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IN THIS ISSUE

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SUPPLY CHAIN ANALYSIS

Coffee retail prices rising, farmers' incomes falling

With coffee consumption increasing by 1.5% annually, a casual observer might think the situation for coffee producers looked pretty rosy. However, this could not be further from the truth, at least for growers in developing countries.

In a cogent paper* presented at a recent international JIRCAS symposium, Shaun Ferris and Peter Robbins of the International Institute for Tropical Agriculture detailed the following "coffee money trail", with prices as at September 2002:

- In Kintuntu, a small village in Uganda, a farmer sells 1 kg of coffee beans to a trader for US$0.10–0.14.
- The trader mills the beans and sells the product to an exporter for US$0.20–0.26/kg.
- The exporter then sells it FOB (free on board) at Mombasa port (southern Kenya) for US$0.40–0.45/kg.
- The CIF (cost, insurance and freight) price for coffee in Felixstowe (United Kingdom) is US$0.52/kg.
- Transport to a UK factory takes the price to US$0.63/kg.
- Processing loose product increases the price to US$1.64/kg.
- The supermarket price of product ranges from US$26–40/kg (depending on the form of the final product).
- The price of a cup of coffee in a coffee shop in the UK is US$3.50 — the weekly income for many coffee farmers in Africa.

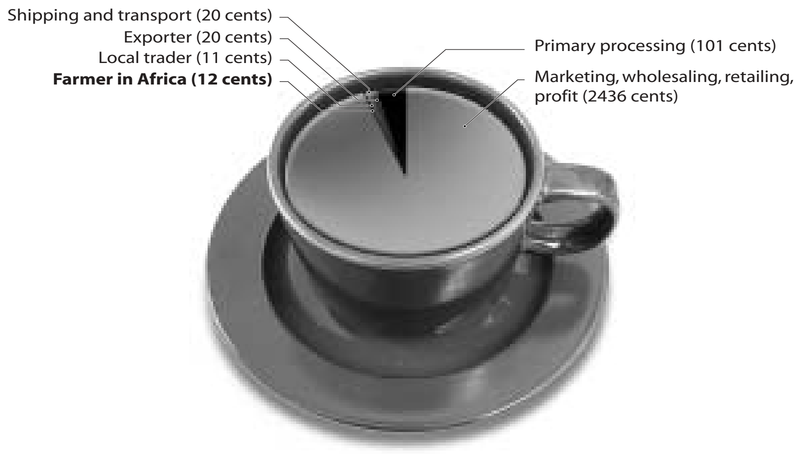
Hence, the price increase between the farm gate and the shopping trolley is somewhere between 22,000 and 31,000% depending on where you drink your coffee. What's more, while coffee prices in developed countries are trending upwards, the price that farmers obtain for their beans has steadily fallen over the past 20 years.

According to Ferris and Robbins, global figures show that coffee-producing nations reap only about US$5.5 billion in a market worth US$77 billion. The authors note that, while Uganda (the eighth largest global producer) earned US$80 million from coffee sales, the top four coffee trading and processing multinationals each made profits between US$2.3 billion and US$5 billion.

Continued on page 2.

* Ferris, R.S.B. and Robbins, P. 2003. The challenges of globalization and opportunities for accessing value-added markets for African producers. In: Mori, Y., Hayashi, T. and Highley, E. ed., Value-addition to agricultural products — towards increase of farmers' income and vitalization of rural economy. Proceedings of the 9th JIRCAS International Symposium, Tsukuba, 16–17 October 2002. JIRCAS International Symposium Series No. 11, 69–84.

WHO GETS WHAT FROM 1 KG OF COFFEE RETAILED IN LONDON FOR US$26



One kg is sufficient for 100 cups in a café, with a total retail value of US$350.
The return to the farmer from a café coffee in London is 12 cents ÷ 100 = **0.12 cents**

Coffee prices up:farmers' incomes fall ... from page 1

Another contributor to the price differential, apart from profit, is the increasing cost of marketing, which includes the advertising, branding, packaging and retailing deemed to be needed to attract increasingly discerning consumers in developed countries. However, all these components of the retail price accrue in the consuming countries, not the producing countries.

But the domination of the market by a small number of multinational companies is only one factor in the growing difference between raw material and retail prices.

Globalisation and liberalisation of markets

The situation with coffee exemplifies the problem of primary producers in developing countries for a range of commodities as the trend continues towards globalisation and liberalisation of agricultural markets. While globalisation theoretically offers increased market opportunities to developing nations, many countries in Eastern and Central Africa (ECA) are experiencing serious problems in attempting to adjust. According to Ferris and Robbins, the reasons for the fall in the price of coffee beans can be attributed to the adoption of domestic and international market liberalisation policies:

Increased production by a few coffee-producing countries. Between 1995 and 2000, Vietnam and Brazil increased production from 4 to 11 million bags and 15 to 32 million bags, respectively.

Devaluation of currencies by developing countries. This has been undertaken as a requirement of "structural adjustment programs" adopted by many developing countries — the measure is aimed at making exports more competitive and therefore boosting their volume.

The withdrawal of the economic clauses of the International Coffee Agreement (ICA). In 1989, consuming countries, led by the United States and UK, decided to end funding to support the coffee price through the International Coffee Organization (ICO), reasoning that this would prevent countries becoming dependent on raw material production based on artificially high prices. It should be said, however, that some participants in the supply chain have benefitted considerably by having access to coffee at very low prices.

Overproduction is a key problem

A major problem has been that, in the course of implementing changes designed to assist agricultural development, almost all tropical countries were advised to increase production. This resulted in overproduction of coffee, sugar, cotton, and many other commodities, which caused prices to plunge in the international markets. On average, and taking account of inflation, the current prices of tropical products are only about one seventh of those prevailing in 1980.

So, although coffee consumption has increased, production has increased even further — 3.5% over the past five years. The oversupply of coffee has seen prices plummet for those near the start of the supply chain. In 1980, green Arabica coffee beans traded on the New York markets at US$1.50/pound (US$3.30/kg). By November 2001, the price had dropped to US$0.46/pound. At the same time, the retail prices of coffee products (roasted and instant coffee) have increased substantially over the same period, e.g. a 200 g jar of instant coffee bought in a London supermarket has jumped from £stg2 to £stg3.99.

In many cases, the income of coffee producers has actually fallen below production costs. However, ECA countries have few other industrial or service sectors, and countries and individual farmers who rely on cash-crop production for revenue are obliged to continue to grow and sell these commodities no matter how low prices fall. The cost of education and health care are no longer heavily subsidised by many governments, and farmers must earn cash from whatever they know how to do best. The problem of declining economic growth for coffee-producing countries such as Uganda, Kenya, Ethiopia, and Rwanda has been compounded by chronic food insecurity, inadequate agricultural research and extension, health care and education services, cheap and subsidised products being "dumped" on the ECA markets, inability to repay debts, and the impact of the HIV/AIDs pandemic which has significantly reduced the useful workforce and led to a great loss of knowledge and experience.

Solutions through markets

The orthodox economic view is that the market should simply be allowed to determine output, consumption and price, but this would be detrimental to small-scale growers. A conscious reduction in output is required, but Ferris and Robbins stress that this would need to be undertaken as fairly as possible. This may not be an insurmountable problem if farmers understood that they could double their income with a 10% cut in production, and would, at the same time, free land to grow staple food. However, for such a measure to succeed, producing countries would need financial and technical assistance, binding agreements with each other, and the full and active participation of associations of coffee farmers.

Ferris and Robbins go on to discuss a range of measures they believe could contribute to improving the ability of countries in ECA to take on the challenges of the new globalised economy. Briefly, they are:

- improving the negotiating powers of least-developed countries in global trade
- managing the oversupply of primary product exports
- stimulating production of added-value products
- strengthening market information services
- developing export strategies based on highly differentiated, higher-value products
- reducing imports of goods that can be competitively produced domestically.

The solution to this problem will be as complex as the problem itself. In considering the potential role of value-addition for ECA's coffee crisis, for example, a seemingly obvious strategy would be for coffee-producing nations to brand and package their own coffee and sell it directly to Western supermarkets, thus reaping more of the accelerating difference between the raw and retail price of coffee. However, this would not be as easy as it sounds, as developing countries would face the problem of escalating tariffs, and would have to compete with their own customers (in developed countries) who are themselves major exporters of processed coffee products, selling under well-established brand names. For example, the US imports about 24.5 million bags of coffee beans each year, but also exports the equivalent of 2.4 million bags — half of which is in the form of roasted or soluble coffee.

For many ECA countries the situation remains bleak. There is a long way to go before producers receive anything like a fair share of the retail price of a cup of coffee.

MW/EH

RESEARCH NEWS

Ethyl formate for grain disinfestation

The use of ethyl formate as a grain fumigant is being investigated by the Stored Grain Research Laboratory (SGRL) in Australia, with financial support from the Grains Research and Development Corporation. New treatments for stored grains are needed — in particular, for on-farm and small-scale private stores, where phosphine is the only fumigant in routine use and is at risk through development of resistance by insects.

Ethyl formate is currently used on dried fruit for insect control and is also used as a food additive for a variety of reasons. It is normally present in a range of grains and seeds and is a widely manufactured and readily available material.

Research by SGRL has shown that ethyl formate kills insects quickly and its residues break down rapidly in warm grain. The toxicity of ethyl formate to the rice weevil, *Sitophilus oryzae*, has been an important part of this study. The rice weevil shows a high tolerance to fumigants under controlled conditions and develops inside the grain kernel. To be fast-acting, the fumigant must therefore rapidly penetrate into the grain. The effectiveness of ethyl formate against adult and juvenile stages — eggs, larvae and pupae — has been studied. A fast kill of all adults and most juveniles has been achieved within one day under ethyl formate fumigation. All stages have been killed in warmer grain within two days. However, it has been more difficult to kill all insect stages in cooler grain.

Sampling an experimental column of wheat for ethyl formate residues

An important property of ethyl formate when applied to grain is the rapid breakdown of the compound to natural products. The rate of breakdown is more rapid in warm grain and at higher grain moisture. Conversely, cold or dry grain gives a slower breakdown. This information will be used to establish suitable withholding periods for grain treated with ethyl formate.

SGRL is also evaluating liquid ethyl formate as a potential grain treatment for use in farm bins. Ethyl formate is a highly flammable liquid that is easily evaporated. The hazardous nature of the fumigant needs to be considered when trialling application methods. Alternative application methods are being examined, such as dispensing from pressurised cylinders. In addition, SGRL is investigating the addition of ethyl formate in a slow-release formulation to enable the compound to be directly applied to grain.

The overall aim of the research is to generate a data package that demonstrates safe and effective use of the fumigant. There is still a great deal of research and field evaluation required before sufficient information has been collated for the commercialisation and registration of ethyl formate for use on grain.

For further information, contact Katherine Damcevski at SGRL: <Kath.Damcevski@csiro.au>

* This article was first published in the August 2002 issue of *Stored Grain Australia*, the newsletter of the CSIRO Stored Grain Research Laboratory. It has been edited slightly to fit the context of the *ACIAR Postharvest Newsletter*.

FORTHCOMING CONFERENCES

ASEAN Food Conference

The 8th ASEAN Food Conference, organised by the ASEAN Committee on Science and Technology and the Federation of Institutes of Food Science and Technoiogy in the ASEAN, will be held in Hanoi, Vietnam on 8–11 October 2003.

A call for papers has been made, on topics including:

- Advanced food technologies: storage, processing and preservation
- Appropriate technologies for small and medium industries
- Food engineering and packaging
- Food chemistry (functional and fortified food, nutrition science)
- Food biotechnology
- Food microbiology and safety
- Food quality and standards
- Food economic policy
- Human resource development.

The deadline for submission of abstracts is 30 March 2003.

A major food technology exhibition will be held in conjunction with the conference.

For more information, contact conference General Secretary, Dr Nguyen Kim Vu, at <phti@hn.vnn.vn>.

World avocado congress

The Fifth World Avocado Congress will be held in Spain during 19–24 October 2003. The venue is the Costa del Sol Convention Centre, Torremolinos, Málaga.

Scientific–technical sessions on the following topics are in the conference program:

- Genetic resources
- Breeding and selection
- Ecological culture
- Flowering, fruit set, and fruit development
- Postharvest physiology
- Marketing, industrialisation, and legislation
- Pests and diseases
- Human nutrition and health.

Also, there will be workshops on several topics, including international marketing, industrialisation, and new varieties.

For copies of a first circular and further information contact the conference secretariat at <secretaria@congresomundialaguacate.org>

REVIEW ARTICLE

Rodents: losses and control in primary produce

Rodents are a key mammalian group and are highly successful in many environments. The number of rodent species worldwide is conservatively estimated to be over 2000, making up more than 42% of mammalian species.

Rodents have a bad reputation for ruining crops, decimating stores of grain and other food and feedstuffs, and spreading disease. While this is certainly true for some species, most rodents are harmless, or become pests only under certain conditions. Indeed, the importance of rodent diversity is being increasingly recognised, and in some cases conservation measures are being undertaken to preserve dwindling rodent populations.

From an agricultural perspective, the impact of rodents, particularly on grain, horticultural and plantation crops, is significant, both before and after harvest. A new ACIAR publication, “Rats, mice and people: rodent biology and management”,* provides a comprehensive account of current studies across the full spectrum of rodent research.

This article draws primarily on information contained in that book to give an overview of the current status of rodents as pests of agricultural production and products, and ways in which their populations can be maintained or reduced to a level such that economic impact is minimised.

Losses attributed to rodent damage

Rodents cause damage to crops and commodities before and after harvest — both directly through gnawing and feeding, and indirectly through spoilage, contamination and hoarding. *Field populations of rodent pests will inevitably transfer their activities to stored product after harvest, so the larger the field population the greater is likely to be the pressure on commodities stored on farm or nearby.*

The extent of damage varies widely, but globally, estimates of preharvest losses to rodents typically fall between 5 and 15% in rice, wheat and maize production systems, with more extreme, episodic losses in systems that experience irruptive rodent outbreaks, driven by favourable climatic or environmental changes. In many areas, the scale of chronic crop losses to rodents is said to have increased in recent decades. This is sometimes attributed to the intensification of crop production as a consequence of the green revolution, but in some cases it is also clearly linked to changes in market systems. Postharvest losses in some areas may match or exceed the preharvest damage, and reports of 20% losses caused by rats to grain after harvest are not unusual.

Although data were not available for all regions of the world, the survey that follows provides a clear indication of the enormity of the problem, particularly for developing countries.

Asia

Rodents are considered to be one of the major causes of preharvest damage to rice crops in many Asian countries. They are responsible for annual losses in rice production of 10–20% in Indonesia, 2–5% in Malaysia, >10% in Vietnam, 6–7% in Thailand, and 5–10% in India and Bangladesh, and are also major pests of rice in Cambodia and the Philippines. Even when using a conservative estimate of 5% for the whole of South and Southeast Asia, the annual losses in that region amount to 16 million tonnes of rice, enough to feed almost 50 million people.

While there are several rodent species that contribute to these losses in Southeast Asia, the rice-field rat, *Rattus argentiventer*, is the major pest of rice as well as some other commodities. It is successful across a wide range of agro-ecosystems (e.g. lowland irrigated rice, rainfed rice in elevated areas, tidal swamp areas) and losses due to this species in Indonesia alone are estimated at US$22.5 million per year. Other crops that suffer significant rodent damage, mainly by *Rattus tiomanicus*, are cocoa, coconut and oil palm. House rats (*Rattus exulans*, *R. norvegicus*, *R. rattus*) and bandicoot rats (*Bandicota indica*) cause serious problems in traditional markets, grain stores and around houses. The total annual losses due to rats in agricultural produce in Indonesia are above US$50 million.

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Rattus argentiventer, the rice-field rat

Semple (1986)† gives estimates of losses due to insects and rodents to various stored products in ASEAN. In the Philippines, these range between 43% in shelled maize and 13% in Thai rice grown there. Figures quoted for losses to individual species of insects are much lower, so, by deduction, rodent damage seems very significant. In Indonesia, losses cited are in the range 3–6%, and in Thailand 12–15%. Furthermore, Semple notes estimates that:

> ... rodents cause spillage of as much a 7.5 times the amount of grain consumed. This can be recovered, but at an additional cost of processing. Grains contaminated with rodent hairs, faeces, and urine were infected with storage fungi such as *Aspergillus flavus* and *Aspergillus ochraceous*, as well as bacteria responsible for food poisoning, and these probably constitute the major form of loss and hazard.

In a paper presented at a recent JIRCAS symposium (see page 1 story), J.F. Rickman of the International Rice Research Institute notes that losses to rodents of 6–15% have been recorded from stored grain in Bangladesh and China.

In China, rodents cause an average of 1–3% loss of crops in Yunnan province, and infest 10–20% of the total area of grasslands used for meat and wool production. Commensal species consume and contaminate substantial quantities of human food and animal feed, as well as damaging building structures by their gnawing and burrowing.

Continued on page 5.

* Singleton, G.R., Hinds, L.A., Krebs, C.J. and Spratt, D.M. (ed.) 2003. Rats, mice and people: rodent biology and management. Canberra, ACIAR Monograph No. 96, 564p.

† Semple, R.L. 1986. Problems relating to pest control and use of pesticides in grain storage: the current situation in ASEAN and future requirements. In: Champ, B.R. and Highley, E., ed., Pesticides and humid tropical grain storage systems. Canberra, ACIAR Proceedings No. 14, 45–75.

Rodents: losses and control in primary produce ... from page 4

In India, the wheat crop suffers similarly to rice, with preharvest losses of 5–15%. Indian researchers identify a variety of reasons for increasing rodent populations, such as increases in intensive cropping in expanding irrigation areas, changing agricultural practices, failure to follow proper spacing in coconut plantations, cultivation of oil palms in rodent-endemic areas, and natural calamities such as flash floods and drought spells followed by heavy rains.

Indian farmers often retain 60–70% of their produce in storage, and overall postharvest losses of grain can be as high as 25–30%, bringing the loss to at least US$5 billion annually in stored food and seed grain in India. Chronic losses often go unrecognised but these losses are economically more important. Population explosions of rodents sometimes occur, and these occasionally lead to famine. The range of crops affected includes cereal crops, sugarcane, pulse and oilseed crops, and plantation crops such as coconut, cocoa and cardamom. Of the 13 main rodent pest species in India, the lesser bandicoot rat, *Bandicota bengalensis*, is predominant in irrigated crops throughout the country. Due to its aggressiveness, it has replaced other species and become a major pest in storages and other premises in metropolitan cities.

Africa

In sub-Saharan Africa, estimates of rodent damage vary widely. A study at the harvesting stage of maize in Ethiopia showed a yield loss of over 25%, and there are reports of annual damage in Kenya with more serious outbreaks every few years and some areas experiencing up to 90% loss. In Tanzania, 5–15% of the maize crop is lost every year — this corresponds to more than 400,000 t, equivalent to an amount that could feed 2.3 million people for a whole year, and representing a financial loss of around US$40 million.

Most households in Mozambique have a tradition of storing their food inside their dwelling. However, this storage practice makes it difficult to exclude rodents from the food store, exacerbating losses and contamination.

In a recent survey conducted in the Limpopo province of South Africa, rodent damage to stored millet, groundnuts and legumes was ranked by farmers as the first or second-most important problem. Postharvest hygiene and waste management was a problem in the villages surveyed, and agricultural waste was often left in the yard, providing shelter for rodents. Open-structure granaries used for maize storage were raised less than 1 m from the ground, allowing rodents free access.

Central America

In Mexico, significant economic impacts of rodent pests have been reported, with crop loss estimates of 0.1% for maize, 6.0% for sugarcane, 8.6% for beans, and 10.0% for sorghum.

Australia

The principal rodent pest in Australian agricultural crops (particularly wheat) is the house mouse (*Mus domesticus*). Mouse populations erupt irregularly causing losses in the range of US$50–150 million, equivalent to average annual losses of around US$10 million. Mouse plagues have in the past devastated grain stores.

Rodent population density

The availability of food is an obvious factor in fluctuating rodent populations, but not the only one. Predators play an important natural role in keeping populations in check. For example, rodents have become increasingly abundant as numbers of snakes, predatory mammals and birds become smaller.

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Mice infesting a silo

Jan van Graver, CSIRO Entomology

Rodent damage to grain fumigation sheets in direct contact with the ground.

In some regions, such as the Mekong River Delta of Vietnam, rat meat is an important source of protein, and harvesting rats helps to not only feed the human population, but also to manage the rodent population. In Indonesia, rats used to be important in traditional medicine, and it is estimated that when this practice ceased, economic losses by rats increased.

Habitat structure is another environmental aspect with a pronounced influence on rodent population density. In East Africa, for example, a mosaic of small plots of various crops, intermingled with patches of fallow and permanent grassland, combined with minimal land preparation and subsequent flourishing of weeds, creates favourable conditions for opportunistic and prolific rodent species, such as *Mastomys natalensis*, and results in a great damage to crops.

Control methods

A seemingly endless array of methods has been devised in the attempt to control rodents, with varying degrees of success.

Frequently the problem is that people tend to make their control efforts after damage is seen in their crops and food stores (reactive or symptomatic control). Unfortunately, by then it is too late and the action has very little impact. Pre-emptive (or 'proactive') control is generally more effective, but requires planning and ecosystem knowledge. For example, cereal crops exhibit compensatory growth if pests inflict damage in the initial stages, but not if the damage occurs after the vegetative stage. Hence, rodent control is advocated during the initial stage of cereal crop growth, when rodents immigrate into and try to establish in the crop. Treatment during this stage is much more effective than if farmers wait until they see large numbers of rats or the damage to crop plants is obvious.

Chemical control using rodenticides is still the method of choice in many countries, including in storage, but prohibitive costs, development of resistance by the target species, and mounting environmental concerns, including secondary poisoning, are factors increasingly restricting their use.

In most cases, chemical control is combined with, or replaced by, other measures including use of physical barriers (fences, and rat-proofing of storages), hunting, fumigation, digging

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Rodents: losses and control in primary produce ... from page 4

up burrows, trapping, synchronising planting and harvesting, reducing the size of bunds within fields, clean cultivation, proper soil tillage, providing alternative food, using chemical repellents or secondary plant products, encouraging predators — such as barn owls, and bounty systems (offering payment for rodents caught). The development of a non-toxic, bait-delivered fertility control also offers promise for the future.

Environmentally based rodent management

Increasingly, researchers are trying to introduce ecologically based rodent management (EBRM) strategies. EBRM aims to manage the target species based on sound knowledge of farming systems and natural factors, such as the availability of food and shelter, that contribute to the limitation of pest rodent populations. In manipulating these factors, control is spatially and temporally focused on the target species and non-target impacts are reduced. Strategies consider the modification of key refuge habitats (non-crop areas close to crops) to minimise the availability of food and shelter for pest rodents, carefully choosing the land preparation method, and synchronising planting and harvesting of crops. The three examples given below are just a sample of the range of EBRM strategies that are proving successful.

In rice fields of Indonesia and other Southeast Asian countries, a trap–barrier system (TBS) first developed at the International Rice Research Institute in the Philippines is being used. This system uses a lure crop (usually a rice crop planted three weeks ahead of surrounding fields) to attract and trap rodents before the surrounding fields reach the booting stage. In theory, this leads to a reduction in rodent populations before the onset of breeding activity. The TBS method is best applied in a coordinated fashion across large cropping areas, but this requires a high level of community involvement and cooperation.

In Queensland, Australia, reduction of refuges by habitat manipulation has been successfully applied to protect macadamia nut orchards, after it was noted that orchards adjacent to structurally diverse, non-crop vegetation dominated by woody weeds exhibited significantly higher

Jan van Graver, CSIRO Entomology

Counter-weighted rodent-proof barrier fitted to a rice storage in Papua New Guinea

Jan van Graver, CSIRO Entomology

Rat guards fitted to the foundations of a traditional grain store in the Philippines

damage when compared to orchards adjacent to managed grasslands. Intentional modification of structurally diverse, non-crop habitat to grassland led to a reduction in rodent damage (by *Rattus rattus*) of 65%. This strategy was cost-effective and has the potential to be sustainable with minimal effort needed to maintain sites in a modified state.

In eastern Africa, mole rats are notorious pests of cassava tubers. Experiments showed that damage could be reduced by two simple and environmentally friendly practices: planting cassava on mounds rather than on ridges; and planting the deep-rooted, poisonous shrub *Tephrosia vogelii* in the field. *T. vogelii* is also used as a green manure crop and as a shade tree in young plantations. Its leaves contain insecticidal products that can be prepared as an extract or powder. The repellent effect on mole rats further increases its value as an agroforestry plant.

EBRM can be highly successful, but its use requires detailed knowledge on the life histories of target species.

Conservation/benefits of rodents

Although much damage is attributed to rodents worldwide, the actual number of pest species makes up only a small proportion of the total number—e.g. in Australia, only 4 of 67 species are clearly pest species, in India 12 of 128 species, and in western Europe 5 of 61. A rodent species' status as a pest is a combination of its own biology and the nature of the agro-ecosystem in which it occurs. Because of their bad reputation, conservation of rodent species is an area which has received scant attention, but is important in maintaining biological diversity. Through habitat destruction, displacement or predation by introduced species or other disturbances, as well as direct "persecution" (culling), many rodent species are in decline.

In South Africa, the characteristics of rodent and other small mammal communities are now being recognised as important indicators of ecological disturbance. Ecological studies are essential to enable us to distinguish between the pest and non-pest status of different rodent species in different geographical areas and to target our control technologies appropriately.

Even in the agricultural setting, a possible positive role of rodents should not be ignored. For example, in the rice-field and garden ecosystems of Southeast Asia, heavy predation by *Bandicota* species on crabs might reduce the level of direct damage inflicted on growing rice tillers by the crabs themselves.

The important point is that we currently do not know enough about the ecology of most agricultural "pest" rodents, at least in Southeast Asia, to know whether or not such potential benefits might outweigh the costs of direct crop losses. The same is probably true in many other parts of the world.

There is no doubt that some species of rodents cause immense damage to crops and stored commodity and suffering to many people throughout the world, but the issue is complex, and we must be careful to balance the management of pest species with the conservation of beneficial species of rodents.

MW

RESEARCH NEWS

New grain storage R&D centre for Canada*

Funding of $Can4.6 million has helped build — at the University of Manitoba, Winnipeg — a new facility for research and development (R&D) covering all aspects of grain drying, handling and storage. The money was granted to an interdisciplinary stored-grain-management group, comprising researchers from the Department of Biosystems Engineering, University of Manitoba and the Cereal Research Centre, Agriculture and Agri-Food Canada.

A team consisting of engineers, entomologists, chemists, mycologists, and agricultural economists at the new facility will examine a range of problems of stored-grain ecosystems, with the aim of increasing the efficiency of grain handling and transportation. The facility has five modules which can be used independently or in combination.

The **near-ambient drying and aeration module** includes three bins (3 m in diameter) that can be used interchangeable as flat-bottom bins (with either fully or partially perforated floors) or hopper-bottom bins. Each bin is equipped with sampling ports, thermocouples for temperature measurement, and semi-rigid plastic tubing for extraction of intergranular gas samples. The room in which the bins are housed can be adjusted to simulate the environmental conditions of any location using hourly or daily weather data from the site of interest. These bins will be used for research on various aspects of storage, such as: validating mathematical models of gas transfer through grain bulks; developing automatic fan controls; determining the shape and rate of temperature-front movements during aeration; and developing structural engineering knowledge for the design of large bins.

The **heated-air drying module** comprises a thin-layer and a hot-air dryer. Temperature and relative humidity can be controlled in the

A view of the research facility showing two storage bins and two bucket grain elevators.

thin-layer dryer and it will be used to determine air conditions required to dry crops without detrimental effects on end-use quality. The hot-air dryer will be employed in the design and evaluation of new sensors for measuring grain temperatures and moisture contents and to develop automatic controls for dryers. This module will also be used to design and to develop new, economically feasible, drying systems, such as infrared and microwave drying, and develop and validate theories of drying.

The **grain handling and cleaning module** includes pilot-scale equipment typical of that used in Canadian grain elevators, as well as an area-scan camera, a line-scan camera with associated computer system, a soft X-ray unit for detecting low-level infestation of grain, and a workshop to design and build new systems. Among other projects, work using this module will focus on: designing and evaluating cleaning and handling equipment for specialty crops to ensure quality is preserved; developing systems that minimise seed loss during cleaning and handling; developing techniques to quantify mechanical damage to kernels caused by grain-handling systems; and integrating machine-vision technology into grain cleaners.

The **physical control of insects module** has the same equipment as the previous one, as well as pneumatic conveyors and augers, airtight pilot-scale bins, a high-temperature grain-treatment unit, and two temperature- and relative-humidity-controlled chambers.

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High-temperature dryer with capabilities to vary drying-air temperature, grain flow rate, and air flow rate

A soft X-ray system for detection of low-level infestation in grain samples

A line-scan camera system for basic research on machine vision systems

Airtight bins for controlled atmosphere and fumigation research

* This article draws on the following paper: Jayas, D.S. and White, N.D.G. 2003. University of Manitoba Centre for Grain Storage Research and Development. In: Stored Product Protection 2002. Proceedings of the 8th International Working Conference on Stored-product Protection, York, UK, July 2002. Wallingford, UK, CAB International, in press.

HEALTH AND FOOD SAFETY

Major new report on mycotoxins

Mycotoxins are a relatively large, diverse group of naturally occurring fungal toxins, many of which have been strongly implicated as disease agents in humans and animals, either as acute poisons after high-level ingestion, or having more chronic effects—manifested as tumour formation, growth retardation, impaired immunity, decreased disease resistance, or decreased milk or egg production.

The inclusion of articles on mycotoxins in many recent issues of the Postharvest Newsletter (Nos 55, 58, 59, 61–63) reflects the growing recognition of their grave importance.

The Council of Agricultural Science and Technology (CAST, Ames, Iowa, USA) recently published a comprehensive report — "Mycotoxins: risks in plant, animal, and human systems" — which is available on the Internet: <www.cast-science.org/pubs/mycotoxins.pdf> (CAST Task Force Report No. 139, January 2003). The aim of the CAST treatise — as with its previous mycotoxin reports, published in 1979 and 1989 — was "to compile the most complete current information on mycotoxins possible and to provide an understanding of their associated risks and impacts on plant, animal and human systems." The latest report covers all aspects of classes of mycotoxins and the fungi that produce them, pre- and postharvest occurrence (including the fate of mycotoxins during grain processing), detrimental effects on humans and animals, management and detection, risk assessment and regulations, decontamination and detoxification strategies, potential economic costs (using the United States as a case study), and research and policy needs.

According to the CAST report, mycotoxin contamination often is an additive process, beginning in the field and increasing during harvest, drying, and storage. Avoiding mycotoxin accumulation in stored grains and oilseeds depends primarily on moisture control. If the product is too dry to allow fungal growth and it is kept dry, no further deterioration will occur. However, if there is insect or rodent activity, moisture migration, condensation or water leaks, fungal growth that could lead to mycotoxin contamination will occur. Most of the contamination in storage comes from infections that began in the field, but fungus can directly infect stored grain as well, if conditions are right.

Other than aflatoxins, mycotoxin contamination of feeds and foods is poorly studied. Aflatoxins have been detected in maize, peanuts, cottonseed, Brazil nuts, copra, almonds, pecans, figs, spices, and a variety of other foods and feeds. Milk, eggs, and meat products can also become infected if the source animal has consumed contaminated feed.

Postharvest methods to decrease or eliminate mycotoxins are being studied, and several approaches, such as physical methods of separation and detoxification, biological and chemical inactivation, and decreasing bioavailability to host animals are being used and/or investigated.

Aside from the huge health issue, we are only just beginning to appreciate the economic costs of mycotoxins. The case study examined in the CASE study — using the United States as the example — estimated the average annual economic costs of crop losses from the major mycotoxins (aflatoxins, fumonisins and deoxynivalenol) to be US$932 million. And we have discussed trade implications for developing countries in several Postharvest Newsletter stories (e.g. Nos 55, 59, 61, 63).

As mycotoxins are now considered to be a najor food safety issue, keeping abreast new information is essential to all those involved in the postharvest arena. The latest CASE report is an invaluable resource to that end.

MW

New grain R&D centre for Canada ... from page 7

The physical control module will be used to study a variety of insect-related problems, such as: assessing the effectiveness of combinations of mechanical action, cool temperatures, and increased carbon dioxide for insect disinfestation; developing integrated pest management strategies; and assessing existing and developing new formulations of diatomaceous earth for insect control in grain or on structural surfaces.

Finally, the **engineering properties measurement module** contains laboratory equipment for measuring physical, thermal, hygroscopic, abrasive, aerodynamic, and dielectric properties and heat of respiration, carbon dioxide production, and oxygen consumption of grains and grain products. Studies using this module will include: designing and developing new equipment for dehulling pulses; developing processing technologies that uniformly mix medicinal and nutritional components into feed; and testing centrifugal and axial fans used for near ambient drying and aeration.

It is expected that research conducted at the facility will contribute much information in the quest to reduce qualitative and quantitative losses in stored grain in Canada and worldwide.

For further information, contact Dr Digvir Jatas:
<digvir_jayas@umanitoba.ca>.

MW

FORTHCOMING CONFERENCE

CAF2004

Sustainable fumigation alternatives

CAF2004, the next International Conference on Controlled Atmosphere and Fumigation in Stored Products, will be held on the Gold Coast, Queensland, Australia from 8 to 13 August 2004. Information on scientific themes, instructions for submission of papers, a register to receive conference updates, accommodation and registration details, and details of the venue can be found at the conference web site at <www.caf2004.com> or from the conference secretariat at <caf2004@ccm.com.au>.

CAF2004 has been scheduled to immediately precede the XII International Congress of Entomology in Brisbane, a short distance from the Gold Coast. Information on the Congress can be found at:
<www.ccm.com.au/icoe>.

National honour to Bruce Champ

Dr Bruce Champ, formerly Postharvest Technology Program manager in ACIAR, was admitted to membership of the Order of Australia in the 2003 Australia Day awards on 26 January.

This is a high national honour, and was made in recognition of Bruce Champ's service to agricultural research and entomology, particularly through the development of stored grain pest control.

Dr Champ will be well known to many readers of this newsletter, for his work in extending postharvest technology in the Southeast Asian region through the research, training, and other activities of the ACIAR program.

When ACIAR was founded in 1982, Bruce was invited to establish a grain storage research and development program consistent with the Centre's mandate to address high priority problems in the agricultural sectors of developing countries by promoting collaborative research programs between Australian research providers and counterpart groups in other countries. Continuing a career already distinguished through achievements in the Queensland Department of Primary Industries and the CSIRO Stored Grain Research Laboratory, he transferred to ACIAR and, until his retirement in 1995, managed this international program that had projects in most countries in Asia. In the early 1990s, the program became the Postharvest Technology Program, extending its ambit to perishable commodities such as fruits and vegetables.

Dr Bruce Champ, AM

During his stewardship of the program, Bruce made many overseas visits to service projects and project-related activities. He was responsible for organising eleven major international conferences and publishing their proceedings. He participated in numerous other international conferences and acted as chairman of many symposia, seminars, and conference sessions.

Though retired, Bruce maintains links with the postharvest community and is a regular participant in major international colloquia. He continues as a member of the permanent committee for the International Working Conferences on Stored-product Protection and as regional editor for Asia and the Pacific of the Journal of Stored Products Research.

We extend our congratulations and best wishes to him on his admission to membership of the Order of Australia.

RESEARCH NEWS

CS_2, an environmentally friendly grain fumigant*

Carbonyl sulfide (CS_2) could provide an effective and safe alternative to phosphine, according to new research.

Phosphine is the most widely used fumigant for on-farm treatment of stored grain, but high levels of insect resistance to phosphine have been detected. These occurrences do not pose an immediate threat to phosphine as currently used on farm, but they flag that even phosphine could be lost as an effective treatment.

CSIRO Stored Grain Research Laboratory (SGRL) scientists believe that carbonyl sulfide has significant potential as a new fumigant for use as an alternative to phosphine and in resistance management.

SGRL scientists first recognised the threat to phosphine about 10 years ago and have been actively pursuing development of alternative fumigants. Developing a new fumigant is not easy. Whereas many gases will kill insects, to be acceptable, a grain fumigant must not damage the grain, must be relatively cheap, and must be environmentally friendly, convenient to apply, safe to handle, and have a range of other attributes. Research into the new fumigant has been funded by CSIRO, the Grains Research and Development Corporation, AWB Limited, and the Australian Bulk Handling Companies.

Carbonyl sulfide is present in the atmosphere, in water, soil, and plants, and in many raw and processed foods, including cereals and oilseeds. It is also known to form an important part of the natural global sulfur cycle. In essence, carbonyl sulfide occurs around us all the time at low levels, a factor that should reduce environmental concerns about its use.

SGRL research shows that carbonyl sulfide is a highly effective fumigant. It works more rapidly than phosphine, with treatment times of about 2–5 days, compared with 5–10 days for phosphine.

The carbonyl sulfide used in fumigation comes as a gas in pressurised cylinders, so it can be applied quickly and easily. Studies have been carried out to determine the amount of carbonyl sulfide and the exposure time needed to kill insects. The dosage regimes determined by SGRL have been shown to control all life stages of most stored-product insect pests. These studies have also shown that carbonyl sulfide is potentially applicable to a wide range of grains, pulses, and oilseeds.

SGRL has a patent on the use of carbonyl sulfide for the fumigation of grain and other stored commodities. Extensive field trials will be carried out over the next years to establish that it is safe to use under Australian conditions. The laboratory is working closely with the Australian grain industry and government regulatory authorities such as the Australian Pesticides and Veterinary Medicines Authority, to produce the information needed for full registration and approval for use of the chemical in Australia and elsewhere.

For further information, contact Gaye Weller at SGRL <gaye.weller@csiro.au>.

* This article was first published in the August 2002 issue of *Stored Grain Australia*, the newsletter of the CSIRO Stored Grain Research Laboratory. It has been edited slightly to fit the context of the *ACIAR Postharvest Newsletter*.

CURRENT AWARENESS

Developing agricultural markets and agro-enterprises

The Agribusiness & Markets Thematics Group of the World Bank is developing an online "Guide to Developing Agricultural Markets and Agro-Enterprises". In the words of its editor, Daniele Giovannucci:

> The guide brings together the work of experts from around the world to help development practitioners better understand key issues in agricultural marketing and agro-enterprises and to enhance their ability to initiate, plan, and monitor supportive activities and analytical work.
>
> By presenting a broad array of "tools" in a simple and accessible format, this work intends to facilitate a more comprehensive understanding of the field *as a system* rather than as a series of components. It also aims to present the most useful roles that can be played by the private sector, government and development agencies to leverage each others' assets toward achieving the goal of development.
>
> This is the first stage of a work in progress. In the spirit of collaboration, we would like to invite colleagues and interested parties from around the globe to help us improve the tools offered here and develop others.

To view progress to date, go to: <http://lnweb18.worldbank.org/essd/essd.nsf/Agroenterprise/mis> then click on "Main Page".

Mycotoxin decontamination specialist visits Australia

Prof. Karl Dawson, from the North American Biosciences Center of Alltech, Inc., presented the keynote address at the Australian Poultry Science Symposium in Sydney during February, and discussed with local researchers the results of his work on the use of materials that adsorb mycotoxins in animal feedstuffs. Such materials, which include both inorganic and biological adsorbents, are able to bind the toxins and allow them to pass through the animal's digestive tract without being adsorbed from contaminated feedstuff. Inorganic adsorbents include clay-based materials and activated charcoal. Among biological materials, a yeast-cell-wall-derived glucomannan product, "Mycosorb", has shown much promise. Among the research groups that Prof. Dawson met with was that of Prof. Ivan Kennedy at the University of Sydney which is leading ACIAR project PHT/1996/004, "Monitoring mycotoxins and pesticides in grain and food production systems for risk management in Vietnam and Australia" and participating in PHT/1997/017 "Reducing aflatoxin in peanuts using agronomic management and bio-control strategies in Indonesia and Australia".

ACIAR Postharvest Newsletter

This newsletter is published quarterly in March, June, September, and December by the ACIAR Postharvest Technology Program.

The Australian Centre for International Agricultural Research was established in June 1982 by an Act of the Australian Parliament. The Centre encourages research aimed at identifying agricultural problems in developing countries and finding solutions to such problems. It is empowered both to commission research and to communicate the results of such research to interested persons and institutions.

ACIAR AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

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FORTHCOMING CONFERENCE

Australian Postharvest Technical Conference (APTC) 2003

"Modern Grain Storage Technology in Australia"

26–27 June 2003
CSIRO Headquarters, Limestone Avenue, Canberra

The Australian Postharvest Technical Conference provides a forum for discussion of grain storage technology and the drivers of change. The theme of the conference encompasses all the major topics on chemical and physical methods of pest control, and environmental and OH&S issues. The program will consider the control of quality and pests in grain in storage. Coverage includes cereal grains, pulses and oilseeds for human consumption, animal feedstuffs, seeds and the processing and warehousing sectors. An important topic will be recent developments in the use of phosphine, a fumigant that is critical to the grain storage industry. The development of alternative fumigants is a matter of urgency with the pending phase-out of methyl bromide from general use in 2005. The conference will cover current research and development on new fumigants and methyl bromide replacements.

The conference is an opportunity for interaction of research providers and funders with the end-users of the developments and with marketers. The Australian grain industry is a leader in the development of grain protection technology. The interaction fostered through this conference is essential to keep this technology relevant and to maintain the industry's position as a leading supplier of premium quality grain and grain products.

To find out more and register on line, go to:

www.graincorp.com.au/aptc2003

Email address:

aptc@ausconvservices.com.au

Abstracts welcome until 18 April.

Sponsorship and trade display opportunities still available!