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SOIL WATER AND ITS CONSERVATION

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Of the various factors affecting crop production, the most influential has been recognized to be water-supply. Temperature as determined by latitude and elevation, and soil characteristics, no doubt, also largely affect plant growth, but their influence on vegetation is next only to that of precipitation. It is the available water, accordingly that more often determines the kind of crop the farmer can profitably grow under any given environmental conditions.

Function of water. One of the uses of water in cultivation lies in its weathering action on the soil whereby more mineral matter is rendered available for the use of plants. More directly, however, water serves as a plant food supplying it with oxygen and hydrogen and as a solvent of the nitrogen and mineral nutrients in the soil which when sucked up feed the plant tissues. The transpiration of large amounts of water through the leaves serves to regulate the temperature of the plant. Water is also necessary to maintain the turgidity of the plant cells. It constitutes a large proportion of the weight of the green plant. Fresh green forage contains 75 per cent and fruits and vegetables up to 95 per cent water.

Water requirements of plants. The upward movement within the plant, of water containing plant nutrients is rendered possible by the process of transpiration whereby water in the form of vapour continually escapes from the leaves. The quantity of water thus lost through transpiration is considerable. The expression *transpiration ratio* or water requirement of the plant denotes the pounds of water lost during the production of one pound of dry matter. This figure varies from 200 to 500 for crops in humid climates and may amount to almost twice as much in arid climates. It is found to depend upon a number of factors such as the crop, climate, amount of water in the soil, fertility of the land, etc. The addition of fertilizers has been found to reduce considerably the water lost by transpiration.

As a concrete example a *cholam* crop raised under dry conditions as in the Ceded Districts may be considered. A fair estimate of the dry matter produced in the above ground parts would be one ton per acre. Assuming the water requirement to be 500 the amount of water actually used by the plant would amount to 500 tons to the acre or about 4·3 acre-inches of rainfall. This figure does not include the evaporation that is continually going on from the soil surface, which might very easily amount from 4 to 6 inches. The total demand excluding run off and drainage would thus amount to 8–10 inches of rainfall.

The results of soil moisture experiments at Coimbatore last year showed that a fodder cholam crop of 1,400 lbs. (0·625 tons) required 6·1 inches of water including losses due to evaporation. Run off losses amounted to 0·12 of an inch while those due to drainage were practically nil.

The rainfall evaporation ratio. The successful raising of a rain-fed crop thus depends not only on sufficient rainfall having reference to the water requirement of the crop being received, but also upon the rate of evaporation. It is the ratio between the rainfall and the rate at which water will evaporate from a free water surface accordingly, which largely determines the distribution of crops as between semi-arid and humid climates. The value of this ratio varies from more than 1 in humid regions to 0·2 in arid tracts.

Sources of water-supply. By far the greater proportion of the world's cropped area depends directly on rainfall. In places where underground water is available, rainfall is supplemented by water raised from wells. In a few favoured places where the underground water is within reach of the roots, crops could utilize the water directly. Since the root range of most crops is within five feet and the maximum height to which water could rise by capillarity is about 10 feet, it follows that underground water would cease to be available for the use of crops at depths beyond 15 feet.

The soil water. The soil is capable of holding large quantities of water. If it were not for this property much of the rain water would be lost as 'run off' or through percolation and what is left would not be enough for the needs of the plants in dry weather. A saturated soil has all its pores filled with water and in this condition could hold from 30 to 50 per cent of its volume. It will part with much of this water, however, when allowed to drain. Since soils are not in condition for the satisfactory growth of most crops when saturated with water, we are more concerned with the removal than with the retention of this drainable or gravitational water whenever it occurs. The water that is left after the soil has been allowed to drain is called *capillary water* and it is in this form that the soil water is most useful to the majority of crops. The capillary capacity of the soil is largely determined by its texture and structure. The finer the texture, the higher is its capillary capacity. It is also influenced by the temperature and the height above the water-table. The element of time is also of considerable importance since often the gravitational water has not had time to percolate down to the water-table before another fall of rain occurs.

Not all the capillary water is available for use by the plant. As the capillary water is used up or drains down, a stage is reached when either no capillary movement towards the rootlets is possible or such movement is too slow compared with the rate at which water is lost by transpiration. At this stage the plant wilts. The expression *wilting co-efficient* is used to denote the percentage of water present in the soil at this stage. A considerable portion of the capillary water in soils is thus not available to the plant. The finer the soil, the higher is the amount of water retained at the wilting point. The capillary water contained in the first five feet of a clay loam may amount to 18 acre-inches, but the available water may not amount to more than 6 acre-inches.

The control of soil water. We have already seen that for a normal yield of any crop, a large amount of water is necessary. Were the water requirements of plants the only source of loss of soil moisture, the question of raising crops with given amounts of water would be a simple one. Three further sources of water loss however usually operate in the soil tending to lower the amount that would go toward transpiration. These are (1) run off over the surface, (2) percolation and (3) evaporation. Some control of soil water is therefore necessary for the needs of the plant. The amounts lost under (1) and (2) are much less in arid and semi-arid than in humid conditions, but loss through evaporation is great and is of especial consequence as it competes directly with the crop.

Run off losses vary with the rainfull and its distribution, the slope of the land, the character of the soil and the vegetative covering. In some regions they may amount to as much as 50 per cent of the rainfall, but such losses are inconsiderable in arid tracts. The amount of run off would be greatly reduced by altering the physical condition of the soil so as to enable it to retain as much of the rain water as possible. Good tillage, deep ploughing and the addition of organic matter would thus help to retain the rain water and so reduce run off. The provision of bunds is an effective means of preventing run off. After a heavy shower some of the water held by the bunds may, however, require to be let off to avoid injury to the crop by water-logging. On steep slopes cultivation across the incline and terracing are some of the means adopted to reduce run off.

Losses from percolation result whenever the rainfall entering the soil becomes greater than the capillary capacity of the soil. Besides water some salts which may serve as plant nutrients are apt to be lost through percolation. Such losses depend largely on the amount and distribution of the rainfall and the capacity of the soil to hold water. Percolation is influenced also by evaporation and the presence of a crop. On uncropped land in humid climates percolation losses may amount to 50 per cent of the rainfall. Evaporation and the presence of a crop greatly reduce the percolation losses. Percolation may be controlled by improving the absorptive capacity of the soil by good tillage and the addition of organic matter. In dry climates, however, owing to excessive evaporation, percolation losses are of minor importance.

Loss due to evaporation on uncropped land may amount from 50 per cent of the rainfall in humid regions (the rest being lost by drainage) to cent per cent in arid sections of the country where there is little or no drainage. The rate of loss of water by evaporation may be very materially reduced by drying the surface thoroughly whereby the capillary movement of the soil water near the surface is very much retarded. This naturally occurs if sufficient time occurs between rains. The drying however has to be rapid if evaporation losses are to be reduced effectively. Under favourable climatic or weather conditions, the rate of drying may be so rapid that no supplemental treatment of the soil to hasten the process is necessary. Where the process is likely to be slow, it would be desirable to cultivate the soil after each heavy rain in order to produce a dry surface layer before serious losses from lower depths have occurred. The loosened soil forms what may be termed a soil mulch and serves to reduce evaporation losses considerably.

The effectiveness of the soil mulch in reducing losses due to evaporation seems to depend upon a variety of factors connected with the crop, the climate, the season and the soil. The failure to take these into consideration seems to be responsible for much of the discrepancy observed between the results obtained from laboratory experiments and those conducted under field conditions.

We have seen how climatic and weather conditions as temperature, humidity of the atmosphere or the velocity of the wind might influence the effectiveness of the soil mulch as a means of conserving moisture. The nature of the crop as to its top growth or the spread of the roots might sometimes be a determining factor. If the top growth is such as, either because of the shade cast or its breaking action on the wind, to retard the drying up of the surface soil inter-cultivation after a heavy rainfall may result in the saving of the soil moisture and so benefit the crop provided, however, it does not cause injury to the roots. In the case of crops with extended root systems, the injury thus caused may outweigh the gain in soil moisture. In such cases inter-cultivation is best limited to the early stages of the crop.

Bare fallowing is often an effective means of adding to the store of water inside the soil and where the annual rainfall is insufficient for the successful raising of a crop, it has been found possible to obtain good crops by fallowing every alternate year or once in three years, the fallowed land being ploughed and harrowed at intervals so that the soil may receive and hold all the rainfall.

A SHORT NOTE ON *PODU* CULTIVATION IN THE GOLUGONDA TALUK

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Cultivation on the hill slopes is generally known as *podu* cultivation and it is largely done in the Agency tracts of this District and also in the plains where the forests are not reserved. Cultivation of these hill slopes is, of course, an evil as the rain water rushing down these deforested slopes, carry a lot of valuable top soil and deposit it in the lower levels of streams and the tanks they feed, or the lands they overflow into. Without giving much heed to this great evil, hill slopes are constantly being given on lease for this kind of cultivation, so much so, that most of the hills owned by private individuals are completely bare and are causing great havoc to the irrigation sources and lands commanded by them since the streams arising from these hills bring with them nothing but sand with their current, thus necessitating the investment of large sums of money at shorter intervals for the repairs of these irrigation sources. The cultivation of these *podu* lands is chiefly in the hands of poor ryots. In the lower slopes of hills in the Agency parts, the hill-men are, of course, obliged to adopt the system as there are no suitable lands for cultivation. But in the plains it is possible to stop the system provided the owners take a general interest and understand the danger of it.

Shrubs are cut from the middle of February to the middle of March and spread over the ground for drying till the beginning of May when they are set on fire. The shrubs that burn away deposit a thin layer of ash on the surface.

Just before the advent of the South West Monsoon, a mixture of 1 lb. *Peddaganti*[1] (long duration *Cumbu*) 4 lbs. of *Korra*,[2] (*Tenai*) and 2 lbs. of

[1] *Pennisetum typhoideum.* [2] *Setaria italica.*