## Even the difficult pests won't get past Azodrin

Azodrin is proving itself the cotton grower's most powerful ally. Not only does Azodrin control all the commonly occurring pests that endanger cotton, but it succeeds in dealing with many of those 'difficult' pests which are not well controlled by other insecticides. For example Azodrin has had outstanding success in dealing with Prodenia (Spodoptera) in Central America and the Middle East and against resistant mites in Brazil.

Azodrin kills these pests two ways. By contact—as they settle or crawl on the plant's surface. By systemic action—killing the

insects as they suck or chew. And not only on cotton. But on rice and tobacco and other crops too.

Azodrin is one in the Shell range of Agricultural Chemicals—extensively tested, well-proven products—which makes an important world-wide contribution to agricultural productivity. For further information contact your Shell Company or Shell Chemicals distributor.

Shell Chemicals





Jnl. of Agric. Sci. 75, 3

### ANIMAL PRODUCTION Journal of the British Society of Animal Production

CONTENTS OF VOLUME 12 PART 4 NOVEMBER 1970 INCLUDES THE FOLLOWING

- ARTHUR, J. A. and ABPLANALP, H. Computer simulation of reciprocal recurrent selection with overdominant gene action.
- HINKS, C. J. M. Performance test procedures for meat production amongst dairy bulls used in AI.
- HINKS, C. J. M. The selection of dairy bulls for artificial insemination.
- HALE, R. W. An experiment on the selection of bacon pigs by high and low carcass densities.
- WOOD, P. D. P. Factors affecting accuracy in the evaluation of progeny tests of growth rate in cattle.
- KRUSE, V. Yield of colostrum and immunoglobulin in cattle at the first milking after parturition.
- KRUSE, V. Absorption of immunoglobulin from colostrum in newborn calves.
- JACKSON, N. and FORBES, T. J. The voluntary intake by cattle of four silages differing in dry matter content.
- ROBINSON, J. J. and FORBES, T. J. Studies on protein utilization by ewes during lactation.
- RUTTER, W. A comparison of the performance of suckled lambs with lambs weaned at seven weeks of age and either grazed or given concentrates.
- CRIGHTON, D. B. The induction of pregnancy during lactation in the sow: the effects of a treatment imposed at 21 days of lactation.

- LAND, R. B. The mating behaviour and semen characteristics of Finnish Landrace and Scottish Blackface rams.
- TRAIL, J. C. M., SACKER, G. D. and FISHER, I. L. Crossbreeding beef cattle in Western Uganda. 1. Performance of Ankole, Boran and Zebu cows.
- SACKER, G. D., TRAIL, J. C. M. and FISHER, I. L. Crossbreeding beef cattle in Western Uganda. 2. Environmental influences on body weight.
- TRAIL, J. C. M., SACKER, G. D. and FISHER, I. L. Crossbreeding beef cattle in Western Uganda. 3. Genetic analysis of body weight.
- KRUSE, V. A note on the estimation by simulation technique of the optimal colostrum dose and feeding time at first feeding after the calf's birth.
- GEDDE-DAHL, T. W. and STANDAL, N. A note on a tremor condition in adolescent pigs.
- FOOT, JANET Z. and GREENHALGH, J. F. D. A note on the relation between weights of alimentary tract contents, body fat and the uterus in Blackface ewes.
- BARKER, J. D. and LAND, R. B. A note on the fertility of hill ewes mated to Finnish Landrace and Border Leicester rams.
- GHORBAN, K., MOZAFAR, A. A., SEFIDBAKHT, N. and SIMHAEE, E. A note on feedlot performance of Grey Shirazi sheep.

#### **OLIVER & BOYD**

33 Montgomery Street, Edinburgh EH7 5JX, Scotland

### THE INDIAN JOURNAL OF AGRICULTURAL SCIENCES

The Indian Journal of Agricultural Sciences is devoted to all branches of experimental agriculture. It lays emphasis on original articles reporting results of problem-orientated, completed researches in India and the adjoining countries with a similar climate. It also includes short research notes and critical review articles.

The journal, a monthly, has 1,200 pages in a volume.

Single copy: Sh. 7.6d

Annual:  $f_{4}/10$  \$10

Orders and enquiries to:

The Business Manager,

Publications Wing,

Indian Council of Agricultural Research,

New Delhi 1,

India.

# THE JOURNAL OF AGRICULTURAL SCIENCE

#### EDITED BY

- G. D. H. BELL, C.B.E., Ph.D., F.R.S., Plant Breeding Institute, Cambridge
- K. L. BLAXTER, Ph.D., N.D.A. (HONS.), D.SC., F.R.S.E., F.R.S., Rowett Research Institute, Bucksburn, Aberdeen
- G. W. COOKE, Ph.D., F.R.I.C., F.R.S., Rothamsted Experimental Station, Harpenden
- JOHN HAMMOND, Jr., M.A., Department of Agricultural Science and Applied Biology, Cambridge
- Prof. Sir J. B. HUTCHINSON, C.M.G., SC.D., F.R.S., Emeritus Professor of Agriculture, Department of Agricultural Science and Applied Biology, Cambridge
- J. L. LINZELL, B.SC., PH.D., M.R.C.U.S., Institute of Animal Physiology, Babraham, Cambridge
- H. L. PENMAN, O.B.E., Ph.D., F.R.S., Rothamsted Experimental Station, Harpenden
- W. J. RIDGMAN, M.A., Department of Agricultural Science and Applied Biology, Cambridge
- H. H. ROGERS, B.SC., DIP.AG.SCI., Plant Breeding Institute, Cambridge
- Prof. E. W. RUSSELL, C.M.G., PH.D., 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 LXXV 1970** 

CAMBRIDGE
AT THE UNIVERSITY PRESS
1970

#### PUBLISHED BY

#### THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS

Bentley House, 200 Euston Road, London, N.W.1. American Branch: 32 East 57th Street, New York, N.Y.10022

Printed in Great Britain at the University Printing House, Cambridge

#### **Contents**

Part 1 (August 1970)	PAGE
Samuel, C. J. A., Hill, J., Breese, E. L. and Davies, Alison. Assessing and predicting environmental response in <i>Lolium perenne</i> . (With 4 text-figures)	1
Andrews, R. P. and Ørskov, E. R. The nutrition of the early weaned lamb. I. The influence of protein concentration and feeding level on rate of gain in body weight. (With 1 text-figure)	11
Andrews, R. P. and Ørskov, E. R. The nutrition of the early weaned lamb. II. The effect of dietary protein concentration, feeding level and sex on body composition at two live weights. (With 2 text-figures)	19
Jones, R. J. and Haydock, K. P. Yield estimation of tropical and temperate pasture species using an electronic capacitance meter. (With 4 text-figures)	27
RODGER, J. B. A. and ROBERTSON, G. M. Effects of high levels of fertilizer on yield of potatoes grown for ware. (With 2 text-figures)	37
Pan, Y. S. Breed and seasonal differences in quantities of lipids of skin surface and hair in cattle. (With 1 text-figure)	41
Andrews, R. J. and Lewis, D. The utilization of dietary fats by ruminants. I. The digestibility of some commercially available fats	47
Andrews, R. J. and Lewis, D. The utilization of dietary fats by ruminants. II. The effect of fatty acid chain length and unsaturation on digestibility	55
Pande, H. K. and Singh, Panjab. Water and fertility management of rice varieties under low atmospheric evaporative demand. (With 2 text-figures)	61
PENMAN, H. L. Woburn irrigation, 1960-8. IV. Design and interpretation. (With 1 text-figure)	69
Penman, H. L. Woburn irrigation, 1960-8. V. Results for leys. (With 7 text-figures)	75
Penman, H. L. Woburn irrigation, 1960-8. VI. Results for rotation crops. (With 5 text-figures)	89
Charles, A. H. Ryegrass populations from intensively managed leys. I. Seedling and spaced plant characters	103
Goldsworthy, P. R. The growth and yield of tall and short sorghums in Nigeria. (With 8 text-figures)	109
Goldsworthy, P. R. The canopy structure of tall and short sorghum. (With 4 text-figures)	123
Doney, J. M. and Evans, C. C. The influence of nutrition during winter on growth rate and sulphur content of wool of pregnant Scottish Blackface and Romney ewes. (With 1 text-figure)	133
Draycott, A. P. and Durrant, M. J. The relationship between exchangeable soil magnesium and response by sugar beet to magnesium sulphate. (With 4 text-figures)	137
Rogers, H. H. and Thomson, A. J. Aspects of the agronomy and genetics of quality components in a diallel set of progenies of <i>Lolium perenne</i> L. (With 3 text-figures)	145

iv Contents

	PAGE
Thomson, A. J. and Rogers, H. H. Recovery and utilization of applied nitrogen by a diallel set of progenies of <i>Lolium perenne</i> L. (With 1 text-figure)	159
BEAN, E. W. Genotypic variation in inflorescence length in <i>Phleum pratense</i> . (With 3 text-figures)	169
OLUBAJO, F. O. and OYENUGA, V. A. Digestibility of tropical pasture mixtures using the indicator technique	175
Morag, M., Raz, A. and Eyal, E. Mother-offspring relationships in Awassi sheep. IV. The effect of weaning at birth, or after 15 weeks, on lactational performance in the dairy ewe. (With 3 text-figures)	183
Part 2 (October 1970)	
Dent, J. B., Blair, R., English, P. R. and Raeburn, J. R. Protein, lysine and feed intake level effects on pig growth. III. Regression analysis and economic aspects. (With 7 text-figures)	189
Burlacu, Gh., Ionila, Dumitra and Baltac, Margareta. Efficiency of the utilization of the energy of casein in fowls	207
CHRISTIAN, K. R., Jones, D. B. and Freer, M. Digestibility and chemical composition of fractions of lucerne during spring and summer. (With 5 text-figures)	213
Hull, R. and Webb, D. J. The effect of sowing date and harvesting date on the yield of sugar beet. (With 3 text-figures)	223
Schröder, H. H. E. Pathways for the elimination of biuret in sheep. (With 4 text-figures) .	231
Walker, N. The effect of feeding at 3, 6 or 12 hourly intervals on the performance and carcass composition of growing-finishing pigs	241
Poulton, S. G. and Ashton, W. M. A study of the composition of Clun Forest ewe's milk. IV. The proteins of ewe's milk and their variation with stage of lactation. (With 2 text-figures)	245
PAQUAY, R., DE BAERE, R. and LOUSSE, A. Statistical research on the fate of water in the adult cow. II. The lactating cow	251
OSMAN, A. H., EL SHAFIE, S. A. and KHATTAB, A. G. H. Carcass composition of fattened rams and wethers of Sudan Desert sheep	257
Leaver, J. D. A comparison of grazing systems for dairy herd replacements. (With 3 text-figures)	265
JAGUSCH, K. T., NORTON, B. W. and WALKER, D. M. Body composition studies with the milk-fed lamb. I. Chemical composition and calorific content of the body and organs of newly-born lambs	273
JAGUSCH, K. T., NORTON, B. W. and WALKER, D. M. Body composition studies with the milk-fed lamb. II. The effect of the age of the lamb and the protein content of the diet on the chemical composition of the body and its organs. (With 1 text-figure)	279
NORTON, B. W., JAGUSCH, K. T. and WALKER, D. M. Body composition studies with the milk-fed lamb. III. The effect of the protein and energy intake on the composition of the live-weight gain. (With 2 text-figures)	287

Contents

	PAG
${\tt Jones}, {\tt D}. {\tt I}. {\tt H}.$ The ensiling characteristics of different herbage species and varieties .	29
Low, A. J. and Piper, F. J. The ammonification and nitrification in soil of urea with and without biuret. (With 2 text-figures)	30
McLeod, D. S., Wilkins, R. J. and Raymond, W. F. The voluntary intake by sheep and cattle of silages differing in free-acid content.	3]
BAILEY, R. W. and MACRAE, J. C. The hydrolysis by rumen and caecal microbial enzymes of hemicellulose in plant and digesta particles	32
McCullough, T. A. A study of the effect of supplementing a concentrate diet with roughages of different quality on the performance of Friesian steers. I. Voluntary food intake and food utilization. (With 6 text-figures)	32
McCullough, T. A. A study of the effect of supplementing a concentrate diet with roughages of different quality on the performance of Friesian steers. II. Growth rate, efficiency of food conversion and carcass yield	33
Reid, D. and Castle, M. E. A comparison of the effects of anhydrous ammonia and a solid ammonium nitrate fertilizer on herbage production from a pure perennial ryegrass sward. (With 2 text-figures)	34
Newton, J. E., Betts, J. E. and Large, R. V. Increasing litter size in three breeds of sheep by superovulation	38
MITCHELL, J. D. D. Yields of, and N uptakes by, some grass species and varieties under different glasshouse conditions. (With 1 text-figure)	30
Addiscott, T. M. A note on resolving soil cation exchange capacity into 'mineral' and 'organic fractions. (With 1 text-figure)	36
Part 3 (December 1970)	
HAGGAR, R. J. and Ahmed, M. B. Seasonal production of Andropogon gayanus. II. Seasonal changes in digestibility and feed intake.	36
LAKHDIVE, B. A. and PRASAD, RAJENDRA. Yield of a tall and a dwarf indica rice as affected by fertilizer nitrogen, with and without nitrification inhibitors	37
Dror, Y., Tagari, H. and Bondi, A. The efficiency of utilization of proteins contained in roughages, soya bean oil meal or mixtures of both, by sheep	38
SREENAN, J. In vitro maturation and attempted fertilization of cattle follicular occytes .	39
Johnson, K. G. Sweating rate and the electrolyte content of skin secretions of Bos taurus and Bos indicus cross-bred cows	39
ROBINSON, J. J., FRASER, C., CORSE, ELIZABETH L. and GILL, J. C. The effect of pattern of protein intake and level of energy intake on the performance and nitrogen utilization of the ewe	40
MATTINGLY, G. E. G. Residual value of basic slag, Gafsa rock phosphate and superphosphate in a sandy podzol	4.
Оломо, O. A. and Adelana, B. O. Variety × environment interactions in groundnut variety tests in Western Nigeria.	4]

vi Contents

	PAGE
Hughes, A. D. The non-protein nitrogen composition of grass silages. II. The changes occurring during the storage of silage	421
Grant, D. R. Some measurements of evaporation in a field of barley	433
Kirby, E. J. M. Evapotranspiration from barley grown at different plant densities	445
Addiscott, T. M. Potassium: calcium exchange in soils of the Broadbalk experiment at Rothamsted	451
Peart, J. N. The influence of live weight and body condition on the subsequent milk production of Blackface ewes following a period of undernourishment in early lactation .	459
Hobson, P. N. and Thompson, J. K. The concentration of soluble polysaccharides in the rumen contents of sheep fed on hay	471
Morris, J. G. The survival feeding of pregnant and lactating beef cows on all-sorghum grain rations: the effects of two levels of grain and early weaning of the calves $\cdot$ .	479
GRIFFITHS, J. G., GUNN, R. G. and DONEY, J. M. Fertility in Scottish Blackface ewes as influenced by climatic stress .	485
WIENER, G., FIELD, A. C. and JOLLY, G. M. The concentration of minerals in the blood of genetically diverse groups of sheep. IV. Factors influencing seasonal changes in copper concentration	489
Searle, T. W. Prediction of body composition of sheep from tritiated water space and body weight—tests of published equations	497
Jolly, M. and Lyne, A. G. The response of skin and wool growth to local subdermal temperature changes in a sheep	501
Jones, D. I. H. The effect of nitrogen fertilizers on the ensiling characteristics of perennial ryegrass and cocksfoot	517
Reid, D. and Castle, M. E. The effects of the date of applying anhydrous ammonia or a solid nitrogen fertilizer on the spring growth from a pure perennial ryegrass sward .	523
DRAYCOTT, A. P., HULL, R., MESSEM, A. B. and WEBB, D. J. Effects of soil compaction on yield and fertilizer requirement of sugar beet	533
COWLING, D. W. and LOCKYER, D. R. The response of perennial ryegrass to nitrogen in various periods of the growing season	539
TERMAN, G. L. and Allen, S. E. Fertilizer and soil P uptake by paddy rice, as affected by soil P level, source and date of application	547
JESSOP, R. S. and Ivins, J. D. The effect of date of sowing on the growth and yield of spring cereals	553
McLeod, D. S. and Wilkins, R. J. The effect of intra-ruminal feeding on the intake of silage	559
ULYATT, M. J., WHITELAW, F. G. and WATSON, F. G. The effect of diet on glucose entry rates in sheep	565
ISLAM, A. and Bolton, J. The effect of soil pH on potassium intensity and release of non-exchangeable potassium to ryegrass	571

#### Continued from back page

	PAGE
JONES, D. I. H. The effect of nitrogen fertilizers on the ensiling characteristics of perennial rye- grass and cocksfoot	517
REID, D. and CASTLE, M. E. The effects of the date of applying anhydrous ammonia or a solid nitrogen fertilizer on the spring growth from a pure perennial ryegrass sward. (With 4 text-figures)	523
DRAYCOTT, A. P., HULL, R., MESSEM, A. B. and WEBB, D. J. Effects of soil compaction on yield and fertilizer requirement of sugar beet. (With 1 text-figure)	533
COWLING, D. W. and LOCKYER, D. R. The response of perennial ryegrass to nitrogen in various periods of the growing season. (With 4 text-figures).	539
TERMAN, G. L. and Allen, S. E. Fertilizer and soil P uptake by paddy rice, as affected by soil P level, source and date of application. (With 5 text-figures)	547
JESSOP, R. S. and IVINS, J. D. The effect of date of sowing on the growth and yield of spring cereals	553
McLeod, D. S. and Wilkins, R. J. The effect of intra-ruminal feeding on the intake of silage	559
ULYATT, M. J., WHITELAW, F. G. and WATSON, F. G. The effect of diet on glucose entry rates in sheep	565
ISLAM, A. and Bolton, J. The effect of soil pH on potassium intensity and release of non-exchangeable potassium to ryegrass. (With 3 text-figures)	571

#### THE JOURNAL OF AGRICULTURAL SCIENCE

#### CONTENTS

VOL. /3 Fail 3 December 19/	V	ol.	75	Part	3	December	19	7(	ſ	ì
-----------------------------	---	-----	----	------	---	----------	----	----	---	---

	PAGE
HAGGAR, R. J. and Ahmed, M. B. Seasonal production of <i>Andropogon gayanus</i> . II. Seasonal changes in digestibility and feed intake. (With 4 text-figures)	369
LAKHDIVE, B. A. and PRASAD, RAJENDRA. Yield of a tall and a dwarf indica rice as affected by fertilizer nitrogen, with and without nitrification inhibitors	375
Dror, Y., Tagari, H. and Bondi, A. The efficiency of utilization of proteins contained in roughages, soya bean oil meal or mixtures of both, by sheep. (With 3 text-figures)	381
SREENAN, J. In vitro maturation and attempted fertilization of cattle follicular oocytes. (With 1 plate)	393
JOHNSON, K. G. Sweating rate and the electrolyte content of skin secretions of Bos taurus and Bos indicus cross-bred cows. (With 3 text-figures)	397
ROBINSON, J. J., FRASER, C., CORSE, ELIZABETH L. and GILL, J. C. The effect of pattern of protein intake and level of energy intake on the performance and nitrogen utilization of the ewe. (With 3 text-figures)	403
MATTINGLY, G. E. G. Residual value of basic slag, Gafsa rock phosphate and superphosphate in a sandy podzol. (With 2 text-figures)	413
Оломо, O. A. and Adelana, B. O. Variety × environment interactions in groundnut variety tests in Western Nigeria	419
Hughes, A. D. The non-protein nitrogen composition of grass silages. II. The changes occurring during the storage of silage	421
GRANT, D. R. Some measurements of evaporation in a field of barley	433
KIRBY, E. J. M. Evapotranspiration from barley grown at different plant densities. (With 4 text-figures)	445
Addiscott, T. M. Potassium: calcium exchange in soils of the Broadbalk experiment at Rothamsted. (With 5 text-figures)	451
PEART, J. N. The influence of live weight and body condition on the subsequent milk production of Blackface ewes following a period of undernourishment in early lactation. (With 5 text-figures)	459
HOBSON, P. N. and THOMPSON, J. K. The concentration of soluble polysaccharides in the rumen contents of sheep fed on hay. (With 2 text-figures)	471
MORRIS, J. G. The survival feeding of pregnant and lactating beef cows on all-sorghum grain rations: the effects of two levels of grain and early weaning of the calves	479
GRIFFITHS, J. G., GUNN, R. G. and DONEY, J. M. Fertility in Scottish Blackface ewes as influenced by climatic stress	485
WIENER, G., FIELD, A. C. and JOLLY, G. M. The concentration of minerals in the blood of genetically diverse groups of sheep. IV. Factors influencing seasonal changes in copper concentration	489
SEARLE, T. W. Prediction of body composition of sheep from tritiated water space and body weight—tests of published equations. (With 2 text-figures)	497
JOLLY, M. and LYNE, A. G. The response of skin and wool growth to local subdermal temperature changes in a sheep. (With 2 plates and 11 text-figures)	501

Continued on inside back cover

SUBSCRIPTIONS. Two volumes of three parts are published annually. The subscription price is £6 net (U.S.A. \$19.50) per volume (post free); single parts are available at £2 12s. net (U.S.A. \$8.00) plus postage. Orders or enquiries may be sent to any bookseller or subscription agent, or to Cambridge University Press, P.O. Box 92, London, N.W.1. (U.S.A. and Canada, Cambridge University Press American Branch, 32 East 57th Street, New York, N.Y. 10022, U.S.A.)