

THE 1997 BRIGHTON CROP PROTECTION CONFERENCE

**Weeds
Volume I**

Proceedings of an international
conference organised by
The BRITISH CROP PROTECTION COUNCIL
held at the Brighton Centre and
the Stakis Brighton Metropole Hotel,
Brighton, UK

17-20 November 1997

BCPC Registered Office:
49 Downing Street
Farnham
Surrey GU9 7PH
UK

CONTENTS

Page

The British Crop Protection Council Members	XXI
The British Crop Protection Council Objectives	XXII
Programme Committee and Conference & Symposia Co-ordinating Group	XXIII
Abbreviations	XXIV

VOLUME I

SESSION I

Session Page

THE TWENTY-FOURTH BAWDEN LECTURE

Saving the planet with pesticides, biotechnology and European farm reform

D T AVERY	1-1	3
-----------------	-----	---

SESSION 2

NEW HERBICIDES, FORMULATIONS AND USES

Papers

Organo-clay formulations of alachlor: reduced leaching and improved efficacy

Y Z EL-NAHHAL, S NIR, T POLUBESOVA <i>et al.</i>	2-1	21
--	-----	----

The use of clomazone as a post-emergence herbicide
in poppies (*Papaver somniferum*)

I L MACLEOD	2-2	27
-------------------	-----	----

Potential use of allelopathic agents as natural agrochemicals

F A MACIAS, D CASTELLANO, R M OLIVA <i>et al.</i>	2-3	33
---	-----	----

LGC-40863: a new broad spectrum post-emergence herbicide

J H CHO, S-C AHN, S J KOO <i>et al.</i>	2-4	39
---	-----	----

JV 485: a new herbicide for pre-emergence broad spectrum
weed control in winter wheat

S D PROSCH, A J CIHA, R GROGNA <i>et al.</i>	2-5	45
--	-----	----

Oxadiargyl: a novel herbicide for rice and sugar cane

R DICKMANN, J MELGAREJO, P LOUBIERE and M MONTAGNON	2-6	51
---	-----	----

Azafenidin: a new, low use rate herbicide for weed control in
perennial crops, industrial weed control and forestry

K AMUTI, A TROMBINI, L GIAMMARRUSTI <i>et al.</i>	2-7	59
---	-----	----

BAY YRC 2388: a novel herbicide for control of grasses and
some major species of sedges and broadleaf weeds in rice

K YASUI, T GOTO, H MIYAUCHI <i>et al.</i>	2-8	67
---	-----	----

MY-100: a new herbicide for pre- and early post-emergence
barnyard grass control in rice

K JIKIHARA, T MARUYAMA, J MORISHIGE <i>et al.</i>	2-9	73
---	-----	----

SESSION 3A
WEED CONTROL IN CEREALS

Papers

Overview of protoporphyrinogen oxidase inhibiting herbicides F E DAYAN and S O DUKE	3A-1	83
JV 485 - an advanced pre-emergence herbicide for the control of <i>Alopecurus myosuroides</i> and broad-leaved weeds in UK winter wheat B J G BOLTON, P W ROSE and A J NORTON	3A-2	93
Rice allelopathy - where are we and how far can we get? M OLOFSDOTTER, D NAVAREZ and M REBULANAN	3A-3	99
The critical period of weed competition and its application in organic winter wheat J P WELSH, H A J BULSON, C E STOPEs <i>et al.</i>	3A-4	105
The implications of reduced doses of fluroxypyr and wheat cultivar choice on the seed production, growth and development of the progeny of common field speedwell G T CHAMPION, R J FROUD-WILLIAMS and J M HOLLAND	3A-5	111
Carfentrazone-ethyl: a new herbicide for the rapid control of key cereal broad-leaf weeds S W SHIRES, L A BOURDOUXHE, A R CROSSMAN <i>et al.</i>	3A-6	117

SESSION 3B
WEED CONTROL IN HORTICULTURE

Papers

Recent developments in the management of the reducing portfolio of plant protection products available to European producers of minor crops C J C WISE and P J CHAPMAN	3B-1	125
The value of older herbicides for vegetable crops in California C E BELL	3B-2	131
Herbicide movement from container grown ornamental plant production nurseries J A BRIGGS and T WHITWELL	3B-3	137
Application of herbicides impregnated onto plastic film in early vegetables and maize S R RUNHAM, S J TOWN and J C FITZPATRICK	3B-4	143
Approaches to the detection of individual plants in horticultural row crops and the implications for pesticide application P C H MILLER, T HAGUE, N D TILLET and J A MARCHANT	3B-5	151

SESSION 3C

BIOLOGY AND CONTROL OF WEEDS IN SUB-TROPICAL AND TROPICAL CROPS

Poster Papers

- Weed composition and population dynamics in intensified smallholder farms in West Africa
D CHIKOYE, F EKELEME and I O AKOBUNDU 3C-1 161
- Integrated weed management for sustainable production of a pigeonpea based cropping system
A N TEWARI and K S RATHI 3C-2 167
- Weed control methods in integrated pest management of citrus in Adana and İçel Provinces of Turkey
O GÖNEN, İ ÜREMİŞ and E OREL 3C-3 173
- On-farm weed control in maize using cultural, physical and chemical methods
J N CHUI, J M KAHUMBURA and T M KUSEWA 3C-4 179
- Weeding – its contribution to soil water conservation in semi-arid maize production
S TWOMLOW, C RICHES and S MABASA 3C-5 185
- Constraints and opportunities for weed management in rainfed lowland rice
A M MORTIMER, R LUBIGAN and C PIGGIN 3C-6 191
- The response of *O. glaberrima*, *O. sativa* and an interspecific hybrid rice cultivar to weed competition
D E JOHNSON, M P JONES, M DINGKUHN and M C MAHAMANE 3C-7 197
- Mechanical weed control: the case of hand weeders
I CHATIZWA 3C-8 203
- Impact of *Imperata cylindrica* on smallholder rubber production
H SURYANINGTYAS, A GUNAWAN, P J TERRY *et al.* 3C-9 209
- Herbicides with alternative modes of action for the control of propanil- and fenoxaprop-P resistant *Echinochloa colona*
J C CASELEY, C PALGRAVE, E HAAS *et al.* 3C-10 215
- Introduction of low volume CDA spraying for the control of invasive weeds in Colombian pastures
R ASTON 3C-11 221
- Catch-cropping with Sudan grass – an option for *Striga* control in subsistence agriculture
A OSWALD, G ABAYO, J K RANSOM *et al.* 3C-12 227

SESSION 4A

TRENDS IN WEED POPULATIONS

Papers

Modelling potential spread of <i>Abutilon theophrasti</i> (velvetleaf) J S HOLT and A B BROOSE	4A-1	235
Genotypic variation in the development of secondary dormancy in oilseed rape and its impact on the persistence of volunteer rape C PEKRUN, T C POTTER and P J W LUTMAN.....	4A-2	243
Changes in field weeds in Hungary during the last 46 years Á TÓTH, G B BENÉCSNÉ and G Y BALÁZS	4A-3	249
Weed seed contaminants in cereal seed R DON	4A-4	255

SESSION 4B

ENVIRONMENTAL IMPACT OF GENETICALLY MODIFIED CROPS

Papers

Transgenes for stress tolerance: consequences for weed evolution J I COOPER and A F RAYBOULD.....	4B-1	265
The possible impacts of multiple transgenes P J DALE and I J SENIOR.....	4B-2	273
The agricultural implications of genetically modified plants M F ASKEW	4B-3	281
The impact of releases of genetically modified herbicide tolerant oilseed rape in the UK J B SWEET, R SHEPPERSON J E THOMAS and E SIMPSON	4B-4	291

SESSION 4C

CHARACTERISATION AND CONTROL OF HERBICIDE RESISTANT WEEDS

Poster Papers

Herbicide resistance and gene flow in black-grass (<i>Alopecurus myosuroides</i>) and wild-oats (<i>Avena</i> spp.) G CAVAN and S R MOSS.....	4C-1	305
Sulfonylurea resistance in a biotype of <i>Monochoria korsakowii</i> , an annual paddy weed in Japan G X WANG, H KOHARA and K ITOH	4C-2	311
Chlorsulfuron cross-resistance in a chlorotoluron-resistant biotype of <i>Alopecurus myosuroides</i> J M MENENDEZ, R DE PRADO and M D DEVINE.....	4C-3	319

Development of new reliable quick tests and state of grass weed herbicide resistance in France A LETOUZÉ, J GASQUEZ, D VACCARA <i>et al.</i>	4C-4	325
Efficacy of diclofop-methyl against isoproturon resistant <i>Phalaris minor</i> in relation to wheat cultivar and spacing L S BRAR and B SINGH.....	4C-5	331
Activity of JV 485, a protoporphyrinogen oxidase inhibitor, on herbicide resistant black-grass (<i>Alopecurus myosuroides</i>) S R MOSS and M S ROOKE	4C-6	337
An integrated strategy for the successful management of herbicide resistant <i>Alopecurus myosuroides</i> (black-grass) in the UK M A READ, J J PALMER and S HOWARD	4C-7	343
The role of propyzamide in management of herbicide resistant black-grass in oilseed rape J EDMONDS and J C CASELEY	4C-8	351
New management approaches for isoproturon resistant <i>Phalaris minor</i> in India S SINGH, R C KIRKWOOD and G MARSHALL	4C-9	357
Increasing the number of mechanisms of action of herbicides for management of weed resistance R A VIDAL, N G FLECK, N A OLIVEIRA <i>et al.</i>	4C-10	363

SESSION 5A

APPLICATION AND FORMULATION PARAMETERS: THEIR INFLUENCE ON PRODUCT PERFORMANCE AND SAFETY

Papers

The international (BCPC) spray classification system including a drift potential factor E S E SOUTHCOMBE, P C H MILLER, H GANZELMEIER <i>et al.</i>	5A-1	371
The influence of spray distribution and drop size, on the dose response of herbicides P ENFÄLT, A ENQVIST, P BENGTSSON and K ALNESS	5A-2	381
Fatty acid derivatives as co-formulants for herbicides P LANGLOIS, C GAUVRIT, Z MOULOUGUI and F DARCHY	5A-3	391
The effects of forward speed on the drift from boom sprayers P C H MILLER and R W SMITH	5A-4	399

SESSION 5B

AGROCHEMICAL OPTIMISATION: POLICY OPTIONS

Papers

The UK Pesticides Forum and the Government policy on minimising the risks from the use of pesticides	5B-1	409
D W F SHANNON		
Possibilities for future EU environmental policy on plant protection products	5B-2	419
B SHERIDAN		
Crop protection between the needs of market and regulation	5B-3	427
P A URECH, N WATELET and G R GARDINER		
Buffer zones: their role in managing environmental risk	5B-4	435
T E TOOBY		

VOLUME 2

SESSION 6A

AGROCHEMICAL OPTIMISATION: LAND MANAGEMENT OPTIONS

Papers

Pesticide management in UK wheat production – optimisation and pragmatism	6A-1	445
J H ORSON		
ECOtillage: a sustainable management programme which reduces the costs of crop establishment and weed control, whilst providing environmental benefits	6A-2	453
C D STRIDE and P J WRIGHT		
Adopting integrated crop management – a practical whole farm approach for the optimisation of agrochemical use	6A-3	461
C J DRUMMOND and J PURSLOW		
The use of impact ranking indices in the regulation of pesticide use: the case of taxes	6A-4	469
F S QUIN and G EDWARDS-JONES		

SESSION 6B

WEED ECOPHYSIOLOGY

Poster Papers

Phenology and reproductive allocation of <i>Bromus sterilis</i> , <i>B. diandrus</i> , <i>B. hordeaceus</i> and <i>B. commutatus</i>	6B-1	479
G BURGHARDT and R J FROUD-WILLIAMS		
Germination ecology of <i>Stellaria media</i>	6B-2	485
A CHRISTAL, D H K DAVIES, P R VAN GARDINGEN and K BROWN		

A molecular study of species-rich grassland ecosystems W SINCLAIR, R P FINCH, G MARSHALL and D ATKINSON	6B-3	491
Competitive effects of multiple weed species on weed biomass and wheat yield K J WRIGHT, G P SEEVERS and B J WILSON	6B-4	497
A simulation approach to identifying the mechanisms of maize tolerance to velvetleaf competition for light J L LINDQUIST and D A MORTENSEN	6B-5	503
Activity and persistence of sorgoleone, a long-chain hydroquinone produced by <i>Sorghum bicolor</i> L A WESTON and M A CZARNOTA.....	6B-6	509

SESSION 6C

APPLICATION AND FORMULATION PARAMETERS: THEIR INFLUENCE ON PRODUCT PERFORMANCE AND SAFETY

Poster Papers

Effects of additives on glyphosate activity in purple nutsedge R SUWANKETNIKOM.....	6C-1	519
Alginate-based formulations of volatile herbicides: factors affecting release rates R M WILKINS and J ZHAO.....	6C-2	525
Influence of emulsifiable oils and emulsifier on the performance of phenmedipham, metoxuron, sethoxydim and quizalofop H DE RUITER	6C-3	531
Effect of drift control adjuvants and a surfactant on a herbicide applied at conventional and ultra low volumes G D WILLS, E J JONES, J E HANKS and R E MACK.....	6C-4	539
Modified spray nozzle design reduces drift whilst maintaining effective chemical coverage A R G CECIL.....	6C-5	543
Effects of adjuvant oil emulsions on foliar retention and spray quality K J HALL, N M WESTERN, P J HOLLOWAY and D STOCK.....	6C-6	549
Effect of liquid properties on the potential for spray drift from flat fan hydraulic nozzles K U SARKER, C S PARKIN and B J WILLIAMS.....	6C-7	555
Emulsions and their effect on spray formation and droplet size with agricultural flat fan nozzles M C BUTLER ELLIS, C R TUCK and P C H MILLER.....	6C-8	561
Assessment of actual pesticide hazard to the applicators A I POTAPOV	6C-9	567

SESSION 7A

NEW CHALLENGES FOR HERBICIDE DISCOVERY AND SELECTIVITY

Papers

Herbicide target sites: recent trends and new challenges K E PALLETT	7A-1	575
Natural products as leads for new herbicide modes of action S O DUKE, F E DAYAN, A HERNANDEZ <i>et al.</i>	7A-2	579
Herbicide selectivity mechanisms in maize: using what we know for the future M BARRETT	7A-3	587
Molecular enzymology of plant cytochromes P ₄₅₀ J A MAUGHAN, J H A NUGENT, I M CLARK <i>et al.</i>	7A-4	597
Comparative metabolism of imidazolinone herbicides B TECLE, D L SHANER, A D CUNHA <i>et al.</i>	7A-5	605

WORKSHOP SESSION 7B AND 8B

AGGREGATED WEED DISTRIBUTION – BIOLOGICAL AND TECHNOLOGICAL CHALLENGES

Workshop Papers

Spatial dynamics of weeds: an overview R D COUSENS and J L WOOLCOCK	7B-1	613
Implications of aggregated weed seed distribution for weed seedbank studies A C GRUNDY	7B-2	619
Estimating weed seedbank density from presence/absence maps M E R PAICE and W DAY	7B-3	621
Some aspects of the spatial dynamics of weeds J N PERRY	7B-4	625
Dynamics of weed clusters: current understanding and some open problems J WALLINGA and M J KROPFF	7B-5	629
Machine vision for plant scale husbandry J A MARCHANT, T HAGUE and N D TILLET	7B-6	633
Spatially selective weed control in arable crops – where are we now? P J W LUTMAN and L J REW	7B-7	637
Methods of controlling sprayer output for spatially variable herbicide application P C H MILLER, M E R PAICE and A D GANDERTON	7B-8	641
The biology underlying weed management treatment maps in maize D A MORTENSEN and J A DIELEMAN	7B-9	645
Patchy weed control in agricultural practice H NORDMEYER and P NIEMANN	7B-10	649

SESSION 7C

POSTGRADUATE RESEARCH

Poster Papers

The effect of mulch from three multipurpose trees (MPTS) on weed composition and biomass in maize

A Y KAMARA, S C JUTZI, I O AKOBUNDU and D CHIKOYE 7C-1 653

Suppression of weeds in maize intercrops in Kenya

J M MAINA and D S H DRENNAN 7C-2 655

Weed control in cotton under three cultivation systems

D PAPAMICHAIL, R J FROUD-WILLIAMS, D S H DRENNAN *et al.* 7C-3 657

Weed control with herbicides and hand-hoe weeding in cotton in Uganda

R M WILKINS and R KABANYORO 7C-4 659

Weeding effects on coffee production and soil weed seed numbers in establishing coffee in Uganda

M P E WETALA and D S H DRENNAN 7C-5 661

The seed bank and weed seedling emergence in sugar cane in Sri Lanka

W R G WITHARAMA, R E L NAYLOR and G P WHYTOCK 7C-6 663

Aggressivity of wheat cultivars

S M R KARIM, R E L NAYLOR and G P WHYTOCK 7C-7 665

The use of varietal selection and seed rates for enhanced weed suppression in winter wheat (*Triticum aestivum* L.)

N E KORRES and R J FROUD-WILLIAMS 7C-8 667

Effects of sub-lethal doses of metsulfuron-methyl on crop-weed competition in two varieties of winter wheat

D S KIM, P BRAIN, J C CASELEY and E J P MARSHALL 7C-9 669

Competition above and below ground between fat hen (*Chenopodium album*) and two sugar beet cultivars

M ABDOLLAHIAN-NOGHABI and R J FROUD-WILLIAMS 7C-10 671

Effect of herbicides on weeds, nodulation, biological nitrogen fixation and yield of peas

G SINGH and D WRIGHT 7C-11 673

Variation in cross-resistance in black-grass (*Alopecurus myosuroides*) within and between populations: implications for management

A D WILLIS, A M MORTIMER, P D PUTWAIN and S R MOSS 7C-12 675

Towards prediction of the effect of wet dormancy on *Orobanche* infestations

E K WELDEGHIORGHIS and A J MURDOCH 7C-13 677

Control of *Molinia caerulea* (L.) Moench in upland Britain

A L MILLIGAN, R H MARRS and P D PUTWAIN 7C-14 679

An analysis of farmer participation in conservation oriented management on set-aside land in England P NEVE, A M MORTIMER and P D PUTWAIN.....	7C-15	681
Interaction of diclofop-methyl and MCPA at the plant plasma membrane S C HAMER, M R HULL and A H COBB.....	7C-16	683

SESSION 7D

AGROCHEMICAL OPTIMISATION: STRATEGIES

Poster Papers

Dynamic and steady-state dose responses of some chemical injection metering systems U R ANTUNIASSI, P C H MILLER and M E R PAICE.....	7D-1	687
Use and optimisation of imidazolinone herbicides in legume production in Nigeria A O AYENI	7D-2	693
A systems approach for the control of Russian knapweed R M BOTTOMS and T D WHITSON	7D-3	699
The effects of six years of reduced rate herbicide use and rotation on weed levels, yields and profitability – TALISMAN results S K COOK and J H CLARKE.....	7D-4	705
COIRE: the impact of the presence of weeds, pests and diseases on crop qualities D H K DAVIES, N McROBERTS, G N FOSTER et al.	7D-5	711
Integration of mechanical and chemical cultivation (low rates) for the control of <i>Panicum maximum</i> L. in the rows of citrus (<i>Citrus cinensis</i> L.) crop L L FOLONI and N G SILVA	7D-6	717

SESSION 8A

REGULATORY ISSUES: CURRENT PROBLEMS AND SOLUTIONS

Papers

European challenges for plant biotechnology P L J RÜDELSHEIM.....	8A-1	725
Genetically modified plants – the European Union regulatory system D A BOSWORTH	8A-2	731
The registration of plant protection products and the implementation of the Directive 91/414/EEC in Portugal J B SOBREIRO	8A-3	739
Directive 91/414/EEC: recent practical experience and a look to the future T E TOOBY.....	8A-4	747

SESSION 8C

MODE OF ACTION AND METABOLISM OF HERBICIDES

Poster Papers

- Regulation of maize glutathione transferases during development
and their induction by xenobiotics
D P DIXON, R EDWARDS and D J COLE 8C-1 759
- Calcium ion dynamics in auxinic-herbicide resistant and
susceptible biotypes of *Sinapis arvensis*
Y WANG, S DESHPANDE and J C HALL 8C-2 765
- Chemical catalysis of the isomerisation of a peroxidising herbicidal thiadiazolidine
I JABLONKAI, T KÖMIVES, P BÖGER *et al.* 8C-3 771
- A role for glutathione-S-transferase in herbicide resistance
in black-grass (*Alopecurus myosuroides*)
J P H READE, M R HULL and A H COBB 8C-4 777
- Characteristics of acetyl- CoA carboxylases from graminicide tolerant grasses
L J PRICE, J L HARWOOD, D J COLE and S R MOSS 8C-5 783
- Purification and characterisation of glutathione transferase
enzymes from soybean seedlings
M SKIPSEY, C J ANDREWS, R EDWARDS *et al.* 8C-6 789
- Phytotoxicity of australifungin and fumonisins to weeds
H K ABBAS and W T SHIER 8C-7 795
- Glutathione and cysteine conjugates inhibit glutathione S-transferase
enzymes mediating GSH conjugation of the herbicide acetochlor
I JABLONKAI, A HULESCH and I C BARTA 8C-8 801
- Is diclofop resistance in *Alopecurus myosuroides* associated with an
altered effect on the plasma membrane electrogenic potential?
R A DE PRADO and R H SHIMABUKURO 8C-9 807
- Purification of glutathione transferases involved in
herbicide metabolism from wheat
I CUMMINS, R EDWARDS and D J COLE 8C-10 813
- The effect of graminicides on plant plasma membrane
H⁺-ATPase activity *in vitro*
M R HULL and A H COBB 8C-11 819
- Changes in glutathione transferase activities in soybean in response
to treatment with herbicides and safeners
C ANDREWS, M SKIPSEY, R EDWARDS *et al.* 8C-12 825

SESSION 8D

WEED CONTROL IN NON-CEREAL CROPS

Poster Papers

Competitive effects of weeds in linseed P J W LUTMAN	8D-1	833
Evaluation of pre- and early post-emergence herbicides for use in winter linseed in England M A FROMENT and D TURLEY	8D-2	839
Weed control in new industrial oilseed species H T H CROMACK, J M SMITH and K MORTON	8D-3	845
Winter lupin – the identification of crop safe and effective herbicide programmes H T H CROMACK, K MORTON and M GREEN	8D-4	851
Effect of weather on efficacy of herbicides in sugar beet M J MAY, M A LAINSBURY and J G HILTON	8D-5	857
Evaluation of pre-plant and pre- and post-emergence herbicides for no-till cotton crop in Cerrados areas L L FOLONI	8D-6	863
Possibilities for chemical weed control in soybean A A PENEVA	8D-7	869
Reducing herbicide inputs in no-till soybeans M M LOUX and J M STACHLER	8D-8	873
Use of new herbicides in chickpea R GIMENEZ-ESPINOSA and R DE PRADO	8D-9	879
Oxadiazyl: a novel herbicide for sunflower and vegetables G TRACCHI, P LOUBIERE and M MONTAGNON	8D-10	885
Reduced herbicide doses in carrot production J SALONEN and S JAAKKOLA	8D-11	891

VOLUME 3

SESSION 9A

CROPPING PRACTICES AND BIRDS

Papers

Responses of birds to organic arable farming: mechanisms and evidence R J FULLER	9A-1	897
Seed-eaters, stubble fields and set-aside A D EVANS	9A-2	907

Effects of cropping practices on declining farmland birds during the breeding season N J AEBISCHER.....	9A-3	915
The diet of nestling linnets <i>Carduelis cannabina</i> before and after agricultural intensification D MOORCROFT, R B BRADBURY and J D WILSON	9A-4	923

SESSION 9B
GLOBAL DEVELOPMENTS IN HERBICIDE TOLERANT CROPS

Papers

Commercial experience and benefits from glyphosate tolerant crops S MOLL	9B-1	931
Glufosinate ammonium tolerant crops – international commercial developments and experiences E RASCHE and M GADSBY	9B-2	941
Management of herbicide tolerant crops in Europe A MESSÉAN.....	9B-3	947
North American developments in herbicide tolerant crops M D K OWEN.....	9B-4	955

SESSION 9C
WEED MANAGEMENT IN ARABLE CROPS

Poster Papers

Integrated weed management – its performance over a five-course combinable crop rotation M C RICHARDS, N M FISHER and A D DRYSDALE	9C-1	967
Changes in weed population in the conversion of two arable farms to organic farming D H K DAVIES, A CHRISTAL, M TALBOT <i>et al.</i>	9C-2	973
A botanical survey of conservation headlands in Breckland Environmentally Sensitive Area, UK D J HODKINSON, C N R CRITCHLEY and A J SHERWOOD	9C-3	979
Can sown field boundary strips reduce the ingress of aggressive field margin weeds? T M WEST, E J P MARSHALL and G M ARNOLD	9C-4	985
Conserving the flora of arable field margins – how much does it cost? P J WILSON.....	9C-5	991
A long-term study on effect of no-tillage on weed development and yield of continuous wheat and barley E A SKORDA, A I ZAMANIS and P G EFTHIMIADIS.....	9C-6	997

27 years of research in maize cultivation according to the minimum tillage and zero tillage technology in Romanian agriculture NŞARPE, G MIHALCEA, E NEGRILĂ <i>et al.</i>	9C-7	1003
The effects of maize cultivars and planting patterns of maize/pea intercrops on weed suppression T SEMERE and R J FROUD-WILLIAMS.....	9C-8	1009
The interaction between shading by wheat with the level of herbicide activity A M BLAIR and J H ORSON.....	9C-9	1015
Response of wheat to <i>Phalaris minor</i> Retz. population density B K DHALIWAL, U S WALIA and L S BRAR.....	9C-10	1021
The importance of mortality in weed populations between autumn and spring on the reliability of yield loss predictions in winter wheat J STORKEY, J W CUSSANS, P J W LUTMAN and A M BLAIR.....	9C-11	1025
Evaluation of seed kill as a broad-leaf weed control technique in wheat G P MADAFIGLIO, R W MEDD, T A SOLE and P S CORNISH	9C-12	1031
Glasshouse and laboratory response of some species of cereals and <i>Bromus diandrus</i> to the new herbicide MON 37500 M VILLARROYA, M C ESCORIAL, H SIXTO <i>et al.</i>	9C-13	1037
Utilization of herbicide resistant crops for weed management in Midwestern United States corn and soybean production S E HART and L M WAX.....	9C-14	1043

SESSION 9D

REGULATORY ISSUES: CURRENT PROBLEMS AND SOLUTIONS

Poster Papers

A decision-making scheme for managing the risk of damage to succeeding crops from carry-over of pesticide residues in soil T D GODSON	9D-1	1053
Reduction of exposure to pesticides with protective clothing: implications to risk assessment for registration purposes D H BROUWER and J J VAN HEMMEN	9D-2	1059
Competition and environmental regulation in the US market L A MILLER and M M SHAFFER.....	9D-3	1067

SESSION 10A

PRODUCT STEWARDSHIP: PRACTICAL EXAMPLES ON WATER ISSUES

Papers

Stewardship of crop protection products – the empty promise? B G JOHNEN and M F WILKS.....	10A-1	1075
---	-------------	------

Global product stewardship - water quality protection T J HOOGHEEM.....	10A-2	1085
Best management practices to reduce hexazinone in groundwater in wild blueberry fields D E YARBOROUGH	10A-3	1091
Stewarding diuron within UK amenity areas A B DAVIES, J C HILL, S HIGGINBOTHAM and R JONES.....	10A-4	1099
A stewardship programme for isoproturon and water quality - a tale of two industries S L WHITE, D C HILLIER, J C EVANS <i>et al.</i>	10A-5	1107

SESSION 10B

HOW TO MANAGE HERBICIDE-RESISTANT WEEDS

Papers

Success from adversity: herbicide resistance can drive changes to sustainable weed management systems S B POWLES	10B-1	1119
The technical and financial impact of herbicide-resistant black-grass (<i>Alopecurus myosuroides</i>) on individual farm businesses in England J H ORSON and D HARRIS	10B-2	1127
HRAC classification of herbicides according to mode of action R R SCHMIDT	10B-3	1133
Quantification of the development of herbicide-resistant black-grass (<i>Alopecurus myosuroides</i>) under herbicide-based resistance management regimes P J RYAN and C E MILLS.....	10B-4	1141
Distribution and management of triazine-resistant weeds in the mid-Atlantic region of the USA R L RITTER and H MENBERE	10B-5	1147

SESSION 10C

CROPPING PRACTICES AND BIRDS

Poster Papers

Availability of weed seeds and waste cereals to birds on arable fields during spring R A H DRAYCOTT, D A BUTLER, J J NOSSAMAN and J P CARROLL.....	10C-1	1155
The effects of herbicide input level and rotation on winter seed availability for birds N E JONES, J H CLARKE and A J BURN.....	10C-2	1161

Seasonal changes in habitat use by yellowhammers (<i>Emberiza citrinella</i>) C STOATE and J SZCZUR.....	10C-3	1167
Effect of cropping practice on skylark distribution and abundance K CHANEY, S A EVANS and A WILCOX	10C-4	1173
The management of set-aside within a farm and its impact on birds J H CLARKE, N E JONES, D A HILL and G M TUCKER	10C-5	1179
The use of game cover and game feeders by songbirds in winter N W BRICKLE.....	10C-6	1185
Timing the cultivation of rotational set-aside for grass weed control to benefit chick-food insects A M BARKER, S C VINSON and N D BOATMAN.....	10C-7	1191
The effects of herbicide use within cereal headlands on the availability of food for arable birds S J MOREBY	10C-8	1197