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89/R/B/1 Factors Limiting Yield - W. Barley

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Rothamsted Research (1990) *89/R/B/1 Factors Limiting Yield - W. Barley* ; Yields Of The Field Experiments 1989, pp 136 - 150 - DOI: <https://doi.org/10.23637/ERADOC-1-40>

89/R/B/1

WINTER BARLEY

FACTORS LIMITING YIELD

Object: To study the effects of a range of factors on the quality and yield of winter barley - Great Knott I.

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Associate sponsors: B.R. Kerry, G.F.J. Milford, Dr. E.D. Baxter (Brewing Research Foundation).

Design: A single replicate of 2 x 2 x 2 x 2 x 2 + 24 extra plots.

Whole plot dimensions: 3.0 x 18.2.

Treatments: All combinations of the following, all sown early (20 Sept, 1988) and given cypermethrin at 0.025 kg in 220 l on 28 Oct:

1. **PREVCROP** Previous cropping:

 BARLEY Potatoes 1986, w. wheat 1987, w. barley 1988
 OATS Potatoes 1986, w. wheat 1987, w. oats 1988

2. **WINTER N** Nitrogen fertilizer in winter (kg N) as urea (46% N):

 0 None
 NOV+FEB On 16 Nov, 1988 20 to BARLEY, 49 to OATS, on 20 Feb, 1989 25 to BARLEY and OATS

3. **SPRING N** Nitrogen fertilizer in spring (kg N) as 'Nitro-Chalk':

 85
 160

4. **N TIME** Timing of spring nitrogen application:

 14 MAR 14 March, 1989
 10 APR 10 April

5. **E FUNG** Early fungicides:

 NONE None
 TFSD Triadimenol and fuberidazole seed dressing

6. **L FUNG** Late fungicides:

 NONE None
 SPRAYS Foliar sprays of prochloraz at 0.40 kg, carbendazim at 0.15 kg and tridemorph at 0.38 kg in 220 l on 12 Apr, 1989. Propiconazole at 0.125 kg and tridemorph at 0.22 kg in 220 l on 19 May

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plus all combinations of the following, all after barley and given late fungicides and 85 kg N in spring, not given cypermethrin in the autumn:

1. **SOWDATEV** Sowing dates:

20 SEPT	20 September, 1988
17 OCT	17 October

2. **WINTR NV** Nitrogen fertilizer in winter (kg N) as urea (46 %N):

0	None
20+25	20 on 16 Nov, 1988, 25 on 20 Feb, 1989

3. **E FUNGV** Early fungicides:

NONE	None
TFSD	Triadimenol and fuberidazole seed dressing

4. **N TIMEV** Timing of spring nitrogen application:

14 MAR	14 March, 1989
10 APR	10 April

plus 2 extra treatments following fallow, sown 20 September and given early and late fungicides, cypermethrin, 85 kg spring nitrogen but not given winter nitrogen:

- | | |
|----------------|--|
| N TIMEF | Timing of spring nitrogen application: |
| 14 MAR | 14 March, 1989 (duplicated) |
| 10 APR | 10 April (duplicated) |

plus 1 extra treatment following barley, sown 20 September given early and late fungicides, cypermethrin, 160 kg spring nitrogen in April:

- | | |
|------------------|--|
| WINTER NX | Extra winter nitrogen (kg N): |
| 45+25 | 45 kg on 16 Nov, 1988, 25 kg on 20 Feb, 1989
(duplicated) |

plus 1 extra treatment following barley, sown 20 September, and given early and late fungicides, cypermethrin but no nitrogen:

- | | |
|-----------------|--------------------------|
| EXTRA NO | |
| 0+0+0 | No nitrogen (duplicated) |

Basal applications: Manure: Magnesian limestone at 5.0 t. Weedkillers: Glyphosate at 0.27 kg in 200 l. Paraquat at 0.60 kg ion in 200 l. Chlortoluron at 3.5 kg in 200 l. Metsulfuron-methyl at 6.0 g with isoproturon at 1.5 kg in 200 l. Growth regulators: 2-chloroethylphosphonic acid at 0.31 kg and mepiquat chloride at 0.61 kg with a wetting agent ('Citowett' at 0.08 l) in 200 l.

Seed: Magie, sown at 300 seeds per square metre.

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Cultivations, etc.:- Rotary cultivated : 10 Aug, 1988. Glyphosate applied, magnesian limestone applied: 6 Sept. Paraquat applied: 19 Sept. Cultivated with rotary grubber, rotary harrowed, first sowing date plots rotary harrowed again, seed sown: 20 Sept. Second sowing date plots rotary harrowed, seed sown: 17 Oct. Chlortoluron applied: 15 Nov. Growth regulators with wetting agent applied: 19 Apr, 1989. Metsulfuron-methyl with isoproturon applied: 26 Apr. Combine harvested: 13 July. Previous crops: S. barley, w. wheat 1987, w. barley, w. oats, fallow 1988.

- NOTES:** (1) Soil was sampled to measure nitrate and ammonium contents in October, 1988 and February, 1989. Crop samples were taken from November to June to measure nitrate N concentrations.
 (2) Plants were sampled in March, April, May and July to measure plant and shoot numbers, dry weights and nitrogen uptakes. After harvest thousand grain weights were measured.
 (3) Leaf diseases, take-all, eyespot, barley yellow dwarf virus and aphid numbers were assessed.

GRAIN TONNES/HECTARE

***** Tables of means *****

WINTER N	0	NOV+FEB	Mean
PREVCROP			
BARLEY	6.98	7.75	7.36
OATS	7.36	7.95	7.65
Mean	7.17	7.85	7.51
E FUNG	NONE	TFSD	Mean
PREVCROP			
BARLEY	7.22	7.51	7.36
OATS	7.64	7.67	7.65
Mean	7.43	7.59	7.51
E FUNG	NONE	TFSD	Mean
WINTER N			
0	7.05	7.28	7.17
NOV+FEB	7.81	7.90	7.85
Mean	7.43	7.59	7.51
L FUNG	NONE	SPRAYS	Mean
PREVCROP			
BARLEY	6.94	7.79	7.36
OATS	7.27	8.04	7.65
Mean	7.10	7.92	7.51

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GRAIN TONNES/HECTARE

***** Tables of means *****

L FUNG	NONE	SPRAYS	Mean
WINTER N			
0	6.90	7.44	7.17
NOV+FEB	7.31	8.40	7.85
Mean	7.10	7.92	7.51
L FUNG	NONE	SPRAYS	Mean
E FUNG			
NONE	6.99	7.87	7.43
TFSD	7.21	7.97	7.59
Mean	7.10	7.92	7.51
SPRING N	85	160	Mean
PREVCROP			
BARLEY	7.11	7.62	7.36
OATS	7.48	7.83	7.65
Mean	7.30	7.72	7.51
SPRING N	85	160	Mean
WINTER N			
0	6.89	7.44	7.17
NOV+FEB	7.70	8.00	7.85
Mean	7.30	7.72	7.51
SPRING N	85	160	Mean
E FUNG			
NONE	7.22	7.64	7.43
TFSD	7.37	7.81	7.59
Mean	7.30	7.72	7.51
SPRING N	85	160	Mean
L FUNG			
NONE	6.89	7.32	7.10
SPRAYS	7.71	8.13	7.92
Mean	7.30	7.72	7.51
N TIME	14 MAR	10 APR	Mean
PREVCROP			
BARLEY	7.48	7.25	7.36
OATS	7.67	7.64	7.65
Mean	7.58	7.44	7.51

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GRAIN TONNES/HECTARE

***** Tables of means *****

N TIME	14 MAR	10 APR	Mean
WINTER N			
0	7.32	7.01	7.17
NOV+FEB	7.83	7.87	7.85
Mean	7.58	7.44	7.51

N TIME	14 MAR	10 APR	Mean
E FUNG			
NONE	7.59	7.27	7.43
TFSD	7.56	7.62	7.59
Mean	7.58	7.44	7.51

N TIME	14 MAR	10 APR	Mean
L FUNG			
NONE	7.09	7.12	7.10
SPRAYS	8.07	7.77	7.92
Mean	7.58	7.44	7.51

N TIME	14 MAR	10 APR	Mean
SPRING N			
85	7.29	7.30	7.30
160	7.86	7.59	7.72
Mean	7.58	7.44	7.51

PREVCROP	E FUNG	NONE	TFSD
WINTER N			
BARLEY	0	6.74	7.22
	NOV+FEB	7.69	7.81
OATS	0	7.37	7.35
	NOV+FEB	7.92	7.99

PREVCROP	L FUNG	NONE	SPRAYS
WINTER N			
BARLEY	0	6.74	7.22
	NOV+FEB	7.13	8.37
OATS	0	7.05	7.66
	NOV+FEB	7.48	8.43

PREVCROP	L FUNG	NONE	SPRAYS
E FUNG			
BARLEY	NONE	6.70	7.73
	TFSD	7.17	7.86
OATS	NONE	7.27	8.01
	TFSD	7.26	8.08

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GRAIN TONNES/HECTARE

***** Tables of means *****

	L FUNG	NONE	SPRAYS
WINTER N	E FUNG		
0	NONE	6.80	7.31
	TFSD	7.00	7.57
NOV+FEB	NONE	7.18	8.43
	TFSD	7.43	8.36
	SPRING N	85	160
PREVCROP	WINTER N		
BARLEY	0	6.65	7.31
	NOV+FEB	7.57	7.93
OATS	0	7.14	7.58
	NOV+FEB	7.82	8.08
	SPRING N	85	160
PREVCROP	E FUNG		
BARLEY	NONE	6.93	7.51
	TFSD	7.30	7.72
OATS	NONE	7.52	7.76
	TFSD	7.44	7.90
	SPRING N	85	160
WINTER N	E FUNG		
0	NONE	6.80	7.31
	TFSD	6.99	7.58
NOV+FEB	NONE	7.65	7.96
	TFSD	7.75	8.05
	SPRING N	85	160
PREVCROP	L FUNG		
BARLEY	NONE	6.68	7.19
	SPRAYS	7.55	8.04
OATS	NONE	7.09	7.44
	SPRAYS	7.87	8.22
	SPRING N	85	160
WINTER N	L FUNG		
0	NONE	6.66	7.13
	SPRAYS	7.13	7.75
NOV+FEB	NONE	7.11	7.50
	SPRAYS	8.28	8.51
	SPRING N	85	160
E FUNG	L FUNG		
NONE	NONE	6.74	7.23
	SPRAYS	7.71	8.04
TFSD	NONE	7.03	7.40
	SPRAYS	7.71	8.23

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GRAIN TONNES/HECTARE

***** Tables of means *****

	N TIME	14 MAR	10 APR
PREVCROP	WINTER N		
BARLEY	0	7.15	6.81
	NOV+FEB	7.82	7.68
OATS	0	7.49	7.22
	NOV+FEB	7.84	8.06
	N TIME	14 MAR	10 APR
PREVCROP	E FUNG		
BARLEY	NONE	7.42	7.01
	TFSD	7.54	7.48
OATS	NONE	7.75	7.53
	TFSD	7.58	7.75
	N TIME	14 MAR	10 APR
WINTER N	E FUNG		
0	NONE	7.29	6.82
	TFSD	7.35	7.21
NOV+FEB	NONE	7.89	7.73
	TFSD	7.77	8.02
	N TIME	14 MAR	10 APR
PREVCROP	L FUNG		
BARLEY	NONE	7.04	6.83
	SPRAYS	7.92	7.66
OATS	NONE	7.13	7.41
	SPRAYS	8.21	7.88
	N TIME	14 MAR	10 APR
WINTER N	L FUNG		
0	NONE	7.00	6.79
	SPRAYS	7.64	7.24
NOV+FEB	NONE	7.17	7.44
	SPRAYS	8.49	8.30
	N TIME	14 MAR	10 APR
E FUNG	L FUNG		
NONE	NONE	7.19	6.79
	SPRAYS	7.99	7.75
TFSD	NONE	6.98	7.44
	SPRAYS	8.14	7.79
	N TIME	14 MAR	10 APR
PREVCROP	SPRING N		
BARLEY	85	7.13	7.10
	160	7.84	7.40
OATS	85	7.46	7.50
	160	7.88	7.78

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GRAIN TONNES/HECTARE

***** Tables of means *****

	N TIME	14 MAR	10 APR
WINTER N	SPRING N		
0	85	6.98	6.81
	160	7.66	7.22
NOV+FEB	85	7.61	7.79
	160	8.05	7.96
	N TIME	14 MAR	10 APR
E FUNG	SPRING N		
NONE	85	7.29	7.16
	160	7.89	7.38
TFSD	85	7.30	7.44
	160	7.83	7.80
	N TIME	14 MAR	10 APR
L FUNG	SPRING N		
NONE	85	6.87	6.90
	160	7.30	7.33
SPRAYS	85	7.71	7.70
	160	8.42	7.84
WINTR NV	0	20+25	Mean
SOWDATEV			
20 SEPT	6.31	6.29	6.30
17 OCT	6.39	6.66	6.53
Mean	6.35	6.48	6.41
E FUNGV	NONE	TFSD	Mean
SOWDATEV			
20 SEPT	6.19	6.41	6.30
17 OCT	6.41	6.65	6.53
Mean	6.30	6.53	6.41
E FUNGV	NONE	TFSD	Mean
WINTR NV			
0	6.21	6.50	6.35
20+25	6.39	6.57	6.48
Mean	6.30	6.53	6.41
N TIMEV	14 MAR	10 APR	Mean
SOWDATEV			
20 SEPT	6.43	6.18	6.30
17 OCT	6.52	6.54	6.53
Mean	6.47	6.36	6.41

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GRAIN TONNES/HECTARE

***** Tables of means *****

N TIMEV	14 MAR	10 APR	Mean
WINTR NV			
0	6.51	6.20	6.35
20+25	6.44	6.52	6.48
Mean	6.47	6.36	6.41

N TIMEV	14 MAR	10 APR	Mean
E FUNGV			
NONE	6.29	6.31	6.30
TFSD	6.66	6.41	6.53
Mean	6.47	6.36	6.41

N TIMEF	14 MAR	10 APR	Mean
	9.04	8.24	8.64

WINTR NX	45+25		
	8.69		

EXTRA NO	0+0+0		
	4.19		

*** Standard errors of differences of means ***

(not including extra plots)
 Margin of two factor tables 0.052
 Two factor tables 0.074
 Three factor tables 0.105

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
WP	22	0.210	2.8

GRAIN MEAN DM% 86.3

PLOT AREA HARVESTED 0.00245

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STRAW TONNES/HECTARE

***** Tables of means *****

WINTER N	0	NOV+FEB	Mean
PREVCROP			
BARLEY	2.85	3.40	3.13
OATS	3.27	3.94	3.60
Mean	3.06	3.67	3.37
E FUNG	NONE	TFSD	Mean
PREVCROP			
BARLEY	2.95	3.30	3.13
OATS	3.57	3.64	3.60
Mean	3.26	3.47	3.37
E FUNG	NONE	TFSD	Mean
WINTER N			
0	2.98	3.15	3.06
NOV+FEB	3.54	3.80	3.67
Mean	3.26	3.47	3.37
L FUNG	NONE	SPRAYS	Mean
PREVCROP			
BARLEY	2.82	3.43	3.13
OATS	3.33	3.87	3.60
Mean	3.08	3.65	3.37
L FUNG	NONE	SPRAYS	Mean
WINTER N			
0	2.87	3.25	3.06
NOV+FEB	3.28	4.06	3.67
Mean	3.08	3.65	3.37
L FUNG	NONE	SPRAYS	Mean
E FUNG			
NONE	2.96	3.56	3.26
TFSD	3.20	3.74	3.47
Mean	3.08	3.65	3.37
SPRING N	85	160	Mean
PREVCROP			
BARLEY	2.91	3.34	3.13
OATS	3.40	3.81	3.60
Mean	3.16	3.58	3.37

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STRAW TONNES/HECTARE

***** Tables of means *****

SPRING N	85	160	Mean
WINTER N			
0	2.85	3.28	3.06
NOV+FEB	3.47	3.87	3.67
Mean	3.16	3.58	3.37
SPRING N	85	160	Mean
E FUNG			
NONE	3.08	3.44	3.26
TFSD	3.23	3.72	3.47
Mean	3.16	3.58	3.37
SPRING N	85	160	Mean
L FUNG			
NONE	2.93	3.23	3.08
SPRAYS	3.38	3.92	3.65
Mean	3.16	3.58	3.37
N TIME	14 MAR	10 APR	Mean
PREVCROP			
BARLEY	3.39	2.87	3.13
OATS	3.74	3.46	3.60
Mean	3.57	3.17	3.37
N TIME	14 MAR	10 APR	Mean
WINTER N			
0	3.27	2.86	3.06
NOV+FEB	3.87	3.47	3.67
Mean	3.57	3.17	3.37
N TIME	14 MAR	10 APR	Mean
E FUNG			
NONE	3.48	3.04	3.26
TFSD	3.66	3.29	3.47
Mean	3.57	3.17	3.37
N TIME	14 MAR	10 APR	Mean
L FUNG			
NONE	3.20	2.96	3.08
SPRAYS	3.93	3.37	3.65
Mean	3.57	3.17	3.37

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STRAW TONNES/HECTARE

***** Tables of means *****

N TIME	14 MAR	10 APR	Mean
SPRING N			
85	3.31	3.01	3.16
160	3.83	3.32	3.58
Mean	3.57	3.17	3.37
	E FUNG	NONE	TFSD
PREVCROP	WINTER N		
BARLEY	0	2.69	3.02
	NOV+FEB	3.22	3.58
OATS	0	3.27	3.27
	NOV+FEB	3.86	4.01
	L FUNG	NONE	SPRAYS
PREVCROP	WINTER N		
BARLEY	0	2.65	3.05
	NOV+FEB	3.00	3.81
OATS	0	3.10	3.44
	NOV+FEB	3.57	4.30
	L FUNG	NONE	SPRAYS
PREVCROP	E FUNG		
BARLEY	NONE	2.57	3.34
	TFSD	3.08	3.52
OATS	NONE	3.35	3.78
	TFSD	3.32	3.96
	L FUNG	NONE	SPRAYS
WINTER N	E FUNG		
0	NONE	2.86	3.09
	TFSD	2.89	3.40
NOV+FEB	NONE	3.05	4.03
	TFSD	3.51	4.08
	SPRING N	85	160
PREVCROP	WINTER N		
BARLEY	0	2.60	3.10
	NOV+FEB	3.22	3.58
OATS	0	3.09	3.45
	NOV+FEB	3.71	4.16
	SPRING N	85	160
PREVCROP	E FUNG		
BARLEY	NONE	2.63	3.28
	TFSD	3.20	3.41
OATS	NONE	3.54	3.59
	TFSD	3.26	4.02

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STRAW TONNES/HECTARE

***** Tables of means *****

	WINTER N	SPRING N	85	160
	0	E FUNG		
		NONE	2.81	3.14
		TFSD	2.88	3.41
	NOV+FEB	NONE	3.36	3.73
		TFSD	3.58	4.02
	PREVCROP	SPRING N	85	160
	BARLEY	L FUNG		
		NONE	2.69	2.96
		SPRAYS	3.14	3.72
	OATS	NONE	3.18	3.49
		SPRAYS	3.62	4.12
	WINTER N	SPRING N	85	160
	0	L FUNG		
		NONE	2.76	2.99
		SPRAYS	2.93	3.56
	NOV+FEB	NONE	3.11	3.46
		SPRAYS	3.83	4.28
	E FUNG	SPRING N	85	160
	NONE	L FUNG		
		NONE	2.84	3.07
		SPRAYS	3.33	3.80
	TFSD	NONE	3.02	3.38
		SPRAYS	3.44	4.05
	PREVCROP	N TIME	14 MAR	10 APR
	BARLEY	WINTER N		
		0	3.13	2.57
		NOV+FEB	3.64	3.16
	OATS	0	3.40	3.14
		NOV+FEB	4.09	3.79
	PREVCROP	N TIME	14 MAR	10 APR
	BARLEY	E FUNG		
		NONE	3.22	2.69
		TFSD	3.56	3.04
	OATS	NONE	3.73	3.40
		TFSD	3.75	3.53
	WINTER N	N TIME	14 MAR	10 APR
	0	E FUNG		
		NONE	3.17	2.79
		TFSD	3.36	2.93
	NOV+FEB	NONE	3.78	3.30
		TFSD	3.95	3.65

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STRAW TONNES/HECTARE

***** Tables of means *****

	N TIME	14 MAR	10 APR
PREVCROP	L FUNG		
BARLEY	NONE	3.07	2.58
	SPRAYS	3.70	3.16
OATS	NONE	3.33	3.34
	SPRAYS	4.16	3.59
	N TIME	14 MAR	10 APR
WINTER N	L FUNG		
0	NONE	3.02	2.73
	SPRAYS	3.52	2.98
NOV+FEB	NONE	3.38	3.18
	SPRAYS	4.35	3.76
	N TIME	14 MAR	10 APR
E FUNG	L FUNG		
NONE	NONE	3.15	2.77
	SPRAYS	3.80	3.32
TFSD	NONE	3.25	3.15
	SPRAYS	4.06	3.42
	N TIME	14 MAR	10 APR
PREVCROP	SPRING N		
BARLEY	85	3.12	2.71
	160	3.66	3.02
OATS	85	3.50	3.30
	160	3.99	3.63
	N TIME	14 MAR	10 APR
WINTER N	SPRING N		
0	85	2.99	2.70
	160	3.54	3.02
NOV+FEB	85	3.62	3.32
	160	4.12	3.63
	N TIME	14 MAR	10 APR
E FUNG	SPRING N		
NONE	85	3.24	2.93
	160	3.71	3.16
TFSD	85	3.37	3.09
	160	3.94	3.49
	N TIME	14 MAR	10 APR
L FUNG	SPRING N		
NONE	85	3.05	2.82
	160	3.36	3.10
SPRAYS	85	3.57	3.20
	160	4.30	3.55

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STRAW TONNES/HECTARE

***** Tables of means *****

WINTR NV	0	20+25	Mean
SOWDATEV			
20 SEPT	2.87	3.25	3.06
17 OCT	3.37	3.86	3.62
Mean	3.12	3.55	3.34
E FUNGV	NONE	TFSD	Mean
SOWDATEV			
20 SEPT	3.09	3.03	3.06
17 OCT	3.56	3.67	3.62
Mean	3.33	3.35	3.34
E FUNGV	NONE	TFSD	Mean
WINTR NV			
0	3.09	3.15	3.12
20+25	3.56	3.55	3.55
Mean	3.33	3.35	3.34
N TIMEV	14 MAR	10 APR	Mean
SOWDATEV			
20 SEPT	3.41	2.71	3.06
17 OCT	3.71	3.52	3.62
Mean	3.56	3.11	3.34
N TIMEV	14 MAR	10 APR	Mean
WINTR NV			
0	3.44	2.81	3.12
20+25	3.69	3.42	3.55
Mean	3.56	3.11	3.34
N TIMEV	14 MAR	10 APR	Mean
E FUNGV			
NONE	3.58	3.07	3.33
TFSD	3.54	3.16	3.35
Mean	3.56	3.11	3.34
N TIMEF	14 MAR	10 APR	Mean
	4.96	3.94	4.45
WINTR NX	45+25		
	4.30		
EXTRA NO	0+0+0		
	1.25		
STRAW MEAN DM%	94.0		
PLOT AREA HARVESTED	0.00245		