has to enter the treated building after several hours to open vents, if this cannot be done from outside. By this time the small droplets should have

settled on horizontal surfaces within the treated space. When carrying a portable fogger into a building or glasshouse, start fogging at the end furthest from the door directing fog behind and to each side and move towards the door.

Space treatments have a key role in many situations where a rapid reduction in pests is urgently needed, for example in fly control, especially where a residual deposit is difficult to maintain and presence of a residue in food must be avoided.



Truck mounted cold fogger

The small compression sprayer that meets WHO specification

Pest control companies often use a small 5 litre compression sprayer for treating surfaces in houses. Most of these have a pump that forms the lid of the tank, but now Guarany in Brazil have produced a smaller version of their compression sprayer with a stainless steel tank that meets the WHO specification.

With a large tank opening separate from the pump, it is easy to fill. The lance is also fitted with a control flow valve so output of the nozzle remains constant irrespective of the tank pressure, provided there is the minimum pressure to open the valve.

The trigger valve is designed so that it can be fixed in either the open or closed position, the latter being a safety device to prevent spray being accidentally released when the operator is not spraying.

An on/off valve is also fitted to the top of the tank so that the lance and hose can be disconnected without losing tank pressure. The robust

construction makes this unit a sturdy sprayer when only small volumes of spray need to be applied.



		
	<h2>Sprayers in perfection</h2> <p>... specially designed for the pest control industry</p> <p>Nearly 100 years of German engineering. Highest quality stainless steel sprayer.</p> <p>A lot of unique features:</p> <ul style="list-style-type: none"> ✓ 2,5 m coiled hose ✓ Funnel cover ✓ filling-level easy to check ✓ 20 years spare parts supply guaranteed ✓ Wide range of accessories <div style="display: flex; justify-content: space-around; align-items: center;">      </div> <p>MESTO Spritzenfabrik Ernst Stockburger GmbH</p> <p>Tel. +49 7141 272-0 • Fax. +49 7141 272 100 • Email: pestcontrol@mesto.de • Internet: www.mesto.de</p> <p>• Ludwigsburger Straße 71 • 71691 Freiberg/Neckar</p>	<p>Meet us at PestEX: Stand No. 28</p>  

Food manufacturers: challenges with managing pests in food handling facilities

Karen Constable*

How do you manage pests in your facility? Firstly any food safety programme should have a comprehensive pest management system. This is designed to control hazards from pests at every operational step of the food handling process, including biological hazards such *Salmonella*. In the USA, a large outbreak of Salmonellosis was caused by contaminated peanut products.

Nine people died and over 700 people became ill. The source of the outbreak was found to be a peanut processing plant in Georgia, which was reported to have had live and

dead rodents, cockroaches and birds in the production areas. As a result of the outbreak, consumption of peanut products dropped by nearly 25% in the US and US Federal prosecutors have in February 2013 filed criminal charges against the former owner and several employees of the now bankrupt company. (1)

Any pest management system will contain elements to control hazards from the pests themselves; particularly the hazard of cross-contamination, such as the microbiological contamination risks as described above. The system will also contain elements to control the risk of chemical contamination from pesticides. Finally, as in all formalised food safety systems, there will be requirements for monitoring and reporting. The pest management process is the responsibility of the food manufacturer, even if some of

the components will be outsourced to a professional pest control company.

The first priority of any pest management system should be to keep the pests outside. This means proofing the facility. Proofing is perhaps the most overlooked aspect of pest management in food facilities. It is common to find smaller manufacturing facilities with numerous holes in food store walls and rodent bait stations scattered around the floor. Proofing can be overlooked because it is not usually part of the service provided by professional pest controllers. In addition, site maintenance is usually managed by personnel who are 'outside the loop' when it comes to food safety and quality issues.

Proofing against the ingress of flying insects and birds is arguably the easiest to achieve; screens, strip curtains, air curtains, swing doors and

*HACCP International www.haccp-international.com. HACCP International is a 'Conformance Assessment Body', accredited by JAS-ANZ in the scope of product certification for food-safe equipment, materials and services.



The pest management process is the responsibility of the food manufacturer, even if some of the components will be outsourced to a professional pest control company



rapid-closing doors are all simple to install on windows and doors. In choosing a rapid closing door for any facility, make sure that it is capable of operating at the speed and frequency that your operation demands. The biggest problem with rapid closing doors is they are so often left open.

Proofing against crawling insects is more difficult, partly because they can fit through the tiniest of gaps, but also because they commonly breed inside a facility. Rats and mice can also fit through very small openings, but rodent proofing is achievable, especially in purpose-built premises.

While proofing is important in keeping the pests outside, pest-free raw materials are also required. Stored product pests, cockroach nymphs and even rodents can get into a facility in shipments of raw materials. Again, this is a job for the food

manufacturer to manage, not the pest control company.

Another high priority in managing pests is removing food sources. Housekeeping is the key here. Food sources, moisture, warmth and shelter all need to be considered, both inside and outside the premises. Don't forget plant rooms and garden beds. If proofing, raw materials and housekeeping are the responsibility of the food company, then conventional pest management operations are the responsibility of the pest control company, right? Wrong! Pest management systems only work effectively when the food company takes responsibility for the system as a whole.

This means following the advice of the pest control technician, particularly when it comes to proofing and housekeeping issues. Be prepared to pay for an appropriate level of service; monthly servicing is recommended for most food businesses. Choose the pest control company with care, make sure the company understand the needs of food facilities in general, and be sure to communicate any special needs of the food process operation. The pest controller's service agreement should clearly list the pesticides which will be used on site, along with the types of treatments, and specific locations to be treated.



Food companies should pay for an appropriate level of service; monthly servicing is recommended for most food businesses.

When it comes to pest control documentation for food safety audits, it pays to be well informed of the auditor's requirements. Many pest control companies are certified and a good pest control company will know what documentation is needed for a basic HACCP-based food safety programme, but do not expect them to know the special requirements of an AIB or BRC certification. Common points of contention between food safety auditors and pest control providers are the format of MSDSs - paper or soft copies; recording of pesticide batch numbers and positioning of rodent bait stations. These issues are best tackled before the audit takes place. If it is known, for example, that the food safety auditor will expect to see paper copies of MSDSs, then be sure to check that the pest control company can provide them in this format, or take the time to print them before your audit.

Finally, remember that no matter how good any pest control provider is, the facility will never be free of pests unless the food manufacturer is willing to pay for the right level of service, and to manage the proofing and housekeeping effectively.

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Rapid action doors and positive pressure greatly reduce access opportunities for flying insects. Photo courtesy of Albany ASSA ABLOY

How the internet can improve local pest control businesses

Ryan Levesque*

When the Internet first started gaining in popularity, search results were both inaccurate and unreliable. The term 'Local Search' was something of an oxymoron with for example, a search for "Pest Control" in Australia often producing the name of a pest control company based in the United States or Europe. As a consequence, many people will have viewed the internet as a tool for global business only.

In the past few years however advances in technology have changed all that, such that it is now much easier for consumers to find services in their own locality - including finding the best local pest control service provider.

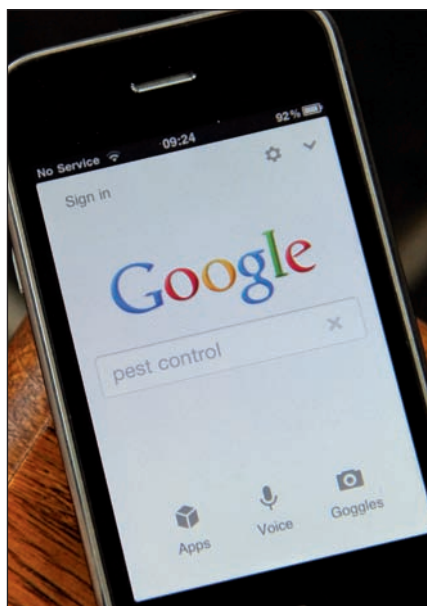
Consider these local search statistics and trends:

- 97% of consumers search for local businesses online (1)(Google)
- 82% of local searchers follow up offline via an in-store visit, phone call or purchase (2) (TMP / comScore)
- 80% of budgets are spent within 50 miles of the home (3) (Direct Marketing Association / CMO Council)
- 74% of internet users perform local searches (4) (Kelsey Group)
- 61% of local searches result in purchases (5) (TMP / comScore / Rio SEO)

What does this all mean?

It means increasingly more prospective customers are going online to find local companies to hire. For pest control operators, this means more opportunities to attract new customers online. At the same time, it also means potentially more competition for those same customers. In order to take advantage of this trend, there are 3 opportunities to

*Ryan Levesque, President, Pest Control Marketing Systems (PCMS). For more information visit www.pestcontrolmarketingsystems.com



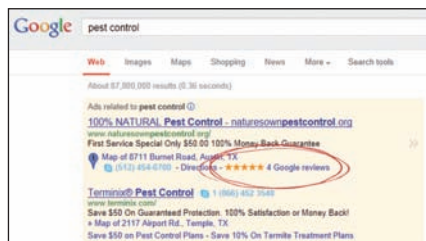
Pest control search used to be hit and miss. Today's search tools help pest controllers to be found more easily

consider taking before the competition gets there first.

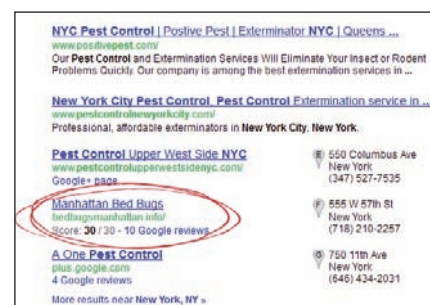
Local search opportunity #1:

In 2012 Google decided to merge two of their most popular services for small business owners: Google Places & Google Plus. One of the biggest opportunities this merger has created for pest control operators is related to customer reviews. Following the merger, the only way for customers to leave reviews on a Google Plus Local Page, is to first setup and sign into a Google Plus account.

While this may involve more work to educate customers on how to do this, the benefit in getting Google-verified customer reviews is significant, as Google will show the average review in the form of 'stars' on a paid search (PPC) listing, like in this example:



In addition Google will show the total number of positive reviews (e.g. 30/30) next to the search listing.



Many companies in competitive geographies, such as New York City are already doing this but for companies located in a smaller city or town, they can often differentiate themselves by being the first (and potentially only) company to do this.

Local search opportunity #2:

In the past, getting found online was simply a matter of releasing more high-quality, relevant content. While this still remains a sound strategy, Google and the other search engines are looking closer at the actual codes and "markup" used behind the content, before deciding whether that content will show up in the search results.

For example, last year Google started using "Author Rel Attribute" in their search results. If, when searching for a topic on Google, some of the results include a person's photo next to it, that's the "Author Rel Attribute" at work. In some market categories, nearly every website is doing this. In pest control, almost nobody is doing this - which means opportunity for those who do.

By adding the "Author Rel Attribute" to an existing online content, if done well, not only will an image show up alongside the search listings (thus making the website listing more prominent), Google also looks at this factor when ranking the site in the search results.



CS Series



PCO series



Unique-Spray Lance



Portable Cold Fogger U260 & U240



Sub-slab Injector



Thermal Fogger



Unique-spray



BAS



ADS



Puffer Duster



Gel Applicator

Aerosol Delivery System



Mountable Aerosol Generator



ULV Cold Fogger
360° rotational
spray-head



Local search opportunity #3:

According to NPD DisplaySearch, in 2013 sales of Tablets are expected to exceed traditional notebook PCs for the first time ever (6). While another study by Arieso has shown that data usage on smartphones has even exceeded data usage on tablets (7)

What this means is that consumers are spending more time browsing the internet on increasingly smaller devices. And yet, most websites are still only optimized to be viewed on a traditional notebook or desktop computer. There is an opportunity

therefore to be among the first pest control companies in the local market, with a “mobile responsive website”. This means, that when a potential customer searches for “pest control” on a smart phone or tablet, the website found, shows up formatted for that particular device.

See left for an example of a site that is mobile responsive.

While this may take a little time to setup, it is definitely worthwhile. Remember that when a consumer comes across a website, they are also just one click away from a competitor’s website. If a website is difficult or impossible to navigate on a mobile device, that prospective customer may choose to select a competitor company and use them forever.

To summarize, Local Search is powerful and it is worthwhile to spend as much time and effort as possible to be better presented than the competition. All of this may seem overwhelming. Internet marketing is a rapidly changing world that requires constant attention. It is

easy to spend considerable sums of money and get little or no results. Outsourcing this service to a company who knows what they’re doing is an investment worth making before the competition decides to do it first.

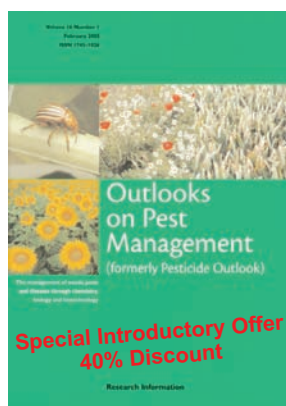
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Improved stink bug trapping methods

Tracey Leskey

Baited black traps in a pyramid shape attract significantly more brown marmorated stink bugs than other traps, according to Agricultural Research Service (ARS) scientists. Evaluating stink bug responses to different visual stimuli may help manufacturers design better traps for monitoring the bugs. Entomologist Tracy Leskey at the ARS Appalachian Fruit Research Station in Kearneysville, W.V., focused on visual stimuli that can attract the stink bugs to traps that will help farmers monitor the level of infestation in their fields and orchards.

In field trials in 2009 and 2010, Leskey and her colleagues found that significantly more stink bug adults and juvenile bugs, called nymphs, were captured in the baited black pyramid traps than in other traps. The researchers also found that more adults and nymphs were captured in a trap placed on the ground than in a commercially available trap hung from a tree limb. These prototype pyramid traps may serve as monitoring tools to assess the presence,

abundance and seasonal activity of pests and natural enemies to determine the need for insecticide applications.

Leskey and her colleagues also found that in 2010, 2011 and 2012, stink bugs produced two generations in one year in Kearneysville, based on the presence of eggs and newly molted adults in field cage experiments. Although it has been reported that these bugs produce only one brood annually in eastern Pennsylvania, it appears that in more southerly locations within the Mid-Atlantic region, they can produce two generations per year, according to Leskey.

Results from 2010 were published in the *Journal of Entomological Science*. A more extensive study is being replicated in several states on the East Coast to determine how many generations may be produced annually in those locations.

Scientific contact: Tracy Leskey, ARS Appalachian Fruit Research Station, Kearneysville, W.Va., Tracy.Leskey@ars.usda.gov



The brown marmorated stink bug is easily recognized by many because it's invading our homes. But the pest, shown here feeding on an apple, is also a major economic threat to fruit crops, garden vegetables, and many ornamentals. ARS scientists are fighting back by developing traps, sequencing the bug's genome, and testing parasitic wasps as biocontrols.



Support scientist Starker Wright (left) and entomologist Tracy Leskey inspect traps baited with experimental pheromone lures. The lures are being tested for brown marmorated stink bug attraction.

Developments in the world of insect detection

David Loughlin*

Integrated Pest Management (IPM) is an approach to managing pests where one of the main benefits is to reduce the amount of pesticide applications. Frequent and reliable monitoring of pest populations is one of the most fundamental components of IPM and semiochemical systems help in IPM by providing precise information as to when and where insect pests arise. Currently pheromone traps, densely deployed in the field are used to monitor insect populations. However checking these traps on a regular basis can be a time consuming activity, making insect population monitoring currently one of the most laborious and often neglected tasks in IPM.

All this is may soon be a thing of the past as three new and competing tech-

nologies that bring innovative solutions to the task of monitoring insect populations in crops continue to be rolled out on both sides of the Atlantic.

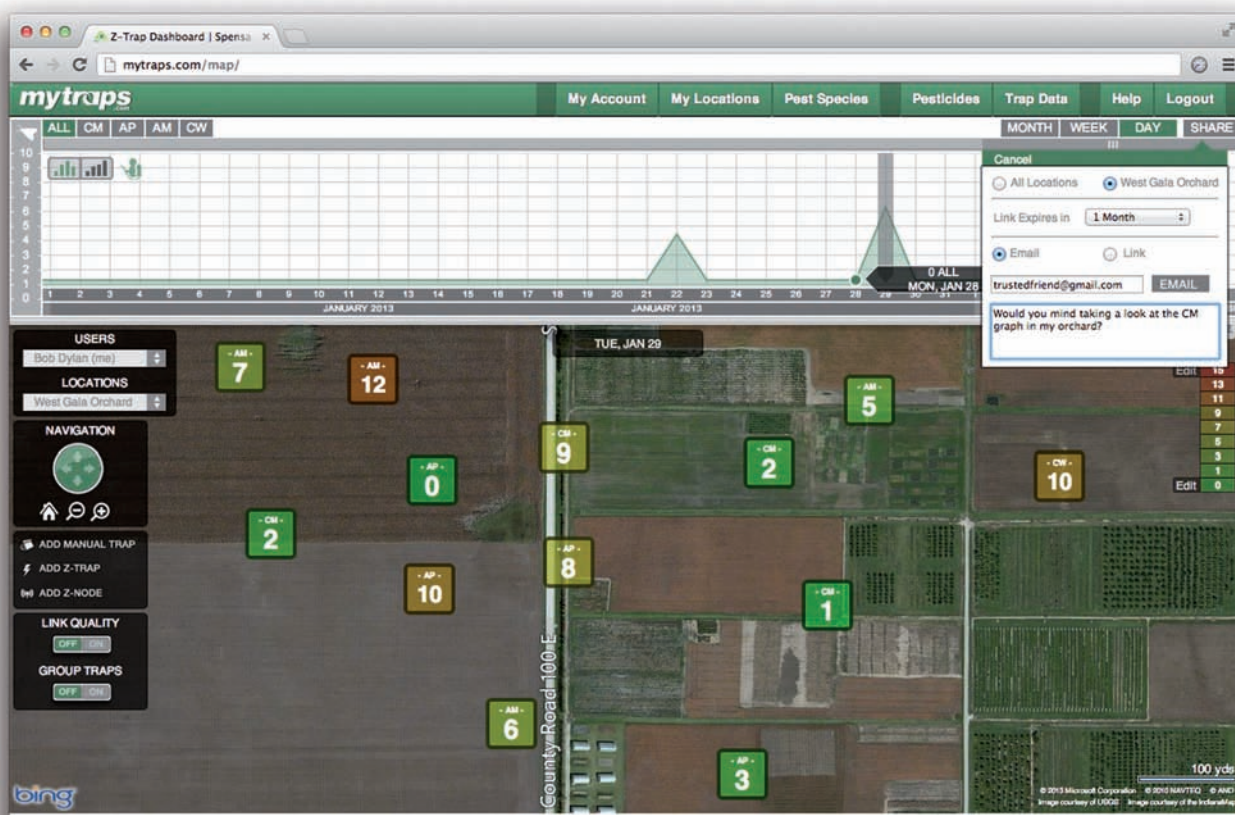
From the relatively small market of Slovenia has emerged Efos, a young company focused on providing complete solutions in the field of environment and food safety. Their new product, which was on display at Fruitlogista in Berlin in February, is a combination of hardware and software for the remote monitoring of different agricultural moth pests. Branded Trapview, the system takes pictures of insects caught in pheromone monitoring traps and then sends the image via GPRS connection to a central server where the image is stored for processing.

The device effectively takes a snapshot of the pest presence in the field on a daily basis. With such an approach, the user is always informed of the situation



Efos trap with solar panel

*David Loughlin is Editor IPC Magazine and Director of Sentomol Ltd.



The Efos Trapview makes farming more precise by offering a complete solution for the automated capturing, sending and processing of pest-related data

in a timely manner. By taking snapshots remotely and sending images to the server, there is no need to go to the field just to count insects. Trapview claims to make monitoring a less labour intensive and time-consuming activity. A visual review of historical data is also possible and the application includes statistical presentations of moth counts. The trap, powered by solar panel and battery and with camera attachment, is sufficiently light so it can be hung in a tree canopy.

Meanwhile in West Lafayette, Indiana, USA another new agricultural electronic insect trapping device has been developed to automatically monitor insect pest populations and reduce the amount of insecticides emitted into the environment. The Z-Trap is an insect trapping device that automatically detects the number of target insects captured by the trap and sends the data wirelessly to the grower's mobile phone or computer. The Z-Trap is a Purdue University discovery being commercialized in the Purdue Research Park by Spensa Technologies Inc.

"Tracking insect populations is a fundamental part of any pest management program and being able to track those numbers in real time electronically through a smartphone or a computer helps growers choose how to use insecticides more judiciously," said Johnny Park, president and CEO of Spensa Technologies, a startup housed in the Purdue Research Park of West

Lafayette. In the U.S. in 2010, crop growers lost \$20 billion to insect damage and spent \$4.5 billion on insecticides, according to Park. The device is patented through the Purdue Office of Technology Commercialization and is being developed by Spensa Technologies Inc.

The Z-Trap technology is currently focusing on the apple market, specifically to monitor Codling Moth, leaf rollers and Oriental Fruit Moth. However, Z-Traps can easily be modified to monitor other pest species as long as there is attractant available for that species.

The Z-trap also comes with a MyTraps software package, a web or mobile application that allows the user to effectively visualize and analyze insect population data collected by insect traps. Instead of writing down the number of insect pests on paper, the catch numbers can be entered using the mobile app and the data then gets uploaded to the server where the data can be visualized and analysed. The MyTraps app can also be used as a general insect monitoring tool with traditional monitoring systems.

The Z-Trap relies on a number of characteristics such as sensor response, pheromone lure selectivity and target insect flying time to estimate the number of target insects detected by the system. Although the correspondence between the number of target insects captured by the Z-Trap and the number reported is not 100% accurate, they are highly correlated. The Z-Trap is powered by

a high density lithium iron phosphate battery which is said to be as efficient as the lithium ion batteries used in laptop computers and mobile phones. Under common Codling Moth monitoring conditions, Spensa Technologies expect a fully charged Z-Trap battery to last approximately six months.

Finally in Canada, Michael Gilbert of SemiosBIO is also promoting the use of wireless communications to change the world of monitoring insects in fruit and nuts. The company is combining chemistry, computer software and wireless networks to not just monitor but also to control insects through mating disruption of moths. Starting with the traditional insect monitoring sticky traps that gauge insect populations in an orchard SemiosBIO has mounted a tiny camera on the roof of a trap and programmed it to transmit an image of what is caught on the floor every 10 minutes. At present, SemiosBIO has entomologists who count the insect levels in traps by examining the photos on a computer screen. In the future, the bug count will be handled by a computer program that will recognize the signs of a breeding-related population surge.

Where the system devised by SemiosBio differs, is that once an increase in insects is detected, either by a human or computer system, an order can be transmitted back to the orchard where a container holding a canister of insect pheromone is wired in. The canister will then emit a puff of female sex pheromone, which is then detected by male moths and which are then confused and prevented from finding females.

There are already pheromone-based products on the market such as pheromone-impregnated dispensers that are hung from trees and which constantly release pheromone and puffers which use a timed application system. Gilbert decided he could do better and has attracted \$6 million capital including \$1 million in seed financing from investors as well as \$5 million government grants. This year the SemiosBIO system will be trialled in 3,000 - 4,000 acres including about a third of the Okanagan Valley, plus orchards in Ontario, Washington



The Z-Trap from Spensa Technologies

State, California, Pennsylvania, Spain, Italy and South America.

In North America, the apple industry alone covers 400,000 acres and is worth \$2 billion a year. SemiosBIO this year will manufacture over 200 devices, including traps, pheromone puffers and solar-powered communication devices which incorporate a weather station and a wireless transmitter that connects the puffers and traps to a database. Farmers can log into the database from a handheld mobile device on a conventional

wireless network and view a pest profile grid that's less than 10 minutes old.

Trials last year in the Okanagan indicated their system was 98% effective in controlling reproduction of codling moths. Costs are claimed by SemiosBIO to be approximately the same as a full regime of pesticide application. The added value is in time saved, and in building a valuable database for farmers. Michael Gilbert doubts his company's products will replace pesticide completely, but is employing precision

pest management, using smart systems to get the same effect.

For more information visit: www.efos.si, <http://spensatech.com> and <http://www.semiosbio.com>



The SemiosBIO puffer system

Two new registrations in Italy add to competing pheromone technologies

Certis Europe has launched a mating disruption product for the control of Codling Moth (*Cydia pomonella*) and Oriental Fruit Moth (*Cydia molesta*) in pome and stone fruits in Italy. The product Cidetrak®, from Trécé Inc., received Italian approval in May 2012.

Pheromones are built in to hand applied dispensers to attract and confuse male moths so that they do not mate with the females. As this method does not affect the fertility of the female or the development of the eggs or larvae, the approach is purely preventative and the dispensers must be placed before the first flight of the moths. Mating disruption only affects the specific species of moths whose pheromones are diffused and does not disrupt natural processes so it is

environmentally friendly and can be used as a part of an Integrated Pest Management (IPM) programme.

The Cidetrak dispensers are placed in the orchard in March or April at a rate of 500 dispensers per hectare against Codling moth and 425 against Oriental Fruit moth. When working well, there should be no male moths in the monitoring traps located in the orchard throughout the season (a phenomena known as trap Shutdown). First registration in Europe was obtained in Belgium for Cidetrak CM early 2012. Registrations for Cidetrak CM and Cidetrak OFM are expected in France and Spain in the very near future.

On 7th February 2013, the Italian Ministry of Health also authorised the use of CheckMate Puffer® CM to control Codling Moth (*Cydia pomonella*) on pome fruit tree and walnut tree. Previously available only in Spain, the Puffer product is new to Italy and is added to the existing Suterra portfolio of CheckMate membrane dispensers and CheckMate Flow, a sprayable pheromone. With alternative systems from BASF (RAK) and CBC Europe (Isomate & Isonet), the pheromone MD market in Italy has become very crowded.

CheckMate Puffer® CM is an aerosol that is installed in orchards before the first generation starts flying and is applied at a dosage of 2-3 units per hectare. All the agriculturist needs to do, is insert the can into the aerosol cabinet, set the time and programme

(12 or 24 hour programme) and place the device on a branch or on a pole, in the upper last third of the tree. The automatic dispenser will release the precise amount of pheromone to control codling moths during the entire season. As with other sexual confusion methods, it is necessary to monitor adult moths by positioning monitoring traps before the insects start flying and to continue carrying out checks during the whole season. If the orchards have been attacked consistently during previous years or if fruit has been heavily damaged, it is recommended to use specific insecticides to integrate with the confusion method.

For more information see www.certiseurope.com or www.suterra.com



Cidetrak dispensers placed in an orchard can protect against Codling moth and Oriental Fruit moth



Suterra's Puffer now approved for use by growers in Italy to control Codling Moth

Quality control for stored coffee and cocoa

Dr Terry Mabbett*

Many commodities are harvested, stored and sold as seed but coffee and cocoa are unique in the nature of on-farm primary processing and the condition of the commodities produced. The sequential steps in on-farm processing for coffee (wet or dry processing) and cocoa (fermentation and drying) are essential for the manufacture of high quality coffee beverage and chocolate.

Fresh mucilage covered cocoa beans undergo heat-generating microbial fermentation followed by natural or arti-

ficial drying. Most Arabica and some Robusta coffee cherry is wet processed (pulped, washed, dried and hulled) while the vast majority of Robusta coffee, together with most Brazilian Arabica coffee, is dry processed (dried and hulled). The finished on-farm products are cured cocoa beans and green coffee.

Primary processing of cocoa and coffee activates and accentuates the taste and aroma compounds which underpin market value and define consumer acceptance. The drying dimensions and storage conditions encountered along the coffee and cocoa processes are essential to the long term integrity of these commodities. Failure to achieve

and maintain bean moisture contents below established critical levels, risks a rapid loss of integrity, quality and commercial value. Damage and deterioration is due to feeding by insect pests and the metabolic activities of microbes, in particular a small and select but highly damaging group of mycotoxin producing fungal moulds.

Pace of change

Physical and physiological integrity of freshly harvested coffee and cocoa is compromised by on farm processing. Cured cocoa beans no longer respire because the once living seeds have been killed by the heat of microbial fermentation.

Processed coffee and cocoa beans will freely furnish the taste, aroma, and other vital chemicals required in the manufacture of coffee beverage and chocolate but their now more porous structure and condition is a 'double edged sword'. What can easily exit the beans can just as easily enter and this means cured coffee and cocoa is at high risk of damage from biotic (biological) as well as abiotic (physical and chemical) agents. Being flavour dependent commodities, they are economically sensitive to any damage or deterioration. Mycotoxins as acutely toxic signature chemicals of specific fun-

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Only clean and disease free ripe cherry should be harvested for processing. Mould growth and mycotoxin contamination can start as early as the unripe green coffee berry stage (Picture Dr Terry Mabbett)



Full ripe and visibly healthy pods give the best results in cured cocoa beans (fermented and dried). (Picture Dr Terry Mabbett)



Fallen and soil contaminated coffee cherry is a major source of mould fungi and mycotoxin contamination (Picture Alan Lowes, Omex)

gal moulds, are unique in presenting chemical risks and hazards biological in origin.

Aggravating the risk to coffee and cocoa in store and transit, is the rapidity and magnitude of any change in temperature and humidity. These physical factors set the scene for conditions experienced in store and transit during movement from place of production, to point of use.

Both coffee and cocoa are tropical crops largely grown in countries with Equatorial type climates but for historical and economic reasons, are mostly manufactured and consumed in cool temperate countries. Being processed commodities, they have a much longer 'shelf-life' than cereal grains and oilseeds. As such coffee and cocoa are stored for much longer periods but the longer the storage period, the more they are at risk from damage and deterioration.

Interacting risk factors

Interacting groups of factors which pose a potential threat to the integrity and quality of stored coffee and cocoa beans are three fold – physical and chemical (both abiotic) and pests and pathogens (biotic). Primary physical factors, are temperature and relative humidity which cause secondary problems such as condensation and surface moisture. Examples of chemical factors that can compromise the quality of stored coffee and cocoa are:

- chemical residues of pesticides applied in the field or in store to control insect pests
- contaminating oils in jute sacks, used to pack the beans
- chemicals stored in the same area as cocoa and coffee especially if volatile with intrinsically strong odours

Biological factors including insect pests and fungal moulds are invariably present but require the interactive intervention of physical factors before they can grow into economically-damaging problems. Insect pest explosions are triggered by high temperature and humidity, while accelerated activity in mould fungi and bacteria, is encouraged by high humidity and the presence of free water as surface moisture.

Different types of deteriorative organism affecting coffee and cocoa in store require different levels of relative humidity to initiate and maintain nor-

mal growth and development. Bacteria, fungal moulds (including mycotoxin producers) and mites require a relative humidity level in excess of 90%, 70% and 60% respectively. Depending on class and species, insect pests require humidity within a 30-50% range.

Bean moisture and relative humidity

Moisture inside stored cocoa and coffee beans evaporates to establish an equilibrium relative humidity (ERH) with the air outside the container or storage structure. Excessive moisture content will generate and establish a correspondingly high ERH to encourage insect pest and fungal mould populations. Most moisture content recommendations for coffee and cocoa come in a range of values, as % w/w [weight/weight] and expressed in g/kg, but store managers should aim for a fixed figure and err on the side of caution.

For safe storage of green coffee, the bean moisture content should not exceed 11.0% w/w. A 2.0% rise to 13.0% w/w will generate an ERH approaching 75% within the storage structure, which is sufficient to support a variety of so called 'dry moulds' including mycotoxin synthesisers. ERH levels exceeding 85% (equivalent to a bean moisture content of 18.5% w/w) supports the growth of yeasts and bacteria leading to tainting and off-flavours associated with the fermentation activity of these wet-growth microbes.

Cocoa beans are most sensitive to changes in relative humidity because like table salt, they are hygroscopic [actively absorb water from the air]. The maximum moisture content of cocoa beans required to secure safe storage is just 8.0% w/w. Moisture levels much above this figure encourage mould growth and musty odours. Free fatty acid content inside the bean is elevated with serious consequences for the cocoa butter fraction and chocolate manufacture.

However, the overall exact situation regarding bean moisture content and its effect on humidity is not as cut and dried as it first seems. This is because not all the water inside the bean will be active in generating an ERH in the surrounding air. More recent consid-



Use of visibly diseased pods may result in off flavours and taints and mycotoxin contamination in cured beans further down the chain (Picture Dr Terry Mabbett)



Relatively high numbers of visibly diseased pods are often seen on trees. These should be discarded if quality control problems further down the line are to be avoided. (Picture Dr Terry Mabbett)

erations and calculations differentiate between bound and unbound water in coffee and cocoa beans and focus on an entity called water activity [aw.] Water activity is regarded as a more meaningful measure of ERH which determines activity at insect, fungal, bacterial and enzymatic levels.

Scale of water activity extends from 0 (bone dry) to 1.0 (pure water). ERH (equilibrium relative humidity) is obtained by multiplying [aw] by 100. Thus dried green coffee with an [aw] of 0.6 has an equivalent ERH of 60% which is below the level at which moulds including the mycotoxin producers can grow.

Chemical risks

Cocoa yield and production is constrained by a wide range of insect pests and pathogens. Exports of cured cocoa beans can be equally constrained by pesticide residues. The use of pesticides e.g. by farmers which are not approved by the importing country, or the too frequent and high dose application of approved pesticides, will cause this potentially serious problem. Major importing countries have lists of chemical pesticides which must not be used in cocoa cultivation and maximum residue levels (MRLs) for those pesticides which are approved.

Chemical pesticides used in the cultivation of cocoa can undermine processed products in other ways. Cocoa grown in West Africa suffers heavy attack from sucking pests called mirids (capsids). Insecticides used to control mirids will invariably have a high fumigant activity for efficient pest knockdown but this property may go hand in hand with strong odours that leave taints and off-flavours in the beans. Lindane (gamma HCH) which is now largely banned, caused taint and off flavours in cured cocoa beans.

Insect storage pests

A large number of different insect storage pests will nibble at cocoa and a handful at coffee but each stored commodity only suffers attack from one major insect pest, although in cocoa two distinct species of the same genus are involved. The Coffee Bean Weevil (*Araecerus fasciculatus*) is the culprit in coffee and the larvae of *Ephestia*

moths, for cocoa. *Ephestia cautella* (Cocoa Moth) is the main storage pest in tropical cocoa origin countries, while closely related *Ephestia elutella* (the Warehouse Moth) takes over as the major pest when cured cocoa reaches cool temperate destinations.

Disinfestation of coffee and cocoa in store, using chemical insecticides to kill insect pests, is a risky business because the commodities, which are now nearer to the manufacturer and consumer, are more likely to fall foul of residue regulations and restrictions. This once widely practised routine control measure, has largely been replaced with pest monitoring and pest reduction programmes using pheromone (insect attractant) loaded traps.

Many storage and transit systems employ modified atmosphere storage. An inert gas such as carbon dioxide or nitrogen is introduced into a hermetically sealed structure containing the coffee or cocoa beans. Any insects present or hatching thereafter are essentially killed by asphyxiation.

Moulds and mycotoxins

Mycotoxins, which are the signature chemicals of specific fungal moulds pose the single biggest threat to coffee and cocoa, with the potential to cause a wide range of acute health conditions in trace amounts [ppm (parts per million) and ppb (parts per billion)], for consumers of contaminated products. The presence of mycotoxins in concentrations exceeding the maximum allowable level stipulated by importing countries and manufacturers can completely destroy marketability.

There is a wide spectrum of different fungal moulds synthesising a correspondingly wide range of mycotoxins but just one specific mycotoxin, from two main fungal moulds, affects coffee and cocoa. Ochratoxin A [OTA] is well established as a serious problem in coffee and more recently recognised as an increasing problem for cocoa.

The two main fungal moulds with the capacity to synthesise OTA are *Aspergillus ochraceus*, which is widespread and frequent in the tropical coffee producing countries, and *Penicillium verrucosum* which predominates in temperate climates. OTA is associated with a raft of health problems showing up in test animals



Green Coffee remains at high risk of mycotoxin contamination and should be regularly tested

and including nephrotoxicity (kidney damage) and carcinogenesis (tumour formation) in pigs, dogs and rats.

Mycotoxins are difficult to destroy and will remain at detectable levels after exposure to coffee and cocoa processing including high temperature roasting. The only way to ensure coffee and cocoa remains as free as possible from OTA contamination is to exclude the moulds responsible for its production right along the chain, from the tree to the consumer. Operation of HACCP (Hazard Analysis of Critical Control Points) is now standard practice in coffee production worldwide; from ripe cherries on the tree or soil, to green coffee beans in store and awaiting manufacture. HACCP allows farmers, managers and scientists to pin-point danger zones and to take the necessary action (e.g. proper drying), to avoid or minimize mould growth and OTA synthesis.

Underpinning the success of HACCP is continual progress in the development of increasingly sensitive and accurate mycotoxin testing equipment. Such equipment is widely used on site and in the laboratory to quantify and monitor mycotoxins in ppm and ppb. OTA is perfectly capable of causing extensive damage to human metabolism in such minute amounts. Exporters, shippers, traders and importers and coffee manufacturers monitor mycotoxin concentrations in coffee and cocoa to ensure the commodity conforms to maximum allowable levels of OTA. For instance, maximum allowable limits set by the European Commission (EC) in 2004,

were 5 ppb (5µg/kg) for roast and ground coffee and 10 ppb (10µg/kg) for soluble (instant) coffee.

Stripping away OTA uncertainty
What's in store for coffee and cocoa is the near certainty of even stricter and more stringent maximum allowable limits for OTA. Only way forward is even more sensitive and accurate OTA testing technology and equipment. High sensitivity of OTA testing is critical but clearly not enough. Tests must be carried out as far upstream as possible and therefore should be suitable for use by farmers and primary processors on-site, to prevent early introduction of OTA into international supply chains.

Although laboratory methods using fluorometry or HPLC with an immunoaffinity column are widely accepted and available from VICAM and other vendors, there is new technology being developed which serves the field and non-technical user and is suitable for producers and buying operations, as well as on-site laboratories: quantitative lateral flow strip tests which are now offered by test kit manufacturers. Lateral flow diagnostic tests eliminate the need for highly skilled technical users which means that accurate results may be obtained at growing, buying and processing points along the chain of custody for green and roasted coffee.

The VICAM Vertu® Lateral Flow Reader is one example of technology at the forefront of current drives to identify and quantify OTA hazards at



Portable mycotoxin testing equipment used to monitor green coffee and cured cocoa for ochratoxin A – such as the VICAM Vertu® Lateral Flow Reader and Ochra-V™ Strip Test shown here – is quick and convenient

critical control points and as far back along the supply chain as possible. VICAM** has gone one stage further with introduction of a 7-minute on-site strip test for ochratoxin A (OTA) which accurately detects OTA over a wide range (0-100 ppb) and with sensitivity as low as 5ppb. VICAM Ochra-V™ strip test was designed for use with the Vertu® Lateral Flow Reader and may be implemented with little or no on-site training or expertise required. This novel test employs the highly sensitive and selective monoclonal antibodies required to accurately measure OTA in samples of coffee and for on-site sampling by non-scientific users.

It is innovations from technology providers like VICAM that will continue to enable producers worldwide to measure the quality and suitability of their coffee and cocoa for internal quality and export regulatory requirements now and for years to come.

Further information and details on the VICAM Vertu® Lateral Flow Reader and the VICAM Ochra-V™ strip test can be obtained from VICAM, A Waters Business, 34 Maple Street, Milford, MA 01757. www.vicam.com

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New venue for the CAC Agrochem Show – a fitting home for a global event

Rob Fryatt*

After finally outgrowing the Everbright Centre in Shanghai, this year, the CAC Agrochem Show which is by far the largest event in the Agrochemical calendar, moved across the busy Huangpu River, into the Shanghai New International Expo Centre. Despite only taking up one side of the Expo Centre, the four exhibition halls contained nearly 800 exhibitors who found their booths busy with thousands of delegates over the three days.

This year the exhibition housed a new international area, which featured many companies exhibiting for the first time. Ma Chunyan, Vice Chairman of the Chemical Sub-council of the China Council for the Promotion of International Trade (CCPIT), explained to International Pest Control “It seems that our growing collaboration with the Indian industry has brought many companies to exhibit for the first time at the CAC Agrochem

Show”. She went on to comment that there were many exhibitors too from Australia, Europe and Japan.

The booths thronged with buyers and sellers from all around the world. It is worth noting that for many, the language of business was clearly English. Many Chinese companies realized the importance of having literature in English and to have staff able to discuss their products with many buyers for whom English may not have been their first language but was the best way to build a valuable export bridge.

The figures around the agrochemical industry in China are sometimes hard to comprehend. In 2012 the industry increased production to 3.55 Million tonnes of product, representing a 19% growth on 2011. Exports accounted for US\$2.86 billion representing a growth of 18%. But it is not all “one-way” trade. China imported US\$ 590 Million of product, an increase of 21%, such is the domestic market growth.



The CAC awards recognized the top 10 exporting companies, CAC recommended suppliers and awards for exhibition design

China is well aware of the challenges ahead. Still short of capability to develop new products, Chinese companies still compete fiercely for the market of prod-

*Rob Fryatt, Xenex Associates



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ucts with similar quality and characteristics. However, the focus for the future is clear: new patented inventions, improved formulations, increased marketing and entering new and more highly regulated markets, such as the European Union. Indeed a gradual transformation from active ingredients to formulated products and brands.

This focus was recognized within the content of the CAC Agrochem Show conference and seminar program which comprised:



*The Anglo-Chinese organising team:
Dong Qingli, Rob Fryatt, Ma Chunyan,
Rod Parker, Charlotte (Char) Taylor and
Simone Ye.*

- 7th Chinese International Forum on the Development of the Pesticide Industry
- 5th World Academic Meeting for the Development of Pesticide Technologies and Application
- 3rd International Beyond-Agriculture Seminar
- 2nd China International Bio-Agrochemical Industry Development Forum
- 3rd China International Pesticide Security Management Seminar

Step by step growth is the message from the opening ceremony

As a prelude to the opening ceremony and banquet, a melodious and modern string quartet proved to be just the start of a dynamic evening which demonstrated that not just the market in China is dynamic, but also those who look to lead its future. For the first time, the event recognized excellence within its own industry with the first CAC awards. Being China, as always the approach was different, not as in Western society singling out one company as a winner. The approach was in recognizing that the industry itself is the winner if many competing companies are rewarded.

So the role call was made of the top 10 exporting companies. Between them, these companies represent an export value of US\$2.5 billion, nearly 40% of all Chinese agrochemical exports. This was followed by the selection by experts and invited guests, of the first list that acknowledged a new category of CAC recommended supplier. Finally the awards for exhibition design, recognized the role of design in communicating both corporate culture and brand image, both strongly Western cultural activities. Throughout the evening and between the awards, national companies were invited to entertain the 600

invited guests. This presented companies with the opportunity to display their highly valued cultural abilities, from singing and dancing, through to magic tricks.

Aside from the cultural activities always considered so important in Asian society and the new awards presentations, the formal part was led by Ma Chunyan, Vice Chairman of CCPIT CHEM. Ms Ma is the recognized global face that is building collaboration around the world for the Chinese industry. During the last year, Ma Chunyan has led successful summits in Australia, Brazil, Thailand and India. In 2013 Europe will be added to the list with the first European Summit to be held at ChemSpec in Munich, during early June.

After welcoming the guests from the all parts of China and the global industry and introducing the CAC Show awards, Ma Chunyan invited the special VIP guests to join her to open the event. These were; Mr. Li Yongwu Chairman and Mr. Zhao Jungui Vice Chairman of the China Petroleum and Chemical Industry Federation Mr. Liu Xia, Vice president of Zhejiang Xinan Chemical Industry Group and representing the international delegates, our own technical consultant Rob Fryatt of Xenex Associates who act in a consultancy capacity to CCPIT CHEM.



VIP guests join Ma Chunyan, Vice Chairman of CCPIT CHEM to toast the success of the event at the opening ceremony

Between these five events over 500 delegates listened and debated with experts from both China and around the globe.

It is without doubt that the largest Agrochemical Exhibition in the world will continue to grow. It has already become the meeting point of the global agrochemical industry. For those who remember the cold November days of the Brighton seafront, the move to the Shanghai New International Expo Centre may seem a whole different world. The CAC Agrochem Show is a window on 21st Century China, but it is so much more. It is the open door to the future of the Agrochemical industry. Put a date in your diary to come in and take a look at the 2014 event.



Throughout the Opening Ceremony the 600 invited guests were entertained with cultural displays including singing, dancing and magic tricks.

Seminars continue to build knowledge and awareness

With two successful seminars behind them, the co-organizers; CCPIT CHEM and Xenex Associates had no doubt about the expected success of the third Beyond Agriculture event. In previous years the seminars had focused on valuing and understanding the market dynamics of these interesting incremental markets for agrochemicals, that include pest management, mosquito abatement, turf, ornamentals and consumer use. With the majority of chemicals used in consumer and pest management markets being insecticides, this year the focus also demonstrated the broader opportunities across herbicides and fungicides.

In Rod Parker's opening presentation he outlined both the Top10 chemicals in each category, including the major weed complexes and pests. Of the 180 identified herbicides used in non-crop markets, the top 10 account for over 70% with Glyphosate the clear number 1. For fungicides, the pattern was very different with the top 10 only accounting for 50% of the chemicals used, with the strobilium fungicide Azoxystrobin, the most used. Finally, Rod highlighted that out of the 330 identified insecticides, permethrin was the most used, with a number of the specialist insect 'knock-down' molecules used in aerosol applications featuring high in the top 10.

With this clear understanding the seminar reviewed some of the spe-

cialist opportunities for these chemicals. Mr. Shen Guohui of the Shanghai Academy of Agricultural Sciences and Mr. Peter May of Xavca Pty in Australia, discussed markets for turf. Mr. Guohui highlighted that weed control in turf grass was still an emerging science in China, in contrast to Peter, who outlined the developed nature of the Australian Turf market.

Mr. Wu Zhenyi, Secretary General of the Biocide Alliance reviewed some of the fungicide and bactericide uses in China, highlighting how important it was for those focusing on markets outside of agriculture to understand the importance they play in supporting the health of the nation. The morning session was closed by Ms. Meng Fengxia from the Chinese Centre for Disease Control, who also focused on the importance of controlling insects in the quest to improve health. In addition, she highlighted the increasing segmentation in the public health market between the role of the state in controlling vectored diseases and the emerging and increasing role of private companies in the provision of pest management services. A trend expected to continue but with increasing speed.

The afternoon took Termite control as its lead theme, with Mr. Steve Broadbent, world renown and experienced termite expert from Ensysstex Australia, giving the stand out presentation of the day on the development of

the global termite control market. Steve highlighted how man has transferred the different species around the globe and the continuing trend of termite markets away from the tropics into new territories such as Europe, Chile, South Africa and the Southern states of his native Australia. Professor Mo. Jianchu from the Zhejiang University Urban Entomology Research Centre followed, outlining the current status and the many challenges facing the Chinese termite control market.

The final presentations of the seminar featured Ms. Wang Yiyan, formerly of ICAMA and now an independent regulatory expert, who reviewed the current regulatory status and approach. This was followed by Dr. Lorenzo Minetti, from Asian company Fair Chem Industries, who shared a practical example of a company identifying and developing new markets in Beyond-Agriculture.

Rob Fryatt of Xenex Associates and Chair of the seminar, highlighted in his summing up, the important place that China holds in 'Beyond-Agriculture' markets worldwide and the value of exchanging information and knowledge to build a strong business in these markets. There are few international experts in these markets and he reminded the delegates how fortunate they were to listen to so many of these in just one day.



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Vital stewardship to managing metaldehyde

Kevin Price*

Whilst the slug control markets in different countries may vary in terms of the balance of active ingredients favoured, the environmental context in which they are used certainly presents similar legislative and stewardship pressures for farmers and growers.

In accordance with the Environmental Action Programmes of the European Community, European governments have targeted “a significant overall reduction in the risks and uses of pesticides consistent with the necessary crop protection” and have now introduced regulations providing for the implementation of the Directive 2009/128/EC on the Sustainable use of pesticides. Requirements include the establishment of National Action Plans; compulsory testing of equipment; provision of training and certification of operators, advisors and users; and provisions to protect water, public spaces and conservation areas.

So with governments working towards reducing pesticide usage (e.g. in France, ‘Ecophyto2018’, aims to achieve 50%

reduction in pesticide usage by 2018), the farming industry has been faced with restriction of the range of active substances available as well as the challenge of ensuring responsible usage of those that remain in order to guarantee their sustainability. In some cases this relates mainly to limiting the development of resistance to the products. In the molluscicide market management of their impact on the environment is the critical issue.

Traditionally metaldehyde or methiocarb have been used in Europe for effective control of slugs and snails. However, concerns arose following the appearance in the UK in 2008 of traces of metaldehyde in raw water at levels exceeding EU drinking water standards and because it has not proved possible to remove these traces effectively, the chemical active ingredient has since been under close scrutiny. Recognising the seriousness of this situation and the potential threat to continued use of the product, the industry responded by developing strategies for best practice usage to help achieve compliance with the stringent standards. In France, for example, distributors and agricultural cooperatives developed strategies to prevent water pollution and national



Slug eating ferric phosphate granule.

research institutes have conducted trials to inform these strategies. In the UK the Metaldehyde Stewardship Group (MSG) was established by a group consisting of all the product manufacturers (Lonza, Certis, Chiltern Farm Chemicals, De Sangosse, Doff Portland, Frunol Delicia and Makhteshim Agan (UK) in 2009. The Group was set up to promote and encourage best practice advice for the responsible use of metaldehyde based slug pellets in order to minimise environmental impact and protect water. MSG launched a major campaign ‘Get Pelletwise’ to inform users about training and the practices they must adopt to achieve that and to maintain the availability of the product.

With the adoption of these strategies and given the very dry conditions in much of Europe over several succeeding summers, the problem had been held in check until last year. 2012 was an exceptional year in terms of rainfall and, with ideal conditions in spring and the early part of the summer, slug populations reached unparalleled levels and posed a serious threat to the autumn establishment of cereals and oilseed rape, requiring the extensive use of control measures.

Robert Lidstone of Certis Europe UK and the MSG confirms the success of the Group to date in raising awareness. “As a result of MSG’s work distributors, advisors and farmers are well aware of the risk metaldehyde poses to water in vulnerable catchment areas and the very high risk occasioned by the weather conditions last year,” he says. “Suppliers promoted the need for a planned strategy with a programmed approach using different active ingredients.”



In many areas soils remain saturated so extreme care and adherence to stewardship guidelines will be required to avoid further problems in water courses.

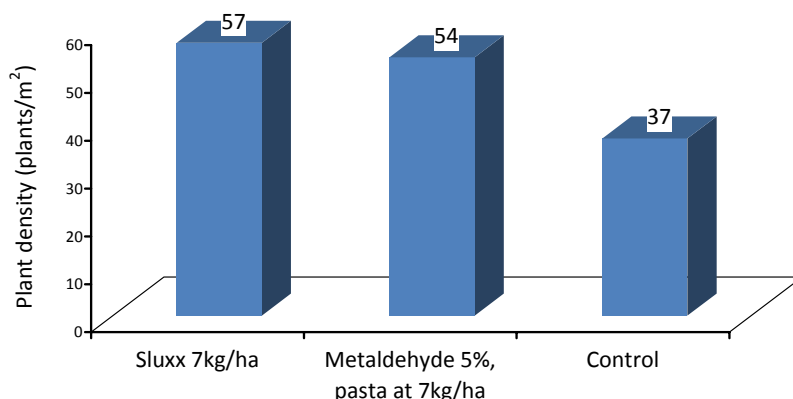
* Kevin Price, Market Development Manager, Certis Europe. price@certiseurope.co.uk or visit Certis Europe: www.certiseurope.com

The armoury available to farmers has been increased by a molluscicide based on a new active ingredient. Slu x x, containing ferric phosphate, proved to be a valuable part of the programmed approach, offering an additional option giving control equal to products based on both metaldehyde or methiocarb and with the further benefit of very low risks to the environment and non-target species (Figure 1). A survey conducted among 100 farmers in Eastern France who have used Slu x x showed high levels of satisfaction on the levels of control achieved and environmental profile, particularly in terms of non-target species, including earthworms and carabid beetles.

Slu x x is available in UK, France, Germany, Netherlands, Italy and Belgium and in the process of registration elsewhere in Europe. Field trials in Germany showed high levels of protection for the crop (Figure 2).

Figure 2: Efficacy pre-emergence, oilseed rape.

Density of emergent crop 30 days after application and 70mm of rain over 4 weeks. Dose: 7kg/ha in Germany (Bonn). Sown 7 September, application 10 September.

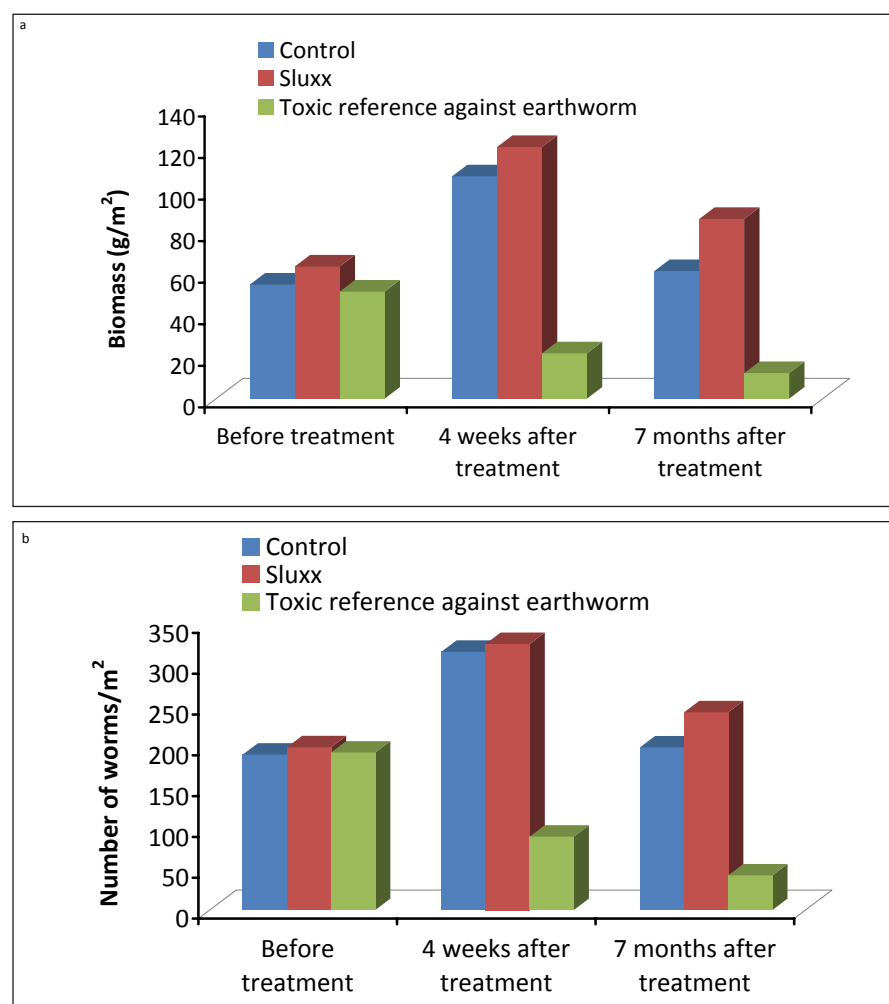


Pierre Taupin of ARVALIS Institut du Végétal, Service Génétique et Protection des Plantes comments, “Effective slug control continues to be particularly important this year and we are delighted that research has con-

firmed the efficacy of the available products, based on different active ingredients. Our laboratory tests, conducted in Spring 2012, have shown Slu x x to have higher mortality than metaldehyde and methiocarb and its non-hazardous classification indicates an environmental advantage. Responsible usage of these various products will assist farmers in respecting stewardship requirements for protection of the environment whilst also safeguarding their crops.”

Uptake of the product in both UK and France was high in 2012 as farmers saw the need for a control strategy that limited metaldehyde usage. The continuation of wet conditions through the winter has certainly favoured slug activity and, with a heavy burden of slugs, farmers face a high risk situation through the Spring. In many areas soils remain saturated so extreme care and adherence to stewardship guidelines will be required to avoid further problems in water courses. An unusually high demand for molluscicides is therefore expected, particularly for potatoes and field vegetables. With such a favourable environmental profile, ferric phosphate may be seen as the product of choice.

Figure 1: Slu x x and earth worms. Mortality compared between control, Slu x x and toxic reference against earthworm 4 weeks and 7 months after application. Top: measure of biomass. Bottom: number of individuals. Trials by BP: 2008 Germany. No statistical difference shown between Slu x x and control, which differ from toxic reference.



Improved plant health through nutrient uptake from foliar feeding

Dr Terry Mabbett*

Inadequate uptake of specific nutrients, especially at high physiological demand times, can potentially cause well-established and wide ranging physiological syndromes, with symptoms specific to the crop and the nutrient in question. However there are well-established extra disease dimensions where microbial pathogens can take advantage of a weakened and damaged plant structure.

While sustained soil fertility is the foundation of plant nutrition, foliar feeding is the most timely and targeted way to apply nutrients and are crucially an important complement. Foliar feeding can short-circuit any lock up of soil-based nutrients, correct specific nutrient deficiencies, provide required nutrients at physiological 'demand times' (e.g. flowering and fruit formation) and facilitate fast fulfilment of poorly mobile nutrients like calcium. Foliar feeding is recognised as the quickest and most effective route to a balanced plant nutrition and uninterrupted production of sugars, especially during nutrient stress,

created by drought or the need to stimulate rapid new root and shoot growth, on small transplants in the field. In this context, foliar feeding is not about addressing shortfalls and deficiencies in specific nutrients through the application of relatively large amounts, but supplying a nutrient profile 'little and often' to maintain plant health. This contrasts with the application of nutrients with higher specific analyses, custom designed and applied to correct deficiencies, identified by plant and soil analysis. For example, if plant analysis reveals manganese (Mn) is low or deficient (even when soil manganese appears adequate), then prompt proactive foliar application can boost bio-available Mn.

Pro-active foliar feeding based on plant and soil analysis and soil-crop history furnishes the required nutrient(s) before plants start to show deficiency symptoms. Benefits are especially big if applications are made before the onset of 'demand times', when nutrients can drop to deficient levels. Pro-active foliar applications supply sufficient nutrient(s) to the plant before any crop quality and production problems come into play.

Rapid and targeted uptake of nutrients via foliage enables farmers and

growers to stop 'simple' nutrient deficiency syndromes like 'blossom end rot' of tomato and capsicum pepper fruit, triggered by calcium deficiency, from developing into plant disease problems after microbial pathogens exploit the weakened and damaged tissue.

Some scientists differentiate between 'foliar feeding' and 'leaf feeding'. Foliar feeding describes the use of products of higher specific analysis to address and remedy specific nutrient requirements and shortfalls. Leaf feeding is defined as the use of foliar fertilizer to achieve and maintain balanced plant nutrient status and sound plant nutrition. Successful foliar feeding requires a profound understanding of formulation, spray application, canopy characteristics and plant surface (Mabbett, 2012) and the micro mechanics of nutrient uptake across plant surfaces.

Micro mechanics of nutrient uptake Whether or not aerial plant parts can compete on equal terms with roots as sites of nutrient uptake, remains a hotly debated topic, but calculations for crops like soybean, show that once the crop canopy closes, total available leaf area can be larger than total root surface. This could be an underestimate, since only a relatively small proportion of the root system (mainly the root hairs) is active in the uptake of nutrients in solution. This gives ample scope and opportunity for nutrients sprayed onto the leaves to move into the plant and fulfil a function; whether remedying specific shortfalls of specific nutrients, or generally maintaining growth and development.

The aerial plant organs, through which nutrients gain most efficient entry and what can be achieved in formulation and spray application to make nutrients gain more efficient, is fairly well understood. Main gaps in the understanding of nutrient uptake remain at the plant 'micro-surface' level, although these gaps are now being closed.

Green leaves clearly present the largest and least obstructive surface area for nutrient 'absorption,' but this is not

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Brassicas possess an inherently waxy cuticle. Head cabbage should be sprayed from above (rather than from the side) to avoid a 'shadow effect' where one side is not covered (Picture Omex)



Crops will invariably have high specific nutrient demands during fruit formation and development which are most easily, quickly and accurately satisfied by foliar feeding. Capsicum peppers shown here (Picture Omex)

the whole story. Nutrients can enter through flowers, fruit, green stems and even woody stems via lenticels. How long nutrients remain on the plant surface is governed by how quickly and to what extent they move into the plant and how much is lost from rainfall or sprinkler irrigation. Other factors like wind and leaf abrasion also have an effect. Plant surface, formulation and environmental factors all play a part in loss of nutrients from plant surfaces. Deposits with sufficient time to dry before exposure to rainfall or sprinkler irrigation are more resistant to wash off. Those deposited on the undersides of leaves (the lower or abaxial surface) are shielded against direct effect of rainfall or sprinkler irrigation.

Low or ultra-low volume sprays that give a discrete pattern of small diameter droplets across the leaf surface, as opposed to high volume sprays of large droplets coalescing to create complete surface wetness and run off, are less susceptible to loss from rainfall or irrigation. Leaf surfaces with waxy cuticles are essentially hydrophobic (water hating) and therefore not ideal templates to secure aqueous hydrophilic (water loving) solutions of plant nutrients. Use of surfactants to reduce surface tension and improve spray droplet spread across leaf surfaces improves tenacity.

Most foliar applied nutrients enter through the leaves but by no means uniformly so. Speed and rate of nutrient entry is governed by a wide range

of plant factors including leaf age and development, the leaf surface (adaxial [upper] or abaxial [lower] and the nature of 'micro level' entry through the leaf epidermis.

Nutrient uptake via cuticle and stomata

The million dollar question exercising plant scientists is the relative importance of the cuticle and stomata as penetration pathways for nutrients. The original thinking was that uptake was only by the cuticle via 'ectodesmata' (strands of cytoplasm extending from epidermal cells) with stomata being impermeable

to nutrients. Both concepts have since been disproved.

The waxy, waterproofing plant cuticle covering the leaf epidermis is there for a purpose: to prevent water loss by evaporation and leaching of nutrients from inside the plant. At first sight the cuticle forms a formidable barrier to the uptake of hydrophilic polar ions, whether monovalent (K^+) or divalent (Ca^{2+}). The cuticle is a biopolymer secreted by the leaf epidermal cells and comprising mainly of cutin (a polyester matrix of polymerized long-chain fatty acids) with embedded (intracuticular) waxes. The cuticle alone is a formidable hydrophobic barrier to water soluble nutrients but is additionally overlain by a highly hydrophobic layer of epicuticular waxes (Pollard et al., 2008; Barthlott et al., 1998)

At its inner surface, the cuticle contains a variable amount of polysaccharide fibrils and pectin lamellae extending from the epidermal cells. These microstructures bind the cuticle to its underlying epidermal tissue (Jeffree, 2006).

Two distinct layers of cuticle are thus recognised. They combine to produce a 'visible' gradient, moving from the more hydrophobic outer surface to a



Nutrient uptake and utilisation from foliar feeding is ideal for providing specific nutrients at high physiological demand times like fruit formation and development. Plum tomatoes shown here (Pictures Omex)

more hydrophilic inner surface interface with the leaf epidermis. Nutrient ions experience this change as they traverse the cuticle, moving from less amenable (more hydrophobic) to more amenable (more hydrophilic) position.

Polar, hydrophilic nutrient ions can and do move passively through hydrophobic cuticles but arguments still persist over how this is achieved. 'Polar pores' created by clusters of water molecules moving into the cuticle from both sides, to provide penetration pathways for hydrophilic ions, have been identified. This 'polar pore' concept was first put forward by Tyree et al., (1990). Fernandez and Eichert (2009) have since suggested nutrient ion movement through the cuticle may simply be caused by a resulting general increase in the hydrophilic capacity of the cuticle (from clusters of water molecules), with a corresponding increase in solubility and ease of ion passage.

That apart, size of pores clearly determines the nature of ions ability to enter and traverse the cuticle. Early estimations on de-waxed citrus leaves suggest-

ed pores with a diameter of around 1nm [1 nanometre] (Schonherr, 1976). This is sufficiently large to allow the entry of hydrated cations (NH_4^+) or anions (NO_3^-) but will exclude large molecules such as sugars and iron chelates. Eichert and Goldbach (2008) said these pore sizes were almost certainly average values and subsequently reported pores of 4-5 nm in the cuticle of coffee leaves.

The biggest breakthrough came with complementary role of stomata (leaf pores) as penetration pathways. Stomata are adjustable-size pores controlled by movement of the surrounding pair of guard cells which regulate pore size and therefore entry of carbon dioxide gas and exit of water vapour and oxygen. Research by Thomas Eichert (University of Bonn) and colleagues showed stomata as nutrient penetration pathways equal in importance to the cuticle (Eichert and Burkhardt, 2001). Nutrients enter leaves directly through stomata without having to pass through the layer of cuticle covering the guard cells.



The visibly thick cuticle and shiny wax bloom on the upper (adaxial) surface of coffee leaves is evident here (Picture Dr Terry Mabbett)

Experiments using nitrogen compounds showed entry of hydrophilic particles up to 40 nm in diameter (Eichert and Goldbach, 2008; Eichert et al., 2008). Hydrophilic nutrient molecules and particles, much larger than previously thought, enter the leaves via stomata by diffusion along the water saturated surfaces of the guard cells and cells lining the sub stomata chamber.

This revised foliar-applied nutrient uptake model provides a more rapid and extensive uptake of particles of much larger dimensions (e.g. Fe-chelates) due to the complementary role of stomata as penetration pathways (Eichert, 2012; Eichert and Fernandez, 2012). As penetration pathways, stomata do not demonstrate the same pore size restrictions on nutrient entry and passage as do 'polar pores' in the cuticle.

What are the practical implications for foliar feeding?

These findings have many practical implications for foliar feeding say Peter Prentis and Alan Lowes at Omex Agrifluids, a research and development based company which designs soluble nutrient products for foliar feeding worldwide.

- The range of nutrients and delivery systems (formulations) which can be effectively used in foliar feeding. Fe-chelates once thought to be inappropriate for foliar feeding is taken up despite a relatively large particle size, says Alan Lowes.



The high zinc demanding citrus tree has stomata confined to the abaxial (lower) surface of its leaves (Pictures Dr Terry Mabbett)

- Frequency and distribution of stomata according to leaf surface - adaxial [upper] and abaxial [lower] - leaf age and development and plant species. Broad leaf species invariably have a higher concentration of stomata on the abaxial surface. In tree crops like coffee and citrus stomata are confined to this lower leaf surface says Peter Prentis.
- Timing of foliar feed application in relation to opening and closing of stomata controlled by environmental conditions and diurnal movements of guard cells. Nutrient entry via stomata will clearly be at its lowest during high-light, high temperature periods, adds Alan Lowes, adding how potential for transpiration is high which means the stomata are closed
- The distribution of nutrients on leaf surfaces from spray application. Air assisted sprayers which improve lower leaf surface coverage are often most appropriate. And especially when used by citrus and coffee growers to ensure maximum coverage of abaxial leaf surfaces where stomata are exclusively found. Citrus has a high demand for zinc and foliar feeding is ideal because zinc is easily locked up in the soil concludes Peter Prentis.

Nutrient deficiencies are often self-perpetuating through their effect on the structure and functioning of stomata. Leaf chlorosis caused by iron deficiency reduces the size of stomatal pores and therefore leaf capacity to take up nutrients. Similarly, boron deficiency can alter the shape and normal functioning of stomata.

Disease dimension to nutrient deficiency

Calcium, one of the least mobile nutrients with key strengthening roles in plant tissue and organ integrity has one of the widest track records in this respect. Classic examples are entry and involvement of *Pythium violae* and *Pythium ultimum* in carrot cavity spot and *Phytophthora* species in blossom end rot of tomato and capsicum pepper. One of the most recently discovered examples is dual roles of calcium and *Sydowia polyspora* in CSNN (Current Season Needle Necrosis) increasingly

affecting conifers grown commercially as Christmas trees (see Calcium as the cementing factor in CSNN on page 106 of this issue).

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Stomata on coffee leaves are confined to the lower (abaxial) surface [left] and absent from the upper (adaxial) surface [right] with its thick cuticle and overlain with a shiny wax bloom (Picture Dr Terry Mabbett)

Managing current season needle necrosis in Christmas trees

Uptake and utilization of nutrients is the cornerstone of physiological health in green plants, but deficiencies in specific nutrients have long been known to play a crucial role in the development of disease caused by plant pathogens. Calcium, a poorly mobile nutrient with an important strengthening role in the structure of plant tissue is well established in this respect.

CSNN (Current Season Needle Necrosis) continues to cause serious losses for Christmas trees in North America, mainly Noble fir (*Abies procera*) and Grand fir (*Abies grandis*) and in Europe the Nordmann Fir (*Abies nordmanniana*), with the United Kingdom the latest country to be hit. CSNN is proving to be one of the most intractable and difficult to decipher problems affecting the Christmas tree industry both sides of the Atlantic Ocean.

CSNN as the name suggests, only affects current season's needle (leaf) growth, starting to show in spring and through into summer. Needles affected by CSNN develop brown to tan bands shortly after the shoots elongate in spring. Affected areas subsequently turn reddish brown and spread over and across the whole fir needle. Badly affected needles are shed but those with just banding symptoms stay attached to the branches.

The fungus *Sydowia polyspora* has been isolated and identified from needles with CSNN sourced from a number of *Abies* spp (true firs) including noble and grand fir from

the Pacific North West. Inoculation trials were conducted on small seedlings but the results were variable leading some scientists to suggest that the fungus may just be an endophyte and not the primary cause of CSNN.

Early research findings in Denmark suggest CSNN is due to the inability of trees to access sufficient calcium, leading to a loss of leaf tissue integrity and enabling infection by *Sydowia polyspora* with consequent disease development.

Deliverance from Denmark

Development of Nordmann fir (*Abies nordmanniana*) as a Christmas tree is the 'brainchild' of the Danes who went into the Caucasus Mountains, to collect seed from wild trees in Georgia. This is where Europe blends with Asia and the natural home of *A. nordmanniana*. It was the Danish who sowed the seeds for today's European Christmas tree industry based mainly on Nordmann fir.

International Pest Control spoke to Lars Bo Pedersen Chief Consultant at Dansk Juletraeer (Danish Christmas Tree Association – Trees and Greenery). We asked Mr Pedersen how far Danish plant scientists had reached in unravelling what is clearly a complex problem, and thereby pin-pointing the exact roles played by the fungus *Sydowia polyspora*, the prevailing weather, atmospheric conditions experienced during the growing season and soil fertility. These factors are widely implicated in



Small Nordmann fir showing CSNN in late summer a definitely not for marketing. Picture Courtesy Lars Bo Pedersen.



CSNN is entirely unpredictable. A badly affected tree surrounded by healthy specimens. Picture courtesy Lars Bo Pedersen.

CSNN from observations made by growers and scientific research carried out in North America, and a range of European countries including Denmark, Norway and Germany.

Lars Bo Pedersen remarked how observations by Danish growers and early trials by scientists have pin-pointed a critical mid-summer period, from late June to early July, when relative humidity remains at very high levels, often at or very close to 100 per cent. With the atmosphere now clearly saturated with water vapour the needles are unable to transpire water.

Such extremely high concentrations of water in the atmosphere means water in the walls of cells which line the stoma cavity, is unable to evaporate, even though the guard cells which control pore size are now fully turgid, characteristically sausage shaped and subtended to reveal a wide open pore. Stomata (singular stoma) are the pores and associated cells which perforate the leaf epidermis and allow gaseous exchange (carbon dioxide in and water and oxygen out) to take place.

With evaporation from the leaves (needles) curtailed the transpiration stream (movement of water in columns up the xylem vessels from the roots to leaves) is static. This has knock-on consequences for uptake of nutrients by the roots and their movement up the plant in the transpiration stream. And critically for calcium ions (Ca^{2+}), which



Heavy needle drop from CSNN makes trees unmarketable. Picture courtesy Lars Bo Pedersen.

together with magnesium ions (Mg^{2+}), is a component of the pectates which cement the walls of adjoining leaf cells together.

The cementing substance is called the middle lamella and is composed of calcium and magnesium pectates which are salts of pectic acid. Plants require stability imparted by middle lamella which additionally allows the formation and maintenance of plasmodesmata. These are strands of cytoplasm which pass through microscopic pores in the cell



Marked necrosis with heavy needle drop already apparent. Picture courtesy Lars Bo Pedersen.

walls to connect one protoplast (living cell) to another thus allowing interaction between them.

Calcium ions are unable to reach the leaves and perform this vital cementing function for new cells and tissues produced in the newly formed and extended needles. Structure and integrity of the new leaf tissue is therefore compromised and vulnerable to infection by the fungus *Sydowia polyspora*. "It is always the south side of the trees which is mostly hit by this CSNN syndrome. We believe that the fungus *Sydowia polyspora* is secondary in the CSNN 'syndrome'," says Lars.

"We also suspect that fertilizer regime is playing a part. The ammonium ion (NH_4^+) is known to compete with the calcium ion (Ca^{2+}) at the sites of nutrient uptake on the root surface", says Lars. "And it is our considered view that damage from CSNN is most often seen within well fertilized stands of trees on clay soils, and especially those growing on former agricultural land," he said.

Sound scientific hypothesis

Lars Bo Pedersen stressed how all this is just a working hypothesis. He says a 'real' investigation to discover and document what the exact causes of CSNN are and what the Danish Christmas tree industry can do to fight the disease, is urgently required. Such investigation is planned for to 2013.

Hypothesis or not, the Danish view makes sense from both plant physiology and plant pathology perspectives. *Sydowia polyspora* would appear to be like a number of potential plant pathogenic fungi that only develop full para-

sitic mode when environmental conditions are favourable and plant host susceptibility is high.

Exceptionally high levels of relative humidity, maintained over long periods of time, will promote and sustain spore germination. Spore germ tube penetration and infection into the needle is made that much quicker and complete by structurally weak leaf tissue. Underlying cause of CSNN symptoms appears to be a combination of water loss, through compromised leaf surface structure and consequent desiccation (drying out), and a deficiency of calcium ions. The now pathogenic fungus *Sydowia polyspora* appears to benefit from an extremely high relative humidity conducive to spore germination and infection and a weakened leaf structure that makes infection and disease development that much easier.

Ex-agricultural clay-based soils will invariably have high ammonium nitrogen contents. Positively charged NH_4^+ sourced from urea, ammonium nitrate and ammonium sulphate are held strongly by the clay fraction which minimises leaching and the loss of these ions from the soil. Since NH_4^+ competes strongly with Ca^{2+} at the root surface it would be easy to understand why CSNN appears to be most prevalent in Christmas trees grown on inherently fertile ex-arable farming soils.

Given the apparent dual role of Ca^{2+} and Mg^{2+} in composition of the middle lamella, could the latter also have a role in suspected loss of leaf integrity and the development of CSNN? Any involvement of magnesium would be at least as serious because Mg^{2+} , in addition to forming magnesium pectate in the middle lamella is also the core structural component of the chlorophyll molecule.



Close up showing the distinctive discolouration of needles typical of CSNN. Picture courtesy Lars Bo Pedersen.

International Pest Control calendar of events

Please find below a list of key international events in the world of pest management. If you know of an exhibition or conference that is not listed here, please send information to editor@international-pest-control.com. It is sadly not possible to list all the events in the pest control

world, however we will aim to publicise as many as possible. If you have attended an event and believe the discussions might be of interest to our readers, we are also interested in receiving reports and photos that you are happy to share with our readership.

Date	Days	Event / Venue / Website	
10-Apr-13	2	PestEx ExCel, London / www.pestex.org	
11-Apr-13	1	Biopesticide Market Opportunities University of Greenwich, London, UK / http://www.enterprise-europe-se.eu/xse/events/register.asp?eventid=115	
22-Apr-13	5	10th International Symposium on Adjuvants for Agrochemicals Foz do Iguaçu, Brazil / http://events.isaa-online.org	
05-May-13	4	11th International Verticillium Symposium Göttingen, Germany / http://dpg.phytomedizin.org/de/11th-international-verticillium-symposium-2013/	
07-May-13	3	IOBC Working Group on Integrated Control in Citrus Fruit Crops Adana, Turkey / http://iobcwprscitruswg.org/	
12-May-13	5	12th European Fusarium Seminar Bordeaux, France / https://colloque.inra.fr/efs2013	
12-May-13	5	6th Meeting, IOBC-WPRS Working Group, Integrated Protection of Olive Crops Becici, Budva, Montenegro / http://www.montenegrolive-iobc.com/	
13-May-13	4	14th Euroblight Workshop Limassol, Cyprus / http://www.euroblight.net/EuroBlight.asp	
20-May-13	5	1st International Whitefly Symposium Kolymbari, Crete, Greece / www.ibws6.gr	
21-May-13	1	65th International Symposium on Crop Protection Ghent, BELGIUM / www.iscp.ugent.be	
29-May-13	1	Museum Pest Workshop: Annual Conf of American Inst of Conservation (AIC) Indianapolis, USA / http://www.conservation-us.org/index.cfm?fuseaction=page.viewpage&pageid=715	
05-Jun-13	3	International Conference on IPM in Museums, Archives and Historic Homes Vienna, Austria / http://www.ipm-conference-vienna2013.at/	
10-Jun-13	4	IOBC-WPRS: Induced resistance in plants against insects and diseases Avignon, France / https://colloque.inra.fr/iobc_inducedresistance_avignon	
24-Jun-13	4	16th European Weed Research Society Symposium Samsun, Turkey / https://www.ewrs2013.org/	
09-Jul-13	1	CEPA, General Assembly and Management Day Belgium / www.cepa-europe.org	
27-Jul-13	6	International Union of Microbiological Societies Congress Montreal, Canada / http://www.montrealiums2014.org/welcome_e.shtml	
03-Aug-13	6	10th European Congress of Entomology York, UK / www.ece2014.com	
03-Aug-13	6	10th International Mycological Congress Bangkok, Thailand / http://www.imc10.kasetsart.org	

International Pest Control calendar of events – continued

Date	Days	Event / Venue / Website
05-Aug-13	4	11th International Verticillium Symposium Gottingen, Germany / http://verticillium.phytomedizin.org .
13-Aug-13	3	New Zealand Plant Protection Society Conference Napier, New Zealand / www.nzpps.org/conference.php
19-Aug-13	5	International Chemical Ecology Conference (ICEC 2013) Melbourne, Australia / http://www.icec2013.com.au/
25-Aug-13	6	International Congress of Plant Pathology Beijing, China / http://www.icppbj2013.org/
09-Sep-13	3	1st Eurasian Pest Management Conference EAPMC-2013 Russian Academy of Sciences / http://www.pestmanagement.su/english/invitation/
22-Sep-13	6	European Vertebrate Pest Management Conference Turku, Finland / www.evpmc.org/home
07-Oct-13	5	European Mosquito Control Association Istanbul, Turkey / http://www.emca-online.eu/
21-Oct-13	3	Annual Biocontrol Industry Meeting Basle / www.abim.ch
23-Oct-13	4	PestWorld Phoenix, Arizona, USA / http://www.npmapestworld.org/pestworld2013/
29-Oct-13	2	CropWorld Amsterdam Rai Centre, Netherlands / http://www.cropworld-global.com/
06-Nov-13	1	PestTech Birmingham, UK / http://www.pesttech.org.uk/
13-Nov-13	1	Barcelona Pest Control International Forum (BPCIF) Barcelona, Catalonia, Spain / http://www.adepap.com/es/barcelona-pest-control-international-forum
13-Nov-13	2	Parasitec Maghreb Casablanca, Morocco / www.parasitec.org
13-Nov-13	3	1st International Forum London Pest Control (BPCIF) London / http://www.adepap.com/es/presentacion
26-Nov-13	3	FAOPMA Seoul, Korea / www.faopma2013korea.com
19-Feb-14	2	Eurocido Dortmund, Germany / http://eurocido.de/
02-Jun-14	3	11th Fumigants & Pheromones Conference Krakow, Poland / http://www.youtube.com/watch?v=xSeh4L6ut0I&feature=player_detailpage
20-Jul-14	4	2014 International Conference on Urban Pests (ICUP) University of Zurich, Switzerland / www.icup.org.uk

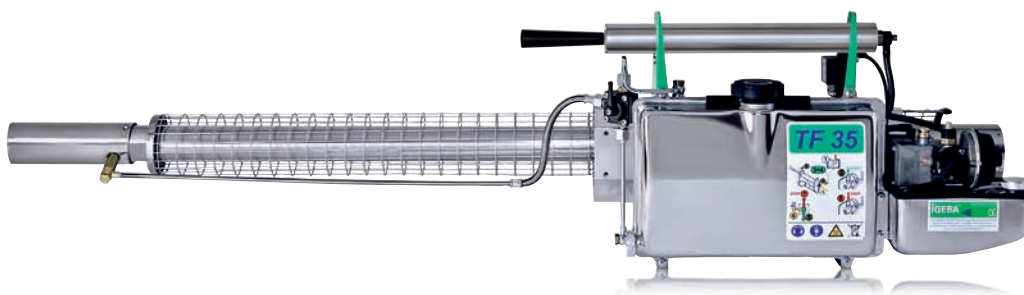


International Pest Control intends to be at the following events. We hope to see you there.

- PestWorld Phoenix USA 23-26 Oct 2013
- Parasitec Casablanca, Morocco 13-14 Nov 2013
- 25th FAOPMA Korea 26-28 Nov 2013
- PestTech Birmingham, UK 06 Nov 2013
- IBMA Basle 21-23 Oct 2013
- CropWorld Amsterdam 29-30 Oct 2013

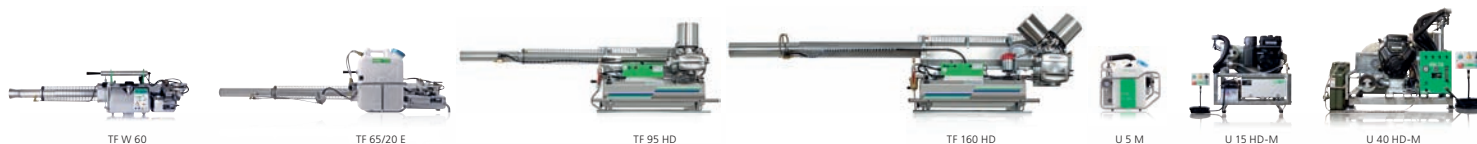


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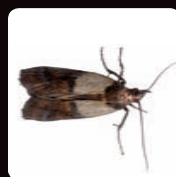
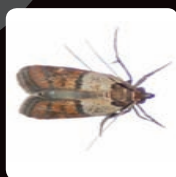
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