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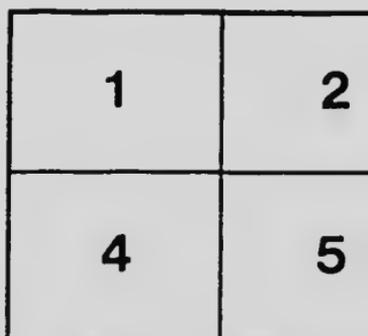
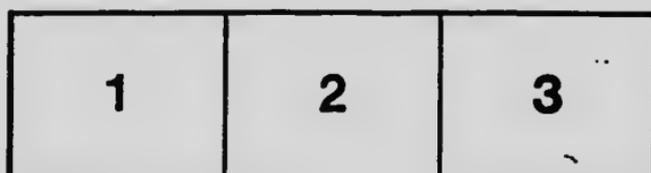
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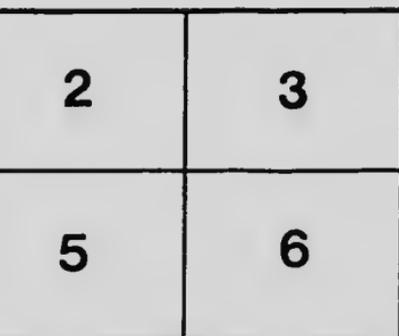
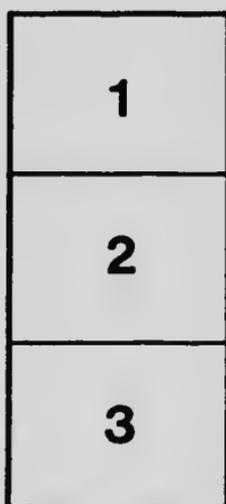
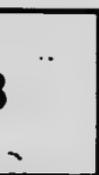
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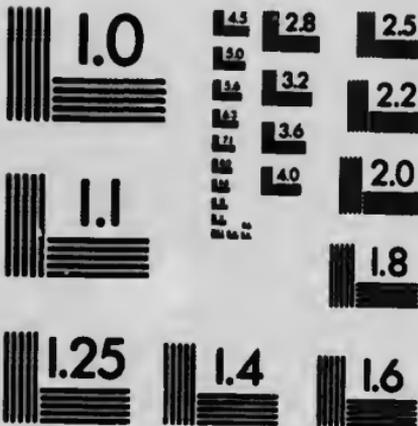
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*Soil Physics Department.*



## Suggestions on the Treatment of Alkali Soils

As the price of farm lands in Western Canada advances, the question of bringing small areas of alkali land into proper condition for crop production must receive more attention. An alkali spot or two of from one to five acres in extent upon a good farm will often spoil the sale of the place, the purchaser fearing that more of the land may prove alkali during unfavorable seasons. The suggestions in the following brief article are not for the large areas of alkali land but for the small spots varying in size from a few square feet to five acres in extent that are sometimes found on otherwise excellent farms.

### *Origin.*

In all parts of the world where the annual rainfall is less than twenty inches, soils so charged with soluble salts that plants cannot grow upon them are found, and these soils are known as alkali soils. They are simply the result of the conditions under which they were formed, namely: first, a light rainfall, not sufficient to wash out the soluble salts as is done in the humid districts; second, poor drainage, allowing the water to gather in low places; and third, the excessive surface evaporation that takes place in the semi-arid districts, bringing all the soluble salts to the surface in a more or less concentrated condition, where they are most injurious to crops when the plants are young and tender. It stands to reason that these soils should be as productive as the surrounding soils of the same origin if they are properly reclaimed, and in many cases this has proven to be true.

### *Two Classes of Alkali.*

There are two classes of alkali soils, "white" and "black," so named on account of the color given to the soil. The white alkali is by far the most common in occurrence in Manitoba, and is largely due to the accumulation of common salt, Glauber's salt and Epsom salt, which

give it a white color. Black alkali is far more injurious to plants, and is due to the presence of sodium carbonate (washing soda) along with the above named salts. Sodium carbonate dissolves the vegetable matter in the soil and gives the soil water a dark brown or coffee color.

#### *Harmful Effects of Alkali.*

All plants take their food from the soil in the form of a weak solution. In alkali soils the soluble salts make the solution so strong that the plants cannot take up the moisture, and in some cases actually give up moisture to the soil and die. Hence we often find that alkali is the most injurious in seasons having fairly good spring rains followed by a dry summer. The spring rains dissolve a large amount of the salts, then, during the dry summer, excessive surface evaporation takes place, bringing the salts up into the root zone in a concentrated condition, causing the plants to quickly succumb to the drouth.

Black alkali also dissolves the humus in the soil and corrodes and eats away the stems of the plants at the surface of the ground. This is most apt to occur when plants are young, but may take place any time during the season.

Both classes of alkali, and especially black alkali, tend to destroy the soil's texture, breaking down the granular condition, causing it to become impervious to water, puddle when wet, and bake in bad clods when dry. This makes it very difficult to work such soils.

#### *Treatment.*

Many ways of handling alkali soils have been tried in the past with varying results. Remedies quite successful in one locality have proven utter failures when tried in other districts. It is well to state at first that no chemical means of treating white alkali has proven economical or practical.

#### *Drainage.*

As poor drainage is usually one of the direct causes of alkali, the first step in treatment is to supply the best possible drainage. The high cost of tile drainage eliminates this method at present, but a few open ditches will often remove the surface water in the spring and prevent it from collecting in these low places.

#### *Cultivation.*

After the best possible drainage has been secured, heavy application of strawy horse manure should be made at the rate of from fifteen to twenty tons per acre during the summer or early fall. The manure has three beneficial effects, first, it makes the soil more open and porous,

allowing better drainage, preventing both puddling and baking; second, it will act somewhat like a mulch, preventing surface evaporation and gathering of the salts at the surface; third, it will supply the young plant with available plant food in the spring, when the alkali soil, which is inclined to be cold and dead, will not. Plow the land in the summer as deep as the subsoil will permit. This will leave the soil open and exposed to the snow and frost during the winter, which will tend to sweeten it for the following year, as fall plowing always tends to do. In the spring, as soon as the land is dry enough to permit, surface cultivation either with the cultivator, disc or spike tooth harrow should be followed. This will prevent surface evaporation and form the best possible seed bed for the crop. Thorough cultivation must always be maintained upon alkali soil in the spring before the crop is seeded.

### *Crops.*

Next comes the question, What crop is to be tried upon such soil? Experiments have proven conclusively that plants differ widely in their ability to withstand alkali. What we want is a crop that will aid in removing the salts and at the same time give a profitable return. Of the cultivated crops, sugar beets will stand the most alkali and give good returns.

They are an inter-tillage crop, being cultivated between the rows like corn, thus keeping a surface mulch on the ground. They also absorb large amounts of soluble salts, and remove the salts in this way. Sometimes the first crop on such soil will absorb such a large amount of salt that cattle will refuse to eat them, and if starved until they do eat the beets the effect is the same as a physic. In Manitoba sugar beets are planted from the 15th to June 1st at the rate of four pounds of seed per acre, the seed being of an inch and a half, in rows thirty to thirty-six inches apart and the plants to nine inches apart in the rows. The Danish sugar beet is a good variety, and will yield from 400 to 500 bushels per acre. The roots should be pulled in the fall before the frost and the tops cut off not too short. They make an excellent succulent winter feed for all classes of live stock and especially for dairy cattle.

The seeding can be done by using the common grain drill, mixing one-third seed with two-thirds barley chop, stopping up the tubes in the drill to make the rows the required distance apart and regulating the drill to plant the seeds at the required rate in the rows. The crop should receive three or four surface cultivations during the summer to keep down the weeds and prevent evaporation. It is sometimes necessary to raise a beet crop the second year on bad spots, but usually it is well to plow in the fall just after harvesting the crop of beets and try a grain crop the following year. Of the grain crops raised in Manitoba, oats have proved more resistant than barley or rye, but under certain conditions barley has given more profitable results. This may be due

to the presence of different salts or to the fact that barley requires a shorter season, hence allowing cultivation to be done two or three weeks later in the spring. After such treatment the land can usually be handled the same as the rest of the field, keeping in mind that *deep preparation* and *thorough cultivation* are essential in keeping alkali soils in a productive condition. Out of the fifty students that have reported on alkali soils in the past two years, about 75 per cent. have mentioned some such treatment as outlined above, and in 85 per cent. of the cases favorable results were obtained.

The following method of treatment has given good success in several parts of Manitoba. The straw is threshed upon the small alkali spots, and the stock allowed to feed around the straw stacks. Then the bottoms of the stacks are scattered and plowed under or all the straw that will is burned and the rest plowed under. The straw acts the same as the manure, and the spots are cropped as mentioned above. Mangels may be used in the place of sugar beets, giving almost as good results.

#### *Summary.*

1. Alkali soils are due to an excess of soluble salts in the soil.
2. Caused by lack of rainfall, poor drainage and surface evaporation.
3. Two classes, "black" and "white."
4. There is as yet no economical chemical means of treating white alkali.
5. Provide the best possible drainage.
6. Make heavy application of horse manure.
7. Plow deep and cultivate thoroughly.
8. Crop with sugar beets or mangels one or two years.

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