SUGAR BEET

LONG TERM EXPERIMENT. THE IMPROVEMENT OF SOIL CONDITIONS NAS 200 ML 76

PHASE II TEST SEQUENCE 1st YEAR

CROP SUGAR BEET

This was the fifth year of this long term experiment in which the value of short term leys and soil conditioners are being examined both on soil structure and the yield of arable crops.

The following fertilizers were applied on 16 Oct 1975 and ploughed in on 6 Jan 1976: 0.5 tonne/ha Kieserite, 0.38 tonne/ha Betrox plus 97 and 193 kg/ha of P_2O_5 and K_2O respectively. The arable + FYM treatment received 50 tonne/ha of farmyard manure which from analysis was calculated to supply an equivalent amount of P and K to that applied as fertilizer to all other treatments.

The sugar beet was originally drilled at 7.5 cm spacing on 24th March but was severely damaged by birds encroaching from surrounding crops. The experiment was therefore re-drilled on 27 April with Nomo pelleted seed at 3.75 cm spacing. The plants were hand singled on 2 and 3 June to give a uniform plant density of 75 thousand/ha. The experiment was hand harvested on 14 December.

Where 125 tonne/ha of factory waste lime (FWL) had been applied 4 years earlier Boron deficiency developed. This was most noticeable in early September when a surge of new leaf growth occurred following rainfall in late August. Soil analysis showed Boron (mg/l) levels at 0-15 cm depth of 0.77, 0.64, 0.66 and 0.84 from the Arable (control), Arable + FYM, Arable + FWL and Arable + 1 yr ley treatments respectively. Soil Boron levels were adequate on all treatments (ADAS index 1) but the increase in alkalinity (pH 8.0) following the large application of factory waste lime probably caused an earlier cessation of Boron uptake during the summer drought. Leaf samples taken in September showed similar concentrations from all treatments but as this is not mobilised to the site of new growth deficiencies can still occur. Approximately 18 per cent of plants exhibited Boron deficiency in early September probably accounting for the lower sugar yields from the factory waste lime treatment.

It seems certain that the extreme drought followed by very rapid new leaf growth induced this deficiency as four sugar beet crops have been grown successfully following such large applications of factory waste lime. Indeed one of these crops was grown on these plots in 1973 following the application of the factory waste lime treatment the previous autumn.

Sugar yield tonne/ha

Soil treatment	Nitrogen level kg/ha 0	38	75	113	151	188	Mean
Arable (Controls)	7.41	7.12	7.49	7.49	7.13	6.75	7.23
Arable (Controls)	6.86	6.37	7.26	7.11	7.10	6.56	6.88
Arable + FYM	7.02	7.56	7.03	7.03	7.09	7.36	7.18
Arable + FWL	6.90	6.45	6.87	6.91	6.14	5.77	6.51
Arable + 1 yr ley	6.80	7.46	7.16	7.21	6.78	6.60	7.00
3 yr ley	7.66	7.11	7.19	7.12	6.80	6.60	7.08
Mean	7.11	7.01	7.17	7.15	6.84	6.61	

After the severe drought sugar yields were rather variable. The previous soil treatments influenced the nitrogen fertilizer requirements of the sugar beet crop. The arable (control) required 75 kg N/ha whilst after 50 tonne/ha FYM this was reduced to 38 kg N/ha. After a 1 year ley, heavily fertilized with nitrogen, the sugar beet crop similarly required 38 kg N/ha whilst after a 3 year ley no nitrogen fertilizer was needed. Large decreases in sugar yield occurred at the higher nitrogen levels.

A comprehensive range of soil physical measurements were made but soil conditions did not influence sugar yield. At the optimum level of nitrogen fertilizer the yields of sugar were similar following all soil conditioning treatments.

PHASE I TEST SEQUENCE 2nd YEAR

CROP SPRING BARLEY

METHOD

This phase was ploughed on 31 December following the previous crop of sugar beet. On 26 February fertilizer was applied to all treatments at 63 kg P_2O_5 and 63 kg K_2O/ha. Avadex was soil incorporated on 1 March to ensure wild oat control followed by drilling of Maris Mink spring barley. The four nitrogen levels were applied on 6 April after crop establishment. The crop was harvested on 22 July, no lodging or shedding occurred.

Grain yield tonne/ha

Soil treatment	Nitrogen level kg/ha 38	75	113	158	Mean
A_1 Control	4.04	4.10	3.71	3.99	3.96
A_2 Control	3.61	3.83	3.62	3.68	3.69
A FYM	3.87	3.99	3.91	3.88	3.91
A FWL	3.90	4.04	3.89	3.82	3.91
A 1 yr ley	4.03	4.18	3.97	3.81	4.00
3 yr ley	4.12	4.12	4.05	3.87	4.04
Mean	3.93	4.04	3.86	3.84	

Severe water deficit and high temperatures caused premature ripening with very little yield difference between treatments. For all treatments 75 kg N/ha gave the highest yield except after a 3 yr ley where only 38 kg N/ha was required.

A comprehensive range of soil physical measurements were recorded but soil conditions had very little effect on grain yield.

PHASE III TREATMENT SEQUENCE 3rd YEAR

CROP SPRING BARLEY

This phase was ploughed on 29 October 1975, on 26 February 1976 fertilizer was applied at 100 N, 63 P_2O_5 and 63 K_2O kg/ha. Maris Mink spring barley was drilled on 4 March into good soil conditions. A good crop establishment was obtained. The crop was harvested on 22 July, no lodging or loss of heads occurred.

Soil treatment	Grain yield tonne/ha	Grain nitrogen %
A_1 Control	3.75	2.32
A_2 Control	3.34	2.35
A FYM	3.63	2.31
A FWL	3.79	2.32

The barley crop ripened prematurely due to drought and high temperatures and no difference in yield was observed. There was no difference in the nitrogen content of the grain.

SOIL ANALYSIS PHASE III

Soil samples at 0-15 and 15-30 cm depths were taken from each plot at the start of each phase and again at the end of the three years treatment sequence. The changes at 0-30 cm depth over the treatment sequence are summarised in the following table of results.

Treatment	pH	P mg/l	K mg/l	Mg mg/l	OM%
	Phase III 1973. At start of treatment sequence				
A_1 Control	7.1	16	58	41	1.80
A_2 Control	7.4	18	63	38	1.93
A FYM	6.9	18	63	41	1.88
A FWL	7.5	20	64	40	2.00
A 1 yr ley	7.2	22	57	37	1.93
3 yr ley	7.2	18	64	38	1.98
	Phase III 1976 At the end of treatment sequence				
A_1 Control	7.1	18	69	37	1.75
A_2 Control	7.2	20	74	35	1.80
A FYM	7.0	18	72	44	1.83
A FWL	8.0	25	68	55	1.85
A 1 yr ley	7.1	21	87	35	1.85
3 yr ley	6.9	18	87	34	1.93
	Differences after 3 yrs treatment cropping				
A_1 Control	0.0	2	11	-4	-0.05
A_2 Control	-0.2	2	11	-3	-0.13
A FYM	0.1	0	9	3	-0.05
A FWL	0.5	5	4	15	-0.15
A 1 yr ley	-0.1	-1	30	-2	-0.08
3 yr ley	-0.3	0	23	-4	-0.05

The soil analysis made in 1973 before treatments were applied demonstrate the uniformity of the site against which changes during the treatment sequence can be measured. The P and K contribution from the FYM application was corrected by reducing the levels of inorganic fertilizer applied. Similarly the application of P and K to the ley treatments was calculated to compensate for the offtake of these nutrients in the herbage. The objective was for all treatments to enter the test crop sequence with similar and adequate levels of soil P and K reserves. The FWL treatment was excepted from this principle as the plant nutrients contained in the 125 tonne/ha application were too large to allow correction by withholding inorganic fertilizer to the treatment crops.

The effect of the FWL three years after application can be clearly seen as an increase in soil pH, P and Mg levels. The allowances made for plant nutrient contributions from FYM have proved satisfactory as the effect on soil reserves was similar to the control treatments. The 1 year and 3 year leys have increased soil K reserves more rapidly than the other treatments. This is in direct contrast to the situation on Phase I reported two years ago. It may be that soil reserves have increased merely because these nutrients were not removed from the soil by the second and third harvest as there was little herbage growth due to drought conditions.

In common with the results of Phases I and II there was little change in soil organic matter levels between treatments

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