https://doi.org/10.29321/MAJ.10.A04991

THE SUNSHINE RECORDER AND SOME INTERESTING WEATHER DATA

By B. S. NARASIMHAN, L. Ag.,
Assistant to Government Agricultural Chemist.

Of all the manifested forces of nature, the Sun probably is the most important for life on earth. Every activity of living beings, both animals and plants can ultimately be traced to the apparently inexhaustible store of solar energy. Horses, cattle and men derive their physical energy from it, all kinds of vegetation thrive wonderfully in sunlight and die when it is denied to them. Water-power used by men whether it be river or waterfall, owes its origin to the action of the sun. Coal and petroleum are in fact stored up reservoirs from the stream of solar energy, for these are but the vegetation of past ages conserved in the entrails of the earth.

The sun even exerts a mental influence. It is associated with joy and the bright side of life. The sleeper is awakened from his lazy bed by the rays of the early morning sun; the dull dreary feeling caused by days of cloudy weather is dissipated by the appearance of the bright sun and one is whipped up to energy and feels more active and cheerful than before. All nature herself smiles at the appearance of the sun, the flowers open out, the bees hum, the crickets chirp and one shares with Browning, the feeling that 'God is in His Heaven and all is right with the World'. The sun is therefore rightly named as *Poornasthamo Mochakah* (the destroyer of all *thamas*).

Recent researches have shown the importance of sun and sunlight, for the promotion of vitamins; the advocates of unfired food and votaries of sundried vegetables and fruits base their theories on this fact. Perhaps, the custom prevalent in many parts of the country of exposing coconut and gingelly oils to the rays of the sun can be traced to this, for these vegetable products are low in vitamins and exposure to the sun enriches their vitamin content.

Small wonder that through ages past the sun has played an important part in the religions of the world. To the ancient Copts of Egypt, Ra, the Sun God, was the supreme of all deities; the Greeks worshipped Him as Helios and identified him with light and joy in the world; the Zoroastrians are even to-day ardent sun-worshippers. The Pongal festival is after all a significantly thanksgiving festival wherein prayers are offered and gratitude expressed to God Surya, for a bounteous harvest. Rightly indeed did the Rig Veda hymn sing of " Savitur, the Sun God; Savitur, Lord of every blessing and God Savitur, the Gold eyed, hath come hither giving the choice treasures unto him who worship". (Rig Veda X. 149 i, 35).

It will thus be seen that a study of sunshine and sunlight at different parts of the globe will have important bearing on agriculture. In fact the amount of sunshine received at any particular place depends chiefly on its latitude and we have thus regions ranging from the Frigid zone to the

'golden sands' of mid-Africa where the 'naked negro pants at the equatorial line". This difference also determines the flora and the fauna of earth's different belts. The cold Arctic regions abound with moss and lichens, vegetations free from chlorophyll and characteristic of the absence of sunlight. The luxuriance of a Tropical growth 'running riot in many a wild fastoon', is never seen in the Temperate regions.

The hours of bright sunshine at different places during different periods of the year, will, if measured, thus give interesting data for academic and agricultural interests. A very simple device is being used to record the hours and intensity of sushine at any place and the instrument used for this purpose is called the 'Sunshine Recorder'. It consists of a sphere of glass about 4 inches in diameter just above a metal frame which is itself the arc of a sphere and concentric with the glass globe. Rays of sun falling on the glass are brought to a focus behind it in the plane of the metal frame. A sensitized paper, graduated into hours, and tenths of hours inserted in a groove of the metal frame thus gets burnt off to different degrees along a regular line depending on the degree of intensity. A number of foci which correspond with the different positions of the sun during its passage through the heavens are thus marked on the paper from which we can accurately get (*a*) the number of hours of sunshine during the day, (*b*) the hours when the sun was brightest, and (*c*) the hours when there was no sun at all. The instrument before installation has to be adjusted, so that its central plane makes with the horizon an angle equal to the latitude of the locality. In this position, the rays of the sun always fall perpendicularly on the surface of glass and the several foci will be on the same line. The location of the instrument should be in such a place as offers no obstruction to the rays of the sun by the proximity of trees and tall buildings. The metal belt below the spherical glass is divided into three arcs in different planes all concentric with the sphere. Such an arrangement permits the insertion of the sensitized cards into any one of the three grooves. This, therefore, permits an adjustment of the instrument to suit the change of direction of the sun in its passage through the highway of the heavens. Three types of cards, equinoctial, winter and summer are, therefore, used for the different periods of the year; the equinoctial being used from the March 1 to April 12 and from September 1 to October 12, the summer from April 13 to August 31 and the winter from October 13 to the last day of February. The lay impression might well be that the total hours of sunshine per day are twelve,—from sunrise to sunset. This, however, is not the case. And at this stage, it must be pointed out that sunlight is different from sunshine, for, long after the instrument finishes up recording the amount of sunshine, sunlight may still be available to earth. On an average, the amount of sunshine received is about 7 or 8 hours a day, although on particular days of the year as many as 11·3 hours have been recorded at Coimbatore.

The sunshine recorder was installed in August 1928 at the Agricultural College, Coimbatore, and has been located on the top of the Freeman Building. The Research Institute terrace although much higher could not be thought of, as the several minarets peculiar to its Indo-Saracenic style, will cast shadows on the instrument when the sun is low on the horizon. The Freeman Building which conforms to the Doric style of architecture is more suitable with its flat terrace.

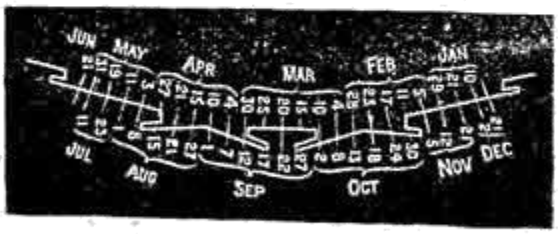
Records maintained since then and tabulated so far, have been represented graphically for a period of two years from September 1928 to September 1930. It will be seen from Graph II, that January, March and May are by far the sunniest months of the year, February and April following as close seconds. June and July (the months of South-West monsoon) have the least sunshine, while the winter months, October, November and December and the transition between the two monsoons, August and September, are months with average sunshine. It is, of course, wrong to jump to generalizations from two years' data but the general trend of sunshine throughout the year is on the lines indicated above. Incidentally, is borne out the general belief that Coimbatore has an agreeable climate for, strictly speaking, only two months in the year, January and March are the sunniest.

Temperature figures both maximum and minimum for all the months for these two years are given in Graph III and Mean Humidity in Graph I. Graph III shows that March, April and May are also the hottest months of the year, while January is the coldest, although January is only second to March among the months in the hours of sunshine recorded. This illustrates how the sunniest month need not necessarily be the hottest, for there are other factors like humidity, playing a part. The amount of rainfall received has thus an important bearing for it is chiefly that, which influences the humidity in the atmosphere. In a later paper, an attempt will be made to trace the relation between rainfall and certain other weather characters. From these two years figures of sunshine record, one can safely say, that March is the hottest, driest and the sunniest month at Coimbatore.

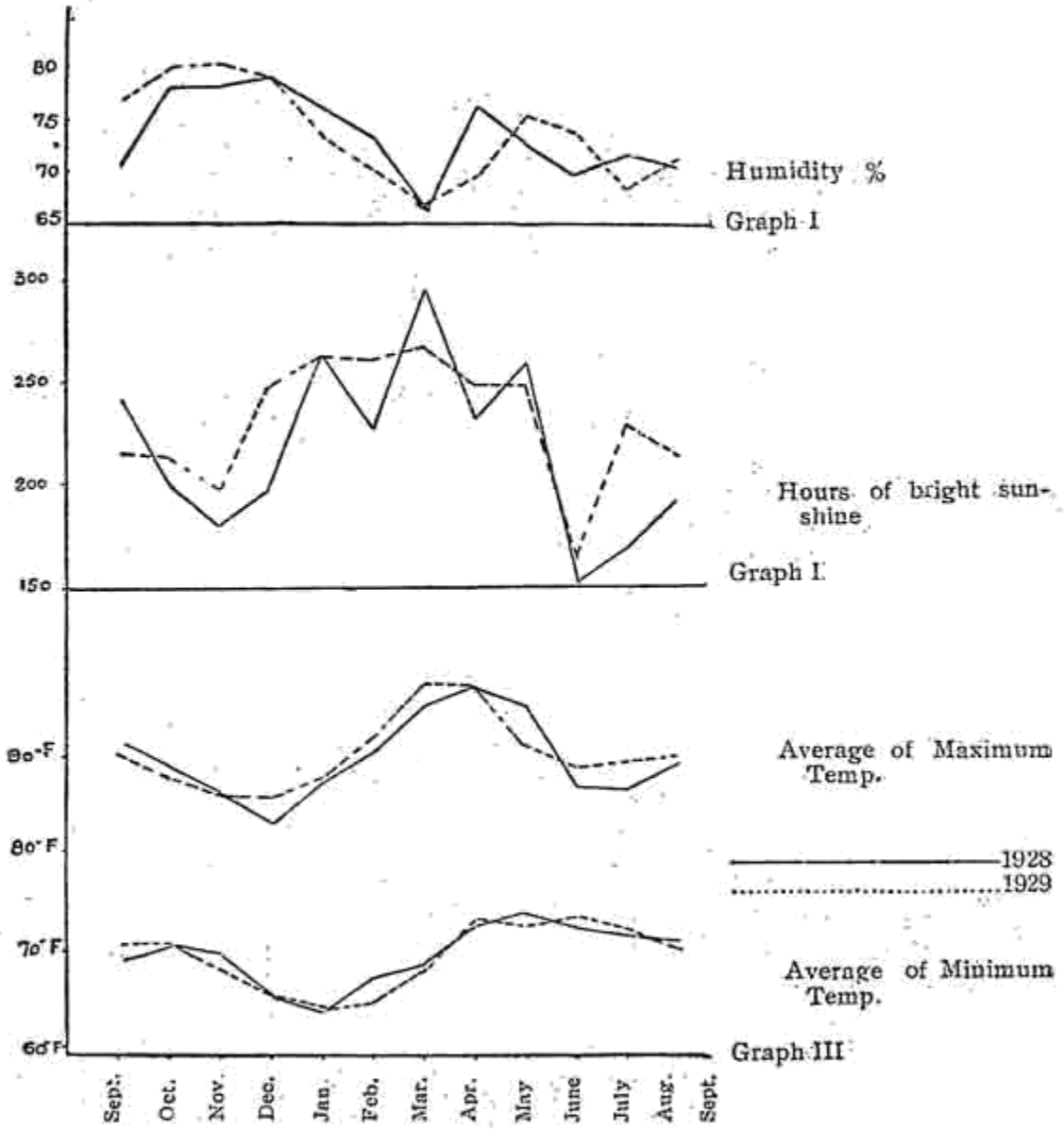
Various are the uses to which the figures obtained by the Sunshine Recorder can be put. The instrument affords valuable data for the location of solar heaters, a device which is becoming popular in America and elsewhere. The solar heater is an arrangement by which an attempt is made successfully to harness the sun's energy for human comforts. A plate of glass inclined at the correct angle and receiving the sun's rays on it, transmits it into an absorber of non-conducting material, with the result, that light rays are utilized to produce heat and it is claimed that with the arrangement, water can be raised to boiling point. The importance of procuring hot water in dairies, cattle sheds and other agricultural buildings at such low cost cannot be over-estimated. The location, however, of the solar heater depends on the preliminary data obtained from sunshine recorder, for, these decide the inclination, situation and the value of the solar constant with the locality. In fact, the solar constant is the unit value of the radiation from the sun and is the theoretical amount of heat which a square centimeter of the earth's surface would receive per unit of time. It depends on the medium of the atmosphere whether it is clear or misty, on the number of hours of sunshine per day, and the nature and colour of the surface receiving. Thus, from Mont Blanc in Switzerland to observatories in South America, the solar constant is found to vary from 1·44 to 2·2 depending on one or all of these factors.

To the breeder and crop specialist, figures obtained from the sunshine recorder will be of importance for correlating the phases of growth of different crops, with the hours of sunshine during different periods of the year. The cotton plant in fact has been known to burst its bolls on sunny days and who knows but that ability to accommodate itself to different degrees of sunniness may be an economic factor in judging a variety of

THE SUNSHINE RECORDER



TYPES OF CHARTS USED TO RECORD SUNSHINE


80
75
70
65
Humidity %
Graph I
300
250
200
150
Hours of bright sunshine
Graph I
90°F
80°F
70°F
60°F
Average of Maximum Temp.
1928
1929
Average of Minimum Temp.
Graph III
Sept.
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.

the ground level. The first node above the collar, whether partially or wholly enclosed within its sheath exhibits well-developed roots ranging in length from ½ to 3 inches, while the node above it though completely enclosed shows (on removal of the sheath) either a few developed roots or early signs of such development (Figs. 2, 4 and 5). The extent of growth of these adventitious roots depends on the distance to which the mycelial growth within the culm has progressed upwards.

5. On splitting open the culm of an infected tiller, there is a distinct brown discoloration of the spongy tissue of the nodular region (Fig. 5) confined in early cases of attack to the lowest root-bearing nodes but visible in advanced stages at the upper one or two nodes as well. In the latter case, long before the death of the tiller the fungus growth is found to spread through the hollow of the lowest internode. Though the root-bearing nodes are discoloured within, the underground root system remains intact, showing the healthy white colour.

6. Some plants which have developed the symptoms described above show externally a white or pink bloom of fungus growth at the lowest one or two nodes. This bloom is often conspicuous on the dead sheaths. When the plants are dead, the bloom extends upwards along the sheath up to a distance of four inches above the collar. If the dead plants are left in the field sufficiently long, the fungus growth on the sheath develops into a pink incrustation which consists of a thick matting of mycelium bearing myriads of conidia (spores). When irrigation water stands at a high level, the portion of the sheath under water does not show the white bloom, but when the field gets drained, the bloom is evident down to the ground level. Dead plants when pulled out, snap at the collar, leaving the root system behind.

7. While approaching the flowering stage, some well developed plants show one or two late-developed side tillers infected by the disease while the remaining tillers are apparently healthy. In such cases, the disease is not known to spread to the whole plant.

Distribution of the disease.—The first record of a serious outbreak of the disease in the Madras Presidency was from Maruter (West Godavari District) in March 1930. The disease was noted at this period in several villages within a fifteen mile radius of the Station. An examination of the straw and stubbles of the previous season showed the fungus at the nodes and within the hollow of the internodes, proving thereby that the fungus was not entirely new to the locality. McRae[1] has recorded a *Fusarium* occurring on *Manipuri* and *Gurkhali* varieties at Tamenglong in Manipur State which causes the sterility of rice grains involving the entire failure of the crop as no grain is formed though the plants looked healthy. He collected a similar fungus from Gurdaspur and round about Pusa. Later, he isolated a *Cephalosporium* from Punjab which killed the seedlings and caused a rot at the collar of grown plants. The cultural characters of this fungus agreed with those of the previous one except in the absence of macroconidia. Stray plants affected by a disease almost identical with the Maruter fungus have been obtained from the Paddy Breeding Station, Coimbatore, towards the end of 1930. The fungus has been observed to produce the

[1] McRae, W., *Scientific Reports of the Agricultural Research Institute, Pusa*, 1926-27, p. 54, and 1927-28, p. 68.

Fusarium and the Cephalosporium types of spores, but unlike the Maruter strain, with a predominance of the former. Apart from the minor differences in the details of the symptoms of the disease and the cultural characters it appears that the fungus responsible is the same and has a wide, though discontinuous, distribution in India. Possibly it exists undetected in many paddy tracts.

Microscopic and cultural characters.—Sections through the infected nodes show septate hyaline hyphæ running across the cells and clogging the vessels of the vascular bundles. Sections containing the fungus when left overnight in distilled water, produce a profuse external gr wth of mycelium and spores. The mycelium is hyaline, closely septate and freely branching, producing bunches of conidia at the tips of branches. The microconidia (Cephalosporium) are oblong, hyaline, single celled and measure 5 to 13 μ × 3 to 5μ. The macroconidia (Fusarium) are hyaline but pink in mass, elliptic to fusiform, 2 to 5 celled and measure 16 to 48 $\mu \times 2{\cdot}5$ to 4 μ. The fungus is a prolific spore bearer and makes good growth on oatmeal agar, rice agar, wheat agar, potato agar and French bean agar, the rate of growth in them being in the order of the media mentioned. When grown on oatmeal agar and French bean agar the fungus imparts a pink tinge to the substratum. Single spore cultures of the Cephalosporium type have given rise to both the Cephalo sporium and Fusarium stages. Wound inoculations kill seedlings in all stages. Contact inoculations produce death in seedlings and the abnormal elongation of tillers in grown plants.

Preventing the spread of the disease.—The fungus grows saprophytically on dead tissue and myriads of spores are borne on dead plants. The stubbles left in infected fields after harvest are found to harbour the mycelium and spores of the fungus. Spores are also found adhering to seed paddy collected from infected areas and to be held in suspension in the irrigation water standing in infected fields. It is therefore probable that the fungus is spread through soil, seed, air and water. Though it is too early to outline definite measures of control from the facts gathered so far, it stands to reason that the systematic collection and destruction of infected plants in a standing crop and of stubbles in infected fields would materially minimise the sources of infection. Since spore production is very heavy after the death of the host plant, infected plants should be pulled out as soon as they are detected and burnt or scorched over a fire to prevent the saprophytic development of spores.

Some field experiments are now in progress at Maruter to study the effect of fungicidal treatments at different stages in the growth of the paddy plant.