

ADAMS, H.R. AND OTHERS (1965)

Losses in agriculture.  
Washington, D.C., U.S. Dept.,  
Agricultural Research Service,  
1965 vi, 120p. (Agriculture  
Handbook 291)

Information on the losses occur-  
ring during production trans-  
portation and marketing of farm  
and forest products in the U.S.A.  
Over 25 references, 1941-1964.

CHIARAPPA, L. (ED.) (1972)

Group loss assessment methods.  
Commonwealth Agricultural  
Bureaus, 1972.  
276p Loose-leaf.

FOOD AND AGRICULTURE ORGANIZA-  
TION (1969)

Food losses: the tragedy ...  
and some solutions. Rome:  
F.A.O., 1969. iv, 38p.  
(PI/ 83132/2.69/E/1/5000).

Largely waste of land resources  
but includes world losses and  
costs to stored products, the  
damage and means of prevention.

INTERNATIONAL DEVELOPMENT  
RESEARCH CENTRE (1975)

Research and development require-  
ments on post-harvest systems.

Background paper issued in con-  
nection with Commonwealth Minis-  
terial meeting on food production  
and development, London, 4-12  
March 1975.

JAMIESON, M.F.S. (1970)

A simple tool for calculating  
loss or gain in weight result-  
ing from a change in the mois-  
ture content of produce.  
Trop. stored Prod. Inf., 1970  
(20), p. 19-20. 1 ref.

Gives a nomograph for calcula-  
ting changes in weight.

HULSE, JOSEPH H. (1975)

Research and development re-  
quirements on post-harvest  
systems: Commonwealth Minister-  
ial Meeting on Food Production  
and Rural Development, London,  
4-12 March 1975. Ottawa:  
International Development  
Research Centre. (ii), 18p.  
On cover: Commonwealth Sec-  
retariat.

Paper argues "that more serious  
attention and material support  
be given to improving post-har-  
vest grain systems, and will  
recommend certain courses of  
action for consideration by  
the Governments of the Common-  
wealth Nations".

Deals with post-harvest (i.e.  
post-production) problems as  
they relate to subsistence  
grains and refers to the whole  
system of operations from the  
place and time of harvest to  
the point of consumption, with  
special reference to Africa  
and Asia (dealt with further in  
separately published appendices).

Recommends that existing organ-  
isations be strengthened, that  
individual efforts be more  
effectively co-ordinated, and  
that mechanisms for technical  
guidance, co-operation and  
exchange of information be  
created. For Appendix A -  
see: Padua, Dante B de (1974)  
Post-harvest rice technology  
in Indonesia, Malaysia, the  
Phillipines, Thailand.

Appendix B (not seen)

3.1

INTERNATIONAL INSTITUTE OF  
TROPICAL AGRICULTURE (1974)

Annual Report Ibadan, IITA,  
1974. 199p.

INTERNATIONAL INSTITUTE OF  
TROPICAL AGRICULTURE (1975)

Annual Report Ibadan, IITA,  
1975. 219p.

## 5.2 -LOSS FACTORS

COURSEY, D.G. & PROCTOR, F.J.  
(1975)

Towards the quantification of post-harvest loss in Horticultural produce. Acta Horticulturae 49, 1975, p. 55-66. 47 refs 1949-73.

Suggests that 25% of horticultural crops are lost between harvest and consumption. Paper reviews the limited information on subject, discusses the major causative factors, illustrating the principles with examples from temperate and tropical countries, indicates ways of reducing loss and stresses the importance of quantifying the elements in loss.

HALL, D.W. (1968)

Prevention of waste of agricultural produce during handling, storage and transportation. Trop. stored Prod. Inf., 1968 (15) p. 15-23. illus.

Revision of a paper read at the 8th F.A.O. Regional Conference for Asia and the Far East, Seoul, Korea, 15th-24th Sept., 1966. Considers the factors causing loss, from harvesting to transportation, the economic results of losses and suggests measure for controlling such losses. No refs.

HALL, T.H.R. (1967)

World crops international directory and handbook. L. Hill, 1967. 320p.

HOWE, R.W. (1976)

Some obvious and not so obvious sources of post-harvest loss. Proc. 8th Br. Insectic. Fungic. Conf., Brighton, 1975, 3, p. 975-980, 3 refs. (Author's address: Ministry of Agriculture, Fisheries and Food, Pest Infestation Control Laboratory, London Road, Slough, Berks. SL3 7HL, England).

A distinction is made between

real losses of weight and quality which are often high in tropical countries and business losses which are important in temperate countries. Three reasons why our knowledge of the extent of national losses of produce in storage are so imprecise are discussed. The patchy distribution of insects, mites and fungi and consequently of the damage they cause makes it almost impossible to estimate losses exactly in single large stacks. We know that moisture is so seldom uniformly distributed in produce that we cannot easily use dry weight as a basis for estimates. In any event, temperature gradients cause the translocation of moisture around a stack and can raise an acceptable moisture content to a dangerous level. Feeding trials are difficult to perform because we cannot be sure that the diets are palatable and free from unwanted toxins, live or dead pests, or disease organisms.- Trop. storage abstracts, 1976 (2) p. 22.

HUGHES, HAROLD D. & HENSON, E.R. (1972)

Crop production. 3rd rev. ed. rev. by D. Metculfe. Collier Macmillan, 1972. 640p.

KIPPS, M.S. (1970)

Production of field crops. 6th ed. rev. McGraw-Hill, 1970. (Agricultural Science Series.) 688p.

POST HARVEST FOOD LOSSES IN DEVELOPING COUNTRIES (1976)

Fmg Dev. - IFAP Liaison Bull., 12 (1), p. 21-22.

Discusses the increasing emphasis being placed on the need to help rural people of developing countries to produce enough food for their own subsistence. One of the main causes of food shortage is agricultural waste in general and post harvest losses in particular. There are five critical stages at which losses occur; at harvest; during processing; in storage; during distribution; losses resulting from marketing systems. Each

stage is examined briefly and a few examples are given.-  
Trop. storage Abstracts.

SPENSLEY, P.C. (1976)

Harvest home - and the destruction starts. The Times, 8 April, V, illus. (Author's address: The Director, Tropical Products Institute, 56/62 Grays Inn Road, London WC1X 8LU, England.

Discusses the estimated magnitude of post harvest losses in food and their causes. Suggests that pest attack by insects, rodents and birds is most important in grains, whilst micro-organisms cause most damage to horticultural produce. Points out that there is a considerable body of technology available to reduce post harvest losses, and at farmer level many simple, low cost techniques have been developed. Some of these are discussed. The need for care in using chemical treatments is emphasised. Other important needs are for agricultural extension workers to be made aware of such techniques, for supplies of low cost structural materials and pesticides to be made available, and for more efficient marketing systems to dispose of local food surpluses.-

Trop. storage Abstracts, 1976 (2) p. 28.

TROPICAL PRODUCTS INSTITUTE, LONDON. (1975)

The reduction of post-harvest food losses.

In FOOD production and rural development: meeting of Commonwealth Ministers, London, 4-12 March 1975. London, Commonwealth Secretariat, (1975?). Pages 308-319. Paper FRDMM (75) P5 - RESTRICTED.

Reviews losses occurring in durable food grains and perishables such as fish, fruit, vegetables and root crops under the following headings: Extent of losses; causes of loss; availability of technology and equipment to prevent losses; problems facing

adoption of remedial measures; work of the TPI on the problem; possible actions by governments. Discussion of the paper by delegates is reported on pages 109-119.

3.2.1.1.3

#### ----DRYING & STORAGE

DE BEER, A.G. (1972)

Drying and storing agricultural produce on the farm. Fmg. S. Africa., 1972 48 (5) p. 29-68. illus., ref.

NEW EQUIPMENT FOR CROP DRYING AND STORAGE (1975)

World crops, Sept/Oct 1975 27 (5) p. 204-5.

Brief description of several new commercially available items of equipment including tropical applications.

3.2.1.1.4

#### ----DRYING, DRYERS

HEARLE, H.F. & HALL, D.W. (1962?)

The use of low temperature high air volume drying of tropical crops. Trop. stored Prod. Inf., 1962?, (5), p 168-173. illus.

Discussed use of Lister Moisture Extraction unit in drying certain crops - including cereals. Unit is portable and suitable for larger farms and plantations. The subject is also discussed in the Editorial, p. 153.

INDIAN AGRICULTURAL RESEARCH INSTITUTE: AGRICULTURAL ENGINEERING DIVISION (1975).

Solar dryer for small farmers. Pesticides, India, 9 (4), p. 59.

Reports on a solar energy collector-cum-dryer for drying crops quickly after harvest, designed and developed by the Division in New Delhi. The main components of the system comprise a metallic roof, air duct, blower and grain bin. The roof is fabricated from corrugated sheets blackened with bituminous paint. The air duct is made from plywood board fitted 6 cm below the roof. One end of the duct is

open as air inlet, the other is connected to the blower. Heat absorbed by the roof is transferred to air in the duct, and then forced through the wet grain bed in the bin by means of the blower. Some test results are given. Grain with up to 34.9% m.c. could be dried to 15% m.c. in adverse humidity and fluctuating sunshine conditions. Some notes are given on roof orientation and elevation, and the use of transparent covers (glass or polythene sheet) to increase air temperature rise.-  
Trop. storage Abstracts

LOCKWOOD, L.M. (1975)

Solar cabinet dryers for drying grain and other agricultural produce in Bangladesh; preliminary report. Rep. IVS/CORR Grain Storage Project, Jalchatra, Tangail District, Bangladesh. duplic, i + 8 pp, 2 tabl, 1 fig, refs. (Author's address: Appropriate Technology Cell (Storage and Handling), Bangladesh Agricultural Research Council, 130-C, Road 1, Dhanmandi, Dacca, Bangladesh).

In the introduction, the various theoretical advantages of solar dryers are discussed, and possible arguments against their introduction in Bangladesh are examined. A study was undertaken to construct and test a model solar cabinet dryer, and the report describes the model, gives details of design and cost, and examines various possible applications. It is concluded that the dryer is unlikely to be of much practical use in drying food grain, because of limited capacity and economic factors, but it may be of value in drying seed grain. The possible use of solar dryers for preserving fruit and vegetables is examined in some detail, but their acceptability for general purposes is considered to be still in question.-  
Trop. storage Abstracts, 1975 (3), p. 39-40.

MC CLOY, J. (1955)

Artificial drying in remote territories and the fuel

problem.

World crops, March 1955, 7 (3) p. 109-113.

Review of problems associated with the drying of produce for market in developing areas with particular reference to the use of fuels. 69 references.

MUCKLE, T.B. & STIRLING, H.G. (1971)

Review of the drying of cereals and legumes in the tropics. Trop. stored Prod. Inf., 1971 (22), p. 11-30\* Natural and artificial drying are described and the methods of operation of artificial driers are explained. Considers the factors in selecting appropriate driers. Maize, rice, groundnuts, peas and beans are dealt with individually.

\* illus. bibliog. (37 entries, 1946-71).

OXLEY, T.A. (1962)

Loss in weight on drying. Trop. stored Prod. Inf., 1962, (4), p. 129-130. Also note in Editorial, p. 93.

Table, p. 130 shows why the change in moisture content in drying is always less than the percentage loss in weight.

Author mentioned in Editorial note.

PETERSEN, W.H. (1975)

New developments-solar heat for crop drying. Proc. Grain Conditioning Conf., Univ. Ill., Champaign 1975, p. 47-48, illus. (Author's address: William H. Petersen, Extension Agricultural Engineer, South Dakota State University, Brookings, South Dakota, 57006, USA).

Refers to successful trials with a solar/electric crop drying installation in South Dakota in recent years. Points out the advantage of solar heating for crop drying. Firstly,

a temperature rise rather than a fixed temperature is adequate for crop drying, making it possible to use a simple inexpensive heat collector. Secondly no heat storage is needed - shelled maize itself acts as a heat storage, although a secondary heat source such as electricity may increase the drying speed. Thirdly, the probabilities of collecting solar energy, even in cloudy conditions, are excellent. A description is given of a simple installation, consisting of a bin, with a double skin painted black on the outside as heat collector, and with a simple heater, fan and ducting system as supplementary.-  
Trop. storage Abstracts, 1975 (5), p. 67-8.

### 3.2.2 --STORAGE LOSSES, STORAGE CONDITIONS.

ADAMS, J.M. (1976)  
 A guide to the objective and reliable estimation of food losses in small scale farmer storage. Trop. stored Prod. Inf., 1976 (32), p. 5-12. illus., 7 refs 1965-76.

Shows that losses in storage are of different types (quantitative, qualitative, nutritional, and loss in seed germination), and states that the use of any estimates must be considered when conducting loss assessments. Describes procedures to be followed and the methods of analysis to be used to produce an estimate of total loss. The main causes of loss are insects, rodents, birds and fungi. The guide is based mainly on experience with maize in Africa.

CARESCHE, L. AND OTHERS (1969)  
 Handbook for phytosanitary inspectors in Africa, by L. Caresche, G.S. Cotterell, J.E. Peachey, R.W. Rayner and H. Jacques-Felix. Lagos, Organisation of African Unity Scientific, Technical and Research Commission, 1969. 444p. illus.

Contains 3 appendices. Stored products and sampling

techniques are dealt with in the appendices.

DAVIES, J.C. (1962)  
 Storage of agricultural produce. Kampala, Department of Agriculture, 1962. 31p.

FOOD STORAGE MANUAL (1970)  
 Prepared by Tropical Stored Products Centre, Ministry of Overseas Development, Slough, England.

Rome; World Food Programme. 1970  
 3 vi illus. Looseleaf.

A comprehensive study of the whole problem of food wastage in storage particularly those problems associated with the range of commodities being shipped to developing countries as Food Aid.

Part I discusses the biological, physical and chemical aspects.

Part II deals with the technological aspects, including packaging, handling and storing.

Part III covers the practical aspects - buildings, warehouse management, inspection and control of pests.

The index is included in part III.

Reviewed in Trop. stored Prod. Inf., 1971 (21), p. 3-4.

Part I xvi, 304p.  
 Part II vi, 305-569p.  
 Part III v, 570-799p.  
 Includes refs.

GERMAN FOUNDATION FOR DEVELOPING COUNTRIES (1970)  
 Storage and marketing of agricultural produce under tropical conditions: proceedings of the seminar from 22 to 27 February 1970 at Colombo, Ceylon. Berlin, German Foundation for Developing Countries, 1970. 161p.

HALL, D.W. (1969)  
 Food storage in the developing countries. Trop. Sci. 1969, 11 (4), p. 298-318.

HALL, D.W. (1963)

Stored products organizations in some overseas countries. Trop. stored Prod. Inf., 1963 (6), p. 191-196. 3 refs 1950-62.

Describes the work then being undertaken in all parts of Commonwealth Africa, excluding Southern Africa. Also includes West Indies and South East Asia.

HALL, D.W. & HYDE, M.B. (1954) The modern method of hermetic storage. Trop. agric. Trin., 1954, 31 (2), p. 149-60.

HUTCHINSON, J. (Chairman). (1975) British aid and the relief of malnutrition. Report of the ODA advisory committee on protein. Minist. Overseas Dev., Overseas Dev. Pap. No 2, ISBO 0 11 580165 0, vi + 44 pp. London: HMSO. Price 51p net.

The terms of reference of the committee were to advise on the scientific, economic and other relevant aspects of problems of the production and consumption of conventional and non-conventional protein foods and supplements with particular reference to the needs of developing countries, bearing in mind the relationship between protein supplies and calorie requirements. The committee finds that protein deficiency in diet is directly related to general malnutrition and poverty. The basic recommendation made is that in the interests of better nutrition, aid should be directed to projects that will generate income among the poor, even where such projects do not have any marked effect on the national income of the country concerned. Other recommendations relate to the provision of personnel with nutrition expertise, suitable training and job opportunities for trained personnel, and increased attention to less productive farming areas and poorer farmers. Finally the report emphasises the importance of food technology, storage, marketing and distribution in developing countries in reducing the effects of food

shortages.- Trop. storage Abstracts, 1975 (4), p. 52-3.

JOURNAL OF STORED PRODUCTS RESEARCH (1965- )  
Oxford: Pergamon, 1965-  
Quarterly

Article on this journal in Tropical Stored Products Information no. 9.

LUCA, Y DE. (1975) Ecologie des denrées stockées (milieu, peuplement, agressions). (Ecology of stored products - environment, populations, attacks). Bull. Ass. Nat. Enseignement Agric. publ., Numero Special, 39pp, 65 ref. (Author's address: Maître Assistant de Zoologie et d'Ecologie, ENSAM, 9 Place Viala, 34060 Montpellier, CEDEX, France).

Discusses the medium in sensu stricto depending upon the characteristics and condition of the commodity or article stored, and in sensu lato, the latter including problems of climate, handling and of storage. Analyses the population of the stored items; systematic structure-animals, plants, microorganisms; qualitative-pests and associated agents; autecology and synecology - relation between the medium, animals, plants, associated agents and man. Discusses attacks (impacts on stored products and environment); causes (climate handling and storage, state of stored produce); nature of the attacker (flora and fauna and man). Notes criteria for detection of changes in stored products and discusses means of control. Finally discusses the seriousness of the damage to the product and its social significance.- Trop. storage Abstracts, 1976 (1). p. 10.

MAJUMDER, S.K. (1970) Protecting food from deterioration during storage, handling and distribution in technologically less developed countries of the world. Proc. 3rd int. Congr. Fd Sci. Technol., Washington,

D.C. 1970, P518-531 + 7 tables + 8 Pl. + 2 figs. (Author's address: Infestation Control and Pesticides, Central Food Technological Research Institute, Mysore 2A, India)

The first section discusses food protection in relation to food technology. It points out that in less developed countries traditional storage methods offer very little protection from insect and other damage, and the small size of individual land holdings does not encourage adoption of modern techniques of harvesting, and tropical and semi-tropical climates provide most favourable conditions for fungal damage and insect infestation. This situation is aggravated by increasing use of convenience foods in flexible packages which are permeable to infestation.

The second section is devoted to food composition and specificity of infestation. Examples given include Sitophilus on endosperm, Ephestia on germ, Rhizopertha and Tribolium on broken or powdered grain, and Callosobruchus on low fat whole legume beans. The conditions which favour different fungi and bacteria are discussed. Biodeterioration, the way in which it is manifested, and methods of detecting and evaluating it are examined.

The third section deals with prevention of biodeterioration. Sophisticated techniques such as ideal warehouses, controlled atmosphere, specialised silos, grain irradiation, and microwave application are at present beyond the reach of many developing countries. Preharvest prophylaxis with malathion, captan, and Bacillus thuringiensis inhibits field infestation by preventing oviposition, excluding fungi, and acting as lepidoptericide respectively. Tricalcium phosphate sprayed on a crop prior to harvest remains effective during post-harvest operations. Post-harvest practices include improvement of traditional

storage structures to exclude rodent and non-mammalian pests, and to provide hermetic and water-vapour proof containers. On a larger scale, modern bins, and inert-gas atmospheres are considered. Other methods discussed include fumigation, parboiling, protectant admixtures such as tricalcium phosphate, and abrasive or absorptive inert dusts.-

Trop. storage Abstracts, 1973 (1), p. 10-11.

NIGERIAN STORED PRODUCTS RESEARCH INSTITUTE (1967)  
Annual report, 1966. Lagos, Nigerian Stored Products Research Institute, 1967. 148p.

Contain 23 technical reports.

STORM, L. (1974)  
Agricultural marketing storage course. Moshi, Tanzania: Cooperative College, 1974. 74p. (FAO/UNDP Project SF TAN 27)

TEMPANY, SIR HAROLD & GRIST, D.H. (1958)  
An introduction to tropical agriculture. London: Longmans, 1958. xvi, 347p. bibl. pp 314-324.

(2nd imp. with corrections 1960; 3rd imp 1964).

Chapter 16, pp 245-258, Storage of crop products. Deals extensively with losses, including quantification, and preventative measures. Refs in text.

TROPICAL PRODUCTS INSTITUTE (1969)  
Food storage bibliography, with special reference to tropical foods.

Slough, Tropical Stored Products Centre, 1969. ii, 7p.

TROPICAL STORED PRODUCTS CENTRE (1960- ) TROPICAL STORED PRODUCTS INFORMATION  
(Trop. stored Prod. Inf.)

Slough

Nos 1 & 2, 1960; 3, 1961;

4, 1962; 5, 1963. 32 issues to 1976. Reprints of some articles are available.

Most, if not all, issues are relevant. 'News Review' in each issue contains many short items some of which are relevant to post-harvest losses. The longer items have been noted but all issues are worth checking. Most articles include lists of references, some very extensive. Some issues contain reviews of major investigations and earlier issues contained lists of recent publications (which have been listed where relevant).

TROPICAL STORED PRODUCTS CENTRE  
(1968) TROPICAL STORED PRODUCTS  
INFORMATION, 15, 1968

News Review includes:-  
"'Cyprus' grain bins in Kenya",  
illus.; "Groundnut fumigation  
trials in Zambia".

TROPICAL STORED PRODUCTS CENTRE  
(1968 a) TROPICAL STORED PRODUCTS  
INFORMATION, 16, 1968.

News Review includes:- "Crib  
storage of maize in Brazil"  
a review of an article by  
Triplehorn (1966) 'Wire netting  
cribs for the storage of maize';  
"Recent stored-products work  
in Nigeria"-a list of 23  
reports contained in the 1966  
annual report of the Nigerian  
Stored Products Research  
Institute.

TROPICAL STORED PRODUCTS CENTRE  
(1969), TROPICAL STORED PRODUCTS  
INFORMATION, 18, 1969

News Review includes a section  
"Losses to stored maize in  
Malawi", "Trials with small  
capacity metal grain silos  
in Dar-es-Salaam, Tanzania"  
and "Tanzanian Produce Export  
(Fumigation) Rules, 1968".

TROPICAL STORED PRODUCTS CENTRE  
(1970) TROPICAL STORED PRODUCTS  
INFORMATION, 19, 1970

'News Review' includes:- "Food  
storage in Zambia", "Crop  
storage problems in Tanzania",  
"Food storage by the Bantu  
in Southern Africa", (illus.),  
"Tests on the use of the Ashman-  
Simon infestation detector

for maize", -(see also Ashman,  
F. and others 1970, in same  
issue).

TROPICAL STORED PRODUCTS CENTRE  
(1971) TROPICAL STORED PRODUCTS  
INFORMATION, 21, 1971

News Review includes:-  
"Approval scheme for the use of  
'Phostoxin'/'Celphos' in Kenya";  
"FAO - two new publications" -  
publications reviewed include  
'Handling and storage of food  
grains in Tropical and Sub-  
Tropical areas' by D.W. Hall  
(q.v.); "World Food Programme-  
Food Storage Manual" (q.v. under  
Food).

TROPICAL STORED PRODUCTS CENTRE  
(1971 a) TROPICAL STORED PRODUCTS  
INFORMATION, 22, 1971

News Review includes:- "A new  
hermetic storage bin for rice"  
illus.; "Use of butyl rubber  
silos for paddy storage in the  
tropics" illus.; "Insecticidal  
dust admixture treatments  
-Effect of biological factors  
on insecticide efficiency";  
"International Agricultural  
Research Institutes"; "Trader/  
Government co-operation on  
safer storage and improved  
insect control in Mombasa Port".

TROPICAL STORED PRODUCTS CENTRE  
(1972) TROPICAL STORED PRODUCTS  
INFORMATION, 23, 1972

"Small, on-farm, storage system"-  
an account of a low-cost maize  
storage unit designed in Dahomey  
for tropical climates; illus;  
"Recent FAO activities on grain  
storage"; "Group for Assistance  
on Storage of Grains in Africa  
(GASGA)"; "Survey of rodent  
damage to growing crops and in  
farm and village storage";  
"Formulations for phosphine  
fumigation"; "Control of insects  
infesting rice bran".

TROPICAL STORED PRODUCTS CENTRE  
(1973), TROPICAL STORED PRODUCTS  
INFORMATION, 24, 1973

News Review includes:-  
"Improved storage for farmers  
in Northern Ghana" (illus);  
"Recent FAO activities on grain  
storage"; "Farmer storage  
extension projects in Africa"  
(illus); "Safe storage moisture  
content for groundnuts";



"14th International Congress of Entomology" - this symposium, held at Canberra, 22-30 August 1972, was devoted to Stored Products Entomology. Lists authors and titles of 14 papers presented - bound volume of abstracts obtainable from Australian Academy of Science. Proceedings not being published but most papers will be published independently.

TROPICAL STORED PRODUCTS CENTRE (1975) TROPICAL STORED PRODUCTS INFORMATION, 29, 1975

News Review includes:- "A simple dosage for the fumigation of commodities with methyl bromide under gas-proof sheets or in freight containers" p4-6, 6 refs; "Rural grain storage project in Swaziland" p6-9 illus.; "A bait trap technique for assessment of stored product beetle populations" p9-11, illus.

TROPICAL STORED PRODUCTS CENTRE (1975a) TROPICAL STORED PRODUCTS INFORMATION, 30, 1975

News Review section includes "FAO activities on grain storage, January-May 1975" (which includes reports on activities in Uganda, East Africa, Mali and Mauritania, Sudan, Chad, Ghana), "Farmers act to reduce losses" (of stored maize in Zambia), "Malawi", "West African seminar on farm and village-level grain storage", "Report on the 8th FAO regional conference for Africa...", etc.

TROPICAL STORED PRODUCTS CENTRE (1976) TROPICAL STORED PRODUCTS INFORMATION, 32, 1976

News Review includes: "Small metal grain silos in Swaziland", p. 1-2, illus. (It is estimated that 15,000 silos, similar to water tanks, are in use in Swaziland, mainly for storage of grain); Brief storage news from Mali, Niger, Senegal and Ghana; "Mini grain dryer" p. 3; "A new rodenticide" p. 3-4; "Recent FAO activities on storage and post-harvest loss reduction", p. 4 (including a brief note on the work of the FAO Interdepartmental Subcommittee on Reduction of Post-Harvest and Food Losses in Developing Countries).

TYLER, P.S. (1970)

Handbook of crop storage (For the use of officers in the Division of Extension of the Ministry of Agriculture, Botswana).

25p

VOLUNTEERS FOR INTERNATIONAL TECHNICAL ASSISTANCE (1970)

Village technology handbook. Rev. ed. Schenectady, N.Y.: VITA, 1970. £4.05. xii, 387p.

Illus. notes on various village development projects for developing countries - including storage.

WHEATLEY, P.E. (1974)

Research being undertaken by the Tropical Stored Products Centre in the United Kingdom and Overseas. EPP0 Bull., 4 (4), p. 495-500. (Author's address: Tropical Stored Products Centre, Tropical Products Institute, London Road, Slough SL3 7HL, England).

Research is undertaken by the Centre both overseas and in the United Kingdom on storage problems facing developing countries. Much of it is of a strictly applied nature although some longer-term basic studies are also underway. Brief notes are given on current work on biological, chemical and engineering studies at all levels of storage, from farm to central storage depot, on a wide range of durable agricultural products and associated pests. Reference is also made to the Centre's publications, and to the various training programmes.- Trop. storage Abstracts, 1975 (3), p. 45.

WYE, A.J. (1971)

Selected bibliography on improving farm storage. Trop. stored Prod. Inf., 1971 (21), p. 13-17.

Contains 83 entries 1923-70.

ZAMBIA. FOOD CONSERVATION AND STORAGE UNIT, MOUNT MAKULU RESEARCH STATION (1971- )

Annual report 1st October 1971 - 30th September 1972. 23p Limited distribution.

Research work included a survey of traditional food storage methods in selected areas, and a survey of lindane resistance in Tribolium castaneum.

Sorghum storage observations indicated that new improved varieties deteriorate more rapidly in store than indigenous varieties. In trials on storage of dried cassava, the most important moulds recorded were Aspergillus glaucus, Penicillium spp and Rhizopus nigricans.

Farm trials included the storage of cob maize in traditional bins. The attempt to control primary insect species in stored cob maize was unsuccessful, the main problem being control of Sitotroga cerealella. Storage of shelled maize in traditional bins was more satisfactory, when combined with the use of malathion at 12 ppm a.i. Storage of shelled maize in improved brick bins, combined with the use of pirimiphos methyl, malathion, lindane dust, and bromophos dust, all maintained visible damage levels at less than 5% up to 12 months after harvest.

Trials were also carried out in depot storage, on shelled maize in jute sacks.  
Trop. storage Abstracts  
(abridged)

### 3.2.2.1.

#### ---AREA STUDIES -AFRICA

BYARUHANGA, E.K. & NYIRA, Z.M.  
(1970)

Variability in techniques of crop storage and an appraisal of the crop loss on farmers farms in Uganda. Report of the Kawande Research Station. Kampala.

12p

DEUSE, J.P.L. AND POINTEL,  
J.G. (1974)

Assessment of research at farm level storage in

Francophone Africa. 1st int. Working Conf. stored Prod. Ent. Oct. 7-11, 1974. Savannah, Georgia, USA.

(Abstract only). (Author's address: Institut de Recherches Agronomiques Tropicales (IRAT), Crop Prot. Divn. 110, Rue de l'Université, Paris, 7 eme, France).

The losses caused by stored products insects reduce the amount of available food and its nutritional value. This is particularly important in West Africa where the quantity of foodstuffs is hardly enough to assure food for all the population. IRAT has therefore oriented its research principally towards post harvest protection in view of improvement of groundnut storage, groundnuts being the principal cash crop of West Africa. Protection of cowpeas and maize have equally been improved in Senegal and in Togo. In West Africa it has been shown that pre-storage damage during drying and threshing, was important and influenced greatly the losses incurred during storage. Research has been carried out to modernize methods of storage. The farmer has already been introduced to low cost maize cribs, plastic bags in which a capsule of carbon tetrachloride was used for insect fumigation, and oil drums. Studies have also been carried out to develop a three-ton capacity bin which responds to the peasants' needs. Finally studies of irradiation for insect control in dried fish in Mali have permitted the introduction of a practical method by irradiation but the method is still rather costly.-  
Trop. storage Abstracts

#### FOOD AND AGRICULTURE ORGANIZATION. AFRICAN RURAL STORAGE CENTRE (1975)

Report of work carried out in Nigeria to June 1975. TF/AFR/45 (DEN). Based at IITA, Ibadan, Nigeria.

GRAHAM, J.F. (1964)  
Stored products work in Kenya.  
Trop. stored Prod. Inf., 1964

(8), p. 287-288.

Brief survey of the history and work of the Pest Infestation of Stored Products Committee.

HAMILTON, A.G. (1975)

Review of post-harvest technologies: Botswana. Rep. Projects Div. Can. Univ. Serv. Overseas (CUSO), 151 Slater Str., Ottawa, Ontario, Can. KIP 5H5 Canada. xii + 200 + xii pp, tabl, 49 pl, refs, 3 append. (Author's address: University of Alberta, Edmonton, Alberta, Canada).

Reports on a survey conducted in four villages in an area of approximately 500 km<sup>2</sup>. Comprises 6 chapters: 1. Description of Botswana; 2. Botswana agriculture; 3. Storage; 4. Marketing and distribution; 5. Utilization of sorghum; 6. Rural food preference and storage survey. Each chapter has summary and own references.

Recommendations are made on future projects concerning: sorghum milling; consumer surveys; controls on imports; intermediate storage facilities; use of malathion; self help; recruitment of women for extension work. Chapter 3 reviews the position of storage in the food supply system, and crop storage work conducted in Botswana over the past 40 years, including early efforts to construct concrete silos during 1939-1945, to the Grain Storage Project introduced in 1968. Attention is given to harvesting and threshing techniques, and detailed descriptions are given of traditional and modern farm storage methods in Botswana. It notes the replacement of traditional bulk storage methods by bags and other convenient forms of storage. Local methods of protecting stored grains are examined, including the use of insecticides (malathion) and fumigants (phosphine). A review of methods of determining grain loss is given, with examples of visual aids

used in promoting improved storage.- Trop. storage Abstracts, 1976 (1) p. 7-8.

HARRIS, W.V. (1941)

Native methods of food storage in Tanganyika. E. Afr. agric. J. 1941, (6), p. 135-138.

HINDMARSH, P.S. (1973)

Food storage work in Zambia. Fmg. Zambia, 7 (3), p. 22-25. (Author's address: Ministry of Agriculture, Research Branch, Mount Makulu Research Station, P O Box 7, Chilanga, Zambia.

Summarises the factors causing deterioration in harvested crops in Zambia. Notes that the climatic conditions are suitable for rapid development of the insects causing damage. Discusses the effects of insect damage - loss of nutritive value of food grains, loss of quality and loss in weight. A brief description of rodent damage is given and there are notes on mould damage and production of mycotoxins, in particular aflatoxin. An account is given of the surveys and research carried out by the Food Conservation and Storage unit on the biology and control of Sitophilus spp and Sitotroga cerealella. A chart indicates the incidence and movements of grain pests throughout the farming year.- Trop. storage Abstracts, 1973 (3) p. 44-45.

HINDMARSH, P.S. (1976)

Reduction of post-harvest losses to durable produce in Zambia. Trop stored Prod. Inf., 1976 (31), p. 13-15.

Describes the agents of deterioration - insects, mites, rodents and fungi - and discusses the role of the Zambian Food Conservation and Storage Unit in reducing losses.

HOYLE, B.S. (1967)

The seaports of East Africa. Nairobi: East African Publishing House, 1967. 137p.; illus.

Reviewed in Trop. stored Prod.

Inf., 1971 (22), p. 51-  
"It is essential as a reference book for those interested in the problems of storing, transporting and disinfecting East African exports" - reviewer.

JAMESON, J.D. (EDITOR) (1970)  
Agriculture in Uganda. Rev. ed. London, O.U.P., for Ministry of Agriculture and Forestry, Uganda, 1970. £5.00 xvi, 395p. maps, illus.

Previous ed. edited by J.D. Tothill, 1940. Includes a section on crop storage.

LAWRENCE, E. (1940)  
Native methods of food storage in Nyasaland. E. Afr. agric. J. 1940, 5 (5) p. 376-379.

MPHURU, A.M. (1971)  
A review of storage problems in Tanzania. Proc. of 2nd Conference of Land Use in Tanzania June 1971.

NIGERIAN STORED PRODUCTS RESEARCH INSTITUTE (1973)  
9th Annual Report. Jan-Dec 1971. 1973.

NYANTENG, V.K. (1972)  
The storage of foodstuffs in Ghana. Univ. Ghana: Inst. statist, soc. econ. Res., Tech, Publ. Ser. No. 18. vii + 92 pp + 75 pl + 17 tables + 2 fig + ref + append.  
(Author's address: Institute of Statistical, Social and Economic Research, University of Ghana, P O Box 24, Legon, Accra, Ghana).

Reports on a survey carried out during 1970 and 1971, by interviewing farmers, agricultural officers and assistants and using two questionnaires, one designed for each group. In the introduction the problems arising from storage of foodstuffs in hot, humid countries are discussed generally, and it is noted that butyl silos have been found to have, in practice, a useful life of only six to twelve months. The

second chapter deals with the role of storage and farmers' storage policies and covers the role of storage in distribution, prices and production of foodstuffs. In the third chapter, the storage of cereals, and methods and structures in current usage are discussed. The fourth chapter deals with storage of other food crops, and includes yams, cassava, cocoyam, plantain, groundnuts and vegetables. There is a final summary and recommendations. The appendix gives details of the questionnaires, and a discussion on storage losses. The plates mainly illustrate storage containers and structures throughout the country.-

Trop. storage Abstracts

PATTINSON, I. (1964)  
The history and organisation of stored products work in The Gambia. Trop. stored Prod. Inf., 1964 (9), p. 323-336. illus., 16 refs 1953-64.

Account of the history and organisation of stored products work in The Gambia arising from the realisation in 1951 that losses during storage were affecting the oil groundnut crop. Reference is also made to other crops.

PATTINSON, I. (1968)  
Report to the government of Tanzania on crop storage problems. Rome, F.A.O., 1968. vii, 42p. illus.

(United Nations Development Programme Reports - no. TA 2454).

PATTINSON, I. (1969)  
The National Agricultural Products Board, Tanganyika. Part 2: Storage problems. Trop. stored Prod. Inf., 1969, (17) p. 23-31. illus., 3 refs.

RILEY, J., PREVETT, P.F. & SIMMONS, E.A. (1964)  
The Nigerian Stored Products Research Institute. Trop. stored Prod. Inf., 1964 (7), p. 249-256. illus.

Summarises the history of the organisation from its origins in 1946 to its new status and change of name in 1963. Describes the current work of the various laboratories, including yam losses during storage, and small scale crib storage of maize-on-the-cob.

SHRIVASTAVA, P.K., TRIPATHI, B.P., GIRISH, G.K. & KRISHNAMURTHY, K. (1973)

Studies on the assessment of losses      Conventional grain storage practices and losses in rural areas in Western U.P. Bull. Grain Technol., 1973, 11 (2), p. 129-139. 2 refs.

Reports on a survey made during Jan-Dec 1971.

Indian Grain Storage Institute, Hapur, U.P., India.

Crops, Loss Factors, Storage Conditions, Storage Structures and Equipment Structures, ---- STORAGE STRUCTURES (BUILDINGS, SILOS, PITS, ETC)

AGRAWAL, N.S. (1973) Design of storage structures. Post harvest technology of cereals and pulses.

Proc. Semin. held New Delhi, Dec 21-23, 1972. p.153-157. New Delhi: Indian National Science Academy.

BUGUNDU, L.M. (1970)

The storage of farm products by farmers in my small village. Samaru Agric. Newsletter, 1970 12 (1), p. 2-9. Describes traditional storage structures of village in North Guinea Savanna zone of Nigeria.

DANBY, M. (1973)

The design of buildings in hot dry climates and the internal environment. Build int., 6 (1), p.55-75 + 12 pl + 8 fig. (Author's address: University of Newcastle-upon-Tyne, Great Britain).

The interaction between buildings and the external climate produces the internal environment and this presents special problems in hot dry climates. Accurate weather data are needed and a knowledge of the effects of different shapes, orientation and materials on thermal performance is necessary. The elimination of direct solar radiation from the interior is a first essential, and accurate data and information are available for prediction of solar angles and the design of shading devices.

Shape, form and orientation are important factors, and their rationalisation to obtain the minimum solar heat load is discussed, together with the concept of the Minimum Thermal Axis. The relative merits of solid mud walls and cavity walls have been deduced from a series of tests carried out at the University of Khartoum on

a building of traditional construction. A type of wall construction is suggested for use in hot dry areas. The effect of natural ventilation through doors and windows on the interior environment is shown to be very important, as is the correct timing for it.

Economic conditions in hot dry areas do not normally permit the use of air conditioning, and recommendations are made for the use of desert air coolers, adopting the traditional methods of cooling by evaporation. (From author's summary). - Trop. storage Abstracts

FULLERTON, R.L. (1968)

Low-cost farm buildings for storage and equipment housing in Ghana. Ghana Jnl agric. Sci., 1 (2), p. 165-170.

LOCKE, M.T. (1975)

Safer storage for the produce of this land of ours. An account of Crop Storage Section's exhibit at the 1975 Nairobi Show. Kenya Ent. Newsl., 1975 (2), p.12-14, illus. (Enquiries to: Senior Entomologist, National Agricultural Laboratories, P O Box 30028, Nairobi, Kenya).

Points out that small-holder stores, made to traditional designs, are usually basically sound provided they are well made and maintained. Examples are given of modifications recommended by the staff of the laboratories to reduce termite attack on the store structure and contents, and to prevent rodent damage. Illustrations show various local designs fitted with ratguards made from different materials. - Trop storage Abstracts, 1976 (3), p. 37.

MUHIHU, S.K. (1975)

Traditional aspects in store design. Kenya Ent. Newsl., 1975, (1), p.3-6, 5 illus.

(Author's address: National Agricultural Laboratories, P O Box 30028, Nairobi, Kenya).

Briefly describes the basic traditional type of structure. Comments on factors influencing the design of such stores and lists: the inherent knowledge of the people upon which several factors play; type and availability of building materials; social and cultural standards of the people including security and risk; local customs; the skills of the people concerned. Suggests that the modern improved grain store should be seen as a development of the traditional store if it is to gain local acceptance. - Trop. storage Abstracts, 1976 (3), p. 38.

McFARLANE, J.A. (1970)

Insect control by airtight storage in small containers. Trop. stored Prod. Inf., 1970 (19), p. 10-14. illus., 7 refs.

Discusses the use of gourds and other containers.

NATIONAL ACADEMY OF SCIENCES. (1973)

Ferrocement applications in developing countries. xiv + 89 pp + fig. (Eng. with Sp. and Fr. summ.) Publ. Office of the Foreign Secretary (JH 210), National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418, U.S.A.

This is a report by an ad hoc panel of the Advisory Committee on Technical Innovation Board on Science and Technology for International Development. Ferrocement is described as a thin-shell concrete reinforced with wire mesh, a high quality construction material whose ingredients are widely available in developing countries. It can be used to build a wide range of structures and can be worked mainly by unskilled but supervised labour. Among subjects discussed are ferrocement for food storage structures (the Thai rice silo is given as

an example); ferrocement in food technology; ferrocement for low cost roofing; ferrocement materials technology. One appendix describes, with costings, the construction of ferrocement-lined underground grain silos in Ethiopia.

ROBERTSON, J.V. (1969)

Trials with small capacity metal grain silos in Dar-es-Salaam, Tanzania. E. Afr. agric. For. J. 1969 34 (2), p. 263-276.

STIRLING, H.G. (1971)

A comparison of storage costs for structures of different materials. Trop. stored Prod. Inf., 1971 (22), p. 31-33. Table. Based on U.K. prices in 1970-71 but takes tropical conditions into account.

TROPICAL STORED PRODUCTS CENTRE (1972)

Underground storage of crops: a selected bibliography. Trop. stored Prod. Inf., 1972 (23) p. 45-46. 7 refs on traditional methods 1920-70; 15 on modern methods 1939-67.

WEBB, E.R. (1969)

A crop dryer and grain storage silo for the small farm. Ibadan, Ministry of Agriculture & Natural Resources, 1969. 31p.

3.2.2.2.

Crops, Loss Factors, Storage Conditions, Storage Structures and Equipment Structures, ---- EQUIPMENT (MACHINERY, ETC)

APPROPRIATE TECHNOLOGY (1974-)

London: Intermediate Technology Development Group. Quarterly. "Aimed at field workers who are concerned in developing 'intermediate technology' equipment for use at village level in developing countries."

ESMAY, M.L. and HALL, C.W. (Ed.).  
(1973)

Agricultural mechanisation in developing countries. xi + 221 pp, tabs, illus, ref. Publ. Sales Dept., Shin-Norinsha Co Ltd., 7-2 Chome, Kanda Nishiki-cho chiyoda-Ku, Tokyo, 102, Japan. Price \$9.00.

The eight chapters comprise: principles of agricultural mechanisation; mechanisation in Equatorial Africa; in Asia; in Latin America; ownership patterns for tractors and machinery; drying, storing and handling food grains in developing countries; irrigation; education and training for agricultural mechanisation. The chapter on drying and storing (Chap. 6 by Merle L. Esmay) covers the following: objectives; terminology; food grain losses; second generation problems; factors influencing storage and transportation; distribution and utilization of food grains; farmers' organisations; storage principles; drying principles; mechanical drying systems; a proposed flat bed batch dryer for paddy rice; storage requirements; grain storage; storage design; storage summary; storage programme recommendation; transportation; guide lines. Each chapter has a summary and a list of selected references. - Trop. storage Abstracts

GOUGH, M.C. and CALVERLEY, D.J.B.  
(1976)

The influence of tropical climates on flexible liners for welded mesh silos. Trop. stored Prod. Inf., 1976 (32), p. 25-31. illus., 2 refs.

Describes the effects of weathering in three tropical climates (hot/humid, hot/dry, uplands equatorial) on sheet materials fabricated from butyl, EPDM and a mixture of the two. For use as liners of welded mesh silos a black blend of butyl and EPDM and black polythene were found to be excellent.

TROPICAL CROP PROCESSING, DRYING AND STORAGE EQUIPMENT: (1975)  
A selection of machines, driers

and silos available for use in hot climates. World Crops, Sept/Oct 1975, 27 (5), p. 207-209, 211-214, 216.

Gives names and addresses of suppliers. Some details are given of types available, such as processing rate, power requirements, capacity. Machines mentioned include threshers, shellers, separators, hullers, crop driers. Brief notes are given on a number of crop storage and animal feed silos.

### 3.2.2.3.1.

Crops, Loss Factors, Storage Conditions, Storage Structures and Equipment Structures, ---- CLIMATE

BRITISH STANDARDS INSTITUTION.  
(1971)

Guide to hazards in the transport and storage of packages. London: BSI, 1971. 2v. (BS 4672)  
Pt.1 Climatic hazards 25p.  
Pt. 2 Climatic hazards (maps and diagrams) 63p.  
Examples are given from a range of climatic zones.

DAVEY, Pauline M. and ELCOATE, S. (1965)

Moisture content/relative humidity equilibria of tropical stored produce.  
Part 1 Cereals. Trop. stored Prod. Inf., 1965 (11), p. 439-467.

DAVEY, Pauline M. and ELCOATE, S. (1966)

Moisture content/relative humidity equilibria of tropical stored produce.  
Part 2 Oilseeds. Trop. stored Prod. Inf., 1966 (12), p. 495-512.

DAVEY, Pauline M. and ELCOATE S. (1967)

Moisture content/relative humidity equilibria of tropical stored produce.  
Part 3 Legumes, spices and



beverages. Trop. stored Prod. Inf., 1967 (13), p. 15-34. refs (in text).  
Commodities considered include beans, peas, soya beans.

MacKAY, P.J. (1967)

Theory of moisture in stored produce. Trop. stored Prod. Inf., 1967 (13), p. 9-14. 4 refs.

Discusses the importance of moisture content/relative humidity equilibrium and illustrates this in the case of several tropical products by means of a graph.

WARD, N. and CALVERLEY, D.J.B. (1972)

A literature survey on the climate relationships in stores. Trop. stored Prod. Inf., 1972 (23), p. 35-44.

"The survey is intended to cover work carried out on relationships between the ambient or outside climate, the macro-climate of the store, and micro-climate within the stored product" - Introduction.  
61 refs 1941-71.

### 3.2.2.3.2.

Crops, Loss Factors, Storage Conditions, Storage Structures and Equipment Structures, ---- PESTS, PESTICIDES

BAKER, A.A. and TAYLOR, R.W.D. (1974)

A review of the fumigation of railtrucks during transit in East Africa. Trop. stored Prod. Inf., 1974 (26), p. 17-32. illus. 19 refs 1952-1973.

BARNES, J.M. (1969)

Pesticide residues as hazards. PANS, 15 (1), p. 2-8.

Review article with some reference to residues in stored products.

BROWN, W.B. (1974)

Fumigation with methyl bromide

under gas proof sheets; 3rd ed rev. by H.K. Heseltine and R.H. Thompson. London, Ministry of Agriculture, Fisheries and Food, 1974. vii, 58p. £0.40  
Reviewed in Trop. stored Prod. Inf., 1974 (28), p. 51-52.

EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION. (1968)

Rep. int. Conf. "Prot. of stored Prod"  
Paris, 1968. 171p. £1.13.0

Many papers including "Infestation control of primary produce exported from tropical countries" by P.E. Wheatley.

FOOD AND AGRICULTURE ORGANIZATION. (1975)

Report on the second course of the FAO/SIDA/TANZANIA Sub-Regional Training Centre on storage pest control. Rome: FAO/SWE/TF, TF AFR 49 (SWE). v + 29 pp, 8 figs, 7 append.  
(Publ. UN:FAO, Via delle Terme di Caracalla, 00100-Rome, Italy.

The course was attended by 12 participants from eight countries: Botswana, Ethiopia, Lesotho, Malawi, Somalia, Swaziland, Tanzania and Zambia. Its objectives were to reinforce for participants the principles of grain storage and pest control, to give some practice in control techniques and provide experience in teaching and extension pest control. The course was based at the Faculty of Agriculture and Forestry of the University of Dar-es-Salaam at Morogoro. Visits were made to a number of storage locations to inspect stores and conduct exercises. The course concentrated on small scale storage pest control problems, although mention was made of pest control at all levels of storage. Data for a full scale evaluation of the course was collected throughout and the analysis of this data is being carried out in FAO, Rome. - Trop. storage Abstracts, 1976 (2), p. 28.

FREYBURG, G. (1972)

Schadilingsbekämpfung und Vorratschutz mit phosphorwasserstoff heute aktueller den (Pest control and stored product protection with phosphine today more up-to-date than before). (Germ.) Muhle, 1972, 109 (16), p. 244. Deals with the Detia Gas Ex systems employing phosphine.

GRAHAM, W.M. and KOCKUM, S. (1958)

Fumigation under a polythene envelope. Nature, Lond., 181 (4624), p. 1675.

GREAT BRITAIN. PEST INFESTATION CONTROL LABORATORY. (1973)

Pest infestation control: combining the report of the Infestation Control Laboratory 1968-70 and Pest Infestation Research, 1970. London: H.M.S.O., 1973. 205p. illus. fl.30.

Reviewed in Trop. stored Prod. Inf. 1974 (26), p. 3. Reviewer states "Although in the main directed towards problems arising in temperate conditions, much of the work is equally applicable to tropical and sub-tropical areas..."

HESELTINE, H.K. (1973)

A guide to fumigation with phosphine in the tropics. Trop. stored Prod. Inf., 1973 (24), p. 25-36. illus. 14 refs 1963-73.

HEUSER, S.G. (1975)

The occurrence and significance of bromide residues in food-stuffs in relation to fumigation practice. Trop. stored Prod. Inf., 1975 (29) p. 15-20. 21 refs 1946-73. Shows that the residue can arise from different sources, e.g. natural traces in the soil, and that they vary greatly in their mammalian toxicity.

KAMEL, A.H. (1974)

Storage pests. Proc. 1st FAO/SIDA Semin. Improv. Prod. Field Fd Crops Pl. Sci. from Afric. and Near E., Cairo, Egypt. 1-20 Sept. 1973, 1974.p. 585-593, 5 ref. (Author's address: Dr Abdel Hakim Kamel, Director, Stored Products Pests Research, Ministry of Agriculture, Dokki Giza, Arab Republic of Egypt).

Begins with a brief description of main storage facilities in Egypt, comprising: 'Shounas' - areas of land, enclosed by walls or fences and usually uncovered; underground storage - sand ditches and pits; room-type stores usually of unbaked bricks; mud and chaff built bins of 1-15 tons capacity; terminal elevators. Emphasizes need for a grain storage programme. Brief notes are given on insects attacking stored cereals, leguminous seeds and flour and milled products. Sources of infestation are discussed, and recommended control measures include store hygiene, residual insecticide sprays on store fabric, dusting of stacks, and fumigation of infested stacks using carbon disulphide, hydrogen cyanide, methyl bromide or phosphine. There are also notes on rodent pests - seven species are named, and recommendations for control include proofing, inspection, baiting, fumigation and store hygiene. Recommendations are also made for control of bird pests - mainly sparrows. - Trop. storage Abstracts.

LEVER, B.G. (1970)

Agricultural extension in Botswana. Reading: Univ. of Reading, Dept. of Agricultural Economics, 1970. 140p. bibl. (Development Study no. 7, Feb. 1970). Abstract of section on crop storage pests, Trop. stored Prod. Inf., 1970 (20), p. 41. The majority of farmers failed to appreciate the need for either insecticides or storage hygiene.

MUNRO, J.W. (1966)

Pests of stored products.  
Hutchinson, 1966. 234p. illus.

NGATIA, C.M. and WARUI, C.M.  
(1976)

Pest control in Mombasa - island and port - a function of the Storage and Infestation Control Survey - Mombasa Unit. Kenya Ent. Newsl., 1976, (3), p. 16-23, illus. (Authors' address: Officer-in-charge, Infestation Control Survey, P O Box 80126, Mombasa, Kenya).

Describes the work of the Unit, which is designed to preserve Mombasa port as an insect pest-free quarantine area. Regular inspections are made of ships and port warehouses, and of import and export cargoes, and recommendations made regarding insecticidal treatments. In addition, regular inspections are made of godowns (warehouses) outside the port area, and storekeepers are advised of any infestation detected. The authors point out that difficulties arise, and in pursuit of their duties staff are more likely to make enemies than friends. - Trop. storage Abstracts.

NIGERIAN STORED PRODUCTS  
RESEARCH INSTITUTE. (1968)

Annual report, 1967. Lagos, Nigerian Stored Products Research Institute, 1968. 158p.

Contains 19 technical reports including:-

Cornes, M.A. and Oyeniran, J.O.: Fumigation of maize in an aluminium silo using a 1:1 carbon tetrachloride: ethylene dichloride mixture. Cornes, M.A., Adeyemi, S.A.O., and Qureshi, A.H.: An assessment of the value of phosphine and ethylene dibromide for the control of pests in grain stored in polythene lined sacks. Qureshi, A.H.: Effects and persistence of dichlorous vapours liberated from Vapona pest strips on Tribolium castaneum Herbst and other stored products pests.

Cornes, M.A.: New records of insects associated with stored products in Nigeria. Part 2. Qureshi, A.H.: An assessment of woven polythene bags for handling produce under Northern Nigerian conditions.

PAGE, B. G. and THOMSON, W.T.  
(1971)

The 1971 insecticide, herbicide, fungicide quick guide. Fresno, Calif., Thomson publications, 1971. v, 157p.

Looseleaf. Includes pesticides suitable for use on agricultural premises.

PREVETT, P.F. (1975)

Stored product pests causing losses of stored food. FAO Pl. Prot. Bull., 23 (3/4), p. 115-117. (Author's address: Tropical Stored Products Centre (TPI), London Road, Slough SL3 7HL. England).

Discusses various estimates of losses in stored foodstuffs, especially at farm level. Insects are the most important agents responsible for post-harvest losses, principally Lepidoptera and Coleoptera. Principal pests in the Lepidoptera are given as Sitotroga cerealella, Ephestia (Cadra) cautella, Plodia interpunctella and Ephestia (Anagasta) kuehniella. The various factors influencing the amount of damage caused by insects are examined, in relation to control. These include pre-harvest and pre-storage infestation, drying and handling, choice of variety and proximity of growing area to storage premises. Discusses extension programmes in relation to the use of insecticides. The difficulties resulting from insecticide resistance are noted. The insecticides most commonly used to protect stored grain are lindane, malathion and pyrethrins. In a recent global survey of resistance, it was found that resistance to lindane occurred in all pest insects - Sitophilus oryzae, S. zeamais, S. granarius, Rhyzopertha dominica,

Tribolium castaneum, T. confusum, Oryzaephilus surinamensis and O. mercator., and malathion resistance was almost equally widespread. There is also evidence of resistance to fumigants (methyl bromide and phosphine) in practical conditions. Losses caused by microorganisms, birds and rodents are mentioned, and the need for general improvement in post harvest techniques, combined with adequate training, is stressed. - Trop. storage Abstracts, 1976 (2), p. 26-7.

PRICE JONES, D. and SOLOMON, M.E. (eds) (1974)

Biology in pest and disease control; the 13th Symposium of the British ecological soc., Oxford, 4-7 Jan. 1972; Wiley, 1974. Includes bibliog.

SCHMÜTTERER, H. (1971)

Contribution to the knowledge of the crop pest fauna in Ethiopia. Z. angew. Ent., 1971 67 (4), p. 371-389. bibliog. Includes storage pests. Reviewed in Trop. stored Prod. Inf., 1971 (22), p. 60.

SCHULTEN, G.G.M. (1974)

Pesticides and post-harvest control. Lect. 12th int. Summer Course Industrialisation, 9 August 1974, The Hague, Netherlands, duplic. 22 pp, refs. (Author's address: Department of Agricultural Research, Royal Tropical Institute, 63 Mauritskade, Amsterdam-Oost, The Netherlands).

A general review of storage problems. The various forms of losses are examined and there is a brief discussion on the assessment of losses in storage. The effect of moisture is noted, and the maximum moisture contents for safe storage of a number of selected commodities e.g. maize, paddy, cowpeas, are given. The most important

stored products insect pests are listed and there is discussion of infestation by insects and mites. There are notes on micro-organisms and mycotoxins, and on the common rodent pests. Storage methods for unshelled produce are mentioned as well as underground storage and airtight storage. There is a general discussion on pesticides, and specific notes on malathion, lindane, pyrethrins, dichlorvos and the use of inert materials. The importance of the CT product in fumigation is emphasized, and there are notes on the use of methyl bromide, phosphine, and liquid fumigants. Other pesticides mentioned are the acute and chronic rodenticides, and the fungicide propionic acid. Finally it notes that the development of resistance to pesticides and even fumigants has been demonstrated in a recent world survey carried out under the auspices of the FAO. - Trop. storage Abstracts, 1975 (3), p. 41.

SINHA, R.N. (1974)

Climate and the infestation of foodstuffs by pests. 1st Int. Working Conf. stored Prod. Ent. Oct. 7-11 1974, Savannah, Georgia, USA. (Abstract only). (Author's address: Research Station, Canada Department of Agriculture, Winnipeg, Manitoba, Canada).

Climate plays an important if not crucial role in determining whether cosmopolitan pests of stored foodstuffs will become established in a food-storing region of the world. Using a recognized climatic classification of regions where major cereal and food crops are produced, the characteristic patterns of infestation of storage insects and mites predominant in these regions are examined. Heterogeneity of species distribution and variation in insect density corresponding to diversity of climatic conditions within a region, such as in Kenya, in East Africa and Uttar Pradesh in India are emphasized. The climatic

conditions during harvest of various wheat producing regions are analysed and considered an important factor in setting the pattern of post-harvest deterioration of stored grain. Laboratory data on physical limits of Sitophilus, Rhizopertha, Sitotroga, Cryptolestes and other major storage pests were correlated to climatic data of selected regions to postulate certain basic patterns of distribution and infestation of major storage insect pests. How the basic relationships between climate variables and infestation records can be used to predict potential insect outbreaks is illustrated by a deductive multivariate analysis of 3 years' insect infestation data from 41 crop districts in the Canadian Prairies. - Trop. storage Abstracts, 1975 (3), p. 43.

SWARRAY, K.A.D. (1971)

Pest control in Sierra Leone. Paper presented to the 1st annual conference of the Agricultural Society of Sierra Leone, 17-19 Sept., 1971. (Pest Control Technical Papers - no 2 of 1971)

SWEENEY, R.C.H. (1965)

Stored product work in Malawi. Trop. stored Prod. Inf., 1965 (10), p. 371-376. illus., 11 refs, 1954-63. Outlines the history of stored product infestation control in Malawi.

WHEATLEY, P.E. (1968)

Infestation control of primary produce exported from tropical countries. Rep. int. Conf. "Prot. of stored Prodd.", Lisbon-Oeiras 1967, p. 97-102. (E.P.P.O. Publns Ser. A, No. 46-E.)

WHITNEY, K.W. (1974)

A general survey of physical means for control of storage pests. Symp. 1st int. Working Conf. stored Prod. Ent.

Oct. 7-11, 1974. Savannah, Georgia, USA. (Abstract only). (Author's address: Cyanamid International, Princeton, New Jersey, USA).

Storage pest control by physical means is the oldest method known and is still one of the most important. This survey deals with the following topics: current agronomic practices as related to storage; physical exclusion of pests; addition of chemically-inert solids; modification of the storage atmosphere; modification of moisture and temperature; physical impact such as turning and use of the Entoleter; radiation such as sound, visible light, UV, IR, radio-frequency and ionizing radiation; host-plant resistance; integration and interactions of physical control methods with other methods; and the future prospects for physical control. - Trop. storage Abstracts, 1975 (3), p. 45-6.

3.2.2.3.2.1.

Crops, Storage Losses, ----  
INSECTS, INSECTICIDES

AGRICULTURAL RESEARCH COUNCIL.  
PEST INFESTATION LABORATORY  
(1969)

Pest Infestation Research 1969: the report of the Pest Infestation Laboratory. Slough: Pest Infestation Laboratory; London: H.M.S.O., 1970. iv, 70p. illus., refs.

Reviewed in Trop. stored Prod. Inf., 1970, (20), p. 39. Includes insects infesting farm stores; insecticide resistance - particularly to development in Tribolium castaneum of resistance to lindane and malathion in several countries.

AITKEN, A.D. (Ed) (1975)

Insect travellers. Vol. 1 Coleoptera. London: H.M.S.O., 1975. xvi, 191p. (Ministry of Agriculture, Fisheries and Food, Technical Bulletins - no. 31)  
Reviewer (C.P. Haines) in Trop. stored Prod. Inf., 1976 (31),

p. 55-56, says that the great majority of tropical storage species are listed and that it is the most complete catalogue of storage pests with full annotation that he has seen.

JAY, E.G. and PEARMAN, G.C. junior (1971)

Susceptibility of two species of *Tribolium* (Coleoptera, Tenebrionidae) to alterations of atmospheric gas concentrations. J. stored Prod. Res., 1971 7 (3), p. 181-186.

ASHMAN, F. and KEMPTON, R.J. (1967)

Stability of malathion dilute dust formulations manufactured in Kenya. E.Afr. agric. For. J., 33 (2), p. 212-218.

BURGES, D.H. and others (1962)

The increasing importance of certain moth pests. Trop. stored Prod. Inf., 1962 (5), p. 174-176. Despite the use of fumigants some moth pests have become more prominent. This leads to a re-examination of the biology of the moths. The subject is also dealt with at some length in the Editorial, p. 153-4.

CARMI, Y. (1974)

The toxicity of pirimiphos-methyl to *Ephestia cautella* (Wlk.). Prog. Rep. Israel Minist. Agric., Inst. Technol. Storage agric. Prod., Div. stored Prod. for yr 1973/74, p. 77-80 in Hebrew, Eng. summ. X, No 10. (Author's address: Ministry of Agriculture, Agricultural Research Organization, Institute for Technology and Storage and Agricultural Products, Division of Stored Products, Yafu, Israel).

The toxicity of pirimiphos-methyl to *E. cautella* was compared with that of three common insecticides, malathion, lindane and baythion. Each insecticide was mixed with wheat grain at dosages of 2,

4 and 8 ppm. Two sizes of larvae were used; small, up to 3mm long; large, over 5mm. The insects were exposed to grain for 24 hr, after which mortality counts were taken. Toxicity indicated was: baythion, pirimiphos-methyl, malathion, lindane in decreasing order. The toxicity of pirimiphos-methyl was almost equal to that of baythion at the 8 ppm level, but less at the lower levels. Differences were found in the susceptibility of the two sizes of larvae. With pirimiphos-methyl and baythion, the small larvae were the more susceptible; with lindane and malathion the small larvae were the more resistant at 4 and 8 ppm, but more susceptible at 2 ppm. A special note is made that lindane was slightly less toxic than malathion, which is known to be inefficient for moth control. - Trop. storage Abstracts.

CHADDICK, P.R. and FILCE LEEK, F. (1972)

Further specimens of stored products insects found in ancient Egyptian tombs. J. stored Prod. Res., 1972, 8 (1), p. 83-86.

COYNE, F.P. (1970)

Weevils cost Kenya £1,000,000. Kenya Farmer, 1970, (170), p. 7-8.

DAVEY, Pauline M. (1965)

Insect pests of stored products in the tropics and the commodities and conditions in which they occur. Trop. stored Prod. Inf., 1965, (10), p. 377-386. Bibl.p378-386 (58 entries); contains two tables in which the knowledge of the pests is summarised and reference is made to the items in the bibliography on each pest.

DONNELLY, J. (comp.) (1970)

Handbook of agricultural insecticides available in Nigeria.

2nd ed. rev. by S.A.O. Adeyemi. Ibadan: Ministry of Agriculture and Natural Resources (Western Nigeria) and Entomological Society of Nigeria, 1970. vii, p. 569.

Reviewed in Trop. stored Prod. Inf., 1971, (22), p. 52.

DYTE, C.E. (1970)

Insecticide resistance in stored-produce insects with special reference to Tribolium castaneum. Trop. stored Prod. Inf., 1970, (20), p. 13-18. 16 refs 1958-70.

DYTE, C.E. (1974)

Problems arising from insecticide resistance in storage pests. (Paper presented at the EPPO Conference on storage pests and diseases, Paris, 11-14 June 1974). EPPO Bull., 4 (3), p. 275-89, 7 tabl, ref. (Author's address: Pest Infestation Control Laboratory, London Road, Slough SL3 7HL, England).

A survey of the occurrence of insecticide or fumigant resistant strains of stored-product insects is given. Studies on the geographic distribution of insecticide resistance show that in some cases resistance is localised, and in others it is almost universal. Tribolium castaneum is known to be resistant to lindane in 71 countries, and lindane-resistant strains of Oryzaephilus surinamensis, Rhyzopertha dominica, Sitophilus oryzae and Sitophilus zeamais occur in over 30 countries. Malathion-resistant T. castaneum strains are known from 70 countries, and T. confusum and R. dominica resistant to malathion are known from 25 countries. Resistance to fumigants appears to be uncommon but field strains resistant to methyl bromide, phosphine or ethylene dibromide have been reported. Cross-resistance has been studied in a few strains, but malathion resistance may involve resistance to other organophosphorus compounds in at least 6 species. Although

resistance to pyrethroids and juvenile hormone analogues is known, these compounds show promise for future use against storage pests. - Trop. storage Abstracts

FAO: WORKING PARTY OF EXPERTS ON THE RESISTANCE OF PESTS TO PESTICIDES. (1974)

Recommended methods for the detection and measurement of resistance of agricultural pests to pesticides. Tentative method for adults of some major beetle pests of stored cereals with malathion or lindane. FAO Method No 15. FAO Pl. Prot. Bull., 22 (5/6), p. 127-137, 31 fig, 4 append.

Test methods are described for detecting resistance to malathion or lindane in Sitophilus oryzae, S. zeamais, S. granarius, Rhyzopertha dominica, Tribolium castaneum, T. confusum, Oryzaephilus surinamensis and O. mercator. The methods are similar in principle and basic detail to the FAO method prescribed for T. castaneum, and depend on exposure of adult insects to insecticide-impregnated papers. Responses are judged after 5 to 6 or 24 hours, according to the speed of action of the insecticides. Base line data are established with known susceptible strains. It is then possible to select discriminating concentrations which can be used to screen samples of beetles for resistance. Survival in such tests is a danger signal calling for more extensive testing to define the degree of resistance present. - Trop. storage Abstracts, 1975 (5), p. 63-4.

FAO: WORKING PARTY OF EXPERTS ON THE RESISTANCE OF PESTS TO PESTICIDES. (1975)

Recommended methods for the detection and measurement of resistance of agricultural pests to insecticides. Tentative method for adults of some major pest species of stored cereals, with methyl bromide and phosphine. FAO Method No 16, FAO Pl. Prot.

Bull., 23 (1), p. 12-25, 6 fig,  
5 append.

A test method is described for detecting and measuring resistance to the fumigants methyl bromide and phosphine in Sitophilus oryzae, S. zeamais, S. granarius, Rhyzopertha dominica, Tribolium castaneum, T. confusum, Oryzaephilus surinamensis and O. mercator.

The method is based on exposure of adult insects to discrete atmospheres containing fumigant. Exposure periods are 5h for methyl bromide and 20h for phosphine. Responses are determined 14 days following termination of the exposure.

Base-line data are established with reference strains of known susceptibility from which it is possible to select discriminating doses that may be used to monitor samples of beetles for resistance. Survival in such tests is indicative of resistance, following which extensive testing should be carried out to determine the degree of resistance present. - Trop. storage Abstracts

FRINGS, H. and FRINGS, M.  
(1971)

Sound production and reception by stored product insect pests: a review of present knowledge. J. stored Prod. Res., 1971, 7 (3), p. 153-162.

GILES, P.H. (1969)

Observations in Kenya on the flight activity of stored product insects, particularly Sitophilus zeamais Motsch. J. stored Prod. Res., 4 (4), p. 317-329.

HALSTEAD, D.G.H. (1967)

A new genus and species of Lathridiini (Coleoptera: Lathridiidae) from farm stores in Kenya. Proc. R. ent. Soc. Lond., B. 36 (11-12), p. 177-180.

HANI-SOLIMAN, M. and HARDIN, R.T. (1972)

Variation in populations of Tribolium castaneum (Herbst) (Coleoptera, Tenebrionidae)

Developmental rate and productivity. J. stored Prod. Res., 1972 8 (1), p. 1-10.

HILL, Dennis S. (1975)

Agricultural insect pests of the tropics and their control. Cambridge, 1975.

Bibliography p. 473-84.

KARNAVAR, G.K. (1971)

Mating behaviour and fecundity in Trogoderma granarium (Coleoptera: Dermestidae). J. stored Prod. Res., 1971, 8 (1), p. 65-69.

KEM, T.R. (1975)

Studies on the development of resistance to phosphine in Tribolium castaneum (Herbst). Ph.D. Thesis, Indian agric. Res. Inst., Ent. Newsl., India, 5 (2), p. 6-7. (Summary only). (Division of Entomology, Indian Agricultural Research Institute, New Delhi - 110012, India).

The thesis reports the results of investigations carried out in the laboratory on the selection of a phosphine-resistant strain of T. castaneum and its cross-resistance characteristics. By selection over ten generations, a strain was obtained which was 11.95 times more resistant than the normal susceptible strain. Bioassay tests with other fumigants did not reveal cross-resistance to EDCT mixture, ethylene dichloride, carbon tetrachloride, carbon disulphide, ethylene dibromide or methyl bromide. No cross resistance was observed in tests with eleven insecticides which included malathion, iodofenphos and pyrethrins. - Trop. storage Abstracts, 1975 (4), p. 53-4.



LAMB, K.P. (1973)

Economic entomology in the tropics. London: Academic P., 1973. 195p.

Reviewed in Trop. stored Prod. Inf., 1974 (28), p. 50-1.

The reviewer states that information on post-harvest pests is scant and incomplete in relation to that on other pests.

LE PELLEY, R. (1969)

Agricultural insects of East Africa. Nairobi, East Africa High Commission, 1969.

LINDGREN, D.L., SINCLAIR, W.B. and VINCENT, L.E. (1968)

Residues in raw and processed foods resulting from post-harvest insecticide treatments. Residue Rev., 1968 21 121p.

McFARLANE, J.A. (1963)

Prospects for pyrethrum with particular reference to its use in the control of pests of stored foodstuffs. Trop. stored Prod. Inf., 1963 (6), p. 202-212. 24 refs, 1948-62.

Describes the research undertaken into the use of pyrethrins and discusses the cost factor. Concludes that the cost factor is the major factor limiting their use though this is to some extent compensated for the the safety factor.

McFARLANE, J.A. (1968)

The productivity and rate of development of Sitophilus oryzae (L) in various parts of Kenya. J. stored Prod. Res., 1968 4 (1), p. 31-51.

McFARLANE, J.A. (1969)

Stored products insect control in Kenya. Illus. Trop. stored Prod. Inf., 1969, (18). Includes a review of previous research and lists 31 references 1948-69 including unpub-

lished works.

McFARLANE, J.A. (1969b)

The effects of synergised pyrethrins and lindane on pre-emergence mortality of Acanthoscelides obtectus (Say.). J. stored Prod. Res., 1969 5 (2), p. 177-180.

McFARLANE, J.A. and WARUI, C. (1973)

A simple technique for stored products infestation surveys. Trop. stored Prod. Inf., 1973 (24), p. 17-24. illus. Describes an insect trapping method used in Mombasa. 2 refs 1970.

MPHURU, A.N. (1974)

Araecerus fasciculatus De Geer (Coleoptera: Anthribiidae): a review. Trop. stored Prod. Inf., 1974 (26), p. 7-15. illus.

Whilst primarily a pest of coffee and cacao it attacks a wide variety of crops - these are listed under countries in Table 1. 71 refs 1775-1970.

NYIIRA, Z.M. (1970)

Infestation of cereals and pulses in the field by stored products insects and two new records of stored products Coleoptera in Uganda. E.Afr. agric. for. J., 1970, 35 (4), p. 411-413.

PARKIN, E.A. (1957)

A provisional assessment of malathion for stored product insect control. Trop. stored Prod. Inf., 1960 (2), p. 38-43. A summary of information given by Dr Parkin in a paper given at the IVth International Congress of Crop Protection, Hamburg, 1957 which was published in J. Sci. Fd. Agric., 1958 (6), p. 370-375. Includes "Code of practice on the use of malathion on stored foodstuffs in Colonial territories".

PREVETT, P.F. (1966)

Observations on the biology of six species of Bruchidae (Coleoptera) in Northern Nigeria. Entomologist's mon. Mag., 1966 102 (1226-1228), p. 174-180.

PROCTOR, D.L. (1970)

An annotated list of arthropods associated with stored food products in Zambia. London: Tropical Products Inst., 1970. 10p. (Tropical Products Inst., report no. L 18).

RAPPORT d'activite de la Commission d'Evaluation des Pestes dans les Denrees Stockees crie a l'issue du Congres de Marseille sur la Protection des Cultures Tropicales.

Aglon. trop. Nogent, 1969, 24 (9), p. 872-876.

Discusses methods of determining losses caused by insects, sampling methods and methods of expressing results.

SABA, F. and LABORIUS, A. (1976)

Vorratsschadliche Insekten in Marroko (Stored product insect pests of Morocco). Anz. Schadlingsk., 1976, 49 (10), p. 149-153. illus., 6 refs. Contains English summary. Over a period of 3 years 48 Lepidoptera and Coleoptera were detected from markets, storage places, houses, etc; 17 are important economically.

SWEENEY, R.H.C. (1962)

Insect pests of stored products in Nyasaland. Zomba: Dept. of Agriculture, 1962. 50p.

TAYLOR, T.A. and AGBATE, L.A. (1974)

Flight activity in normal and active forms of Callosobruchus maculatus (F) in a store in Nigeria. J. stored Prod. Res., 10 (1), p. 9-16, 4 fig, ref. (Authors' address: Department of Agricultural

Biology, University of Ibadan, Ibadan, Nigeria).

A suction trap was run continuously in a Nigerian store containing cowpeas in order to capture flying adults of Callosobruchus maculatus. Of the 211 adults caught, 149 were females and 135 of these were of the active form. Adults were also removed from in all, 8 kg of cowpeas sampled on four occasions from the store, and in these only one-third of the adults were active females. The numbers of adults caught by the traps were recorded hourly and from these records using probability paper, two peaks of flight activity were detected, a small one with a mean at 07.20 hr - 260 min. and the main one at 17.50 hr - 110 min. The beetles flew throughout the day and night with no inhibition by low light intensity. Temperature appears to be the most important factor and peak flight activity occurred at highest temperatures and low relative humidity. The first small peak activity in the morning was ascribed to the rise in temperature above the low ambient night temperatures which are probably lower than the threshold for the species. - Trop. storage Abstracts, 1974 (3), p. 44.

WALKER, D.J. and BOXALL, R.A. (1974)

An annotated list of the insects associated with stored products in Ethiopia, including notes on mites found in Harar Province. E. Afr. agric. For. J., 39 (3), p. 330-335, 8 refs. (Authors' address: Tropical Stored Products Centre, London Road, Slough SL3 7 HL, England).

This list was compiled during 1971-72, in the course of an investigation into grain storage practices in Ethiopia, sponsored by the Freedom from Hunger Campaign, England. It comprises insects collected by the authors during the period, and a review of storage records published by

previous authors. The insects were collected over a very wide area from a variety of storage structures ranging from the small farmer's baskets to large dock warehouses. The mites were only collected in Harar Province. Among the insects listed, the following Orders are represented: Coleoptera, Dictyoptera, Hemiptera, Hymenoptera, Lepidoptera, Thysanura and among mites, Astigmata, Mesostigmata and Prostigmata. There are brief notes on the commodities with which the various arthropods are associated, and some comments on the distribution and frequency of the various species. - Trop. storage Abstracts

WARUI, C.M. (1976)

Insecticide resistance in field strains of Tribolium castaneum collected in Mombasa, Kenya, 1973/74. Kenya Ent. Newsl., 1976, (3), p. 10-16, 3 tabl. (Author's address: National Agricultural Laboratories, P O Box 30028, Nairobi, Kenya).

Samples of Tribolium castaneum and other storage insects were collected from ships and stores in Mombasa port, which is designated as a quarantine area, and where, therefore, stores are regularly treated, mainly with malathion as a fabric spray. T. castaneum samples were compared with known susceptible strains, using malathion, lindane, fenitrothion and pirimiphos methyl. A high degree of malathion specific resistance was found in the Mombasa strains, and there was some degree of cross-tolerance. Fenitrothion showed promise as an alternative to malathion, but it is noted that continued use of any single spray protectant is likely to end in development of resistance. - Trop. storage Abstracts.

WATTERS, F.L. (1972)

Control of storage insects by physical means. Trop. stored Prod. Inf., 1972 (23), p. 13-28. illus.  
Alternatives to chemical insecticides such as electromagnetic energy, temperature and sound are described.  
104 refs 1893-1972.

WOOD, D.L. and others, (editors) (1970)

Control of insect behaviour by natural products, edited by D.L. Wood, R.M. Silversten and M. Nakajima. London: Academic P., 1970. 346p.

Chapters dealing with stored products insects include:-  
BURKHOLDER, W.C. Pheromone research with stored-product coleoptera.  
NAKAJIMA, M. Fr. Studies on sex pheromones of the stored grain moths.  
YAMAMOTO, I. and YAMAMOTO, R. Host attractants for the rice weevil and cheese mite.

### 3.2.2.3.2.2.

Crops, Storage Losses, ----  
RODENTS, RODENTICIDES

BUENA conservacion y manejo = buenos pesos (II parte), (Good storage management leads to increased profits).

Boln ANDSA, 1974 4 (43), p4-5. (Span.). (Publ: Almacenes Nacionales de Deposito, S.A., Organizacion Nacional Auxiliar de Credito, Plaza de la Constitution No 7, Mexico 1, D.F.).

Comments on the importance of rodent infestation and its effect on the quality of stored foods, such as contamination by hair, urine and excreta. Rodents are known to transmit at least 10 diseases of man. A description is given of the three most important rodent species in Mexico, Rattus norvegicus, Rattus rattus, and Mus musculus. Various control methods are discussed, and it is pointed out

that poisons used in control methods should be specific, and not affect the grain. The economic implications are mentioned. Precautions to be taken during handling and application are listed. The use of fumigants is discussed, and commercial types available are named - methyl bromide, carbon tetrachloride/carbon bisulphide 4:1 mixture and phosphine. The use of plastic gas-proof sheets is discussed and a description of a phosphine fumigation is given. Other rodent control methods noted include rodent proofing and traps. As regards baiting, reference is made to rats' need for water, and a simple bait container which does not allow access to children and domestic animals. - Trop. storage Abstracts.

FOOD AND AGRICULTURE ORGANIZATION AND WORLD HEALTH ORGANIZATION. (1973)

Bibliography on rodent pest biology and control, 1950-1959. Rome: FAO and WHO, 1973. 2v. Part I v, 210p. Part II iii, 211-448p. Contains 3791 entries in continuation of the previously published bibliography covering 1960-1969.

"...refers to articles dealing with rodent taxonomy, distribution, ecology, biology and behaviour, as well as those concerning rodent damage to stored food products, agriculture and forestry, rodents as carriers of human and animal disease, and the public health importance of rodents and their ectoparasites. Articles are also listed on measures, methods and materials for the control of rodents and their ectoparasites" - Introduction.

Note: the 1960-1969 bibliography is by WHO and FAO (not FAO and WHO).

FRANTZ, S.C. (1976)

The web of hunger: Rats in the granary. Nat. Hist., 85 (2), p. 10-21. (Author's address:

The John Hopkins University, International Centre for Medical Research, 550 N. Broadway, Suite 115, Baltimore, Maryland 21205, USA).

Describes studies on the biology of Bandicota bengalensis, the lesser bandicoot rat, with special reference to grain stores in India. Points out that badly maintained buildings lack of hygiene, and poor handling of bagged grain leading to spillage, combined with the rodent's inherent fertility, have resulted in build-up of large populations in many Indian cities. Some estimates of the grain losses caused by these rodents are given. Points out that poisoning and trapping will not necessarily reduce the effective breeding population. Suggests that the most useful means of managing urban rodent populations is environmental manipulation, i.e. elimination of rodent access to food, repair of structural defects, removal and disposal of accumulated trash, blockage of passages, hygienic disposal of garbage and sewage. Such cheap, labour intensive and culturally adapted methods are most appropriate in the existing situation. Trop. storage Abstracts, 1976 (3), p. 34-35.

"FRÖHLICH, Gerd. and others. (1970)

Pests and diseases of tropical crops and their control; tr. by H. Liebscher and F. Koehler; ed. by H. Liebscher. Oxford: Pergamon, 1970. ix, 371p. bibliogs. Includes a survey "Pests of stored food and their control" pp. 314-325.

GREAT BRITAIN. PEST INFESTATION LABORATORY (1976)

Control of rats and mice: reference manual for pest control personnel. Surbiton: Pest Infestation Control Laboratory, 1976. v, 97p. illus, bibliog. Produced in cooperation with

the Local Government Training Board.

Written primarily for use in Britain but the general principles of control are universal.

HOPF, H.S., MORLEY, G.E.J. and HUMPHRIES, J.R.O. (Editors) (1976)

Rodent damage to growing crops and to farm and village stores in tropical and sub-tropical regions: results of a postal survey 1972-73. London: Centre for Overseas Pest Research and Tropical Products Institute, 1976. vi, 115p.

PINGALE, S.V. (1970)

Mechanical proofing against rodents. Bull. Grain Technol., 1970, 8 (3), p. 89-91.

TAYLOR, K.D. (1963)

Rodent control with special reference to the use of poisons. Trop. stored Prod. Inf., 1963, (6), p. 222-225. No refs.

Shows that the principal rodent pests of stored products in tropical countries are usually the same as those in temperate regions.

TROPICAL STORED PRODUCTS CENTRE (1974)

Tropical stored Products Information, 26, 1974. News Review includes:- "Rodents and Sacks", "Recent FAO activities on grain storage" (this includes a note about a bibliography on rodent pest biology and control\*) and a review of "Pest infestation control. Combining the report of the Infestation Control Laboratory 1968-70 and Pest Infestation Research, 1970 by the Director of the Pest Infestation Control Laboratory". (q.v.).

\*See FOOD AND AGRICULTURE ORGANIZATION AND WORLD HEALTH ORGANIZATION; Also WORLD HEALTH ORGANIZATION AND FOOD AND AGRICULTURE ORGANIZATION.

WOODS, Arthur (1974)

Pest control: a survey; consulting ed: D.L. Lee. Wiley 1974. (xiii), 407p. Bibliog. p. 361-82. Advocates the use of integrated crop control measures. Contains some reference to storage pests and discusses the difficulty of expressing crop losses.

WORLD HEALTH ORGANIZATION AND FOOD AND AGRICULTURE ORGANIZATION. (n.d.)

Bibliography on rodent pest biology and control, 1960-1969. (Rome): WHO and FAO, n.d. 4v. (VCB/71.9) Part I (i), iii, 232p. Prepared by FAO and previously issued, in 1970, as document VBC/70.18. Part II (iii), 242p. Part III (i), iii, 267p. Part IV (iii), 206p.

Parts II-IV prepared by WHO.

Over 7,000 refs "... on rodents ... distribution and taxonomy, ... rodent biology, ecology and behaviour, the economic importance of rodents in relation to stored food products, ... and on measures, methods and materials for rodent control" - Introduction.

Note: a continuation covering the period 1950-1959 was prepared by FAO and WHO (not WHO and FAO).

Copies of each available on request substantiated by a statement of need from: Dr. H.R. Shuyler, Crop Storage Pest Control Officer, FAO-UN, Via delle Terme di Caracalla, 00100 - Rome, Italy.

3.2.2.3.2.3.

Crops, Storage Losses, --- FUNGI, FUNGICIDES

CLARKE, J.H. (1968)

Fungi in stored products. Trop. stored Prod. Inf., 1968 (15) p. 3-14. illus., 46 refs 1935-1968. Outlines the occurrence and

and significance of fungi in stored products and some methods for their isolation.

#### 3.2.2.4.

##### Crops, Storage Losses, ---- QUALITY CONTROL

GOLOB, P. (1976)

Techniques for sampling bagged produce. Trop. stored Prod. Inf., 1976 (31) p. 37-48. illus. 6 refs. 1969-72.

GOLOB, P. and NICHOLS, W. (1975)

The design and development of the TPI produce inspection sieve. Rep., Trop. Prod. Inst. No L.42 iv + 10pp, 3 tabl, 4 fig, 1 pl, append. ISBN: 0 85954 0391 (Authors' address: Tropical Products Institute, 56/62 Grays Inn Road, London WC1X 8LU, England).

Describes the development of a sieve which deals with large samples of a commodity, i.e. whole sacks. It eliminates in-sack variations in factors such as broken grain, insects and dust, which often occur in isolated pockets. Some advantages claimed are: that the sieve permits a visual inspection of the commodity in each sack; a composite sample may be taken by hand from all parts of the commodity as it flows over the sieve; dust, broken grains, etc. can be collected and weighed as an indication of the degree of damage; insects can be isolated, and very small numbers, e.g. 5-10 insects per sack can be detected. Tests of the sieve using coffee beans are described. An average 60 kg sack could be sieved in 2 min. 20 sec. It is concluded that satisfactory results were obtained with coffee, and that the sieve would probably perform equally well with other commodities. - condensed from Trop. storage Abstracts, 1975 (3) p. 37.

##### INTERNATIONAL ORGANISATION FOR STANDARDISATION. (1969)

ISO recommendation R950. Cereals. Sampling (as grain) 1969.  
ISO recommendation R951. Pulses. Sampling. 1969.  
ISO recommendation 2170. Cereals and pulses - sampling of milled products.

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