Workshop Reports

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Future of fumigation technology and controlled atmospheres

Conveners: *Jonathan Banks* (Australia) and *Eli Shaaya* (Israel)

The workshop, which was attended by 92 Conference participants, was conducted on the basis of short presentations by invited speakers followed by discussion by participants Topics covered included:

1 Influence of time, temperature and concentration on phosphate effectiveness-Peter Annis (Australia);
2 Environmental levels of phosphine around fumigation-Stephen Pratt(Australia);
3. Siroflo® and Sirocirc™ technology-Bob Ryan (Australia);
4. Distribution of phosphine with carbon dioxide-Yigal Carmi (Israel);
5. Split application of phosphine-Cao Yang (China);
6. Phosphine at low temperatures-Chris Bell (UK);
7. Advances in phosphine recirculation-Ron Noyes (USA);
8. Alternatives to methyl bromide-Dave Mueller (USA);
9. New fumigants-Larry Zettler (USA);
10 Carbon disulfide-Ren Yong Lin (Australia);
11. Carbonyl sulfide-Tan Xian Chang (China).

There was extensive discussion on the time required for effective phosphine treatments, with opinions in the audience ranging from three days to over three weeks exposure It was noted that phosphine resistance was becoming widespread in warmer parts of the world and had reached such a high level in the Indian subcontinent that some strains were very difficult to kill with phosphine

Discussion on alternatives to methyl bromide highlighted promising new and 'old' fumigants and the regulations and practical barriers to their widespread use.

Development and application of diatomaceous earths

Conveners: *Paul Fields* (Canada) and *Bhadriraju Subramanyam* (USA)

The workshop was attended by 29 Conference participants.

We would like to thank the Conference Organizing Committee for giving us a time slot to hold this workshop to continue the tradition that started at the Canberra Conference.

The goal of the workshop was to provide participants with basic and applied knowledge on the use of diatomaceous earths in their respective countries There were six presentations.

Paul Fields outlined the advantages and limitations of diatomaceous earths. The advantages are that diatomaceous earth dusts have a place in stored product protection as suitable alternatives to currently used fumigants and protectants in some situations The limitations of importance are the reduction in bulk density of treated grain, and possible development of behavioural resistance.

Bhadriraju Subramanyam presented information on biological and environmental factors that must be considered in interpreting the efficacy of results

Zlatco Korunic described a quick method for screening effective and ineffective dusts

Barry Bridgeman presented information on how diatomaceous earth dusts can be integrated with fumigation and aeration techniques.

Jim Desmarchelier discussed health and safety issues especially concerning the crystalline silica, which is now classified as a human carcinogen. The use of diatomaceous earth slurries is one way to reduce worker exposure to these dusts and it is being used as such in Australia for structural and grain applications.

Finally, Flavio Lazzari outlined use of diatomaceous earths in Brazil

The presenters also submitted papers and posters in the general Conference program.

Recommendations for ongoing activities were agreed by on all present The specific areas where action is necessary is as follows:

1. Development of standardized techniques for evaluating formulations so that results can be compared.
2. Forming a group to work towards the goal of standardizing techniques.
3. Studies to generate more information on the efficacy of dusts on grain under a range of conditions.
4. Establishing a network for exchange of information Names and addresses of those interested in diatomaceous earths were obtained during the workshop.

The workshop did not agree that diatomaceous earth dusts should be termed pesticides. This was regarded as a matter of semantics decided mostly by regulators.

What went wrong? Common errors in stored-product research

Conveners: *Paul Fields* (Canada) and *David Armitage* (UK)

The workshop comprised a series of topics the highlights of

which were as follows.

Francis Fleurat-Lessard (France) reviewed progress since the 6th IWCSPP workshop on minimum standards for key research topics. Eight papers have been drafted but have not yet been published to date. One paper has been published in the *Journal of Stored Products research*.

Franklin Arthur (USA) discussed contact insecticides studies.

There are several physical and biological factors that should be considered whea-designing experiments with contact insecticides Failure to account for these factors can lead to problems when research papers are submitted to scientific journals. This is not an all-inclusive list, and there is no significance to the order in which these topics are listed.

1. Studies with protectants that involve a single insect introduction I have seen examples and papers in which commodities have been treated, placed into storage, and insects immediately introduced into the storage environment The commodity was sampled at regular intervals during storage, and if no insects were found, the insecticide was said to have given protection for the entire time. Repeated introductions of insects are necessary to make this claim.
2. Attempting to apply the results from one species. Insecticide, or commodity to other situations. This usually occurs in discussion sections when authors are trying to relate their findings to other studies. The susceptibility of a particular species is not consistent with insecticide or formulation, that is, one species can be more susceptible to another to a particular insecticide, yet the order can be reversed when tests are conducted with a different insecticide. Failure to account for this factor can lead to problems when manuscripts are reviewed.
3. Toxicological studies conducted in a single set of exposure conditions, with one species. The temperature at which bioassays are conducted could have an effect on the efficacy of the particular pesticides, also individual species can vary in their response. While all possible conditions cannot be tested in one experiment, it is becoming increasingly difficult to publish limited studies in major journals. Editors do not want studies that can be repeated time after time using different insects, exposure conditions, etc., and just changing a couple of lines in the method section. They prefer to see more detailed studies.
4. Any study that can be seen as 'preliminary data'. Such data are necessary in many instances to establish testing conditions for a project, yet some journals specifically say they will not accept preliminary data. Authors may have to incorporate such data within a larger study.
5. Laboratory studies that do not reflect field conditions. Laboratory studies may be necessary to establish basic information regarding the susceptibility to a particular insecticide. Problems arise when authors try to use these results to predict how the insecticide will perform when applied in the field. Toxicity will sometimes vary with commodity, and research with treated substrates wiu indicate that toxicity is usually greater on non-porous surfaces compared to porous surfaces.
6. Failure to present the results in the required format. I have seen papers in which the authors made no attempt to follow the style of a particular journal. The research itself may be valid, but the organization and analysis is not suitable for publication and the journal reviewers will probably reject the manuscript. For example, manuscripts submitted to one journal might be rejected because of the statistical analysis, yet the methods of analysis may be acceptable for another journal.

Bh. Subramanyam (USA) discussed Experimental Design, Replication, and Data (Probit) Analysis.

Errors in stored-product research arise during the planning, execution, data analysis, and reporting phases of the experiments. The consequences of these errors may affect the biological interpretation of the results. A thorough review of published literature is necessary for conducting research to answer relevant biological questions. The implementation of a research project should be based on statistically valid experimental design, adequate number of replicates, and should take into consideration biological design, and environmental factors that could affect the results. The type of data analyses is dictated by the experiment and there is considerable flexibility in a choosing an appropriate statistical procedure. The experimental design and statistical procedures used should be explained fully, along with a rationale for choosing a specific statistical procedure. Means, standard errors (or a measure of variance), and sample sizes should be provided in tables and figures. The author(s) reporting the results should fully understand the benefits and drawbacks of the experiment and the collected data. This knowledge Wiu help design additional experiments to answer specific questions raised by the first experiment.

Below is a brief outline of common errors I have seen in papers published on stored-product insects. This is by no means a comprehensive listing.

Topic Error Solution

Research objectives inadequate miterature search. A thorough review of literature. Not clearly stated. Frame objectives as questions.

Benefits of work not mentioned. State importance of work

Experimental design not mentioned. All experiments have their experimental designs.

Complicated experimental plan. fit any existing designs.

Improper statistical analysis used. Understand how experiment is conducted.

Randomization not practiced. It is essential to randomize logistical problems during implementation of the experiment not mentioned. Define difficulties encountered, and alterations made to the original design.

Is your design gauging the attribute that is of interest to you? Repeat experiment until you are convinced

Replication resources not mentioned. The number of replicates used is a function of your resources (time, money, personnel, and inherent variability of the organism) Not independent (pseudo-replication) Independent replicates are ideal

Replicates examined over time. Choose the right statistical analysis for such data

Variability among replicates not characterized Teu you the sample size needed for a given precision (confidence level). Also help in choosing the right transformation for data

Data (Probit) Analysis mostly parametric methods used Determine normality of data; use non-parametric methods for non-normal data.

Interactions in ANOVA ignored Characterize interactions.

Probit lines drawn using 3 data points 4 or more data points are needed; at least one point should be close to LD or LT of interest

Goodness-of-fit test not reported. Important to know fit of line to data

Probit-regression slope not given Should provide slope and intercept estimates, along with standard errors

Dose-response or time-response, which is important? That depends on your test organism, control agent, and your objectives

Adamant about using probit analysis Explore newer software (Table Curve 2D) and newer statistical procedures

Data reporting interested in statistical significance Biological significance or lack thereof, is important (provided the design and execution of work were nearly perfect)

Selective in reporting data (only the “ good” data are reported) Fully report data, including means, standard errors, sample sizes, and anomalous results

Nachman Paster (Israel) discussed mycotoxins and moulds and identified areas that were not covered adequately.

Moulds, which attack grains and foodstuffs, can cause serious damages, which may result, among others, in reduction in quality, mustiness, biochemical changes and heating In addition, many mould species may produce mycotoxins, toxic secondary metabolites that are regarded as a primary threat to animal and human health.

Although research on moulds and mycotoxins is linked, we have several aspects distinguish between the research carried out in the field of mycotoxins and that undertaken in the field of moulds.

For each field of activity: Are there any wrong or uncovered directions? Are we doing enough to tackle with the associated problems?

Moulds:

Enumaration and identification of the governing species can give much information concerning the way the food is stored, the quality of the raw materials and indicate future possible health hazards when high incidence of mycotoxigenic species are present.

Are we doing enough to cope with the mould problem?

The answer seems to be negative mainly because the basic concept relies on checking for the presence of mycotoxins Why not for moulds?

As a result, methods for assessing mould presence such as molecular or serological means are not available Control methods still rely on low-molecular-weight organic acids. To conform with the worldwide trend to restrict or even ban the use of chemicals, there is an urgent need to urge the research on alternatives means such as modified atmospheres, natural products, integrated means, biological control and induced resistance Standards (if available) rely on total mould count and no importance is made on species determination

Mycotoxins:

Progress has advanced in the field of detection Using immunological techniques.

Biosynthesis Identification of genes and pathways.

Progress in plant genetics: Transgenic plants, inducing resistance

Worldwide recognition as toxicants: Regulation concerning mycotoxins presence exists in most of the countries.

Future research is still needed in the fields of: Detoxification; Still ammonia

Safe levels: Why & ldquo; zero tolerance & rdquo; Which and where: & ldquo; Take the sample (grains, flour, nuts etc) and search for mycotoxins (aflatoxins, ochratoxins, trichothecenes, fumonisins and all the others) & rdquo; Resistant plants

A lot of progress has been done throughout the years in the area of moulds and mycotoxins and the knowledge accumulated assists us to confront with the problems that arise However, there are still subjects, which should be promoted in both of the fields towards consuming better and safer food.

Peter Credland (UK), Editor-in-Chief of the *Journal of Stored Products Research* , led the discussion on reasons for rejection of manuscripts The matters to which attention

should be directed in screening manuscripts so as not to aggravate editors were highlighted as follows:

Basic content:

1 Is the subject important &ndash, nationally or internationally?
2. Has the question been appropriately framed?
3. Have the experiments been properly designed?
4. Have all the variables been taken into account?
5. Has the work been conducted efficiently and reliably?
6. Is the analysis of the data appropriate?
7. Do the data justify the conclusion?
8. Is there a conclusion? Does the work significantly progress our knowledge?

Format of the manuscript.

9. Does the Introduction tell anyone but you and two colleagues why you did the work?
10. Are the aims stated clearly in an appropriate context?
11 Could the work be repeated, based upon your description of the Material and Methods employed?
12. Have you explained both physical and biological conditions?
13. Have you stated the sample sizes & ndash; and are they big enough?
14. Are the results presented clearly and succinctly & ndash, and once?
15 Are all the Tables and Figures necessary?
16 Are the Tables and Figures intelligible simply and without reference to the text?
17. Does the Discussion simply repeat the results?
18. Does the Discussion state clearly what you deduce from the results?
19. Does the Discussion relate to your initial aims?
20. Does the Discussion put your work into its appropriate national or international context?
21. If your work is of international importance & ndash; provide evidence not assertion.
22. Have you consulted and cited appropriate relevant literature & ndash; again of international importance where you are submitting to an international journal?

The actual writing.

23. Is the English clear and unambiguous?
24. Is the grammar acceptable and have you checked the spelling? Usually English or American spellings may be used as long as authors are consistent.
25. Have you avoided terminology known only to a few close friends?
26. Is it too long? Usually!

Submission of your manuscript.

27. Does the journal to which you wish to submit cover the subject of your paper?
28. Are you submitting work of local importance to an international journal?
29. Should you write a Short Note rather than a standard paper?
30 Does the format of your manuscript conform to the requirements of the journal to which you propose to submit?
31. Are the figures big enough but capable of reduction?
32. Have you written in the journal & ldquo; style & rdquo? Are all references cited correctly?

Do not aggravate the editor!!

33. Send the required number of copies.
34. Make sure that the manuscript is properly packed and addressed.
35. Send your manuscript to the right editor – if there are several
36 Remember that (s)he is human.

Finally kndazh:

Do not be upset by rejection – it happens to any of us

Technology transfer and adoption

Conveners: *Peter Golob* (UK) and *Li Guangcan* (China)

The workshop was attended by 33 Conference participants

The objectives of the workshop were:

1. to exchange ideas
2 to relate experiences to technology transfer problems
3 to identify possible solutions

The main focus of discussion was to identify ways to assist smallholder farming communities who store most of their own cereal crops for food on their farm

The problems of transferring technical messages to farmers were highlighted by Robin Boxall who outlined various options for involving farmers.

The workshop then took the form of an open discussion in which participants exchanged ideas.

Examples of methods used to disseminate information to farms were presented from Kenya, Pakistan, Zanzibar and China. Participants agreed that a more participatory approach, to involve farmers more fully throughout the process, was needed. Farmers should be involved from the design of research, through its execution to its assessment.

It is important that farmers be screened to ensure that those with particular problems to be addressed are involved and not necessarily random selection of the community, in order to make better use of, and to focus resources. It was felt that rather than work with individual farmers it would be more productive to work with communities.

A recurring problem in the past has been the poor linkage between researchers and extensionists, often due to the desegregation of the functions of different public bodies. However, the gap can be bridged by involving all the parties concerned in the development of fully participatory approaches to problem solving, technology development and

transfer

It was suggested that researchers might take on some of the extension activities but it was felt that, generally, post-harvest scientists do not possess the necessary skills to do this effectively and it would be essential to include inputs by socio-economists.

Furthermore, there was general agreement that, the introduction of the commercial sector, and of competition, into the provision of advice and assistance at all levels of the post-harvest sector would have beneficial effects even down to the small-scale-farmer.

Information transfer from developed to developing countries could be facilitated by greater use of Internet links but these are poorly developed in many countries For the time being, the availability of information on CD-ROM could bridge this gap.

The vast population of the world's poor are being neglected to a large extent throughout the proceedings of these international Working Conferences and this is an issue which should be addressed if the research reported at this Conference is to have any meaningful impact on rural populations.

Application of computers in stored-product protection

Conveners: *Robert Driscoll* (Australia) and *Niu Xinghe* (China)

Group leaders for the workshop were as follows:

Niu Xinghe, Deputy Director, Research & Design. Chinese Academy of Sciences of the ministry of Internal Trade

Barry Longstaff, CSIRO, Canberra, Australia

Robert Driscoll, Food Science and Technology, University of NSW, Australia

George Srzednicki, Food Science and Technology, University of NSW. Australia

Dirk Maier, Agricultural Extension Engineer, Purdue University, Indiana, USA

Introduction

Control systems have entered almost every part of our lives, since on-line process control based on a computer was first developed in the 1960s, suitable and reliable control methods have been advanced rapidly. Their cost has fallen remarkably quickly, while the capacity and speed of the controllers have increased Can these remarkable developments be of practical value in grain storage?

The workshop on application of computers was used to examine the effect of computer control on the postharvest industry Computer models of various typical drying methods were used to demonstrate different aspects of computer control. The workshop was conducted in three parts. In the introductory part, the workshop leaders were introduced and a description of the workshop objectives was given, in the second (and major part) or the workshop, four computer models were set up on seven computers scattered around the room. The workshop participants divided into groups, to do one of the following applications.

Applications

There were three applications of process control that were demonstrated:

1 Continuous grain moisture control, relevant to continuous dryers;
2 In-store air selection control, used for aerating and drying control of a bulk grain dryer;
3. Grain temperature control, used for aeration of grain, primarily to preserve quality in-store and in colder climates, minimize insect activity.

In addition, an expert system was demonstrated:

Expert system and Teach/Tutor, used for teaching about insect identification, fumigation practice and other aspects of grain postharvest management

All four aspects were demonstrated in this workshop

Workshop cases

Case 1 Cross-flow dryer controller
Case 2. In-store drying of paddy in Thailand
Case 3 Development of a conditioning system for popcorn in the USA maize belt
Case 4 Computer-assisted learning

As it was not possible to work with real dryers in the context of the workshop, computer models were used to demonstrate control principles. Modern models of drying try to include as many realistic factors as possible, although of course the real world will always surprise us with something new. 'Control' refers to an objective of bringing the grain to a required condition of safe storage, by means of an electronic control system or by a management strategy So the models are used as indications.

Sets of notes were provided for each workshop case. The notes were written in two parts, the first part of which describing how to use the software. The second and important part was the design exercise. A scenario was described, and the group asked to use the software to develop a control solution For example, to use the Cross-flow dryer, the controller needs to control the grain outlet moisture. This can be done using a method called PID control How can this be implemented?

People were able to move between groups Some people did several of the case studies, others concentrated on doing just one in more depth

Reconvening

The groups reassembled for discussion of their results and

deter maintain of the best approach in each of the three cases analyzed.

Wrap-up Session

The workshop concluded a brief free discussion time.

Intransit fumigation

Convener: *Chris Watson* (UK)

The Workshop held on Intransit Fumigation during the 7th IWCSPP conference in Beijing, People's Republic of China (PRC) was organized by the Intentional Maritime Fumigation Organization with assistance from the conference organizing committee. Sixty delegates representing a mix of scientists, technicians and commerce, attended the workshop with the majority being from P. R. China.

The workshop was based on the paper presented at the conference written by 5 authors who are all IMFO members called 'Intransit Disinfestation of bulk and bagged commodities – A new approach to safety and efficacy'. A presentation on some of the main findings and developments in the paper was made by two of the authors-Chris Watson from the UK and Denis Bureau from Canada. This was followed by a lively discussion and as a result the workshop conclusions were generally agreed

1. Intransit fumigation makes use of the time the cargo is on board a vessel while moving from load port to discharge port and is an opportunity to carry out effective fumigation during the voyage period It should be carried out only where necessary to form part of an integrated pest management procedure to help ensure effective protection of the goods. Phosphine is currently the fumigant of choice but other gases or mixtures of gases may be used in the future
2. Intransit fumigation of bulk or bagged cargoes in ship holds is currently not carried out as efficiently or safely as it could be in most cases.
3. Methyl Bromide is still sometimes used for intransit fumigation, or fumigation prior to sailing, and phosphine could replace Methyl Bromide for these uses.
4 A correctly installed powered and enclosed recirculation system will provide the most efficient form of phosphine fumigation intransit.
5. Effective safety procedures prior to sailing, during the voyage, and also at the discharge port, which should include removal of all powdery and gaseous residues, are all technically possible.
6. The main reason why effective procedures in respect of safety, and also effective eradication of visible and hidden insect infestation are currently not carried out, is that buyers do not specify sufficiently, clearly or precisely their infestation control requirements Commercial pressures therefore result in the seller supplying the cheapest options to enable the buyer to accept the cargo.

The organizers of the Workshop would like to thank all the participants, and in particular the scientists and engineers from both the People's Republic of China and Australia for their detailed contributions to the debate. As was pointed out by several delegates it provided an opportunity for scientists and practical applicators to make progress in understanding how good science and best practice can be incorporated in practical commercial situations. Due to the high level of interest and the unresolved issues it is hoped to arrange similar Workshops at future conferences