

# BAH

# BIOLOGICAL AGRICULTURE & HORTICULTURE

An International Journal  
for Sustainable Production Systems

**Editor: R D Hodges PhD**

**Deputy Editors: A M Scofield PhD**

**J M Lopez-Real PhD**

The first international scientific journal in the field of sustainable agriculture, *Biological Agriculture and Horticulture* is a well-established and significant focus for the publication of research and information in such areas as soil fertility and management, biological control methods, energy utilisation studies, agricultural systems and environmental management, and the development of appropriate agricultural technology. As well as scientific papers, each issue includes a news and reviews section.

Recent papers include:

R L Bugg *et al*: Insects Associated with Cool-Season Cover Crops in Southern Georgia; Implications for Pest Control in Truck-Farm and Pecan Agroecosystems.

S Parish: A Review of Non-Chemical Weed Control Techniques.

R J Macrae *et al*: Agricultural Science and Sustainable Agriculture: A Review of the Existing Scientific Barriers to Sustainable Food Production and Potential Solutions.

N N Agbim: The Effect of Plant and Animal Waste Combinations on Intercropping Yields in a Tropical Environment.

H Stöppler *et al*: Vesicular-Arbuscular Mycorrhiza in Varieties of Winter Wheat in a Low External Input System.

J Vandermeer: Notes on Agroecosystem Complexity: Chaotic Price and Production Trajectories Deducible from Simple One-Dimensional Maps.

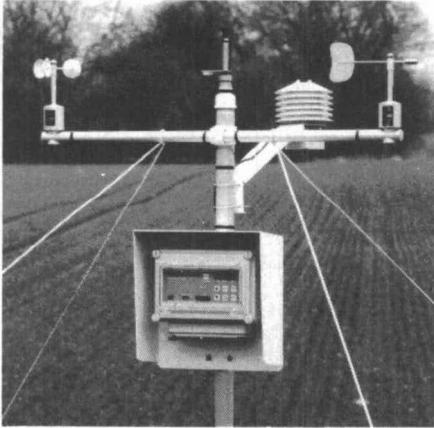
**Editorial correspondence should be sent to Dr R D Hodges, Wye College (University of London), Wye, Ashford, Kent, TN25 5AH, UK.**

Subscription rates per volume of 4 issues: £79/US \$155.

**To subscribe, obtain further information, or a sample issue, please write to the publishers, AB ACADEMIC PUBLISHERS, PO BOX 42, BICESTER, OXON, OX6 7NW, UK.**

# DELTA-T WEATHER STATION

**A complete system of instrumentation for automatically measuring and recording the weather at remote sites.**



**Standard sensors measure:**

- air temperature
- rainfall
- relative humidity
- soil temperature
- solar radiation
- wind direction
- wind speed

- \* **Memory expandable from 16k to 128k readings**
- \* **User-defined recording**
- \* **Typically 12 months battery life**
- \* **On-site checks using LCD on control panel**
- \* **Remote interrogation via RS232 link**

**Description** All sensors are mounted on a 2m mast, except for the soil temperature probe and the rain gauge. An environmental data logger (the Delta Logger) initiates readings, controls the sensors and stores data.

**Data collection** Stored readings can be collected with a portable computer or printer without interrupting logging.

**Programmable** The user has independent control over each

sensor to define: sampling interval, valid reading range, engineering units (eg mm of rainfall), and data compression. These are specified using a personal computer.

**Special requirements** We are able to supply part-systems and non-standard combinations of sensors, (the Logger is expandable and can accept up to 60 analogue/counter inputs). Further information, advice or a quotation will be provided on request.

# AT

**DELTA-T DEVICES LTD.**

128 Low Road, Burwell, Cambridge CB5 0EJ  
Telephone: 0638 742922 Fax: 0638 743155  
Telex: 817670 ASABSE G "ATTN DELTA-T"

We also supply: Solar and Thermal Radiation Sensors, Psychrometers, Integrators, Area Measurement Systems and Porometers

# EXPERIMENTAL AGRICULTURE

VOLUME 27 1991

*Editor*

DR F. G. H. LUPTON

*Managing Editor*

DR SUSAN CARR

*Book Review Editor*

PROFESSOR J. M. HIRST

*Editorial Board*

DR M. H. ARNOLD (*Chairman*)

DR M. G. R. CANNELL

PROFESSOR M. K. V. CARR

PROFESSOR I. D. CARRUTHERS

DR R. H. V. CORLEY

DR J. C. DAVIES

DR D. J. GREENLAND

DR P. J. GREGORY

DR N. W. HUSSEY

MR R. KEMP

MISS J. RILEY

PROFESSOR N. W. SIMMONDS

DR G. SQUIRE

DR R. D. STERN

DR R. J. SUMMERFIELD

*Overseas Correspondents*

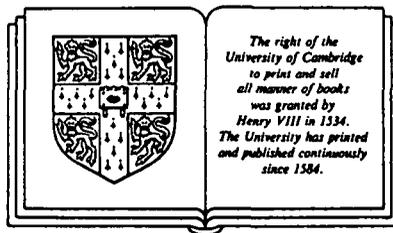
PROFESSOR J. L. MONTEITH, ICRISAT

DR M. P. COLLINSON, CGIAR

DR P. J. M. COOPER, ICRAF

DR W. ERSKINE, ICARDA

DR G. KIRK, IRRI



CAMBRIDGE UNIVERSITY PRESS

*Cambridge*

*New York Port Chester Melbourne Sydney*

PUBLISHED BY  
THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE

The Pitt Building, Trumpington Street, Cambridge CB2 1RP

40 West 20th Street, New York, N.Y. 10011-4211, USA

10 Stamford Road, Oakleigh, Victoria 3166, Australia

© Cambridge University Press 1991

8

*Printed in Great Britain at the University Press, Cambridge*

## CONTENTS

### Part 1 (January 1991)

- Dunstan S. C. Spencer:** Institutionalizing the Farming Systems Perspective in Multi-commodity Research Institutes: The Role of Systems-based Research Groups (Farming Systems Series – Number 27) 1
- R. J. Summerfield, E. H. Roberts, R. H. Ellis and R. J. Lawn:** Towards the Reliable Prediction of Time to Flowering in Six Annual Crops. I. The Development of Simple Models for Fluctuating Field Environments 11
- G. O. Iremiren, A. W. Osara and D. A. Okiy:** Effects of Age of Harvesting after Pod Set on the Growth, Yield and Quality of Okra (*Abelmoschus esculentus*) 33
- J. V. Wilkins:** The Search for a Viable Alternative to Slash and Burn Agriculture in the Lowland Plains of Bolivia 39
- H. E. Nyirenda:** Use of Growth Measurements and Foliar Nutrient Content as Criteria for Clonal Selection in Tea (*Camellia sinensis*) 47
- D. J. Rees, M. Islam, A. Samiullah, Fahema Rehman, S. H. Raza, Z. Qureshi and S. Mehmood:** Rain-fed Crop Production Systems of Upland Balochistan: Wheat (*Triticum aestivum*), Barley (*Hordeum vulgare*) and Forage Legumes (*Vicia* species) 53
- H. M. Ishag and O. A. A. Ageeb:** The Physiology of Grain Yield in Wheat in an Irrigated Tropical Environment 71
- M. D. Reddy, A. R. Sharma and M. M. Panda:** Effect of Mixed Row Cropping of Early and Late Maturing Rice Varieties on Crop Productivity under Intermediate Deepwater Conditions 79
- Book Reviews** 87
- Notes for Contributors** 91

### Part 2 (April 1991)

- Derek Byerlee, Bernard Triomphe and Michel Sébillotte:** Integrating Agromomic and Economic Perspectives into the Diagnostic Stage of On-farm Research (Farming Systems Series – Number 28) 95
- Allan Low and S. R. Waddington:** Farming Systems Adaptive Research: Achievements and Prospects in Southern Africa (Farming Systems Series – Number 29) 115
- S. Fukai, L. Li, P. T. Vizmonte and K. S. Fischer:** Control of Grain Yield by Sink Capacity and Assimilate Supply in Various Rice (*Oryza sativa*) Cultivars 127

<b>N'guettia R. Yao, Kabrah Yeboua and Angbonou Kafrouma:</b> Effect of Intensity and Timing of Defoliation on Growth, Yield Components and Grain Yield in Maize	137
<b>S. N. Silim, M. C. Saxena and W. Erskine:</b> Effect of Sowing Date on the Growth and Yield of Lentil in a Rainfed Mediterranean Environment	145
<b>R. Shorter, R. J. Lawn and G. L. Hammer:</b> Improving Genotypic Adaptation in Crops – a Role for Breeders, Physiologists and Modellers	155
<b>William Stephens and M. K. V. Carr:</b> Responses of Tea ( <i>Camellia sinensis</i> ) to Irrigation and Fertilizer. I. Yield	177
<b>William Stephens and M. K. V. Carr:</b> Responses of Tea ( <i>Camellia sinensis</i> ) to Irrigation and Fertilizer. II. Water Use	193
<b>Suzanne C. Nelson, Gary P. Nabhan and Robert H. Robichaux:</b> Effects of Water, Nitrogen and Competition on Growth, Yield and Yield Components of Field-grown Tepary Bean	211
<b>J. M. Ngeve and J. C. Bouwkamp:</b> Effects of Sweet Potato Virus Disease (SPVD) on the Yield of Sweet Potato Genotypes in Cameroon	221
<b>Book Reviews</b>	227

### Part 3 (July 1991)

<b>Joshua L. Posner and Eric W. Crawford:</b> An Agro-economic Analysis of Field Trials from a Farming Systems Research Perspective: Weed Control in Rainfed Lowland Rice in Senegal (Farming Systems Series – Number 30)	231
<b>Frans Doorman:</b> Identifying Target Groups for Agricultural Research: The Categorization of Rice Farmers in the Dominican Republic (Farming Systems Series – Number 31)	243
<b>Sam Fujisaka:</b> Improving Productivity of an Upland Rice and Maize System: Farmer Cropping Choices or Researcher Cropping Pattern Trapezoids? (Farming Systems Series – Number 32)	253
<b>Robert B. Kagbo:</b> A Comparison of Natural Rock Phosphate with Imported Cotton Fertilizer in Cotton/Cereal Rotations in Mali	263
<b>J. P. Wright, J. L. Posner and J. D. Doll:</b> The Effect of Tied Ridge Cultivation on the Yield of Maize and a Maize/Cowpea Relay in the Gambia	269
<b>R. L. Yadav, Ravi Kumar and R. S. Verma:</b> Effect of Planting Technique and Planting Density on Yield of Late Planted Sugarcane in North Central India	281
<b>Charles Staver:</b> The Role of Weeds in the Productivity of Amazonian Bush Fallow Agriculture	287
<b>D. J. Midmore and J. Alcazar:</b> Mixed Planting of Potato Cultivars: Growth, Yield and Leafminer Damage in the Cool Tropics	305

<b>A. E. Elshafie and A. A. Elhussein:</b> An Evaluation of <i>Rhizobium</i> Survival in Two Carriers New to Sudan	319
<b>R. R. Weil and G. S. Belmont:</b> Dry Matter and Nitrogen Accumulation and Partitioning in Field Grown Winged Bean	323
<b>R. R. Weil and A. Samarnayake:</b> Effects of Winged Bean on a Following Maize Crop	329
<b>Book Reviews</b>	339

#### Part 4 (October 1991)

<b>D. M. Merrill-Sands, S. D. Biggs, R. J. Bingen, P. T. Ewell, J. L. McAllister and S. V. Poats:</b> Institutional Considerations in Strengthening On-farm Client-oriented Research in National Agricultural Research Systems: Lessons from a Nine-country Study (Farming Systems Series – Number 33)	343
<b>Asfaw Negassa, Benti Tolessa, Steven Franzel, Gemechu Gedeno and Legesse Dadi:</b> The Introduction of an Early Maturing Maize ( <i>Zea mays</i> ) Variety to a Mid-altitude Farming System in Ethiopia	375
<b>J. Kahurananga:</b> Intercropping Ethiopian <i>Trifolium</i> Species with Wheat	385
<b>H. M. Abdel Magid, M. F. Ghoneim, R. K. Rabie and R. E. Sabrah:</b> Productivity of Wheat and Alfalfa under Intercropping	391
<b>I. A. M. Yunusa and N. A. Gworgwor:</b> Growth and Yield of Maize Genotypes during Dry Seasons in Northern Nigeria	397
<b>T. I. Ofuya:</b> Observations on Insect Infestation and Damage in Cowpea ( <i>Vigna unguiculata</i> ) Intercropped with Tomato ( <i>Lycopersicon esculentum</i> ) in a Rain Forest Area of Nigeria	407
<b>P. H. Le Mare:</b> Rock Phosphates in Agriculture	413
<b>R. K. Mahey, Rajwant Singh, S. S. Sidhu and R. S. Narang:</b> The Use of Remote Sensing to Assess the Effects of Water Stress on Wheat	423
<b>S. Kurien, A. M. Goswami and D. L. Deb:</b> The Distribution of Root Activity in Acid Lime ( <i>Citrus aurantifolia</i> )	431
<b>P. E. Odo:</b> Evaluation of Short and Tall Sorghum Varieties in Mixtures with Cowpea in the Sudan Savanna of Nigeria: Land Equivalent Ratio, Grain Yield and System Productivity Index	435
<b>Book Reviews</b>	443
<b>Index</b>	449

*Continued from inside front cover*

**Preparation and submission of manuscripts.** 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, 27 Congress St., Salem, Mass. 01970. 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 US copyright law) subject to payment to C.C.C. of the per copy fee of \$5.00. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0014-4797/91 \$5.00 + .00.

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

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

# Experimental Agriculture

## CONTENTS

<b>D. M. Merrill-Sands, S. D. Biggs, R. J. Bingen, P. T. Ewell, J. L. McAllister and S. V. Poats:</b> Institutional Considerations in Strengthening On-farm Client-oriented Research in National Agricultural Research Systems: Lessons from a Nine-country Study (Farming Systems Series – Number 33)	343
<b>Asfaw Negassa, Benti Tolessa, Steven Franzel, Gemechu Gedeno and Legesse Dadi:</b> The Introduction of an Early Maturing Maize ( <i>Zea mays</i> ) Variety to a Mid-altitude Farming System in Ethiopia	375
<b>J. Kahurananga:</b> Intercropping Ethiopian <i>Trifolium</i> Species with Wheat	385
<b>H. M. Abdel Magid, M. F. Ghoneim, R. K. Rabie and R. E. Sabrah:</b> Productivity of Wheat and Alfalfa under Intercropping	391
<b>I. A. M. Yunusa and N. A. Gworgwor:</b> Growth and Yield of Maize Genotypes during Dry Seasons in Northern Nigeria	397
<b>T. I. Ofuya:</b> Observations on Insect Infestation and Damage in Cowpea ( <i>Vigna unguiculata</i> ) Intercropped with Tomato ( <i>Lycopersicon esculentum</i> ) in a Rain Forest Area of Nigeria	407
<b>P. H. Le Mare:</b> Rock Phosphates in Agriculture	413
<b>R. K. Mahey, Rajwant Singh, S. S. Sidhu and R. S. Narang:</b> The Use of Remote Sensing to Assess the Effects of Water Stress on Wheat	423
<b>S. Kurien, A. M. Goswami and D. L. Deb:</b> The Distribution of Root Activity in Acid Lime ( <i>Citrus aurantifolia</i> )	431
<b>P. E. Odo:</b> Evaluation of Short and Tall Sorghum Varieties in Mixtures with Cowpea in the Sudan Savanna of Nigeria: Land Equivalent Ratio, Grain Yield and System Productivity Index	435
<b>Book Reviews</b>	443
<b>Index</b>	449

CAMBRIDGE UNIVERSITY PRESS

The Pitt Building, Trumpington Street, Cambridge CB2 1RP  
40 West 20th Street, New York, NY 10011-4211, USA  
10 Stamford Road, Oakleigh, Victoria 3166, Australia