SOIL MOISTURE

and

ITS RELATION TO CROPS.

by

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SOIL MOISTURE AND ITS RELATION TO CROPS.

While generally the soil of Kansas is said to be abundantly rich in all the essential elements of plant life and the climate well adapted to the growth of plants, yet in many localities in Central Kansas each year we find light crops and thought they seem to have b been carefully cultivated, yet the yield was small and the farmer generally attributed it to lack of sufficient moisture. Most of the leading Agriculturists of the state claim, however, that in all parts of the state, excepting possibly the extreme western portion, there is sufficient moisture to mature a large crop but that the fault is with the farmer who fails to properly conserve and economize that moisture which is at his disposal and as a result, of his excessive waste of moisture the crop is short.

Of course before the farmer can economize soil moisture he must must have it to economize, that is, there must be sufficient rainfall each year to mature the desired crop, and then when this condition is fulfilled it remains for him to use all the means in his power to use the water to the greatest advantage and this is done by proper cultivation and crop management.

With a view of determining as near as possible the amount of moisture at the disposal of the crop for the three months of April May and June, I took a series of ten soil samples on the Kansas State Agricultural College farm. The samples were taken at the depth of five feet, but only the first four samples were used finally, as the root system does not extend below this very often and though capillarity

larity draws a considerable amount of moisture from below this depth, yet this comes from water that has percolated through the first four feet of soil, and as I had no means of determining the amount thus lost, I used the amount of water in the first four feet only, letting the amount gained by capillarity offset the amount lost by percolation.

The samples were all taken on the second bottom of the Kaw valley of a soil that in average productiveness is about equal to any in the vicinity. The samples showed a soil of a sandy nature. The first twelve to eighteen or twenty inches was a dark sandy loam which changed rather abruptly to a sandy clay of a yellow color and of considerable compactness. In some places the soil was of a close, sticky, heavy, clayey nature, usually of rather gray color called here gumbo but is not the type of soil generally described gumbo.

The samples were taken with the King soil tubes and after taking were weighed as soon as possible and then thoroughly dried and again weighed, and from these weights the per cent of moisture was calculated on the dry weight of the soil. The weight of the soil per cubic foot was found by means of a hollow cylinder, in the bottom of which, fitting closely was an auger which held the soil in the cylinder when drawn out of the hole. The cylinder collected all the loose earth from the auger from being driven down with it. The cylinder was three and one-right inches in diameter and ten inches in length, and held practically one-twenty-second of a cubic foot of soil. These samples were taken to a depth of three feet only, on account of the shortness of the auger handle, but as the third and fourth foot are practically of the same nature, the weight for the third foot was used for the fourth also. The weights were as following:

1st foot	78.98 pounds per cubic foot.
2nd foot	89.80 pounds per cubic foot.
3rd foot	92.80 pounds per cubic foot.
4th foot	92.80 pounds per cubic foot.

The average moisture content as found by the samples from the surface down were as follows:

1st foot	22.17 per cent.
2nd foot	21.00 per cent.
3rd foot	18.63 per cent.
4th foot	16.02 per cent.

Taking this per cent of the dry weight per cubic foot given above, gives the following number of pounds of water per cubic foot in each foot from the surface;

1st foot	17.45 pounds.
2nd foot	18.85 pounds.
3rd foot	17.26 pounds.
4th foot	14.84 pounds.

One acre = 43560 square feet or 43560 cubic feet to a depth of one foot, and from this the total water content is, in tons for each foot from the surface and one acre in area:

1st foot	380.06 tons of water.
2nd foot	410.34 tons of water.
3rd foot	375.92 tons of water.
4th foot	324.71 tons of water.

Or a total of 1491.03 toms of water in the first four feet of soil and one acre in area, to begin the cropping season. This of course is not sufficient for all crop needs but starts the young plants and is an aid to what will fall during the growing season.

The records at this station for the last ten years show the following average rain fall for April, May and June:

April 5.86 inches or 663.35 tons per acre,

May 4.51 inches or 510.50 tons per acre,

June 4.72 inches or 535.30 tons per acre,

or a total of 1709.15 tons of water that falls through the months of April, May and June, which added to that already in the soil gives a total of 3200.18 tons of water that is supplied to the soil during these three months. Of this a large part is unavailable, that is, the plant is unable to thrive after the moisture content falls below a certain per cent of the total weight of the soil. The availability varies in different soils, usually, accordingtto King, after the moisture content has fallen below about one-third the total water capacity of the soil the plant wilts. About six per cent is given as the amount, generally, of unavailable moisture in the soil. Of the amount left in the soil a part is lost by percolation, a part by evaporation and what is left is used by the plant. Again in figuring the rainfall, unless the ground is in a very receptive condition for rainfall and the rainfall is no faster than can be taken in by the soil, more or less is lost by surface drainage. Taking six per cent as the amount of unavailable water in the soil, or that below which the plant begins to wilt, we have, considering the average weight of the soil for the first four feet as 88.59 pounds per foot:

4X88.59 X 43560 = 7613.38 tons

7613.39 X .06 = 456.8 tons of unavailable water.

3200.18 - 456.8 = 2743.38 tons of water at the disposal of crop and subject to loss by evaporation, percolation and drainage.

Now the average yield of some of the common cr ops raised on nearly every farm in central Kansas, according to Secretary Coburn are:

Corn, 24 bushels.

Oats, 22.4 bushels.

Clover, perhaps about one and one-half toms is the average crop raised on an acre up to July 1.

According to Professor King the amount of moisture drawn from a soil by transpiration and evaporation are:

Maize,	270.9	tons per ton dry matter.
Oats,	503.9	tons per tom dry matter.
Clover,	576.6	tons per ton dry matter.

Of corn the yield of fodder is given by Henry as one and five-tenths the weight of grain, which would, considering twenty-six bushels of corn per acre, equal about two tons of dry matter per acre.

2 X 270.9 = 541.8 tons of moisture required by the crop for transpiration and evaporation.

Of oats, considering the ratio of grain to straw as 1:2 or one-third grain and two-thirds straw and the average yield of 22.4 bushel gives the total weight of dry matter as about one and one-fourth tons.

1.25 X 503.9 = 629.8 tons of moisture required By the average oats crop for evaporation and transpiration.

Clover required 576.6 tons of moisture per ton of dry matter which gives, using about the average crop of clover produced up to July: 15 X 576.6 = 774.9 tons of moisture required by the average crop of clover.

Thus we have the average crops requiring about:

Maize, 600 tons of moisture,

Oats, 600 tons of moisture,

Clover, 800 tons of moisture,

and we found before that we had 2743.38 tons of moisture in the soil, or about four times the amount of moisture required to raise these crops. The actual results would not be quite as large as this on account of not having included the loss by percolation and surface drainage. The moisture regained by capillarity however was not included either and this would tend to a considerable extent, to diminish the above error. Still, admitting the above error, the results show beyond doubt that there is more than sufficient moisture in the soil for even our least drouth resistant crops -- clover, corn and oats -- not to mention the more hardy crops as cane, Kafir-corn, etc.

The fault lies largely with the farmer to economize the moisture he has at his disposal. The amount of rainfall is less than that further east and necessarily cannot be as recklessly wasted. The western farmer must give more attention to the prevention of excessive losses of soil moisture by evaporation. He should understand the principles of soil capillarity that he may realize the importance of maintaining a soil mulch where possible over the cultivated fields. The common practice of allowing the plowed lands to lay open and loose, allowing air to circulate through it and dry it out, will have to give way to shallower surface cultivation which will leave the soil fine and loose, breaking the capillarity to the surface.

When the principle of soil moisture conservation, manuring and systematic crop rotation are better understood, the great dread and much of the possibility of crop failure from drouth will disappear.