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WHEAT

Effects of fallow and of one-year leys of clover, ryegrass and clover and ryegrass, cut once and followed by summer fallow or by green manure crops of mustard or vetches, or cut twice. Effects of sulphate of ammonia applied to leys and to wheat.

RW—FOSTERS, 1938

W ↑	C1 (L) CVN (R) R2 (L) CMN (L) F2N (R) R1 (R) CR2N (R) RVN (R) C2 (L) F1N (R) CR1N (R) RMN (R) CRV (R) CRM (R) FM (L) FV (L)	CM (R) C1N (R) FVN (L) R1N (R) RV (L) R2N (R) CV (R) CR9 (R) F2 (L) CR1 (R) RM (L) CRMN (R) CRVN (L) C2N (R) F1 (R) FMN (L)
	F1 (L) FMN (R) RVN (L) C2N (L) FV (L) RM (L) F2N (R) R2 (L) C1 (R) CRM (L) CR1N (R) CRVN (R) CMN (R) CV (L) CR2 (L) R1N (L)	CR2N (L) CM (L) C2 (R) F2 (L) R2N (L) CRV (R) F1N (L) CR1 (L) FM (R) RV (L) RMN (L) FVN (L) CVN (R) C1N (L) CRMN (R) R1 (L)

Note.—The plots were split for sulphate of ammonia applied to the wheat as a top dressing. (L) the left half of the plot received this dressing and (R) the right half received the dressing.

SYSTEM OF REPLICATION : 4 randomized blocks of 16 plots each, the plots being split for sulphate of ammonia at the rate of 0.3 cwt. N per acre applied as a top dressing to the wheat.

AREA OF EACH SUB-PLOT : 1/80 acre (68.7 lks. × 18.2 lks.).

TREATMENTS : 4 × 4 × 2 × 2 factorial design.

Fallow (F), clover (C), clover and ryegrass mixture (CR), ryegrass (R).

Vetches sown after first cut (V), mustard sown after first cut (M), summer fallow after first cut (1), two cuts taken (2).

Sulphate of ammonia : None, 0.3 cwt. N per acre applied to the leys (N).

Sulphate of ammonia applied as top dressing to wheat : None, 0.3 cwt. N per acre (see note below plan).

BASAL MANURING : Nil.

CULTIVATIONS, ETC. : 1936. Leys sown under barley.

Ploughed : March 16 and 17. Harrowed : March 31 and May 7. Rolled : May 4 and 7.

Barley sown : March 31. Variety : Plumage Archer. Seeds sown : May 5 and 6. Varieties :

Montgomery Red Clover and Italian Ryegrass. Barley harvested : August 31.

1937-8.

Ploughed fallow plots : Jan. 4-7. Applied sulphate of ammonia to ley plots : April 13.

Rolled ley plots : April 26. Harrowed fallow plots : April 28. Cultivated fallow plots :

June 10. Cut ley plots : June 15. Ploughed all plots except second cut leys : June 29-

July 2. Harrowed July 6, 8, 9, 12 and 13. Rolled : July 6, 9, 12, 13 and 14. Vetches

sown : July 12. Mustard sown : July 13. Thistles cut on all plots excepting second cut

plots : August 6. Cut second crop : Sept. 2. Ploughed all plots : Sept. 15-28. Har-

rowed : Oct. 21, Nov. 3 and March 17. Rolled : Oct. 21 and March 21. Wheat sown :

Nov. 3. Variety : Victor. Applied top dressing of sulphate of ammonia : March 15.

Hand hoed : May 12. Harvested : August 12 and 13.

SPECIAL NOTE : Barley 1936; the yield of grain was estimated from the weight of the total produce per plot by means of random sampling from the stooks to determine the grain-straw ratio. The samples suffered from attacks by mice before threshing. Standard error per plot : Grain : 3.85 cwt. per acre or 15.3%.

STANDARD ERRORS : Grain : per plot : 1.81 cwt. per acre or 5.94% ; per sub-plot : 1.96 cwt. per acre or 6.31%.

Barley, 1936
Grain : cwt. per acre (±0.962)

None	Clover	Ley undersown Clover and Ryegrass	Ryegrass	Mean
24.8	26.6	23.7	25.2	25.1

Effect of Nitrogen on Leys, 1937
Dry Matter : cwt. per acre

Nitrogen to leys	Clover	Clover and Ryegrass		Ryegrass
		First Cut	Second Cut	
None	30.1	44.6		27.6
0.3 cwt. N per acre	30.7	48.4		42.0
<i>Increase</i>	+0.6	+3.8		+14.4
<i>Mean</i>	18.1	13.6		4.2

Green manure crops : Nitrogen buried lb. per acre

	Fallow	Clover	Clover and Ryegrass	Ryegrass	Mean
Mustard	101.4	70.9	31.9	14.0	54.5
Vetches	110.6	57.4	31.9	48.6	62.1

Effects of Leys and nitrogen applied to wheat

Nitrogen to wheat	Fallow	Clover	Clover and Ryegrass	Ryegrass	Mean	Standard Errors
Grain : cwt. per acre ($\pm 0.640^*$, $\pm 0.490^\dagger$)						
None	35.8	33.8	27.7	24.9	30.5	
0.3 cwt. N per acre ..	36.8	33.5	28.7	27.4	31.6	
Mean	36.3	33.6	28.2	26.2	31.0	± 0.453
Increase		-2.7	-8.1	-10.1		
Difference	+1.0	-0.3	+1.0	+2.5	+1.1	± 0.693
Increase		-1.3	0.0	+1.5		
Straw : cwt. per acre						
None	40.4	38.2	30.1	25.8	33.6	
0.3 cwt. N per acre ..	42.2	39.2	32.5	29.8	35.9	
Mean	41.3	38.7	31.3	27.8	34.8	
Increase		-2.6	-10.0	-13.5		
Difference	+1.8	+1.0	+2.4	+4.0	+2.3	
Increase		-0.8	+0.6	+2.2		

* For comparisons involving the averages of the two levels of sulphate of ammonia.
 † For comparisons involving the differences of the two levels of sulphate of ammonia.

Effect of green manures and of nitrogen to leys

	Nitrogen to Leys cwt. N per acre	1 cut		2 cuts		Mustard	Vetches
GRAIN : cwt. per acre (± 1.28 , Means : ± 0.905)							
Fallow	0		36.1 ¹		34.6		36.4
	0.3		37.8 ¹		34.6		37.2
	Mean		37.0 ²		34.6		36.8
Clover	0		36.0		30.8		34.8
	0.3		34.4		33.0		32.4
	Mean		35.2		31.9		33.6
Clover and Ryegrass ..	0		29.4		31.2		26.0
	0.3		28.9		27.6		26.9
	Mean		29.2		29.4		27.5
Ryegrass	0		29.6		21.8		27.8
	0.3		33.6		22.0		23.6
	Mean		31.6		21.9		27.8
STRAW : cwt. per acre							
Fallow	0		41.3		37.4		41.2
	0.3		44.2		37.4		43.7
	Mean		42.8		37.4		42.4
Clover	0		41.6		35.0		40.9
	0.3		41.5		37.0		38.8
	Mean		41.6		36.0		40.2
Clover and Ryegrass ..	0		32.6		34.1		28.8
	0.3		32.1		29.0		29.7
	Mean		32.4		31.6		29.2
Ryegrass	0		32.2		21.8		31.0
	0.3		37.6		21.8		25.4
	Mean		34.9		21.8		30.7

Standard Errors : (1) ± 0.905 , (2) ± 0.640 .

Conclusions

There were no significant effects of the leys sown under barley on the yields of barley grain.

Sulphate of ammonia applied to the leys had no appreciable effect on the yields of clover, but increased the dry matter in the first cut of the clover-ryegrass mixture by 3.8 cwt. per acre and the dry matter in the first cut of ryegrass by 14.4 cwt. per acre.

The amount of nitrogen in the green manure crops ploughed under was greatest after fallow and considerably greater after clover than after the other leys.

All three leys produced significant reductions as compared with fallow in the yield of wheat grain, the average reduction being 2.7 cwt. per acre after clover, 8.1 cwt. per acre after clover-ryegrass mixture and 10.1 cwt. per acre after ryegrass. For clover and for ryegrass, the decreases in yield were significantly greater with two cuts of the ley than with a single cut followed by a summer fallow, but for the clover-ryegrass mixture the decreases were about the same.

The growing of a green manure crop of mustard or vetches also reduced the yield of wheat grain significantly as compared with a summer fallow. The average reduction was 3.7 cwt. per acre with mustard and 1.8 cwt. per acre with vetches, the difference between the two green manures being significant.

The residual effects of the nitrogen applied to the leys were not significant. Sulphate of ammonia applied to the wheat produced a significant increase of 1.1 cwt. per acre. The increases did not differ significantly according to the previous treatment, but it may be noted that there was no increase after clover.

CLOVER

Second year residual effect of dung, straw and sulphate of ammonia applied to the potato crop of 1936

RC—Great Harpenden, 1938

Plan and yields of hay in lb.

1 W ↑ 41	St N	DL	St	DL St	DE	DE St	DE N	DL St	8
	97	108	106	81	96	80	64	83	
	N	DE St N	DL St N	DE	Nil	DL	St	DE St N	
	88	110	116	91	69	82	57	63	
	Nil	DL N	DE St	DE N	DL N	St N	DL St N	N	
	91	111	118	95	74	68	76	37	
Nil	DE St N	St	N	DE	St N	St	DE N		
80	102	104	76	74	54	59	78		
St N	DE N	DL St N	DL St	DL St N	DL	DL St	DL N		
74	107	110	81	67	58	59	74		
DE St	DE	DL	DL N	DE St	DE St N	N	Nil		
108	100	108	88	86	55	42	64	48	

SYSTEM OF REPLICATION : 4 randomized blocks of 12 plots each.

AREA OF EACH PLOT : 1/40 acre (45.5 lks. x 54.9 lks.).

TREATMENTS: Applied to potatoes in 1936 (see 1936 Report, p. 213): 3 x 2 x 2 factorial design.

Dung : None, 15 tons per acre ploughed in in December (DE), or an equivalent amount stored and applied in the bouts (DL).

Straw : None, 40 cwt. per acre (chaffed) (St), ploughed in in December, except when applied with DL, for which straw and dung were mixed and stored.

Sulphate of ammonia : None, 0.4 cwt. N per acre applied in the bouts (N).

BASAL MANURING : 0.5 cwt. P₂O₅ per acre as superphosphate, and 1 cwt. K₂O per acre as sulphate of potash applied in the bouts (applied in 1936); 0.2 cwt. N as sulphate of ammonia (applied in 1937).

CULTIVATIONS, ETC. : Clover undersown in oats and harrowed in : May 19, 1937. Variety : Montgomery Red. Previous crops : Oats (see 1937 Report, p. 153), and Potatoes (see 1936 Report, p. 213).

STANDARD ERROR PER PLOT : 3.62 cwt. per acre or 12.2%.

Summary of Results : Yields of separate treatments

		HAY : cwt. per acre (± 1.81)		
		No dung	Dung	
			Ploughed in	In the bouts
No sulph. amm.	No straw	27.1	32.2	31.8
	Straw	29.1	35.0	27.1
Sulph. amm.	No straw	21.7	30.7	31.0
	Straw	26.2	29.5	33.0
<i>Mean</i>		26.0	31.8	30.7

Conclusions

Dung applied to potatoes in 1936 resulted in a significant increase in the yield of clover hay of 5.3 cwt. per acre. There were no other significant effects.

SPRING OATS

Residual effect of dung, straw, sulphate of ammonia, superphosphate and sulphate of potash applied to preceding potato crop

RO—Gt. Knott, 1938

Plan and yields in lb., grain above, straw below

1	DE _{N₁} P	DE St	N ₂ St	N ₂ St P	NIL	DE _{N₂} St K	6
	83.8	97.4	94.1	85.3	80.5	100.6	
	67.2	62.6	60.9	55.7	57.5	69.4	
	P	St K	DE _{N₂}	St PK	DL _{N₁} St P	DL _{N₂}	
	83.4	83.0	99.2	81.8	95.4	99.5	
	60.6	57.0	65.8	53.2	68.6	62.5	
	N ₁	DL _{N₂} St K	DE _{N₁} St K	DE _{N₁}	N ₁ St K	DL P	
	81.2	102.3	97.1	92.9	79.6	90.6	
	50.8	62.7	63.9	61.1	54.4	62.4	
	DL	DL St PK	N ₂ PK	N ₂ K	DE St P	N ₁ P	
	80.8	95.7	95.7	89.4	99.9	92.2	
	61.2	73.3	62.3	72.6	64.1	62.8	
	DL _{N₁} St	DE PK	DL _{N₁} PK	DE _{N₂} P	DL St K	DL _{N₂} St PK	
	91.3	86.4	94.3	106.6	103.0	105.8	
	72.7	63.6	71.7	74.4	74.0	71.2	
NW	DL _{N₂} P	N ₁ St PK	DE _{N₂} St PK	DE _{N₁} St PK	DE K	DL _{N₁} K	
↑	80.0	89.1	94.0	92.3	96.4	103.7	
	83.0	65.9	68.0	68.7	70.6	63.3	
	DE _{N₁} K	N ₁ St	DL PK	DE _{N₂} K	St	DE P	
	95.4	96.9	102.3	105.6	91.2	101.0	
	74.6	64.1	68.7	78.4	61.8	69.0	
	N ₂ St PK	DL _{N₂} St P	DL _{N₁}	DL St P	DE _{N₂} St P	DE St K	
	100.4	104.6	101.4	95.0	111.9	101.0	
	66.6	76.4	67.6	65.0	79.1	69.0	
	DL _{N₁} St PK	N ₁ PK	K	DE _{N₁} St	N ₁ St P	DL _{N₂} St	
	90.9	93.3	89.5	98.0	95.4	99.1	
	66.1	62.7	55.5	67.0	63.6	64.9	
	DE	St P	DE _{N₂} St	DE _{N₁} PK	DL _{N₁} P	N ₂ St K	
	86.9	73.7	95.8	99.6	110.2	92.2	
	58.1	48.3	65.2	73.4	65.8	62.8	
	DE _{N₂} PK	DE _{N₁} St P	DE St PK	DL _{N₂} PK	DL _{N₁} St K	PK	
	101.6	94.2	96.0	103.8	106.3	87.7	
	71.4	68.8	63.0	71.2	65.7	58.3	
	DL _{N₂} K	DL St	N ₂	DL K	N ₁ K	N ₂ P	
	86.8	80.4	83.3	91.2	82.9	83.1	
67	56.2	51.6	51.7	56.8	49.1	46.9	72

SYSTEM OF REPLICATION : 4 randomized blocks of 18 plots each. Certain interactions confounded with block differences.

AREA OF EACH PLOT : 1/40 acre.

TREATMENTS : Applied to potatoes in 1937 (see 1937 Report, p. 155) : 3 × 3 × 2³ factorial design.

Dung : None, 15 tons per acre ploughed in in January (DE), or an equivalent amount stored and applied in the bouts (DL).

Straw : None, 40 cwt. per acre (chaffed) (St), ploughed in in January, except when applied with DL, for which straw and dung were mixed and stored.

Sulphate of ammonia : None, 0.4 (N₁), 0.8 (N₂) cwt. N per acre.

Superphosphate : None, 0.8 cwt. P₂O₅ per acre (P).

Sulphate of potash : None, 1.6 cwt. K₂O per acre (K).

BASAL MANURING : None in 1937. Sulphate of ammonia : 1 cwt. per acre in 1938.

CULTIVATIONS, ETC. : Ploughed during January. Cultivated : Feb. 5. Seed sown : March 1.

Sulphate of ammonia applied : March 4. Harrowed : March 1, 11. Rolled : March 14.

Clover under-sown : June 7. Covered in with horse rake. Harvested : Aug. 3. Variety :

Marvellous. Previous crop : Potatoes.

SPECIAL NOTE : Three random samples per plot were taken from the sheaves to determine the grain-straw ratio.

STANDARD ERROR PER PLOT : Grain : 2.33 cwt. per acre or 6.94%.

K

Summary of residual effects of nitrogenous fertilizers

Sulph. amm. (cwt. N)	No straw			Straw		
	No Dung	Dung Ploughed in	Dung In the bouts	No Dung	Dung Ploughed in	Dung In the bouts
	GRAIN : cwt. per acre (± 1.16)					
0.0	30.5	33.1	32.6	29.4	35.2	33.4
0.4	31.2	33.2	36.6	32.2	34.1	34.3
0.8	31.4	36.9	33.0	33.2	35.9	36.8
	STRAW : cwt. per acre					
0.0	20.7	23.3	22.2	19.7	23.1	23.6
0.4	20.1	24.7	24.0	22.1	24.0	24.4
0.8	20.8	25.9	24.4	22.0	25.2	24.6

Main effects : Interactions of Dung

Dung	Sulph. amm. (cwt. N)			Straw (cwt.)		Super. (cwt. P ₂ O ₅)		Sulph. pot. (cwt. K ₂ O)		Mean	Increase
	0.0	0.4	0.8	0	40	0.0	0.8	0.0	1.6		
	GRAIN : cwt. per acre										
None ..	29.9 ¹	31.7	32.3	31.0 ²	31.6	31.1 ²	31.6	31.0 ²	31.7	31.3	
Ploughed in	34.2	33.6	36.4	34.4	35.1	34.7	34.7	34.8	34.7	34.7	+ 3.4 ²
In the bouts	33.0	35.4	34.9	34.1	34.8	34.1	34.8	33.6	35.3	34.4	+ 3.1 ²
Mean ..	32.4	33.6	34.5	33.2	33.8	33.3	33.7	33.1	33.9	33.5	
Increase ..	+ 1.2 ²	+ 0.9 ²		+ 0.6 ³		+ 0.4 ³		+ 0.8 ³			
	STRAW : cwt. per acre										
None ..	20.2	21.2	21.4	20.6	21.3	20.7	21.0	20.3	21.4	20.9	
Ploughed in	23.2	24.3	25.5	24.6	24.0	24.0	24.8	23.8	24.8	24.3	+ 3.4
In the bouts	22.9	24.2	24.5	23.5	24.2	22.6	25.1	23.8	23.8	23.8	+ 2.9
Mean ..	22.1	23.2	23.8	22.9	23.2	22.4	23.6	22.6	23.3	23.0	
Increase ..	+ 1.1	+ 0.6		+ 0.3		+ 1.2		+ 0.7			

St. errors : (1) ± 0.824 , (2) ± 0.673 , (3) ± 0.549 .

Interactions of Sulphate of ammonia with Straw and Minerals

Sulph. amm. (cwt. N)	Straw (cwt.)		Super. (cwt. P ₂ O ₅)		Sulph. pot. (cwt. K ₂ O)	
	0	40	0.0	0.8	0.0	1.6
	GRAIN : cwt. per acre (± 0.673)					
0.0	32.0	32.7	32.2	32.5	31.6	33.2
0.4	33.7	33.5	33.5	33.7	33.7	33.5
0.8	33.8	35.3	34.2	34.9	34.0	35.1
	STRAW cwt. per acre					
0.0	22.1	22.1	21.9	22.3	21.5	22.7
0.4	22.9	23.5	22.4	24.0	23.2	23.2
0.8	23.7	23.9	23.0	24.6	23.4	24.2

Conclusions

The residual effect of dung was significant, with an increase in yield of just over 3 cwt. per acre of grain, there being no difference due to the manner in which the dung was applied in the previous year.

The residual effect of the double dressing of sulphate of ammonia produced a significant increase of 2.1 cwt. of grain per acre. The residual effects of the minerals and straw were small and not significant.

SUGAR BEET

Effect of agricultural salt, superphosphate and muriate of potash, ploughed in in January, broadcast in February, broadcast in March, broadcast at sowing, and of dung

RS—Pastures, 1938

Plan and yields in lb.

Roots (dirty), tops, sugar percentage and plant number in descending order

1	NA DM ₁	NA PM ₂	KP M ₃	NA PM ₄	PM ₂	DM ₃	DM ₁	NA KPM ₁	8
	584	526	512	564	483	446	452	418	
	805	658	820	887	726	671	672	645	
	16.44	16.07	16.04	15.61	15.66	15.58	15.69	15.61	
	572	557	545	494	508	532	510	526	
	KP M ₁	NAKPDM ₁	NA DM ₃	M ₁	PM ₄	KPDM ₁	NA KDM ₂	NAKPM ₃	
	476	589	603	452	448	514	430	474	
	670	723	835	747	728	676	620	696	
	16.30	16.24	15.75	14.82	15.61	15.61	15.29	15.64	
	605	563	559	537	553	572	536	544	
	NA KM ₂	KDM ₄	KDM ₂	PDM ₄	NA M ₁	NA PDM ₂	NA KDM ₄	KPDM ₃	
	529	484	560	527	466	570	486	448	
	581	654	898	856	704	688	682	678	
	16.07	15.98	15.92	15.43	15.00	16.44	15.32	15.00	
	627	600	598	589	550	598	562	599	
	NAKPDM ₃	PDM ₂	NAKM ₄	M ₃	NA M ₃	NA PDM ₄	KM ₂	K M ₄	
	603	476	603	488	516	524	389	378	
	674	680	749	713	799	728	604	559	
	16.27	15.46	16.01	15.58	15.87	15.43	14.92	15.29	
	617	602	579	576	569	580	541	598	
	NA KM ₃	NA DM ₂	KDM ₁	M ₄	NA M ₄	NA KDM ₃	NA KDM ₁	NAKPM ₂	
	556	547	552	446	532	516	492	320	
	623	720	758	720	772	694	664	694	
	16.76	16.07	15.66	15.55	15.49	16.04	16.04	16.44	
	596	601	619	592	572	569	528	568	
	NAKPDM ₂	KPM ₄	NA PM ₁	P DM ₃	NA PDM ₁	PM ₁	P M ₃	KPDM ₄	
	598	458	550	516	542	360	390	434	
	734	638	664	744	765	565	636	700	
	15.55	15.87	15.75	15.12	15.95	15.61	14.71	15.61	
	612	604	603	578	563	461	490	592	
	KDM ₃	M ₂	NA DM ₄	KPM ₂	DM ₄	KPDM ₂	NA PDM ₃	NA M ₂	
	500	351	570	493	532	454	434	466	
	729	558	749	730	756	686	706	678	
	15.69	15.00	15.72	15.32	14.89	15.00	14.54	15.66	
	591	555	594	584	524	528	501	564	
	NA PM ₃	PDM ₁	NA KPDM ₄	NA KM ₁	DM ₂	NA KPM ₄	K M ₃	K M ₁	
	552	467	592	538	528	402	332	340	
	626	644	768	752	798	528	562	575	
	15.90	15.61	15.46	15.06	15.29	15.55	15.52	15.00	
57	610	597	566	538	483	405	369	490	64

SYSTEM OF REPLICATION : 4 randomized blocks of 16 plots each. Certain interactions partially confounded with block differences.

AREA OF EACH PLOT (after rejecting edge-rows) : 1/48 acre. Plots actually 1/40 acre (82.5 lks. x 30.3 lks.).

TREATMENTS : 4 x 2⁴ factorial design.

Dung : None, 10 tons per acre ploughed in at end of January (D).

Agricultural salt : None, 5 cwt. per acre (NA).

Superphosphate : None, 0.5 cwt. P₂O₅ cwt. per acre (P).

Muriate of potash : None, 1.0 cwt. K₂O per acre (K).

Minerals ploughed in in January (M₁), broadcast in February (M₂), broadcast in March (M₃), broadcast at sowing (M₄).

BASAL MANURING : 0.6 cwt. N per acre as sulphate of ammonia.

CULTIVATIONS, ETC. : Minerals (M₁) applied : Nov. 29. Dung applied : Nov. 30. Ploughed : Jan. 25-Feb. 3. Minerals (M₂) applied : Feb. 3. Cultivated : March 8, 11. Harrowed : March 12, May 11, 12. Rolled : March 12, May 11, 12. Minerals (M₃) applied : March 21. Minerals (M₄) and basal dressing applied : May 10. Seed sown : May 12. Horse hoed : June 14, July 12-15. Singled : June 29-July 5. Hand hoed : July 25-Aug. 22 on various dates. Lifted : Dec. 5-10. Variety : Kleinwanzleben E. Previous crop : wheat.

SPECIAL NOTE : The minerals (M₁) were applied on November 29, but owing to bad weather conditions they were not ploughed in till the end of January instead of shortly after applying as was intended.

STANDARD ERRORS PER PLOT : Total sugar : 2.63 cwt. per acre or 9.50%. Tops : 1.51 tons per acre or 10.1%. Mean dirt tare : 0.157.

Effects of mineral manures

	Minerals							All	Mean
	None	Salt	Mur. of pot.	Salt and Mur. of pot.	Super.	Salt and super.	Mur. of pot. and super.		
TOTAL SUGAR : cwt. per acre (± 1.86)									
M ₁		29.9	24.9	28.5	23.4	32.1	29.4	29.0	28.2 ²
M ₂		29.9	26.0	27.9	26.6	32.6	25.1	25.3	27.6 ²
M ₃	24.9 ¹	32.9	24.1	32.6	25.2	27.2	26.7	31.7	28.6 ²
M ₄		31.4	23.6	31.1	27.6	29.4	25.1	27.9	28.0 ²
ROOTS (washed) : tons per acre									
M ₁		9.46	8.07	9.18	7.49	10.09	9.22	9.09	8.94
M ₂	8.14	9.39	8.38	8.87	8.52	10.04	8.27	7.97	8.78
M ₃		10.36	7.71	9.94	8.43	8.91	8.59	9.90	9.12
M ₄		10.06	7.50	9.92	8.89	9.46	7.98	8.99	8.97
TOPS : tons per acre (± 1.07)									
M ₁		16.17	14.28	15.17	12.95	15.31	14.42	14.66	14.71 ⁴
M ₂	15.09 ³	14.98	16.09	12.87	15.06	14.42	15.17	15.30	14.84 ⁴
M ₃		17.51	13.83	14.11	14.79	14.27	16.05	14.68	15.03 ⁴
M ₄		16.30	13.00	15.33	16.97	17.30	14.34	13.89	15.30 ⁴
SUGAR PERCENTAGE									
M ₁		15.72	15.33	15.55	15.61	15.85	15.96	15.92	15.71
M ₂	15.30	15.86	15.42	15.68	15.56	16.26	15.16	16.00	15.70
M ₃		15.81	15.60	16.40	14.92	15.22	15.52	15.96	15.63
M ₄		15.60	15.64	15.66	15.52	15.52	15.74	15.50	15.60
PLANT NUMBER : thousands per acre									
M ₁		26.9	26.6	25.6	25.4	28.0	28.2	26.1	26.7
M ₂	25.9	28.0	27.3	27.9	26.6	27.7	26.7	28.3	27.5
M ₃		27.1	23.0	28.0	25.6	26.7	27.5	27.9	26.5
M ₄		28.0	28.8	27.4	27.4	25.8	28.7	23.3	27.1

Standard errors : (1) ± 0.930 , (2) ± 0.703 , (3) ± 0.534 , (4) ± 0.404 .

M₁ = Minerals ploughed in in January.
M₂ = broadcast in March.

M₃ = broadcast in February.
M₄ = broadcast at sowing.

Differential responses to fertilizers

	Mean response	Differential responses							
		Dung		Salt		Muriate of potash		Superphosphate	
		Absent	Present	Absent	Present	Absent	Present	Absent	Present
TOTAL SUGAR : cwt. per acre (± 0.930 . Means : ± 0.658)									
Dung	+ 3.2	—	—	+4.1	+2.3	+2.8	+3.6	+3.7	+2.6
Salt	+ 4.5	+5.4	+3.6	—	—	+5.4	+3.6	+5.7	+3.3
Muriate of potash	- 0.5	-0.9	-0.2	+0.3	-1.4	—	—	-0.6	-0.4
Superphosphate ..	+ 0.1	+0.6	-0.4	+1.3	-1.1	0.0	+0.2	—	—
ROOTS (washed) : tons per acre									
Dung	+ 1.01	—	—	+1.30	+0.72	+0.87	+1.16	+1.10	+0.92
Salt	+ 1.25	+1.54	+0.96	—	—	+1.49	+1.02	+1.62	+0.88
Muriate of potash	- 0.26	-0.40	-0.11	-0.02	-0.49	—	—	-0.28	-0.22
Superphosphate ..	+ 0.03	+0.12	-0.06	+0.40	-0.34	0.00	+0.06	—	—
TOPS : tons per acre (± 0.534 . Means : ± 0.378)									
Dung	+ 1.04	—	—	+1.40	+0.67	+0.85	+1.22	+1.35	+0.72
Salt	+ 0.31	+0.68	-0.06	—	—	+0.77	-0.15	+0.61	+0.01
Muriate of potash	- 0.83	-1.01	-0.64	-0.37	-1.28	—	—	-1.33	-0.32
Superphosphate ..	- 0.03	+0.29	-0.34	+0.27	-0.32	-0.53	+0.48	—	—
SUGAR PERCENTAGE									
Dung	+ 0.02	—	—	+0.04	0.00	+0.10	-0.05	+0.24	-0.19
Salt	+ 0.34	+0.36	+0.32	—	—	+0.38	+0.29	+0.39	+0.28
Muriate of potash	+ 0.15	+0.22	+0.08	+0.19	+0.10	—	—	+0.14	+0.16
Superphosphate ..	+ 0.04	+0.26	-0.17	+0.10	-0.01	+0.03	+0.06	—	—
PLANT NUMBER : thousands per acre									
Dung	+ 1.1	—	—	+1.5	+0.6	+0.6	+1.6	+0.4	+1.8
Salt	+ 0.4	+0.9	0.0	—	—	+1.2	-0.3	+1.2	-0.3
Muriate of potash	+ 0.3	-0.2	+0.8	+1.1	-0.5	—	—	+0.2	+0.4
Superphosphate ..	+ 0.1	-0.6	+0.8	+0.9	-0.6	0.0	+0.3	—	—

Conclusions

Dung gave a significant increase of 3.2 cwt. per acre in sugar and 1.0 tons per acre in tops. Salt increased total sugar by 4.5 cwt. per acre, but its effect on tops was small and not significant.

The response in sugar to dung was somewhat greater in the absence of salt than in its presence. While this difference was not significant, a significant effect of the same type was observed at Woburn (see page 157).

Muriate of potash had no apparent effect on sugar and decreased the tops significantly by 0.8 tons per acre.

The effects of superphosphate were negligible.

No significant differences were produced by the different methods of applying the minerals.

KALE

Effect of sulphate of ammonia, poultry manure, soot, rape dust and dung

RK—Foster's, 1938 (5th year)

Plan and yields in lb.

1		D ₄	N ₂	M ₂	O	O	D ₄	D ₂	N ₁	
		465	494	520	414	388	532	441	526	8
		S ₂	D ₂	N ₁	O	O	D ₂	M ₂	N ₂	
		438	409	457	364	340	444	500	567	
		O	D ₂	R ₂	O	R ₂	S ₂	O	O	
		347	461	538	330	547	511	321	350	
		O	N ₂	O	D ₄	D ₄	R ₂	D ₂	D ₂	
		362	542	389	513	554	550	448	476	
		O	M ₂	O	D ₂	O	N ₂	N ₁	S ₂	
		333	495	370	415	330	548	461	465	
		D ₂	S ₂	R ₂	N ₁	O	O	O	M ₂	
41	SW ↑	432	498	508	440	326	348	312	482	48

SYSTEM OF REPLICATION : 4 randomized blocks of 12 plots each.
 AREA OF EACH PLOT (after rejecting edge rows) : 0.0231 acre. Plots actually : 0.0289 acre (14 yds. × 10 yds.).
 TREATMENTS : None, sulphate of ammonia at 0.4 cwt. and 0.8 cwt. N per acre (N₁, N₂) poultry manure (M₂), soot (S₂), rape dust (R₂) all at 0.8 cwt. N per acre, and dung at 0.8 cwt. and 1.6 cwt. N per acre (D₂, D₄).
 BASAL MANURING : Superphosphate and muriate of potash applied to every plot to give a total of 1.0 cwt. P₂O₅ and 1.0 cwt. K₂O per acre, including the P₂O₅ and K₂O in the organic fertilizers.
 CULTIVATIONS, ETC. : Dung spread : Feb. 10. Ploughed : Feb. 10-12. Rolled and harrowed : May 12, 19, 26 and June 1. Applied organic fertilizers : May 23. Applied artificials (sulphate of ammonia at half rate) : May 25. Seed sown : June 1. Variety : Thousand head. First sowing failed. Rolled and harrowed : July 5 and 7. Seed resown : July 7. Top dressing (second half of the sulphate of ammonia) : Aug. 10. Horse hoed : Aug. 2. Previous crop : Kale. Cut : Dec. 14, Jan. 12, Feb. 1, 17 and 27.
 STANDARD ERROR PER PLOT : 0.544 tons per acre or 6.36%.

Summary of results

cwt. N per acre ..	Nil	Sulphate of ammonia		Poultry manure 0.8	Soot 0.8	Rape dust 0.8	Dung	
		0.4	0.8				0.8	1.6
Kale : tons per acre	6.78 ¹	9.09 ³	10.37 ³	9.63 ³	9.22 ³	10.34 ³	8.50 ²	9.95 ³
	Standard errors : (1) ±0.136, (2) ±0.188, (3) ±0.272.							

Conclusions

All dressings produced significant increases in yield. At the 0.8 cwt. N per acre level of dressing, rape dust and sulphate of ammonia gave yields which were significantly higher than soot or dung and also higher than poultry manure, though this latter difference did not quite reach significance. The double dressing of dung was not significantly different from the single dressings of the other four fertilizers.

At both levels of application, sulphate of ammonia was slightly though not significantly better than a double dressing of dung.

KALE

Effect of sulphate of ammonia, dung, treated town refuse, superphosphate and muriate of potash

RK—Foster's, 1938
Plan and yields in lb.

51	H ₀ M ₂ 383	S ₀ M ₁ 384	H ₂ M ₁ 541	S ₀ M ₀ 414	D ₀ M ₂ 420	D ₁ M ₀ 460	D ₂ M ₀ 503	H ₂ M ₂ 586	D ₀ M ₁ 508	75
	S ₂ M ₀ 510	D ₀ M ₀ 370	H ₁ M ₀ 521	H ₁ M ₂ 433	H ₀ M ₁ 398	H ₂ M ₀ 501	S ₁ M ₀ 497	D ₁ M ₂ 498	S ₀ M ₂ 466	
49	S ₁ M ₂ 446	D ₁ M ₁ 422	D ₂ M ₂ 466	S ₁ M ₁ 469	D ₂ M ₁ 467	S ₂ M ₂ 545	H ₁ M ₁ 496	H ₀ M ₀ 399	S ₂ M ₁ 574	73

SYSTEM OF REPLICATION : 3 randomized blocks of 9 plots each.
AREA OF EACH PLOT (after rejecting edge rows) : 0.0202 acre. Plots actually : 1/40 acre (60.6 lbs. × 41.3 lbs.).

TREATMENTS : 3 × 3 × 3 factorial design.
Nitrogenous fertilizers : None (0), single dressing (1), double dressing (2) of sulphate of ammonia (S), treated town refuse* (H), dung (D). The single dressing was 0.4 cwt. N per acre for sulphate of ammonia and 0.8 cwt. for treated town refuse and dung.
Minerals : None (M₀), single dressing (M₁), double dressing (M₂), the single dressing being 0.4 cwt. P₂O₅ and 0.5 cwt. K₂O per acre.

BASAL MANURING : Nil.
CULTIVATIONS, ETC. : Applied dung and town refuse : April 2. Ploughed : April 4-6. Rolled and harrowed : May 12, 19, 26, 31. Applied artificials : May 25. Seed sown : May 31. Horse hoed : June 30, July 8, 19. Cut : Dec. 15-Feb. 10. Variety : Thousand head. Previous crop : Barley.

SPECIAL NOTE : *Town refuse screened, and fermented in silos.
STANDARD ERROR PER PLOT : 0.698 tons per acre or 6.71%.

Main effects and interactions of amount of nitrogen with kind of nitrogenous manure and minerals

Amount of nitrogen	Sulphate Treated of town refuse			Minerals			Mean	Increase
	ammonia	town refuse	Dung	None	Single dressing	Double dressing		
KALE : tons per acre (±0.403)								
None		9.20 ¹		8.73	9.52	9.36	9.20 ¹	
Single dressing ..	10.42	10.70	10.18	10.91	10.24	10.16	10.43 ¹	+1.23 ²
Double dressing ..	12.02	12.01	10.60	11.77	11.67	11.79	11.54 ¹	+1.11 ²
Mean	11.22 ³	11.36 ³	10.39 ³	10.27 ¹	10.48 ¹	10.44 ¹	10.39	
Increase		+0.14 ⁴	-0.83 ⁴	+0.21 ²	-0.04 ²			

Standard errors : (1) ±0.233, (2) ±0.329, (3) ±0.285, (4) ±0.403.

Interaction of kind of nitrogenous manure with minerals (adjusted for block differences)

	KALE :	Minerals		
		None	Single dressing	Double dressing
KALE : tons per acre (±0.451)				
Sulphate of ammonia ..		11.08	11.13	11.43
Treated town refuse ..		11.78	11.43	10.88
Dung		10.24	10.30	10.62

Conclusions

It should be noted that sulphate of ammonia was applied at half rate per unit of N as compared with town refuse and dung.
All three nitrogenous fertilizers produced significant increases in the yield of kale. There was little difference between the responses to sulphate of ammonia and treated town refuse, but the response to the double dressing of dung was significantly less than the response to the double dressings of the other two fertilizers.
Minerals produced no significant results.

POTATOES

Effect of fresh and stored dung, superphosphate, sulphate of potash, straw and of sulphate ammonia

RP—Pastures, 1938

Total produce in lb. on left and percentage ware on right

1	DrPK 202 N ₀ 81.3 247 N ₁ 88.1 277 N ₂ 87.8	Dr 192 N ₀ 83.3 218 N ₁ 84.0 234 N ₂ 85.0	P 72 N ₁ 49.6 95 N ₂ 58.4 95 N ₀ 57.2	DfStPK 233 N ₁ 88.0 210 N ₀ 84.9 282 N ₂ 88.7	StP 77 N ₀ 45.5 120 N ₁ 64.3 132 N ₂ 66.1	Dr 182 N ₀ 82.9 208 N ₂ 84.7 221 N ₁ 86.1	121
	DrStP 255 N ₀ 86.8 292 N ₂ 88.8 258 N ₁ 86.6	K 202 N ₁ 84.3 158 N ₀ 81.6 211 N ₂ 84.1	DfStP 252 N ₀ 88.2 248 N ₂ 87.0 267 N ₁ 89.1	DfSt 259 N ₂ 88.7 207 N ₀ 87.6 236 N ₁ 86.7	NIL 106 N ₀ 61.9 90 N ₁ 55.5 229 N ₂ 83.7	StK 184 N ₁ 82.0 167 N ₂ 76.8 199 N ₀ 84.0	
	St 278 N ₂ 88.1 222 N ₁ 85.6 232 N ₀ 84.8	DfPK 304 N ₁ 90.1 267 N ₀ 89.2 320 N ₂ 88.9	Df 285 N ₀ 89.1 282 N ₂ 87.5 306 N ₁ 90.5	DrPK 314 N ₁ 88.2 265 N ₀ 85.6 324 N ₂ 88.2	DrStP 278 N ₀ 86.3 318 N ₂ 88.9 319 N ₁ 88.6	DrStK 289 N ₂ 86.6 230 N ₀ 84.5 265 N ₁ 85.8	
	StPK 284 N ₀ 87.5 327 N ₂ 89.3 301 N ₁ 88.5	DrStK 292 N ₁ 88.6 312 N ₂ 88.2 290 N ₀ 86.0	DfStK 298 N ₁ 88.6 279 N ₀ 88.0 276 N ₂ 87.8	PK 330 N ₂ 87.7 217 N ₀ 83.9 279 N ₁ 86.0	DfK 293 N ₂ 89.8 285 N ₀ 88.5 293 N ₁ 87.8	DfP 290 N ₀ 87.4 309 N ₁ 89.0 323 N ₂ 89.7	
S ↑	DrSt 337 N ₂ 90.6 289 N ₁ 89.7 230 N ₀ 87.8	StK 290 N ₂ 87.5 194 N ₀ 83.1 184 N ₁ 86.2	DrP 271 N ₀ 87.3 298 N ₁ 88.6 287 N ₂ 89.9	DrK 253 N ₀ 87.4 240 N ₁ 85.9 240 N ₂ 89.2	DrP 262 N ₀ 88.1 259 N ₁ 88.0 266 N ₂ 86.8	DrSt 308 N ₁ 89.1 219 N ₀ 86.7 251 N ₂ 88.0	
	DfK 255 N ₁ 88.9 234 N ₀ 86.4 288 N ₂ 88.1	DrK 198 N ₀ 84.4 243 N ₁ 86.0 299 N ₂ 89.9	DfSt 193 N ₀ 86.9 233 N ₁ 85.8 264 N ₂ 88.5	DrStPK 212 N ₀ 86.0 253 N ₁ 87.9 302 N ₂ 89.5	DfPK 216 N ₀ 87.5 310 N ₂ 90.0 266 N ₁ 88.1	P 132 N ₂ 69.7 127 N ₀ 73.3 170 N ₁ 80.9	
	StP 243 N ₀ 88.2 260 N ₂ 87.9 248 N ₁ 88.4	DrStPK 297 N ₁ 90.2 260 N ₀ 90.0 310 N ₂ 90.1	NIL 189 N ₀ 84.7 232 N ₂ 86.6 203 N ₁ 82.4	StPK 215 N ₀ 87.1 273 N ₁ 88.8 284 N ₂ 89.8	K 162 N ₀ 83.4 185 N ₁ 84.0 215 N ₂ 83.7	DfStP 217 N ₁ 88.5 226 N ₀ 87.3 273 N ₂ 89.9	
24	DfP 293 N ₁ 90.9 300 N ₀ 89.4 346 N ₂ 91.4	DfStPK 295 N ₀ 91.4 327 N ₂ 89.6 337 N ₁ 91.7	PK 217 N ₀ 83.5 262 N ₁ 85.6 298 N ₂ 88.9	Df 269 N ₁ 89.0 234 N ₀ 88.3 277 N ₂ 89.6	DfStK 279 N ₁ 89.4 284 N ₂ 90.1 232 N ₀ 88.2	St 221 N ₂ 84.7 141 N ₀ 77.4 151 N ₁ 78.0	144

SYSTEM OF REPLICATION : 4 randomized blocks of 12 plots each, the plots being split for sulphate of ammonia at the rates of 0, 0.4 and 0.8 cwt. N per acre.

AREA OF EACH SUB-PLOT (after rejecting edge bouts) : 0.00882 acre. Plots actually 0.01176 acre (42 lks. × 28 lks.)

TREATMENTS : 3² × 2³ factorial design.

Dung : None, 15 tons fresh (Df), 15 tons stored (Dr) per acre.

Straw : Dung made with normal amount of straw, or with 50% additional straw (St).

Superphosphate : None, 0.8 cwt. P₂O₅ per acre (P).

Sulphate of potash : None, 1.6 cwt. K₂O per acre (K).

Sulphate of ammonia : None, 0.4 cwt., 0.8 cwt. N per acre (N₀, N₁, N₂).

BASAL MANURING : Nil.

CULTIVATIONS, ETC. : Feb. 10-16, ploughed. March 16, rolled and harrowed. April 17, rolled and ridged. April 21-23, applied artificials and stored dung. April 25-26, applied fresh dung. April 27-29, potatoes planted. May 19, rolled. June 3, ridged. June 4, harrowed. June 21, hand hoed. June 24-July 1, grubbed. July 7-27, hand hoed. July 20-21, earthed up. Oct. 17-20, lifted. Variety : Ally. Previous crop : Wheat.

SPECIAL NOTES : Potatoes passed through a 1 3/4 inch riddle to determine percentage ware.

There was a marked drop in fertility from the centre of the site towards the south end. The whole-plot yields of total produce were corrected for this fertility gradient by estimating the relative fertilities of the top four rows in the plan by the method of least squares. The standard error per whole plot was reduced by these corrections from 12.8 per cent. to 8.2 per cent.

STANDARD ERRORS : Total produce : per whole plot : 1.02 tons per acre or 8.21% ; per sub-plot: 1.11 tons per acre or 8.92%. Percentage ware : per whole plot : 16.3 ; per sub-plot: 3.38.

Summary of effects of dung and artificial fertilizers

	Sulph. of Ammonia (cwt. N)	Superphosphate (cwt. P ₂ O ₅)				St. errors	Superphosphate (cwt. P ₂ O ₅)				St. errors		
		0		0.8			0		0.8				
		Sulphate of potash (cwt. K ₂ O)					Sulphate of potash (cwt. K ₂ O)						
		0		1.6		0		1.6					
		TOTAL PRODUCE : tons per acre								PERCENTAGE WARE			
No dung	0	8.18	9.27	8.38	10.83	±0.866*	77.2	83.0	66.0	85.5	±14.3*		
	0.4	8.15	9.80	9.24	13.14	±0.556†	75.4	84.1	70.8	87.2		±1.69†	
	0.8	11.87	11.42	9.36	14.70		85.8	83.0	70.5	88.9			
Dung ..	0	11.65	11.73	13.18	12.55	±0.626*	86.6	86.7	87.6	87.0	±10.0*		
	0.4	13.78	12.77	13.73	14.54	±0.393†	87.6	87.6	88.7	89.0	±1.20†		
	0.8	13.99	13.50	14.57	15.94		87.8	88.7	89.0	89.1			

*mean yield 12.45 tons
mean no dung 10.36 tons*

Comparison of fresh and stored dung

Dung	Straw		Super-phosphate (cwt. P ₂ O ₅)		Sulphate of potash (cwt. K ₂ O)		Sulphate of ammonia (cwt. N)			Mean
	Normal	Additional	0	0.8	0	1.6	0	0.4	0.8	
		TOTAL PRODUCE : tons per acre								
Fresh ..	13.55	13.35	12.75	14.15	13.16	13.75	12.36	13.56	14.44	13.45
Stored ..	13.59	13.48	13.06	14.02	13.81	13.27	12.20	13.85	14.56	13.54
St. errors	±0.361*						±0.278†			±0.255*
		PERCENTAGE WARE								
Fresh ..	89.0	88.4	88.3	89.0	88.6	88.7	88.0	88.9	89.1	88.7
Stored ..	86.5	88.0	86.7	87.8	87.2	87.3	85.9	87.6	88.3	87.3
St. errors	±5.77*						±0.845†			±4.08*

Comparison of normal and additional straw

Straw	Superphosphate (cwt. P ₂ O ₅)		Sulphate of potash (cwt. K ₂ O)		Sulphate of ammonia (cwt. N)			Mean		
	0	0.8	0	1.6	0	0.4	0.8			
		TOTAL PRODUCE : tons per acre								
Normal ..	13.03	14.11	13.84	13.30	12.48	13.74	14.50	13.57		
Additional	12.77	14.06	13.12	13.71	12.08	13.67	14.50	13.42		
St. errors	±0.361*						±0.278†			±0.255*
		PERCENTAGE WARE								
Normal ..	87.2	88.3	87.8	87.7	86.6	88.1	88.5	87.7		
Additional	87.8	88.5	88.0	88.3	87.3	88.4	88.8	88.2		
St. errors	±5.77*						±0.845†			±4.08*

* For comparisons involving means of the three levels of sulphate of ammonia.

† For comparisons involving differences between the three levels of sulphate of ammonia.

Conclusions

The average response in total produce to dung was 3.1 tons per acre. The response was significantly greater in the absence of sulphate of potash than in its presence, and also slightly though not significantly greater in the absence of sulphate of ammonia than in its presence. There were no apparent differences between the effects of fresh and stored dung, or of normal and strawy dung.

The effects of dung on percentage ware were similar to those on yield; in particular, the increase to dung was 13.6 in the absence of potash and 2.7 in the presence of potash.

The double dressing of sulphate of ammonia produced a significant increase in total produce of 2.4 tons per acre. The response was significantly greater in the presence of potash than in its absence. The three-factor interaction between sulphate of ammonia, sulphate of potash and superphosphate was also statistically significant, the response to the double dressing of sulphate of ammonia being significantly greater on plots receiving neither or both the minerals than on plots receiving one of the minerals but not the other. No explanation of this effect can, however, be offered, and it is not supported by the results with the single dressing of sulphate of ammonia.

Sulphate of ammonia also produced a significant increase of 2.9 in percentage ware.

In addition to producing the effects noted above, sulphate of potash gave a significant average response of 0.8 tons per acre in total produce and superphosphate a significant average response of 1.2 tons per acre. The response to each was significantly greater in the presence of the other than in its absence.

Sulphate of potash gave a significant increase in percentage ware of 10.0 in the absence of dung, but had no appreciable effect in the presence of dung. Superphosphate had little effect on percentage ware.