The Journal of Agricultural Science

Now published eight times a year, this leading journal is concerned with the advance of agriculture and the use of land resources throughout the world. It publishes original scientific work related to strategic and applied studies in all aspects of agricultural science, including agronomy and crop physiology, breeding, genetics and pathology, soil science, animal nutrition, physiology and genetics, and the mathematical and statistical methods used in experimentation and data analysis. The journal also publishes book reviews and invited short reviews of scientific topics of current relevance.

Recent Articles

Crops and soils

Inter-plot interference and nearest-neighbour analysis of field experiments

AINSLEY, A. E., DYKE, G. V. & JENKYN, J. F.

A comparison of the responses of two cultivars of lateautumn-sown wheat to applied nitrogen WEBB, J. & SYLVESTER-BRADLEY, R.

Quantitative selection for compact, high-yielding maize hybrids

ZHANG, J. H., LUO, Y. N., WANG, Z. X. & GAO, X. Z.

Five years of straw incorporation and its effect on growth, yield and nitrogen nutrition of sugarbeet (*Beta vulgaris*)

Allison, M. F. & Hetschkun, H. M.

Animals

Effects of forage to concentrate ratio in the diet and protein intake on the performance and carcass composition of beef heifers STEEN, R. W. J. & ROBSON, A. E.

Rumen-undegradable dry matter and neutral detergent fibre as ratio indicators of digestibility in sheep given cereal straw-based diets

Fondevila, M., Catrillo, C., Gasa, J. & Guada, J. A.

The thermal response of sheep to a hot environment in different years McCrabb, G. J., Bortolussi, G., Hennoste, L. M. & McDonald, B. J.

Comparison of seasonal patterns of growth, voluntary feed intake and plasma hormone concentrations in young sambar deer (*Cervus unicolor*) and red deer (*Cervus elaphus*)

Semiadi, G., Barry, T. N. & Muir, P. D.

Subscription Information

Volumes 126 & 127 in 1996. Published in February, March, May, June, August, September, November and December: £268; delivery by airmail costs £47 per year extra. ISSN 0021-8596

Subscribe today!

Please enter my subscription to The Journal of Agricultural Science, Volumes 126 & 127 in 1996

🗆 £268

D Please send by airmail @ £47 per year extra

□ Please find enclosed a cheque in sterling (made payable to Cambridge University Press)

Please send me an invoice

□ Please send me a FREE sample copy

Name___

Address____

Also of interest

You may find some of our other publications are of interest. Please tick the relevant box if you would like more information:

Experimental Agriculture;

□ Journal of Dairy Research;

Complete Journals Catalogue

Send this coupon to:

Journals Marketing Department, Cambridge University Press, FREEPOST*, The Edinburgh Building, Cambridge CB2 IBR, UK.

(*no postage stamp necessary if posted in UK). In USA, Canada & Mexico, write to Cambridge University Press, 40 West 20th Street, New York,





Research grade data acquisition

Giving you reliability, power and the results you need

Dataloggers

A range of rugged, battery-powered standalone dataloggers with channel capacities from 12 to over 250.

Automatic Weather Stations

Complete professional systems (including configurations approved by The Met. Office) supporting all standard meteorological measurements and a wide range of communication options.

Special-Purpose Systems

Pre-configured systems for use in micrometeorology, soil science and

other environmental monitoring applications.



Campbell

S C I E N T I F I C 14-20 Field Street, Shepshed, Leicestershire, LE12 9AL Tel: +44 (0) 1509 601141 Fax: +44 (0) 1509 601091 email: sales@csluk.demon.co.uk.

International Cashew and Coconut Conference

Dar es Salaam, Tanzania

17-21 February, 1997

ALL ASPECTS OF RESEARCH AND DEVELOPMENT CONNECTED WITH CASHEW AND COCONUT

Organised by: The Government of Tanzania [represented by The Agricultural Research Institutes of Naliendele (cashew) and Mikocheni (coconut)]

GTZ (German Agency for Technical Cooperation) and ODA (Overseas Development Agency, UK)

Expressions of interest in attending, indicating if you wish to make a paper or poster presentation, by 31st July 1996, or as soon as possible thereafter.

Further information and registration forms from the Local Organiser: Dr Alois Kullaya ARI Mikocheni PO Box 6226 Dar es Salaam Tanzania *Tel: + 255 51 74834 or 74605/6/9; Fax: + 255 51 46454 or 75549*

Feeding a Hungry Planet

Rice, Research, and Development in Asia and Latin America

James Lang

Rice is the food crop the world depends on most. In *Feeding a Hungry Planet*, James Lang demonstrates how research has benefited rice growers and increased production. He describes agriculture as a chain of events linking the farmer's field with the scientist's laboratory, and he argues that rice cultivation is shaped by different social systems, cultures, and environments. Ultimately, Lang says, the ability to feed growing populations and protect fragile ecologies depends as much on sustainable on-site farm technologies as on high-yielding crop varieties.

204 pp. \$34.95 cloth / \$15.95 paper



at bookstores or by toll-free order

The University of North Carolina Press

Chapel Hill Phone (800) 848-6224, Fax (800) 272-6817 http://sunsite.unc.edu/uncpress/

PESTICIDES 1996 Reference Book 500

Pesticides approved under The Control of Pesticides Regulations 1986

Pesticides 1996 contains details of all the products fully or provisionally approved as pesticides under The Control of Pesticides 1986. The book lists products for use in areas such as agriculture, commercial and amenity horticulture, food storage, homes and gardens, and for wood preservation, masonry treatment or use as public health and hygiene insecticides.

As the official handbook of approved products, *Pesticides 1996* is an important and valuable source of information for all concerned with pesticides, whether in their production, distribution, sale or use, or in the enforcement of The Control of Pesticides Regulations 1986. It is also particularly useful in identifying those products approved for agricultural use to which certification requirements apply.

Published by HMSO Books for the Ministry of Agriculture, Fisheries and Food and the Health & Safety Executive

February 1996 210x148mm 540 pages ISBN 0 11 243002 3 Paperback £16.50

Farm Incomes in the United Kingdom 1994/95

Farm Incomes in the United Kingdom 1994/95 provides an authoritative and detailed source of information on the incomes and financial structure of the agriculture industry in each of the four countries of the United Kingdom.

This edition, the eleventh in the series, contains the results of the 1994/95 Farm Business Survey in England and Wales and corresponding surveys in other countries. These provide information at the farm level for farm and off-farm incomes, performance measures and assets and liabilities by country, farm type, business size and tenure. These results are supplemented by an indication of the expected movement in farm incomes in 1995/96 and by the inclusion of a section showing the gross margins of farm enterprises and how they are changing over time.

Published by HMSO Books for the Ministry of Agriculture, Fisheries and Food, Scottish Office Agriculture, Environment & Fisheries Department, Department of Agriculture Northern Ireland and Welsh Office

March 1996 297x210mm 140 pages ISBN 0 11 243005 8 Paperback £28

Agriculture in the United Kingdom: 1995

Agriculture in the United Kingdom: 1995 provides, in an accessible format, information on the economic conditions of the United Kingdom agriculture industry. The government will draw on this information when considering policy issues, including proposals by the European Commission for agricultural support in 1996/1997.

Published by HMSO Books for the Ministry of Agriculture, Fisheries and Food, Scottish Office Agriculture, Environment & Fisheries Department, Northern Ireland Department of Agriculture and Welsh Office

March 1996 297x210mm 104 pages ISBN 0 11 243004 X Paperback £15

HMSO Books are available from: HMSO Bookshops, Agents (see Yellow Pages: Booksellers) and throughout all good booksellers. Mail order: HMSO Publications Centre, PO Box 276, London SW8 5DT (post & packaging free) Telephone orders: 0171 873 9090 Fax: 0171 873 8200



EXPERIMENTAL AGRICULTURE

VOLUME 32 1996

Editor DR J. G. W. JONES

Book Review Editor PROFESSOR J. M. HIRST

Editorial Board

PROFESSOR M. K. V. CARR DR R. H. V. CORLEY DR D. GIBBON PROFESSOR P. J. GREGORY PROFESSOR N. L. INNES MR R. KEMP DR F. G. H. LUPTON DR. W. REED MISS J. RILEY DR P. R. SCOTT PROFESSOR N. W. SIMMONDS MR R. W. SMITH DR G. SQUIRE PROFESSOR R. J. SUMMERFIELD (Chairman)

International Correspondents

DR M. P. COLLINSON, CGIAR DR P. J. M. COOPER, ICRAF MR M. DE NUCÉ DE LAMOTHE, CIRAD DR W. ERSKINE, ICARDA DR J. HAMBLIN, CLIMA DR G. KIRK, IRRI DR T. G. KELLEY, ICRISAT



PUBLISHED BY

THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE The Pitt Building, Trumpington Street, Cambridge CB2 1RP, United Kingdom

CAMBRIDGE UNIVERSITY PRESS

The Edinburgh Building, Cambridge CB2 2RU, United Kingdom 40 West 20th Street, New York, N.Y. 10011-4211, USA 10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Cambridge University Press 1996

Printed in the United Kingdom at the University Press, Cambridge

CONTENTS

Part 1 (January 1996)

P. Q. Craufurd, R. H. Ellis, R. J. Summerfield and L. Menin: Development in Cowpea (<i>Vigna unguiculata</i>). I. The Influence of Temperature and Seed Germi-	
nation and Emergence	1
P. Q. Craufurd, A. Qi, R. H. Ellis, R. J. Summerfield and E. H. Roberts: Development in Cowpea (<i>Vigna unguiculata</i>). II. Effect of Temperature and Saturation Deficit on Time to Flowering in Photoperiod-insensitive Genotypes	13
P. Q. Craufurd, A. Qi, R. J. Summerfield, R. H. Ellis and E. H. Roberts: Development in Cowpea (<i>Vigna unguiculata</i>). III. Effects of Temperature and Photoperiod on Time to Flowering in Photoperiod-sensitive Genotypes and Screening for Photothermal Responses	29
G. Lockwood and Joe Pang Thau Yin: Yields of Cocoa Clones in Response to Planting Density in Malaysia	41
K. W. Jeanes, R. C. Gutteridge and H. M. Shelton: Competition Effects between Leucaena and Maize Grown Simultaneously in an Alley Cropping Sys- tem in Sub-tropical Australia	49
K. D. Subedi: Effect of Leaf Stripping, De-tasselling and Topping of Maize on the Yield of Maize and Relay Intercropped Finger Millet	57
N. E. A. Malenga: Response of Young Unirrigated Clonal Tea to Nitrogen Fertilizer	63
Gayatri Devi, O. Ito, R. Matsunaga, S. Tobita, T. P. Rao, N. Vidyalakshmi and K. K. Lee: Simulating Root System Development of Short-duration Pigeon- pea	67
Ekow Akyeampong: The Influence of Time of Planting and Spacing on the Production of Fodder and Fuelwood in Associations of <i>Calliandra calothyrsus</i> and <i>Pennisetum purpureum</i> Grown on Contour Bunds in the Highlands of Burundi	79
V. E. Sabarathnam and S. Vennila: Estimation of Technological Needs and Identification of Problems of Farmers for Formulation of Research and Exten- sion Programmes in Agricultural Entomology	87
M. Ruppenthal, D. E. Leihner, T. H. Hilger and J. A. Castillo F: Rainfall Erosivity and Erodibility of Inceptisols in the Southwest Colombian Andes	91
Book Reviews	103
Notes for Contributors	107

Part 2 (April 1996)

P. A. Omanga, R. J. Summerfield and A. Qi: Flowering in Pigeonpea (<i>Cajanus cajan</i>) in Kenya: Responses of Medium- and Late-maturing Genotypes to Location and Data of Savring	111
tion and Date of Sowing	111
D. J. Flower: Physiological and Morphological Features Determining the Performance of the Sorghum Landraces of Northern Nigeria	129
Ashok Kumar: Use of Leptochloa fusca for the Improvement of Salt-Affected Soils	143
Rashid A. Shad and Sadar Uddin Siddiqui: Problems Associated with <i>Phalaris</i> minor and Other Grass Weeds in India and Pakistan	151
T. G. Kelley, P. Parthasarathy Rao, E. Weltzien R. and M. L. Purohit: Adoption of Improved Cultivars of Pearl Millet in an Arid Environment: Straw Yield and Quality Considerations in Western Rajastan	161
Alfred E. Hartemink, J. F. Osborne and Ph. A. Kips: Soil Fertility Decline and Fallow Effects in Ferralsols and Acrisols of Sisal Plantations in Tanzania	173
J. Vollmann, H. Buerstmayr and P. Ruckenbauer: Efficient Control of Spatial Variation in Yield Trials Using Neighbour Plot Residuals	185
Abe Goldman: Pest and Disease Hazards and Sustainability in African Agricul- ture	199
K. F. Ng Kee Kwong, G. Umrit and J. Deville: Nitrogen Fertilization of Sugarcane in an Intercropping System with Maize and Potato in the Humid Tropical Climate of Mauritius	213
Siegfried K. Debrah, Diakalia Sanogo and Fred O. Boadu: On-Farm Experi- ments with Sorghum to Assess the Acceptability of New Varieties and Herbicide Treatments	219
Fidelis A. Myaka and Joe C. B. Kabissa: Fitting Short Duration Cowpea into a Cotton-Based Cropping System in Tanzania: Effect of Planting Pattern, Time of Planting Cowpea, and Insecticide Application to the Cotton	225
Book Reviews	231
Part 3 (July 1996)	
P. J. M. Cooper, R. R. B. Leakey, M. R. Rao and L. Reynolds: Agroforestry	
and the Mitigation of Land Degradation in the Humid and Sub-humid Tropics	
of Africa	235

I. Scoones: Crop Production in a Variable Environment: a Case Study from Southern Zimbabwe

A. Rodriguez, N. A. Shah, M. Afzal, U. Mustafa and I. Ali: Is Water-	
harvesting in Valley Floors a Viable Option for Increasing Cereal Production in	
Highland Balochistan, Pakistan?	305

291

Lamers, A. Buerkert, H. P. S. Makkar, M. von Open and K. Becker: Biomass Production, and Feed and Economic Value of Fodder Weeds as By- products of Millet Cropping in a Sahelian Farming System	317
D. E. Leihner, M. Ruppenthal, T. H. Hilger and J. A. Castillo F.: Soil Conservation Effectiveness and Crop Productivity of Forage Legume Intercropping, Contour Grass Barriers and Contour Ridging in Cassava on Andean Hillsides	327
M. Pala, A. Matar and A. Mazid: Assessment of the Effects of Environmental Factors on the Response of Wheat to Fertilizer in On-farm Trials in a Mediterranean Type Environment	339
N. W. Simmonds: Yields of Cereal Grain and Protein	351
P. J. Burgess and M. K. V. Carr: Response of Young Tea (<i>Camellia sinensis</i>) Clones to Drought and Temperature. I. Yield and Yield Distribution	357
Book Reviews	373

Part 4 (October 1996)

P. J. Burgess and M. K. V. Carr: Response of Young Tea (<i>Camellia sinensis</i>) Clones to Drought and Temperature. II. Dry Matter Production and Partition- ing	377
H. Schnell, M. Kunisch, M. C. Saxena and J. Sauerborn: Simulation of the Seed Bank Dynamics of <i>Orobanche crenata</i> Forsk. in some Crop Rotations Common in Northern Syria	395
X. Bonneau: Optimization of Mineral Nutrition in a Coconut Plantation Taking an Experimental Approach <i>in situ</i>	405
S. M. El-Amin, B. Adam, E. Varis and E. Pehu: Production of Seedling Tubers Derived from True Potato Seed and Their Use as Seed Tubers in the Sudan	419
K. G. Cassman, S. K. De Datta, S. T. Amarante, S. P. Liboon, M. I. Samson and M. A. Dizon: Long-term Comparison of the Agronomic Efficiency and Residual Benefits of Organic and Inorganic Nitrogen Sources For Tropical Low- land Rice	427
J. R. Witcombe, A. Joshi, K. D. Joshi and B. R. Sthapit: Farmer Participa- tory Crop Improvement. I. Varietal Selection and Breeding Methods and Their Impact on Biodiversity	445
A. Joshi and J. R. Witcombe: Farmer Participatory Crop Improvement. II. Participatory Varietal Selection, a Case Study in India	461

B. R. Sthapit, K. D. Joshi and J. R. Witcombe: Farmer Participatory Crop	
Improvement. III. Participatory Plant Breeding, a Case Study for Rice in Nepal	479
Book Reviews	497

SUBSCRIPTIONS

Experimental Agriculture (ISSN 0014-4797) is published four times a year in January, April, July and October.

Orders, which must be accompanied by payment, may be sent to any bookseller, subscription agent or direct to the publisher: Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, UK; or in the USA, Canada and Mexico: Cambridge University Press, 40 West 20th Street, New York, NY 10011–4211, USA.

The subscription price (excluding VAT) of Volume 32 1996 is £104 net (including postage) (US \$192 in the USA, Canada and Mexico), payable in advance. Single parts are £28 (US \$52 in the USA, Canada and Mexico) plus postage.

EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered subscribers should provide their VAT registration number. Japanese prices for institutions (including ASP delivery) are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan.

Periodicals postage paid at New York, NY and at additional mailing offices. POSTMASTER: send address changes in the USA, Canada and Mexico to: *Experimental Agriculture*, Cambridge University Press, 110 Midland Avenue, Port Chester, New York, NY 10573–4930, USA.

BACK VOLUMES

Previously published parts of *Experimental Agriculture* are available from Cambridge or the American Branch of Cambridge University Press. Enquiries about Vols. 1–32 of *The Empire Journal of Experimental Agriculture* should be addressed to Wm Dawson & Sons Ltd, Cannon House, Folkestone, Kent, UK.

PREPARATION AND SUBMISSION OF MANUSCRIPTS

Papers should be submitted to Dr J. G. W. Jones, Department of Agriculture, The University of Reading, Earley Gate, PO Box 236, Reading RG6 6AT, UK. Detailed instructions on the preparation of manuscripts are printed at the back of the first number of each volume of this journal.

Potential contributors are asked to give careful attention to these instructions. This will greatly assist the editors and thus speed the processing of their contributions.

COPYING

This journal is registered with the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, USA. Organizations in the USA who are also registered with C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of U.S. Copyright law) subject to payment to C.C.C. of the per copy fee of \$11.00+0.10. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0014-4797/96 \$11.00+0.10.

ISI Tear Sheet Service, 3501 Market Street, Philadelphia, PA 19104, USA, is authorized to supply single copies of separate articles for private use only.

Organizations authorized by the Copyright Licensing Agency may also copy material subject to the usual conditions.

For all other use, permission should be sought from Cambridge or the American Branch of Cambridge University Press.

CAMBRIDGE UNIVERSITY PRESS The Edinburgh Building, Cambridge CB2 2RU, United Kingdoim 40 West 20th Street, New York, NY 10011–4211, USA 10 Stamford Road, Oakleigh, Melbourne 3166, Australia

Printed in the United Kingdom at the University Press, Cambridge

VOLUME 32 NUMBER 4 OCTOBER 1996

Experimental Agriculture

CONTENTS

P.J. Burgess and M. K. V. Carr: Response of Young Tea (<i>Camellia sinensis</i>) Clones to Drought and Temperature. II. Dry Matter Production and	×.
Partitioning	377
H. Schnell, M. Kunisch, M. C. Saxena and J. Sauerborn: Simulation of the Seed Bank Dynamics of <i>Orobanche crenata</i> Forsk. in some Crop Rotations Common in Northern Syria	395
X. Bonneau: Optimization of Mineral Nutrition in a Coconut Plantation Taking an Experimental Approach <i>in situ</i>	405
S. M. El-Amin, B. Adam, E. Varis and E. Pehu: Production of Seedling Tubers Derived from True Potato Seed and Their Use as Seed Tubers in the Sudan	419
K. G. Cassman, S. K. De Datta, S. T. Amarante, S. P. Liboon, M. I. Samson and M. A. Dizon: Long-term Comparison of the Agronomic Efficiency and Residual Benefits of Organic and Inorganic Nitrogen Sources For Tropical Lowland Rice	427
J. R. Witcombe, A. Joshi, K. D. Joshi and B. R. Sthapit: Farmer Participatory Crop Improvement. I. Varietal Selection and Breeding Methods and Their Impact on Biodiversity	445
A. Joshi and J. R. Witcombe: Farmer Participatory Crop Improvement. II. Participatory Varietal Selection, a Case Study in India	461
B. R. Sthapit, K. D. Joshi and J. R. Witcombe: Farmer Participatory Crop Improvement. III. Participatory Plant Breeding, a Case Study for Rice	
in Nepal	479
Book Reviews	497
Index	501



CAMBRIDGE UNIVERSITY PRESS