HGCA

PROJECT REPORT No. 58

MALTING BARLEY VARIETY TRIALS 1988 - 1990

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MALTING BARLEY

VARIETY TRIALS 1988 - 1990

by

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Final report of a three year project at the National Institute of Agricultural Botany, Huntingdon Road, Cambridge CB3 0LE. The work commenced in September 1987 and was supported by a grant of £102,778 from the Home-Grown Cereals Authority (Project No. 0056/2/87).

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1. INTRODUCTION

The commodity malting barley, is of considerable importance to UK agriculture and the crop is one of few with genuine export potential. Fortunately the maritime climate of the UK allows the production of high quality malting barley given the correct management and, most importantly, the correct choice of variety.

Plant breeders have for many years been striving to produce malting varieties which are attractive to the grower. They have targeted characters such as stiff straw, good disease resistance and high yield whilst attempting to retain the desirable quality attributes sought by the maltster and brewer. This breeding effort has resulted in the production of many varieties with malting potential and has raised questions as to the best means of evaluation in order to identify the benefits of the new varieties.

The National List and Recommended List Trials System

New varieties are initially tested for two years under the National List system. Varieties for which malting quality is claimed by the breeder are tested using micro-malting techniques. At the end of the two year period, a selection of the best of these varieties is promoted to a third year of trials - Recommended List trials - where their performance is assessed alongside the older, more established varieties. Although the Recommended List trials are more comprehensive than those of the National List, some criticism has been levelled at the system from two angles:-

i) that the quality assessment of malting varieties places too much emphasis on hot water extract and insufficient attention to other important criteria such as wort viscosity.

ii) that malting varieties and feed varieties are both tested on the same soil types and with the same management regimes. It is argued that malting varieties may perform differently when grown on soil-types and under management regimes conducive to the production of malting barley.

Whilst the problems highlighted in (i) are being addressed by both the testing authorities and representatives of the malting industry the criticisms of (ii) could not be answered without a special study.

2. OBJECTIVES

The main objective of the project was to assess the yield and malting performance of a selection of winter and spring barley varieties grown in typical malting barley situations throughout the UK. Micro-malting tests were conducted at NIAB and samples were made available to the Brewing Research Foundation. The varieties chosen were those currently grown, or showing promise for the production of malting barley. The performance of the varieties in the Malting trials series would also be compared to the performance of the same varieties grown in NIAB Recommended List trials. This was to try to determine whether the relative performance of the varieties changed under the two different regimes.

A second objective was to provide an evaluation of the cost-effectiveness of malting barley production over the trial period by managing selected varieties under both a malting and feed fertilizer regime.

3. METHODS

3.1 The trials

Seven winter and seven spring barley variety trials were grown each year at typical malting barley sites throughout the UK (Table 1). The trials were co-ordinated by the National Institute of Agricultural Botany with the co-operation of the Agricultural Development and Advisory Service (ADAS), Arable Research Centres (ARC), Newcastle University and the Scottish Agricultural College (SAC).

Table 1: HGCA Malting barley trial sites

Winter barley

Midlothian (SAC)
Northumberland (Newcastle University)
Norfolk (NIAB)
Essex (ADAS)
Hertfordshire (ADAS)
Hampshire (NIAB)
Gloucestershire (ARC)

Spring barley

Midlothian (SAC)
Northumberland (Newcastle University)
Humberside (ADAS)
Norfolk (NIAB)
Hampshire (NIAB)
Gloucestershire (ARC)
Avon - 1988 only)
Cornwall - 1989 only) (ADAS)
Wiltshire - 1990 only)

Varieties in trials

Eight varieties of winter barley were grown in 1988 and nine varieties were grown in 1989 and 1990. Seven varieties of spring barley were grown in 1988 and 1990, and six in 1989.

The varieties selected were those with malting potential and either widely available to the commercial grower or considered likely to become so during the period of the project.

The newer malting varieties, Melusine, Puffin and Alexis, were included in trials for the last two years of the project as their malting potential became apparent. Conversely, Marinka and Fergie were omitted from trials as their importance as malting varieties diminished. It was necessary to omit Triumph from spring barley trials in 1989 due to the inadvertent contamination of seed with that of another variety at the seed-handling stage.

Table 2: Varieties in trial

Winter barley

Halcyon (control)
Pipkin (control)
Finesse
Magie
Waveney
Melusine (1989 and 1990 only)
Puffin (1989 and 1990 only)
Plaisant (six-row variety)
Maris Otter
Marinka (1988 only)

Spring Barley

Blenheim (control)
Prisma (control)
Triumph (1988 and 1990 only)
Doublet
Natasha
Corniche
Alexis (1989 and 1990 only)
Fergie (1988 only)

Protocol of the trials

A protocol was prepared by the co-ordinators which was designed to be used in conjunction with the Recommended List protocol issued annually to Trials Officers. This protocol gave husbandry guidelines and requirements specific to the Malting trial series. General instructions such as those for the recording of field data were detailed in the main instruction booklet. The section and sub-section numbers within each document were standardised so that cross-references could easily be made.

3.2 Trial management

Fungicides

The schedule of fungicide use and timing employed on National List and Recommended List trials was employed and a copy of the schedule was circulated to each participant. Disease levels were kept to below 5% infection in all plots to eliminate disease interactions.

Fertilizers

Trial sites for this series were situated on land suitable for the successful production of malting barley. The soil texture, previous crop and sowing date for each trial are summarised in Tables 3 and 4.

Table 3 : Soil texture, previous cropping and sowing date for winter barley trials

Trial	Year	Soil texture	Previous crop	Sowing date
Midlothian (SAC)	88	Sandy loam	Spring barley	27/9/87
	89	Sandy loam	Winter barley	27/9/88
	90	Silt loam	Winter barley	26/9/89
Northumberland (Newcastle Uni)	88	Sandy clay loam	Winter wheat	26/9/87
	89	Sandy loam	Fallow	27/9/88
	90	Sandy loam	Fallow	9/10/89
Norfolk (NIAB)	88	Sandy clay loam	Spring barley	25/9/87
	89	Sandy loam	Spring barley	1/10/88
	90	Sandy loam	Spring barley	5/10/89
Essex (ADAS)	88	Sandy loam	Winter wheat	21/10/87
	89	Sandy loam	Winter barley	29/9/88
	90	Sandy loam	Winter kale	28/9/89
Hertfordshire (ADAS)	88	Sandy loam	Winter barley	14/10/87
	89	Sandy loam	Winter wheat	18/10/88
	90	Sandy loam	Winter wheat	19/10/89
Hampshire (NIAB)	88	Silt loam	Winter wheat	29/9/87
	89	Silty clay loam	Winter wheat	7/10/88
	90	Silt loam	Winter wheat	29/9/89
Gloucestershire (ARC)	88	Silty clay loam	Winter wheat	24/9/87
	89	Silty clay loam	Winter barley	10/10/88
	90	Silty clay loam	Winter barley	21/9/89

Table 4 : Soil texture, previous cropping and sowing date for spring barley trials

Trial	Year	Soil texture	Previous crop	Sowing date
Midlothian (SAC)	88	Sandy loam	Spring barley	5/4/88
	89	Sandy loam	Winter wheat	7/3/89
	90	Sandy loam	Spring barley	28/3/90
Northumberland (Newcastle Uni)	88	Sandy loam	Fallow	12/3/88
	89	Sandy loam	Fallow	13/3/89
	90	Sandy loam	Fallow	19/3/90
Humberside (ADAS)	88	Silt loam	Spring barley	5/4/88
	89	Silt loam	Swedes	22/3/89
	90	Clay loam	Winter barley	8/3/90
Norfolk (NIAB)	88	Sandy loam	Sugar beet	5/4/88
	89	Sandy loam	Sugar beet	8/2/89
	90	Sandy loam	Sugar beet	7/3/90
Hampshire (NIAB)	88	Silt loam (calc)	Winter wheat	25/2/88
	89	Silt clay loam(calc	Winter wheat	31/3/89
	90	Silt loam (calc)	Linseed	7/3/90
Gloucestershire (ARC)	88	Silty clay loam	Winter wheat	31/3/88
	89	Silty clay loam	Winter barley	31/3/89
	90	Silty clay loam	Winter wheat	15/3/90
Avon) Cornwall) (ADAS) Wiltshire)	88	Clay loam	Winter wheat	24/2/88
	89	Clay loam	Winter barley	31/3/89
	90	Silty clay loam	Spring barley	9/3/90

Nitrogen fertilizer was applied to emulate good commercial practice - the best yield possible without jeopardising any malting premium with excessive lodging or high grain protein.

The early application of nitrogen was advised - by mid-March for winter barley and by the third leaf stage for spring barley. It was made clear that delay beyond these timings would increase the risk of unacceptably high grain nitrogen content.

High nitrogen plots (Feed regime)

Additional plots were sown of the following varieties:-

Winter barley

Magie
Plaisant
Marinka (1988 only)

Spring barley

Blenheim
Prisma (1989 and 1990 only)
Corniche (1988 only)

On these plots the nitrogen rate appropriate to a feed crop was applied, best local practice again being adopted. This split treatment was designed to provide a measure of the cost-effectiveness of undertaking a malting or feeding regime in any one year. A summary of fertilizer rates and timings is given in Tables 5 and 6.

Table 5 : Fertilizer application and timing to winter barley malting trials 1988-90

Trial	Year	Total N applied (feed regime)	Individual Applications											
			1st top dressing			2nd top dressing			3rd top dressing			Additional (feed regime only)		
			Amount	Date	GS	Amount	Date	GS	Amount	Date	GS	Amount	Date	GS
Midlothian	88	125 (165)	30	29/2/88	18	50	30/3/88	20	45	13/4/88	30	40	11/4/88	24
(SAC)	89	120 (160)	30	16/2/89	19	50	17/3/89	20	40	19/4/89	30	40	*	*
	90	120 (160)	50	12/3/90	25	70	10/4/90	28				40	*	*
Northumberland	88	100 (160)	100	10/3/88	*							60	6/4/88	*
(Newcastle	89	100 (150)	100	8/3/89	*							50	5/4/89	*
Uni)	90	100 (150)	100	12/3/90	30							50	19/4/90	31
Norfolk	88	102 (142)	42	17/2/88	20	60	8/3/88	26				40	7/4/88	*
(NIAB)	89	75 (125)	75	8/3/89	25							50	12/4/89	*
	90	102 (142)	42	8/3/90	26	60	15/3/90	28				40	18/4/90	*
Essex	88	100 (160)	100	14/3/88	*							60	9/3/88	*
(ADAS)	89	96 (156)	41	2/3/89	30	55	22/3/89	31				60	15/3/89	30
	90	100 (160)	100	3/3/90	30							60	25/3/90	31
Hertfordshire	88	112 (172)	112	29/2/88	*							60	10/3/89	*
(ADAS)	89	47 (94)	47	21/3/89	*							47	29/4/89	*
	90	61 (123)	61	3/3/90	*							61	19/3/90	*
Hampshire	88	100 (140)	40	26/2/88	*	60	22/3/88	*≠				100	13/4/88	30
(NIAB)	89	110 (145)	60	6/3/89	*	50	23/3/89	29≠				85	21/4/89	32
	90	100 (140)	40	20/2/90	28	60	21/3/90	30				40	21/3/90	30
Gloucester-	88	130 (180)	50	18/2/88	25	80	25/3/88	26				50	13/4/88	31
shire ARC)	89	125 (175)	50	2/3/89	23	75	31/3/89	24				50	18/4/89	31
	90	125 (175)	50	2/3/90	25	75	9/4/90	30				50	18/4/90	32

≠ not applied to plots with feed regime * information not supplied
GS = Growth stage (Tottman and Broad)

Table 6 : Fertilizer application and timing to spring barley malting trials 1988-90

Trial	Year	Total N applied (feed regime)	Individual Applications											
			1st top dressing			2nd top dressing			3rd top dressing			Additional (feed regime only)		
			Amount	Date	GS	Amount	Date	GS	Amount	Date	GS	Amount	Date	GS
Midlothian	88	100 (120)	60	6/4/88	0	40	25/4/88	11				20	25/4/88	11
(SAC)	89	110 (130)	110	6/3/89	0							20	6/3/89	0
	90	80 (130)	80	29/3/90	0							50	17/4/90	11
Northumberland	88	100 (150)	100	10/3/88	0							50	19/4/88	*
(Newcastle	89	80 (130)	80	5/4/89	*							50	5/4/89	*
Uni)	90	60 (110)	60	19/4/90	*							50	19/4/90	*
Humberside	88	110 (160)	46	5/4/88	0	64	9/5/88	13				50	10/5/91	13
(ADAS)	89	127 (127)+	32	21/3/89	0	95	18/4/89	11				+	-	-
	90	125 (160)	125	*	0							35	10/4/90	12
Norfolk	88	100 (140)	100	28/4/88	10							40	9/5/91	13
(NIAB)	89	100 (140)	100	23/3/89	13							40	12/4/89	15
	90	100 (140)	100	2/4/90	13							40	18/4/90	20
Hampshire	88	90 (125)	60	22/8/88	0	30	12/4/88	13				35	13/4/88	13
(NIAB)	89	80 (80)+	80	28/4/89	12							+	-	-
	90	80 (120)	80	3/3/90	0							40	19/4/90	14
Gloucester-	88	95 (145)	50	12/4/88	11	45	6/5/88	13				50	7/5/88	13
shire	89	100 (150)	100	19/4/89	0							50	17/5/89	22
(ARC)	90	100 (150)	100	10/4/90	11							50	*	13
Avon)	88	122 (170)	58	23/4/88	0	64	15/4/88	15				48	15/4/88	15
Cornwall)(ADAS)	89	100 (151)	100	8/5/89	*							151	8/5/89	*
Wilts)	90	120 (150)	120	15/3/90	0							30	4/4/90	11

* Information not received
\+ No additional nitrogen applied to feed regime
GS = Growth stage (Tottman and Broad)

Plant Growth Regulator (PGR)

Plant growth regulators were in many instances applied to winter barley trials to minimise the risk of lodging. The programme was:-

i) Chlormequat (overall) at the recommended application rate was applied when the most advanced variety reached Tottman growth stage 30-31 with no variety sprayed prior to mid-tillering.

ii) 2-chloroethylphosphonic acid + mepiquat chloride (e.g. Terpal) were applied in the period between the second node and the time at which the flag leaf was just visible (Tottman 32-37). Trials Officers used half rates in order to reduce the risk of late secondary tillering which may have had a detrimental effect on sample quality.

3.3 Records during the growing season

Agronomic records

The following agronomic records, except straw length, were taken:-

lodging	brackling
leaning	ear loss
ripening date	necking
winter hardiness	bird damage

Disease records

Since fungicides were to be used to keep disease levels below 5%, records were only taken where it was thought disease would affect the validity of results.

Site data

Site data were recorded on a standard form used for National List and Recommended List trials. Details of soil texture, drainage, sowing date, seedrate, previous cropping and soil analysis were taken.

Yield data

All yield data were analysed using the analysis of variance technique including Least Significant Difference (LSD) (P=0.05), Standard Error (SE) and Coefficient of Variation (CV%). Variety yields were expressed as a percentage of the mean of control varieties at 15% moisture content. The control varieties used throughout were:-

Winter barley

Halcyon
Pipkin

Spring barley

Blenheim
Prisma

Individual trials were scrutinised technically and subjected to the same standards of accuracy applying to Recommended List trials. Any individual trials with a coefficient of variation of 10% or greater were therefore excluded.

The overtrial yield analyses were all computed using the Fitted Constants technique (Patterson, 1982) which allows adjustment for missing data, enabling valid comparisons to be made between the mean results for each variety. Since they were in trial for only one year in three, the winter barley variety Marinka and the spring barley variety Fergie were omitted from over-year analyses.

Results are also presented by ranking the yields so that the position of any variety in relation to the others within each data set can easily be seen. Although a useful method of highlighting major differences in variety performance, it should however be remembered that a 1% difference in yield (not significant) can alter the ranking order.

3.4 Grain samples for micro-malting tests

Grain samples were taken at harvest to be used for comprehensive micro-malting tests.

The characters recorded in micro-malting tests were:

Germinative energy	Wort viscocity (cp)
Total nitrogen (g/100 g)	Friability (%)
Hot water extract (l°kg)	Homogeneity (%)
Malt nitrogen (g/100 g)	Fermentability (%)
Total soluble nitrogen	Spirit yield
Soluble nitrogen ratio	
Colour (EBC units)	
Clarity	

Samples from trials were also made available to members of the Institute of Brewing and the Brewing Research Foundation.

4. RESULTS

4.1 Weather conditions

1988

Although the autumn of 1987 was one of the wettest on record, most of the winter barley trials were drilled in September, before the onset of the heaviest rainfall. All trials established well and came through the winter satisfactorily.

Following a very wet autumn and winter, spring was also very unsettled and the drilling of the seven spring barley trials was spread over a six week period. The establishment of the spring barley trials was satisfactory. Average rainfall in April and May gave way to dry conditions in June. July was very unsettled, many regions having the wettest July conditions for many years. Lodging was recorded in three winter barley trials during this period and the harvest was somewhat delayed at all sites.

1989

The autumn of 1988 was warm, with below average rainfall and all trials were drilled successfully and established well. The winter was mild and all trials came through it without damage and in good condition. Weather conditions remained good into the spring drilling period and all spring barley trials were sown in good time, into dry seedbeds. Conditions in April were cool and wet, allowing good establishment throughout May, June, July and August, rainfall was well below average whilst temperatures and sunshine hours were above average. Growth in the winter barley trials was good but the spring barley trials suffered drought throughout this period. The harvest was early and took place in ideal conditions.

1990

The hot, dry conditions of the 1989 summer extended well into the autumn. The winter barley trials were drilled into dry seedbeds but although emergence was often protracted, final establishment was good. It remained mild throughout the winter, presenting no problems to the autumn-sown trials.

The spring barley trials were all sown in good time and establishment was generally good. The weather conditions from May to August were similar to those of the previous year, with below average rainfall and temperatures and sunshine hours above average. Growth in the winter barleys was good but spring barley again suffered the effects of drought.

4.2 Progress of the winter barley trials through the growing seasons

Winter hardiness

As previously mentioned in section 4, winter conditions were generally not severe during the period of the project. At the Midlothian (SAC) site in 1988, however, winter damage was sustained with some loss of plant, chiefly in those varieties known to be susceptible to winter damage, e.g. Halcyon and Finesse. In each case where winter damage was recorded, subsequent tillering compensated for any plant loss and the validity of yield results was unaffected.

Disease

All trials were treated with fungicide and no reports were received of disease levels above 5% infection.

Lodging

All winter barley trials were treated with plant growth regulator except those at the Gloucestershire (ARC) site. Lodging was only recorded at three sites in 1988 but it was not felt that the validity of results was adversely affected.

Brackling, necking and ear loss

Brackling, that is the buckling of the stems between the stem base and the neck, was recorded at five sites in both 1988 and 1989 and in three sites in 1990. The mean brackling scores ranged from 10% to 40%, with the early varieties Waveney and Plaisant giving the highest scores.

Necking, the creasing of the stem immediately below the ear, was recorded at two sites in both 1988 and 1989. Plaisant was most seriously affected, particularly when grown under the feed regime.

In all cases, brackling and necking did not result in ear loss and the validity of trials was unaffected.

Ear loss was recorded at low levels at one site only in 1988 but at levels not considered high enough to invalidate the trial.

4.3 Progress of the spring barley trials through the growing seasons

Disease

All trials were treated with fungicide and no reports were received of disease levels above 5% infection.

Lodging

None of the spring barley trials were treated with plant growth regular. Lodging was recorded at only one site - the Norfolk (NIAB) site in 1990. The validity of the trial was unaffected.

Brackling and necking

Low levels of brackling were recorded at three sites in 1988. Moderate to severe necking was recorded at the Norfolk (NAIB) site in 1988. There were no reports of any ear loss in any trial and the validity of trials was unaffected.

4.4 The validity of yield data

The validity of winter barley yield data

The co-efficient of variation of the 1989 Gloucestershire (ARC) site was above 10% and was therefore omitted from all further analyses. The yield data from all other trials was deemed valid.

Since it was in trial for one year only the variety Marinka was excluded from both yield and quality analyses.

A summary of individual trial statistics is given in Table 7.

Table 7 : Control yield, standard error and coefficient of variation for winter barley malting trials 1988-90

Site	Year	≠Control mean t/ha at 15% moisture content	Standard error variety mean	Coefficient of variation %
Midlothian (SAC)	88	7.56	2.29	3.8
	89	6.55	3.21	5.3
	90	8.88	2.18	3.6
Northumberland (Newcastle University)	88	7.42	4.95	8.2
	89	6.73	3.76	5.7
	90	7.51	5.06	8.2
Norfolk (NIAB)	88	6.54	3.61	6.3
	89	7.52	1.91	3.3
	90	7.51	1.96	3.5
Essex (ADAS)	88	6.35	2.55	4.2
	89	7.43	3.31	5.6
	90	6.68	2.39	4.2
Herts (ADAS)	88	5.88	3.04	5.3
	89	7.02	1.94	3.4
	90	4.83	2.10	3.6
Hampshire (NIAB)	88	6.57	3.33	5.9
	89	8.50	1.86	3.3
	90	8.14	1.28	2.3
Gloucs (ARC)	88	6.70	2.34	3.7
	89	6.75	6.52	11.1
	90	6.43	4.97	7.9

≠ Controls Halcyon and Pipkin

The validity of spring barley yield data

The coefficient of variation of the 1988 Humberside (ADAS) trial was above 10% and was omitted from all further analyses. The yield data from all other trials was deemed valid.

Since it was in trial for one year only the variety Fergie was excluded from both yield and quality analyses. Corniche was omitted from the feed regime analyses since it too was only in trial for one year.

A summary of individual trial statistics is given in Table 8.

Table 8 : Control yield, standard error and coefficient of variation for spring barley malting trials 1988-90

Site	Year	≠Control mean t/ha at 15% moisture content	Standard error variety mean	Coefficient of variation %
Midlothian (SAC)	88	6.40	1.73	3.1
	89	7.38	1.15	2.0
	90	5.65	2.57	4.6
Northumberland (Newcastle University)	88	6.30	5.66	9.6
	89	5.37	5.05	8.4
	90	7.71	2.63	4.6
Humberside (ADAS)	88	4.55	7.87	12.8
	89	5.20	2.38	4.2
	90	7.20	2.16	3.8
Norfolk (NIAB)	88	4.64	2.41	3.9
	89	4.83	2.38	4.1
	90	6.77	1.60	2.9
Hampshire (NIAB)	88	6.13	2.30	4.2
	89	3.53	2.89	4.8
	90	6.39	1.44	2.6
Gloucestershire (ARC)	88	3.87	1.78	2.9
	89	3.42	4.29	7.7
	90	2.54	3.34	5.5
Avon) Cornwall) (ADAS) Wilts)	88	6.08	0.92	1.9
	89	3.46	3.24	5.5
	90	3.46	2.67	5.2

≠ Controls Blenheim and Prisma

4.5 Winter barley yields

Table 9 : Winter barley malting trials - mean of all sites 1988-90 (Appendix 1a)

Treated yield of grain at 15% moisture content as a % of the treated mean of Halcyon and Pipkin.

Varieties	1988-90	Ranking Order
Malting regime		
Puffin	108+	1
Finesse	105+	2=
Plaisant	105+	2=
Melusine	102	4
Magie	101	5=
Pipkin	101	5=
Halcyon	99	7
Waveney	98	8
Maris Otter	88-	9
Feed regime		
Plaisant	111+	1
Magie	107+	2
Control yield t/ha	7.04	
LSD (V control)	4.0	
LSD (pairwise)	4.9	
SE (variety mean)	1.48	
CV%	6.5	

The order of varieties and relative yields shown in table 9 are used throughout for comparisons involving yield.

The varieties Puffin, Finesse and the six-row variety Plaisant gave yields significantly higher than the control varieties, Halcyon and Pipkin. The yields of Plaisant and Magie were significantly higher when grown under the feed management regime than under the malting regime, giving a yield difference of around 0.42 tonne. The only variety to give yields significantly below control was Maris Otter, yielding some 0.77 tonnes below Halcyon and 1.4 tonnes below Puffin.

Tables 10 and 11 show the performance of varieties in the individual years 1988, 1989 and 1990.

Table 10 : Treated yield as % control in winter barley Malting trials 1988, 1989 and 1990 (Appendix 1b)

Varieties	88-90	1988	1989	1990
Malting regime				
Puffin	108+	*	109+	107+
Finesse	105+	102	103	109+
Plaisant	105+	108+	107+	100
Melusine	102	*	100	104
Magie	101	99	101	102
Pipkin	101	101	101	100
Halcyon	99	99	99	100
Waveney	98	95	98	100
Maris Otter	88-	89-	86-	89-
Feed regime				
Plaisant	111+	115+	115+	105
Magie	107+	107+	109+	106
Control yield t/ha	7.04	6.72	7.29	7.14
LSD (V control)	4.0	5.7	6.2	5.6
LSD (pairwise)	4.9	6.5	7.2	6.5
SE (variety mean)	1.48	2.20	2.54	2.30
CV%	6.5	5.7	6.1	6.0

Table 11 : Ranking order in winter barley Malting trials 1988, 1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Puffin	1	-	1	2
Finesse	2=	2	3	1
Plaisant	2=	1	2	5=
Melusine	4	-	6	3
Magie	5=	4=	4=	4
Pipkin	5=	3	4=	5=
Halcyon	7	4=	7	5=
Waveney	8	6	8	5=
Maris Otter	9	7	9	9
Feed regime				
Plaisant	1	1	1	2
Magie	2	2	2	1

The yield of controls was higher in 1989 and 1990 than in the wetter year of 1988. The performance of the varieties was consistent between years with the following exceptions:-

Plaisant gave disappointing yields in 1990 under both the malting and the feed regime. Since no ear loss was reported at any site in 1990, this variable performance cannot be explained.

Finesse gave very good yields in 1990. Both Finesse and Puffin gave yields significantly higher than controls and their yields were also higher than those of Plaisant and Magie grown under the feed regime.

For the purposes of comparison the yields from winter barley Malting trials and NIAB Recommended List yield trials are given in Table 12. In the second column the mean of all Recommended List trials in the project years 1988-90 are presented.

The third column consists of data from a subset of Recommended List trials. The rationale for the selection of this subset is given below:-

For Recommended List purposes, quality samples are collected from all varieties in all trials. The nitrogen content and germination % for a nominated control variety from each site are then tested. Using these data and following a visual examination of the samples, a selection of the most suitable trials is made and all varieties from these sites are then subjected to full micro-malting tests. It is data from these tests, in combination with those from other years, that form the data set from which the malting ratings are derived. It is the yield data from this subset of trials that are given in the third column of Table 12.

Table 12: Yield as % control in the malting trials, in all winter barley NIAB Recommended List trials and the subset of NIAB Recommended List trials selected for micro-malting tests 1988-90

Variety	Malting trials 1988-90	All RL trials 1988-90	RL trials Malting subset 1988-90
Puffin	108+	109+	107+
Finesse	105+	104+	105+
Plaisant	105+	108+	103
Melusine	102	101	99
Magie	101	103+	98
Pipkin	101	101	101
Halcyon	99	99	99
Waveney	98	101	98
Control yield t/ha	7.04	6.98	7.39
LSD (V control)	4.0	2.9	3.5
LSD (pairwise)	4.9	3.3	4.0
SE (variety mean)	1.48	1.08	1.27
CV%	6.5	7.1	5.8

Table 13: Ranking order in all winter barley NIAB Recommended List trials and in Recommended List malting subset

Variety	Malting trials 1988-90	All RL trials 1988-90	RL trials Malting subset 1988-90
Puffin	1	1	1
Finesse	2=	3	2
Plaisant	2=	2	3
Melusine	4	5=	5=
Magie	5=	4	7=
Pipkin	5=	5=	4
Halcyon	7	8	5=
Waveney	8	5=	7=

Note:- Maris Otter was not included in Recommended List trials 1988-90.

The relative performance of varieties was very similar in both the malting trials and NIAB Recommended List Trials. In the subset of Recommended List trials selected for micro-malting tests the mean control yield was 0.4 t/ha higher than that of the complete data set. Again the relative performance of individual varieties was similar to those in the malting trials series with the exception of Plaisant which gave yields somewhat below expectations.

4.6 Spring barley yields

Table 14: Spring barley malting trials - mean of all sites 1988-90

Treated yield of grain at 15% moisture content as % of the treated mean of Blenheim and Prisma (Appendix 2a)

Varieties	1988-90	Ranking order
Malting regime		
Alexis	104+	1
Blenheim	103	2
Doublet	99	3
Corniche	98	4
Prisma	97	5
Natasha	95-	6
Triumph	94-	7
Feed regime		
Blenheim	105+	1
Prisma	99	2
Control yield t/ha	5.32	
LSD (V control)	4.0	
LSD (pairwise)	4.9	
SE (variety mean)	1.51	
CV%	6.8	

This order of varieties and relative yields are used throughout for comparisons involving yield.

The relative yield differences between varieties were small - only 0.53 t/ha difference between the highest and lowest yielding varieties and the control mean yield was only moderate at 5.32 t/ha. This was due mainly to the effects of the drought, which was especially severe at the eastern and southern sites in 1989 and 1990.

The only variety which gave yields significantly above control under the malting regime was Alexis. Blenheim gave yields significantly above control under the feed regime. Both Natasha and Triumph gave yields significantly below those of controls. The yield benefit from the application of additional fertilizer under the feed regime was small as the yield of both Blenheim and Prisma only increased by 2% overall.

Tables 15 and 16 show the performance of varieties in the individual years 1988,1989 and 1990.

Table 15: Treated yield as % control in Malting trials 1988,1989 and and 1990 (Appendix 2b)

Varieties	88-90	1988	1989	1990
Malting regime				
Alexis	104+	*	108+	101
Blenheim	103	103	105	100
Doublet	99	94	104	98
Corniche	98	102	96	97
Prisma	97	97	95	100
Natasha	95-	94	97	94
Triumph	94-	95	*	94
Feed regime				
Blenheim	105+	107	105	103
Prisma	99	*	95	102
Control yield t/ha	5.32	5.57	4.74	5.68
LSD (V control)	4.0	7.6	5.6	4.5
LSD (pairwise)	4.9	8.8	6.4	5.2
SE (variety mean)	1.51	3.03	2.25	1.83
CV%	6.8	7.5	5.9	4.9

Table 16: Ranking order in spring barley Malting trials 1988,1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Alexis	1	-	1	1
Blenheim	2	1	2	2=
Doublet	3	5=	3	4
Corniche	4	2	5	5
Prisma	5	3	6	2=
Natasha	6	5=	4	6=
Triumph	7	4	-	6=
Feed regime				
Blenheim	1	-	1	1
Prisma	2	-	2	2

Only Alexis in 1989 gave yields significantly higher than control and was the highest yielding variety in the two years it was grown.

The yields of Blenheim and Prisma in 1989 were not significantly improved by the application of additional fertilizer under the feed regime.

Tables 17 and 18 present data from spring barley NIAB Recommended List trials. The first column presents data from the Malting trial series. The second column presents the mean yield of all Recommended List trials during the same period 88-90 while the figures in the third column are the mean yield data from those Recommended List trials selected for micro-malting tests (see rationale given on page 18).

Table 17: Yield as % controls in the Malting trials, in all NIAB spring barley Recommended List Trials and the subset of NIAB Recommended List trials selected for micro-malting tests 1988-90

Variety	Malting trials 1988-90	All RL trials 1988-90	RL trials Malting subset 1988-90
Alexis	104+	100	99
Blenheim	103	103+	103
Doublet	99	99	98
Corniche	98	95-	95-
Prisma	97	97-	97
Natasha	95-	96-	94-
Triumph	94-	96-	95-
Control yield t/ha	5.32	5.57	5.81
LSD (V control	4.0	2.0	4.7
LSD (pairwise)	4.9	2.5	4.7
SE (variety mean)	1.51	0.82	1.45
CV%	6.8	6.2	6.3

Table 18: Ranking order in all NIAB RL trials and in RL malting subset 1988-90

Variety	Malting trials 1988-90	All RL trials 1988-90	RL trials Malting subset 1988-90
Alexis	1	2	2
Blenheim	2	1	1
Doublet	3	3	3
Corniche	4	6	5=
Prisma	5	4	4
Natasha	6	5=	6
Triumph	7	5=	5=

The relative performance of varieties in NIAB Recommended List trials was similar to those in the malting series with the exception of Alexis which gave relatively poorer yields in Recommended List trials. Blenheim gave yields significantly above those of the controls in Recommended List trials. There were negligible differences between the performance of varieties in all Recommended List trials and of those in the subset selected for micro-malting tests.

4.7 The micro-malting test

Of the characters assessed in the micro-malting process, grain nitrogen content and hot water extract give the clearest indication of malting potential. These characters are strongly influenced by variation due to site, husbandry and weather conditions.

Grain nitrogen content

Grain nitrogen content should ideally be below 1.6% of dry matter and it is unusual for samples above 1.75% to be considered acceptable by commercial maltsters. Although some varieties inherently produce grain with a relatively high grain nitrogen content, site, husbandry and weather conditions are frequently the controlling influences.

Hot water extract

The hot water extract is the most important criterion in the assessment of suitability for malting. It is a measure of the amount of fermentable sugar produced in hot water by a malted barley sample.

The potential for producing good hot water extract is genetically based and is an important objective for the plant breeder. The character is, however, linked to grain nitrogen content and hence, protein content, since in samples with low protein content starch is more readily freed from the surrounding protein and malting can be achieved more rapidly.

4.8 The validity of winter barley quality data

No malting quality data is available for the Northumberland trial in 1988. This was due to the high moisture content of the sample sent for testing which subsequently rotted during the micro-malting process. The

mean moisture contents of samples from the Northumberland site in 1990 and the Gloucestershire site in 1989 were also above 20% with the latter site giving poor germinative energy values.

In the malting trial series the control variety Halcyon had a grain nitrogen content of below 1.75% at twelve sites out of twenty (60%).

The sites at which Halcyon gave mean grain nitrogen values above 1.75% were Northumberland (89 and 90), Hertfordshire (88 and 90), Hampshire (89) and Gloucestershire (88,89 and 90).

These high values could not easily be attributed to husbandry factors except in the case of the Hampshire and Gloucestershire sites, where a large proportion of the total nitrogen application was applied later than the mid-March protocol guideline.

Of the twenty three Recommended List trials selected for micro-malting tests over the project period, Halcyon gave a nitrogen content of under 1.75% at twelve sites (52%). Since germinative energy is an important criteria in the selection of Recommended List sites for micro-malting it is not surprising that the mean values were greater than 95%.

Apart from the site omitted because of high coefficients of variation for yield, all other sites tested were retained in the database regardless of levels of germinative energy, hot water extract or grain nitrogen content.

A summary of individual trial data for moisture content, grain nitrogen content and germinative energy % is given in Table 19

Table 19 : Mean moisture content, grain nitrogen content and germinative energy % for winter barley malting trials 1988-90

Control yield, moisture content % of harvested grain, standard error, coefficient of variation %, grain nitrogen content % and germinative energy %

Site	Year	Mean moisture content %	Mean grain nitrogen content % (Halcyon)	GE%
Midlothian (SAC)	88	18.4	1.46 (1.43)	92
	89	14.8	1.47 (1.37)	97
	90	18.1	1.58 (1.58)	96
Northumberland (Newcastle University)	88	24.4	*	*
	89	16.2	2.42 (2.31)	100
	90	21.4	1.77 (1.80)	96
Norfolk (NIAB)	88	16.0	1.42 (1.40)	99
	89	13.2	1.39 (1.40)	97
	90	11.2	1.59 (1.61)	99
Essex (ADAS)	88	13.1	1.57 (1.47)	97
	89	14.0	1.63 (1.58)	98
	90	13.2	1.37 (1.37)	100
Herts (ADAS)	88	15.3	1.89 (1.85)	98
	89	11.6	1.56 (1.60)	98
	90	12.0	2.00 (1.95)	99
Hampshire (NIAB)	88	16.6	1.56 (1.54)	94
	89	12.0	1.61 (1.76)	97
	90	9.6	1.52 (1.52)	97
Gloucs (ARC)	88	19.5	1.85 (1.89)	95
	89	25.6	2.03 (2.09)	87
	90	13.5	1.83 (1.80)	98

* Sample rotted during micromalting

The validity of spring barley quality data

In the Malting trial series the control variety Blenheim gave grain nitrogen content values below 1.75% in only six out of the twenty valid sites (30%). Thirteen of the fourteen sites giving high nitrogen values were in 1989 and 1990. The only site to give acceptable grain nitrogen values in these two years was the Hampshire site in 1990. These high nitrogen values could almost entirely be attributed to the hot, dry conditions which prevailed during the summers of 1989 and 1990 which seriously reduced the yield of all spring-sown combinable crops. This yield depression would have left grain protein content (and hence grain nitrogen content) undiluted.

A similar pattern emerged from the Recommended List micro-malting tests where the grain protein content of only six sites out of the twenty tested were on or below 1.75% - again most of the poor values came from the 1989 and 1990 tests.

The germinative energy values for all sites tested were satisfactory and for the majority of sites were very good. As with winter barley, all data were retained in the database apart from the one trial omitted due to a high coefficient of variation.

Table 20 : Mean moisture content %, grain nitrogen content and germinative energy % for spring barley malting trials 1988-90

Site	Year	Mean moisture content %	Mean grain nitrogen content % (Blenheim)	GE%
Midlothian (SAC)	88	25.1	1.69 (1.61)	96
	89	18.0	1.88 (1.84)	98
	90	19.0	1.76 (1.76)	99
Northumberland (Newcastle University)	88	*	2.08 (1.92)	98
	89	15.8	2.29 (2.14)	100
	90	24.8	2.09 (2.04)	97
Humberside (ADAS)	88	19.9	2.17 (2.11)	98
	89	17.7	2.38 (2.29)	98
	90	16.1	2.09 (2.03)	99
Norfolk (NIAB)	88	14.0	1.69 (1.65)	98
	89	12.6	1.92 (1.90)	95
	90	8.4	2.01 (1.93)	99
Hampshire (NIAB)	88	13.6	1.69 (1.68)	98
	89	13.7	2.10 (2.00)	99
	90	10.7	1.56 (1.50)	100
Gloucestershire (ARC)	88	20.8	1.85 (1.72)	93
	89	12.0	2.25 (2.18)	100
	90	13.7	2.27 (2.22)	98
Avon) Cornwall) (ADAS) Wiltshire)	88	21.5	1.52 (1.37)	96
	89	17.8	2.05 (1.91)	99
	90	11.1	1.87 (1.82)	99

4.9 Winter barley quality data

Results for hot water extract and grain nitrogen content are summarised in Table 21.

Table 21 : Hot water extract (l°/kg) in Malting trials 1988-90

Varieties	1988-90	Ranking order
Malting regime		
Puffin	309.3	1
Halcyon	307.4	2
Pipkin	307.3	3
Finesse	305.7	4
Maris Otter	305.0	5
Melusine	304.5	6
Magie	302.8	7
Waveney	301.6	8
Plaisant	300.4	9
Feed regime		
Magie	296.1	1
Plaisant	293.0	2
Grand mean	303.0	
SE average	1.196	

Puffin have hot water extracts 2 l°/kg higher than those of Halcyon and Pipkin. It gave value higher than Halcyon in 18 out of the 19 sites tested.

The values for Magie and Plaisant were considerably lower under the feed regime than under the malting regime, extracts under the feed regime being depressed by 6.7 and 7.4 l°/kg respectively.

Tables 22 and 23 show the hot water extract data for individual years.

Table 22: Hot water extract (l°/kg) in Malting trials 1988,1989 and 1990 (Appendix 3a)

Varieties	88-90	1988	1989	1990
Malting regime				
Puffin	309.3	*	308.9	311.7
Halcyon	307.4	307.6	305.7	308.6
Pipkin	307.3	306.1	307.1	308.4
Finesse	305.7	298.6	309.1	308.8
Maris Otter	305.0	306.4	305.2	305.1
Melusine	304.5	*	303.3	307.5
Magie	302.8	300.5	302.5	305.1
Waveney	301.6	297.8	301.3	305.2
Plaisant	300.4	297.6	301.0	302.3
Feed regime				
Magie	296.1	295.0	295.8	297.1
Plaisant	293.0	290.0	294.5	294.2
Grand mean	303.0	299.8	303.1	304.9
SE average	1.196	2.986	1.515	1.086

Table 23: Ranking order of hot water extract in malting trials 1988, 1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Puffin	1	*	2	1
Halcyon	2	1	4	3
Pipkin	3	2	3	4
Finesse	4	5	1	2
Maris Otter	5	3	5	7=
Melusine	6	*	6	5
Magie	7	4	7	7=
Waveney	8	6	8	6
Plaisant	9	7	9	9
Feed regime				
Magie	1	1	1	1
Plaisant	2	2	2	2

The hot water extracts were generally higher in 1989 and 1990. The ranking order of varieties for hot water extract was less consistent between years than those for yield but clear trends were still apparent with Puffin, Halcyon, Pipkin and Finesse giving the highest extracts. Finesse gave poor extracts in 1988, however.

It is interesting to note that the extracts of Maris Otter, for many years the standard malting variety, did not compare well with those of the new standards Halcyon and Pipkin or with the high yielding variety Puffin.

For the purposes of comparison the hot water extracts of varieties grown in Recommended List trials (micro-malting subset) are presented in Tables 24 and 25.

Table 24: Hot water extract (l°/kg) in Recommended List trials 1988-90 (Appendix 3b)

Varieties	Malting trials 1988-90	RL trials 1988-90
Puffin	309.1	305.7
Halcyon	307.4	304.6
Pipkin	307.3	304.4
Finesse	305.7	303.4
Melusine	304.3	301.4
Magie	302.8	299.9
Waveney	301.6	303.3
Plaisant	300.4	297.1
Grand mean	304.8	302.5
SE average	1.259	1.027

Table 25: Ranking order of varieties by hot water extract in Recommended List trials 1988-90

Varieties	Malting trials 1988-90	RL trials 1988-90
Puffin	1	1
Halcyon	2	2
Pipkin	3	3
Finesse	4	4
Melusine	5	6
Magie	6	7
Waveney	7	5
Plaisant	8	8

Note: Maris Otter was not grown in Recommended List trials during the period of the project.

The hot water extracts of varieties in Recommended List trials were some 2 l°/kg lower than those in the malting trial series. The relative differences between varieties in each trials series were consistent, with the exception of Waveney which gave higher hot water extract figures in Recommended List trials. This observation was made on limited data, however.

Table 26: Grain nitrogen content (%) in winter barley Malting trials 1988-90

Variety	1988-90 mean	Ranking order
Malting regime		
Plaisant	1.49	1
Pipkin	1.57	2
Finesse	1.61	3
Puffin	1.62	4
Halcyon	1.64	5=
Maris Otter	1.64	5=
Magie	1.66	7
Melusine	1.67	8
Waveney	1.73	9
Feed regime		
Plaisant	1.70	1
Magie	1.89	2
Grand mean	1.66	
SE average	0.0325	

The mean grain nitrogen content for all varieties in the winter barley Malting series (malting regime) were at levels low enough to be acceptable to commercial maltsters, ie below 1.75%. This was despite the inclusion of several sites which gave nitrogen figures higher than this level. As expected, the nitrogen contents for Plaisant and Magie were higher in the feed regime than in the malting regime (0.21 and 0.23% higher respectively).

Tables 27 and 28 give the total nitrogen content values for individual years:-

Table 27: Total grain nitrogen content % in Malting trials 1988,1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Plaisant	1.49	1.49	1.47	1.50
Pipkin	1.57	1.56	1.59	1.57
Finesse	1.61	1.58	1.66	1.60
Puffin	1.62	*	1.67	1.60
Halcyon	1.64	1.60	1.67	1.66
Maris Otter	1.64	1.59	1.61	1.70
Magie	1.66	1.61	1.69	1.68
Melusine	1.67	*	1.73	1.64
Waveney	1.73	1.72	1.82	1.67
Feed regime				
Plaisant	1.70	1.65	1.68	1.75
Magie	1.89	1.81	1.93	1.93
Grand mean	1.66	1.62	1.68	1.67
SE average	0.0325	0.0395	0.0691	0.0452

Table 28: Ranking order of total nitrogen content in Malting trials 1988,1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Plaisant	1	1	1	1
Pipkin	2	2	2	2
Finesse	3	3	4	3=
Puffin	4	*	5=	3=
Halcyon	5=	5	5=	6
Maris Otter	5=	4	3	9
Magie	7	6	7	8
Melusine	8	*	8	5
Waveney	9	7	9	7
Feed regime				
Plaisant	1	1	1	1
Magie	2	2	2	2

The varieties Plaisant and Pipkin consistently gave the lowest grain nitrogen values. Maris Otter gave unexpectedly high values in 1990 although its mean figure was inflated by a high value at the Gloucestershire site.

For comparative purposes, the grain nitrogen content values for varieties grown in Recommended List trials are given in Tables 29 and 30.

Table 29: Total grain nitrogen content % in Malting trials and in Recommended List trials 1988-90 (Appendix 4a and 4b)

Varieties	Malting trials 1988-90	RL trials 1988-90
Plaisant	1.49	1.65
Pipkin	1.57	1.66
Finesse	1.61	1.71
Puffin	1.62	1.75
Halcyon	1.64	1.74
Magie	1.66	1.78
Melusine	1.67	1.75
Waveney	1.73	1.82
Grand mean	1.63	1.73
SE average	0.0292	0.0252

Table 30: Ranking order of total grain nitrogen in Malting trials and Recommended List trials 1988-90

Varieties	Malting trials 1988-90	RL trials 1988-90
Plaisant	1	1
Pipkin	2	2
Finesse	3	3
Puffin	4	5=
Halcyon	5	4
Magie	6	7
Melusine	7	5=
Waveney	8	8

The total grain nitrogen content figures in Recommended List trials were 0.1% higher than those in the malting trials series. The mean values for Magie and Waveney were higher than 1.75% but the grand mean was just below the 1.75% benchmark. The relative values were similar for each series although Halcyon and Melusine had better relative values in the Recommended List series and Puffin and Magie slightly worse.

4.10 Spring barley quality data

Results for hot water extract and grain nitrogen content are summarised in table 31.

Table 31: Hot water extract (l°/kg) in Malting trials 1988-90

Varieties	1988-90 mean	Ranking order
Malting regime		
Alexis	307.8	1
Corniche	307.1	2
Prisma	306.4	3
Triumph	305.4	4
Natasha	304.8	5
Blenheim	304.3	6
Doublet	302.1	7
Feed regime		
Prisma	306.4	1
Blenheim	301.1	2
Grand mean	305.1	
SE average	1.051	

Alexis gave the best mean extracts in the malting barley series although its value was 1.51°kg lower than the best winter barley value over the same period (Puffin).

Tables 32 and 33 show the hot water extract data for individual years.

Table 32: Hot water extract (l°/kg) in Malting trials 1988,1989 and 1990 (Appendix 5a)

Varieties	88-90	1988	1989	1990
Malting regime				
Alexis	307.8	*	306.2	309.8
Corniche	307.1	307.0	306.4	308.1
Prisma	306.4	305.4	302.9	310.7
Triumph	305.4	308.1	*	304.7
Natasha	304.8	304.3	303.4	306.6
Blenheim	304.3	304.5	304.4	304.0
Doublet	302.1	300.3	302.1	303.8
Feed regime				
Prisma	306.4	*	305.0	308.3
Blenheim	301.1	299.6	300.7	302.9
Grand mean	305.1	304.2	303.9	306.5
SE average	1.051	2.246	1.756	0.765

Table 33 : Ranking order of hot water extract in Malting trials 1988,1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Alexis	1	*	2	2
Corniche	2	2	1	3
Prisma	3	3	5	1
Triumph	4	1	*	5
Natasha	5	5	4	4
Blenheim	6	4	3	6
Doublet	7	6	6	7
Feed regime				
Prisma	1	*	1	1
Blenheim	2	1	2	2

The relative performance of varieties was less consistent between years than was seen for yield but this might be expected with small differences between varieties compounded by the effects of drought and the resulting high grain nitrogen content values.

For the purposes of comparison the hot water extracts of varieties grown in Recommended List trials are presented in tables 34 and 35.

Table 34 : Hot water extract (l°/kg) in Malting trials and in Recommended List trials 1988-90

Varieties	Malting trials 1988-90	RL trials 1988-90
Alexis	307.9	306.8
Corniche	307.2	305.8
Prisma	306.4	306.5
Triumph	305.4	304.3
Natasha	304.8	303.4
Blenheim	304.3	303.7
Doublet	302.1	304.4
Grand mean	305.4	305.0
SE average	1.061	1.095

Table 35 : Ranking order of varieties by hot water extract in Recommended List trials 1988-90

Varieties	Malting trials 1988-90	RL trials 1988-90
Alexis	1	1
Corniche	2	3
Prisma	3	2
Triumph	4	5
Natasha	5	7
Blenheim	6	6
Doublet	7	4

The hot water extract values from Recommended List trials tended to be slightly lower than those from malting trials with the exception of Doublet which gave higher extracts in RL trials and Prisma which gave similar extracts in both series.

Alexis again gave the best extracts, followed by Prisma and Corniche.

Table 36 : Total grain nitrogen content % in Malting trials 1988-90

Varieties	1988-90	Ranking order
Blenheim	1.88	1=
Triumph	1.88	1=
Prisma	1.89	3
Alexis	1.92	4
Doublet	1.93	5
Natasha	1.98	6
Corniche	2.05	7
Feed regime		
Prisma	1.95	1
Blenheim	1.96	2
Grand mean	1.94	
SE average	0.0250	

The mean grain nitrogen content for all varieties in the spring barley malting series were all at unacceptably high levels (see validity of spring barley quality data, page 26).

Tables 37 and 38 present the total nitrogen content data from malting trials in individual years.

Table 37 : Total grain nitrogen content % Malting trials 1988, 1989 and 1990

Varieties	88-90	1988	1989	1990
Malting regime				
Blenheim	1.88	1.66	2.04	1.90
Triumph	1.88	1.58	*	1.95
Prisma	1.89	1.63	2.11	1.90
Alexis	1.92	*	2.11	1.91
Doublet	1.93	1.77	2.08	1.91
Natasha	1.98	1.74	2.16	2.01
Corniche	2.05	1.81	2.26	2.05
Feed regime				
Prisma	1.95	*	2.12	1.97
Blenheim	1.96	1.82	2.11	1.93
Grand mean	1.94	1.71	2.12	1.95
SE average	0.0250	0.0500	0.0366	0.0251

Table 38 : Ranking order of total grain nitrogen in Recommended List trials 1988-90

Varieties	88-90	1988	1989	1990
Malting regime				
Blenheim	1=	3	1	1=
Triumph	1=	1	*	5
Prisma	3	2	3=	1=
Alexis	4	*	3=	3=
Doublet	5	5	2	3=
Natasha	6	4	5	6
Corniche	7	6	6	7
Feed regime				
Prisma	1	-	2	2
Blenheim	2	-	1	1

The mean nitrogen content for 1988 was below the benchmark figure of 1.75% and the varieties Blenheim, Triumph and Prisma all gave mean values clearly below this value. Little confidence could be attached to data obtained in 1989 and 1990 since all values were very similar and very high.

Tables 39 and 40 present the nitrogen content values from recommended List trials.

Table 39 : Total grain nitrogen content % in Malting trials and in Recommended List trials 1988-90 (Appendix 6a and 6b)

Varieties	Malting trials 1988-90	RL trials 1988-90
Blenheim	1.88	1.81
Triumph	1.88	1.88
Prisma	1.89	1.82
Alexis	1.91	1.79
Doublet	1.93	1.84
Natasha	1.98	1.90
Corniche	2.05	1.98
Grand mean	1.93	1.86
SE average	0.0230	0.0240

Table 40 : Ranking order of Total Grain Nitrogen content in Malting trials and in Recommended List trials 1988-90

Varieties	Malting trials 1988-90	RL trials 1988-90
Blenheim	1=	2
Triumph	1=	5
Prisma	3	3
Alexis	4	1
Doublet	5	4
Natasha	6	6
Corniche	7	7

The nitrogen content values in the RL trials series were slightly lower than those in the malting series but all values were still above acceptable levels. With very small differences between varieties the relative performance of varieties was not consistent between the two series although Natasha and Corniche produced the highest values in both series.

In common with the Malting trials series, acceptable nitrogen contents were only possible in 1988 and in this year, only Corniche gave mean nitrogen values above 1.75%. As with the Malting series, values from 1989 and 1990 were consistently high due to the effects of the drought.

5. DISCUSSION

5.1 The trials

Since most root and crop development in the winter barley crop took place during periods of adequate moisture, neither yield nor quality appeared to be adversely affected by the drought. In the spring barley trials, however, the dry conditions had a profound affect on both yield and quality. It was unfortunate that the period of the project coincided with one of the most severe droughts for many years.

Weather conditions apart, the appropriate management of the trials was of vital importance to the validity of the project. Although most trial managers adhered to the protocol produced specifically for the malting project, this was not always the case. The most obvious example of this was with respect to fertilizer, which in a small number of cases was not applied early enough or at levels low enough to give the best chance of achieving samples with low grain nitrogen content.

The yield performance of varieties in the malting trials was very similar to their performance in both the full set of Recommended List trials and the subset of Recommended List trials subsequently selected for micro-malting tests. The ranking order of varieties in the two trials series was not significantly different for hot water extract or grain nitrogen content. These results are perhaps surprising since none of the Recommended List trials were managed specifically for the production of malting quality.

The results of this project do not, therefore, support the view that varieties bred specifically for the production of malting quality are in any way penalised by the current Recommended List trials system. The proposal, however, to designate a number of Recommended List trials for management under a malting regime would appear sensible, since it would increase the likelihood of achieving test samples with acceptable grain nitrogen content without prejudicing the yield performance of feed varieties.

5.2 The cost-effectiveness of growing malting barley

In order to fulfil the second objective of the project - an assessment of the cost-effectiveness of growing varieties for malting compared with growing for feed - it was assumed that the only difference between the malting and feed management was the total amount of fertilizer applied and the number of applications. The following variable costs were assumed.

Nitrogen top dressing
Feed regime:

Winter barley:- 2 applications of N fertilizer at £6 per hectare per application (ADAS figures) with a total of 150 kg N per hectare applied at 30p per kilogram.

Spring barley:- Application costs as per winter barley with a total of 140 kg per hectare applied at 30p per kilogram.

Total cost of N fertilizer:	Winter barley	= £57.00
	Spring barley	= £54.00

Malting regime:

Single application of N fertilizer at £6 per hectare with a total of 100 kg per hectare applied to both winter and spring barley trials at 30p per kilogram.

Total cost of N fertilizer winter and spring barley £36.00

The differences in fertilizer costs between the malting and feed regime were therefore £21 for winter barley and £18 for spring barley. These figures were taken into account when calculating gross margins.

Other variable costs:-

The other variable costs used in calculations were:-

	Winter Barley	Spring Barley
Seed	£48	£51
Sprays	£64	£38
P+K fert.	£20	-
Total	£132	£89

The total variable cost would therefore be:-

Winter barley	feed	= £189
	malt	= £168
Spring barley	feed	= £143
	malt	= £125

The mean price of grain obtainable during the period of the project was £126 (malt) and £95 (feed) nett of levies, giving a premium of £31. (Nix, 1988, 89, 90).

Using these assumed variable costs, grain prices and actual yields achieved in the malting trials the gross margins for each variety could be calculated (Tables 41 and 42).

Table 41 : Winter barley gross margins - Malting trials 1988-90

Variety	Mean yield 1988-90	Mean grain price* £	Variable costs £	Gross margin £
Malting regime				
Puffin	7.60	)	)	790
Finesse	7.39	)	)	763
Plainsant	7.39	)	)	763
Melusine	7.18	)	)	737
Magie	7.11	) 126	) 168	728
Pipkin	7.11	)	)	728
Halcyon	6.97	)	)	710
Waveney	6.90	)	)	701
Maris Otter	6.20	)	)	613
Feed regime				
Plaisant	7.81	95	) 189	553
Magie	7.53		)	526

* Nett of levies

Table 42 : Spring barley gross margins - Malting trials 1988-90

Variety	Mean yield 1988-90	Mean grain price* £	Variable costs £	Gross margin £
Malting regime				
Alexis	5.65	)	)	587
Blenheim	5.54	)	)	573
Doublet	5.32	)	)	545
Corniche	5.38	) 126	) 125	553
Prisma	5.32	)	)	545
Natasha	5.16	)	)	525
Triumph	5.16	)	)	525
Feed regime				
Blenheim	5.70	) 95	) 143	398
Prisma	5.43	)	)	373

* Nett of levies

Since the gross margins are based on trial yields, they appear somewhat inflated compared with what might be expected from a farm situation. The differences between varieties and between the two regimes, however, give a useful indication as to the relative merits of growing for these specific markets. Since premium payments for malting quality are variable, and heavily dependent on market requirements, it should not be assumed that the gross margins for malting barley will always be as

attractive as those illustrated by this project. This would be particularly true where weather conditions foil the best management efforts to meet market requirements, leaving the grower with low yields of grain with a low market value. These figures do, however, illustrate what can be achieved on suitable land, with good management and with favourable weather.

6. CONCLUSIONS

Although the results from spring barley trials were affected by the serious summer drought conditions of 1989 and 1990, some useful observations can be made from the project as a whole:-

1. There were no significant differences between the relative yield performance of varieties in the malting series and the same varieties in the full Recommended List series.

2. It was possible to produce a similar number of samples suitable for micro-malting (i.e. high hot water extract, low nitrogen content) from the small number of specialist malting trials and from the larger "general purpose" Recommended List series.

3. While hot water extract and nitrogen content levels differed between the two series, the relative performance of varieties was largely the same in both series.

This project was valuable in showing that it is most unlikely that varieties bred for the production of malting barley are penalised by the current trials system. This will help to increase confidence in the value of the barley Recommended Lists.

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Cereals and Pulses
Chemistry and Quality Assessment
Regional Trials
Statistics and Data Processing

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KEY TO TRIAL CODES USED IN APPENDICES

WINTER BARLEY

1988		1989		1990	
ES71	ESCA EDINBURGH (BUSH)	ES71	ESCA EDINBURGH (BUSH)	ES71	ESCA EDINBURGH (BUSH)
N3	COCKLE PARK	N3	COCKLE PARK	N3	COCKLE PARK
N71	NEWCASTLE UNIVERSITY (COCKLE PARK)	N31	ADAS N YORKS (HUNMANBY)	N31	ADAS N YORKS (HUNMANBY)
N31	ADAS N YORKS (HUNMANBY)	N71	NEWCASTLE UNIVERSITY	N71	NEWCASTLE UNIVERSITY
EC3	HEADLEY HALL	WC5	HARPER ADAMS	EC3	HEADLEY HALL
WC31	ADAS STAFFS (TAMWORTH)	WC6	ROSEMAUND	EC4	HEADLEY HALL OC (HORNCASTLE)
EE5	CAMBRIDGE	WC31	ADAS STAFFS (HAUNTON)	WC5	HARPER ADAMS
EE96	MORLEY	EE5(A+B)	CAMBRIDGE	WC6	ROSEMAUND
EE7	SUTTON BONINGTON	EE6	MORLEY	EE5	CAMBRIDGE
EE31	ADAS HERTS (CHISHILL)	EE31	ADAS CAMBS (CASTOR)	EE6	MORLEY
EE32	ADAS SUFFOLK (WASHBROK)	EE32	ADAS SUFFOLK	EE31	ADAS LINCS (NOCTON)
EE33	ADAS LINCS (NOCTON)	EE33	ADAS HERTS (ROYSTON)	EE32	ADAS SUFFOLK (GT BRICETT)
EE71	MORLEY	EE71	MORLEY	EE71	MORLEY
EE72	ADAS ESSEX (LT OAKLEY)	EE72	ADAS ESSEX (LT OAKLEY)	EE72	ADAS ESSEX (LT OAKLEY)
EE73	ADAS HERTS (BARLEY)	EE73	ADAS HERTS (ROYSTON)	EE73	ADAS HERTS (ROYSTON)
S3	BRIDGETS	S3	BRIDGETS	S3	BRIDGETS
S31	ADAS BERKS (LAMBOURN)	S4	WYE	S31	ADAS BERKS (U LAMBOURN)
S71	BRIDGETS	S71	BRIDGETS	S71	BRIDGETS
S72	ARC CIRENCESTER	S31	ADAS BERKS (U LAMBOURN)	S72	ARC CIRENCESTER
SW3	SEALE HAYNE	SW3	SEALE HAYNE	SW3	SEALE HAYNE
SW31	ADAS SOMERSET (DURSTON)	SW31	ADAS DORSET (K MAURWARD)	SW31	ADAS GLOS (WOODMANCOTE)
SW32(A+B)	ADAS AVON (W LITTLETON)	SW32	ADAS GLOS (WOODMANCOTE)	SW32	ADAS DORSET (K MAURWARD)

SPRING BARLEY

1988		1989		1990	
ES71	ESCA EDINBURGH	ES71	ESCA EDINBURGH (HIGHFIELD)	ES71	ESCA EDINBURGH FIFE (TREATON)
N3	COCKLE PARK	N3	COCKLE PARK	N3	COCKLE PARK
N71	NEWCASTLE UNIVERSITY	N71	NEWCASTLE UNIVERSITY (COCKLE PARK)	N71	NEWCASTLE UNIVERSITY (ACKLINGTON)
EC3	HEADLEY HALL	EC3	HEADLEY HALL	EC3	HEADLEY HALL
EC4	HEADLEY HALL OC	EC4	HEADLEY HALL OC (HIGH MOWTHORPE)	EC4	HEADLEY HALL OC (HIGH MOWTHORPE)
EC95	SUTTON BONINGTON	EC5	HEADLEY HALL OC (GT STURTON)	EC5	HEADLEY HALL OC (HORNCASTLE)
WC3	HARPER ADAMS	EC71	ADAS HUMBERSIDE (KILHAM)	EC71	ADAS YORKS
WC4	ROSEMAUND	WC3	HARPER ADAMS	WC3	HARPER ADAMS
WC95	MYERSCOUGH	WC94	ROSEMAUND	WC4	ROSEMAUND
WC31	ADAS MERSEYSIDE	WC5	TARLTON	WC5(A+B)	TARLTON
EE5	CAMBRIDGE	WC31	ADAS LANCS (RIXTON)	WC31	ADAS CHESHIRE (WARRINGTON)
EE6(A+B)	MORLEY	EE5	CAMBRIDGE	EE5	CAMBRIDGE
EE32	ADAS LINCS (NOCTON)	EE6	MORLEY	EE6	MORLEY
EE71	MORLEY	EE31	ADAS NORFOLK (N BARSHAM)	EE31	ADAS NORFOLK (HILLINGTON)
S3(A+B)	BRIDGETS	EE32	ADAS LINCS (NOCTON)	EE71	MORLEY
S94	WYE	EE71	MORLEY	S3	BRIDGETS
S71	BRIDGETS	S3	BRIDGETS	S4	WYE
S72	ARC CIRENCESTER	S4(A+B)	WYE	S71	BRIDGETS
SW3	SEALE HAYNE OC (NETHEREXE)	S71	BRIDGETS	S72	ARC CIRENCESTER
SW4	SEALE HAYNE	S72	ARC CIRENCESTER	SW3	SEALE HAYNE
SW31	ADAS CORNWALL (NEWLYN EAST)	SW3	SEALE HAYNE (NETHEREXE)	SW4	SEALE HAYNE OC (NETHEREXE)
SW71	ADAS AVON (TORMARTON)	SW31	ADAS WILTS (CHISELDON)	SW31	ADAS CORNWALL (NEWLYN EAST)
W3	TRAWSGOED	SW71	ADAS CORNWALL (NEWLYN EAST)	SW71	ADAS WILTS (DEVIZES)
W31	ADAS WALES (RUTHIN)	W3(A+B)	TRAWSGOED	W3	TRAWSGOED
		W31	ADAS WALES (WELSHPOOL)	W31	ADAS WALES (PWLLELI)

WINTER BARLEY MALTING TRIALS 1988 - 90

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF HALCYON AND PIPKIN

		1988							1989						1990						
	MEAN	ES 71	N 71	EE 71	EE 72	EE 73	S 71	S 72	ES 71	N 71	EE 71	EE 72	EE 73	S 71	ES 71	N 71	EE 71	EE 72	EE 73	S 71	S 72
CONTROL (MT/HA)	7.04	7.56	7.42	6.54	6.35	5.88	6.57	6.70	6.55	6.73	7.52	7.43	7.02	8.50	8.88	7.51	7.51	6.68	4.83	8.14	6.43
CONTROL (C/A)	56.1	60.3	59.1	52.1	50.6	46.9	52.4	53.4	52.2	53.7	59.9	59.2	56.0	67.7	70.7	59.8	59.8	53.2	38.5	64.9	51.2
HALCYON	99	100	103	101	96	98	98	95	98	104	97	96	102	98	99	103	99	98	101	96-	106
PIPKIN	101	100	97	99	104	102	102	105	102	96	103	104	98	102	101	97	101	102	99	104+	94
FINESSE	105+	106	98	100	109+	106	99	97	109+	107	104	101	98	100	109+	114+	108+	104	115+	103	113+
MAGIE	101	101	100	97	99	98	88-	111+	103	119+	99	107	96	89-	106+	109	96	95	97	94-	116+
M OTTER	88-	95	89	82-	97	92-	85-	85-	90-	89-	84-	88-	82-	85-	92-	93	87-	82-	95	81-	95
MELUSINE	102	*	*	*	*	*	*	*	100	118+	91-	106	94-	94-	102	111	97	101	107+	99	112
PLAISANT	105+	112+	103	101	*	94	110+	120+	117+	124+	99	107	98	99	111+	102	94-	94	87-	95-	113+
PUFFIN	108+	*	*	*	*	*	*	*	97	132+	105+	113+	104	102	98	101	105+	107+	118+	106+	122+
WAVENEY	98	94	92	93	98	89-	93	105	86-	114+	96	101	99	91-	101	108	92-	96	88-	94-	117+
MAGIE(HIGH N)	107+	111+	108	106	108+	110+	88-	117+	114+	122+	113+	106	106+	94-	115+	119+	101	95	107+	94-	106
PLAISANT(HIGH N)	111+	123+	116+	112+	118+	104	101	127+	129+	125+	120+	104	111+	103	118+	115+	104	100	93-	96-	99
LSD (V CONTROL) (P=0.05)	4.0	5.8	12.6	9.2	6.6	7.8	8.6	6.0	8.2	9.6	4.9	8.5	4.9	4.7	5.6	12.9	5.0	6.1	5.4	3.3	12.8
LSD (PAIRWISE) (P=0.05)	4.9	6.7	14.6	10.6	7.6	9.0	9.9	6.9	9.5	11.1	5.7	9.8	5.7	5.5	6.4	14.9	5.8	7.0	6.2	3.8	14.7
SE (VARIETY MEAN)	1.48	2.29	4.95	3.61	2.55	3.04	3.33	2.34	3.21	3.76	1.91	3.31	1.94	1.86	2.18	5.06	1.96	2.39	2.10	1.28	4.97
CV(%)	6.5	3.8	8.2	6.3	4.2	5.3	5.9	3.7	5.3	5.7	3.3	5.6	3.4	3.3	3.6	8.2	3.5	4.2	3.6	2.3	7.9

WINTER BARLEY MALTING TRIALS 1988

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF HALCYON AND PIPKIN

	MEAN	ES 71	N 71	EE 71	EE 72	EE 73	S 71	S 72
CONTROL (MT/HA)	6.72	7.56	7.42	6.54	6.35	5.88	6.57	6.70
CONTROL (C/A)	53.5	60.3	59.1	52.1	50.6	46.9	52.4	53.4
HALCYON	99	100	103	101	96	98	98	95
PIPKIN	101	100	97	99	104	102	102	105
FINESSE	102	106	98	100	109+	106	99	97
MAGIE	99	101	100	97	99	98	88-	111+
M OTTER	89-	95	89	82-	97	92-	85-	85-
MELUSINE	*	*	*	*	*	*	*	*
PLAISANT	108+	112+	103	101	*	94	110+	120+
PUFFIN	*	*	*	*	*	*	*	*
WAVENEY	95	94	92	93	98	89-	93	105
MAGIE(HIGH N)	107+	111+	108	106	108+	110+	88-	117+
PLAISANT(HIGH N)	115+	123+	116+	112+	118+	104	101	127+
LSD (V CONTROL) (P=0.05)	5.7	5.8	12.6	9.2	6.6	7.8	8.6	6.0
LSD (PAIRWISE) (P=0.05)	6.5	6.7	14.6	10.6	7.6	9.0	9.9	6.9
SE (VARIETY MEAN)	2.20	2.29	4.95	3.61	2.55	3.04	3.33	2.34
CV(%)	5.7	3.8	8.2	6.3	4.2	5.3	5.9	3.7

WINTER BARLEY MALTING TRIALS 1989

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF HALCYON AND PIPKIN

	MEAN	ES 71	N 71	EE 71	EE 72	EE 73	S 71
CONTROL (MT/HA)	7.29	6.55	6.73	7.52	7.43	7.02	8.50
CONTROL (C/A)	58.1	52.2	53.7	59.9	59.2	56.0	67.7
HALCYON	99	98	104	97	96	102	98
PIPKIN	101	102	96	103	104	98	102
FINESSE	103	109+	107	104	101	98	100
MAGIE	101	103	119+	99	107	96	89-
M OTTER	86-	90-	89-	84-	88-	82-	85-
MELUSINE	100	100	118+	91-	106	94-	94-
PLAISANT	107+	117+	124+	99	107	98	99
PUFFIN	109+	97	132+	105+	113+	104	102
WAVENEY	98	86-	114+	96	101	99	91-
MAGIE(HIGH N)	109+	114+	122+	113+	106	106+	94-
PLAISANT(HIGH N)	115+	129+	125+	120+	104	111+	103
LSD (V CONTROL) (P=0.05)	6.2	8.2	9.6	4.9	8.5	4.9	4.7
LSD (PAIRWISE) (P=0.05)	7.2	9.5	11.1	5.7	9.8	5.7	5.5
SE (VARIETY MEAN)	2.54	3.21	3.76	1.91	3.31	1.94	1.86
CV(%)	6.1	5.3	5.7	3.3	5.6	3.4	3.3

WINTER BARLEY MALTING TRIALS 1990

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF HALCYON AND PIPKIN

	MEAN	ES 71	N 71	EE 71	EE 72	EE 73	S 71	S 72
CONTROL (MT/HA)	7.14	8.88	7.51	7.51	6.68	4.83	8.14	6.43
CONTROL (C/A)	56.9	70.7	59.8	59.8	53.2	38.5	64.9	51.2
HALCYON	100	99	103	99	98	101	96-	106
PIPKIN	100	101	97	101	102	99	104+	94
FINESSE	109+	109+	114+	108+	104	115+	103	113+
MAGIE	102	106+	109	96	95	97	94-	116+
M OTTER	89-	92-	93	87-	82-	95	81-	95
MELUSINE	104	102	111	97	101	107+	99	112
PLAISANT	100	111+	102	94-	94	87-	95-	113+
PUFFIN	107+	98	101	105+	107+	118+	106+	122+
WAVENEY	100	101	108	92-	96	88-	94-	117+
MAGIE(HIGH N)	106	115+	119+	101	95	107+	94-	106
PLAISANT(HIGH N)	105	118+	115+	104	100	93-	96-	99
LSD (V CONTROL) (P=0.05)	5.6	5.6	12.9	5.0	6.1	5.4	3.3	12.8
LSD (PAIRWISE) (P=0.05)	6.5	6.4	14.9	5.8	7.0	6.2	3.8	14.7
SE (VARIETY MEAN)	2.30	2.18	5.06	1.96	2.39	2.10	1.28	4.97
CV(%)	6.0	3.6	8.2	3.5	4.2	3.6	2.3	7.9

SPRING BARLEY MALTING TRIALS 1988 - 90

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF BLENHEIM AND PRISMA

		1988						1989							1990						
		ES	N	EE	S	S	SW	ES	N	EC	EE	S	S	SW	ES	N	EC	EE	S	S	SW
	MEAN	71	71	71	71	72	71	71	71	71	71	71	72	71	71	71	71	71	71	72	71
CONTROL (MT/HA)	5.32	6.40	6.30	4.64	6.13	3.87	6.08	7.38	5.37	5.20	4.83	3.53	3.42	3.46	5.65	7.71	7.20	6.77	6.39	2.54	3.46
CONTROL (C/A)	42.4	51.0	50.2	37.0	48.9	30.9	48.5	58.8	42.8	41.4	38.5	28.1	27.3	27.6	45.0	61.4	57.4	53.9	50.9	20.2	27.6
BLENHEIM	103	95-	111	105	103	100	102	102	108	109+	105	111+	102	99	99	98	98	104+	99	109+	103
PRISMA	97	105+	89	95	97	100	98	98	92	91-	95	89-	98	101	101	102	102	96-	101	91-	97
ALEXIS	104+	*	*	*	*	*	*	99	125+	96	104	128+	99	111+	91-	105	98	103	94-	135+	103
CORNICHE	98	96	111	111+	93-	118+	92-	92-	104	88-	91-	106	94	105	88-	100	101	94-	91-	111+	100
DOUBLET	99	94-	79-	111+	96	91-	97-	102	110	107+	103	103	96	101	99	98	98	95-	96-	105	99
NATASHA	95-	94-	96	102	88-	98	92-	96-	94	89-	104	101	95	101	90-	92-	98	93-	93-	95	101
TRIUMPH	94-	96	95	102	92-	89-	94-	*	*	*	*	*	*	*	92-	95	98	88-	92-	95	102
BLENHEIM(HIGH N)	105+	99	108	120+	105	96	116+	105+	107	107+	103	107	99	105	102	101	95	104	106+	110+	109+
PRISMA(HIGH N)	99	*	*	*	*	*	*	99	96	92-	96	90-	89	97	105	103	102	91-	107+	97	110+
LSD (V CONTROL) (P=0.05)	4.0	4.5	14.7	6.3	6.0	4.6	2.3	3.0	13.3	6.3	6.2	7.6	11.3	8.5	6.7	6.9	5.6	4.2	3.7	8.7	6.8
LSD (PAIRWISE) (P=0.05)	4.9	5.2	17.0	7.3	6.9	5.3	2.7	3.5	15.3	7.2	7.2	8.8	13.0	9.8	7.7	7.9	6.5	4.8	4.3	10.0	7.8
SE (VARIETY MEAN)	1.51	1.73	5.66	2.41	2.30	1.78	0.92	1.15	5.05	2.38	2.38	2.89	4.29	3.24	2.57	2.63	2.16	1.60	1.44	3.34	2.67
CV(%)	6.8	3.1	9.6	3.9	4.2	2.9	1.9	2.0	8.4	4.2	4.1	4.8	7.7	5.5	4.6	4.6	3.8	2.9	2.6	5.5	5.2

SPRING BARLEY MALTING TRIALS 1988

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF BLENHEIM AND PRISMA

	MEAN	ES 71	N 71	EE 71	S 71	S 72	SW 71
CONTROL (MT/HA)	5.57	6.40	6.30	4.64	6.13	3.87	6.08
CONTROL (C/A)	44.4	51.0	50.2	37.0	48.9	30.9	48.5
BLENHEIM	103	95-	111	105	103	100	102
PRISMA	97	105+	89	95	97	100	98
ALEXIS	*	*	*	*	*	*	*
CORNICHE	102	96	111	111+	93-	118+	92-
DOUBLET	94	94-	79-	111+	96	91-	97-
NATASHA	94	94-	96	102	88-	98	92-
TRIUMPH	95	96	95	102	92-	89-	94-
BLENHEIM(HIGH N)	107	99	108	120+	105	96	116+
PRISMA(HIGH N)	*	*	*	*	*	*	*
LSD (V CONTROL) (P=0.05)	7.6	4.5	14.7	6.3	6.0	4.6	2.3
LSD (PAIRWISE) (P=0.05)	8.8	5.2	17.0	7.3	6.9	5.3	2.7
SE (VARIETY MEAN)	3.03	1.73	5.66	2.41	2.30	1.78	0.92
CV(%)	7.5	3.1	9.6	3.9	4.2	2.9	1.9

SPRING BARLEY MALTING TRIALS 1989

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF BLENHEIM AND PRISMA

	MEAN	ES 71	N 71	EC 71	EE 71	S 71	S 72	SW 71
CONTROL (MT/HA)	4.74	7.38	5.37	5.20	4.83	3.53	3.42	3.46
CONTROL (C/A)	37.8	58.8	42.8	41.4	38.5	28.1	27.3	27.6
BLENHEIM	105	102	108	109+	105	111+	102	99
PRISMA	95	98	92	91-	95	89-	98	101
ALEXIS	108+	99	125+	96	104	128+	99	111+
CORNICHE	96	92-	104	88-	91-	106	94	105
DOUBLET	104	102	110	107+	103	103	96	101
NATASHA	97	96-	94	89-	104	101	95	101
TRIUMPH	*	*	*	*	*	*	*	*
BLENHEIM(HIGH N)	105	105+	107	107+	103	107	99	105
PRISMA(HIGH N)	95	99	96	92-	96	90-	89	97
LSD (V CONTROL) (P=0.05)	5.6	3.0	13.3	6.3	6.2	7.6	11.3	8.5
LSD (PAIRWISE) (P=0.05)	6.4	3.5	15.3	7.2	7.2	8.8	13.0	9.8
SE (VARIETY MEAN)	2.25	1.15	5.05	2.38	2.38	2.89	4.29	3.24
CV(%)	5.9	2.0	8.4	4.2	4.1	4.8	7.7	5.5

SPRING BARLEY MALTING TRIALS 1990

TREATED YIELD OF GRAIN AT 15% MOISTURE AS % OF THE TREATED MEAN OF BLENHEIM AND PRISMA

	MEAN	ES 71	N 71	EC 71	EE 71	S 71	S 72	SW 71
CONTROL (MT/HA) -	5.68	5.65	7.71	7.20	6.77	6.39	2.54	3.46
CONTROL (C/A)	45.2	45.0	61.4	57.4	53.9	50.9	20.2	27.6
BLENHEIM	100	99	98	98	104+	99	109+	103
PRISMA	100	101	102	102	96-	101	91-	97
ALEXIS	101	91-	105	98	103	94-	135+	103
CORNICHE	97	88-	100	101	94-	91-	111+	100
DOUBLET	98	99	98	98	95-	96-	105	99
NATASHA	94-	90-	92-	98	93-	93-	95	101
TRIUMPH	94-	92-	95	98	88-	92-	95	102
BLENHEIM(HIGH N)	103	102	101	95	104	106+	110+	109+
PRISMA(HIGH N)	102	105	103	102	91-	107+	97	110+
LSD (V CONTROL) (P=0.05)	4.5	6.7	6.9	5.6	4.2	3.7	8.7	6.8
LSD (PAIRWISE) (P=0.05)	5.2	7.7	7.9	6.5	4.8	4.3	10.0	7.8
SE (VARIETY MEAN)	1.83	2.57	2.63	2.16	1.60	1.44	3.34	2.67
CV(%)	4.9	4.6	4.6	3.8	2.9	2.6	5.5	5.2

WINTER BARLEY MALTING TRIALS 1988

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	EE71	EE72	EE73	S71	S72
HALCYON	307.6	307.6	6	315.3	318.4	315.8	299.7	297.4	299.3
PIPKIN	306.1	306.1	6	305.0	312.9	315.1	310.4	295.5	297.5
FINESSE	298.6	298.6	6	302.6	310.5	294.4	281.8	301.0	301.4
MAGIE	300.5	300.5	6	303.0	308.7	309.4	301.8	291.4	288.6
M OTTER	304.6	304.6	6	308.6	314.3	311.5	302.2	294.8	296.0
MELUSINE	*	*	0	*	*	*	*	*	*
PLAISANT	297.6	297.6	6	299.1	302.5	303.1	292.8	294.3	294.0
PUFFIN	*	*	0	*	*	*	*	*	*
WAVENEY	297.8	297.8	6	303.8	311.3	304.1	293.0	294.7	280.0
MAGIE(HIGH N)	295.0	295.0	6	295.3	304.4	299.6	299.6	283.6	287.8
PLAISANT(HIGH N)	290.0	290.0	6	294.6	300.0	291.2	285.0	289.1	280.1
ENVIRONMENT EFFECT				3.3	9.5	5.1	-3.5	-6.2	-8.1

GRAND MEAN 299.8

SMALLEST S.E. (DIFF) 2.986

LARGEST S.E. (DIFF) 2.986

AVERAGE S.E. (DIFF) 2.986

TOTAL D.F. 40

WINTER BARLEY MALTING TRIALS 1989

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EE71	EE72	EE73	S71
HALCYON	305.7	305.6	6	308.5	289.3	312.1	307.6	310.9	305.5
PIPKIN	307.1	307.1	6	314.4	291.4	312.2	307.3	311.2	306.0
FINESSE	309.1	309.1	6	317.7	290.1	313.9	309.7	311.2	312.0
MAGIE	302.5	302.5	6	306.2	288.0	311.5	309.4	304.3	295.7
M OTTER	305.2	305.1	6	309.9	289.8	310.5	307.2	306.0	307.5
MELUSINE	303.3	303.3	6	305.7	286.2	309.3	307.7	305.2	305.7
PLAISANT	301.0	301.0	6	307.3	281.7	306.1	304.9	303.9	302.2
PUFFIN	308.9	308.9	6	312.0	294.1	314.1	311.9	311.9	309.3
WAVENEY	301.3	301.3	6	304.3	280.7	308.5	305.9	305.2	303.1
MAGIE(HIGH N)	295.8	295.8	6	297.2	285.8	306.6	293.3	297.8	294.1
PLAISANT(HIGH N)	294.5	294.5	6	298.7	279.9	299.7	293.9	300.7	294.3
ENVIRONMENT EFFECT				4.3	-16.1	6.4	2.2	3.1	0.1

GRAND MEAN 303.1

SMALLEST S.E. (DIFF) 1.515

LARGEST S.E. (DIFF) 1.515

AVERAGE S.E. (DIFF) 1.515

TOTAL D.F. 50

WINTER BARLEY MALTING TRIALS 1990

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EE71	EE72	EE73	S71	S72
HALCYON	308.6	308.6	7	308.3	306.2	308.3	316.9	307.1	309.6	304.0
PIPKIN	308.4	308.4	7	307.1	310.4	308.9	317.3	304.3	308.4	302.6
FINESSE	308.8	308.8	7	309.2	308.2	308.8	319.0	307.4	308.5	300.8
MAGIE	305.1	305.1	7	304.5	303.6	307.1	315.2	299.0	306.7	299.5
M OTTER	305.1	305.1	7	306.8	302.2	307.2	316.6	301.5	307.9	293.6
MELUSINE	307.5	307.5	7	307.3	307.9	308.1	315.3	302.0	310.5	301.5
PLAISANT	302.3	302.3	7	302.7	300.0	304.4	308.9	296.7	307.1	296.6
PUFFIN	311.7	311.7	7	310.8	310.5	314.1	321.1	305.9	312.2	307.6
WAVENEY	305.2	305.2	7	307.2	303.5	303.7	314.7	301.3	305.3	301.0
MAGIE(HIGH N)	297.1	297.1	7	303.3	294.0	296.4	306.6	287.2	297.5	294.6
PLAISANT(HIGH N)	294.2	294.2	7	297.1	292.1	296.3	302.0	287.9	296.9	287.2
ENVIRONMENT EFFECT				0.9	-1.4	0.8	9.0	-4.9	1.5	-5.9

GRAND MEAN 304.9

SMALLEST S.E. (DIFF) 1.086

LARGEST S.E. (DIFF) 1.086

AVERAGE S.E. (DIFF) 1.086

TOTAL D.F. 60

WINTER BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90

HOT WATER EXTRACT (l^{o}/kg)

				1988							1989							
VARIETY	MEAN	UNADJ MEAN	COUNT	N3	N31	EE33	SW32A	SW32B	S3	S31	N3	WC6	EE5A	EE5B	EE6	EE33	S3	S31
HALCYON	304.6	304.6	23	315.1	297.0	306.2	306.1	306.0	312.9	309.1	301.1	296.1	312.3	303.0	300.0	305.0	297.5	293.0
PIPKIN	304.4	304.4	23	310.0	302.0	299.5	301.9	304.0	307.1	311.9	305.8	296.7	309.2	308.0	303.7	304.0	303.2	297.0
FINESSE	303.4	303.2	22	316.8	292.0	299.5	306.0	297.0	302.2	306.1	308.4	304.1	305.0	306.0	302.7	302.0	301.5	294.0
MAGIE	299.9	299.9	23	306.9	297.0	301.0	296.2	299.0	302.2	305.0	298.8	295.9	301.0	303.0	296.6	298.0	297.1	291.0
MELUSINE	301.4	301.4	23	311.1	296.0	304.0	304.4	299.0	301.2	305.8	299.6	302.4	307.4	305.0	303.2	289.0	295.0	291.0
PLAISANT	297.1	296.4	15	304.4	292.0	295.3	295.3	297.0	295.6	303.0	290.0	295.1	296.0	301.0	294.9	299.0	294.2	293.0
PUFFIN	305.7	305.7	23	315.5	297.0	305.2	304.0	307.0	306.7	314.3	303.7	307.5	304.0	301.0	304.5	304.0	303.1	289.0
WAVENEY	303.3	302.6	17	311.6	296.0	306.0	302.3	299.0	305.3	305.9	304.9	295.7	310.1	305.0	299.8	299.0	300.2	292.0
ENVIRONMENT EFFECT				9.0	-6.3	-0.4	-0.4	-1.5	1.7	5.2	-0.9	-3.3	3.2	1.5	-1.8	-2.5	-3.5	-10.0

GRAND MEAN 302.5

SMALLEST S.E. (DIFF) 0.964

LARGEST S.E. (DIFF) 1.164

AVERAGE S.E. (DIFF) 1.027

TOTAL D.F. 139

WINTER BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90 CONTINUED..

HOT WATER EXTRACT (l^{o}/kg)

				1990							
VARIETY	MEAN	UNADJ MEAN	COUNT	EC3	EC4	WC5	WC6	EE5	EE32	S3	S31
HALCYON	304.6	304.6	23	303.7	311.9	302.1	304.9	308.6	297.0	310.0	307.0
PIPKIN	304.4	304.4	23	301.2	307.9	307.5	305.6	309.0	297.0	304.0	306.0
FINESSE	303.4	303.2	22	295.9	311.1	304.1	307.1	311.9	294.0	304.0	*
MAGIE	299.9	299.9	23	295.8	306.4	298.0	303.3	301.3	304.0	296.0	305.0
MELUSINE	301.4	301.4	23	298.0	309.1	300.9	299.5	310.4	298.0	299.0	303.0
PLAISANT	297.1	296.4	15	*	*	*	*	*	*	*	*
PUFFIN	305.7	305.7	23	302.5	310.6	308.7	311.7	312.3	297.0	314.0	307.0
WAVENEY	303.3	302.6	17	*	*	*	*	*	298.0	313.0	*
ENVIRONMENT EFFECT				-3.7	6.3	0.3	2.1	5.7	-5.4	2.5	2.4

GRAND MEAN 302.5

SMALLEST S.E. (DIFF) 0.964

LARGEST S.E. (DIFF) 1.164

AVERAGE S.E. (DIFF) 1.027

TOTAL D.F. 139

WINTER BARLEY MALTING TRIALS 1988 - 90

NITROGEN CONTENT (%)

				1988						1989						1990						
VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	EE71	EE72	EE73	S71	S72	ES71	N71	EE71	EE72	EE73	S71	ES71	N71	EE71	EE72	EE73	S71	S72
HALCYON	1.64	1.64	19	1.43	1.40	1.47	1.85	1.54	1.89	1.37	2.31	1.40	1.58	1.60	1.76	1.58	1.80	1.61	1.37	1.95	1.52	1.80
PIPKIN	1.57	1.57	19	1.33	1.33	1.43	1.75	1.65	1.89	1.43	2.30	1.28	1.59	1.49	1.42	1.52	1.56	1.58	1.33	1.84	1.39	1.76
FINESSE	1.61	1.61	19	1.37	1.34	1.55	1.90	1.48	1.83	1.40	2.51	1.40	1.61	1.53	1.49	1.60	1.71	1.50	1.28	1.88	1.47	1.73
MAGIE	1.66	1.66	19	1.53	1.43	1.53	1.83	1.61	1.75	1.62	2.52	1.39	1.51	1.53	1.56	1.53	1.93	1.49	1.36	2.05	1.56	1.87
M OTTER	1.64	1.64	19	1.40	1.43	1.55	1.83	1.55	1.81	1.40	2.10	1.40	1.70	1.51	1.55	1.60	1.77	1.66	1.36	1.90	1.47	2.17
MELUSINE	1.67	1.68	13	*	*	*	*	*	*	1.51	2.58	1.43	1.59	1.59	1.66	1.60	1.73	1.59	1.38	1.93	1.51	1.77
PLAISANT	1.49	1.49	19	1.33	1.23	1.60	1.75	1.46	1.58	1.27	2.04	1.21	1.41	1.47	1.44	1.50	1.57	1.47	1.18	1.79	1.32	1.65
PUFFIN	1.62	1.63	13	*	*	*	*	*	*	1.39	2.68	1.32	1.53	1.53	1.57	1.56	1.59	1.57	1.35	1.93	1.49	1.72
WAVENEY	1.73	1.73	19	1.54	1.40	1.65	2.10	1.62	2.02	1.62	2.93	1.40	1.71	1.61	1.67	1.54	1.88	1.47	1.33	2.09	1.57	1.81
MAGIE(HIGH N)	1.89	1.89	19	1.67	1.57	1.81	2.06	1.72	2.06	1.72	2.49	1.59	2.07	1.75	1.93	1.70	2.01	2.01	1.64	2.46	1.80	1.92
PLAISANT(HIGH N)	1.70	1.70	19	1.46	1.48	1.60	1.96	1.53	1.85	1.42	2.18	1.45	1.68	1.61	1.71	1.65	1.89	1.58	1.44	2.15	1.61	1.96
ENVIRONMENT EFFECT				-0.21	-0.26	-0.08	0.23	-0.09	0.19	-0.19	0.77	-0.27	-0.02	-0.09	-0.04	-0.08	0.11	-0.06	-0.29	0.34	-0.14	0.18

GRAND MEAN 1.66

SMALLEST S.E. (DIFF) 0.0311

LARGEST S.E. (DIFF) 0.0376

AVERAGE S.E. (DIFF) 0.0325

TOTAL D.F. 168

WINTER BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90

NITROGEN CONTENT (%)

				1988							1989							
VARIETY	MEAN	UNADJ MEAN	COUNT	N3	N31	EE33	SW32A	SW32B	S3	S31	N3	WC6	EE5A	EE5B	EE6	EE33	S3	S31
HALCYON	1.74	1.74	23	1.55	1.89	1.64	1.76	1.71	1.71	1.61	1.94	1.85	1.65	1.51	1.71	1.53	1.91	1.82
PIPKIN	1.66	1.66	23	1.41	1.84	1.74	1.60	1.57	1.51	1.58	1.77	2.03	1.60	1.39	1.41	1.55	1.83	1.84
FINESSE	1.71	1.72	22	1.50	1.90	1.61	1.71	1.71	1.76	1.58	1.80	1.92	1.64	1.41	1.70	1.59	1.86	1.86
MAGIE	1.78	1.78	23	1.86	1.75	1.67	1.78	1.73	1.89	1.65	1.89	2.04	1.66	1.53	1.83	1.63	2.01	1.93
MELUSINE	1.75	1.75	23	1.62	1.74	1.68	1.75	1.68	1.83	1.65	1.85	1.78	1.67	1.49	1.71	1.72	1.94	1.91
PLAISANT	1.65	1.64	15	1.57	1.95	1.54	1.79	1.66	1.61	1.53	1.62	1.89	1.55	1.32	1.61	1.44	1.73	1.82
PUFFIN	1.75	1.75	23	1.65	1.91	1.72	1.82	1.75	1.78	1.60	1.84	1.75	1.79	1.65	1.69	1.59	1.85	1.96
WAVENEY	1.82	1.82	17	1.71	1.95	1.79	1.93	1.84	1.82	1.74	2.03	2.06	1.54	1.52	1.78	1.73	2.09	1.90
ENVIRONMENT EFFECT				-0.12	0.13	-0.06	0.03	-0.03	0.01	-0.12	0.11	0.18	-0.10	-0.26	-0.05	-0.14	0.17	0.15

GRAND MEAN 1.73

SMALLEST S.E. (DIFF) 0.0236

LARGEST S.E. (DIFF) 0.0285

AVERAGE S.E. (DIFF) 0.0252

TOTAL D.F. 139

WINTER BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90 CONTINUED..

NITROGEN CONTENT (%)

				1990							
VARIETY	MEAN	UNADJ MEAN	COUNT	EC3	EC4	WC5	WC6	EE5	EE32	S3	S31
HALCYON	1.74	1.74	23	1.96	1.49	2.03	1.92	1.56	1.87	1.85	1.55
PIPKIN	1.66	1.66	23	1.91	1.47	1.86	1.91	1.60	1.77	1.61	1.42
FINESSE	1.71	1.72	22	2.08	1.50	1.97	1.83	1.57	1.80	1.60	*
MAGIE	1.78	1.78	23	2.01	1.51	1.92	1.83	1.87	1.76	1.66	1.62
MELUSINE	1.75	1.75	23	2.01	1.58	1.83	2.05	1.61	1.86	1.66	1.52
PLAISANT	1.65	1.64	15	*	*	*	*	*	*	*	*
PUFFIN	1.75	1.75	23	1.97	1.66	1.90	1.79	1.68	1.81	1.59	1.51
WAVENEY	1.82	1.82	17	*	*	*	*	*	1.76	1.67	*
ENVIRONMENT EFFECT				0.26	-0.20	0.19	0.16	-0.08	0.06	-0.08	-0.21

GRAND MEAN 1.73

SMALLEST S.E. (DIFF) 0.0236

LARGEST S.E. (DIFF) 0.0285

AVERAGE S.E. (DIFF) 0.0252

TOTAL D.F. 139

SPRING BARLEY MALTING TRIALS 1988

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EE71	S71	S72	SW71
BLENHEIM	304.5	304.5	6	298.6	300.5	307.9	313.9	289.4	316.9
PRISMA	305.4	305.4	6	304.2	301.0	308.9	314.1	288.9	315.4
ALEXIS	*	*	0	*	*	*	*	*	*
CORNICHE	307.0	304.9	5	306.3	299.3	304.9	317.1	297.1	*
DOUBLET	300.3	300.3	6	304.1	294.5	296.2	310.4	282.6	313.7
NATASHA	304.3	304.3	6	305.2	297.9	310.9	312.0	291.1	308.4
TRIUMPH	308.1	311.1	5	304.4	302.8	314.9	309.6	*	323.9
BLENHEIM(HIGH N)	299.6	299.6	6	300.8	295.3	302.2	312.2	281.1	305.9
PRISMA(HIGH N)	*	*	0	*	*	*	*	*	*
ENVIRONMENT EFFECT				-0.8	-5.4	2.4	8.6	-15.1	10.3

GRAND MEAN 304.2

SMALLEST S.E. (DIFF) 2.174

LARGEST S.E. (DIFF) 2.422

AVERAGE S.E. (DIFF) 2.246

TOTAL D.F. 28

SPRING BARLEY MALTING TRIALS 1989

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EC71	EE71	S71	S72	SW71
BLENHEIM	304.4	304.4	7	309.3	298.9	293.5	306.9	308.9	306.6	306.7
PRISMA	302.9	302.9	7	312.8	291.4	289.0	308.0	308.5	303.8	306.7
ALEXIS	306.2	306.2	7	313.4	299.2	297.9	312.1	304.6	307.7	308.2
CORNICHE	306.4	306.4	7	312.7	296.2	299.9	315.0	308.2	304.8	307.7
DOUBLET	302.1	302.1	7	308.9	299.5	294.1	302.1	302.3	305.8	302.3
NATASHA	303.4	303.4	7	310.6	294.5	297.9	312.9	302.6	305.2	300.2
TRIUMPH	*	*	0	*	*	*	*	*	*	*
BLENHEIM(HIGH N)	300.7	300.7	7	308.9	291.3	292.5	299.4	309.2	304.9	299.0
PRISMA(HIGH N)	305.0	305.0	7	311.9	302.6	296.3	306.4	303.0	312.5	302.0
ENVIRONMENT EFFECT				7.2	-7.2	-8.7	4.0	2.0	2.5	0.2

GRAND MEAN 303.9

SMALLEST S.E. (DIFF) 1.756

LARGEST S.E. (DIFF) 1.756

AVERAGE S.E. (DIFF) 1.756

TOTAL D.F. 42

SPRING BARLEY MALTING TRIALS 1990

HOT WATER EXTRACT (l^{o}/kg)

VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EC71	EE71	S71	S72	SW71
BLENHEIM	304.0	304.0	7	304.5	303.9	300.8	305.6	310.3	299.4	303.7
PRISMA	310.7	310.7	7	310.3	310.7	306.7	313.2	319.2	304.0	310.8
ALEXIS	309.8	309.8	7	307.4	307.6	304.8	313.6	320.4	304.2	310.7
CORNICHE	308.1	308.1	7	307.7	305.9	304.2	310.9	316.7	303.3	307.7
DOUBLET	303.8	303.8	7	303.0	302.8	300.8	305.8	314.0	298.7	301.2
NATASHA	306.6	306.6	7	308.1	301.6	300.8	307.1	319.1	301.5	307.8
TRIUMPH	304.7	304.7	7	306.7	302.7	299.8	304.6	314.4	300.8	303.9
BLENHEIM(HIGH N)	302.9	302.9	7	303.3	300.4	299.9	303.3	312.4	297.9	302.9
PRISMA(HIGH N)	308.3	308.3	7	309.0	307.1	305.6	310.6	318.0	302.2	305.4
ENVIRONMENT EFFECT				0.1	-1.8	-3.9	1.8	9.5	-5.2	-0.5

GRAND MEAN 306.5

SMALLEST S.E. (DIFF) 0.765

LARGEST S.E. (DIFF) 0.765

AVERAGE S.E. (DIFF) 0.765

TOTAL D.F. 48

SPRING BARLEY MALTING TRIALS 1988 - 90

NITROGEN CONTENT (%)

VARIETY	MEAN	UNADJ MEAN	COUNT	1988 ES71	N71	EE71	S71	S72	SW71	1989 ES71	N71	EC71	EE71	S71	S72	SW71
BLENHEIM	1.88	1.88	20	1.61	1.92	1.65	1.68	1.72	1.37	1.84	2.14	2.29	1.90	2.00	2.18	1.91
PRISMA	1.89	1.89	20	1.60	2.03	1.60	1.57	1.57	1.40	1.90	2.34	2.32	1.96	2.00	2.26	2.00
ALEXIS	1.92	2.01	14	*	*	*	*	*	*	1.92	2.29	2.30	1.82	2.13	2.20	2.10
CORNICHE	2.05	2.08	19	1.81	2.23	1.75	1.69	1.81	*	1.98	2.53	2.59	2.00	2.24	2.40	2.10
DOUBLET	1.93	1.93	20	1.68	2.04	1.72	1.79	1.85	1.53	1.79	2.23	2.36	1.81	2.18	2.26	1.96
NATASHA	1.98	1.98	20	1.74	1.96	1.81	1.67	1.71	1.53	1.89	2.33	2.50	1.84	2.18	2.29	2.10
TRIUMPH	1.88	1.79	12	1.57	2.09	1.46	1.51	*	1.23	*	*	*	*	*	*	*
BLENHEIM(HIGH N)	1.96	1.96	20	1.68	2.09	1.71	1.75	1.95	1.75	1.84	2.25	2.32	1.99	2.00	2.28	2.10
PRISMA(HIGH N)	1.95	2.04	14	*	*	*	*	*	*	1.81	2.20	2.35	2.07	2.06	2.23	2.10
ENVIRONMENT EFFECT				-0.27	0.11	-0.27	-0.27	-0.18	-0.45	-0.07	0.34	0.43	-0.02	0.15	0.32	0.10

GRAND MEAN 1.94

SMALLEST S.E. (DIFF) 0.0228

LARGEST S.E. (DIFF) 0.0294

AVERAGE S.E. (DIFF) 0.0250

TOTAL D.F. 131

SPRING BARLEY MALTING TRIALS 1988 - 90 CONTINUED..

NITROGEN CONTENT (%)

				1990						
VARIETY	MEAN	UNADJ MEAN	COUNT	ES71	N71	EC71	EE71	S71	S72	SW71
BLENHEIM	1.88	1.88	20	1.76	2.04	2.03	1.93	1.50	2.22	1.82
PRISMA	1.89	1.89	20	1.68	2.07	2.03	2.01	1.54	2.15	1.83
ALEXIS	1.92	2.01	14	1.79	2.03	2.13	1.92	1.53	2.19	1.80
CORNICHE	2.05	2.08	19	1.87	2.15	2.18	2.08	1.65	2.45	1.98
DOUBLET	1.93	1.93	20	1.67	2.10	2.06	1.91	1.53	2.24	1.89
NATASHA	1.98	1.98	20	1.81	2.12	2.11	2.08	1.59	2.44	1.93
TRIUMPH	1.88	1.79	12	1.74	2.10	2.10	2.02	1.51	2.31	1.84
BLENHEIM(HIGH N)	1.96	1.96	20	1.77	2.02	2.02	2.05	1.60	2.23	1.85
PRISMA(HIGH N)	1.95	2.04	14	1.77	2.14	2.11	2.10	1.56	2.18	1.92
ENVIRONMENT EFFECT				-0.18	0.15	0.15	0.07	-0.38	0.33	-0.06

GRAND MEAN 1.94

SMALLEST S.E. (DIFF) 0.0228

LARGEST S.E. (DIFF) 0.0294

AVERAGE S.E. (DIFF) 0.0250

TOTAL D.F. 131

SPRING BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90

NITROGEN CONTENT (%)

				1988									1989						
VARIETY	MEAN	UNADJ MEAN	COUNT	EC3	EC4	EC95	WC95	EE5	EE6A	EE6B	S3A	S3B	EC5	WC94	WC5	S4A	S4B	W3A	W3B
BLENHEIM	1.81	1.81	23	1.78	1.66	1.58	1.57	1.58	1.69	1.65	1.79	1.86	1.78	2.28	1.83	1.95	1.96	1.96	1.88
PRISMA	1.82	1.82	23	1.71	1.74	1.57	1.58	1.62	1.57	1.50	1.82	1.83	1.84	2.32	1.66	1.96	1.98	1.99	1.92
ALEXIS	1.79	1.91	13	*	*	*	*	*	*	*	*	*	*	2.19	1.65	1.96	1.99	1.94	2.01
CORNICHE	1.98	1.98	22	*	1.83	1.71	1.85	1.68	1.74	1.66	1.85	2.01	1.90	2.61	1.81	2.23	2.19	2.17	2.11
DOUBLET	1.84	1.81	16	1.75	1.81	1.64	1.57	1.58	1.78	1.50	1.76	1.81	1.63	2.34	1.84	1.98	2.00	2.01	1.93
NATASHA	1.90	1.87	16	1.89	1.81	1.71	1.54	1.79	1.76	1.55	1.85	1.71	1.86	2.40	1.96	2.04	2.08	2.03	2.00
TRIUMPH	1.88	1.82	16	1.74	1.79	1.65	1.39	1.75	1.75	1.66	1.76	1.80	*	*	*	*	*	*	*
ENVIRONMENT EFFECT				-0.08	-0.10	-0.23	-0.29	-0.21	-0.16	-0.29	-0.07	-0.04	-0.07	0.50	-0.07	0.16	0.18	0.16	0.12

GRAND MEAN 1.86

SMALLEST S.E. (DIFF) 0.0205

LARGEST S.E. (DIFF) 0.0275

AVERAGE S.E. (DIFF) 0.0240

TOTAL D.F. 100

SPRING BARLEY NIAB AND ADAS/NIAB RECOMMENDED LIST 1988 - 90 CONTINUED..

NITROGEN CONTENT (%)

				1990						
VARIETY	MEAN	UNADJ MEAN	COUNT	N3	EC3	EC5A	EC5B	EE5	S3	S4
BLENHEIM	1.81	1.81	23	1.75	1.83	1.37	2.18	2.18	1.60	1.98
PRISMA	1.82	1.82	23	1.93	1.94	1.46	2.27	2.09	1.63	2.03
ALEXIS	1.79	1.91	13	1.82	1.93	1.44	2.25	2.03	1.56	2.02
CORNICHE	1.98	1.98	22	2.01	2.11	1.54	2.32	2.36	1.78	2.19
DOUBLET	1.84	1.81	16	*	*	*	*	*	*	*
NATASHA	1.90	1.87	16	*	*	*	*	*	*	*
TRIUMPH	1.88	1.82	16	2.06	2.04	1.41	2.25	2.10	1.70	2.19
ENVIRONMENT EFFECT				0.06	0.11	-0.41	0.40	0.30	-0.20	0.23