ROTHAMSTED RESEARCH

Yields of the Field Experiments 2008

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R/BK1 Broadbalk

Rothamsted Research

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BROADBALK

Object: To study the effects of organic manures and inorganic fertilisers on continuous w. wheat and wheat in rotation. From 1968 two three-year rotations were included: potatoes, beans, w. wheat and fallow, w. wheat, w. wheat. In 1979 the first rotation was changed to fallow, potatoes, w. wheat. In 1980 the second rotation reverted to continuous w. wheat. Since 1985 part of the second rotation was added to the first to extend the rotation to fallow, potatoes, w. wheat, w. wheat, w. wheat. In 1996 the fallow was replaced by w. oats and potatoes replaced by maize in 1997.

The 165th year, w. wheat, w. oats and forage maize.

For previous years see 'Details' 1967 and 1973, Station Report for 1966, pp. 229-231; Station Report for 1968, Part 2; Station Report for 1982, Part 2, pp 5-44 and Yield Books for 74-O7R//BK/1.

Areas harvested:

	Section	
Wheat:	0	0.00320
	1	0.00589
	2,4,6 and 7	0.00487 (*see note 4, below)
	8,9	0.00512
Oats:	3	0.00487
Maize:	5	0.00162

Treatments:

In 2001 a number of the treatments were changed. The treatments are now:-

Whole plots

PLOT	Fertilizers and organic manures Treatments Plot	From 2001
01 (FYM)N4	01	N4
21FYMN3	2.1	FYM N2 (1)
22FYM	2.2	FYM
03Nil	03	None
05(P)KMg	05	(P) K Mg
06N1 (P) KMg	06	N1 (P) K Mg
07N2(P)KMg	07	N2 (P) K Mg
08N3(P)KMg	08	N3 (P) K Mg
09N4(P)KMg	09	N4 (P) K Mg
10N4	10	N4
11N4PMg	11	N4 P Mg
12N1+3+1(P)K2Mg2	12	N1+3+1 (P) K2 Mg2 (2)
13N4PK	13	N4 P K
14N4PK*(Mg*)	14	N4 P K* (Mg*)
15N5(P)KMg	15	N5 (P) K Mg
16N6(P)KMg	16	N6 (P) K Mg
17N1+4+1PKMg	17	N1+4+1 P K Mg

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18N1+2+1PKMg	18	N1+2+1 P K Mg
19N1+1+1KMg	19	N1+1+1 K Mg
20N4KMg	20	N4 K Mg

(1) FYM N3 since 2005

(2) N1+3+1 (P) KMg since 2006

W. oats; Nitrogen and farmyard manure were not applied.

N1, N2, N3, N4, N5, N6:	48, 96, 144, 192, 240, 288 kg N as 33.5% N; to be applied at the same time as the second dressings in the split nitrogen plots for wheat and to the seedbed for forage maize.
Split N to wheat	
N1+1+1, 1+2+1 etc:	Rates as above. Timings: first two weeks of March, GS31 or mid-April (whichever comes first) and GS37/mid-May.
Split N to forage maize	
N2+1, 2+2, 2+3,2+4:	Rates as above. Timings: to the seedbed and post-emergence.
P:	35 kg P as triple superphosphate
(P):	(none), to be reviewed in 2010/11.
K:	90 kg K as potassium sulphate.
K2:	180 kg K as potassium sulphate (plus 450 kg K autumn 2000 only)
K*:	90 kg K as potassium chloride
Mg:	12 kg Mg as kieserite.
Mg2:	24 kg Mg as kieserite.(plus 60kg Mg, autumn 2000 only).
(Mg*):	(none), to be reviewed in 2010/11
FYM:	Farmyard manure at 35 t

Previous treatment:-

Whole plots

PLOT			Fertilizers and organic manures:-	
	Plot	Treatments until 1967	Treatments from 1968	Treatments from 1985 – 2000
01DN4PK	01	-	D N2 P K	D N4 P K
21DN2	21	D	D N2	D N2
22D	22	D	D	D
030	03	None	None	None
05F	05	P K Na Mg	P K (Na) Mg	PK Mg
06N1F	06	N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg
07N2F	07	N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg
08N3F	08	N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg
09N4F	09	N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg
10N2	10	N2	N2	N2
11N2P	11	N2 P	N2 P	N2 P
12N2PNA	12	N2 P Na	N2 P Na	N2 P Na
13N2PK	13	N2 P K	N2 P K	N2 P K
14N2PKMG	14	N2 P Mg	N2 P K Mg	N2 P K Mg
15N5F	15	N2 P K Na Mg	N3 P K(Na) Mg	N5 P K Mg
16N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg
17N1+3FH	17	N2 (A)	N2 ½[P K (Na) Mg]	N1+3 ½[P K Mg] (A)+
18N0+3FH	18	P K Na Mg (A)	N2 ½[P K (Na) Mg]	N0+3 ½[P K Mg] (A)+

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19(C)	19	C	C	(C) (since 1989)
20N2KMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg

(A) Alternating each year
+ This change since 1980. Treatments shown are those to w. wheat; autumn N alternates. Maize received N3 ½[PK Mg] on both plots 17 and 18. These treatments shown incorrectly in 1999-2002 Yield books.
W. oats; Nitrogen and dung were not applied.

N1, N2, N3, N4, N5, N6:	48, 96, 144, 192, 240, 288 kg N as sulphate of ammonia until 1967, except N* which was nitrate of soda. All as 'Nitro-Chalk' in spring from 1968 to 1985, as 34.5% N since 1986.
N0+3; N1+3:	None in autumn + 144 kg N in spring; 48 kg N in autumn + 144 kg N in spring.
P:	35 kg P as triple superphosphate in 1974 and since 1988, single superphosphate in other years
K:	90 kg K as sulphate of potash
Na:	55 kg Na as sulphate of soda
(Na):	16 kg Na as sulphate of soda until 1973
Mg:	30kg Mg annually to Plot 14 (applied at 26 kg 1990 to 2000), 35 kg Mg every third year to other plots since 1974 (applied at 30 kg in 1991, 1994, 1997 and 2000 and at 15 kg on half rate treatments). All as kieserite since 1974, previously as sulphate of magnesia annually.
D:	Farmyard manure at 35 t
(C):	Castor meal to supply 96 kg N until 1988, none since
F:	Full rate P K (Na) Mg as above
H:	Half rate of above.

Strips of sub-plots: Until 1967 wheat alone was grown on the experiment, with some bare fallowing. From 1968, the experiment was divided into 10 sections with the following cropping:-

SECTION

Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
1968	W	W	W	W	F	W	W	P	W	BE
1969	W	W	W	W	W	F	W	BE	P	W
1970	W	W	W	W	W	W	F	W	BE	P
1971	W	W	W	W	F	W	W	P	W	BE
1972	W	W	W	F	W	F	W	BE	P	W
1973	W	W	W	W	W	W	F	W	BE	P
1974	W	W	W	W	F	W	W	P	W	BE
1975	W	W	W	W	W	F	W	BE	P	W
1976	W	W	W	W	W	W	F	W	BE	P
1977	W	W	W	W	F	W	W	P	W	BE
1978	W	W	W	W	W	F	W	BE	P	W
1979	W	W	W	W	W	W	F	W	P	F
1980	W	W	W	W	W	W	W	F	W	P
1981	W	W	W	F	W	W	W	P	F	W

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Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
1982	W	W	W	W	W	W	W	W	P	F
1983	W	W	W	W	W	W	W	F	W	P
1984	W	W	W	W	W	W	W	P	F	W
1985	W	W	W	W	W	F	W	W	P	W
1986	W	W	W	W	W	P	F	W	W	W
1987	W	W	W	W	W	W	P	W	W	F
1988	W	W	W	F	W	W	W	F	W	P
1989	W	W	W	W	W	W	W	P	F	W
1990	W	W	W	W	W	F	W	W	P	W
1991	W	W	W	W	W	P	F	W	W	W
1992	W	W	W	W	W	W	P	W	W	F
1993	W	W	W	W	W	W	W	F	W	P
1994	W	W	W	F	W	W	W	P	F	W
1995	W	W	W	W	W	F	W	W	P	W
1996	W	W	W	W	W	P	O	W	W	W
1997	W	W	W	W	W	W	M	W	W	O
1998	W	W	W	W	W	W	W	O	W	M
1999	W	W	W	W	W	W	W	M	O	W
2000	W	W	W	W	W	O	W	W	M	W
2001	W	W	W	F	W	M	O	W	W	W
2002	W	W	W	W	W	W	M	W	W	O
2003	W	W	F	W	W	W	W	O	W	M
2004	W	W	F	W	W	W	W	M	O	W
2005	W	W	W	W	W	O	W	W	M	W
2006	W	W	W	W	W	M	O	W	W	W
2007	W	W	W	W	W	W	M	W	W	O
2008	W	W	W	F	W	W	W	O	W	M

W = w. wheat, O = w. oats (spring oats 2001), P = potatoes, BE = s. beans, F = fallow, M = forage maize

* Straw incorporated since autumn 1986. ** No sprays except weedkillers since 1985.
+ No weedkillers.

NOTES:

(1) For a fuller record of treatments see 'Details' etc.

(2) From autumn 1975 to autumn 1986, chalk was applied at 2.9t each autumn to all plots in sets of Sections on a three-year cycle. Year 1: Sections 1, 2, 3. Year 2: Sections 6, 7, 8, 9. Year 3: Sections 0, 4, 5. From autumn 1988 until autumn 1992 a five-year cycle was used. Year 1: Sections 1, 3. Year 2: Sections 2, 8. Year 3: Sections 7, 9. Year 4: Sections 4, 6. Year 5: Sections 0, 5. None applied since autumn 1991.

(3) In 2003 and 2004 section 0 was used for an experiment (CS/595) investigating different herbicides to control *Equisetum arvense*.

(4) In 2006 part of plots 2.2, 06, 09 and 14 on Section 4 were used for a nutrition trial with the application of urea. 5m was cut off the end of these plots before the yield measurement was taken.

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Experimental Diary:

All sections:			Rate	Unit
13-Sep-07	p	Weedazol-TL sections 0-3, 4-7, 9	20.00	l/200 l/ha
01-Oct-07	f	Muriate of Potash - strip 14	181.00	kg/ha
	f	Triple Superphosphate, strips 11, 13, 14, 17, 18	171.00	kg/ha
10-Oct-07	f	Farmyard manure, Strips 21 & 22, excluding section 7	35.00	t/ha
11-Oct-07	a	Plough / N, completed 12-Oct-2007		
15-Oct-07	a	Cultipressed		
26-Nov-07	a	Erect rabbit fence		
04-Apr-08	f	Sulphate of Potash - strips 5, 6, 7, 8, 9, 12, 13,15,16,17,18,19,20	217.00	kg/ha
	f	Kieserite - strips 5, 6, 7, 8, 9, 11, 12,15,16,17,18,19,20	80.00	kg/ha
12-May-08	a	Mow / Rotavate paths		
02-Jun-08	a	Power Harrowed Fallow discards		
	a	Mow / Rotavate paths		
05-Jun-08	a	Mow / Rotavate paths		
17-Jun-08	a	Mow / Rotavate paths		
25-Jul-08	a	Rogue wild oats/thistles/weeds - 4 wild oats found		
08-Sep-08	p	Weedazol-TL all except sections 3 & 8	20.00	l/290 l/ha

Selected plots:			Rate	unit
05-Oct-07	f	Chalk - Plots 080, 071, 161, 012, 082, 162, 134, 154, 115, 145, 126, 136, 196, 097, 167, 068, 108, 168, 198, 129, 169	2.00	t/ha
05-Oct-07	f	Chalk - Plots 150, 081, 125, 135, 155, 195, 076, 106, 116, 156, 067, 077, 107, 127, 078, 088, 118, 128, 079, 089, 109, 119, 139, 199	4.00	t/ha
05-Oct-07	f	Chalk - Plots 151, 152, 085, 105, 086, 087, 117, 137, 147, 157, 197, 138, 148, 158, 149, 159	6.00	t/ha

Cropped Sections:

Winter Wheat			Rate	unit
29-Aug-07	a	Chop straw , section 0		
15-Oct-07	a	Combination Drilled		
	s	Hereward tr redigo twin + deter	400.00	seeds/m^2
17-Oct-07	p	Decoy Wetex wheat plots	7.00	kg/ha
31-Oct-07	p	Liberator wheat sections	0.60	l/200 l/ha
	p	Alpha Trifluralin 48 EC, wheat sections	2.00	l/200 l/ha
16-Nov-07	p	Huron, wheat and oat plots	5.00	kg/ha
17-Nov-07	p	Stomp 400 SC wheat plots	3.30	l/200 l/ha
	p	Arelon 500 wheat plots	2.00	l/200 l/ha
	p	Hallmark with Zeon Technology wheat plots	50.00	ml/200 l/ha
18-Mar-08	f	Nitraprill Wheat strips 12, 17, 18, 19	139.00	kg/ha
17-Apr-08	f	Nitraprill - Wheat, strips 6,19	139.00	kg/ha
	f	Nitraprill - Wheat, strips 7, 18	278.00	kg/ha
	f	Nitraprill - Wheat, strips 2.1, 8, 12	417.00	kg/ha
	f	Nitraprill - Wheat, strips 1,9,10,11,13,14,20	556.00	kg/ha
	f	Nitraprill - Wheat, strip 15	696.00	kg/ha

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			Rate	Unit
17-Apr-08	f	Nitraprill - Wheat, strip 16	835.00	kg/ha
08-May-08	p	Deuce wheat excluding section 6	1.00	l/150 l/ha
	p	Bravo 500 wheat excluding section 6	0.75	l/150 l/ha
	p	Flexity wheat excluding section 6	0.20	l/150 l/ha
	p	BASF 3C Chlormequat 720 - wheat excluding section 6	1.00	l/150 l/ha
15-May-08	f	Nitraprill - Wheat, strips 12, 17, 18, 19	139.00	kg/ha
21-May-08	p	Ally Max SX Wheat	42.00	g/200 l/ha
	p	Starane 2 wheat	0.75	l/200 l/ha
05-Jun-08	p	Amistar Opti Wheat excluding section 6	1.25	l/200 l/ha
	p	Opus Wheat excluding section 6	1.00	Q
23-Jun-08	p	Amistar - Wheat excluding section 6	0.50	l/200 l/ha
	p	Icon - wheat excluding section 6	0.50	l/200 l/ha
25-Aug-08	a	Combine harvest discards		
	a	Swath straw		
	a	Baled		
26-Aug-08	a	Combine harvest, plots for yield		
	a	Swath straw		
27-Aug-08	a	Sample, bale and weigh straw sections 1 and 3		
29-Aug-08	a	Combine harvest discards		
	a	Swath straw		
30-Aug-08	a	Baled		

W.Oats

			Rate	unit
19-Oct-07	a	Combination Drilled		
	s	Gerald tr sibutol secur	400.00	seeds/m^2
24-Oct-07	a	Rolled oat section		
16-Nov-07	p	Huron, wheat and oat plots	5.00	kg/ha
14-Dec-07	p	Lexus Class oats	60.00	g/200 l/ha
	p	Hallmark with Zeon Technology oats	50.00	ml/200 l/ha
21-May-08	p	Ally Max SX Oats	42.00	g/200 l/ha
	p	Duplosan KV oats	1.50	l/200 l/ha
14-Jun-08	p	Flexity Oats section 7	0.20	l/200 l/ha
16-Aug-08	a	Combine harvest, plots for yield - Oats		
	a	Swath straw - Oats		
	a	Combine harvest discards - Oats		
	a	Sample, bale and weigh straw - Oats		

Forage Maize

			Rate	Unit
15-Apr-08	p	Azural - maize plots	4.00	
08-May-08	f	Nitraprill maize, strip 6	139.00	kg/ha
	f	Nitraprill maize, strips 7,12,17,18,19	278.00	kg/ha
08-May-08	f	Nitraprill maize, strips 21,8	417.00	kg/ha
	f	Nitraprill maize, strips 1, 9,10,11,13,14	556.00	kg/ha
	f	Nitraprill maize, strip 15	696.00	kg/ha
	f	Nitraprill maize, strip 16	835.00	kg/ha
12-May-08	a	Flexitined maize and fallow sections		

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			Rate	unit
12-May-08	a	Power harrowed Maize		
	a	Nodet drilled maize		
	s	Hudson tr measurol	10.20	seeds/m2
13-May-08	a	Rolled Maize		
06-Jun-08	f	Nitraprill Maize plot 192	139.00	kg/ha
	f	Nitraprill Maize plot 182	278.00	kg/ha
	f	Nitraprill Maize plot 122	417.00	kg/ha
	f	Nitraprill Maize plot 172	556.00	kg/ha
24-Jun-08	p	Samson - maize	1.50	l/200 l/ha
29-Jun-08	p	Callisto - maize	1.00	l/200 l/ha
23-Sep-08	a	Cut harvest strips, weighed and sampled - Maize plots		
	a	Forage harvest maize discards		

Fallow: Section 8

22-Apr-08	a	Flexitined section 8
02-Jun-08	a	Plough, /S Section 8
14-Jul-08	a	Flexitined - Section 8, and fallow discards
16-Jul-08	a	Flexitined - Section 8, and fallow discards
21-Jul-08	a	Power harrowed - Section 8, and fallow discards
03-Sep-08	a	Plough section 8, /N

Wilderness

28-May-08	a	Topped wilderness, middle section
19-Jun-08	a	Topped wilderness, middle section
01-Aug-08	a	Topped wilderness, middle section
30-Sep-08	a	Topped wilderness, middle section

NOTE: Samples of wheat and oat grain and straw and forage maize were taken for chemical analysis. Unground wheat grain and straw from Section 1 and maize samples from Section 4 were archived

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WHEAT

GRAIN TONNES/HECTARE

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

SECTION PLOT	3/W1	5/W2	4/W3	6/W31	0/W4	1/W42	9/W50	Mean
01(FYM)N4	11.04	9.79	9.90	8.17	*	*	*	9.72
21FYMN3	10.64	9.32	9.11	8.27	7.13	7.50	8.34	8.61
22FYM	6.94	4.85	4.90	5.93	5.45	5.02	5.69	5.54
03Nil	1.49	1.53	1.27	1.38	0.98	0.03	0.32	1.00
05(P)KMg	1.48	1.27	1.33	1.49	0.85	0.68	0.76	1.12
06N1(P)KMg	4.56	4.15	4.23	3.83	3.91	3.74	4.24	4.09
07N2(P)KMg	7.28	5.50	6.02	6.12	5.58	5.88	6.05	6.06
08N3(P)KMg	8.60	4.71	7.39	6.26	6.52	6.45	7.43	6.77
09N4(P)KMg	10.30	8.34	8.71	8.10	7.59	7.73	8.01	8.40
10N4	6.73	4.31	3.27	3.41	2.13	2.66	1.85	3.48
11N4PMg	4.60	5.72	4.47	4.40	4.99	3.39	3.87	4.49
12N1+3+1(P)K2Mg2	10.89	7.77	8.91	7.43	7.92	8.41	8.34	8.52
13N4PK	9.26	7.33	7.63	7.33	7.18	7.62	7.79	7.73
14N4PK*(Mg*)	9.03	6.91	7.23	7.02	7.84	7.74	7.06	7.55
15N5(P)KMg	10.99	7.10	8.06	7.35	8.15	7.65	8.33	8.23
16N6(P)KMg	10.66	9.32	9.14	7.25	7.89	8.29	8.34	8.70
17N1+4+1PKMg	10.81	9.54	9.13	7.34	7.76	7.87	7.35	8.54
18N1+2+1PKMg	10.23	9.32	9.04	7.54	7.49	7.06	4.58	7.89
19N1+1+1KMg	8.09	5.76	6.20	5.47	5.88	6.50	2.23	5.73
20N4KMg	*	*	*	*	1.87	0.82	*	1.35

GRAIN MEAN DM% 83.5

STRAW TONNES/HECTARE

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

SECTION PLOT	3/W1	5/W2	4/W3	6/W31	0/W4	1/W42	9/W50	Mean
01(FYM)N4	6.16	*	*	*	*	*	*	6.16
21FYMN3	7.11	*	*	*	*	4.12	*	5.62
22FYM	2.74	*	*	*	*	2.19	*	2.47
03Nil	0.24	*	*	*	*	0.01	*	0.12
05(P)KMg	0.38	*	*	*	*	0.07	*	0.23
06N1(P)KMg	2.02	*	*	*	*	1.63	*	1.82
07N2(P)KMg	3.21	*	*	*	*	2.49	*	2.85
08N3(P)KMg	3.75	*	*	*	*	2.81	*	3.28
09N4(P)KMg	5.20	*	*	*	*	3.88	*	4.54
10N4	2.64	*	*	*	*	1.20	*	1.92
11N4PMg	1.97	*	*	*	*	1.14	*	1.55
12N1+3+1(P)K2Mg2	5.41	*	*	*	*	4.08	*	4.75
13N4PK	4.76	*	*	*	*	3.55	*	4.16
14N4PK*(Mg*)	4.37	*	*	*	*	3.16	*	3.77
15N5(P)KMg	5.95	*	*	*	*	3.83	*	4.89
16N6(P)KMg	6.02	*	*	*	*	4.13	*	5.08
17N1+4+1PKMg	6.45	*	*	*	*	3.83	*	5.14
18N1+2+1PKMg	5.56	*	*	*	*	4.07	*	4.82
19N1+1+1KMg	3.96	*	*	*	*	2.74	*	3.35
20N4KMg	*	*	*	*	*	0.37	*	0.37

STRAW MEAN DM% 84.1

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W. OATS

TONNES/HECTARE

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

PLOT	GRAIN	STRAW
1(FYM)[N4]	5.07	1.60
21[FYMN2]	7.45	2.87
22[FYM]	4.80	2.79
03Nil	1.87	0.36
05(P)KMg	2.43	0.42
06[N1](P)KMg	2.03	0.41
08[N2](P)KMg	2.49	0.46
08[N3](P)KMg	2.80	0.53
09[N4](P)KMg	3.25	0.76
10[N4]	4.52	1.19
11[N4]PMg	3.39	1.27
12[N1+3+1](P)K2Mg2	2.91	0.68
13[N4]PK	2.85	0.55
14[N4]PK*(Mg*)	1.82	0.29
15[N5](P)KMg	3.13	0.73
16[N6](P)KMg	4.91	1.58
17[N1+4+1]PKMg	5.33	1.91
18[N1+2+1]PKMg	3.00	0.70
19[N1+1+1]KMg	1.50	0.17
MEAN DM%	83.7	66.5

FORAGE MAIZE

WHOLE CROP (100% DM) TONNES/HECTARE

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

PLOT	Whole Crop
01(FYM)N4	13.60
21FYMN3	16.56
22FYM	11.71
03Nil	3.03
05(P)KMg	3.98
06N1(P)KMg	6.10
07N2(P)KMg	8.93
08N3(P)KMg	9.28
09N4(P)KMg	9.99
10N4	2.31
11N4PMg	5.64
12N2+3(P)K2Mg2	10.07
13N4PK	8.87
14N4PK*(Mg*)	9.66
15N5(P)KMg	9.84
16N6(P)KMg	9.57
17N2+4PKMg	9.05
18N2+2PKMg	9.50
19N2+1KMg	5.86
MEAN	8.61
MEAN DM%	24.9

PLOT AREA HARVESTED 0.00162

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