



# **WILD OATS IN WORLD AGRICULTURE**



Agricultural Research Council

# Wild Oats in World Agriculture

An interpretative review of world literature

Edited  
by  
D. PRICE JONES

AGRICULTURAL RESEARCH COUNCIL  
LONDON

1976

ISBN 0 7084 00 18 3

# Contents

LIST OF CONTRIBUTORS	vii
PREFACE <i>John D. Fryer</i>	ix
1. ORIGINS AND IDENTIFICATION OF WEED SPECIES OF <i>A VENA</i> <i>Hugh Thomas and Ieuan T. Jones</i>	1
Classification and identification of species	2
Description of the main weed species	6
Relationships between wild and cultivated species	14
Wild species as progenitors of cultivated species	16
Wild species in oat improvement	17
2. DISTRIBUTION <i>Joan M. Thurston and Arthur Phillipson</i>	19
World distribution	19
Recent changes in distribution	52
Methods of dissemination	57
3. SEED BEHAVIOUR <i>Richard J. Chancellor</i>	65
The duration of wild oat seed viability	67
The germination of wild oat seed	72
Dormancy in wild oat seed	78
4. GROWTH AND DEVELOPMENT OF WILD OAT PLANTS <i>Richard J. Chancellor</i>	89
Seedling establishment	90
Vegetative development	91
Factors affecting wild oat incidence and development	93
Reproduction	95
5. COMPETITION BETWEEN WILD OATS AND CROPS <i>Richard J. Chancellor and Nicholas C. B. Peters</i>	99
Yield reduction and its measurement	100
Effect of competition on crop seed protein and other quality factors	105
Factors influencing competition between wild oats and crops	105

<b>6. OBJECTIVES AND SYSTEMS OF CONTROL</b>	<b>113</b>
<i>James G. Elliott</i>	
Objectives of control	113
Systems of control	115
<b>7. POPULATION STUDIES</b>	<b>119</b>
<i>George W. Cussans</i>	
Increase in seed potential during the plant growth phase	120
Loss of seeds at harvest	121
Post-harvest losses	121
Effective germination of seeds from soil reserves	122
Annual decline of soil seed reserves	123
Studies of the whole population cycle	124
<b>8. CULTURAL CONTROL</b>	<b>127</b>
<i>George W. Cussans and Bernard J. Wilson</i>	
Effect of date of harvesting	128
Effect of post-harvest operations	129
Effect of spring cultivations and sowing date	133
Crop competition as an agent of control	136
Rotations	139
Roguing	141
<b>9. CHEMICAL CONTROL</b>	<b>143</b>
<i>John Holroyd with Richard J. Chancellor, W. George Richardson, Bernard J. Wilson, Peter J. Lutman, David R. Tottman and Paul Ayres</i>	
Herbicides	143
Haloalkanoic acids	146
Benzonitriles	153
Amino propionic acids	154
Nitrophenyl ethers	171
Carbamates	173
Thiocarbamates	183
Ureas	192
Triazines	196
Miscellaneous	200
Effects of chemicals on seeds	206
Effects of herbicides and plant growth regulators on seed production	206
Herbicide glove	208
Effects of herbicides and plant growth regulators on seed viability, dormancy and germination	208

10.	PLANT HEALTH AND THE POSSIBILITIES OF BIOLOGICAL CONTROL	211
	<i>Joan M. Thurston and George W. Cussans</i>	
	Plant health	211
	Invertebrates attacking wild oats	212
	Diseases	215
	Possibilities of biological control	225
11.	LEGAL ASPECTS OF CONTROL	229
	<i>D. Bruce MacKay</i>	
	United Kingdom	229
	European Economic Community	231
	Other countries	232
12.	THE SCIENTIFIC LITERATURE ON WILD OATS	235
	<i>John E. Y. Hardcastle</i>	
	Scientific journals and reports	235
	Proceedings of conferences and symposia	237
	Commercial literature	237
	History and role of <i>Weed Abstracts</i>	238
	GLOSSARY	239
	LIST OF COMMON NAMES AND ABBREVIATIONS USED FOR HERBICIDES, PLANT GROWTH REGULATORS AND OTHER PESTICIDES MENTIONED	243
	REFERENCES	245
	INDEX	285

# Index

- Agropyron repens*, see Couch grass  
Alachlor  
    effect on *Avena spp.* seeds, 208  
Algeria  
    *Avena sterilis* ssp. *macrocarpa*, 24  
*Alopecurus myosuroides*, see Black grass  
Aminotriazole  
    effects on *Avena spp.*, seeds, 208  
    in wild oat control, 199  
Aphids  
    attacks on *Avena spp.*, 214  
    virus transmission, 214  
Arabia  
    *Avena sterilis* ssp. *tricophylla*, 24  
Argentina  
    *Avena fatua*, 25  
*Aristulatae*, 3  
Asparagus crops  
    tolerance to simazine, 198  
Asulam  
    in wild oat control, 144  
        crop tolerance, 182  
        formulation, 183  
        mode of action, 182  
Atrazine  
    in wild oat control, 145, 196, 199  
        concentration needed, 199  
        crop tolerance, 199  
        residues, 200  
Australia  
    *Avena barbata* distribution, 25  
    *Avena fatua* distribution, 24, 25  
    nematode-resistant *Avena spp.*, 213  
*Avena spp.* see also Oats, seed behaviour  
    *A. abyssinia*  
        growth and development, 96-7  
    *A. barbata*  
        aphid attack, 214  
        Australian, 25  
        awns, 9  
        chemical control  
            benzoylprop-ethyl, 162  
            difenoquat, 205  
    Chilean, 31  
    chromosome number, 3, 8  
    dormancy, 78-9  
    growth and development, 89, 96,  
        97  
    identification features, 7-13  
    Israeli, 37  
    Japanese, 38  
    lemma characteristics, 9, 13  
    Maltese, 39  
    panicles, 8, 206  
    Portuguese, 42  
    Spanish, 44  
    spikelets, 9, 13  
    virus diseases, 224-5  
    Yugoslav, 52  
    *A. brevis*  
        growth and development, 96  
    *A. byzantina*, 1  
        growth and development, 96-7  
    *A. canariensis*, 1  
        chromosome number, 3  
        lemma characteristics, 3  
    *A. clauda*  
        growth and development, 97  
        in Israel, 14  
    *A. fatua*, 1, 20  
        abundance, 21  
        aphid attack, 214  
        Australian, 25  
        British, 24, 46-51, 53, 131  
        Canadian, 29  
        chemical control, 143 *et seq.*  
            barban, 176-82  
            benzoylprop-ethyl, 154-63  
            chlortoluron, 194  
            dalapon, 149-50  
            di-allate, 185  
            difenoquat, 205  
            EPTC, 183  
            flamprop-isopropyl, 163-7  
            flamprop-methyl, 167-9  
            isoproturon, 195  
            NA, 182  
            nitrofen, 171-3  
            phenmedipham, 181  
            simazine, 197  
            TCA, 146-8

*Avena* spp.—cont.

chemical control—cont.

time factors, 147, 149, 158, 172  
triallate, 185  
chromosome number, 8  
competition with crops, 99-112,  
113-17, 124  
allelopathic reaction with rye,  
112  
control by fertiliser, 115  
control study, 116  
cross with *A. sativa*, 18  
cultural control, 128 *et seq.*  
Denmark, 31  
dormancy, 78 *et seq.*, 132-3, 209  
Finnish, 32  
French, 33  
frit fly attack, 214  
fungus attack, 215, 216, 217, 219,  
220, 222  
growth and development, 89-98  
hardiness, 20  
hybrids, 14  
identification features, 7-13  
Italian, 38  
Japanese, 38  
lemma characteristics, 3, 7, 9, 22  
nematode attack, 212  
Netherlands, 24, 39  
New Zealand, 40  
Norwegian, 41  
origin, 20  
panicles, 8, 206  
Phillipines, 42  
Polish, 42  
Portuguese, 42  
reduction by grass rotation, 140  
reproductive capacity, 120  
Rhodesian, 43  
roots, 91  
seed behaviour, 65, 67, 72-87, 115,  
208-10  
seed contamination, 57  
seed loss, 123, 128  
seed production, 90, 206  
Spanish, 44  
spikelets, 9  
subspecies, 7, 21, 22, 29-31  
Swedish, 24, 45  
tillering, 7, 120  
Turkish, 24  
types, 20, 21, 24, 35

United States, 24, 51-2  
virus diseases, 224-5  
world distribution, 20, 21, 24  
by country, 24, 28, 52  
Yugoslav, 52  
*A. hirtula*, 1, 13  
Israeli, 37  
*A. loca*  
control by benzoylprop-ethyl, 162  
*A. longiglumis*  
growth and development, 96  
*A. ludoviciana*, 1 see also *A. sterilis*  
abundance, 20  
Australian, 25  
British, 46-51, 53, 131  
Bulgarian, 29  
chemical control  
benzoylprop-ethyl, 156, 162  
chlorfenprop-methyl, 153  
chlortoluron, 194  
dalapon, 149-50  
difenoquat, 205  
flamprop-isopropyl, 167  
isoproturon, 195  
competition with crops, 99  
French, 33  
fungus attack, 215, 216  
growth and development, 89-97  
Italian, 38  
lemma characteristics, 22  
Moroccan, 39  
nematode resistance, 213  
Norwegian, 41  
origin, 20  
reduction by grass rotation, 140  
Rumanian, 43  
seed behaviour, 65, 67, 72-87, 209  
Turkish, 46  
types 24  
world distribution, 20, 52  
*A. macrocarpa*  
chemical control, 205  
*A. magna*, 3  
chromosome number, 3  
growth and development, 97  
lemma characteristics, 3  
*A. murphyi*, 1, 3  
lemma characteristics, 3  
*A. nuda*, 1  
growth and development, 96  
*A. pilosa*  
in Iran, 14

- A. sativa* see also Oats, cultivated cross with *A. fatua*, 18 growth and development, 89, 97 hybrids, 14 Israeli, 38
- A. septentrionalis*, see also *A. fatua* British, 46-51
- A. sterilis*, 1 aphid attack, 214 Australian, 25 awns, 9 character variation, 20 chemical control, 143 *et seq.* benzoylprop-ethyl, 162 difenzoquat, 205 resistance, 153 chromosome number, 8 Ethiopian, 32 French, 33 fungus attack, 216 growth and development, 97 identification features, 7-13 Israeli pasture plant, 37 Italian, 38 lemma characteristics, 3, 7 Japanese, 38 Maltese, 39 Moroccan, 39 nematode attack, 212 origin, 20 panicles, 8 roots, 91 selection for nematode resistance, 212 Spanish, 44 spikelets, 9 Tunisian, 46 Turkish, 46 world distribution, 20 Algeria, 24 Arabia, 24
- A. strigosa*, 1 see also *A. barbata* chemical control benzoylprop-ethyl, 162 dalapon, 150 chemical-resistance, 153 growth and development, 91, 96, 97
- A. ventricosa* growth and development, 97
- A. wiestii*, 1, 3, 13
- Bacteria in wild oats, 223-4 Barban, 116, 117 effect on *Avena* spp. germination, 209 in *Avena* roguing, 142 in crop control, 136, 137 in crop yield measurement, 101, 102, 103 in wild oat control, 144, 145, 204 application factors, 178 concentration needed, 177-8 crop tolerance, 179-81 effect on soil mechanisms, 182 mixtures, 181-2 mode of action, 176-7
- Barley crop reduction by *A. fatua*, 99, 127, 138 crop yield measurement, 100, 102 rotation, 139 susceptibilities barban, 145, 179-80 benzoylprop-ethyl, 160 EPTC, 183 flamprop-methyl, 169 simazine, 198 tolerances di- and tri-allate, 189 difenzoquat, 203 flamprop-isopropyl, 166 metoxuron, 193
- Beans competition with wild oats, 107 susceptibility to EPTC, 183 tolerances barban, 180 benzoylprop-ethyl, 160 simazine, 198 tri-allate, 189
- Beet crops susceptibilities difenzoquat, 204 EPTC, 183 tolerances barban, 180 chlorpropham, 175 cycloate, 191 di- and tri-allate, 189 propham, 174 wild oat control, 146, 148, 149, 174
- Belgium *Avena fatua* distribution, 24, 28-9 *Avena* spp. seed behaviour, 72

- N*-(Benzothiazol-2-yl)-*N,N'*-dimethylurea,  
 see Methabenzthiazuron  
**Benzoylprop-ethyl**  
 in wild oat control, 146, 154-63, 181  
 concentration needed, 155-6  
 crop tolerance, 159-60  
 formulation, 156-7  
 mode of action, 154  
 residues, 161  
 Blackgrass control, 116, 171, 192  
 Boxworth Experimental Husbandry Farm,  
 116, 124, 129, 132  
 Bromoxynil in wild oat control, 204  
 Bulgarian *Avena ludoviciana*, 29  
*N*-Butyl-*N'*-(3,4-dichlorophenyl)-*N*-methylurea, see Neburon
- Cacodylic acid**  
 in reduction of *Avena* spp. seeding, 207  
**Calcium cyanamide**  
 effect on *Avena* spp. germination, 77-8  
**Canada**  
*Avena fatua* distribution, 29  
*Avena* spp seed behaviour, 72  
 crop control measurements, 101-3  
 seed legislation, 232  
 stubble cultivation, 131  
**Carbetamide**  
 effect on *Avena* spp. seeds, 208  
**Carbyne**, see Barban  
**Carrot crops**  
 tolerance to di- and tri-allate, 189  
**Cereals** see also Barley, Beans, Flax, Oats, Wheat  
 weed control, 113-17, 139, 143  
*Chaetonium globosum*  
 effect on *Avena* spp. sterility, 69  
**Chemical control of *Avena* spp.**, see *Avena* spp., Oats, wild  
**Chilean *Avena barbata***, 31  
**Chlorfenprop-methyl**  
 effect on *Avena* spp. seeds, 208  
 in wild oat control, 145, 150-53  
 concentration needed, 151-2  
 crop tolerance, 152  
 mode of action, 151  
**2-Chloro-4,6-bisethylamino-1,3,5-triazine**  
 see Simazine  
**4-Chlorobut-2-ynyl *N*-3-chlorophenyl-carbamate**, see Barban
- 2-Chloro-4-(1-cyano-1-methylethylamino)-6-ethylamino-1,3,5-triazine**,  
 see Cyanazine  
**α-Chloro-2,6-diethyl-*N*-(methoxy-methyl)acetanilide**, see Alachlor  
**2-Chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine**, see Atrazine  
**Chlorhydrin**  
 effect on *Avena* spp. germination, 78-9  
*N*'-(3-chloro-4-methoxyphenyl)-*N,N*-dimethylurea, see Metoxuron  
 $(\pm)$ 2-(4-Chloro-2-methylphenoxy) propionic acid, see Mecoprop  
**4-Chloro-2-methylphenoxyacetic acid** see MCPA  
*N*'-(3-Chloro-4-methylphenyl)-*N,N*-dimethylurea, see Chlortoluron  
*N*'-(4-Chlorophenyl)-*N*-methoxy-*N*-methylurea, see Monolinuron  
**Chlorpropham**  
 effect on *Avena* spp. seeds, 208  
 in crop yield measurement, 103  
 in wild oat control, 143, 144, 175  
 crop tolerance, 175  
 mode of action, 175  
**Chlorthiamid**  
 effect on *Avena* spp. seeds, 208  
**Chlortoluron**  
 in wild oat control, 145, 146  
 concentration needed, 194  
 crop tolerance, 194  
 mode of action, 194  
**Chromosome numbers**, 3-4, 8  
**Combine harvesters**  
 factor in spread of wild oats, 115, 127  
**Common Market seed legislation**, 231-2  
**Couch grass**, 116  
 control by benzoylprop-ethyl, 163  
 control by flamprop-methyl, 170  
**Crops** see also Barley, Beans, Beet, Flax, Oats, Rye, Wheat  
 control of weeds, 113-17  
 effect of density on yield, 107-10  
 effort of fertiliser, 110-11  
 yield measurement, 100  
**Cyanazine**  
 effect on *Avena* spp. seeds, 208  
**Cycloate** in wild oat control, 144  
 crop tolerance, 191  
 mode of action, 191  
*N*'-Cyclohexyl-*N*-ethyl *S*-ethyl(thiocarbamate), see Cycloate

- Cyprus wild oat distribution, 31
- Czechoslovakia  
*Avena fatua* distribution, 24, 31  
 crop control measurements, 101-3
- 2,4-D  
 effect on *Avena* spp. germination, 77-8, 208-9  
 in wild oat control, 181, 199, 204
- 3,5-D  
 effect on *Avena* spp. germination, 209
- Dalapon  
 effect on *Avena* spp. germination, 77-8, 207, 208, 209  
 in wild oat control, 143, 145, 148, 204  
 concentration needed, 150  
 crop tolerance, 149  
 mode of action, 148  
 time factors, 149
- Denmark  
*Avena* spp. distribution, 24, 32, 56  
*Avena sterilis* nematode resistant, 212
- Denticulatae, 3
- Di-allate  
 effect on *Avena* spp. germination, 77-8, 210  
 in crop yield measurement, 101, 102, 103  
 in wild oat control, 144, 145  
 concentration needed, 186-8  
 crop tolerance, 189  
 mode of action, 184  
 residues, 189
- 3,5-Dibromo-4-hydroxybenzonitrile,  
 see Bromoxynil
- Dicamba  
 in wild oat control, 204
- Dichlobenil  
 effect on *Avena* spp. germination, 210  
 in wild oat control, 144, 153-4  
 concentration needed, 153  
 crop tolerance, 154
- Dichlorethylene  
 effect on *Avena* spp. germination, 77-8
- S-2,3-Dichloroallyl di-isopropylthiol carbamate, see Di-allate
- 2,6-Dichlorobenzonitrile, see Dichlobenil
- 3,5-Dichloro-*N*-(1,1-dimethylpropynyl) benzamide, see Propyzamide
- 2,2-Dichloropropionic acid, see Dalapon
- 3,6-Dichloro-2-methoxybenzoic acid, see Dicamba
- 2,4-Dichlorophenoxyacetic acid, see 2,4-D
- 3,5-Dichlorophenoxyacetic acid, see 3,5-D
- (±)-2-(2,4-Dichlorophenoxy)propionic acid, see Dichlorprop
- N*-(3,4-Dichlorophenyl)-*N*-methoxy-*N*-methylurea, see Linuron
- 2,4-Dichlorophenyl-4-nitrophenyl ether, see Nitrofen
- 2,6-Dichlorothiobenzamide, see Chlorthiamid
- Dichlorprop  
 in wild oat control, 204
- Difenoquat  
 in wild oat control, 145, 146, 200-6  
 concentration needed, 201  
 crop tolerance, 203-4  
 formulation, 201-2, 204  
 mode of action, 200  
 residues, 205
- 9,10-Dihydro-8a,10a-diazoniphenanthrene, see Diquat
- Dimethyl arsenic acid, see Cacodylic acid
- 1,1'-Dimethyl-4,4'-bipyridylum ion, see Paraquat
- 1,2-Dimethyl-3,5-diphenyl-pyrazolium, see Difenoquat
- 2,6-Dinitro-*NN*-dipropyl-4-trifluoromethyl-aniline, see Trifluralin
- Diploids, see Oats
- Diquat  
 effect on *Avena* spp seeds, 208
- Disodium methylarsonate, see DSMA
- Ditylencus dipsaci*, see Nematodes
- DNOC  
 in *Avena* spp seed production, 207
- Dormancy see Oats, Seed behaviour
- DSMA  
 effect on *Avena* spp. seeds, 208
- Dung in dissemination of *Avena* spp., 59, 61
- EEC, see Common Market
- Eelworms, see Nematodes
- EPTC  
 effect on *Avena* spp. seeds, 208
- in wild oat control, 144  
 concentration needed, 183  
 crop tolerance, 183-4  
 mode of action, 183  
 time factors, 184
- Ether  
 effect on *Avena* spp. germination, 77-8

- Ethiopia  
*Avena sterilis*, 32
- Ethofumesate  
 effect on *Avena* spp seeds, 208
- Ethrel  
 effect on *Avena* spp. seeds, 208
- 2-Ethoxy-2,3-dihydro-3,3-dimethylbenzofuran-5-yl-methylsulphonate,  
 see Ethofumesate
- Ethyl-N-benzoyl-N-(3,4-dichlorophenyl)-2-aminopropionate, see Benzoylprop-ethyl
- S-Ethyl N,N-dipropyl(thiocarbamate),  
 see EPTC
- D-N-ethyl-2-(phenylcarbamoyloxy) propionamide, see Carbetamide
- Feeding stuffs in dissemination of *Avena* spp., 115
- Fertilisers  
 effect on *Avena* spp. growth, 94  
 effect on crops with *Avena* spp. 110-11, 115, 137
- Finland  
 aphid attacks on *Avena* spp. 214  
*Avena fatua* distribution, 24, 32
- Flamprop-isopropyl  
 in wild oat control, 146, 163-7  
 concentration needed, 164  
 crop tolerance, 166-7  
 mode of action, 163
- Flamprop-methyl  
 in wild oat control, 146, 167-71  
 concentration needed, 168  
 crop tolerance, 169  
 mixtures with other herbicides, 170  
 mode of action, 167
- Flax  
 crop yield measurement, 100, 103  
 crop reduction by *Avena fatua*, 99, 138  
 oil content, 105  
 seed analysis, 105
- wild oat control  
 sensitivities  
 asulam, 182  
 flamprop-methyl, 170
- tolerances  
 barban, 181  
 di- and tri-allate, 189  
 difenzoquat, 204  
 prophan, 175
- Fluorodiphen  
 effect on *Avena* spp. seeds, 208
- Fluoro-phenoxyacetic acid salts  
 in reduction of *Avena* spp. seeding, 207
- Footrot, see Fungi
- France  
*Avena fatua* distribution, 24, 33  
 reason for spread, 33-4  
*Avena ludoviciana*, 33  
*Avena sterilis*, 33  
*Avena strigosa*, 33
- Frit fly  
 attacks on *Avena* spp., 214, 226
- Fungi, see also *Avena* spp  
 effect on *Avena* spp. seeds, 217-23  
 footrot formers, 215, 216  
 leaf-stripe formers, 215  
 mildew formers, 215  
 parasitic, 215, 217  
 pathogenic, 215-23  
 rust-formers, 215, 216  
 saprophytic, 215, 217  
 smut-formers, 215, 216  
 sterility of *Avena* spp. 69
- 6-Furfurylaminopurine, see Kinetin
- Fusarium culmorum*  
 effect on sterility of *Avena* spp., 69
- Germany, East  
*Avena fatua* distribution, 24, 34-5
- Germany, West  
*Avena fatua* distribution, 24, 34-5  
 reasons for spread, 34-5  
 crop control measurements, 101-3
- Germination, see Oats (wild); seed behaviour
- Gibberellic acid  
 effect on *Avena* spp. germination, 77-8, 79
- Glyphosate  
 effect on *Avena* spp. germination, 77-8, 208  
 in *Avena* roguing, 142
- Great Britain see United Kingdom
- Greece  
*Avena ludoviciana* distribution, 36
- Hardiness, 20
- Herbicide glove, 206
- Herbicides, see also Individual herbicides;  
 Oats, wild

*Heterodera avenae*, see Nematodes  
4-Hydroxy-3,5-di-iodobenzonitrile, see Ioxynil  
  
Indian wild oats, 36  
Indole-3-acetic acid  
effect on *Avena* spp. germination, 210  
Ioxynil  
in wild oat control, 204  
Iran wild oats, 14  
Iraq wild oats, 14  
Ireland  
rarity of wild oats, 37  
Isopropyl ( $\pm$ )-2-(*N*-benzoyl-3-chloro-4-fluoroanilino)propionate, see Flamprop-isopropyl  
Isopropyl *N*-(3-chlorophenylcarbamate), see Chlorpropham  
Isopropyl *N*-phenylcarbamate, see Propham  
*N*-4-Isopropylphenyl-*N,N*'-dimethylurea, see Isoproturon  
Isoproturon  
in wild oat control, 145, 195-6  
concentration needed, 195  
crop tolerance, 196  
mode of action, 195  
Israel  
*Avena barbata*, 37  
*Avena hirtula*, 37  
*Avena sativa*, 38  
*Avena* spp., 14  
*Avena sterilis*, 37  
as pasture plant, 37  
Italy  
*Avena fatua*, 38  
*Avena ludoviciana*, 38  
  
Japan  
*Avena barbata*, 38  
*Avena fatua*, 38  
*Avena sterilis*, 38  
  
Kenya  
*Avena fatua*, 39  
*Avena sterilis*, 39  
fatuoids, 39  
hybrids, 39  
Kinetin  
effect on *Avena* spp. germination, 210  
  
Leaf stripe, see Fungi

Legislation re-wild oats, 232  
*Lema melanopa*, 215  
Lemma structures, 3, 9, 13  
Lentil crops  
tolerance to di-allate, 189  
*Limothrips cerealium*, 215  
Linseed  
effects of *Avena fatua*, 137  
Linuron  
in wild oat control, 145, 173, 192  
  
Machinery (farm) in dissemination of *Avena* spp., 60  
*Macrosiphum avenae*, see Aphids  
Maize crops  
resistance to simazine, 198  
Majorcan *Avena barbata*, 39  
Maleic hydrazide  
effect on *Avena* spp. germination, 77-8, 206, 208  
Malta  
*Avena barbata*, 39  
*Avena sterilis*, 39  
*Mayetiola avenae*, 215  
MCPA  
effect on *Avena* spp. germination, 77-8, 209  
in wild oat control, 181, 204  
Mecoprop  
in wild oat control, 195, 204  
*Meloidogyne incognita* see Nematodes  
Methabenzthiazuron  
in wild oat control, 145, 192  
3-(Methoxycarbonylamino)phenyl  
N-(3-methylphenyl)carbamate, see Phenmediphem  
Methyl *N*-(4-aminobenzenesulphonyl)carbamate, see Asulam  
Methyl( $\pm$ )-2-(*N*-benzoyl-3-chloro-4-fluoroanilino)propionate, see Flamprop-methyl  
Methyl 2-chloro-3(4-chlorophenyl)propionate, see Chlorfenpropmethyl  
2-Methyl-4,6-dinitrophenol see DNOC  
*Metopolophium dirhodum*, see Aphids  
Metoxuron  
in wild oat control, 145  
concentration needed, 193  
crop tolerance, 193-4  
mode of action, 192  
residues, 194

Mildew, see Fungi  
Monolinuron  
    in wild oat control, 145, 192  
Monosodium methylarsonate, see MSMA  
Morocco  
    *Avena ludoviciana*, 39  
    *Avena sterilis* ssp. *macrocarpa*, 39  
MSMA  
    effect on *Avena* spp. seeds, 208  
Mustard (yellow)  
    susceptibility to flamprop-methyl, 170  
    tolerance to benzoylprop-ethyl, 160

Naphthalacetic acid  
    effect on *Avena* spp. germination, 210

Neburon  
    in wild oat control, 173

Nematodes  
    attacks on wild oats, 212-13

Netherlands  
    *Avena fatua* distribution, 24, 39  
    control and spread, 40  
    nematode-resistant *Avena* spp., 213

New Zealand  
    *Avena fatua* as serious weed, 40

Nitrofen  
    effect on *Avena* spp. seeds, 208  
    in wild oat control, 144  
        concentration needed, 171  
        crop tolerance, 172  
        mixtures, 173  
        mode of action, 171

4-Nitrophenyl-2-nitro-4- trifluoromethyl-phenylether, see Flurodiphen

Norway  
    *Avena* spp. distribution, 24, 41, 42  
    *Avena* spp. seed behaviour, 72  
    seed legislation, 232

Oats, see also *Avena* spp.; Crops; Seed behaviour  
cultivated  
    classification, 1-6  
    competition with wild, 91, 99, 137  
    diagnostic features, 2-6  
    fungal attack, 215  
    identification, 1-6  
    relationship with wild, 14-16  
    resistance to chlorfenpropmethyl, 145

sensitivities  
    benzoylprop-ethyl, 160, 162  
    flamprop-isopropyl, 167  
    simazine, 198

diploid spp., 3, 14  
dormoats, 18  
evolution, 14-17  
fatuoid, 15, 16  
hexaploid spp., 3, 14  
hybrids, 14-16, 42  
polyploid spp., 14  
tetraploid spp., 3  
wild  
    aphid attack, 214  
    bacteria present, 223-4  
    biological control, 211, 215, 225, 226-7  
    seed loss, 225-6  
character variation with country, 20-1  
chemical control, 143-210  
    asulam, 144, 182-3  
    atrazine, 145, 196-7, 199-200  
    barban, 144, 145, 176-82, 204, 205  
    benzoylprop-ethyl, 144, 146, 154-63, 205  
    bromoxynil, 204  
    chlorfenprop-methyl, 144, 145, 150-3  
    chlorpropham, 143, 144, 175  
    chlortoluron, 145, 146, 194-5  
    cycloate, 144, 191  
    dalapon, 143, 144, 148-50, 204  
    2,4-D, 204  
    di-allate, 144, 145, 184-91  
    dicamba, 204  
    dichlobenil, 145, 153-4  
    dichlorprop, 204  
    difenoquat, 146, 200  
    EPTC, 144, 183-4  
    flamprop-isopropyl, 144, 146, 154-63, 205  
    flamprop-methyl, 144  
    ioxynil, 204  
    isoproturon, 145  
    linuron, 145, 192  
    MCPA, 181, 204  
    mecoprop, 204  
    methabenzthiazuron, 145, 192  
    metoxuron, 145, 192-4  
    monolinuron, 145, 192

- NA, 182  
 neburon, 173  
 nitrofen, 144, 171-3  
 phenmedipham, 181  
 prophan, 143, 144, 173-5  
 simazine, 145, 196-9  
 2,4,5-T, 204  
 2,3,6-TBA, 181  
 TCA, 143, 144  
 tri-allate, 144, 145, 184-91  
 triethanolamine, 181  
 chromosome numbers, 3  
 classification, 1-6  
 competition with cereals, (see also:  
     Chemical control) 91, 94,  
     99-112, 120  
 allelopathic interactions, 112  
 control in farming, 113-17  
     crop rotation, 139-41  
     cultural, 127 *et seq.*, 143  
 effect of crop density, 107  
 effect of harvest time, 128  
 effect of fertilisers, 94, 110-11,  
     115, 137  
 effect of herbicides, 142  
 effect of planting time, 105-6  
 effect on protein content, 105  
 effect of seedrate, 136  
 elimination by herbicide/  
     culture, 128, 132, 136  
 nitrogen utilisation, 110-11,  
     137  
 phosphorus utilisation, 111  
 spring cultivation factors, 133-4  
 strawburning removal of seeds,  
     129-31  
 stubble cultivation, 131-3  
 weed density, 105  
 crosspollination, 90  
 diagnostic features, 2-6  
 dissemination, 57-64  
     birds, 57, 63  
     dung, 59, 61  
     feeding stuffs, 59  
     machinery, 60  
     sacks, 61  
     silage, 62  
     straw, 60  
     wind, 62-3  
 flowering, 96  
 frit fly attack, 214, 226  
 fungus attacks, 215-23
- growth, 89-98  
     effect of chemicals, 94  
     effect of climate, 93  
     effect of daylength, 89, 96  
     effect of fertilizers, 93, 94, 110,  
         115  
     effect of herbicides, 149, 150,  
         151, 158-9, 163-4, 165,  
         169, 172, 179, 182, 183,  
         189, 193, 194, 196, 202  
     effect of soil type, 15  
 germination, 90  
 panicle emergence, 89, 142  
 root development, 91  
 seeding, 97-8, 119  
 seedling establishment, 90-91,  
     122  
     seed potential increase, 120  
 identification, 1-6  
 legislation, 229-31  
 nematode attack, 212-13  
 pest in Australia, 25  
 pest in New Zealand, 40  
 population studies, 119-25  
 progenitors of cultivated, 16, 17  
 relationship with cultivated, 14-16  
 seed loss at harvest, 121, 123  
 selection for nematode resistance,  
     212  
 vegetative development, 91-3  
     tillering, 91  
     variation by subspecies, 92-3  
 vegetative regeneration, 89, 95  
 virus diseases, 224-5  
 world distribution, 14, 19-63  
 yeasts, 223
- Opomyza florum*, 215  
*Oscinella frit*, see Frit fly
- Pakistan  
*Avena fatua*, 42  
 Panicles, 8  
     density, 119  
     treatment by herbicide glove, 206, 208  
 Paraquat  
     effect on *Avena* spp. germination,  
         77-8, 208

- Peas**  
 crop reduction by *Avena fatua*, 99, 137  
 crop yield measurement, 100  
 susceptibilities  
     EPTC, 183  
 tolerances  
     barban, 180  
     chlorpropham, 175  
     di-allate, 189  
     propham, 174  
**Phenmedipham**  
     in wild oat control, 181  
**Phillipines**  
     *Avena fatua*, 42  
**N-(Phosphoromethyl) glycine**, see Glycophosphate  
**Poland**  
     *Avena fatua*, 42  
     control, 42  
     nematode-resistant *Avena* spp., 213  
**Portugal**  
     *Avena* spp. distribution, 42  
**Potassium gibberellate**  
     effect on *Avena* spp. germination, 210  
**Potassium nitrate**  
     effect on *Avena* spp. germination, 77-8, 94  
**Potassium sulphate**  
     effect on *Avena* spp. germination, 77-8, 94  
**Potato crops**  
     tolerance to propham, 175  
     wild oat control, 147  
***Pratylenchus minyus***, see Nematodes  
**Propham**  
     effect on *Avena* spp. germination, 77-8, 208-9  
     in wild oat control, 143, 144  
         crop tolerance, 174-5  
         mode of action, 173  
         time factors, 174  
**Propionic acid**  
     effect on *Avena* spp. seeds, 208  
**Propyzamide**  
     effect on *Avena* spp. seeds, 208  
**Protein in cereals**, 105  
  
**Rape crops**  
     susceptibilities  
         flamprop-isopropyl, 167
- tolerances  
     benzoylprop-ethyl, 160  
     di-allate, 189  
     difenoquat, 204  
     wild oat control, 119  
**Rhodesia**  
     *Avena fatua*, 43  
***Rhopalosiphum padi*** see Aphids  
**Roguing**, 141  
**Rotation of crops**, 139  
**Rothamsted Research Station**, 20, 140  
**Rumania**  
     *Avena ludoviciana*, 43  
**Russia**  
     crop control measurements, 101-3  
     wild oat distribution, 43-4  
**Rusts**, see Fungi  
**Rye**  
     allelopathic reaction with *Avena fatua*, 112  
**Ryegrass tolerances**  
     difenoquat, 204  
     flamprop-isopropyl, 167  
  
**Sacks**  
     disinfection, 57  
     dissemination of *Avena* spp., 61  
**Safflower crop**  
     tolerance to di-allate, 189  
**Saprophytes**, see Fungi  
**Seed behaviour (*Avena* spp.)**, 65-87, see also: Chemical control; Fungi; Oats (wild)  
     bacterial inhibitors, 69  
     cultivation burial, 122  
     dormancy, 65-6, 72-3, 94  
         breaking, 79  
         definition, 65, 81  
         effect of chemicals, 79, 208-10  
         effect of moisture, 82  
         effect of pathogenic fungi, 69, 217-23  
         effect of straw burning, 129  
         effect on survival, 68  
         effect of temperature, 74, 78, 80-81, 218  
         induction, 82-3  
         loss with age, 87  
         mechanism, 83-7  
         relation to weed control, 66, 206

- germination, 72-8, 122, 217-23  
     cultural factors, 123  
     effect of aeration, 76, 218  
     effect of chemicals, 77, 208-10  
     effect of light, 74  
     effect of pathogenic fungi, 217-23  
     effect of sterilisation, 222  
     effect of temperature, 74, 218  
     effect of tillage, 75-6  
     in various countries, 73-4  
     periodicity, 73-4  
     relation to weed control, 206  
     variation by subspecies, 72  
 maleic hydrazide treatment, 206, 208  
 self-burying, 121  
 variation by variety, 65  
 viability, 65  
     arable soils, 67  
     depth, 68  
     effect of dryness, 69-70  
     effect of fungi, 69, 217-23  
     effect of herbicides, 208-10  
     effect of  $\gamma$ -irradiation, 70-1  
     effect of low temperature, 70-1  
     effect of manures, 71-2  
     effect of plant growth regulators, 208-10  
     effect of soil type, 71, 221  
 grass, 67-8  
     unripe seeds, 76  
 waterlogging, 65, 70  
 yeasts in, 223
- Seedling establishment, see Oats, wild (growth)  
 Seed production, see also: Seed behaviour  
     effects of herbicides, 206-7  
         time factors, 207  
         reduction by herbicide glove, 208  
 Seed quality, 230-1  
 Seed testing  
     *Avena* spp. in barley, rye, oats, 57-8  
     legislation, 229
- Sicily  
     *Avena ludoviciana*, 38  
     *Avena sterilis*, 38
- Silage  
     presence of *Avena* spp., 62
- Simazine  
     in wild oat control, 145, 196-8  
         concentration needed, 197  
         crop tolerance, 198
- mode of action, 196-7  
     residues, 198
- Smuts, see Fungi
- Sodium cacodylate  
     effect on *Avena* spp. germination, 77-8, 208
- Sodium chloride  
     effect on *Avena* spp. seeds, 208
- Sodium 2,2,3,3-tetrafluoropropionate  
     effect on *Avena* spp. seeds, 208
- Sodium thiocyanate  
     effect on *Avena* spp. germination, 77-8
- Sodium trichloroacetate, see TCA
- Soil types, see Seed behaviour
- South Africa  
     *Avena fatua* distribution, 24, 44
- South West Africa  
     *Avena* spp. distribution, 20
- Spain *Avena* spp. distribution, 44
- Spikelets, see also: Oats, wild; Seed behaviour, 2, 9, 13
- Stenothrips graminum*, 215
- Straw  
     burning, 129  
     presence of *Avena* spp., 60
- Strawberry crops  
     tolerance to simazine, 198
- Stubble cultivation, 131-3
- Sunflower crops tolerance to di-allate, 189
- Sweden  
     *Avena fatua* distribution, 24, 45-6  
     *Avena* spp. distribution, 56  
     crop control measurement, 101-3  
     delayed sowing to control *Avena*, 134  
     seed legislation, 232
- 2,4,5-T  
     effect on *Avena* spp. germination, 77-8, 209  
     in wild oat control, 204
- TCA  
     effects on *Avena* spp. seeds, 208  
     in crop yield measurement, 103  
     in wild oat control, 145  
         concentration needed, 147  
         crop damage, 147  
         crop tolerance, 146  
         mode of action, 146
- Thiourea  
     effect on *Avena* spp. germination, 77-8

- Toowomba Research Station (Australia), 20
- Tri-allate, 116, 117  
effect on *Avena* spp. seeds, 208  
in *Avena* roguing, 142  
in crop yield measurement, 101, 102, 103  
in wild oat control, 144, 145  
concentration needed, 186  
crop tolerance, 189-90  
formulation, 187-8  
mode of action, 184
- 2,3,6-Trichlorobenzoic acid  
in wild oat control, 181
- S-2,3,3-Trichloroallyl di-isopropylthiol-carbamate, see Tri-allate
- 2,4,5-Trichlorophenoxyacetic acid, see 2,4,5-T
- Triethanolamine in wild oat control, 181
- Trifluralin  
effect on *Avena* spp. seeds, 208
- Tunisian *Avena sterilis*, 46
- Turkey  
*Avena fatua* distribution, 24  
*Avena ludoviciana*, 46  
*Avena sterilis*, 46
- United Kingdom, see also Rothamsted  
*Avena fatua* distribution, 24, 46-51, 53  
*Avena ludoviciana* distribution, 46-51  
*Avena septentrionalis* distribution, 47  
*Avena* spp. behaviour, 72, *et seq.*  
crop control measurements, 101-3  
legislation (wild oats), 229-31
- United States  
*Avena fatua* distribution, 24, 51-2  
crop central measurements, 101-3  
stubble cultivation, 131
- Virus diseases (*Avena* spp), 224-5
- Weed Abstracts, 235-7
- Weed control, see also: Oats, wild 66, 100, 113-17, 141, 229-31  
literature, 235-8
- Weed density, see Oats, wild
- Wheat  
crop reduction by *Avena fatua*, 99, 137  
protein content, 105  
crop yield measurement, 100-101  
susceptibilities  
barban, 145, 180  
chlorthaluron, 176  
EPTC, 183  
simazine, 198
- tolerances  
benzoylprop-ethyl, 159  
chlortoluron, 194  
difenzoquat, 203  
di- and tri-allate, 189-90  
flamprop-isopropyl, 166  
flamprop-methyl, 169  
metoxuron, 193
- Wild oats, see *Avena* spp.; Oats
- Yeasts, 217
- Yugoslavia  
*Avena* spp. distribution, 52

## Contributors

Paul Ayres	Weed Research Organization
Richard J. Chancellor	Weed Research Organization
George W. Cussans	Weed Research Organization
James G. Elliott	Weed Research Organization
John E. Y. Hardcastle	Weed Research Organization
John Holroyd	Weed Research Organization
Ieuan T. Jones	Welsh Plant Breeding Station
Peter J. Lutman	Weed Research Organization
D. Bruce MacKay	Official Seed Testing Station
Nicholas C. B. Peters	Weed Research Organization
Arthur Phillipson	Recently, Weed Research Organization
W. George Richardson	Weed Research Organization
Hugh Thomas	Welsh Plant Breeding Station
Joan M. Thurston	Rothamsted Experimental Station
David R. Tottman	Weed Research Organization
Bernard J. Wilson	Weed Research Organization

### Addresses

Weed Research Organization  
Rothamsted Experimental Station  
Official Seed Testing Station  
Welsh Plant Breeding Station

Begbroke Hill, Yarnton, Oxford  
Harpenden, Herts  
Huntingdon Road, Cambridge  
Plas Gogerddan, Aberystwyth, Dyfed

Published by the  
AGRICULTURAL RESEARCH COUNCIL  
and obtainable from  
HER MAJESTY'S STATIONERY OFFICE  
*Government Bookshops*  
49 High Holborn, London WC1V 6HB  
13a Castle Street, Edinburgh EH2 3AR  
41 The Hayes, Cardiff CF1 1JW  
Brazennose Street, Manchester M60 8AS  
Southey House, Wine Street, Bristol BS1 2BQ  
258 Broad Street, Birmingham B1 2HE  
80 Chichester Street, Belfast BT1 4JY  
or through any bookseller  
Price £3.00 net

ISBN 0 7084 0011 6

Printed in Great Britain by  
The Whitefriars Press Ltd, London and Tonbridge