

Soil Loosening — The New Technique

F. P. D. MOORE

Grove Farm House, Thornham Magna, Eye, Suffolk IP 23 8LL /United Kingdom/

Practically every known form of cultivation was invented before the beginning of this century, including rotary machines of both horizontal and vertical axis. V-formation cultivators, gantries and mechanical ploughs and diggers of every conceivable formation. All appear to have been intended to cultivate the soil as thoroughly and deeply as possible. There are only two "new" ideas in cultivation that I can discover

- zero tillage /as a result of the discovery of Gramoxone herbicide/, and
- soil loosening /that is the idea of breaking up all the soil below the surface without inverting it, nor creating surface clods requiring subsequent secondary cultivations/.

In fact, the term "soil loosening" sometimes referred to as "topsoil loosening", was coined by Howard Rotavator Company in 1980 to describe the action of the new prototype Paraplow, which was neither a conventional sub-soiler nor a cultivator or chisel plough. The term has now been widely adopted to describe this new principle. Another term that might describe it is invisible ploughing.

The Howard Paraplow was developed from the original concept of the slant-leg sub-soiler, originated by Dr. EDE's Land and Water Management Company of Cambridge, but it was the late PAUL KORONKA of ICI's Plant Protection Division who realised the potential of the slant-leg principle. Incorporating his modifications and with some assistance from the National Institute of Agricultural Engineering, the Howard Rotavator Company was able to create this new class of machine. All patents are held jointly by Howard and ICI.

The action of the Paraplow legs is to lift and loosen the soil and, as it flows over the legs, bend it by putting it into tension so that it breaks along its natural lines of weakness and thus is more stable and more able to carry subsequent traffic than if it had been cut and crushed by compressive forces.

Moreover, only the points are rubbing along the bottom, whilst the oblique furrow slices are broken away by being pushed slightly sideways and upwards by the action of the machine, without causing any smearing or sealing of the vertical channels present in the soil. Since there is an adjustable shatter-flap at the rear of each leg, this amount of loosening can be controlled.

The machine, therefore, fulfils the criteria laid down by ICI agronomists, that it should:

- a/ Loosen the soil, as necessary, for water penetration and root growth.
- b/ Enhance the natural structure of the soil.
- c/ Leave the surface level ready for drilling or the minimum necessary surface cultivation.
- d/ Be adjustable for different soil conditions.
- e/ Be economic in operation.

In the matter of operation, tests have indicated 20/30% reduction in draught requirements by use of the slant-leg compared to a vertical leg, although 30-35 HP per leg is a normal requirement.

We now have three seasons' experience of the production model Paraplow, plus some of the original prototype, which was capable of working to 50 cm depth. This, incidentally, taught us that there were very few situations where work below 35 cm gave any additional benefit - other than to the diesel oil and tyre suppliers! Once soil loosening techniques are adopted in place of ploughing, there is little likelihood of soil compaction at greater depths.

A number of results, both from properly supervised and replicated trials carried out by the Agricultural Development and Advisory Service in the UK and various institutes, universities and colleges as well as a great number of individual reports from farmers, have filtered in over the last two years and, rather than quoting some of the dramatically good effects some farmers have reported /frequently because their land was suffering some particularly severe compaction problem/, I would like to summarise what can be expected from paraplowing, as follows:

1. If the soil is in perfect condition and well-structured /Category I type soil/, no beneficial effect is likely, although Nottingham University reported in their trials beneficial results even though no compaction was measurable, primarily due to the deeper rooting /Fig.1/.

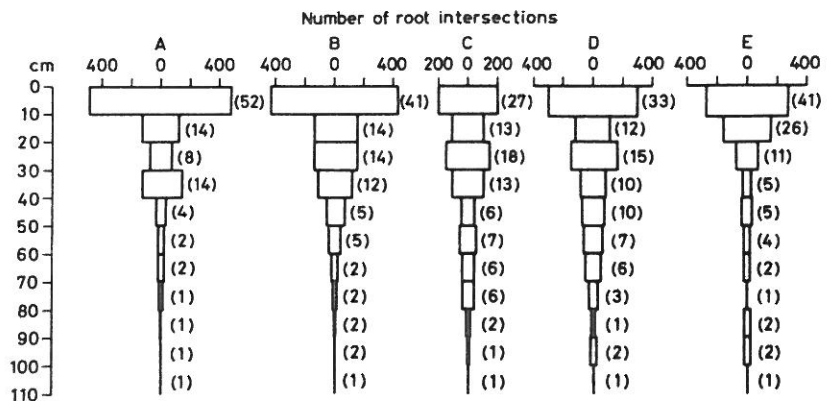


Fig. 1

Root number of oil seed rape with depth in the five cultivation treatments /May, 1983/. /Figures in parentheses indicate percentage number of root intersections./ A. S. rotavation; B. direct drill; C. paraplow; D. paraplow and s. rotavation; E. plough. /Source: University of Nottingham, School of Agriculture/

2. On self-restructuring soils, weather conditions can repair damage without mechanical aid. In the UK, in the rather exceptional 1981/82 season, the relatively dry winter which resulted in little surface waterlogging, followed by the very wet June which "rescued" many plants which were on the point of suffering from drought-stress at the end of May, meant that there were few significant yield increases where soil loosening had been carried out. The problem for the farmer is that he cannot guarantee a dry winter and a wet June every year. In a more normal year such as 1982/83, even on well-managed soils, the use of the Paraplow shows economic results, and I was recently sent an aerial photograph of a Gloucestershire field where about one hectare had been left un-paraplowed for comparison and where the difference in yield was 20%.

Table 1

Grain yield of first and second winter wheats following grass on a sandy clay loam soil /Headley Hall/ /expressed in t/ha at 85% dry matter/
/Source: Leeds University, 1983/

Year	Wheat variety	N kg ha ⁻¹	Direct drilling		Shallow tine		Direct drilling without paraplowing
			without	with	without	with	
			paraplowing				
1982	Bounty	190	7.37	7.32	7.77	7.60	-
1983	Avalon	150	3.86	9.71	8.86	9.52	9.62

3. Loosening should not be overdone. Soil that is over-loosened is more easily compacted and it is the stability of the soil blocks after loosening that is important, together with the continuity of the pores rather than the total amount of fissuring. Moreover, over-loosened soil can dry out too much. Visual inspection to show how much the soil has been broken can be most misleading, and a single face profile pit used at practically every demonstration only shows the fissures in two dimensions, not three. An "L" shaped pit would be much more significant.

4. After loosening, cultivations should be kept to a minimum to prevent re-compaction. Work by Oak Park Research Station, Ireland, which showed a 15% yield increase of sugar beet after Paraplowing and two subsequent cultivations, showed no increase where five or six subsequent cultivations were carried out, and in one case a marginal decrease. At Leeds University, Paraplowing has shown an overall mean increase in the 1981 harvest of 12% when used in conjunction with direct drilling, shallow cultivation and ploughing even when Paraplowing was carried out after drilling - a practice which has been successfully carried out by a number of farmers, sometimes in desperation at the waterlogged state of their over-compacted seedbeds. Where conditions are suitable, however, the majority of users appear to carry out some form of scratch tillage first, followed by Paraplowing, then drilling, though a small number use it in conjunction with the plough. A Scottish potato grower reported that the machine paid for itself loosening his potato field headlands alone.

5. Some of the most satisfactory results of Paraplowing came from its use in grassland, where generally the compaction from poaching and traffic is really quite shallow. Our Company has had farmers ringing up to report

that last winter /which in England was so wet that many pastures were nearly ruined by turning out the cattle too soon/ Paraplowed fields were able to carry stock virtually without damage, while alongside untreated pastures were fast becoming quagmires. The machine, however, should not be used just prior to expected spells of dry weather as the subsequent loosening may dry out and retard grass growth. Also, when used shallow, the legs should be set closer together to achieve proper all-over loosening.

6. The frequency of Paraplowing will depend on the soil and the amount of damage caused by subsequent farming operations. On the heavier soils, it would only be necessary about every three years, but Paraplowing is not a substitute for proper field drainage.

In dryland areas and land in the semi-arid tropics, the problem is not one of drainage but of saving moisture and allowing the soil to soak up and hold water when it does rain /often violently/ without surface runoff and erosion. Here, the Paraplow is the ideal "water harvester", fulfilling this very role, and even in well-managed conditions its use can show dramatic results. The introduction last autumn of our new high clearance trash leg version, capable of operating in deep surface trash up to 25 cm thick, has caused quite a sensation in the United States, where in some areas they have been losing up to 30 tons of topsoil per acre annually down the Mississippi. Initial trials at the International Institute of Tropical Agriculture /Nigeria/ gave a 15% crop response even though standard legs /rather than trash/ were used on this trial. In France, use of the Paraplow for planting maize has given yield increases from 15% to 92% /Table 2/.

Table 2
Maize yield in 1983
/Source: Howard Rotavator Co., France/

Place of origin	Soil type	Green matter yield, t/ha		Difference, %
		Traditional technique	Paraplowing technique	
Nort-sur-Erdre	siliceous-silty	54.0	62.0	+ 15
Thehillac	clayey-silty	48.7	56.8	+ 17
Sainte-Cécile	clayey	45.0	54.0	+ 20
Sainte-Cécile	clayey-silty	52.0	70.0	+ 35
Chantonay	clayey	37.0	71.0	+ 92
Arzenay	silty-clayey	46.0	54.0	+ 20
Feneu	silty-clayey	55.6	71.5	+ 29

The development of the Howard Paraplow, simple though it looks, has been a long and fascinating /and expensive/ business involving air-lifting prototype machines and development teams to various parts of the World to test it in different soil and climatic conditions. It is very satisfying, therefore, to find that it is proving to be such a benefit to farmers world-wide.