# Some Practical Methods for the Conservation of Soil Moisture.

A. L. Frowe, '98.

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# Some Practical Methods for the Conservation of Soil Moisture.

The problems confronting every wide-a-wake farmer of today are numberous, but there are few of greater importance to the Kansas farmer than the problem of the Conservation of Soil Moisture; for whatever other conditions may be necessary to success, he must have moisture, and this is one thing, which if he has to depend upon rain for it he cannot always get when he needs it. Portions of our state, which when water can be supplied are very productive, yet because of its lack under present methods, are worthless for agricultural purposes. And even in the better portions, as well as, in other states, not seldom are crops materially injured by only a few weeks of drought at a critical time. If the crops could be tided over such periods, large losses might be avoided.

While, in limited areas, the attempt has been made to make up the diffeciency in the natural water supply, during the growing season by irrigation, yet this cannot be used extensively and some other method must be used. The most practical plan seems to be to convert, as far as possible, the soil into a reservoir and, by proper tillage, hold the water there to be taken up by the plant as needed. Much experiment of late has been conducted along this line, and just now many persons are very enthusiastic over what is called the Campbell Soil Culture. Its advocates claim for it, that in any year by this treatment a fair crop may be raised and in the years when by the old treatment, a small crop would be produced, they would get mammoth crops. It is just being introduced into the arid tracts and whether or not the dreams of its advocates shall be realized remains to be seen. At any rate the theory is good and may be applied in part tho perhaps not in detail in any section where rain is liable to fail.

The theory upon which the method is based is "that the amount of water in the soil is largely governed by the mechanical condition of the top seven or eight inches. The proper mechanical condition is attained by merely working the soil." The first seven or eight inches are thoroughly pulverized and then turned as completely over as possible. At the end of the season, the plant food is concentrated chiefly in the top four inches and this is thus turned to the bottom of the furrow, where the roots will be found. The bottom four or five inches are then packed by what are called sub-surface packers to make a firm seed-bed, drive out the air and cause the moisture to collect there. The crop is then planted, and the remaining tillage consists in working the top two inches to keep a dry dust-mulch to prevent evaporation.

The average rainfall in Kansas ranges from 19 inches in the Western third of the state to 41 inches in the Eastern. But at present, in the western part a large per cent (80 to 90%) is of no avail for much of it falls in heavy downpours and runs off before it can enter the soil. It has been estimated that the average amount of water needed for each ton of dry matter produced is about 400 tons or 3.56 inches per acre. Prof. King, professor of Agricultural Physics in the University of Wisconsin and our best authority, says, "Were it possible to have 16 in. of water to the acre for crop production, over and above losses by percolation and evaporation from the soil surface large yields, so far as water contributes to them, would be certain, yields amounting to from 3.5 to 7 tons of dry matter to the acre." Prof. W. J. Spillman, of

Washington Experiment Station, Pullman, says, "If we could entirely prevent evaporation except from the plant itself, we could on an average, produce 5 tons of hay with nineteen inches of water." It, of course, will never be possible to save all the water that falls onto the soil for plant use, but much of it can be saved, and even a small saving would be of incalculable value. And it certainly would seem that if the aridwest can be reclaimed as some enthusiasts think, we ought to be able to tide crops over but a few weeks of drought.

The claim is often made that no matter how much moisture there is in the soil, the crops will be injured by the scorching hot winds that occasionally sweep over the state during the growing season. Reliable authorities, however claim that this is not the case, but that with plenty of available moisture at the roots the plant will suffer no injury as this only occurs when evaporation from the leaves is so rapid that absorption by the roots cannot keep up with it, and it is not probable that this will occur with a moist root-bed.

In order to better understand how to treat the soil to conserve its moisture, it will be well to consider its functions, in what conditions and amounts we ordinarily find it in the soil, and the laws governing its passage thru it.

Functions - All plant food, except gases, such as oxygen, must enter the plant in solution, and must so be transported thru it. Some of the water enters into the tissue of the plant as food, but the greater part passes on thru to make room for more food-laden water. This is the plants only means of taking organic food. Then, too, the absorption of water from the soil causes currants to set in toward the roots and these carry with them the food which they hold in solution, thus bringing it within reach of the roots. Again, were there no moisture in the soil there would be no decay of vegetable matter buried in the soil.

Capacity - A handful of soil appears to have very little vacant space in it, but nevertheless, there is as much space between the grains of an average dry soil as they occupy, so a saturated soil contains 50% of water. The water on entering the soil spreads out evenly as a film around its grains. The finer the grains the larger is the surface presented, and consequently, the greater is its water-holding capacity. A cubic foot of average soil has a surface of 10,000 sq. ft. and can contain about 20% of water and yet be in good condition to work. A crop can grow with but 6 or 8% of moisture. The capacity of a sandy soil is far less than clay but it gives up what it has more readily and completely.

Capillarity - The main force aside from gravitation operating in the passage of water thru the soil is capillarity, due to surface tension. This is the same force that raises the oil in a wick and that causes the water to rise in a tube. It is surface tension that causes a drop of water to assume a globular form and that causes a soap-bubble to contract and force the water out thru the stem before it is detached. The film of water around a grain is similar to a soap-bubble and is tightly contracted around it, but when the soil is compact and the grains close together, the films unite and form a continuous sheet thru the soil. We can see how easy it would be for the air to enter a porous soil and with so much surface exposed take out a great deal of moisture.

Now if such a soil were to come in contact with a soil with a denser film, contraction would take place in the thinner film causing it to thicken, and drawing after it a film of water from the moister soil till saturated or nearly so when the surface tension would be destroyed. But if the case were reversed and loss occurred in some portion, a current would set in toward that point at the expense of the other parts till the film became so thin and the tension so great that it overcame farther attraction. So under ordinary conditions a soil will cease giving up moisture before wholly exhausted of its supply.

Storing Moisture. We will now consider methods of storing moisture in the soil till needed. Of course it is easily seen that loosening the soil to a greater depth will increase its absorptive power and capacity. Furthermore, since the film forms around the grains, the more surface in the soil, the more water it will retain. Hence, the finer the soil, the more thoroughly pulverized, the more surface it will present and the nearer the ideal condition. If finely pulverized, the first foot of soil containing 7½ % of moisture may absorb two inches of rain and still contain but 20%, which is about right for the best growth and tillage, but if only four inches be loosened, the same amount of rain would increase the per cent. in that soil to 35%. The ground is then too wet for the best growth, too wet to work, and the saturation has filled the pores of soil. Roots and seeds to grow require air, which they cannot have if the soil is saturated with water. Before growth can continue, it will be necessary for nearly half of this to be drained or evaporated away and lost, except what may sink into the hard subsoil, and what is left is so near the surface that much of it will be lost by the time a two-inch mulch has been made.

We want the ground plowed deep then, seven or eight inches at least, and thoroughly pulverized, and as it is difficult to work up the subsurface after plowing it is thought to be a good plan to work this over before with a disc harrow. Farmers who have much land to plow for fall crops often have difficulty in getting it plowed before it is too dry. To avoid this, the ground should be disked as soon after taking off the summer crop as possible. The moisture is thus retained by the mulch, and there is the additional benefit of the surface tillage. After plowing, the sub-surface should be well packed.

There are special machines for this purpose but the spring toothed harrow is recommended and in the absence of something better an ordinary harrow will do. The object of this is to fill up the air spaces, and by compacting the soil, increase its capillarity, which will cause it to draw moisture, thus securing a good seed-bed and a condition favorable for decay of rubbish turned under in plowing.

When to plow. As to the time to plow, this, of course, depends upon the crop, but whether spring or fall-plowed it should be done early in time to catch the early rains. Fall plowing for spring crops has the advantage of catching the winter snows. Ground plowed in the fall was found to contain 2.31% more moisture than that plowed in the spring. And of two plots plowed in the spring, one plowed a week later than the other was found to have lost during the week 9.13 lbs. per square foot more than the other.

The plow leaves the land loose and full of air and air passages and rapid evaporation will result unless it be followed with the harrow. This should be done keeping the harrow well up with the plow.

Subsoiling - Another method tried for

increasing the water capacity of the soil is subsoiling. This loosens up the subsoil without bringing it to the surface, enabling the water to sink deeper into it. This practice has been attended, however, with various results, depending upon local conditions, some farmers being very enthusiastic in its praise, while others in disgust report it a failure. As a rule it has not given satisfactory results on hardpan uplands, owing to the fact that it would not stay subsoiled; that is, it runs together again, or when on a slope the furrow may act more as a drain than a reservoir if running down the slope. But generally on bottom and second-bottom land it has given good results. Judgment and common sense should govern its use.

Conservation - But now that the reservoir has been provided, how is it to be sealed? Water may be lost by percolation down into deeper layers of soil. "Little, however, can be done to prevent this. In loose, sandy soils, the addition of well-rotted manure gives the soil the power of retaining more moisture and thus prevent percolation to some extent."

Evaporation - The greatest loss, however, comes thru evaporation. Under ordinary conditions on a hot day when the soil is filled with water, Prof. King calculates that there may be as high a loss as 1.3 to 1.6 lbs per day to the square foot, and the loss right after a rain when the greatest has been known to be as high as 2 lbs.

Mulch - Nature's means of preventing loss is a mulch of grass and leaves. Manure or straw is good but these cannot be used on any large scale. A mulch of dry dust is found to be almost equally as effectual. This is due to the fact that a dry soil is not a good conductor of water. The film connection has been broken and the capillary force greatly weakened. The mulch should be from two to four inches in depth, depending upon the crop raised. A deep-rooted crop as potatoes, should have a deeper mulch than corn. The Campbell Method requires two inches and of a uniform depth from first to last. Campbell advocates stirring the mulch ordinarily once in from four to seven days and when very hot, every three or four days. Experiment at the Kansas Experiment Station did not show any practical benefit resulting from cultivation oftener than once in 10 or 12 days.

Prof. Roberts, in speaking of the benefits resulting from the mulch in California says: "In orchards in Sacramento Valley, California the trees are usually loaded to the earth with fruit, the great, broad, green leaves of one tree touching those of its neighbor, and yet irrigation is not practical, tho rain seldom falls from the last of April to the first of October. As one sinks to the shoe latchets in the soft dusty earth of these fruitful lands, he is led to appreciate the power of capillarity to bring moisture to the rootlets, and the efficiency of a deep-earth mulch to conserve it. The winter rains fill the sub-soil with water, the deep, dry earth-mulch of four inches or more arrests evaporation, capillary attraction lifts the water from the sub-reservoir to the rootlets and as high as the under surface of the earth-mulch and thus by scientific treatment of the soil, the orchards are carried safely thru the drought of five months duration".

Renewal of mulch. The mulch should be renewed as soon after each rain as possible, as the contact of the lower soil is then restored to the surface and evaporation may again set in. Often a light shower will in a few days especially if followed by a few days of drying wind, leave the soil drier than before. This is due to the fact that capillarity at the surface has been increased enabling the broken current from below to again set in with greater vigor. Evaporation may then set in, and not only the water of the shower pass off but also that drawn from below. Hence the necessity of restirring the mulch as soon as possible, even after a light shower.

To avoid greater evaporation the ground should not be left in ridges as it was found that corn-ground left in ridges six inches high lost 5% more moisture than that not so left.

The roller.- The effect of the roller is to compress the surface-soil and so tend to draw the moisture to the surface. If the surface soil be dry when sowing and that requires shallow planting, this is beneficial as it will favor germination but should be followed with a harrow to restore the mulch

Humus in the soil favors the conservation of moisture and may be added as well-rotted manure, by plowing under cover-crops, and by rotation with large rooted crops as clover or alfalfa, the roots of which will rot when the plant has been killed by plowing. Lime, gypsum, and salt also favor it.

The ideal condition of the soil is a thoroly pulverized soil, seven or eight inches deep, compact enough to favor capillarity, yet loose enough to allow the entrance of water freely, with a fine, dry earth-mulch of from two to four inches, two inches for most purposes.

Conclusion- This then in brief, is a general statement of the question. Definite rules cannot be laid down to meet every possible case. but only principles, which may form a basis for intelligent observation, thought, and action on the part of the farmer as he meets his varying conditions. Just how far any plan or method is applicable to his own conditions, he must judge for himself. This is a question, which to the Kansas farmer is worthy of his most careful study and its judicious application will well repay him. To the farmer as to other classes, nature's law of the "Survival of the fittest" operates. If we would succeed, we must adapt ourselves to surrounding conditions. He is most successful who can do this best. If our water supply is scant we must make the best use possible of what we have. Work in harmony with nature, not against her. One thing must be borne in mind, namely, that a single trial is not always conclusive. We are too prone to base our judgment on a single experiment. If that one proves a success, we are ready to enthusiastically advocate its general adoption, but if it fail, woe be unto it! We will steer clear of it in the future and advise others to do likewise. It is well to go slow with any new method at the start, but it should not be condemned till it has had a fair trial.

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