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Why Is Subsoil Unproductive?

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A good crop of broomcorn is shown in the background on uneroded soil, compared with a stunted growth in the foreground on a spot where erosion has left the infertile subsoil exposed.

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LEVELING of land for irrigation by removing the surface soil from the humps and depositing it in the depressions is often necessary on Colorado farms, and as a result many spots of the infertile subsoil are left exposed. The erosive action of wind and water frequently causes surface soil removal and subsoil exposure.

The loss of fertility through the latter agencies recently has come into prominence as a matter of national concern. The fact that the soil is less productive when the surface has been removed, and that erosion is a vital problem, has received much attention. Much less attention has been paid to the problem of repairing the damage done through the loss of the surface soil, and the cause of the loss of fertility has been shrouded in considerable mystery. An impression is widespread that nature took many years to build the blanket of fertile topsoil and that once the topsoil has been removed the same number of years must elapse while natural forces rebuild this blanket.

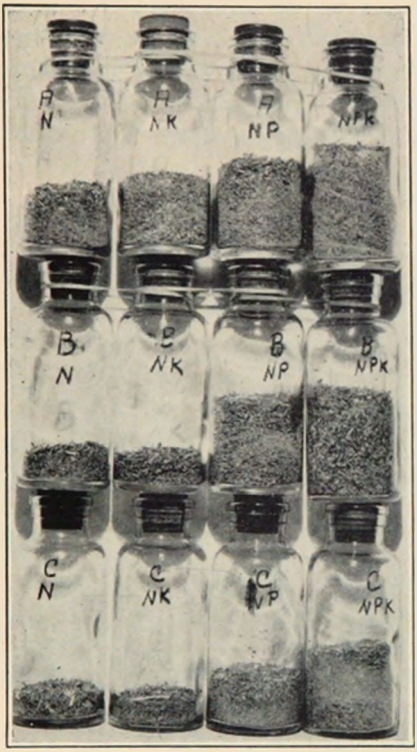
Why is topsoil so important, and what can be done to restore fertility to land depleted of its valuable surface layer?

The recent awakening of the public through the soil conservation movement has left these unanswered questions in the minds of farmers. What are the answers?

Evidence from laboratory and greenhouse studies made of Colorado soils indicate that a lack of available phosphorus and nitrogen in the subsoils accounts for a large part of the decrease in crop yields following loss of the surface soils. It also indicates that the subsoils are comparatively well supplied with available forms of most of the other essential plant foods.

FIELD tests are yet needed to verify the laboratory and greenhouse results, but under laboratory and greenhouse conditions good growth of the common field crops has been produced by adding only nitrogen and phosphorus fertilizers to subsoils which were so poor that they would produce practically no growth without fertilization.

These sunflowers are shown 5 weeks after they were planted in samples of soil from 45 northeastern Colorado fields. A, B, and C represent the depths of 0 to 8 inches, 8 to 18 inches, and 18 to 36 inches, respectively. From left to right, the first group three cans wide and 45 cans deep all received nitrogen, phosphorus, and potassium; the second group received nitrogen and potassium; the third group received nitrogen and phosphorus; and the right-hand group received nitrogen only. Better growth is quite evident in the first and third groups. A dwarf sunflower was used because it is convenient to grow and responds well to differences in fertility.



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The jars shown here contain the yield of dried, ground sunflowers obtained in experiments with soil taken from 45 irrigated fields of northeastern Colorado. Material in the top row of bottles was grown on soil taken to a depth of 0 to 8 inches, the middle row on soil which came from a depth of 8 to 18 inches, and the bottom row on soil taken from a depth of 18 to 36 inches.

Vertical row 1 contains material grown on soil fertilized with nitrogen; 2, on soil fertilized with nitrogen and potassium; row 3, on soil fertilized with nitrogen and phosphorus; and row 4, on soil fertilized with nitrogen, phosphorus, and potassium.

Slightly better yields were obtained with nitrogen, phosphorus, and potassium than with nitrogen and phosphorus, but no marked potassium deficiency was evident. The results indicate that only nitrogen and phosphorus are necessary to make the subsoil practically as productive as the surface soil, so far as sunflowers are concerned.

Acute deficiency of available phosphorus is found in western as well as eastern Colorado subsoils. The sunflowers shown here are growing on subsoil from a pear orchard near Grand Junction. The soil in the can at the left received phosphate and nitrogen; the soil in the can at the right received only nitrogen.

Other plants as well as sunflowers suffer from lack of phosphorus when grown on subsoils. The corn plants at the top and the alfalfa plants at the bottom of this illustration were grown on samples of subsoil from eastern Colorado. The plants at the left in each case received phosphate, while those at the right received none. These are typical examples of the effect of phosphate on such plants when they are grown on subsoil.

WITH sugar beets as well as with sunflowers all that was needed to produce plants fully as good as those grown on the surface soils was the addition of nitrogen, phosphorus, and potassium to the subsoils. The sugar beets in the illustration below were grown on some of the same soil samples used in the previous test with sunflowers after the sunflowers were harvested. Plants grown on soils receiving nitrogen and phosphorus only are not shown, but they were practically as good as those receiving all three elements.

This picture shows that subsoil receiving nitrogen, phosphorus, and potassium as fertilizer produced much better growth in sugar beets than subsoil receiving nitrogen alone. Both rows of pots marked "C" (the two inside rows) contained subsoil from the 18- to 36-inch level; both rows marked "B" (rows next to outside) contained soil taken from depths of 8 to 18 inches; and both rows marked "A" (outside rows) contained topsoil. Pots in the three rows on the left received nitrogen, phosphorus, and potassium; pots in the three rows on the right received only nitrogen.

FIELD experience is not lacking to show the value of materials containing nitrogen and phosphorus on denuded subsoils. Manure which is rich in nitrogen and carries some phosphorus has been used with good results for a long time by farmers in restoring fertility to scraped or eroded spots in their fields. It seems certain that much quicker results often could have been obtained by adding phosphate in addition to the manure.

Field results from fertilizer treatments cannot be expected to be as outstanding as those made in the greenhouse, and the experimental evidence at present available is not sufficient to warrant the recommendation of nitrogen and phosphorus as a cure for all the evils of the loss of the fertile topsoil. However, on the basis of the available evidence, it is safe to recommend trial applications of phosphate along with manure or a commercial nitrogen fertilizer on at least a portion of areas which do not produce well because of loss of topsoil.

The laboratory and greenhouse experiments indicate that an application of from 100 to 200 pounds of treble superphosphate with 20 tons or more of manure per acre should give good results on most eroded or scraped irrigated land. In cases where less manure is available, from 100 to 600 pounds of ammonium sulfate (the amount depending on the manure available) should generally increase crop yields. Also, legumes turned under as green manure are effective means of restoring nitrogen to the soil.

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