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Yields of the Field Experiments 1995

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Rotations

Rothamsted Research

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95/W/RN/3

LEY/ARABLE

Object: To compare the effects on soil fertility of rotations with or without leys - Woburn, Stackyard D.

Sponsor: P.R. Poulton.

The 58th year, leys, w. beans, w. wheat, w. rye, s. barley.

For previous years see 'Details' 1967 & 1973 and 74-94/W/RN/3.

Design: 5 series of 8 plots, split for treatments other than rotations.

Whole plot dimensions: 8.53 x 40.7.

Treatments: All phases of four five-course rotations were originally present:

ROTATION

LEY	Clover/grass ley:	L, L, L, P, W
CLO	All legume ley:	SA, SA, SA, P, W until 1971 then CL, CL, CL, P, W
A	Arable with roots:	P, R, C, P, W until 1971 then P, B, B, P, W
A H	Arable with hay:	P, R, H, P, W until 1971 then P, B, H, P, W

P = potatoes, R = w. rye, C = carrots, W = w. wheat, B = s. barley,
H = hay, L = clover/grass ley, SA = sainfoin ley, CL = red clover ley

Rotations themselves followed different cycles:

On four plots in each block the rotations were repeated

On four plots in each block arable rotations alternated each five years with ley rotations

From 1976 all the rotations were changed on all phases except for the first and second test crops in 1976:

LN 3	(Previous LEY) LN, LN, LN, W, R
LC 3	(Previous CLO) LC, LC, LC, W, R
AF	(Previous A) F, F, BE, W, R
AB	(Previous A H) B, B, BE, W, R

LN1 to LN3 = three year grass ley with N, 1st year to 3rd year,
LC = clover/grass ley no N, BE = beans (s. oats until 1980), F = fallow

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Plots hitherto in alternating rotations were changed to test eight-year leys:

LLN	LN, LN, LN, LN, LN, LN, LN, LN, W, R
LLC	LC, LC, LC, LC, LC, LC, LC, LC, W, R

LLN1 to LLN8 = eight year grass ley with N, first year to eighth year, similarly for LLC

The new scheme started by sowing these new leys in spring 1976 on four phases and in spring 1977 on the fifth phase (2nd test crop in 1976).

In 1992 w. rye (R) replaced s. barley (B) as the second test crop.

Yields are taken only from the leys and the test crops.

Treatments to first test crop w. wheat, all combinations of:

Whole plots

1. ROTATION Rotations:

LN 8
LN 3
LC 8
LC 3
AF
AB

1/2 plots

2. FYMRES64 Farmyard manure residues, last applied 1964:

NONE	
FYM	38 t on each occasion

1/8 plots

3. N Nitrogen fertilizer (kg N) as 27% N:

0
70
140
210

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Treatments to second test crop w. rye, all combinations of:

Whole plots

1. ROTATION

Rotations:

LN 8
LN 3
LC 8
LC 3
AF
AB

1/2 plots

2. FYMRES63

Farmyard manure residues, last applied 1963:

NONE
FYM

38 t on each occasion

1/8 plots

3. N

Nitrogen fertilizer (kg N) as 27% N:

0
30
60
90

Treatments to leys:

FYM RES

Farmyard manure residues:

NONE
FYM

38 t on each occasion, last applied 1962 to 1st and 6th year leys, 1966 to 2nd and 7th year leys, 1965 to 3rd and 8th year leys, 1964 to 4th year leys, 1963 to 5th year leys

Corrective K dressings (kg K₂O) as muriate of potash, applied to first test crop w. wheat and long-term leys in the wheat block, applied: 5 Oct, 1994:

Continuous rotations

No FYM
half plots

FYM
half plots

LN
LC
AF
AB

0
0
420
420

0
0
420
420

95/W/RN/3

Ex-alternating rotations

LN 8 ploughed for w. wheat	0	0
LN 8 not ploughed	0	0
LC 8 ploughed for w. wheat	0	0
LC 8 not ploughed	0	0

Experimental diary:

Treatment crops:

Grass ley and clover/grass ley, 1st year (**ROTATION** LN1, LC1, LLN1 and LLC1):

- 30-Aug-94 : **T** : Roundup Biactive at 4.0 l in 200 l.
- 05-Sep-94 : **T** : Ploughed.
- 23-Sep-94 : **T** : LN1 and LLN1 only: 27% N at 278 kg, rotary harrowed, 50% Rossa meadow fescue and 50% Erecta Timothy mixture drilled at 30 kg.
- : **T** : LC1 and LLC1 only: 27% N at 185 kg, rotary harrowed, 40% Rossa meadow fescue, 48% Erecta RVP Timothy and 12% Huia white clover mixture drilled at 30 kg.
- 06-Apr-95 : **T** : Rolled.
- 12-Apr-95 : **T** : PK as (0:20:32) at 469 kg.
- : **T** : LN1 and LLN1 only: NK as 25:0:16 at 300 kg.
- : **T** : LC1 and LLC1 only: Muriate of potash at 80 kg.
- 13-Jun-95 : **T** : First cut.
- 15-Jun-95 : **T** : Produce removed.
- 19-Jun-95 : **T** : LN1 and LLN1 only: NK as (25:0:16) at 300 kg.
- : **T** : LC1 and LLC1 only: Muriate of potash at 80 kg.
- 19-Dec-95 : **T** : Second cut.

Grass leys, 2nd to 8th years (**ROTATION** LN2-3, LLN2-8):

- 04-Oct-94 : **T** : LLN5 only: Dolomite at 5.0 t.
- 05-Apr-95 : **T** : Chain harrowed.
- 06-Apr-95 : **T** : Rolled.
- 12-Apr-95 : **T** : PK as (0:20:32) at 469 kg, NK as (25:0:16) at 300 kg.
- 13-Jun-95 : **T** : First cut.
- 15-Jun-95 : **T** : Produce removed.
- 19-Jun-95 : **T** : NK as (25:0:16) at 300 kg.
- 19-Dec-95 : **T** : Second cut.

Clover/grass leys, 2nd to 8th years (**ROTATION** LC2-3 and LLC2-8):

- 04-Oct-94 : **T** : LLC5 only: Dolomite at 5.0 t.
- 05-Apr-95 : **T** : Chain harrowed.
- 06-Apr-95 : **T** : Rolled.
- 12-Apr-95 : **T** : PK as (0:20:32) at 469 kg, muriate of potash at 80 kg.
- 13-Jun-95 : **T** : First cut.
- 15-Jun-95 : **T** : Produce removed.
- 19-Jun-95 : **T** : Muriate of potash at 80 kg.
- 19-Dec-95 : **T** : Second cut.

S. barley, 1st and 2nd treatment crops (**ROTATION** AB):

- 30-Aug-94 : **T** : Roundup Biactive at 4.0 l in 200 l.
- 05-Sep-94 : **T** : 1st treatment crop only: Ploughed.
- 21-Mar-95 : **T** : 2nd treatment crop only: Ploughed.
- 24-Mar-95 : **T** : NPK applied as (20:10:10) at 400 kg. Rotary harrowed, Alexis, dressed Baytan, drilled at 350 seeds per m².
- 02-Jun-95 : **T** : Ally at 30 g with Starane 2 at 0.5 l in 300 l.
- 07-Aug-95 : **T** : Combine harvested.

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Experimental diary:

W. beans, 3rd treatment crop (**ROTATION** AF and AB):

30-Aug-94 : **T** : AB only: Roundup Biactive at 4.0 l in 200 l.

06-Oct-94 : **T** : PK as (0:24:24) at 168 kg. Punch broadcast at 16 seeds per m², ploughed.

02-Jun-95 : **T** : Rovral Flo at 2.0 l in 300 l.

07-Aug-95 : **T** : Combine harvested.

Fallow, 1st and 2nd treatment years (**ROTATION** AF):

30-Aug-94 : **T** : 1st year only: Roundup Biactive at 4.0 l in 200 l.

05-Sep-94 : **T** : 1st year only: Ploughed.

21-Mar-95 : **T** : 2nd year only: Ploughed.

06-Jun-95 : **T** : Rotary cultivated.

19-Jul-95 : **T** : Spiked rotary cultivated.

W. wheat, 1st test crop (W):

26-Sep-94 : **T** : Barclay Gallup at 4.0 l in 200 l.

05-Oct-94 : **T** : Ploughed.

06-Oct-94 : **T** : PK applied as (0:24:24) at 260 kg. Yaltox at 150 kg, rotary harrowed, Mercia, dressed Rappor, drilled at 300 seeds per m², rolled.

28-Nov-94 : **T** : Panther at 2.0 l with Decis at 200 ml in 200 l.

25-Apr-95 : **T** : **N** 70, 140 and 210: Applied as 27% N.

28-Apr-95 : **T** : Halo at 2.0 l in 200 l.

01-Jun-95 : **T** : Cyclone at 1.0 l with Mallard 750EC at 0.3 l in 200 l.

29-Jun-95 : **T** : Pirimicarb 50 DG at 280 g in 300 l.

04-Aug-95 : **T** : Combine harvested.

W. rye, 2nd test crop (R):

30-Aug-94 : **T** : Roundup Biactive at 4.0 l in 200 l.

05-Sep-94 : **T** : Ploughed.

04-Oct-94 : **T** : Dolomite at 5 t.

06-Oct-94 : **T** : PK as (0:24:24) at 260 kg, Yaltox at 150 kg. Rolled, harrowed.

11-Oct-94 : **T** : Rotary harrowed, Amando, dressed Cerevax, drilled at 400 seeds per m².

25-Apr-95 : **T** : **N** 30, 60 and 90: Applied as 27% N.

28-Apr-95 : **T** : Punch C at 0.625 l with Calixin at 0.35 l and Starane 2 at 1.0 l in 200 l.

29-Jun-95 : **T** : Pirimicarb 50 DG at 280 g in 300 l.

07-Aug-95 : **T** : Combine harvested.

NOTE: Samples of grass, clover/grass, wheat and rye grain were taken for chemical analysis.

95/W/RN/3

LEYS

1ST CUT (13/6/95) DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	2.12	2.09	2.11
LC2	5.19	5.50	5.35
LC3	4.40	4.30	4.35
LN1	4.55	4.43	4.49
LN2	5.89	5.74	5.82
LN3	4.01	4.00	4.01
LLC1	1.22	1.47	1.35
LLC2	5.17	5.01	5.09
LLC3	4.30	4.03	4.16
LLC4	3.12	2.82	2.97
LLC5	4.03	3.89	3.96
LLC6	4.90	4.63	4.77
LLC7	4.51	4.72	4.62
LLC8	3.90	4.34	4.12
LLN1	4.14	4.65	4.40
LLN2	6.32	6.30	6.31
LLN3	4.48	4.60	4.54
LLN4	3.69	5.00	4.35
LLN5	4.66	4.26	4.46
LLN6	6.00	5.85	5.92
LLN7	4.14	4.99	4.56
LLN8	5.63	5.63	5.63
Mean	4.38	4.47	4.42

1ST CUT MEAN DM% 23.7

95/W/RN/3

LEYS

2ND CUT (19/12/95) DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	0.37	0.56	0.47
LC2	0.92	1.10	1.01
LC3	0.00	0.00	0.00
LN1	0.67	0.62	0.65
LN2	1.03	1.01	1.02
LN3	0.00	0.00	0.00
LLC1	0.30	0.43	0.36
LLC2	1.15	1.05	1.10
LLC3	0.15	0.62	0.38
LLC4	0.14	0.14	0.14
LLC5	0.60	0.55	0.58
LLC6	0.41	0.85	0.63
LLC7	0.56	0.61	0.59
LLC8	0.00	0.00	0.00
LLN1	0.67	1.04	0.86
LLN2	1.78	2.39	2.08
LLN3	0.41	0.27	0.34
LLN4	0.06	0.08	0.07
LLN5	0.68	0.73	0.70
LLN6	0.79	0.49	0.64
LLN7	0.25	0.25	0.25
LLN8	0.00	0.00	0.00
Mean	0.50	0.58	0.54

2ND CUT MEAN DM% 17.2

95/W/RN/3

LEYS

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	2.50	2.65	2.57
LC2	6.11	6.61	6.36
LC3	4.40	4.30	4.35
LN1	5.22	5.05	5.14
LN2	6.91	6.75	6.83
LN3	4.01	4.00	4.01
LLC1	1.52	1.90	1.71
LLC2	6.32	6.06	6.19
LLC3	4.45	4.65	4.55
LLC4	3.26	2.96	3.11
LLC5	4.63	4.44	4.54
LLC6	5.32	5.48	5.40
LLC7	5.07	5.33	5.20
LLC8	3.90	4.34	4.12
LLN1	4.82	5.69	5.25
LLN2	8.09	8.69	8.39
LLN3	4.89	4.87	4.88
LLN4	3.75	5.08	4.41
LLN5	5.33	4.99	5.16
LLN6	6.79	6.33	6.56
LLN7	4.39	5.24	4.82
LLN8	5.63	5.63	5.63
Mean	4.88	5.05	4.96

TOTAL OF 2 CUTS MEAN DM% 20.4

PLOT AREA HARVESTED 0.00200

95/W/RN/3

W. WHEAT 1ST TEST CROP

GRAIN TONNES/HECTARE

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

FYMRES64	NONE	FYM	Mean
ROTATION			
LN 8	4.66	5.40	5.03
LN 3	4.53	4.65	4.59
LC 8	6.01	5.29	5.65
LC 3	5.46	4.79	5.13
AF	3.73	3.59	3.66
AB	3.91	3.20	3.55
Mean	4.72	4.49	4.60

N	0	70	140	210	Mean
ROTATION					
LN 8	2.52	5.71	5.36	6.53	5.03
LN 3	2.17	5.01	5.39	5.79	4.59
LC 8	3.52	6.60	6.36	6.14	5.65
LC 3	2.57	5.70	6.46	5.78	5.13
AF	1.27	3.82	4.60	4.96	3.66
AB	1.30	4.21	4.35	4.35	3.55
Mean	2.22	5.17	5.42	5.59	4.60

N	0	70	140	210	Mean
FYMRES64					
NONE	2.17	5.24	5.59	5.88	4.72
FYM	2.28	5.11	5.25	5.30	4.49
Mean	2.22	5.17	5.42	5.59	4.60

	N	0	70	140	210
ROTATION	FYMRES64				
LN 8	NONE	1.92	5.61	4.61	6.51
	FYM	3.12	5.81	6.10	6.56
LN 3	NONE	2.02	5.07	5.41	5.63
	FYM	2.32	4.95	5.37	5.94
LC 8	NONE	3.72	7.04	6.61	6.68
	FYM	3.32	6.16	6.11	5.59
LC 3	NONE	2.95	5.89	6.87	6.14
	FYM	2.19	5.51	6.05	5.42
AF	NONE	1.04	3.72	5.33	4.84
	FYM	1.50	3.92	3.86	5.08
AB	NONE	1.38	4.08	4.68	5.49
	FYM	1.22	4.33	4.01	3.22

GRAIN MEAN DM% 90.2

PLOT AREA HARVESTED 0.00183

95/W/RN/3

W. RYE 2ND TEST CROP

GRAIN TONNES/HECTARE

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

FYMRES63	NONE	FYM	Mean
ROTATION			
LN 8	5.35	4.91	5.13
LN 3	5.25	4.75	5.00
LC 8	4.59	4.69	4.64
LC 3	4.50	4.80	4.65
AF	3.15	3.01	3.08
AB	3.09	3.03	3.06
Mean	4.32	4.20	4.26

N	0	30	60	90	Mean
ROTATION					
LN 8	3.24	4.10	5.80	7.37	5.13
LN 3	3.50	4.15	5.68	6.69	5.00
LC 8	3.27	4.20	5.06	6.03	4.64
LC 3	2.99	4.70	5.21	5.71	4.65
AF	1.50	1.99	4.03	4.81	3.08
AB	1.36	2.74	3.57	4.56	3.06
Mean	2.64	3.65	4.89	5.86	4.26

N	0	30	60	90	Mean
FYMRES63					
NONE	2.65	3.62	5.12	5.90	4.32
FYM	2.63	3.67	4.66	5.82	4.20
Mean	2.64	3.65	4.89	5.86	4.26

ROTATION	N	0	30	60	90
	FYMRES63				
LN 8	NONE	3.24	4.43	6.66	7.05
	FYM	3.23	3.76	4.94	7.69
LN 3	NONE	3.35	4.38	6.17	7.12
	FYM	3.65	3.92	5.19	6.26
LC 8	NONE	3.41	3.98	5.06	5.93
	FYM	3.13	4.42	5.06	6.14
LC 3	NONE	2.90	4.26	5.18	5.67
	FYM	3.07	5.14	5.25	5.75
AF	NONE	1.48	2.29	3.67	5.17
	FYM	1.53	1.68	4.39	4.46
AB	NONE	1.53	2.37	3.98	4.47
	FYM	1.19	3.12	3.16	4.65

GRAIN MEAN DM% 88.2

PLOT AREA HARVESTED 0.00183

95/W/RN/12

ORGANIC MANURING

Object: To study, from crop yields and soil analyses, the effects of a range of types of organic matter - Woburn, Stackyard B.

Sponsor: P.R. Poulton.

The 31st year, w. wheat.

For previous years see 'Details' 1973 and 74-94/W/RN/12.

Design: 4 blocks of 8 plots split into 6 sub-plots.

Whole plot dimensions: 8.0 x 30.5.

Treatments: From 1966 to 1971 the experiment had a preliminary period designed to build up organic matter, derived from different sources. An arable rotation was started on two blocks in 1972 and the remaining two blocks in 1973. After a period of testing the residues built up, a further period of accumulation was started; on two blocks (which included ley sown in 1979) in 1981 and on the other two (which included ley sown in 1980) in 1982. A second test phase began when leys on the first pair of blocks were ploughed for the 1st test crop in 1987 and on the second pair for the 1st test crop in 1988.

Whole blocks

1. CROPSEQ

WHEAT 4	4th wheat, after w. wheat 1988, potatoes 1989, w. wheat 1990, w. beans 1991
WHEAT 5	5th wheat, after w. wheat 1987, potatoes 1988, w. wheat 1989, w. beans 1990

Whole plots

2. TREATMNT

Previous treatments:

LC 8 GM	Eight-year clover/grass ley until 1987 (WHEAT 4) or 1986 (WHEAT 5), green manure in the preliminary period
LC 8 PT	As above, peat in the preliminary period
LC 6 LC	Six-year clover/grass ley until 1987 (WHEAT 4) or 1986 (WHEAT 5), clover/grass ley in the preliminary period
LC 6 LN	As above, grass ley with N in the preliminary period
FYM	Farmyard manure annually 1981 to 1986 (WHEAT 4) or 1985 (WHEAT 5) and in the preliminary period
STRAW	Straw in both periods
FERT-FYM	Fertilizers only in both periods, rates of P, K & Mg equivalent to amounts in FYM
FERT-STR	Fertilizers only in both periods, rates of P, K & Mg equivalent to amounts in straw (+P)

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Sub-plots

3. **N** Residual effects of nitrogen fertilizer applied in
 1994 (kg N) as 'Nitro-Chalk':

(0)
(50)
(100)
(150)
(200)
(250)

NOTE: In 1995 nitrogen was applied to all plots at 100 kg N.

Experimental diary:

09-Sep-94 : B : Dolomite at 7.5 t.
26-Sep-94 : B : Barclay Gallup at 4.0 l in 200 l.
03-Oct-94 : B : Ploughed.
07-Oct-94 : B : Rotary harrowed, Mercia, dressed Rappor, drilled at 300
 seeds per m².
28-Nov-94 : B : Panther at 2.0 l with Decis at 0.20 l in 200 l.
21-Apr-95 : B : 34.5% N at 290 kg.
28-Apr-95 : B : Halo at 2.0 l in 200 l.
01-Jun-95 : B : Cyclone at 1.0 l with Mallard at 0.30 l in 200 l.
29-Jun-95 : B : Pirimicarb 50 DG at 280 g in 300 l.
03-Aug-95 : B : Combine harvested.

NOTE: Straw yields were recorded on the **CROPSEQ** WHEAT 5 plots. Grain and straw samples were taken for chemical analysis.

95/W/RN/12

CROPSEQ WHEAT 4

GRAIN TONNES/HECTARE

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

	N	(0)	(50)	(100)	(150)	(200)	(250)	Mean
TREATMNT								
LC 8 GM		4.35	3.98	3.84	2.98	3.63	3.29	3.68
LC 8 PT		5.02	4.15	4.20	4.09	3.93	3.56	4.16
LC 6 LC		5.20	3.73	4.00	4.37	3.71	4.27	4.21
LC 6 LN		4.51	4.85	4.75	4.60	3.83	3.45	4.33
FYM		4.19	3.18	3.46	3.88	3.55	3.13	3.56
STRAW		5.36	5.03	4.82	4.90	4.73	5.15	5.00
FERT-FYM		3.56	2.88	3.24	3.08	3.10	3.29	3.19
FERT-STR		4.89	4.48	3.85	3.49	3.59	3.72	4.00
Mean		4.63	4.04	4.02	3.92	3.76	3.73	4.02

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

TREATMNT	N	TREATMNT
		N
	1.133	0.207
		1.253
Except when comparing means with the same level(s) of		
TREATMNT		0.586

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

Stratum	d.f.	s.e.	cv%
BLOCK.WP	7	1.133	28.2
BLOCK.WP.SP	40	0.586	14.6

GRAIN MEAN DM% 91.6

95/W/RN/12

CROPSEQ WHEAT 5

GRAIN TONNES/HECTARE

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

	N	(0)	(50)	(100)	(150)	(200)	(250)	Mean
TREATMNT								
LC 8 GM		4.76	5.21	4.57	4.29	3.84	3.83	4.41
LC 8 PT		5.52	5.10	4.39	4.54	4.25	4.57	4.73
LC 6 LC		5.09	3.71	4.94	5.24	4.11	4.20	4.55
LC 6 LN		5.43	5.40	5.43	4.32	4.08	4.40	4.84
FYM		5.14	4.51	4.74	3.82	3.86	4.15	4.37
STRAW		3.30	3.19	2.73	2.55	3.09	2.84	2.95
FERT-FYM		4.61	4.01	4.24	3.18	3.65	3.00	3.78
FERT-STR		3.46	3.27	3.14	3.01	3.02	3.00	3.15
Mean		4.66	4.30	4.27	3.87	3.74	3.75	4.10

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

TREATMNT	N	TREATMNT	N
	0.346	0.167	0.553
Except when comparing means with the same level(s) of			
TREATMNT			0.473

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

Stratum	d.f.	s.e.	cv%
BLOCK.WP	7	0.346	8.5
BLOCK.WP.SP	40	0.473	11.5

GRAIN MEAN DM% 91.3

95/W/RN/12

CROPSEQ WHEAT 5

STRAW TONNES/HECTARE

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

	N	(0)	(50)	(100)	(150)	(200)	(250)	Mean
TREATMNT								
LC 8 GM		3.05	3.20	2.95	3.14	2.94	2.82	3.02
LC 8 PT		3.50	2.93	2.57	2.77	2.77	2.91	2.91
LC 6 LC		3.41	2.40	2.95	2.94	2.43	2.68	2.80
LC 6 LN		3.88	3.53	3.47	2.87	3.14	3.26	3.36
FYM		3.06	2.83	3.05	2.66	2.44	2.77	2.80
STRAW		2.41	2.21	2.09	2.24	2.16	2.33	2.24
FERT-FYM		2.80	2.33	2.37	1.78	2.43	1.95	2.28
FERT-STR		2.49	2.19	2.18	1.93	2.04	2.15	2.16
Mean		3.07	2.70	2.70	2.54	2.54	2.61	2.70

STRAW MEAN DM% 93.9

SUB PLOT AREA HARVESTED 0.00202