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CONFERENCE REPORT

ASEAN/APEC postharvest seminar signals bright future

The 19th ASEAN/1st APEC Seminar on Postharvest Technology, held in Ho Chi Minh City on 9–12 November 1999, was one of the most successful to date in this premier regional seminar series.

Both numbers of participants and presentations were up on previous years: almost 200 people were registered, about equally divided between local and overseas participants, and over 80 papers were presented, on the theme "Quality assurance in agricultural produce". The future of the seminar series thus looks bright, particularly as the Ho Chi Minh event was, for the first time, also held under the banner of APEC, the Asia–Pacific Economic Cooperation forum, and the expectation is that this support will extend to future seminars.

The seminar was organised by the Post-Harvest Technology Institute in Ho Chi Minh City, under its Director Dr Le Van To, who was seminar convener. ACIAR, the Australian Agency for International Development (AusAID), and the Danish International Development Agency (DANIDA) provided support for the organisation of the seminar and the attendance of many local, regional, and international participants. The seminar was opened by Professor Ngo The Dan, Vice Minister of the Ministry of Agriculture and Rural Development.

The 19th ASEAN/1st APEC Seminar on Postharvest Technology attracted participants from throughout the world.

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Contributors to this issue: Jimmy Botella, John Brice, Robert Driscoll, Li Fujun, Ed Highley, Greg Johnson, George Srzednicki, Mary Webb

ACIAR PHTP ANNUAL MEETING REPORT

Delivering research results

Ensuring that the results of ACIAR-supported research are realised and adopted was a theme of discussions at the 1999 annual meeting of the Postharvest Technology Program, held in Canberra on 1–2 December and chaired by Postharvest Technology Program Manager Dr Greg Johnson.

The participants, numbering about 40, included project leaders and other personnel involved in ACIAR postharvest technology activities in Australia. They gave progress reports on their project activities in all partner countries and outlined plans for the future.

ACIAR Director's overview

The meeting was delighted to again welcome ACIAR Director Bob Clements to give his—now almost traditional—overview of the Centre's activities and plans.

Dr Clements focused in particular on changes to the Centre's approach and policy consequent on the findings and recommendations of the independent review of ACIAR activities that was completed a year or so ago. Both the report of the review and the ACIAR Board of Management's policy response can be found in the "News" section at <www.aciar.gov.au>.

A major outcome of the review, Dr Clements said, was the re-emphasis of ACIAR's "partnership" mode of operation in which an overall aim of research sponsored by the Centre was to bring *mutual* benefits to Australia and partner countries.

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ASEAN/APEC postharvest seminar signals bright future...from page 1

Though this is primarily a regional forum, it has, in recent years, attracted attendance from all quarters of the globe. There were participants from Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Thailand, and Singapore in the ASEAN region and, from further afield, Australia, Belgium, Canada, China, Denmark, Fiji, France, Germany, India, Israel, Japan, Morocco, New Zealand, Papua New Guinea, Samoa, South Africa, UK, and USA.

There was a packed technical program with three days of paper presentations in conference and poster sessions, four specialist workshops run in parallel during one evening, and a full-day field trip. The topics for the workshops, which attracted strong participation, were:

- Quality systems in fruit industries;
- Ship fumigation;
- Contaminant management; and
- Grain quality issues.

Agriculture is the economic mainstay of Vietnam and so a subject of great interest to the nation. Aspects of an introductory paper by Ms Bui Thi Lan, Vice-Director of the International Cooperation Department of the Ministry of Agriculture and Rural Development on the topic "Vietnam's agriculture in the context of regionalisation and globalisation: opportunities and challenges" received prominent coverage in the press (see clippings at <http://www.aciar.gov.au/aciarptp/aseanphti.htm>).

Ms Bui Thi Lan, Deputy Director of the International Cooperation Department of Vietnam's Ministry for Agriculture and Rural Development presenting her overview of the prospects for Vietnam's agricultural sector.

Postharvest technology in Vietnam: a brief overview

The main agency for postharvest research and development in Vietnam is the Post-Harvest Technology Institute (PHTI) with headquarters in Hanoi and a major sub-institute in Ho Chi Minh City, but many universities and other institutes also conduct research relevant to the postharvest subsector (see references below). PHTI is part of the Ministry of Agriculture and Rural Development.

PHTI's objectives are to:

- study the losses due to various factors, i.e. insects, rodents, birds etc., under the climatic conditions applying in Vietnam. Based on these research results, to develop appropriate technologies to reduce postharvest losses at different stages e.g. pre-storage, storage, processing etc.;
- investigate processing technologies for agricultural products;
- conduct quality control in order to maintain standards and to increase quality of agro-products, particularly food grains;
- develop educational programs and training courses for staff members;
- transfer new postharvest technologies to farmers; and
- develop international cooperation.

Specific research interests include:

- physiology and biochemistry in the context of food grain characteristics;
- improving pre-storage and storage of grain;
- pest control;
- milling and processing;
- quality control and standardisation;
- biotechnology;
- utilisation of waste and by-products; and
- marketing and economics.

Further reading

My-Yen Lam 1993. A review of food research in Vietnam, with emphasis on postharvest losses. ACIAR Technical Reports No. 26, 111 p.

Champ, B.R. and Highley, E., ed. 1995. Postharvest technology for agricultural products in Vietnam. ACIAR Proceedings No. 60, 166 p. ■

The papers presented by the local participants, and what was seen during the field excursion, indicated that, although there are many problems yet to be solved in the postharvest subsector in Vietnam, remarkable progress has been made over the past 15–20 years.

The seminar papers and reports of workshops and discussion sessions are currently being prepared for publication in the ACIAR Proceedings Series. Publication of the completed volume is expected in about May 2000, but after March 2000, as each paper is completed, it will be placed on the ACIAR home page at <http://www.aciar.gov.au/aciarptp/aseanphti.htm>.

During the closing session in Ho Chi Minh City, Dr Mulyo Sidik of Indonesia's National Logistics Agency (BULOG) indicated his country's desire to host the next ASEAN seminar in 2001. ■

SEE PAGES 8 AND 9 FOR MORE SEMINAR PHOTOGRAPHS

Disastrous floods in Vietnam

The central region of Vietnam, around the city of Hué, suffered the calamity of serious flooding at the time of the ASEAN seminar. The floods led to the tragic loss of over 500 lives and the destruction of the rice crop.

An appeal among ASEAN/APEC seminar participants for donations to help the victims of the flood raised some US$350. The money was sent to the Hospital of Hue, the Department of Agriculture and Rural Development of Hue, and the University of Agriculture of Hue: "In order to help the recovery process from the flood damage and to create a new abundant harvest in the next spring". ■

Delivering research results

ACIAR Director's overview...from page 1.

The "mutual benefits" approach, Dr Clements noted, was a distinguishing feature of ACIAR in the Australian official development assistance (ODA) program. In addition, the goals of the ACIAR program embrace not only poverty alleviation (as emphasised by the 1997 Simons' review of the ODA program) but also food security and the conservation of the agricultural resource base.

Dr Clements said that while the review of ACIAR had been generally very favourable, it had also identified a number of areas that needed to be strengthened if ACIAR is to stay ahead. Chief among these are to ensure delivery of the benefits of research, and to be able to identify benefits and their impacts in Australia and partner countries. As regards the former, he emphasised that benefit delivery pathways need to be built into every project and must be an explicit part of project development. On the matter of identifying benefits, the Director reported the establishment of a "project impacts database", which already contained some 250 items, and for which further contributions are constantly being sought. The database would be a powerful resource in communicating the economic and other benefits to Australia and partner countries of ACIAR-supported research.

Current moves to streamline project development are another outcome of the review. Dr Clements acknowledged that projects currently take too long to develop and that pipeline management needs to be improved to reduce the time involved. ACIAR's research program managers—the group most directly affected—were working on this problem. The Director also briefly mentioned the overhaul of ACIAR's training program, and a new emphasis on matching training modalities to the needs of each trainee. ACIAR's role in training was covered in more detail by Deputy Director (R&D) John Skerritt later in the meeting.

Program overview

Postharvest Technology Program Manager Greg Johnson tabled a comprehensive report on the years activities. The various projects of the program (see Box on page 4) now target improved handling, transport, and storage of a diversity of perishable and durable commodities—from bok choy to rice—using an array of disciplines from mechanical to genetic engineering.

Dr Johnson introduced a discussion of the place of networking and communication in project activities, and the need to raise project awareness in partner countries, topics generating a deal of discussion highly relevant to, among other things, the issue of "benefit delivery" raised by the Director.

Stronger links need to be forged between research and development and the communication of the results of R&D to potential beneficiaries. The Program Manager stressed that all projects, right from their inception, must have "communication plans" embracing activities such as workshops and training, linkages to professional societies, and liaison with the training and promotion activities of the Crawford Fund. These plans should, on the one hand, enhance understanding of the market for particular research results and, on the other, make the market aware of research in progress. By this means, the likelihood will increase that the benefits of research will be captured through the adoption of the new technologies developed.

Also discussed was the timing of project workshops: should they be held at the beginning or end of projects, or even mid-term?

Participants in the 1999 annual meeting of the Postharvest Technology Program.

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Some project highlights

- PHT/1997/131 — This project, also supported by funds from AusAID, developed a training course on pest management and store hygiene for grain store managers and staff in the APEC region. The course integrates multilingual, multimedia computer-assisted learning (CAL) methods with conventional training techniques. The course has been run successfully in Indonesia, the Philippines, and Vietnam (see page 5).
- PHT/1996/04 — A successful start-of-project workshop was held in Vietnam in November 1999. This served, among other things, to train research partners in the mycotoxin and pesticide assessment techniques central to the work plan. The workshop was supported by the Crawford Fund.
- PHT/1995/134 — This project has been successful in fostering cross-country communication and training. On the research front, it has been demonstrated that surface mulching up to the edge of the drip line promotes more vigorous feeder roots and thus greater resistance to phytophthora in durian trees. Also, a bioassay which permits use of leaf disks or strips to screen for resistance has been developed. Screening using whole leaves is problematic because leaves can be up to 1.8 m long! ■

Delivering research results...from page 3.

Workshops in the Program have more often than not been held at the end of project activities, whereas the various views put tended to favour workshops at, or close to, the start of project activities. One project leader noted the value of commencement workshops in simply bringing team members together, to establish a close relationship between researchers in the various country teams right from the outset. Another participant noted that a workshop held, say, 1 year into a 3-year project could identify any emerging problems and refine project strategy to overcome them and enhance the likelihood of project success.

Training...and the GST

Deputy Director (R&D) Dr John Skerritt outlined ACIAR education and training policy and activities to participants. Most ACIAR training in the postharvest arena is associated with bilateral projects. Opportunities for multilateral projects and associated training through the International Agricultural Research Centres (IARCs) are restricted because the IARCs have no specific postharvest program.

The primary requirement for ACIAR to provide training is that the trainee must be associated with an ACIAR project, but providing that condition is met training may take any of a number of forms. The mode of training should be tailored to the training outcome sought. Postgraduate fellowships are available for longer-term education or training, or training in specific areas might be delivered as part of project activities or through the programs of the Crawford Fund for International Agricultural Research.

Concluded at the foot of page 5.

ACIAR'S CURRENT POSTHARVEST PORTFOLIO

(*projects under development in italics*)

1) Produce quality and suitability (PHT Outcome 1)

Projects

94/016 Shelf life of leafy vegetables (China)

94/007 Pineapple quality improvement (Malaysia)

94/045 Shelf-life extension by molecular transformation of papaya and mango (Philippines and Malaysia)

99/040 Postharvest evaluation of pineapples genetically engineered for resistance to blackheart (Malaysia) (phase 1)

2) Postharvest systems improvement (PHT Outcomes 2 & 4)

Projects

94/037 Grain drying in China (China)

93/877 Low-cost disinfestation systems (Thailand, Vietnam)

95/136 Cocoa fermentation, drying and quality evaluation (Papua New Guinea)

Small projects

97/131 Computer-aided learning to improve grain store pest management (co-funded under AusAID APEC) (Vietnam; Philippines; Indonesia)

97/161 Market based analysis of constraints to banana industry development (Indonesia) (phase 4)

97/065 Development of a spouted bed dryer as part of a two-stage drying strategy for grain (Vietnam)

3) Pests & disease control (PHT Outcome 2)

Projects

94/015 Phosphine resistance in stored grain pests (China, India)

95/134 *Phytophthora* in durian (Thailand/Vietnam)

97/094 *Fruit resistance to disease (Sri Lanka, Indonesia) (phase 1)*

Small projects

96/152 Postharvest diseases in melons (China)

96/193 *Phytophthora in Southeast Asia (ASEAN) (phase 4)*

4) Contaminant risks and environmental impact (PHT Outcomes 3 & 5)

Projects

94/009 *Replacement of methyl bromide for timber fumigation (Malaysia; PNG) (phase 1)*

96/004 Reducing mycotoxins in pesticide residues in food (Vietnam)

98/137 *Enhancing the efficacy of phosphine fumigation (China, Vietnam) (phase 1)*

Some project highlights

- PHT/1994/15 — This project has characterised the extent and types of phosphine-resistance present in stored grain insects in Australia, China, and India. The information collected is vital to the storage industries in all three countries since it allows the possibility of continued safe and effective use of phosphine, a fumigant on which they are heavily reliant.
- PHT/1994/16 — This project has identified optimal storage conditions for a range of leafy vegetables grown in China and developed relatively simple strategies to reduce the often massive postharvest losses encountered there.
- PHT/1996/152 — Losses of melons during transport from inland growing areas in China to far-distant markets can be very high. This small project has identified treatments that may significantly reduce these losses. It has also demonstrated the potential of some biological agents for control of postharvest diseases in melons, but further research is required.
- PHT/1994/037 — This project is tackling difficult grain drying problems in both northern and southern China. In the north, it has demonstrated that the use of ambient air aeration to dry frozen, stored maize is technically and economically feasible. ■

Storage pest management workshop in Vietnam

A training workshop in grain storage pest management was held in Ho Chi Minh City on 15–17 November 1999. There were 26 participants, who came from throughout the country; from government departments, universities, research organisations, and the grain industry. Most of the course was conducted in Vietnamese.

This was the second such in-country workshop run as part of ACIAR project PHT/97/131, "Computer-assisted learning as a tool to improve grain storage pest management in key ASEAN countries". The project, which is funded jointly by ACIAR and AusAID/APEC, is developing a multilingual multimedia tutorial system to teach the concepts and techniques of grain storage management.

The software package devised in the project has two parts: a tutorial system covering grain drying, control of moulds and mycotoxins, use of carbon dioxide in controlled atmosphere storage, and integrated commodity management; and a reference system providing information on grain pests, insect ecology, insecticides, the influence of temperature, and fumigation techniques. Fundamental principles of physical methods, definitions and glossaries, databases, pest identification keys, demonstrations of laboratory techniques, and computer simulations aiming at optimising management of a grain depot are part of the program.

Participants and trainers in the Vietnam grain storage pest management workshop.

Since the package is destined for not only formal teaching but also distance education, the developers have included a large number of pictures, sound-tracked videos, and extensive cross-referencing. The full versions of the tutorial and reference systems are in English. There are three bilingual versions: English–Indonesian, English–Vietnamese, and English–Thai. A fourth version, produced for the Philippines, is in English only, but includes chapters specific to that country. All versions are available on CD-ROM. At the end of training courses the participants are issued with the appropriate version for further practice and for use as a teaching tool.

The training workshop in Vietnam was conducted at the headquarters of the Post-Harvest Technology Institute (PHTI), Ho Chi Minh City Branch. It included formal classes, directed by a trainer, on the different parts of the package. These were followed by hands-on sessions in which the individual participants practised the use of the software, interacting with other participants. In these sessions the trainer intervened only as required.

The three-day course comprised two days in class, mostly with computers, and a third day in a grain store for a practical session on fumigation and controlled atmosphere storage.

The teaching staff were an international team comprised of those who developed the content of the program and those who translated it into the local language. They included: Dr Le Van To and Dr Gang Vu Hong Mien (PHTI), Mr Nguyen Huu Dat (Plant Protection Department, Southern Regional Plant Quarantine Service), and Dr Phan Hieu Hien (University of Agriculture and Forestry, Ho Chi Minh City); the Australian collaborators Dr Barry Longstaff and Mr Jan van Graver (CSIRO Australia) and Dr George Srzednicki (University of New South Wales); and Dr Hariyadi Halid from BULOG Indonesia. Dr Halid provided the benefit of his experience of the first workshop conducted in Bogor, Indonesia in March 1999 (see *PH Newsletter* No. 49). ■

Participants during a hands-on training session with computers.

Mr Nguyen Huu Dat explaining the insect identification keys

Delivering research results...from page 4.

Cross-program, multidisciplinary training is a more recent delivery mode whose current priorities include scientific writing in English, experimental design, priority setting, and laboratory and biotechnology techniques.

Linkages between project teams can provide opportunities for training. In PHT/1995/134 (Management of phytophthora diseases in durian), for example, project members from the Southern Fruit Research Institute (SOFRI) in Vietnam, a relatively new institute, will travel to and be trained with the project team in Kasetsart University, Bangkok. This suggests a productive new paradigm for linkages between project teams.

The only link between training and the GST in the context of this report is that it was ACIAR's other Deputy Director (Corporate Programs), Mr Michael Brown, who addressed the meeting about the likely impacts on ACIAR projects of the goods and services tax (GST), a value-added tax to be levied in Australia from 1 July 2000. It was Mr Brown's view that the impact on funding would be minimal, primarily because any GST payable on R&D-associated activities can be reclaimed. Therefore, there should be no need, when estimating and applying for project funds, to make any adjustments for the tax. There are two confounding factors, however: (1) the time between payment of the tax and its recovery during which those funds are not available; and (2) the compliance costs of collecting, paying, and recovering the tax. What will be the degree of influence of these two factors is currently a topic of intense debate. The GST will not apply when funds are sent overseas. ■

ACIAR–China cooperation in grains postharvest research

*Li Fujun**
Vice Director of Section, Department of Storage, State Administration of Grain Reserve, China

Both China and Australia are significant grain-producing countries, with outputs each year of about 490 million t and 30 million t, respectively. China is one of the main grain reserve countries of the world and imports large amounts of grain each year, including in some years a significant tonnage of wheat from Australia. At present, China has over 250 million t of grain stored in its state grain depots. In addition, over 100 million t is stored on farms.

A large industry has been created to deal with the storage, transportation, processing, and marketing of this vast amount of stored grain, however—especially in the areas of safe storage and good quality maintenance—this industry faces a series of difficulties.

To study and resolve these problems, the governments and research institutions of China and Australia have had an extremely beneficial cooperative relationship. In particular, there has been great success from the 10 years of cooperative research between China and the Australian Centre for International Agricultural Research.

For example, the results of Project PHT/1990/035—which concerned integrating protectants into storage pest management—have led to a series of practical applications in China. The efficacy of pesticides against pests has risen, and the dosages used and pesticide residues have dropped greatly, through the use of two mixed protectants. Now the mixed protectant has been applied in 15 provinces, treating 1.2 million t of stored grain per year. Through this project, three CD-ROMs have been developed: the Grain Pest Management Expert System (GMES); the Stored Grain Encyclopaedia; and the Grain Pest Identification and Control (GPIC) package. In addition, there is great interest in them from the many managers and technicians involved with stored grain.

The results of Project PHT/1994/015—on phosphine resistance in insect pests of stored grain—indicate that the problem of resistance of stored grain pests to phosphine is very serious in China. In many areas of southern China, phosphine resistance has caused grain to be fumigated with phosphine two or more times. For this reason, the Chinese Government has decided that the phosphine recirculation method should be installed in new stores, in order to increase the effectiveness of phosphine fumigation in controlling resistant pests. The importance of gastightness in the construction of new storehouses has also been stressed.

The project on grain drying in stores (Project PHT/1994/037) is in progress in northern and southern China. The primary results of the study indicate that it is technically feasible that paddy rice and maize, with high moisture content, can be dried in store.

Current challenges in the Chinese grain postharvest area

As already mentioned, today China faces many pressures and difficulties in the grains postharvest area.

Firstly, how can we store over 250 million t of grain safely? We have three difficulties in this area:

1. Lack of grain storage capacity. The Chinese Central Government has attached great importance to this problem and has invested a great amount to construct new grain storehouses with a capacity of 25 million t since 1998. However, even these new storehouses are already completely filled, so the lack of storage is not completely resolved and some grain still has to be stored in the open.
2. Lack of successful experience with the new technology used in the new storehouses—which include squat silos of total capacity 5 million t, and other designs such as large horizontal warehouses.
3. Lack of new fumigants to use on stored grain. Today, the major method used to control stored grain pests is fumigation, with the fumigants being phosphine and methyl bromide. However, use of methyl bromide is being phased out in China as elsewhere. As noted earlier, the resistance of stored grain pests to phosphine is a very serious problem today because of poor gastightness of stores, improper fumigation operations, and the inefficient method of using phosphine in China. Pest management is one of the most serious threats to safe storage, but alternatives to phosphine and methyl bromide are in short supply worldwide.

Secondly, how can we retain or improve the quality of so much stored grain? Some people may ask—why does China store so much grain? The reasons stem from Chinese grain policy, the grain market, and the price of grain in China and internationally. However, these reasons overlook the poor or deteriorated grain quality which results from long-term storage, and which is not well received by consumers. The Chinese Government has given a great deal of attention to this issue and has heeded pressure to develop better quality grain varieties, as well as, for example, limiting the production of some poor quality grain varieties. The Government emphasises that grain industry products must be of good quality and market value, and that the different varieties must be stored, processed, and marketed separately. In this way, we have begun to modify practices and establish new national quality standards for good quality paddy rice, wheat, and maize. At the same time, we need to continue to examine new ways to maintain and modify grain quality.

Thirdly, a huge amount of stored grain losses occur on farms—at a rate of 5–10%—because of poor storage and lack of appropriate technology. While the total quantity of grain stored on farms is extremely large, each farmer has only a small quantity and farms are characteristically widely spread, which makes the problem very difficult to overcome. There is an urgent need to study new methods that will reduce farm-stored grain losses and are suitable for use by farmers.

Fourthly, one major concern is how to satisfy our need for food in the 21st century while moving toward the "three high and three low" grain postharvest aim—that is, high quality, high nutrition, and high benefit, and low losses, low pollution, and low cost.

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* This is an edited transcript of a talk given by Mr Li during the ACIAR–China Consultation in Beijing in October 1999.

CONFERENCE REPORT

International conference on agricultural engineering

The main theme of an international conference ('99 ICAE) held to celebrate the 20th anniversary of the Chinese Society of Agricultural Engineering was "Innovation of Agricultural Technologies for the 21st Century".

The conference, organised by the China Agricultural University (CAU), was held in Beijing on 14–17 December 1999. Professor Wang Maohua was chairman of the organising committee. Professor Lu Ming, Vice-Minister of Agriculture, opened the conference.

Major sponsors included CAU, the Chinese Society of Agricultural Engineering, the International Commission of Agricultural Engineering, the Asian Association of Agricultural Engineering, the American Society of Agricultural Engineering, UNESCO, and a number of Chinese and international organisations.

The conference was held at Beijing Xijiao Hotel in the heart of Haidian district where several universities, including CAU, are located. This venue enabled interaction between conference participants and university people; some mini-workshops were held in the university compound.

Professor Cao Chongwen from China Agricultural University presenting his paper on impinging stream drying of grain

There were nearly 200 participants, the largest group from China but with representation from many other countries, including Australia, Canada, Chinese Taiwan, Germany, India, Iran, Israel, Japan, New Zealand, South Korea, Sri Lanka, Thailand, and the USA. Many postgraduate students, from several agricultural universities in China and elsewhere, presenting the results of their research.

There were five keynote sessions. The keynote speakers covered broad topics on the role and future of agricultural engineering, including:

- Agricultural and biological engineering: the place to be in the 21st century
- Challenges facing China's agriculture for 21st century and the historic mission of agricultural engineering
- Energy and environment for sustainable plant production
- Applications of soil mechanics principles in wet paddy field conditions
- An integrated system for the production of horticultural crops—the Chinese case-study
- On the role of agricultural engineering in China in the 21st century
- Strategies for sustainable agriculture development in Mongolia
- Farm mechanisation in China
- Capacity increase in crop harvesting
- Discussion on modern farm development

Concluded at foot of page 15.

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In summary, the main tasks that I think we face in the grains postharvest area are to:

1. study safe stored grain technology with regard to new types of storehouses;
2. resolve the problem of resistance to phosphine;
3. examine how to maintain and improve grain quality;
4. reduce the loss of farm-stored grain and increase the income of farmers; and
5. develop a suitable policy for the grain market in China.

Priorities for future cooperative research between China and ACIAR in the grain postharvest area

I put forward the following proposals for cooperative studies between China and ACIAR in the grain postharvest area:

1. The technology of integrated control of stored grain pests resistant to phosphine, including: investigating the nature of the resistance; extending the application of advanced technology and rules of operation, including gastight store technology; studying pesticide rotation and replacement technology; and emphasising that grain pest control must incorporate integrated pest management for resistant pests.
2. Maintaining and improving the quality of major grain and oil varieties in storage and processing, e.g. wheat, maize, paddy rice, soybean, oil and oilseed—especially focusing on technology for reducing moulds and retaining the quality of rapeseed in southern China, and controlling mycotoxins in northern China.
3. A complete technology package for farm-stored grain, incorporating cleaning, drying, and storage, and with emphasis on development of storage equipment and pesticides suitable for farm use, and including the development of science and technology extension activities for farmers. Low mammalian toxicity protectants, such as inert dusts, could also be studied.
4. Methods and technology to replace methyl bromide in stored grain pest control. According to the Montreal Protocol Agreement, China must eventually phase out the use of methyl bromide. Hence, finding an alternative to methyl bromide, and appropriate application technology, is very important—for example, Australia is studying carbonyl disulfide (CS_2), carbonyl sulfide (COS), and ethyl formate. Likewise, China needs to be involved in such studies for new protectants or other new pest control technology.
5. Chinese grain policy and market rules and the effect on future grain trade between China and Australia after China enters the World Trade Organization.
6. Strengthening training on stored grain management and postharvest technology, especially for the technology involved in large, high warehouses and squat silos. A large number of people will need to be trained for the study and operation of good management methods and technology. ■

(L–R) Dr Wee Chong Wong of Quality Technologies International, Australia; Professor Helen Nair of the University of Malaya; and Professor Ahmed Ait-Oubahou of the Institut Agronomique et Vétérinaire Hassan II, Morocco.

An opening address by ACIAR Postharvest Technology Program manager Dr Greg Johnson was simultaneously translated into Vietnamese by the Centre's assistant country manager for Vietnam, Ms Ly Duong Huong.

CONFERENCE REPORT

Inaugural Asian–Australian drying conference

The First Asian–Australian Drying Conference (ADC '99) was held in Nusa Dua, Bali, Indonesia from 24–27 October 1999.

This international conference was the outcome of planning initiated by Professor Arun Mujumdar of McGill University, Montreal, Canada. Professor Mujumdar is well known to all involved in drying technology as the founder of the International Drying Symposia (IDS) some 20 years ago and as editor of the international journal *Drying Technology*.

Such a conference was needed primarily because of the very rapid development of drying technology in the region. It provided an excellent platform for exchange of scientific information between those involved in research on, and teaching of the discipline. Furthermore, there are specific interests, especially in the area of drying of agricultural produce, that have particular appeal to those working in the region. Last but not least, a regional conference was more accessible to scientists whose budgets still suffer from the consequences of the recent Asian economic crisis.

ADC '99 attracted scientists from Southeast and South Asia, Australia, Canada, Europe, and the USA. Seven keynote papers were presented by speakers from academe and industry. They covered areas such as innovative technologies and trends in research and development; models relating to freeze drying; design of heat pump dryers; solar drying; and environmental aspects related to drying. The topics of technical sessions included: fundamentals of drying; modelling, simulation, and optimisation; drying of materials, agricultural products, and pharmaceuticals; drying of ceramics, papers, and other products; solar drying; energy efficiency aspects of drying; freeze drying and spray drying; osmotic dehydration; drying equipment and control; and innovations in drying. Several posters on various aspects of research on drying were also presented.

Professor Somchart Soponronnarit (Thailand) receiving the Drying Technology award from Professor Arun Mujumdar (Canada).

The conference received financial support from the Indonesian Ministry of Education and Culture, the local government of Bali Province, the Canadian International Development Agency, and ACIAR, which sponsored the attendance of some regional participants.

For innovation, service to the profession, assistance to other drying researchers around the world, and substantial intellectual contributions in drying technology, three researchers in the field of drying technology—Professor Arun Mujumdar (McGill University, Canada), Professor Yasuyuki Sagara (Tokyo University, Japan), and Professor Somchart Soponronnarit (King Mongkut's University of Technology Thonburi, Thailand)—were honoured by the award of gold medals by the organising committee. Professor Soponronnarit also received an award for his work on the development and promotion of the fluidised bed dryer in Thailand and other countries of Southeast Asia, undertaken in an earlier ACIAR project (PHT/1990/008).

At the conclusion of the conference, Professor Wan Ramli bin Wan Daud, the Malaysian representative on the International Advisory Committee, proposed that his country organise the 2nd ADC in 2001 on the island of Langkawi. ■

IMAGES FROM THE 19TH ASEAN/1ST APEC SEMINAR ON POSTHARVEST TECHNOLOGY

Dr Shlomo Navarro (left) of the Agricultural Research Organization, Israel discusses rice quality with Mr Pyseth Meas and Ms Chang Theary from Cambodia.

Seminar convener Dr Le Van To, Director of the Post-Harvest Technology Institute, Ho Chi Minh City branch.

Ms Koh Siew Hua of Global Food Services, Malaysia tries her hand at a Vietnamese musical instrument. Ms Koh was responsible for the travel, accommodation, and other logistics for the attendance of seminar participants sponsored by ACIAR and AusAID.

Dr Phan Hieu Hien outlines the characteristics of an 8-tonne batch dryer for paddy installed at a Long An rice millers. This type of dryer, developed by his team at the University of Agriculture and Forestry, Ho Chi Minh City, is in widespread use in Vietnam.

Australian and Chinese members of ACIAR project PHT/1994/016 "Extending the shelf-life of leafy vegetables": (L–R) Mr John Bagshaw, Dr Amanda Able, Dr Tim O'Hare, Mr Lung Wong, Mr Shufang Zheng, Ms Wu Ping, and Mr Xianyang Wang.

The seminar field excursion included a visit to the Foster's Tien Giang Co. brewery.

Dr Jimmy Botella (ACIAR project PHT/1994/045) makes his presentation on Biotechnological approaches to control postharvest problems.

Mr Nguyen Duy Doc, Deputy Director of the Post-Harvest Technology Institute, Ho Chi Minh City, outlines some quality factors for export rice during a visit to the Long An Food Company by seminar participants.

Program Manager Greg Johnson, Edgar Cocker (Fiji) and Cliff Studman (New Zealand) relax during a Mekong boat trip.

The dragon fruit (centre) is much prized in Vietnam and the subject of research to develop postharvest handling technology.

Ms Marie Piccone (standing left) and Mr Colin Bunt (standing centre) of Piccone PHT, Australia open their seminar workshop on fruit quality systems.

Packaging for quality produce

Packaging will be the topic for the 10th Silsoe postharvest convention, to be held on 22 March 2000 at Silsoe College, Cranfield University, UK. The university is organising the convention in conjunction with the Association of Applied Biologists and the Institution of Agricultural Engineers.

A promotional leaflet on the convention says that it will bring together the interests of industry and research groups. Presentations will cover exciting new advances in technology as well as other issues challenging industry, such as legislation, environmental concerns, and marketing trends.

The draft program includes papers on:

- Key issues in the packaging industry
- Novel MAP for fresh, prepared fruit and vegetable products
- Forces in packages
- Fresh produce packaging
- Packaging as a marketing tool
- Packaging legislation.

Inquiries and requests for further information should be directed to:

Mrs Linda Chapman,
Marketing, Food and Postharvest Group
Cranfield University at Silsoe
Bedford, MK45 4DT
Fax: +44 01525 863 277
Email: <L.Chapman@cranfield.ac.uk>.

International Rice Research Conference 2000

The latest breakthroughs in rice research will be discussed by some of the world's leading agricultural scientists at an international conference to be held in the Philippines.

The International Rice Research Conference (IRRC), organised by the International Rice Research Institute (IRRI), will focus on efforts to ensure food security and alleviate poverty during the first quarter of the 21st century.

More than 200 scientists, researchers, and policymakers from around the world are expected to attend the meeting. The key issues they will discuss include increasing yield potential, exploiting hybrid vigour, stress tolerance, host-plant resistance, integrated nutrient and pest management, and the impact of technology on food security and poverty alleviation.

The IRRC 2000 will be held at the Institute's headquarters in Los Baños from 31 March to 3 April in conjunction with IRRI's 40th anniversary celebrations.

Dr Ronald P. Cantrell, the Institute's Director General, said the IRRC 2000 reflected IRRI's commitment to increasing total food production through research while protecting the environment and sustaining natural resources.

IRRI is working with its partners to try and ensure that farmers can produce 40–50% more rice to meet expected consumer demand in 2025, but with a need to use less land, less water, less labour, and fewer chemicals.

For further information contact:

Sylvia Oliver-Inciong
Public Awareness Manager
International Rice Research Institute
P.O. Box 933
1099 Manila, Philippines
Fax: (63-2) 891-1292; (63-2) 845-0606
Email: S.INCIONG@CGIAR.ORG

Engineering in agriculture

A conference on engineering in agriculture, "SEAg 2000 Growing Links", will be held in Adelaide, South Australia on 2–5 April 2000.

The Society for Engineering in Agriculture (SEAg), which is organising the conference, has invited papers on the following topics, several of which will be of interest to postharvest people:

- Agricultural waste management, energy and sustainability
- Agroforestry
- Automation and electrical technologies
- Biosystems engineering and environmental engineering
- Bulk storage and handling systems
- Ergonomics
- Food handling and processing
- Information and engineering technologies
- Power and machinery
- Precision farming systems and modelling
- Soil and water
- Structures and environments
- Tillage systems and soil dynamics

More details on this conference can be found at <www.adelaide.edu.au/SEAgconf/seagconf.html>,

or obtained from:

SEAg 2000
c/- Agricultural Machinery Research and Design Centre
University of South Australia
The Levels Campus
Mawson Lakes
South Australia 5095
email: <seagconf@adelaide.edu.au>.

7th ASEAN Food Conference

This conference will be held in Manila, Philippines on 20–22 November 2000. It will explore the theme "ASEAN Food Science and Technology: Moving Towards the New Millenium" through plenary presentations and discussions, short courses, trade exhibitions, and social gatherings.

Several workshops will be held as part of the program. Tentative topics for these include: food safety; food processing and the environment; processing and packaging technologies; postharvest technologies; and food analysis and testing.

For further information contact:

Secretariat
7th ASEAN Food Conference 2000
Fax +63 2 837 3167
Email <nea@sun1.dost.gov.ph>
(attn: Engr. José G. Bautista III). ■

See also details of P*h*Action seminar on page 14.

Computer-mediated distance learning

To improve access for students to international training courses on postharvest issues, the U.K. Natural Resources Institute (NRI) has recently developed two of its long-established postgraduate training programs into computer-mediated, distance-learning formats.

Students are now able to "attend" the postgraduate diploma (PGDip)/ master of science (MSc) programs from their own office/home via the World Wide Web, avoiding the need for students to have to leave their work for extended periods, and cutting the costs of obtaining university validated, postgraduate training. One of the units from the Grain Storage Management PGDip/MSc program was recently very successfully piloted with a Ghanaian student currently based in Japan.

Traditional in-attendance programs, where the student visits the host organisation, still provide a very effective method of training. By introducing a variety of methods of teaching, the "student experience" on in-attendance courses has been greatly improved—the inclusion of case studies, syndicate work, laboratory practicals, field visits, and appropriate individual project assignments can provide a fulfilling learning experience. Students also benefit greatly from having met fellow professionals from other organisations/countries/continents. However, the major disadvantages of attending such programs are that the student has to leave their work place and their family, and that such courses can be relatively expensive.

Paper-based distance-learning programs, where correspondence between student and tutor is by post, have been available for many years. Unfortunately, however, such learning can be an extremely lonely experience, apart from occasional short in-attendance sessions which may be built into some programs.

The recent development of computer-mediated distance-learning (CMDL) methods of study, combined with the dramatic growth of the World Wide Web, has opened-up many possibilities for training. NRI therefore decided to develop the **Grain Storage Management PGDip/MSc** and **Post Harvest Horticulture PGDip/MSc** programs it runs within the University of Greenwich into CMDL modes.

So what does CMDL involve? On beginning their studies, students are provided with detailed technical manuals, together with videos, CDs, pamphlets and posters. Students log on to the university's "On-Line Campus" where they can access a training room and a resource centre. They are then in weekly or even daily contact across the Internet with their tutors, who set activities to be tackled either individually or in groups. Completed activities may be displayed in the virtual classroom for peer review or sent direct to the tutor. So it is possible that a student in Zimbabwe will be working together with one in Jamaica and another in, say, Indonesia, to complete an activity by exchanging ideas and points of view on the best approach to tackling multidisciplinary storage problems.

CDML has few drawbacks. It is true that students do not get to meet either the tutors or other students: nevertheless, a close rapport is soon established. As in the in-attendance programs, discussion is encouraged. Although the number and scale of practical sessions possible is limited, creative thinking in developing practical exercises that can be performed at home has minimised this limitation.

Our experiences from the pilot trial have demonstrated the need to be mindful of time constraints and not to set too many activities. Also, the healthy discussion generated by activities may continue for a considerable time. With this in mind we have reviewed the number of activities in each course, and have decided that a strict timetable of activities is necessary so that the next one starts at a set time even if the previous one is still being discussed.

Comments from a student attending the pilot trial give us extra confidence about the validity of the CMDL approach to learning: "Although there is a considerable distance between me and my lecturers, our activities in the virtual classroom are not different to those encountered in traditional classrooms ... lecturers devote their time responding to problems of interest to me. The course manuals, brochures and videos are an invaluable source of information for the student as a future professional in grain storage management".

CMDL thus provides an exciting way of delivering an existing program in an alternative way, meeting the training needs of a greater proportion of the profession. Given the success of the pilot run, we look forward to expanding the scope of CMDL training offered by NRI. One example is the development of a specialist professional short course in Pest Management for Tropical Grain Storage (due to run for the first time around April–May 2000), derived from selected components of the Grain Storage Management program. ■

Schedule of **Grain Storage Management PGDip/MSc** and **Post Harvest Horticulture PGDip/MSc** programs offered by NRI in 2000:

Attendance courses:

PGDip	13 March to 30 June 2000
MSc	3 July 2000 onwards

CMDL courses:

PGDip	7 February 2000
MSc	to follow

NRI also offers an MSc in Natural Resources (in-attendance only), as well as other professional short courses.

For more details on CMDL programs or any other training-related issue, please contact:

The Training Support Unit
Natural Resources Institute
Chatham Maritime
Kent ME4 4TB, UK
Telephone: +44 (0)1634 883448 or 883095
Fax: +44 (0)1634 883386
Email: <nri-training@gre.ac.uk>
Web site: <http://www.nri.org/Training/>

REVIEW

Mycotoxins — a global menace

Many researchers and health workers believe that the single most effective and beneficial change which could be made in human diets around the world would be the elimination of mycotoxins from food.

Mycotoxins occur globally in a wide variety of commodities and demand attention because of their serious effects on human and animal health. A comprehensive account on the occurrence and effects of these substances is provided in a recent paper by Professor Ray Coker of the University of Greenwich, UK*. This article by Dr Mary Webb of Arawang Communication Group summarises the main points of the paper, from a postharvest perspective

Mycotoxins are fungal metabolites which, when ingested, inhaled or absorbed through the skin, cause lowered performance, sickness or death in man or animals, including birds. An 'important' mycotoxin will have demonstrated its capacity to have a significant impact upon human health and animal productivity in a number of countries.

Significance

Mycotoxins occur in a wide variety of foods and feeds, and have been implicated in a range of human and animal diseases. Exposure to mycotoxins can produce both chronic and acute toxicities ranging from deleterious effects on the central nervous, cardiovascular and pulmonary systems, and the alimentary tract, to death. Mycotoxins are variously carcinogenic, mutagenic, teratogenic, and immunosuppressive. The ability of some mycotoxins to compromise the immune response, and, consequently, to reduce resistance to infectious disease is now widely considered to be their most important effect.

Consequently, contamination by mycotoxins can cause significant economic losses and has had a significant effect on the international trade of important foods and feeds.

* Coker, R. 1999. Mycotoxins—the silent threat to human and animal health. Chatham, Kent, University of Greenwich, 52p.

Trade restrictions have the greatest effect on developing nations which can least afford to upgrade postharvest handling of their commodities to reduce contamination. Poorer people also suffer through having less choice about consumption of more badly affected products, while those who are economically better off can afford to pay for commodities with acceptably low levels of mycotoxin.

Occurrence

The moulds (fungi) which produce these toxins occur throughout the world. Moulds can grow over a wide range of temperatures and, in general, the rate of mould growth will increase with increasing temperative and available water. Maize, for example, can be relatively safely stored for 1 year at a moisture level of 15% and a temperature of 15°C, but the same maize stored at 30°C will be substantially damaged by moulds within 3 months. The main factors which influence the production of mycotoxins are water activity and temperature, but damage by insects and mites, the presence of broken kernels, the composition of the storage atmosphere, etc. also play a part.

Classification

In his paper, Professor Coker examines in detail the various classes of mycotoxins that have been described, the conditions under which they flourish, their geographical distribution and their known toxic effects on animals and humans. Though only a few examples are given here, they highlight the global scope and severity of the mycotoxin problem.

The aflatoxins

The aflatoxin-producing moulds (*Aspergillus* spp.) occur widely in subtropical and tropical climates throughout the world. The aflatoxins may be produced both before and after harvest on many foods and feeds, especially oilseeds, edible nuts, and cereals. They affect all manner of livestock, both acutely (i.e. causing death) and chronically (low level ingestion) as expressed through reduced feed efficiency, poor growth rates, decreased disease resistance, and increased vaccination failure.

Aflatoxin B_1 is one of the most potent human hepatocarcinogens known. Human fatalities have also occurred from acute aflatoxin poisoning. In India in 1974, for example, unseasonal rains and a scarcity of food prompted the consumption of heavily contaminated maize, leading to many deaths.

The trichothecenes

This group of toxins is produced by *Fusarium* moulds. One of these, T-2 toxin, is produced on cereals in many parts of the world and is particularly associated with prolonged wet weather at harvest. It is the probable cause of "alimentary toxic aleukia", a disease which affected thousands of people in Siberia during World War II, leading to the demise of entire villages. Symptoms included fever, vomiting, acute inflammation of the alimentary tract and a variety of blood abnormalities. T-2 toxin is responsible for outbreaks of haemorrhagic disease in animals and causes oral lesions and neurotoxic effects in poultry.

Deoxynivalenol (DON) is probably the most widely occurring *Fusarium* mycotoxin, contaminating a variety of cereals, especially maize and wheat. Low concentrations of DON commonly occur in grains in North America, Japan, and Europe, whereas higher levels may occur, intermittently, in some developing countries. Outbreaks of emetic (and feed refusal) syndromes amongst livestock, caused by the presence of DON in feeds, have led to it being given the common name "vomitoxin".

The ingestion of DON has caused outbreaks of acute human mycotoxicoses in India, China, and Japan. The Chinese outbreak, in 1984–85, was caused by mouldy maize and wheat—symptoms occurred within 5–30 minutes of consumption and included nausea, vomiting, abdominal pain, diarrhoea, dizziness, and headache.

Co-occurrence of mycotoxins can affect both the level of mycotoxin production and the toxicity of the contaminated material. The production of the aflatoxins in stored grains, for example, may be enhanced by the presence of trichothecenes, whereas the toxicology of naturally occurring combinations of trichothecene mycotoxins in experimental animals has been reported to be influenced by synergistic interactions. Unfortunately, very little is yet known about this particularly important area of mycotoxicology.

Continued on next page.

Mycotoxins...from page 12.

Intervention

The interventions most likely to be employed may be considered in terms of three interacting subsystems: (i) prevention; (ii) identification and segregation of contaminated material; and (iii) detoxification. Whatever approach is taken, to be successful it will need to be pursued by multidisciplinary investigative teams drawing on a range of technical, socioeconomic, and analytical data.

The following case study illustrates the success of such a "team approach". Philippine copra exports to the European Union were under threat because of unacceptably high aflatoxin levels. Investigation found that contamination was principally occurring on-farm or at the first buyer in the marketing chain, during the first two weeks after splitting open the coconut. Monthly samples of Tapahan-dried (smoke-dried) and sun-dried copra showed that aflatoxin levels in the latter were almost ten times those in the former. Farmers could readily benefit from this finding by changing to use of Tapahan dryers, and since these are cheap to build and maintain there was no impediment to their adoption.

It was also indicated that copra dried to 10% moisture content (by any means) could be safely stored for two months. This knowledge initially created a problem, as farmers had a strong *dis*incentive to produce good quality copra with this moisture level. The 'farm-gate' price for copra assumed a 20–25% moisture content, so the drier the product, the less it will weigh, and therefore the lower the return the farmer would receive for his crop. Consequently, a revised Copra Classification was developed, which aimed to provide an incentive to farmers to produce good quality (low moisture) copra at the first buyer stage.

Prevention of contamination

Obviously, as we cannot control the weather, it is very difficult to control a commodity's environment in the preharvest period. Both insufficient and excessive rainfall during critical phases of crop development can lead to mould contamination and mycotoxin production. The very substantial economic losses attributed to mycotoxins in North America clearly demonstrates the difficulties, even in developed nations.

After harvest, it is important that the crop be dried to a "safe" moisture level (which will not support the production of moulds and mycotoxins) as quickly as possible. This is comparatively easy for farmers in the developed world who can afford to mechanically dry their crop and control the temperature during storage through refrigeration, but the resource-poor farmer will still be at the mercy of the prevailing climatic conditions—hoping for no rain and plenty of sun and wind.

Attempts have been made to prevent mycotoxin contamination by: (a) breeding for resistance to moulds; and (b) "biocontrol" through the introduction of atoxigenic strains of fungi that will out-compete the toxic strains. Both strategies require further research to become commercially available (for the former) or fully assessed as safe (for the latter).

Identification

Contaminated material must be identified via sampling and analysis. An integrated approach using chemical, immunochemical, and bioassay methods is ideal.

Taking representative samples can prove quite difficult in some cases, particularly in large sack storages etc. If a large number of samples is to be analysed, an automated procedure such as high performance liquid chromatography (HPLC) will be advantageous. Such methods offer the advantage of high sample throughput, accuracy and precision, but require the purchase of expensive equipment—justifiable for a busy quality control or research laboratory, but not for situations in which analysis takes place only intermittently or on a small scale, or in resource-poor countries.

Methods must be available which are simple to perform by relatively unskilled operators and require cheap, unsophisticated equipment. Collaborative work at the Natural Resources Institute (NRI) has resulted in the development of a relatively sophisticated method for the determination of mycotoxins, which can be applied in developing country laboratories. The method utilises solid phase extraction to clean up the crude sample extract, followed by the quantification of the mycotoxin by high performance thin-layer chromatography (HPTLC).

Immunochemical technology (e.g. enzyme-linked immunosorbent assay—ELISA) has also been used in the production of proprietary test kits for the rapid analysis of samples of foods and feeds. A challenge is to overcome the instability of some antibody preparations under high ambient temperatures.

Bioassays for the detection of mycotoxins can be defined as tests on biological systems designed primarily to confirm the presence of biologically active compounds, the identity and concentration of which can then be determined by chemical analysis. Development of a bioassay requires the choice of a sensitive biological indicator (such as a yeast) and the establishment of a dose-response relationship. Other biological techniques under development are a biosensor for the determination of mycotoxins and a gene probe for the detection of aflatoxigenic moulds.

Detoxification

The chemical detoxification of contaminated feeds has a major role to play in the prevention of economic loss and human disease. Although the use of ammonia has been very widely investigated and commercially exploited, the use of ammoniated commodities as animal feeds has not been widely accepted. This acceptance will not be forthcoming until general agreement has been reached on the toxicological implications of ammoniation.

Research goals

Professor Coker believes that it is essential that developed nations work in partnership with developing nations in order to reduce the levels of mycotoxin contamination to an acceptable level. Toward this goal, work should continue towards: a better understanding of the aetiology of mould and mycotoxin production in the field, the metabolism and toxicity of mycotoxins in animals and humans, and the role of mycotoxins in the epidemiology of human disease; the development of measures to prevent contamination (including drying and storage methods) which can be utilised by resource-poor communities in climatically challenged environments; the development of mould and/or mycotoxin–resistant crop varieties; and the identification of detoxification procedures which deliver a "safe" product. ■

Further reading

Champ, B.R. et al., ed. 1991. Fungi and mycotoxins in stored products. ACIAR Proceedings No. 36, 270 p.

GASGA 1997. Mycotoxins in grain. GASGA Technical Leaflet No. 3, 12 p. [Available from CTA, Postbus 380, 6700 AJ Wageningen, The Netherlands.]

Dietzgen, R.G., ed. 1999. Elimination of aflatoxin contamination in peanut. ACIAR Proceedings No. 89, 98 p.

BOOK REVIEW

Drying and storage of cereal grains*

The thirteen chapters of this book cover aspects of grain storage in varying degrees of detail. Other texts cover the same area, but here the grain bin is reviewed in a novel way in the context of the total grain system.

All aspects, from engineering, simulation, and mechanisms of deterioration, are covered. The overall style of writing is clear and easy to comprehend. The problems set at the end of the chapters are well chosen and useful.

Bala starts by introducing grain storage and drying in its postharvest context, defining various types of product loss. In chapter 2, grain equilibrium moisture properties are defined, and techniques given for measuring them. This section is excellent and thorough, with salt solution properties, measurement methods, theory, and simple models explained well. The Chung–Pfost model has been successful for grains and is described here, but the Guggenheim–Anderson–deBoer model, which is arguably the best theoretical model currently available, is not mentioned.

Next, components of theory required for drying simulation are described (chapters 3–6). Psychrometrics is covered in depth, in a similar fashion to other grain storage texts. The thermophysical property analysis is not covered uniformly, with the section on Schumann's equations in disproportionate depth to its importance. The analysis here is limited by assumptions of constant properties (such as moisture). The chapter on fans and airflow is again of good depth, although practical application is not strong (the theory presented is designed for flow computation rather than in-field estimates), and does not present new information. Nevertheless, concepts are explained well. Finally, thin-layer drying is presented. This section is thorough, with the only criticism being that the author supports the concept of dynamic moisture content, the theory of which I find to be misleading.

This prepares the ground for the deep-bed drying models. This section is disappointing, as it lacks substance and tends to spend excessive time on dated models such as the logarithmic (Hukill) model. More information on current theoretical modelling would have improved this chapter. Also, the treatment is not logical and systematic, but tends to switch from topic to topic. The approach to partial differential equations (such as the thermal equilibrium model of Thomson) needs polishing for the next edition; for example, the wave equation approach, despite the important concepts it teaches (Banks, Sutherland etc.), is not mentioned. However, there is good coverage (using Bakker-Arkema's method) of different flow directions, as well as fluidised-bed drying. Short programs to demonstrate each type of drying are listed in the chapter.

Grain drying systems are dealt with in variable depth. Solar drying systems are covered well, batch systems in little detail (but then these are well treated by other grain storage texts), only a few examples of continuous dryers are given, and limits on drying systems are covered well. No models of limits (for example fungal growth models) are given. The following chapters give more depth on these limits: deterioration and migration principles; migration of heat and moisture; and various storage pests. The basic material is covered better in other texts, but the section on radial heat flow is both simple and useful.

The last two chapters cover design and construction of grain stores, and are well-written with pressure analysis, several stress models, and good examples of bin layouts and controlled atmosphere stores.

The first two appendixes (maths analyses) could be dropped—psychrometric charts would have been more useful.

Overall the book would sit easily on the shelf of a storage engineer as an introductory reference in this area, and would be useful in teaching. Despite being variable in quality, it is interesting and readable.

Robert Driscoll
Department of Food Science and Technology
University of New South Wales, Sydney ■

* Bala, B.K. 1997. Drying and Storage of Cereal Grains. New Delhi, Oxford and IBH Publishing Co., 302 p.

FORTHCOMING P*h*ACTION SEMINAR

Linking farmers to markets

A one-day international symposium on this topic is being organised by P*h*Action, the new global post-harvest forum (see Box below).

The symposium will explore postharvest systems as the link between farmers and markets, and their significance for sustainable development and safe food supply in rural and urban areas. It will be held at the headquarters of Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Eschborn, Germany on 7 June 2000.

The contact for further information about the symposium is Dr C. Henckes at GTZ; email: <christian.henckes@gtz.de>.

About P*h*Action ...

P*h*Action is an expansion of the former Group for Assistance on Systems relating to Grain After-harvest (GASGA). It was established in June 1999 at a meeting of 10 national and international research and development organisations: ACIAR; Centro Internacional de Agricultura Tropical (CIAT); International Potato Centre (CIP); Centre de Co-operation Internationale en Recherche Agronomique pour le Developpement (CIRAD); FAO; Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ); International Food Policy Research Institute (IFPRI); International Institute of Tropical Agriculture (IITA); International Rice Research Institute (IRRI); and Natural Resources Institute (NRI).

The vision of P*h*Action is that development of sustainable and efficient postharvest systems is a *key action* to improve the livelihoods of rural communities and to secure access to safe food supplies for all.

Its objective is to raise the profile of post-harvest research and development and accomplish greater impact in the postharvest sector.

For more information contact the Joint Secretariat: Mr A. Bell, GTZ <albert.bell@gtz.de>; or Dr R.J. Hodges, <R.J.Hodges@gre.ac.uk>. ■

PROJECT NEWS

Genetic engineering of papaya and mango

During a recent visit to Malaysia, Dr José Botella, head of the University of Queensland's Plant Genetic Engineering Laboratory, and Mexican scientist, Dr Andres Cruz-Hernandez, his senior research assistant, met with their collaborators in project PHT/1994/045 "Control of ripening in papaya and mango by genetic engineering".

Like many other tropical fruits, papaya have several postharvest problems that account for significant losses every year. The project aims to improve the postharvest characteristics of papaya fruits currently limiting domestic and export markets throughout the Southeast Asian region. It will also provide the foundations for plant tissue culture and transformation in mango. The primary focus will be the use of genetic engineering techniques to extend the life of these fruits.

It is not yet fully known what factors initiate or coordinate fruit ripening. Experiments on transgenic plants with reduced ethylene synthesis strongly link ethylene to fruit ripening and senescence in climacteric fruits, but its exact role and mode of action have yet to be determined. More research needs to be conducted into the activation of ripening genes, so that an understanding of how the individual processes are coordinated can be obtained.

Genetically engineered fruits with slower rates of ripening would have extended shelf lives beyond that of current cultivars. This would allow the fruit to be shipped further without spoilage, thus expanding the market. The quality of such fruit may also be enhanced since the fruit could remain longer on the tree before harvest. For example, papaya need to be picked late in the ripening process if the fruit is to develop maximal flavour. Genetically engineered fruits have generated much biotechnological interest, as their ripening characteristics will make them superior to current-day fruit.

This project brings together the complementary expertise and enthusiasm from five different groups, to the benefit of the Philippines, Malaysia, and Australia. The major outcomes of this project will be the production of Filipino, Malaysian, and Australian cultivars of papaya with better postharvest characteristics, the optimisation of a regeneration system for mango, the transfer of generic technology, and the development of a strong collaboration that will extend to the study of other tropical fruits. ■

Dr William Padolina (4th from left) , Secretary for Science and Technology in the Government of the Philippines with Dr Botella and PHT/1994/045 project staff at the Institute of Plant Breeding, Los Baños.

CURRENT AWARENESS

POSTHARVEST PUBLICATIONS

Food safety in the postharvest industry

Food safety in the postharvest industry was the subject of the 1999 postharvest convention at Silsoe College, Cranfield University, UK. The proceedings of the convention are published in *Postharvest News and Information* Volume 10, Number 3 (1999). A list of the papers in the proceedings follows.

- New structures, new customers and new strategies: implications for food safety, J.A. Giles
- Minimizing the risks: HACCP considerations in fresh cut produce, H. Cleather
- The application of Hazard Analysis Critical Control Point (HACCP) approach to the control of mycotoxins in foods and feeds, P. Wareing
- Environmental fate and uptake of pesticides in the food chain, C. Brown
- The response to allergenic contaminants in the storage of durables, J. Chambers and D.J. Pearson
- Diatomaceous earths as alternatives to organophosphorus (OP) pesticide treatments on stored grain in the UK, D.A. Cook, D.M. Armitage, and D.A. Collins
- Food contamination from human and organic waste, B. Pourkomailian
- Prospects for exploitation of natural disease resistance in harvested horticultural crops, D.C. Joyce and G.I. Johnson

NEWS

CGIAR TAC Chair appointed

Dr Ismail Serageldin, Chairman of the Consultative Group for International Agricultural Research (CGIAR), recently announced the appointment of Dr Emil Javier as Chair of the Group's Technical Advisory Committee (TAC) for a five-year term beginning on 1 January 2000.

Dr Javier received his Ph.D. in plant breeding at Cornell University, and has had a distinguished national and international career, with strong involvement in the CGIAR. He is naturally suited, Dr Serageldin said, to join the eminent line of TAC Chairs established by Sir John Crawford, and is particularly suited to provide the CGIAR with strategic advice and guidance as it confronts the challenges that lie ahead.

In the Philippines, Dr Javier has held a number of high-level positions including that of Minister of Science. ■

'99 ICAE...from page 7.

There were five technical sessions:

- Agricultural equipment and mechanisation engineering;
- Water resources utilisation and water saving irrigation technologies;
- Agricultural bio-environment and energy engineering;
- Post-harvest technologies and food processing engineering; and
- Information technology and precision farming.

The papers presented were published in a proceedings volume distributed to the participants at the time of registration. ■

CURRENT AWARENESS

NEWS

Award for fruit disinfestation researcher

Bob Corcoran, who is entomology sub-project leader in Project PHT/1993/877, "Low-cost disinfestation systems for fruit", is the leader of the postharvest disinfestation team in the Queensland Horticulture Institute which recently won an export support award in the annual State Premier's Awards for Export Achievement. The multidisciplinary team received the award for its development of quarantine disinfestation treatments that allowed export of Queensland horticultural products such as mangoes, tomatoes, capsicums, zucchini, and melons. Rod Jordan, leader of PHT/1993/877, was also on the team.

The award is a tribute too to the past efforts of Dr Neil Heather (now retired) who led the research team when Japan first approved the import of Australian mangoes.

Quarantine treatments are aimed primarily at fruit flies, which are considered the highest risk pests by importing countries. ACIAR has supported research on these pests through a number of projects in both its Crop Sciences and Postharvest Technology programs.

ACIAR appointment in India

Dr Kuhu Chatterjee has been appointed ACIAR Assistant Country Manager for South Asia, based in New Delhi. She will commence duties in January 2000.

Dr Chatterjee previously worked for the British Council, where she was a Development Projects Officer, Environment and Natural Resources for the past five years. She also has six years research experience in subtropical wetland ecology.

Food survey in China

"Most food products meet standards" was the headline of a recent article in the *China Daily* reporting on a nationwide food quality inspection by the Ministry of Health. Products inspected included flour, tea, instant noodles, purified water, ice cream, and "health goods". Some results quoted in the report follow:

- 137 of 146 brands of tea met state standards;
- 94% of 143 brands of instant noodles met standards;
- 83% of 156 kinds of purified water passed the test;
- 56 of 70 kinds of ice cream qualified.

Higher than permitted amounts of benzoyl peroxide were found in flours that failed the test. This compound is an additive to whiten flour and make the resulting dough more flexible. Its overuse destroys nutrients such as vitamins A, B, and E.

Survey data were collected in 15 provinces, autonomous regions, and municipalities. Ministry officials said it was planned to extend the survey to other parts of China.

Foodnet in Africa

The Foodnet project is a new type of regional agricultural research and development network focusing on market-orientated research and sales of value-added agricultural products. The project is a network of the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) and is funded by USAID.

The network has three main objectives and is seeking partnerships with a range of public and private sector partners to undertake market research and postharvest research, and to implement commercial agro-enterprise activities.

Activities in *market analysis* seek to promote the use of market information and methods for market analysis in agricultural research , in order to identify market opportunities or key constraints within the production-to-marketing chain.

Foodnet's *agro-enterprise development* program will work in collaboration with a range of public and private sector agents to catalyse and develop small to medium-scale agro-enterprises which add value to low value primary commodities.

Training and information exchange will assist in developing skills for implementing market-orientated research and in developing innovative methods for information exchange.

More information about the Foodnet project can be found at <http://www.cgiar.org/foodnet> or obtained from:

Foodnet
c/- Lambourn and Co.
26 Dingwall Road,
Croydon CR3 9EE, U.K.

New CIAT Director General and Board Chairman

The International Centre for Tropical Agriculture (CIAT), based in Colombia, has announced the appointment of Canadian anthropologist and research manager Dr Joachim Voss as its new Director General. Dr Voss is currently manager of the Research Division of Canada's International Development Research Centre (IDRC). His main responsibilities at IDRC are to organise and lead problem-focused, interdisciplinary teams working on natural resource management, the environment, and information and communications. He will take up the new position in April 2000. Dr Lauritz Holm-Nielsen has been elected Chairman of CIAT. ■

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.

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