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Science for the Farmer — II

Grass for Fertility

by

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During the last few years there has been in this country a spate of talk about scientific farming and carrying science to the farmer. The sum and substance of all this talk that is being made seems to me to be nothing but a lavish use of ammonium sulphate and insecticides. My ten years' study of agriculture has, however, given me a totally different idea of scientific farming. I am attempting to express here the essence of what I have learnt, in the hope that if I am wrong, some expert will put me right.

I have gathered that the type of soil fertility which results in high productivity depends firstly, upon a certain physical condition of the soil. The physical properties of the soil which determine productivity are known collectively as "soil structure" by which is ment the state of aggregation of the soil particles on which depend the principal air and water regimes of the soil. In a structureless soil the separate particles tend to pack into the smallest possible space, producing a minimum of porosity, aeration, permeability, and water-holding capacity, which are qualities indispensable to the healthy growth of cultivated crops. We are told that experience has shown that the degree of granulation of a soil is a rough measure of its state of fertility, and that the higher the state of granulation of any given soil the more productive it will be, as measured by crop yields.

Considerable research has been made on this so-called "granular structure", (commonly also spoken of as "crumb" structure) in which the granules or crumbs are formed when separate particles of sand, silt, clay etc. are cemented together by means of the organic and inorganic colloids in the soil. Innumerable experiments have been made to study the effect on crop yields of varying degrees of granulation in the same soil with other factors like manuring kept constant. I quote only one instance. Striking results were observed in an investigation of the relation of onion yields to degree of soil granulation. The yields of onions increased from 157 bushels per acre to 487 bushels, more than threefold, as soil in granules larger than 0·5 m.m. increased from about 21 to 37 percent. This high yield was obtained in a rotation in which the onion crop followed two years of grass. In an earlier experiment

on similar soil the onion yield increased from 72 bushels to 524 bushel with an increase in granulation from 21 to 37·9 per cent. Another effect of improved soil structure of immense importance to us is that a granular soil offers considerable resistance to erosion even when bare of vegetation.

Humid climates exert a disintegrating effect on soil structure and granulation is less highly developed than in more arid climates and destruction of soil structure is very rapid under heavy rainfall. Both these factors, inimical to the formation and maintenance of soil structure are present on our West Coast. Add to this the fact that red laterite soil is the least fertile type of soil even to begin with and we can appreciate the importance to the West Coast farmer of systems which will develop and maintain a high degree of granulation.

What I read about soil structure so impressed me that I felt forced to take stock of my own farming. Logical thinking is indispensable to scientific method. I found myself facing two facts :—

1. The extremely low fertility of my sandy soil which was in most parts of the farm below even what may be called the threshold level, below which even weeds do not grow.

2. It is notoriously difficult to bring pure sand without even a trace of silt or clay into a state of aggregation of the sand grains. If, I said to myself, I am to make my farming venture pay, I must first restore " structure " to my structureless soil. What is the most efficient and most economical method of bringing about aggregation into granules? The advice most commonly thrust on one is to add silt or clay. This is from my experience, the most expensive and at the same time the most inefficient method, It means merely heavy capital expenditure which will not yield an adequate return even in the first year of application; and in this deep sand no trace of the silt or clay will be visible after a couple of years of cultivation. In any case even this ephemeral effect of added silt will be only on the top three or four inch layer of sand. The temporary beneficial effect on crop yields produced by heavy additions of silt or clay to sands is due more to the manurial content of the additions than to physical qualities; for silts and clays can be devoid of structure, and structureless silts and clays are worse than sands from the point of view of plant growth, which depends on root penetration and spread.

We must first learn how these aggregates, granules, or crumbs are formed out of discrete particles of soil, for every type of soil-silts, clays or loam – will be structureless unless the necessary causal factors are present in the soil.

The two causal factors are — (1) root action
— (2) the cementing substances which are formed when organic matter is reduced to humus by the action of soil bacteria and fungi.

Though both are necessary for aggregate formation, root-systems play an active part and are therefore the more important; for investigations have shown that farmyard manure, composts or green manure, fail to have the desired effect on soil structure. The root systems of plants by themselves will have the desired effect upon the soil because they are also the source of much humus to cement the soil particles into aggregates. Organic manures accelerate the processes by serving as a source of ample food for bacteria and consequent rapid conversion to humus. The addition of farmyard manure and ripe compost will also provide ample supplies of microbes to soils like sands with low microbial populations. If that is all there is to restoring soil structure, are we not growing crops which have root systems and manuring them, even if inadequately, with organic manures? Why then should any special measures be necessary to form soil aggregates? Unfortunately, it seems that (to make the farmers task more difficult) Nature has decreed that granulation can be effected only by a special type of root system which is denied to our normal cultivated crops. One can understand the uselessness of the paddy crop as a builder of soil structure, for in many respects it is an abnormal crop revelling in puddled, swampy conditions which destroy all structure, but even the dryland, cereal crops like sorghum apparently have not the type of roots which can form aggregates. Moreover, to get good yields from our crops we have to do so many cultivations, hoeings, weedings, and irrigations; all operations which tend to destroy structure, that after a few successive cultivated crops, there is very little left of the aggregates that might have existed at the start.

The most efficient natural producer of granular soil structure is grass and this is one more reason why livestock are said to be inseparable from good farming. Soil granulation in all climates, we are assured, becomes greater under perennial grasses than under any other kind of vegetation. Several explanations of the action of a

grass crop in granulating the soil have been given, but, for us farmers, the essential fact is that under all circumstances it does have this granulating effect which, from the point of view of maintaining on increasing soil fertility, is one important reason for introducing perennial grasses in the crop rotation. Some other observations derived from scientific research which are of practical importance to farmers are:—

(1) Even grasses vary considerably in their granulating ability because of differences in their root-system and habits of growth. For instance, among tropical grasses, which alone are of any use to us in this part of our country, the most outstanding in graulating ability is said to be elephant grass, whereas a stoloniferous grass with stolons buried deep in the soil like *Panicum repens* is practically useless. *Panicum repens*, in spite of its palatability, drought resistance, and its ability to survive and grow in the most unpromising soil, is an obnoxious pest on arable land.

(2) The most active part of a grass crop in aggregate formation is the root system which is not only the source of much of the humus, which cements the soil particles in aggregates but also has a purely mechanical action which assists the formation of aggregates of the right size while preventing the soil from coalescing into clods.

(3) In the tropics, Uganda was the first colonial territory to adopt the grass–resting period for the restoration of soil structure as the corner-stone of its agricultural policy. The Uganda investigations have shown (a) farmyard manures and composts fail to have the desired effect on soil structure. (b) the root systems of legumes are not so valuable in crumb formation as are those of grasses.

(4) Legumes add fertility by the nitrogen-fixing activities of nodule bacteria but their root systems produce only a cloddy structure throughout the root-inhabiting layer which, though it assists aeration and peremeability, particularly in the deeper layers, has not the effect on the following cereal crops in the rotation, which the well-developed medium to fine structure in the top 18 inches to 2 feet of soil produced by grasses has on increasing yields of crops which follow grass in the rotation.

(5) The optimal air-water regimes throughout the entire soil to a depth of several feet is therefore effected by a mixture of legumes and grass. Numerous investigations have indicated the superiority, from the structure point of view, of a mixture of grasses and legumes over either component separately.

For this as well as other reasons, in all those countries which grow grass as a crop for fertility restoration and livestock maintenance "grass" has come to mean the sward produced by sowing a seeds mixture of grasses, legumes, and possibly other plants.

In Europe, grass is an essential crop invariably grown in the rotation though farmyard manure is so plentiful that the minimum basic dose used is 10 to 15 tons an acre. Though we have in this country hundreds of millions of cattle, farmyard manure is conspicuous by its absence on the average farm and yet nobody ever thinks of growing grass for restoring fertility or even just for feeding our animals.

Only one who keeps all these facts in mind will realise the full import of what one expert said :—

"Grass is the most important natural product that the country can possess. Grass restores natural fertility to the soil more quickly and more effectively than any other form of vegetation. Grass maintains the fertility of the soil longer than any other crop. Grass creates structure in soil more effectively than any other plant growth, and thereby renders it less liable to erosion than is the case under any other form of plant cover. The neglect of grass cover spells declining soil fertility and a crumbling agriculture; then poverty, ill-health, disease, hunger, starvation and national disaster follow".

We have always neglected grass and ruined our communal grazing grounds. Soil fertility has already declined and erosion has begun to be a serious problem. Our agriculture has been crumbling and we have poverty, ill-health, disease, hunger and starvation. Remains only national disaster to follow. Our community projects and our expanding extension services can save us from the inevitable national disaster only if they show a proper appreciation of the value of grass and the animal factor in the restoration of lost fertility and prevention of erosion.

The need is for a re-orientation of food and fodder production policies and the re-arrangement of ideas about farming generally.