

Maintaining Soil Fertility.

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Having lived for a number of years upon a southern Kansas wheat farm and observed the steady decrease in the productive power of the land, the writer has been interested in investigating practical methods by which this loss might be prevented and the soil maintained in a high state of productivity.

For years, many farms in the Kansas wheat belt have been sown continuously in wheat. This means that every year with a crop of twenty bushels, there have been removed from each acre of such farms, thirty-five pounds of nitrogen twenty pounds of phosphoric acid and thirty-five pounds of potash.

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Only in rare cases have any fertilizing materials been returned to the soil. On a wheat farm but little stock is fed and hence little manure is produced.

That little, too often is wasted through careless handling. A large part of the straw is burned at threshing time on the largest farms because there is no use for it.

Our comparatively new soil has withstood this steady drain so well that wheat is still profitably grown over a large part of the state. But on the lands longest cultivated, the diminished yields of grain clearly indicate that a new system of farming must be inaugurated.

The injury wrought to a soil by continual cropping

with wheat is of two kinds:

First, the soil is quickly drained of its nitrogen the most important element of plant food. Second, the soil is brought to a bad physical condition. Chemically viewed, old wheat lands are not in bad condition. The only element which is likely to be seriously deficient is nitrogen. Not only has a large quantity of this element been removed annually in the grain, but the system which leaves the ground bare during the summer permits loss of nitrogen by oxidation and leaching.

The yellow, spindling growth of wheat in many fields that have been long sown to wheat is due to lack of nitrogen.

The unproductiveness of the soil is largely due also to

the unfavorable physical condition.

The constant cropping with wheat has destroyed the supply of humus originally in the soil.

A soil with little humus is subject to several ills: - Such soils wash badly. Humus binds the soil particles together thus preventing washing. With the depletion of the supply of humus, many fields have begun to wash and if not remedied will become as hopelessly ruined as are many of the old cotton fields of the South. Not less destructive than washing is the drifting of soils in heavy winds.

The capacity of a soil for holding moisture depends largely on the amount of humus it contains. Manuring a sandy or loamy soil may increase its water holding capacity as much

as sixty five per cent. Soils with little humus will often appear very wet at the surface when they contain a relatively small amount of water. Heavy rains result in puddling such soils and when evaporation takes place a crust is formed which excludes the air and thus prevents nitrification and the proper growth of plants. These are the conditions prevailing in many of our older wheat fields. The one crop system has been the bane of agriculture in the South and will be here if continued long enough for its results are invariably disastrous to the soil.

We can not continue indefinitely to raise wheat alone.

The time has already come when we can not secure a

profitable crop by this method of farming. (While wheat can not continue to be the only crop grown, it may still remain the money crop. By restoring the land to its former state of productivity and by crop rotation and manuring and by more thorough tillage we shall be able to make larger profits with one third of the farm in wheat than with it all in that crop.

The matter of restoring our lands to a productive condition is not a difficult one because even our oldest soils are far from being worn out.

For some soils it may be economy of time and money to purchase and apply commercial fertilizers. To decide what is needed, a plot of ground of as uniform quality

as possible should be selected. It should also be as near as possible like the soil on the remainder of the farm. This plot should be divided as nearly as possible into eight equal parts leaving a three foot space between them.

A convenient size for the plots is 204 ft. long by 10 ft 8 in. wide, containing 2176 sq. ft.

By applying different fertilizers on each plot and comparing the results the need of the soil may be found. Corn is a good crop to use in this test which may be carried on two years to give accurate results.

The plots are treated as follows:-
Plot No 1 receives nothing

" " 2 " sodium nitrate,
acid phosphate and potassium
chloride or sulfate.

Plot No 3 receives nitrates and

phosphoric acid.

Plot No 4 receives nitrates and potash.

" " 5 " only nitrates.

" " 6 " phosphoric acid
and potash

Plot No 7 receives potash alone.

" " 8 " Phosphoric acid
alone.

An increased yield from plot No 3 would indicate a lack of nitrogen and phosphoric acid.

If plot No 5 also gives good results, the soil evidently needs nitrogen. Suppose that plot No 8 gives an increased yield, the need of phosphoric acid would be indicated.

To determine the amount of a fertilizer needed, two crops of widely different powers of assimilation should be used. For example, to test the amount of phosphoric acid needed, turnips

and barley should be grown upon plots to which phosphates have been applied. If both crops give increased yields, a decided deficiency in phosphoric acid is indicated. If only the turnips respond, the soil has a fair supply of available phosphoric acid.

Should phosphoric acid be found lacking, it will be necessary to supply it in commercial fertilizers or barnyard manures.

The same is true of potash although it is usually abundant in our soils.

Nitrogen can best be supplied by cropping with legumes or in manures. If nitrogen be supplied in this way, the soil gains humus at the same time and thus the proper physical condition of the soil can be restored.

Supplying a soil with all

the necessary elements of fertility does not insure productiveness if the physical condition is bad. The presence of humus in the soil is essential. As mentioned before, humus prevents washing, baking and drifting of the soil, and increases the water holding capacity. And by its decay, humus contributes to the growth of the plant by supplying it the nitrogen element of plant food.

The humic acids formed by decaying vegetable and animal materials in the soil, have the power of combining chemically with the potash and phosphoric acid which otherwise would be unavailable as plant food.

Thus we see how important is the presence of humus since it not only improves the physical condition of soils but also

supplies plant food.

Humus may be applied to the soil by seeding it to grass, by the application of manure or by plowing under green cover crops.

The latter is the quickest and most practical way in southern Kansas. No tame grass has proven generally successful so far and the application of farm-yard manure is of course not possible on large fields.

There are two legumes which are excellent crops for green manuring. These are the cow pea and soy bean. To get good results it is necessary to inoculate the soil with the bacteria which live upon the roots of these plants. If bacteria are not introduced, the soil will not be made more fertile as regards nitrogen. The inoculation

may be made by sowing along with the seed a little of the infected soil from a field in which these plants have been grown. If a heavy growth results it is advisable to lime the land to prevent the formation in too great quantity of free humic acid when the plants decay.

After one or two green manurings, the soil will possess a largely increased supply of humus and of nitrogen.

The object of the farmer from now on should be to maintain or improve his land with regard to productivity. The means at his disposal will be crop rotation, manures and improved tillage. Most of the farmers of the state came from the east where rotations with grass and clover are regularly practiced. Since grass

and clover refused to grow successfully in central Kansas and no substitutes for them were known, the idea was generally accepted that rotations were not practicable.

In later years the cow pea and soy bean have been tried and found to be successful drouth resisting crops. They possess all the value of clover as nitrogen gatherers and are fully its equal as forage producers.

Soy beans may be sown in the stubble after the wheat crop is removed. Shallow listing has proved a very successful method of planting. By planting a fairly early variety as Early Yellow, a fair crop of forage may be produced and harvested in time to prepare the ground for seeding to wheat.

Double disking the ground and harrowing would be a better prepara-

tion than plowing. This method is practicable only where the rainfall is rather heavy. In the western part of the wheat belt the soy bean crop should be allowed a full season for its growth. By selecting an early variety and planting as soon in the spring as the ground is warmed, the crop may be harvested in time to admit of a thorough preparation of the seed bed for wheat and allow the accumulation of sufficient moisture to give the wheat crop a good start.

One of the chief difficulties of raising soy beans has been the harvesting of the crop. This difficulty has largely been overcome however. There are on the market today several makes of bean harvesters which do the work rapidly and efficiently.

Alfalfa must not be overlooked as a factor in maintaining soil fertility. Because of the difficulty in securing a good stand and the fact that it is several years in attaining its full development, it is not profitable to let it stand less than six to ten years. Hence we must look to other legumes for shorter rotations.

For a short rotation in the wheat belt, I believe that the following is thoroughly practical:

First year, wheat. Second year, oats and kafir corn in proportion desired. Third year, soy beans.

This does not include that part of the farm which was sown to alfalfa. Allowing one fourth of the farm to be given to alfalfa and allowing the crop to stand six years, the entire rotation would be wheat, oats

and kafir corn, soybeans, wheat and so on for eighteen years when alfalfa would follow the last crop of soy beans and continue for six years. making a rotation for twenty-four years.

While this rotation does not give to wheat the largest acreage, it does give it the most favored position in the rotation. The wheat is sown in a soil of good tilth stocked with nitrogen by the soy bean crop. The wheat is followed by kafir corn and oats both of which are more vigorous feeders than wheat.

By this system the soil will retain an abundance of nitrogen and humus. But as with all systems, unless plant food is supplied to the land in the form of manure, the phosphates and potash will grow less. The

farmer can not afford to waste the smallest part of the manure produced on the farm and he should feed all field products if possible on the farm. With the greatest care in saving the manure, there will be a loss of twenty-five percent of the fertilizing constituents of the feed.

Stables and cattle sheds should be built with a view of saving the manure as easily and completely as possible. A manure spreader should be on every large farm.

In the rotation just discussed the best time to apply the manure would be during the winter when it could be spread on the ground intended for corn the next spring. By composting the manure and spreading it on the field just before plowing there would be very little

loss by leaching. Hauling it out as produced involves less labor and more loss. Circumstances will decide which method to follow.

After everything has been done to furnish the soil with an abundance of the elements of fertility, it must be remembered that thorough tillage is necessary to secure the highest yields of grain. The great agricultural chemist, Liebig said that the influence of tillage upon the fertility of a soil is marvellous. The verification of this statement may be seen today. It is the chief means by which the English farmers have produced yields so far superior to those secured by the American farmers. Tillage renders the plant food of the soil more available. It especially promotes nitrification

This is one reason that wheat sown on a well prepared seed bed makes a more vigorous growth than when sown on freshly turned soil. In a lesser degree potash and phosphoric acid are rendered available by tillage. On light sandy soils, much less tillage is needed than on heavy clays and loams. But it is safe to say that there are few if any Kansas farms that increased tillage would not render more productive. The one crop system will no longer pay. Henceforth the successful farmer will find his profits coming through rotation of crops, manuring and better tillage.