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ROTHAMSTED RESEARCH

Power for Cultivation and Haulage on the Farm

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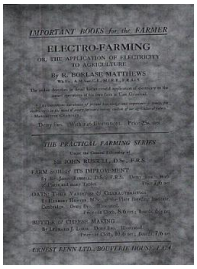

Rotary Tillage

R. D. Mozer

R. D. Mozer (1928) *Rotary Tillage ;* Power For Cultivation And Haulage On The Farm, pp 34 - 38 **- DOI: https://doi.org/10.23637/ERADOC-1-199**

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superseded by motors. I feel, however, that it is better for most farmers to hire rather than to purchase a motor, as, in these days of telephones, there is no difficulty in bringing a motor to the farm almost at any time, which is a wonderful convenience.

In conclusion, it is obvious that mechanical power applied to agriculture is an important factor making for the improvement of farming conditions—a factor which may prove to have a very special appeal to the oncoming generation—and if in this way we can raise the standard of life on the countryside it will be due very largely to the skill and resource of our agricultural engineers. I hope that their efforts on behalf of agriculture may still further result in "better farming, better business, and better living."

ROTARY TILLAGE

By R. D. MOZER

Simar Rototillers

The subject of "Rotary Tillage" is not a simple one and is not easily condensed, and I must confine myself to stating a few facts and deductions which may prove to be the basis for subsequent developments of this intricate matter. In certain phases of farm management the question is relatively simple—harvesters, automatic milking machines, and many other power-driven implements are manufactured along more or less standard lines, and often there remains only the problem to choose such machines as will give long life and continuous service.

In the department of tillage operations, however, the problem is more difficult. As a general rule, the farmer knows instinctively that such-and-such processes will yield certain results, but there is a wide gap between the process and the final result, and he is accordingly loth to change anything from his former methods, because he cannot foresee step by step what effect will follow the introduction of new methods at any stage of his operations. Hence the difficulties facing the agricultural engineer are very acute.

The first problem to be faced in connexion with the application of power to tillage operations is the nature of the power which should be used, but that is a problem which is beyond the scope of this paper. The second problem is whether the mechanical unit should be designed so as to make use of conventional tillage implements, or whether the implements themselves should be re-designed to fit in, as it were, with the usual consequences of the generation of power by mechanical means. Within the latter category we find

https://doi.org/10.23637/ERADOC-1-199

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only one class of implement, known in general terms as "Rotary Tillers."

There are, of course, considerable variations between the different rotary tillers, and in general there is a broad distinction to be drawn between those with rigid tools and those with elastic tools. All rotary tillers have for their object the production of a seed-bed in a single operation, and a machine capable of giving such a result without counteracting disadvantages must find its place wherever soil is to be tilled.

Mechanical power being essentially rotary in character, it is only logical to assume that such power should be employed in its original rotary form in connexion with the work of tillage. A simple illustration will suffice. In general, the axis of the rotary tilling unit is parallel to the main axle of the propelling wheels; it corresponds to the back axle of a car, and has a rolling action with the qualification that a certain breaking effect is caused by soil resistance and other factors. Most of us, however, as novices in the art of car driving, have forgotten to release at some time our hand brake and have only experienced a reduction of the maximum output of the engine, and by no means a complete extinction of power.

What probably constitutes the first recorded vision of rotary tillage as an accomplished art is to be found in the pages of Hoskyn's book *Talpa; or, The Chronicles of a Clay Farm*, written when steam-power was being adopted very largely in industry generally. Hoskyn foresaw an implement which, to use his own words, would be one "which completed the whole work of tillage as it moves along" and, "in one comprehensive act—and word—cultivation." Since the time of Hoskyn much has been said and done in the field of rotary tillage, yet it cannot be said that the results achieved, so far as a general adoption of a machine of Hoskyn's conception is concerned, are in accordance with the simple logic underlying the author's words. We need to examine in some detail the reasons why rotary tillage has not been adopted more widely than is actually the case, and it is unbelievable that this method will not be given at least the extensive trial which it deserves, so that the claims of its sponsors should at least be proved or disproved.

The introduction of mechanical power to the farm was in the form of tractors, and rotary tillers only made their appearance in this country after the War. Since the introduction of the latter machines a strong controversy has been carried on as to the respective merits of the two power units as compared one with the other, while each in turn is the subject of comparison with the horse.

Rotary tillers are generally specially designed, self-contained machines, and while modifications in design are usually possible to permit of the use of the power for such purposes as belt-work, etc., they do not at present replace horse-power to the same extent as do

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tractors. Nevertheless, it should not be impossible to effect modifications of design to rotary tillers to widen the field of usefulness of such machines to cover most farm operations.

It may be said that all the considerations which are leading to the replacement of horse-power by mechanical power in industry generally, apply, with a few modifications, to agriculture. The horse is an imperfect power generator because it consumes independently of the power supplied and whether required to generate power or not. Again, the horse consumes part of the products of the soil, and is in consequence an adverse economic unit, especially in the case of relatively small farms.

The tractor is uneconomical because, in order to get the necessary adherence, it must be given weight on the driving wheels or track. To drag a plough consuming effectively 4 h.p., a tractor weighing about 18 cwt. is wanted, which practice has shown to require an engine of at least 14 h.p., so that there is a waste of some 70 per cent. of the power generated.

This weight-cum-adherence problem is largely centred in the fact that the plough as used with the tractor exerts a backward draught. Similar considerations need not apply to rotary tillers, where the action of the revolving tines helps the whole machine forward. There is, consequently, a very much lower loss of power between the point of its generation and that of its application.

Nevertheless, rotary tillers so far produced—except the smaller types up to about 10 h.p.—have been wrongly evolved in not taking advantage of all the weight reduction which is possible. It must be admitted with some reluctance that there is at present no rotary tiller which is really fit for the farmer, and that only those more suitable for the nurserymen, etc., are at present sound commercial propositions.

The problem from the agricultural standpoint is a question of the respective merits of the plough and the implements which normally follow it, on the one hand, and the rotary tiller on the other hand. Here we are concerned only to find the best means to produce a tilth or seed-bed. On a properly managed farm the cost of seed-bed making represents about 10 per cent. of the crop value, and a 10 per cent. increase in yield as the result of better or more timely work would therefore cover this part of production costs.

Rotary tillage can effect much greater saving than this, as, for example, by eliminating several operations, by better utilization of manures—which are more uniformly distributed—and by a reduction in the amount of manure required.

The specific weight per horse-power of rotary tillers can be reduced to a minimum, and this reduction means that there is less compression of the soil. A distinction can also be made between the low compression of the soil and the low-friction effect of a set

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of independently mounted tines, and the comparatively high friction between the plough and the solid earth which it is required to turn over in large masses.

The fact that the work of tillage is completed in one operation with the rotary tiller is an unquestionable advantage in spring cultivation, and, as seeding is the only operation subsequent to tilling, compression of the tilled soil is still further reduced. Again, the action of the rotary tiller is such that instead of the hard, smooth pan which is left by the plough, the bottom of the tilth is left rough, obviating the necessity to subsoil and permitting percolation of water during rainy periods, to be stored as a reserve for the top soil. Next, it is claimed that the tilth produced with the rotary tillers is a much more uniform and a finer one than can be secured by any other means, with the possible exception of very careful hand labour. The fine even texture of this tilth is productive of better aeration, while it is of considerable assistance in promoting free and rapid root growth.

The principal criticism against rotary tillage is its unsuitability for autumn cultivation. It is thought that because the tilth produced is such a fine one there will be a tendency, with heavy winter rains, for the soil to pan down and set hard. This is a point on which there is much conflicting evidence that must be carefully sifted before any general verdict can be passed. In any case it should be possible to modify the design of the tiller to enable a much coarser tilth to be obtained at will.

The question will be asked as to what evidence there is in practice that the claims for rotary tillage are justified. In the commercial field, rotary tillers are now comparatively well known amongst fruit-growers, market-gardeners and nurserymen, and have justified themselves to a much greater extent in connexion with intensive farming than with farming in its more general aspect. This is not surprising, since the principal objection to rotary tillage—namely, its probable unsuitability to autumn tillage—does not apply in this particular sphere. On the other hand, all the admitted advantages of rototillage apply. Market-gardeners require a fine seed-bed, ability to catch the weather, and facilities for sowing a fresh crop immediately the preceding one has been harvested.

As applied to the raising of root crops, very favourable reports are available, and one case is recorded of rotary-tilled soil yielding a potato crop of 30 tons to the acre. Very favourable results have also been secured with swedes, turnips, mangolds and sugar-beet. On the other hand, a conflicting experience was obtained at this Institute, where swedes were grown in three plots which had been respectively horse-ploughed, tractor-ploughed and rotary-tilled. The latter plot at first gave every promise of being the best crop of the three. Suddenly there occurred a marked change. The soil

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became "panned" or hard, the appearance of the foliage fell away considerably, and, in the final result, the crop was inferior in weight to that of the other two plots. My company has been invited to participate in further experiments at this Institute to ascertain whether this apparently deleterious effect of rotary-tilling can be overcome by the simple expedient of inter-cultivation at defined stages during growth. If, with one additional passage with the rotary tiller, with its tines set shallow to skim the surface, the pan can be quickly and effectively disturbed, there will be an answer to the somewhat widespread belief that the rotary tiller is unsuitable as an autumn cultivator.

Leaving once again this rather controversial field we can give a few 'moments' consideration to other points where the rotary tiller is of undoubted benefit. By a simple depth-regulation arrangement it is possible to use these machines, not only in the preparation of the soil for seeding, but for cultivation at all stages of growth. In the summer months they can be used to promote a fine surface mulch which is of such great benefit in helping to tide over the effects of scarcity of rainfall. They will deal efficiently with weed growths of variable natures, though it is to be noted that repeated cultivation is the *modus operandi* for destroying these pests effectively, for, unless frequent cultivation is resorted to, a marked increase in weed growths is noted, which is incidentally a finger-post pointing to the possibilities of rotary tillage as a fertilizing method.

Reviewing the field covered by this new method it may be stated that rotary tillage is an accomplished fact in certain departments. It exists as a fully evolved commercial force in such work as nurseries and for specialized crops, and it is extremely useful in its present form for certain farming operations requiring intensification of methods. The larger types of existing rotary tillers represent by no means the last word, and we may say that, so far as general farming is concerned, rotary tillage is still in its infancy. It is doubtful if there is one agriculturist who is not sufficiently far-seeing to watch with interest the developments in the practice which are bound to take place during the next few years, and, to quote Hoskyn once more: "In the Arts as well as in morals, difficulties are opportunities."

https://doi.org/10.23637/ERADOC-1-199