

crop protection monthly

international news, comments, features and conference reports

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LEAD ARTICLES

UPHEAVAL AT NUFARM

There has been considerable activity in the generic sector in recent weeks involving both Nufarm and Makhteshim Agan as they grapple with various financial considerations. Nufarm held its 2010 AGM on 3 December against a backdrop of poor performance and had taken some steps to appease both its shareholders and banks by revealing in advance that the long time board member and deputy chairman Doug Curlewis was to retire immediately. Nufarm had breached two banking covenants back in July and the banks gave the company waivers from the breaches until mid-December, in exchange for a strategy review and boardroom changes. "We see board renewal as an important component of the strengthening of the business and we want to ensure the board has the right mix of skills, experience and fresh insight to help guide the company back to a position where it can generate strong shareholder value," said the chairman Don McGauchie. However, the shareholders, who have endured two years of poor performance, were still clearly upset about the issues that had caused the shares to collapse from around \$14 to a low of \$3.20 in the past year and delivered a hefty protest vote against Nufarm's resolutions at the meeting.

In recent months the company's management has been repeatedly called into question. There has also been pressure on the long-serving CEO, Doug Rathbone, to step down, particularly after it emerged he had used his significant Nufarm shareholding as collateral against loans for personal business interests. Mr McGauchie said at the AGM that Mr Rathbone's personal financial affairs posed no risk to the company, as his other personal assets were "well above" his liabilities. He said Mr Rathbone had shown commitment to Nufarm above and beyond what was required. Don McGauchie went on to defend his chief executive saying: "It has been a remarkably volatile period for the company and there are some parts of the business that have been put under more pressure than any of us have ever seen. There have been difficult times and they have led to a series of issues that we have had to deal with." He also reiterated that the company has strong support from its main shareholder, Sumitomo Chemicals.

Nufarm had announced prior to the meeting a \$900 million, one year, syndicated debt facility with its banks at interest rates consistent with what it had been paying. With a short term bridging facility due to expire, there had been concerns that the company would need to raise capital again if it failed to strike an agreement with its lenders. The one year facility is with Rabobank, ANZ, NAB and HSBC. Nufarm said it had also authorised Rabobank to finalise longer term debt facilities to replace the one year arrangement. It had also been revealed prior to the AGM that the Australian Securities and Investments Commission (ASIC) has fined Nufarm \$66,000, and imposed restrictions on how it can raise capital in the next nine months. This was because the company failed to disclose material information regarding its year to date financial results in the period from 11 February to 2 March 2010. Nufarm is now required to engage an independent external consultant to review its financial reporting and disclosure systems, recommend changes, and review the implementation and effectiveness of those changes.

Nufarm posted a net loss of \$23.99 million for the year ended 31 July 2010. In his presentation at the annual meeting Mr Rathbone said that the company was aware that it has fallen short of shareholders' expectations and needed to do better. He said that operating profits should come in between \$10 million and \$20 million for the six months to 31 January 2011. The improved result is expected to be driven by better earnings for most of its products and improved market conditions for its main herbicide glyphosate.

Mr Rathbone gave a commitment that the company would make changes to ensure that there was improved capacity to meet the challenges of the business and to ensure that it delivered earnings recovery in 2011 and profitable growth in the years ahead. He said that the recent review process had been thorough and had benefited from the input of external consultants. In the future the company would strengthen its presence in more defensible, high value segments by leveraging its strengths in product development and strong commercial partnerships. This included building its seed and seed treatment business. Whilst Nufarm will continue to operate in global markets it did not need to be present in all global markets and the focus in the short term would be on the company's existing markets. He said there were also opportunities to rationalise the product portfolio, remove underperforming products and increase

the efficiency of the product development programmes. He said the company had also targeted some specific cost savings and efficiencies in the business and that there will need to be improvements in both management and systems. Nufarm has also established a Business Analysis Unit to ensure that its business intelligence needs are met and has recruited Bonita Croft as Group Executive, Human Resources and Organisation Development to cope with areas such as management transition and succession planning. A Group Treasurer will also be recruited to strengthen the financial management of the company. "The review process is now coming to a close. Management will now proceed with the implementation programme. We can now focus all of our attention on rebuilding the profitability of the business," Mr Rathbone concluded.

MAKHTESHIM MAKING PROGRESS

Makhteshim Agan has reported that its third quarter 2010 sales valued at \$533.1 million were up 22.3% compared with \$435.9 million in the corresponding period of 2009. The company says that the strong growth was achieved despite a decline in the average sales price for products. Sales for the first nine months ended 30 September 2010 were \$1.9 billion, an 8.1% increase compared with the same period last year. On a geographic basis, the strongest sales increases were in the Asia Pacific & Africa region, which contributed \$98.0 million in the third quarter of 2010, a 68.4% increase from \$58.2 million in the same quarter last year. This improvement was due to an increase in sales volume, particularly in India and Australia. For the first nine months of 2010, sales in this region amounted to \$277.2 million, compared to \$176.2 million in the same period last year, an increase of 57.3%.

There has been considerable activity at Makhteshim too. During the third quarter the company says it undertook several strategic business initiatives to strengthen its operations in key markets around the world. These included the restructuring of its Brazilian subsidiary and acquisitions in Korea and Mexico (see page 10), both attractive growth markets. The company also entered into a collaboration agreement with Monsanto in the North and Latin American markets. In addition, and as part of a manufacturing optimisation process, Makhteshim reached agreement with its labour unions in Israel to allow for the early retirement of approximately 250 employees. This seemed to be a prerequisite of ChemChina's approach to Koor Industries regarding the company's future ownership (*October CPM*). On 21 November there was a further announcement stating that these discussions were continuing but that it may take several more weeks to agree a deal. It was also reported at the same time that some changes in the terms and structure of the agreement are being considered, in particular a reduction in the valuation of Makhteshim from \$2.72 billion to a lower value, with ChemChina seeking to put the valuation at \$2.4 billion. The two parties are also reviewing the possibility that as part of the transaction Koor should sell a smaller amount of the shares than in the initial understandings, so that Koor's holdings in Makhteshim post the transaction would be at a higher level than the 30% it was meant to have been in the initial discussions. Finally on 25 November it was announced that Ami Ere would replace Avraham Bigger, Makhteshim Agan's chairman for the last four years, who had already announced his intention of withdrawing from office at the end of 2010.

CROP PROTECTION MARKET DOWN IN 2009

Delegates interested in the generic market gathered in Brussels on 23-24 November for Informa Life Science's 5th annual conference, *Crop Protection, Post Patent Products, Formulations and IPR*. Dr Matthew Phillips of consultants Phillips McDougall said that in 2009 the agrochemical market including \$5,860 million of non-crop sales dropped by 5.2% to \$43,420 million. Use of agrochemicals on crops was down 6.5%. Seed sales, both conventional and GM, reached \$26,730 million, up 2.7%. In 2009 there was some very modest growth in the Africa and Middle East region. The crop protection market, however, saw the biggest decreases in Europe and Latin America in contrast to 2008 when both of these regions showed the largest growth. In 2008 there was 10.3% of real market growth: in 2009 this was down by 1.5% due to lower commodity prices, lower glyphosate pricing, the global economic situation and high levels of distributor inventory.

Sales in 2010 look set for a small decrease. Dr Phillips showed how in the first half of 2010 compared to the same period in 2009 FMC sales were 16.5% up, DuPont 10.5%, Amvac 7.4%, Sumitomo Chemicals 7.3%, Makhteshim Agan 2.7% and Chemtura 2.5%. However, Monsanto saw a 34.8% decrease, Bayer 7.3%, Cheminova 6.4%, BASF 1.0%, Dow 0.8% and Syngenta 0.1% (all expressed in US dollars terms).

The average \$ decline was 0.9%. However, this was up 1.7% if Monsanto with glyphosate was excluded. Dr Phillips is projecting that the crop protection market over the next five years through to 2014 will increase by an average of 2.2% per annum.

He said that one of the factors affecting the market in Europe in 2010 was that the 2009 agrochemical prices were not sustainable. Also impacting on sales was the prolonged winter followed by flooding in central Europe and drought in Russia and NW Europe. In Brazil weaker crop prices, inventory problems and an increased area of GM crops had all impacted on sales. There was still modest growth in Africa and the Middle East although this was still limited by political and infrastructure issues.

With reference to generic agrochemicals Dr Phillips told delegates at the conference that the agrochemical market in value terms now splits into 25.2% patented or proprietary products and 74.8% off patent products. The off patent sector comprises 35% proprietary off patent products and 65% generics. Generic companies took a decreased share of the world market in 2009, just less than 30%.

EUROPEAN NEWS AND MARKETS

BIOSCIENCE RESEARCHERS DEFEATING POTATO BLIGHT

Researchers funded by the UK's Biotechnology and Biological Sciences Research Council (BBSRC) Crop Science Initiative have made a discovery that could instigate a paradigm shift in breeding resistance to late blight in potatoes and tomatoes. Professor Paul Birch of the University of Dundee and his team at the Scottish Crop Research Institute (SCRI), the University of Dundee, and the University of Aberdeen have developed a new approach to breeding resistance to the fungus *Phytophthora infestans* that causes late blight. Through their work on the interactions between potato plants and *P.infestans* the researchers have come up with a completely new approach to breeding resistance to late blight in potatoes. This will now be taken forward in a new project working with colleagues at the Sainsbury Laboratory in Norwich to identify resistance in potato plants that could then be used for breeding new resistant varieties.

Professor Birch said: "In the past we have tried to breed resistance to late blight by identifying plants that survive an infection period and could, in future generations, potentially give rise to resistant varieties. This approach is slow, resource intensive and requires a degree of luck that the resistance will last for any prolonged period. So far, all such resistances have been defeated because of the broad extent of variation in the population of *P.infestans* in the environment. With the new discovery, it is possible to use genetic analysis to identify plants for breeding that are inherently resistant to infection. When introduced into cultivated varieties, such disease resistance should be far more durable."

By studying the interactions between *P. infestans* and potato plants the team has identified proteins that are secreted by the invading pathogen and are essential for infection. Professor Birch continued: "We now know a lot more about how *P.infestans* gets round the potato plant's natural defences and therefore what it takes for the plant to resist infection. We can actually look at a potato plant's genetic makeup and say whether it will be sustainably resistant to late blight, which is a huge step forward. Whilst our approaches are suitable for breeding, in future we also hope to use a GM approach to produce a variety that is resistant to both blight and potato cyst nematode." Dr Mike Storey, head of Research and Development, AHDB - Potato Council said: "Blight is a serious problem for the potato industry. We are working hard to raise grower awareness and ensure best practice to control the disease but we have the challenge of a continually changing pathogen population. What we need now is the application of this new research to improve variety resistance and identify new crop protection targets and integrate these approaches for sustainable control and to reduce the impact when blight does occur. This will be of great benefit to farmers and the economy."

NEW BIOFUNGICIDE FOR TOMATOES GROWN IN TURKEY

A novel biofungicide, *Regalia* from US-based Marrone Bio Innovations, has been registered for use in Turkey on greenhouse tomatoes. The product is to be marketed as *Vertisol* by agricultural distributors Boyut Dis Ticaret (www.boyutf.com) located in Istanbul. *Regalia* is an extract of giant knotweed, *Reynoutria sachalinensis*, which effectively controls powdery mildew, bacterial diseases, rusts, grey mold and other crop diseases. Compounds that are extracted from the knotweed have been proven to stimulate the crops' natural defence system against plant pathogens. *Vertisol* can be used in tank mixes, in programmes or as a stand-alone treatment. It has a zero day harvest interval and is exempt from tolerance requirements for all food commodities. In the US the product is recognised for use in certified organic production and efforts are underway to secure similar recognition in Turkey.

BIOLOGICAL PRODUCT TO REDUCE CROP INPUTS

Scientists at UK-based CBio (Cleveland Biotech), an environmental biotechnology company, have developed a biological product that could potentially be used to directly reduce the amount of nitrogen and other fertilisers used by arable farmers. *Amnite A100* relies on an improved symbiotic relationship between plants and soil microbes. By increasing and improving the biological activity in the soil, the plants are better able to utilise macro and micro nutrients.

Given recent changes to legislation regarding fertiliser usage, the company says that early indications show that the product could assist farmers in achieving their environmental targets, as well as significantly improving crop yields and water quality. *Amite* has also shown disease suppressing activity in a number of crops in numerous investigations and could potentially be used to supplement reduced doses of conventionally used fungicides in a standard programme. Ben Hoskyns, managing director of CBio, said: “The product could provide the means to significantly reduce the quantity of nitrogen applied to the soil and therefore the amount that reaches the water ways and this will have a direct impact on water quality, the sustainability of intensive agriculture and could possibly provide a replacement product for banned fungicides – all of which would benefit the wider community in general.” Further trials will take place next year before the product can be officially launched and marketed to agronomists and the farming industry.

AMERICAN NEWS AND MARKETS

CHEMINOVA RECEIVES APPROVAL FOR INSECTICIDE

Cheminova Inc has received US Environmental Protection Agency (EPA) registration for its insecticide *Fyanon Plus ULV* to control tarnished plant bugs and other insects in cotton. Individual state registrations are pending. "The insecticide is a pre-mixed combination of malathion and gamma cyhalothrin," says Dr Jim Barrentine, technical services director for Cheminova. "Gamma cyhalothrin is the most active pyrethroid with the lowest use rate of any comparable insecticide. Malathion provides superior performance against a broad range of insects, so this combination is a powerful, new tool for cotton producers." Dr Barrentine says both farmers and aerial applicators will like *Fyanon Plus ULV*. "We have looked at ULV applications of malathion plus a pyrethroid for Mid-South tarnished plant bug control for four years now," he says. "The product controls both nymph and adult plant bugs and provides residual activity. This offers growers the opportunity to reduce the number or frequency of insecticide applications."

FBSCIENCES LAUNCHES NEW CROP PROTECTION DIVISION

US-based FBSciences (www.fbsciences.com) has strengthened its position as a life sciences company by launching a new plant protection division to advance the development of seed treatments and crop protection products based on its proprietary naturally-occurring plant growth regulator (PGR) technology. "The formation of the new division will enable us to explore and develop the new technology dedicated to improving plant health and crop productivity," says FBSciences CEO Peter Stromberg. "We see this as an important step towards building our global position in life sciences." The PGR technology has been demonstrated to have the ability to influence genetic responses which improve plant health and productivity in a wide variety of agronomic and horticultural crops. FBSciences anticipates registration of new products by the US EPA in the second quarter of 2011. The EPA has already assigned the PGR technology as a new class of biopesticide.

SYNGENTA TAKES ON FULL OWNERSHIP OF GREENLEAF GENETICS

Syngenta and DuPont have announced that Syngenta has assumed full ownership of GreenLeaf Genetics. The transaction dissolves a joint venture between Syngenta Seeds Inc and the DuPont seed business Pioneer Hi-Bred. It enables Syngenta and Pioneer to pursue independent licensing strategies for their respective proprietary corn and soybean genetics and biotechnology traits. Davor Pisk, chief operating officer for Syngenta Seeds, said: "With full control of GreenLeaf Genetics, we will be able to move more quickly in broadening access to our rapidly expanding portfolio of innovative traits and germplasm. This new ownership structure underlines Syngenta's commitment to helping independent seed companies provide a wide range of choices to growers." GreenLeaf Genetics was originally launched by Syngenta in 2004 and became a joint venture with Pioneer in April 2006. It will now operate as a wholly owned subsidiary of Syngenta Seeds Inc.

CERTIS USA TO MARKET NEW STRESS MANAGEMENT PRODUCTS

Crop Microclimate Inc (CMM) (www.cropstress.com), a leader in the research and development of technology for the management of abiotic stress in crop plants, and Certis USA, a leading biopesticide company, have entered into agreements to develop and market new products. These agreements cover the distribution of CMM's *Screen Duo* by Certis and an exclusive agreement for CMM's *G3* technology for use in fruit and vegetables in the NAFTA region. *Screen Duo* sales and marketing activities will start immediately while the *G3* technology is in accelerated development with market entry targeted for 2013.

CMM says that *Screen Duo* offers the most advanced technology for the management of crop stress due to adverse environmental conditions. The product protects fruit and vegetable crops by eliminating losses due to excess heat, light and drought. It is based on CMM's unique *Fusion* technology that combines dual modes of action to protect plants both internally and externally. The dual action means that *Screen Duo* provides superior protection at lower rates than competitor products providing better yields and crop quality.

G3 technology utilises naturally-occurring dicarboxylic acids to help plants to maintain productivity under adverse conditions. The product can thus reduce stress-related issues such as flower abortion, fruit set, fruit sizing, fruit retention and sunburn resulting in increased yield of higher quality fruits and vegetables.

According to CMM president Dr Chuck Kupatt G3 technology represents a significant advance in maintaining agricultural productivity under adverse environmental conditions. Dr Hjow-Lih Su, president and CEO of Certis USA, added: "Abiotic stress management is the new frontier for the biopesticide industry which has traditionally focused on discovering and marketing naturally occurring compounds for insect, disease and weed control. Natural compounds can also provide opportunities to achieve yield and quality improvements for growers that were once beyond reach." Although the current agreement with Certis USA covers the North American fruit and vegetable markets, the low rates at which G3 technology is active, make it an ideal fit in row crops, cereals, biofuels and other extensively grown crops.

JUDGE ORDERS DESTRUCTION OF GM SUGAR BEET

The US Department of Agriculture (USDA) has been engaged in an ongoing legal battle with several advocacy groups that have used the courts to block any additional planting of biotech sugar beet. As a result a federal judge has ordered the destruction of plantings of genetically modified sugar beet developed by Monsanto, ruling that the USDA Department illegally approved the crop in 2005. He said the government must conduct a thorough environmental review before approving the crop to comply with the law. Shortly after the ruling, the USDA issued permits allowing companies to plant seedlings to produce seed for future GM sugar beet crops. Earthjustice, a consumer group that brought the case against the USDA, said the action was the first court-ordered destruction of a GM crop.

Sugar beet accounts for more than half of the US sugar supply and Monsanto's *Genuity Roundup Ready* sugar beet represents around 95% of the 2010 crop. However, environmentalists say widespread use of GM sugar beet leads to increased use of herbicides, proliferation of herbicide resistant weeds, and contamination of conventional and organic crops.

Monsanto is to appeal against the ruling. In previous court hearings it said revoking the government's approval of its genetically modified seed could cost the company and its customers some \$2 billion in 2011 and 2012.

OTHER NEWS AND MARKETS

GOWAN ACQUIRES DOW PRODUCTS

Gowan Company has reached an agreement with Dow AgroSciences to acquire the rights to the insecticide *M-Pede* and the herbicide *Scythe*. *M-Pede* is an Organic Materials Review Institute (OMRI) certified insecticide that controls aphids, thrips, and mites on a variety of crops including vegetables, grapes, tree fruits, tree nuts, cotton and ornamentals. *Scythe* is made from a naturally occurring fatty acid and is a non-selective herbicide used for controlling a broad spectrum of weeds. "The acquisition of these products will enhance our continued efforts to provide IPM solutions to growers around the world. The addition of these two products combined with Gowan's bioinsecticide *Aza-Direct* a broad-spectrum product that controls key insect pests on greenhouse and outdoor food crops, and supports our commitment to building a strong green platform," said Sergio Comparini, Gowan Company business development manager. Under the agreement, Gowan and its subsidiaries started selling the two products in November 2010.

MAKHTESHIM MAKES TWO ACQUISITIONS

Makhteshim Agan (MAI) has made two strategic acquisitions, Ingenieria Industrial SA de CV (BravoAg) in Mexico, and JK Inc in Korea. MAI has signed an agreement to purchase 100% of BravoAg and has taken a 51% majority stake in JK Inc. Together, these new operations are expected to generate sales of approximately \$40 million in 2010, and will contribute to MAI's sales starting in 2011. The acquisition of BravoAg enables Makhteshim Agan to realise its long term growth potential by expanding into Mexico, one of the largest crop protection markets in the world with approximately \$700 million in annual sales. Established in 1951, BravoAg is a privately held manufacturer and distributor of copper-based pesticides used in organic agriculture. The company has annual sales of approximately \$30 million and manufacturing facilities in Mexico in addition to a national sales force. Mr Alberto Bravo, CEO of the company, which had a long-standing business relationship with Makhteshim Agan, will remain as head of operations.

The business cooperation with JK provides Makhteshim Agan with a direct presence in Korea's stable and profitable crop protection market. The company has annual sales of approximately \$10 million, sales offices throughout Korea and over 1,000 retailers carrying its product line, in addition to a local formulation facility. JK has developed commercial relationships with leading international crop protection suppliers, as well as with Makhteshim Agan with which it has worked since 2005. Makhteshim Agan says that its product range and global commercial and registration capabilities, combined with JK distribution network and local formulation facility, will enable MAI to better meet customer needs in the Korean market. Mr Erez Vigodman, Makhteshim Agan's president and CEO, said: "With these transactions, we continue to implement our strategy of expanding into emerging markets through buying existing platforms and using them to generate further growth."

BASF OPENS NEW OFFICE IN ZAMBIA

BASF Crop Protection division has opened a new representative office in Lusaka, Zambia. The company has opened three other offices in Africa this year in Kenya, the Ivory Coast and Mali. This is part of BASF's plans to triple crop protection sales on the continent in the next three years. "Like many African countries, Zambia has huge untapped potential in agriculture. But no two countries are alike. To assist local farmers with sustainable solutions we need to better understand their needs, which is why we are investing in local offices and staff," said Gabor Mehn, in charge of BASF Crop Protection business in Africa.

In Zambia, where BASF plans to focus on corn, soybeans and wheat, the regulatory authorities this year have approved two of the company's latest products, a wheat fungicide *Abacus* (pyraclostrobin + epoxiconazole) and *Stellar* (dicamba + topramezone), a post emergent herbicide. *Stellar* will complement the pre-emergence herbicides *Frontier Optima* and *Prowl CS* in Zambian corn programmes. It controls a broad range of grasses and weeds, including some that are hard to control such as weeping love grass, or common finger grass. In the first three quarters of 2010, BASF Crop Protection increased sales by 30% in the Africa and the Middle East sub-region, with countries such as Kenya, the Ivory Coast and Mali all making major contributions.

SUMITOMO GOES DIRECT IN VIETNAM

Sumitomo Chemical has set up a direct sale operation for its crop protection products in Vietnam. It says that after working with distributors and trading companies it has failed to create brand recognition in the Asian region. The company will market its products through a subsidiary, Sumitomo Chemical Vietnam, which previously functioned as the local base for filing and holding registrations for agrochemicals. Sumitomo Chemical Vietnam will also market Nufarm's products. The company says it aims to establish an efficient development and sales organisation supported by good technical services to market its portfolio of products for paddy rice.

BAYER BUYS BEE PRODUCT FROM EXOSECT

Bayer CropScience has acquired a product from Exosect, Winchester, UK for the control of varroa mites (*Varroa destructor*). The market launch of this new bee health product in the US is planned for 2011. First registrations in major European countries are expected from 2012 onwards. The acquisition will enable Bayer CropScience to develop bee health solutions and to commercialise new products worldwide. The product is based on the innovative *Entostat* technology, a food grade powder refined from a natural wax which is sustainably harvested from a particular species of palm tree and combined with the miticidal active ingredient thymol. After being spread directly onto the top of the frames, bees start to clean the powder out of the hive. It adheres to their bodies via electrostatic attraction. As they move throughout the hive, the powder is distributed to other bees and onto the framework of the hive, including open brood cells.

"Bayer is aware of its responsibility as a producer both of crop protection products and of bee health products", said Dr Franz-Josef Placke, head of Development at Bayer CropScience. "We are investing in research and development to provide beekeepers with sustainable solutions to improve the health of their bees and beehives." *Varroa destructor* is a relatively new parasite of the honey bee and has spread to most areas of the world within a short time. The varroa mite is considered a crucial factor in the decreasing number of honey bee colonies in Europe and North America.

PLANT HEALTH AND SYNGENTA SIGN ANOTHER RESEARCH AGREEMENT

Plant Health Care, a leading provider of naturally derived products to the agriculture and landscape industries, has announced that it has signed another research agreement with Syngenta Crop Protection to evaluate and possibly develop Plant Health Care's Harpin protein as a foliar spray in combination with a number of Syngenta's major products. In trials, Harpin has been shown to increase yields significantly on a variety of crops when applied in combination with other active ingredients. Syngenta will test various Harpin formulations in combination with a number of leading Syngenta fungicidal, insecticidal and growth regulator products. Improvements in yield, plant health and product efficacy will be evaluated in a range of crop and production situations. In cases where testing identifies synergies the parties intend to develop full, long-term commercialisation arrangements.

In July of this year, Plant Health Care announced its first agreement with Syngenta to develop and market its Harpin protein as a foliar spray in combination with Syngenta's herbicide products containing glyphosate. The combined treatment will be recommended on all crops that are tolerant to glyphosate. Plant Health Care believes that working with a major industry partner in this way is the best way to screen and identify commercial opportunities for the foliar application of Harpin proteins.

NEW REPORT ON GENERICS

Enigma Marketing Research (www.enigmamarketingresearch.com) has produced a new report, *New Off-Patent/Generic Agrochemicals - post 2011*, the eighth in the series. Managing director Dr Nigel Uttley says it will assist manufacturers to identify their next generic product for development by listing 24 active substances whose patents will expire between 2011-2015. The report outlines the new opportunities that exist in what has become a buoyant and expanding generic agrochemical sector. In Section 1 the report addresses how the top six R&D based companies with over 70% of all products off-patent control over 75% of the market. It explains how inventor companies prepare for patent expiry utilising a variety of strategic options designed to defend market share such as intellectual property rights, protected registration data, technical defence via process know how and marketing alliances.

Enigma has now identified a total of 114 active substances with patent expiries between 2002 and 2015. With so many active substances coming off patent choosing the right off-patent/generic to develop requires analysis. Section 2 of the report looks at how to analyse the following following key areas: the marketing environment; intellectual property rights chemistry/technology of manufacture and registration issues. Each area is reviewed and the key strategies employed by generic companies to enter markets are discussed. Some practical examples are also given. In this section dates for the expiry of data protection in the EU for 187 existing active substances are also provided. Finally Section 3 profiles the active substances listing patent and expiry dates, details of products, modes of action, uses and markets as well as registration issues and details of chemistry.

Dr Uttley says that the report should be of interest to the many different types of companies involved in agrochemicals including generic manufacturers, marketing companies, R&D based multinationals, contract manufacturers and intermediate suppliers.

CONFERENCES AND FEATURES

UK CROP SCIENCE INITIATIVE YIELDS FIRST RESULTS

The UK Biotechnology and Biological Sciences Research Council (BBSRC) organised an event in London on 18 November 2010 to give a progress report on its Crop Science Initiative. It was a showcase for some of the results coming from the projects and a chance to look to the future. Dr Alan Baylis reports.

BBSRC annually invests almost £0.5 billion (\$0.79 billion) in bioscience research and training. In 2007, funding of £13 million was committed to a set of 18 research projects under the Crop Science Initiative. Subsequently, a further £30 million has been allocated to associated activities such as the Crop Improvement Club, collaboration with the French state agricultural research organisation INRA and post-doctoral research fellowships. Projects were agreed following a strategic review of technological priorities addressing food security and the demand for non-food products from crops. One third of projects involve research into pests and diseases, although none concerns weeds. A further third of projects involve improving the fundamental understanding of genetics and tools for genomics which could find a wide range of applications in plant breeding. The final third comprises topics of crop quality and seed vigour. Considering the target crops, more than half involve wheat, a quarter concern fruit or vegetables and the remainder include potatoes, sugar beet and coppice willow for biomass. The technologies of genetics and plant breeding are the subject or tools of 15 projects, while only three involve more biochemical or physiological studies. The latter include work which could lead to both chemical and plant breeding approaches to crop protection or enhancement.

Crop protection and enhancement projects

Collaboration between the Universities of Durham and Newcastle with the Food and Environment Research Agency (FERA) is investigating routes to controlling aphids and other serious insect pests of UK cereals. No modern wheat varieties or primitive lines appear to have any significant resistance to the grain aphid (*Sibitot avenae*) or wheat bulb fly (*Delia coarctata*). However, other insects such as the hessian fly (*Mayetiola destructor*) will induce an insect-specific response in some wheat genotypes. The project has found that when wheat is infested with aphids, non-specific defence proteins are produced. This is similar to the response to abiotic stress. On the other hand, the response to attack by wheat bulb fly larvae is similar to the effect of mechanical wounding. The expression of genes producing proteins toxic to these pests has been investigated and there seems to be potential to exploit these in conventional breeding programmes. Two other approaches to novel control of insect pests are being pursued. The first targets the ability of sucking pests to deal with the high sucrose concentrations in phloem sap. Plant flavonoids inhibit aphid sucrose transporters and their glycosides are toxic to aphids by ingestion. The potential control route would involve crop plants expressing insect toxins such as spider venoms fused to plant lectins. A GM strategy would be needed to implement this approach.

Another project addressing the resistance of wheat to aphids is being conducted at Rothamsted Research. The goal is to understand how plant defence strategies based on the hydroxamic acids, also known as benzoxazinones (BX), can be incorporated into breeding programmes. These compounds are made early in development and stored in vacuoles as glucosides. They are released in response to pathogen infection or wounding by insect stylets. Several ancestors of modern hexaploid wheat have been found to have higher levels of the most potent BX. This is present in the extracellular spaces of leaves through which aphid stylets pass during feeding. During experiments involving certain diploid wheats and *Rhopalosiphum padi* (bird cherry aphid) and *S. arvenae*, useful reductions in aphid settling, growth and fecundity were observed. Some diploids which did not contain high levels of BX were still more resistant than modern wheat varieties. These genotypes could contribute to conventional or GM breeding programmes for enhanced resistance.

Researchers at Rothamsted and the John Innes Institute aim to exploit the role of gibberellin (GA) in controlling plant height and stress tolerance in wheat. Field trials with various dwarf and semi-dwarf lines have shown that although tolerance to salt, heat and water stress may be improved, the problem is how to avoid intrinsically lower yields. Opportunities to achieve this may lie in finding and understanding new genes which are individually or collectively involved in regulating plant height. New variants of the widely used Rht1 gene are being identified and characterised in one line of work. In another, genes for all

components of GA biosynthesis and signalling pathways are being mapped. These generally have small individual effects but were collectively responsible in various combinations for reductions in the height of wheat varieties before the introduction of Rht dwarfing genes in the 1970s. Especially promising is a single gene for an oxidase enzyme which degrades GA and has a strong effect on height.

Other projects targeted at crop protection include developing resistance to the potato cyst nematode (*Globodera pallida*). The University of Leeds has used gene silencing techniques to genetically modify potatoes. In contained glasshouse trials these were 65% resistant to potato cyst nematodes and early results indicate that a similar benefit has been achieved in UK field trials. A partnership between the University of Warwick and Syngenta Seeds has been formed to utilise a novel resistance mechanism to viral diseases of brassicae. Turnip mosaic virus of vegetable brassicae is the first target and others such as turnip yellows virus of oilseed rape will also be tackled. Finally, researchers at the Universities of Dundee and Aberdeen are looking to curb the £4 billion annual global losses due to potato blight (*Phytophthora infestans*). A better understanding of the infection process has begun to reveal genes which recognise and respond to 'effector' proteins which the fungus secretes into host cells to commence infection. These promise to be a more durable source of resistance to late blight.

Practical application and the future

Collaborations with industry will continue to ensure implementation of useful knowledge emerging from the *Crop Science Initiative* and other BBSRC funded research. These include: an Industry Interchange Programme involving Advanta Seeds and the University of Bristol on the application of genotyping tools; Rothamsted Research and the Italian fine chemicals company Endura working on novel formulations of encapsulated insecticides; and the University of Cambridge and Bayer CropScience investigating plant stress tolerance. Researchers at the University of Sheffield are working with Syngenta to find soil active herbicides suitable for no-till farming.

BBSRC aims for the *Crop Science Initiative* to foster projects that will deliver better and wider value than if they were conducted in isolation. Looking to the future, a number of issues were discussed. These included not only the technologies needed to meet the challenges of food security, especially with climate change, but also ways and means of engaging end-users and the general public, and the need for a rejuvenated skill-base in crop science.

CROPWORLD 2010

In the last issue of Crop Protection Monthly we promised some further reporting on some of the presentations given at the CropWorld 2010 event held in London on 1-3 November. In this issue we look at the concurrent sessions on application and formulation, new products, GM crops and genomics, and the closing plenary session.

Application technology and formulation

One of the concurrent sessions was devoted to application technology and formulation. Alistair Murdoch, Reading University, UK described a project looking at the feasibility of mapping grass weeds in cereals as a basis for patch spraying of herbicides. The four year project involves a number of commercial collaborators including Syngenta and Masstock. The project is based on the detection of blackgrass in wheat when the crop is in ear. There are three phases to the project: establishing a methodology for identifying the seed heads of the weeds by species; defining mapping procedures; and then patch spraying. A pilot study carried out in 2009 concentrated on the first two steps. After a trial run with a camera mounted on a sprayer the main detection work was based on a camera fitted to the combine harvester. Identification and recognition of blackgrass seed heads was very good. Unlike many remote sensing techniques, which rely on near infra-red, the favoured method was to measure hue, saturation, value (HSV). This makes it easier to record different shades of green irrespective of the intensity of the light. In the trial all blackgrass heads were detected automatically where they were visible to the human eye. Just a few were falsely detected where there were none visible. Allowing for those heads which were below the crop canopy, around 47% of all blackgrass heads present were detected. Preliminary trials were also carried out to prove, with reasonable confidence, that weed patches in one season will relate to the location of patches in subsequent seasons.

Dave Duncalf, IOTA NanoSolutions Limited, Liverpool, presented examples of how the activity of dispersible formulations of agrochemicals is enhanced when particle size is close to nano level. The officially recognised definition of a nano particle is a particle smaller than 100 nanometres (nm). However Mr Duncalf looks upon any particle between 999 nm and 1 nm as effectively in the nano range. Results from a number of case studies were presented. With a nanodispersed formulation of tebuconazole, fungicidal activity was enhanced in petri dish experiments and for the control of Septoria on growing plants. The nanodispersed formulation, dispersed in water, produced similar results to the conventional emulsion in water, EW, formulation, but at around 25% of the dose of active ingredient. Similar results were obtained with fungicides used for brown rust control. Isoproturon herbicidal activity on resistant blackgrass, using a nanodispersed formulation, was considerably enhanced compared with the commercial SC formulation as was dock control with diflufenican. Mr Duncalf also showed evidence of how nanodispersed formulations offer much better retention properties and rainfastness on the leaf. As a closing comment he pointed out that the regulatory issues associated with nanodispersed formulations had yet to be fully addressed.

An innovation at CropWorld was Speaker's Corner, based on short informal presentations. Mark Bell, Battelle, explained that the agrochemical industry was a late comer in the adoption of nanodispersed formulations, compared, for example, with the pharmaceutical industry. He explained that the milling process to make nano dispersed formulations can be added to the end of the conventional suspension concentrate (SC) production process, but the ease of milling varies considerably with active ingredient. Battelle have worked on two fungicide products. One had a particle size of 200 nm and another was 350 nm. Trials results showed how the nanodispersed formulations gave a more rapid response at 75% of the active ingredient dose rate, compared with the conventional SC. The new formulations present an opportunity to reduce agrochemical rates by 15-20%.

New products

In the session on *New active ingredients, products, compounds and approaches* Dr David Ellerton, technical development director of H L Hutchinson, stressed the importance of the new Succinate Dehydrogenase Inhibitor (SDHI) fungicides. He said there is now reduced sensitivity to both the strobilurins and triazoles. Triazoles were also at risk should the new Pesticide Registration Regulation (1107/2009) define them as endocrine disruptors. The SDHI fungicides were, therefore, needed to combat cereal diseases effectively. Active ingredients (ai) belonging to the group are broad spectrum cereal

fungicides with activity on oilseeds, pulses, vegetables and fruit. They are highly persistent and their good preventative activity gives some flexibility in timing. There is also some curative action but how much depends on the ai and disease. On wheat SDHIs are particularly active on Septoria and rusts. They also have strong activity on barley diseases such as net blotch, Ramularia, brown rust and Rhynchosporium. There is also activity on mildew, eyespot and ear diseases but again this depends on the active ingredient being used.

In trials the products have given yield responses of four tonnes/ha and more in high disease situations and have outyielded current standards by one tonne/ha. Responses are dose and disease dependent. SDHIs also have some phytotonic effects such as prolonged greening. They can also help overcome stress conditions and can enhance host defence mechanisms. The fungicides work on the mitochondria and there is no risk of cross resistance with existing chemistry. However, because they act at a single site there is a moderate risk of resistance building up to the new chemistry. Dr Ellerton, therefore, spoke of the need to protect SDHIs by mixing them with other ais.

Chris Longhurst, Dow AgroSciences, presented the new insecticide sulfoxachlor. He said it belonged to a new class of insecticides, the sulfoximines, and controlled sap-feeding insects such as aphids and whitefly at low rates. It had excellent systemic activity and had been evaluated against various cotton pests including *Lygus hesperus*, aphids and whitefly as well as cotton jassid in Pakistan. The product was found to have a good profile on beneficials and was harmless on predatory mites and lacewing (*Chrysoperla carnea*) larvae. It was, therefore, ideally suited to IPM programmes. Sulfoxachlor interacts in a unique manner with the nicotinic receptor and treated aphids exhibit tremors followed by paralysis and mortality. Studies defining the precise nature of the interaction are still underway. The insecticide exhibits no cross resistance with other neonicotinoids and there is no cross resistance with imidacloprid. There is also a lack of cross resistance with multi-resistant pests.

GM crops and genomics

GM crops and genomics featured in several of the conference sessions. In a session on science and technology transfer, Juan Ferreira, general manager of Monsanto Europe, Middle East and Africa, outlined how the company saw the opportunities for crop improvement in Africa. Through collaboration with BASF, Monsanto are close to introducing a drought tolerant maize trait. Trials have demonstrated maize yield benefits under drought conditions in the US of 94 bushels per acre (5.6 tonnes/ha) compared with 76 bushels per acre. As a contributor to the Water Efficient Maize for Africa (WEMA) initiative, Monsanto will be making available royalty free genes together with training programmes to the African Agricultural Technology Foundation, thus enabling benefits to participating countries. Up to 2 million extra tonnes of maize are projected as a direct result of the collaboration, enhancing food availability for 14 to 21 million people.

In the session *The role of GM in future approaches to food security*, Scott Day, a farmer from Manitoba, talked about 15 years' experience in GM canola production in Western Canada. Since the first introduction of GM herbicide tolerant canola in 1995, there is now no conventionally bred crop grown. Of the 16-17 million acres (6.5 million hectares) planted in 2010, there were around eight million acres each of *Roundup Ready* (glyphosate tolerant) and *Liberty Link* (glufosinate tolerant) and one million acres of the conventionally bred *Clearfield* (tolerant to several BASF herbicides). Mr Day had no doubts of the economic and environmental benefits. The fact that conventional soil acting herbicides invariably fail due to lack of soil moisture has been the main driver for the demand for GM crops. A high proportion of the crop is now grown under a minimum tillage regime. A study carried out by the University of Saskatchewan compared farm practice in 2006 with that in 1995. The study shows that 83% of farmers have better water conservation and 86% have reduced soil erosion on their land as a result of growing GM canola. It also shows a marked decline in chemical use. Growers applied 4.7 million kg of herbicides on their canola fields in 2006 compared to 8.3 million kg on about the same amount of canola in 1995, the year before GM canola was introduced.

Professor Jim Dunwell, University of Reading, projected some of the benefits from agricultural biotechnology yet to come such as the introduction of the *Arabidopsis* gene into rice, thereby stepping up biomass accumulation and yields, and the development of perennial wheat. He also described how the introduction of drought tolerant GM maize could result in Brazil growing up to four million hectares of the

crop each year. Furthermore, with less water needed for irrigation and spraying, 2.5 million people could benefit from enhanced water availability.

Closing address

In his closing address Professor Sir John Beddington, the UK Government's chief scientific advisor, reflected on the current issues relating to global food security saying: "...climatic events, such as the floods experienced this year in Pakistan and China, and the heat wave in Russia, are likely to continue and food prices are expected to remain volatile. By 2030 we will need up to 50% more production on less land, with less water, using less energy, fertilisers and pesticides, whilst not increasing greenhouse gas (GHG) emissions and affecting biodiversity." He then went on to highlight some of the *CropWorld* conference sessions and offered his input. "In terms of R&D funding, agricultural research has been neglected for too long", he said. "We need to improve our knowledge bases, establish good interactive relationships and ensure researchers understand the practical context for farmers. In terms of land use, only 9.95% of land is developed so agriculture is extremely important. To meet our GHG emission targets 10% of UK land needs to grow bioenergy crops but there are inevitable problems with this and one does not want to be using grade one agricultural land." He then went on to indicate that biotechnology can be used to address real problems in growing crops in drought areas and on saline soils. Also that the tide was turning on GM crops with fears on human health and the environment being dispelled and that many countries such as the US, Latin America, China, Australia have already adopted GM.

Jim Paice, UK Minister of State for Agriculture, announced to delegates at the end of the conference that funding of £12.6 million was going to be allocated to improve the understanding of how UK agriculture contributes to climate change. "Tackling climate change is a real priority," said Mr Paice. "This investment demonstrates our commitment to supporting the agricultural sector as it faces the challenges of reducing greenhouse gas emissions. "The UK is a world centre for scientific research with a tradition of science and innovation. Events such as *CropWorld*, that encourage the exchange of knowledge and ideas at a global level, are to be encouraged," he concluded.

SCANNING THE AGRICULTURAL HORIZON TO 2050

A one day conference titled Scanning the agricultural horizon to 2050 was organised by the UKs SCI BioResources Group with the support of the Royal Society of Chemistry and hosted by Syngenta at its Jealott's Hill Research centre, on 30 November. The premise for the seminar was that global food production has to double by 2050. Bruce Knight reports on some of the presentations.

The challenge

The first two papers at this forward looking conference outlined the challenge. The first paper describing the "Agricultural Treadmill" was given by Professor Harald von Witzke, Humboldt University, Berlin. This elaborated on information presented earlier in the year (*March CPM*). He reiterated the arguments that to meet greater demands for food and under increased energy costs, as well as safeguarding climate change impact and biodiversity, the only viable route was through increased productivity and therefore investment in R&D. He considers that policy makers need to recognise that the social rate of return from agricultural research, measured in terms of increased productivity for society at large, is high at around 30-50%.

The EU is the single largest net importer of food. Exports from the region in 2008 were valued at \$128 billion, but imports were \$173 billion, a net deficit of £45 billion. China was a close second and is responding by land grabbing in Africa and elsewhere. The EU is not a land grabber, but can be described as a "virtual land grabber" as it needs extended areas of land outside of the EU to satisfy its needs. Based on 2007-8 data the actual area needed was 35 million hectares. With productivity increases this could be reduced to 30 million hectares, but if the supply was from organic production the area needed would be 45 million hectares.

Rainer von Mielecki, BASF, Limburgerhof, covered the pending conflicts over land use, water availability and energy, for food production. Future water availability is critical. Around 70% of water use is for agriculture, so he said: "...water grabbing goes with land grabbing". While daily consumption of drinking water is only about 2-4 litres per person, it takes 2-5,000 litres to produce the daily intake of food. Furthermore by 2025 it is estimated that two thirds of the global population will be living in drought affected regions. Delivering water to the right place is possible and desalination and purification methods do exist but need refinement. Producing more from less land calls for a pulling together of the economic, ecological and social drivers. In his view what industry has to do is encourage better and more efficient integration of technologies through dialogue.

Can chemistry deliver ?

David Lawrence, former Syngenta Group R & D director, presented a more optimistic picture on the potential of science and particularly chemistry to deliver. He said the challenge could be met by a mix of several factors: by increasing yields in all regions; by eliminating food waste; and by moving away from meat diets and raising food production derived from the sea to at least 25% of that from land.

There needs to be a regeneration of research in soil science and improved efficiency in nitrogen fixation is a clear requirement. Biological routes will include extending nitrogen fixation ability to crops other than legumes and improved efficiency through gene transfer. Chemically there is much to be achieved in the nitrogen fertiliser production process. Using renewable energy sources has scope as does nano catalysis in the production cycle. Increased water availability for crop production through improved desalination methods, sensor managed irrigation systems and the use of soil applied chemicals to reduce drought stress are also chemical routes. Crop enhancement chemicals such as Syngenta's *Moddus* growth regulator can reduce water demand by 15% and yet still deliver yield benefits of 15-25%. In conventional chemical crop protection, new molecule discovery remains vital particularly to improve management for agrochemical resistance. Seed treatment chemicals could offer up to 50% yield benefits where plants are subjected to abiotic stress.

New approaches to crop protection

Jonathan Margolis, AgraQuest, California, described how the complexities of soil organisms had been more fully understood over the last five to seven years. Most organisms are associated with a complex population of microbes and plants are no exception. Up to 10^9 bacteria per gramme exist in the soil. In his

opinion we are only now scratching the surface of developing microbiologicals which can offer real benefits. By improved genomic tracking techniques and diagnostics it is possible to characterise and enhance microbes to benefit the growing crops. Work has shown that chemical signals from the plant-colonising bacteria trigger physiological changes in their host plants, leading to increased growth and yields. AgraQuest has commercialised two products and have around 15 more in development. *Serenade* (*Bacillus subtilis*), a microbial seed treatment, increased the yield of beans in trials by 13.8% compared with untreated controls. Conventional chemical treatments gave a 6.0% yield increase.

Mike Bushell, Syngenta, outlined a range of approaches adopted by Syngenta at discovery level and in development. Formulation is recognised as a key part of the development process and at Jealott's Hill a robotic formulation development and sample production facility have recently been commissioned. The laboratory was opened in 2009 and has the potential to create and test up to 1000 formulations per day.

He also explained how Syngenta was giving priority to assisting smallholders in developing countries to benefit from new technologies. While appropriate packaging and the training of extension workers are important factors real success requires partnerships to be established at a local level to bring in finance and investment in logistics.

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Website: www.crop-protection-monthly.co.uk

Editor: Martin Redbond E-mail: mredbond@aol.com

Deputy Editor: Bruce Knight E-mail: innovationmanagement@btopenworld.com

Contributors: Elaine Warrell, Alan Baylis

Editorial and Subscription Enquiries to:

Crop Protection Monthly

Blacksmiths Cottage

Ashbocking Road

Henley,

Ipswich,

Suffolk

IP6 0QX

UK

Tel: +44 (0) 1473 831645

E-mail: Cpmsubs@aol.com