

Oxford University Press

Farming Systems in the Tropics

Hans Ruthenberg

This book will provide students of tropical agriculture and agricultural development workers with an analysis of seven farming systems of the tropics, together with an introduction to the farm-management problems that arise in each particular case. In this new edition the text has been completely updated, and an appendix has been included. Third edition illustrated £30 paper covers £12.50

The Characterization of Soils in Relation to their Classification and Management

Edited by D. J. Greenland

The major soils of the humid tropics of southern Nigeria and adjacent parts of West Africa have been characterized for the first time in terms of their chemical, physical, mineralogical, and biological properties. These properties have been assessed in terms of the ability of the soils of these regions to sustain intensified crop production. Only with careful management based on an understanding of their properties will these soils sustain continued, intensified crop production. Illustrated £35

EXPERIMENTAL AGRICULTURE

Editor: J. P. HUDSON

University of Bristol

Experimental Agriculture publishes the results of general agronomic work on field and industrial crops, fruit and vegetable crops that provide important components of human diets, and herbage and forage crops used in animal production, with the main emphasis on field experiments relevant to husbandry in the warmer climates of the world. It also includes papers with some plant breeding content so long as the interest is primarily agronomic. The journal welcomes accounts of new experimental techniques, which are reviewed in a series on Methodology of Experimental Agriculture; critical discussions of specific problems met in countries where agricultural production is developing rapidly; and papers on new developments in experimental crop husbandry and cropping systems as well as on wider subjects such as technical, economic and sociological aspects of farming systems. Books that are relevant to those subjects are reviewed regularly.

Volume 17: January, April, July and October 1981
£33.00/\$97.50 per year Single parts: £10.00/\$29.50

CAMBRIDGE UNIVERSITY PRESS

The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, England
32 East 57th Street, New York, N.Y. 10022, U.S.A.

New from Butterworths

Environmental Aspects of Housing for Animal Production

31st Nottingham Easter School

Editor J A Clark, BSC, PhD, MInstP

Lecturer in Environmental Physics, University of Nottingham School of Agriculture

In the last twenty years there has been an impressive amount of progress in the housing of farm animals. Research has allowed improved understanding of the environmental needs of the animals, derived from physiological, physical and behavioural studies. Meteorological data and economic criteria have been used to assess the requirements for housing and the design of suitable systems has drawn on information and principles from applied engineering.

Those working in this field, both in research and development and at a practical level, have recognised the need for the multi-disciplinary approach and the 31st Nottingham Easter School provided a forum for international experts in all the relevant disciplines to review current knowledge. Based on the proceedings of this conference, this volume presents a systematic coverage of the housing environment for all the major species of farm animals.

It constitutes a reference text spanning all the subjects relevant to academic and industrial workers in the area of animal housing and those concerned with any aspect of animal production.

1981 528 pages £39.50 0 408 10688 3

Order today from your bookseller. Further details available from



Butterworths, Borough Green, Sevenoaks, Kent TN15 8PH

THE JOURNAL OF AGRICULTURAL SCIENCE

EDITED BY

PROF. J. W. L. BEAMENT, SC.D., F.R.S., Department of Applied Biology, Cambridge

G. D. H. BELL, PH.D., C.B.E., SC.D.(*h.c.*), D.SC.(*h.c.*), F.R.S., 6 Worts Causeway, Cambridge

SIR K. L. BLAXTER, PH.D., N.D.A. (HONS.), D.SC., F.R.S.E., F.R.S.,
Rowett Research Institute, Bucksburn, Aberdeen

PROF. A. D. CARE, D.SC., M.R.C.V.S., Department of Animal Physiology and
Nutrition, Leeds

G. W. COOKE, C.B.E., PH.D., F.R.S.C., F.R.S., Rothamsted Experimental Station,
Harpenden

J. A. CURRIE, PH.D., Rothamsted Experimental Station, Harpenden

S. K. ELTRINGHAM, PH.D., Department of Applied Biology, Cambridge

PROF. SIR J. B. HUTCHINSON, C.M.G., SC.D., F.R.S., Emeritus Professor of
Agriculture, Department of Applied Biology, Cambridge

D. B. LINDSAY, B.SC., M.A., D.PHIL., Agricultural Research Council, Institute of Animal
Physiology, Babraham, Cambridge

PROF. J. B. OWEN, B.SC., PH.D., M.A., The Department of Agriculture, Bangor

W. J. RIDGMAN, M.A., Department of Applied Biology, Cambridge

PROF. E. W. RUSSELL, C.M.G., D.SC., F.INST.P., Department of Soil Science,
University of Reading

F. YATES, C.B.E., SC.D., F.R.S., Rothamsted Experimental Station, Harpenden

VOLUME 97

CAMBRIDGE UNIVERSITY PRESS

CAMBRIDGE

LONDON NEW YORK NEW ROCHELLE

MELBOURNE SYDNEY

1981

**PUBLISHED BY
THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE**

The Pitt Building, Trumpington Street, Cambridge CB2 1RP
32 East 57th Street, New York, N.Y.10022

© Cambridge University Press 1981

Printed in Great Britain at the University Press, Cambridge

Contents

PART 1 (AUGUST 1981)

PAGE

KAISER, A. G., TAYLER, J. C., GIBBS, B. G. and ENGLAND, P. The effects of the quantity of formaldehyde applied at ensiling and of urea supplementation at feeding on the utilization of red clover silages by young growing cattle	1
MCDONALD, R. C., MANLEY, T. R., BARRY, T. N., FORSS, D. A. and SINCLAIR, A. G. Nutritional evaluation of kale (<i>Brassica oleracea</i>) diets. 3. Changes in plant composition induced by soil fertility practices, with special reference to SMCO and glucosinolate concentrations	13
DOWKER, B. D. and FENNEL, J. F. M. The relative performance of inbreds and open-pollinated populations of spring-sown onions.	25
BASS, JEAN M., HEMINGWAY, R. G., FISHWICK, G. and PARKINS, J. J. The voluntary intake of oat straw by adult cattle as affected by the method of dietary presentation of a concentrated solution of urea, minerals and vitamins	31
BASS, J. J., JOHNSON, D. L., COLOMER-ROCHER, F. and BINKS, G. Prediction of carcass composition from carcass conformation in cattle	37
KHALIFA, F. M. Some factors influencing the development of sunflower (<i>Helianthus annuus</i> L.) under dry-farming systems in Sudan	45
CHAPMAN, ELIZABETH A. Methods of analysing yield from trials in which the produce is graded according to diameter	55
MCKENZIE, R. A., BLANEY, B. J. and GARTNER, R. J. W. The effect of dietary oxalate on calcium, phosphorus and magnesium balances in horses	69
CHAUHAN, R. P. S. and ASTHANA, A. K. Tolerance of lentil, barley and oats to boron in irrigation water	75
AGBIM, N. N. Interactions of phosphorus, magnesium and zinc affecting the iron content of maize	79
SKIPITARIS, C. N. Potentialities of producing lean meat by restricting both energy intake and water consumption of pigs	83
SALEH, M. S., GAABOUB, I. A. and KASSEM, SH. M. I. Larvicidal effectiveness of three controlled release formulations of Dursban and Dimilin on <i>Culex pipiens</i> L. and <i>Aedes aegypti</i> (L).	87
ANDREWS, A. H. The relationship of bovine rostral tooth development to age determined by post-mortem radiographic examination of cattle aged between 12 and 24 months	97
SINGH, A., PRASAD, R. and SARAF, C. S. Effects of plant type, plant population density and application of phosphate fertilizer on growth and yield of pigeon pea	103
STARR, CAROL, MORGAN, A. G. and SMITH, D. B. An evaluation of near infra-red reflectance analysis in some plant breeding programmes	107
AHLAWAT, I. P. S. and SARAF, C. S. Response of pigeon pea (<i>Cajanus cajan</i> (L.) Millsp.) to plant density and phosphorus fertilizer under dryland conditions	119
LUCAS, E. O. The growth of two maize varieties in farmers' plots located at two contiguous ecological zones in Nigeria	125
DHILLON, G. S. and KLER, D. S. Relation of shape of canopy to interception of radiation and yield of wheat	135

	PAGE
DAVIDSON, J., MCFADYEN, MORAG and MILNE, E. The nutritive value of the forage pea <i>Pisum arvense</i> cv. 'Rosakrone' for laying hens	143
TRIGG, T. E. and TOPPS, J. H. Composition of body-weight change during lactation in Hereford x British Friesian cows	147
LAST, P. J., DRAYCOTT, A. P. and WEBB, D. J. Effect of green manures on yield and nitrogen requirement of sugar beet	159
WILCOCKSON, S. J. and SCOTT, R. K. A comparison of herbicide-treated and handweeded sugar beet	171
RAHMAN, M. M. Yield potential heterozygous seedling lethal mutants of barley (<i>Hordeum vulgare</i> L.)	183
SCARISBRICK, D. H., DANIELS, R. W. and ALCOCK, MARY. The effect of sowing date on the yield and yield components of spring oil-seed rape	189
HUNDAL, H. S., ARORA, B. R. and SEKHON, G. S. Efficiency of nitric phosphates and Mussoorie rock phosphate in three cycles of clusterbean-wheat and groundnut-wheat rotations	197
ABDALLAH, O. Y., SHAHIN, KARIMA A. and LATIF, M. G. A. Growth and development of water buffalo and Friesian cross-bred cattle, with special reference to body and carcass composition	205
CHAMBERLAIN, A. G. and CLARKE, S. H. Copper deficiency of sheep in eastern Saudi Arabia	213
WANYOIKE, MARGARET M. and HOLMES, W. The effects of winter nutrition on the subsequent live-weight performance and intake of herbage by beef cattle	221
SHORT NOTES	
CLOUGHLEY, J. B. Effect of some field variables on the dry-matter content of tea shoots	227
SRISKANDARAJAH, N., KELLAWAY, R. C. and LEIBHOLZ, JANE. Retention times in the rumen of roughages and a protein supplement	231
SINHA, S. K., AGGARWAL, P. K., CHATURVEDI, G. S., KOUNDAL, K. R. and KHANNA-CHOPRA, R. A comparison of physiological and yield characters in old and new wheat varieties	233
SANORIA, C. L. and MALLIK, M. K. The effect of seed inoculation with <i>Rhizobium</i> and <i>Azotobacter</i> on yield and quality of lentils (<i>Lens esculenta</i>)	237
PART 2 (OCTOBER 1981)	
THOMPSON, N. Modelling the field drying of hay	241
RALPH, R. L. and RIDGMAN, W. J. A study of the effects of potassium fertilizer with special reference to wheat on boulder-clay soils	261
ABOUL-NAGA, A. M., EL-SHOBOKSHY, A. S., MARIE, I. F. and MOUSTAFA, M. A. Milk production from subtropical non-dairy sheep. 1. Ewe performance	297
ABOUL-NAGA, A. M., EL-SHOBOKSHY, A. S. and MOUSTAFA, M. A. Milk production from subtropical non-dairy sheep. 2. Method of measuring	303
BROMFIELD, A. R., DEBENHAM, D. F. and HANCOCK, I. R. The deposition of sulphur and sodium in rainwater in the coastal region of Kenya	309
MITTAL, J. P. and GHOSH, P. K. Male reproductive characteristics of sheep in the Indian arid zone	313

ADAMS, T. McM. and LAUGHLIN, R. J. The effects of agronomy on the carbon and nitrogen contained in the soil biomass	319
HAMILTON, W. J. and BLAXTER, K. L. Growth of red deer stags under farm conditions	329
SIONIT, N., STRAIN, B. R. and HELLMERS, H. Effects of different concentrations of atmospheric CO ₂ on growth and yield components of wheat	335
WATSON, S. E. and WHITEMAN, P. C. Grazing studies on the Guadalcanal Plains, Solomon Islands. 1. Climate, soils, and soil fertility assessment	341
WATSON, S. E. and WHITEMAN, P. C. Grazing studies on the Guadalcanal Plains, Solomon Islands. 2. Effects of pasture mixtures and stocking rate on animal production and pasture components	353
BASS, JEAN M., FISHWICK, G., HEMINGWAY, R. G., PARKINS, J. J. and RITCHIE, N. S. The effects of supplementary phosphorus on the voluntary consumption and digestibility of a low phosphorus straw-based diet given to beef cows during pregnancy and early lactation	365
BROOKING, I. R. and KIRBY, E. J. M. Interrelationships between stem and ear development in winter wheat: the effects of a Norin 10 dwarfing gene, Gai/Rht ₂	373
DAHIYA, I. S., MALIK, R. S. and SINGH, MAHARAJ. Field studies on leaching behaviour of a highly saline-sodic soil under two modes of water application in the presence of crops	383
EVANS, S. A. and NEILD, J. R. A. The achievement of very high yields of potatoes in the U.K.	391
BINNIE, R. C. and CLIFFORD, P. E. Flower and pod production in <i>Phaseolus vulgaris</i>	397
RANAWEERA, K. N. P. and NANO, W. E. True and apparent metabolizable energy of some indigenous feedingstuffs and finished feeds determined by modified rooster bioassay techniques	403
WURR, D. C. E., KAY, ROSEMARY H., ALLEN, E. J. and PATEL, J. C. Studies of the growth and development of winter-heading cauliflowers	409
WURR, D. C. E., KAY, ROSEMARY H. and ALLEN, E. J. The effect of cold treatments on the curd maturity of winter-heading cauliflowers.	421
FREE, J. B., PICKETT, J. A., FERGUSON, A. W. and SMITH, M. C. Synthetic pheromones to attract honeybee (<i>Apis mellifera</i>) swarms	427
POOLE, D. A. The effect of age at which spring-born calves are introduced to pasture	433
PANDEY, R. K. and SINGH, V. B. Influence of partial defoliation on dry-matter production and seed yield of urd bean (<i>Vigna mungo</i> L. Hepper)	437
BOLAND, M. P., CROSBY, T. F. and GORDON, I. Effect of mating management and PMSG dose on lambing outcome in ewes bred in late anoestrus	445
BHAT, P. N., KOUL, G. L., KOUL, S. K., KUMAR, R. and GARG, R. C. Factors affecting body weight and growth rate of Awassi lambs	449
CARLES, A. B., KING, J. M. and HEATH, B. R. Game domestication for animal production in Kenya: an analysis of growth in oryx, eland and zebu cattle	453
SHORT NOTES	
BOLAND, M. P., CROSBY, T. F. and GORDON, I. Induction of pregnancy in lactating anoestrous ewes	465
PRASAD, V. S. S. Effect of the residue after hand boning on the yield of bone in lamb carcasses	469
TILLS, ALISON R. and ALLOWAY, B. J. Subclinical copper deficiency in crops on the Breckland in East Anglia	473

	PAGE
MAKKAR, H. P. S., LALL, D., SHARMA, O. P. and NEGI, S. S. Urea-formaldehyde complexes and their hydrolysis by rumen urease <i>in vitro</i>	477
LIM, L. G. and GAUNT, R. E. Leaf area as a factor in disease assessment	481
FUJIHARA, T. Eating and rumination behaviour in sheep given silage made from the fibrous residue of ladino clover	485
GALBRAITH, H. and PATERSON, G. F. M. Response of growing steers to monensin sodium supplementation and implantation with trenbolone acetate and hexoestrol	489
SAKAL, R., SINGH, A. P. and SINGH, B. P. Evaluation of critical limit of zinc in calcareous soils for predicting response of maize to applied zinc fertilizer	493

PART 3 (DECEMBER 1981)

GIVENS, D. I., HOPKINS, J. R., BROWN, MARJORIE E. and WALSH, W. A. The effect of copper therapy on the growth rate and blood composition of young growing cattle	497
BLANEY, B. J., GARTNER, R. J. W. and MCKENZIE, R. A. The effects of oxalate in some tropical grasses on the availability to horses of calcium, phosphorus and magnesium	507
BASS, J. J., CARTER, A. H., JOHNSON, D. L., BAKER, R. L. and JONES, K. R. Sire-breed comparison of carcass composition of steers from Angus dams	515
INNES, P., BLACKWELL, R. D., AUSTIN, R. B. and FORD, MARGARET A. The effects of selection for number of ears on the yield and water economy of winter wheat	523
HASDAI, A. and BEN-GHEDALIA, D. Sewage-grown algae as a source of supplementary nitrogen for ruminants	533
LITTLETON, E. J., DENNETT, M. D., ELSTON, J. and MONTEITH, J. L. The growth and development of cowpeas (<i>Vigna unguiculata</i>) under tropical field conditions. 3. Photosynthesis of leaves and pods	539
GAABOUB, I. A., WIDAATALLA, A. E. E. and KELADA, N. L. Survey of rats and mice and their ectoparasites in relation to cultivated areas in the vicinity of Alexandria governorate, Egypt	551
BELFORD, R. K. Response of winter wheat to prolonged waterlogging under outdoor conditions	557
FARMER, LINDA J., MACKIE, W. S. and RITCHIE, P. J. Developmental changes in the biochemical composition of muscle from 'splayleg' piglets with special reference to DNA synthesis	569
GARTNER, R. J. W., BLANEY, B. J. and MCKENZIE, R. A. Supplements to correct oxalate-induced negative calcium and phosphorus balances in horses fed tropical grass hays	581
ARORA, C. L., HUNDAL, H. S. and TAKKAR, P. N. Soil characteristics and nutrient indexing of vineyards in Punjab, India	591
BHALARU, SURINDER S., DHILLON, J. S. and TIWANA, M. S. Effect of body weight at calving on body-weight changes during early lactation and post-partum reproductive performance in buffaloes	595
RIGGS, T. J., HANSON, P. R., START, N. D., MILES, D. M., MORGAN, C. L. and FORD, MARGARET A. Comparison of spring barley varieties grown in England and Wales between 1880 and 1980	599
OSMAN, A. M. and MAHMOUD, Z. M. Yield and yield components of wheat (<i>Triticum aestivum</i> L.) and their interrelationships as influenced by nitrogen and seed rate in the Sudan	611

MAHMOUD, Z. M. and OSMAN, A. M. Tillering of wheat as influenced by nitrogen and seed rate in the Sudan	619
OLOMU, J. M., OFFIONG, S. A. and ABED, S. Effects of different protein and energy levels on the performance of growing and finishing turkeys in the tropics	629
BRADSHAW, J. E. The effects of cultivar, sowing date, and plant spacing on the yield and quality of fodder kale (<i>Brassica oleracea</i> L.)	633
BLANEY, B. J., GARTNER, R. J. W. and MCKENZIE, R. A. The inability of horses to absorb calcium from calcium oxalate	639
BROSTER, W. H., BROSTER, VALERIE J., CLEMENTS, A. JUNE and SMITH, T. The relationship between yield of milk solids of dairy cows and response to change in plane of nutrition	643
HOLNESS, D. H., SPROWSON, G. W., SHEWARD, CAROLE and GEEL, AMANDA. Studies on plasma progesterone concentrations and fertility in Friesland dairy cows during the post-partum period	649
SINGH, S. P. Studies on spatial arrangement in sorghum-legume intercropping systems	655
KUMAR, S., PAHWA, S. K., PROMILA, K. and SHARMA, H. R. Effect of simazine and prometryne on the growth and nodulation of chickpea (<i>Cicer arietinum</i> L.)	663
WATSON, S. E. and WHITEMAN, P. C. Animal production from naturalized and sown pastures at three stocking rates under coconuts in the Solomon Islands	669
POLLARD, F., ELLIOT, J. G., ELLIS, F. B. and BARNES, B. T. Comparison of direct drilling, reduced cultivation and ploughing on the growth of cereals. 4. Spring barley and winter wheat on silt loam soils over chalk	677
MCLAREN, J. S. Field studies on the growth and development of winter wheat	685
BRISEÑO DE LA HOZ, V. M. and WILMAN, D. Effects of cattle grazing, sheep grazing, cutting and sward height on a grass-white clover sward	699
DESHPANDE, K. S. and BONDE, H. S. Genetic studies on peak yield in Holstein Friesian × Sahiwal cross-bred cattle	707
POWLSON, D. S. and JENKINSON, D. S. A comparison of the organic matter, biomass, adenosine triphosphate and mineralizable nitrogen contents of ploughed and direct-drilled soils	713
RUSSEL, A. J. F., FOOT, JANET Z., WHITE, I. R. and DAVIES, G. J. The effect of weight at mating and of nutrition during mid-pregnancy on the birth weight of lambs from primiparous ewes	723
RAGAB, S. M. Cotton growth and nutrient uptake following Temik aldicarb application	731
 SHORT NOTES	
FINCH, VIRGINIA A. Black cattle in the cool pastoral highlands of Kenya	739
GRACE, N. D. and BODY, D. R. The possible use of long chain (C ₁₉ -C ₃₂) fatty acids in herbage as an indigestible faecal marker	743
SIDDIQUI, M. F., BONDE, H. S., ROTTE, S. G. and DESHPANDE, K. S. Studies on some growth attributes of Osmanabadi goat kids	747

OLOMU, J. M., OFFIONG, S. A. and ABED, S. Effects of different protein and energy levels on the performance of growing and finishing turkeys in the tropics	629
BRADSHAW, J. E. The effects of cultivar, sowing date, and plant spacing on the yield and quality of fodder kale (<i>Brassica oleracea</i> L.)	633
BLANEY, B. J., GARTNER, R. J. W. and MCKENZIE, R. A. The inability of horses to absorb calcium from calcium oxalate	639
BROSTER, W. H., BROSTER, VALERIE J., CLEMENTS, A. JUNE and SMITH, T. The relationship between yield of milk solids of dairy cows and response to change in plane of nutrition	643
HOLNESS, D. H., SPROWSON, G. W., SHEWARD, CAROLE and GEEL, AMANDA. Studies on plasma progesterone concentrations and fertility in Friesland dairy cows during the post-partum period	649
SINGH, S. P. Studies on spatial arrangement in sorghum-legume intercropping systems	655
KUMAR, S., PAHWA, S. K., PROMILA, K. and SHARMA, H. R. Effect of simazine and prometryne on the growth and nodulation of chickpea (<i>Cicer arietinum</i> L.)	663
WATSON, S. E. and WHITEMAN, P. C. Animal production from naturalized and sown pastures at three stocking rates under coconuts in the Solomon Islands	669
POLLARD, F., ELLIOT, J. G., ELLIS, F. B. and BARNES, B. T. Comparison of direct drilling, reduced cultivation and ploughing on the growth of cereals. 4. Spring barley and winter wheat on silt loam soils over chalk	677
MCLAREN, J. S. Field studies on the growth and development of winter wheat	685
BRISEÑO DE LA HOZ, V. M. and WILMAN, D. Effects of cattle grazing, sheep grazing, cutting and sward height on a grass-white clover sward	699
DESHPANDE, K. S. and BONDE, H. S. Genetic studies on peak yield in Holstein Friesian × Sahiwal cross-bred cattle	707
POWLSON, D. S. and JENKINSON, D. S. A comparison of the organic matter, biomass, adenosine triphosphate and mineralizable nitrogen contents of ploughed and direct-drilled soils	713
RUSSEL, A. J. F., FOOT, JANET Z., WHITE, I. R. and DAVIES, G. J. The effect of weight at mating and of nutrition during mid-pregnancy on the birth weight of lambs from primiparous ewes	723
RAGAB, S. M. Cotton growth and nutrient uptake following Temik aldicarb application	731
SHORT NOTES	
FINCH, VIRGINIA A. Black cattle in the cool pastoral highlands of Kenya	739
GRACE, N. D. and BODY, D. R. The possible use of long chain (C ₁₉ -C ₃₂) fatty acids in herbage as an indigestible faecal marker	743
SIDDIQUI, M. F., BONDE, H. S., ROTTE, S. G. and DESHPANDE, K. S. Studies on some growth attributes of Osmanabadi goat kids	747

THE JOURNAL OF AGRICULTURAL SCIENCE

CONTENTS

Vol. 97 Part 3 December 1981

GIVENS, D. I., HOPKINS, J. R., BROWN, MARJORIE E. and WALSH, W. A. The effect of copper therapy on the growth rate and blood composition of young growing cattle	497
BLANEY, B. J., GARTNER, R. J. W. and MCKENZIE, R. A. The effects of oxalate in some tropical grasses on the availability to horses of calcium, phosphorus and magnesium	507
BASS, J. J., CARTER, A. H., JOHNSON, D. L., BAKER, R. L. and JONES, K. R. Sire-breed comparison of carcass composition of steers from Angus dams	515
INNES, P., BLACKWELL, R. D., AUSTIN, R. B. and FORD, MARGARET A. The effects of selection for number of ears on the yield and water economy of winter wheat	523
HASDAI, A. and BEN-GHEDALIA, D. Sewage-grown algae as a source of supplementary nitrogen for ruminants	533
LITTLETON, E. J., DENNETT, M. D., ELSTON, J. and MONTEITH, J. L. The growth and development of cowpeas (<i>Vigna unguiculata</i>) under tropical field conditions. 3. Photosynthesis of leaves and pods	539
GAABOUB, I. A., WIDAATALLA, A. E. E. and KELADA, N. L. Survey of rats and mice and their ectoparasites in relation to cultivated areas in the vicinity of Alexandria governorate, Egypt	551
BELFORD, R. K. Response of winter wheat to prolonged waterlogging under outdoor conditions	557
FARMER, LINDA J., MACKIE, W. S. and RITCHIE, P. J. Developmental changes in the biochemical composition of muscle from 'splayleg' piglets with special reference to DNA synthesis	569
GARTNER, R. J. W., BLANEY, B. J. and MCKENZIE, R. A. Supplements to correct oxalate-induced negative calcium and phosphorus balances in horses fed tropical grass hays	581
ARORA, C. L., HUNDAL, H. S. and TAKKAR, P. N. Soil characteristics and nutrient indexing of vineyards in Punjab, India	591
BHALARU, SURINDER S., DHILLON, J. S. and TIWANA, M. S. Effect of body weight at calving on body-weight changes during early lactation and post-partum reproductive performance in buffaloes	595
RIGGS, T. J., HANSON, P. R., START, N. D., MILES, D. M., MORGAN, C. L. and FORD, MARGARET A. Comparison of spring barley varieties grown in England and Wales between 1880 and 1980	599
OSMAN, A. M. and MAHMOUD, Z. M. Yield and yield components of wheat (<i>Triticum aestivum</i> L.) and their interrelationships as influenced by nitrogen and seed rate in the Sudan	611
MAHMOUD, Z. M. and OSMAN, A. M. Tillering of wheat as influenced by nitrogen and seed rate in the Sudan	619

Continued on inside back cover

© Cambridge University Press 1981

SUBSCRIPTIONS. Two volumes of three parts are published annually. All orders must be accompanied by payment. The subscription price of volumes 96 and 97, 1981, is £39.50 net (U.S.A. and Canada US \$117.50) per volume (post free); single parts are available at £15.50 net (U.S.A. and Canada US \$46.00) plus postage. Orders or enquiries may be sent to any bookseller or subscription agent, or Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU (U.S.A. and Canada, Cambridge University Press, 32 East 57th Street, New York, N.Y. 10022, U.S.A.). Second class postage paid at New York, N.Y., and at additional mailing offices.

Printed in Great Britain at the University Press, Cambridge