

CONFIDENTIAL*

DEEP LOOSENING OF SOIL, 1983

NAS 205 ML (SA 96)
3rd Year

SUMMARY

In autumn 1980, several different machines were used to deep loosen a sandy loam soil. These machines were a Wye double-digger, an NCAE winged subsoiler, used as a two pass complete loosener or a one pass subsoiler, and a Paraplow.

Deep placement of 350 kg/ha of phosphate and potash was possible with two of these machines and these treatments were carried out to compare with soil loosening alone and with extra P and K ploughed down.

Spring barley was grown on the trial in 1983.

Deep soil loosening or the application of extra phosphate and potash did not affect the yield, 1000 grain weight or the P and K content of the grain of Triumph spring barley.

OBJECT

To evaluate techniques of deep soil loosening, and to monitor their effects on soil conditions and crop performance in an arable rotation. Also to test the value of deep placement of phosphate and potash fertilizer. This experiment is part of a series being co-ordinated by ADAS Eastern Region Soil Science Department.

TREATMENTS

1. Control - mouldboard ploughing, no deep loosening or phosphate and potash placement.
2. Extra phosphate and potash, ploughed down in autumn.
3. Wye double-digger, no phosphate and potash placement.
4. Wye double-digger, with phosphate and potash placement.
5. NCAE winged-subsoiler, complete loosening, no phosphate and potash placement.
6. NCAE winged-subsoiler, complete loosening, with phosphate and potash placement.
7. NCAE winged-subsoiler, one pass, no phosphate and potash placement.
8. Howard Paraplow, no phosphate and potash placement.

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These treatments were applied (in four randomised blocks) in September 1980, before winter barley was drilled for the 1981 harvest. The 1982 crop was sugar beet, whilst spring barley was grown in 1983.

METHOD

Sample areas of the 1982 sugar beet crop were hand harvested on 19 October, with the remaining beet machine-harvested between 3 and 13 December. The site was ploughed to a depth of 25 cm on 11-12 January 1983. Triumph spring barley was drilled with a Carrier drill (at 160 kg/ha) on 7 March, after one pass with a Dutch harrow the previous day. Nitrogen was applied (100 kg/ha) on 9 March. Weed control was by the application of Mofix 500L (bromofenoxim + terbuthylazine) at 1.7 l/ha on 16 April. Diseases were controlled by Bayleton BM (1.0 kg/ha) applied on 27 May and Tilt (0.5 l/ha) applied on 17 June.

There was no lodging and the trial was harvested on 11 August. Soil strength measurements were taken on 28 April to a depth of 45 cm. Neutron probe tubes were also installed and measurements of moisture changes taken during the growing season.

RESULTS

Particle size distribution and nutrient status of the soil at the start of the trial (September 1980) are summarized below.

Particle size distribution (%)

Depth (cm)	C. Sand		F. Sand		C. Silt		Clay <2 μ
	>600	210-600	105-210	60-105	20-60	2-20	
0-10	2.3	34.6	22.1	8.4	9.8	7.8	12.0
10-20	3.0	34.4	21.9	8.2	9.0	7.1	11.7
20-30	2.5	33.9	22.4	8.5	8.4	7.4	12.1
30-40	2.7	30.0	22.0	8.6	8.9	8.1	13.0
40-50	3.1	31.5	20.8	7.7	8.6	8.3	16.2
50-60	3.2	28.1	18.6	7.6	8.4	9.4	20.8

This experiment is sited on a sandy loam soil and is classified as being in the sandier Ashley soil series.

Soil Analysis

Depth (cm)	pH	P		K		Mg		% O.M.
		mg/l	Index	mg/l	Index	mg/l	Index	
0-10	8.0	38	3	93	1	52	2	1.5
10-20	8.1	40	3	108	1	52	2	1.5
20-30	8.0	44	3	130	2	58	2	1.6
30-40	8.1	28	3	115	1	53	2	1.2
40-50	8.1	23	2	108	1	53	2	1.1
50-60	8.0	18	2	104	1	49	1	1.0

Soil pH was very high, and uniform down through the profile. Organic matter content was relatively low at 1.5 - 1.6% down to 30 cm and very low below this depth. Soil analysis generally showed an index in the topsoil of 3 for P, 1-2 for K and 2 for Mg. There was a tendency for nutrient levels to be highest at 20-30 cm depth.

Soil Strength

Measurements obtained from the cone penetrometer are presented as a mean for the three blocks I, II and IV for the control (unloosened), Wye double-digger, NCAE complete loosening and Paraplow treatments.

Cone penetrometer readings in KPa

Depth cms	Treatment			
	Control	Wye double digger	NCAE Complete	<u>Paraplow</u>
0	33	16	18	36
5	449	372	401	425
10	837	724	778	767
15	908	856	824	772
20	912	768	737	884
25	1154	920	972	904
30	2291	1553	1892	1863
35	2889	1796	1991	2370
40	2702	2023	2539	2632
45	2777	2491	2688	2722

The effect on the 0-30 cm layer of loosening in 1980 was minimal, as might be expected after 3 years of cropping. The Wye double-digger tended to be looser than other treatments whilst the control (unloosened) was more compact at 35 cm depth. These differences were however small and most of the loosening effect had been lost.

Soil Water Content

During the growing season, there were no real differences in the rate of water extraction between the deep loosening treatments, water being extracted from a soil depth of at least 1 metre on all treatments.

Grain yield and grain size

Treatment	Grain yield at 85% d.m. (t/ha)		1000 grain weight at 100% d.m. (g)	
	-	PK +	-	PK +
E.S.E.	(±0.122)		(±0.42)	
Control	6.02	5.78	46.3	47.0
Wye double digger	5.82	6.25	46.7	46.2
NCAE Complete	6.10	6.11	46.5	46.1
NCAE Subsoiler	5.87	-	46.1	-
<u>Paraplow</u>	5.87	-	47.3	-
S.E. per plot (21 d.f.)	±0.243 or 4.1% of G.M.		±0.847 or 1.8% of G.M.	

There were no significant effects of deep soil loosening or the addition of extra phosphate and potash in the autumn of 1980 on the grain yield or grain size of Triumph spring barley in 1983.

% P and K in grain

Treatment	%P		%K	
	-	PK +	-	PK +
E.S.E.	(±0.004)		(±0.008)	
Control	0.34	0.35	0.49	0.50
Wye double digger	0.35	0.36	0.49	0.50
NCAE Complete	0.35	0.35	0.51	0.50
NCAE Subsoiler	0.35	-	0.50	-
<u>Paraplow</u>	0.34	-	0.49	-
S.E. per plot (21 d.f.)	±0.009 or 2.4% of G.M.		±0.018 or 3.5% of G.M.	

None of the treatments had any significant effect on the concentration of P and K in the grain.

CONCLUSIONS

Over the three years, neither deep soil loosening nor the application of extra phosphate and potash in the autumn of 1980 had any significant effect on yield, grain size or the P and K content in the grain of Igr1 winter barley in 1981 or Triumph spring barley in 1983. Nor were there any significant effects on plant number, the P and K content of the leaves, root shape or the yield of roots or sugar in a crop of sugar beet in 1982.

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