Proceedings of the Iowa Academy of Science

Volume 39 | Annual Issue Article 13

1932

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Introduction

Soil temperature measurements made at Iowa State College in connection with studies in the germination of tree seeds, indicated that soil temperature at various depths under maple-linden cover was lower throughout the winter than it was under shrub cover (Meginnis, (3)). As this was at variance with measurements taken in the more mesophytic regions of eastern United States and Europe, a more careful study of the effect of different types of plant cover on soil temperature was considered advisable. This paper

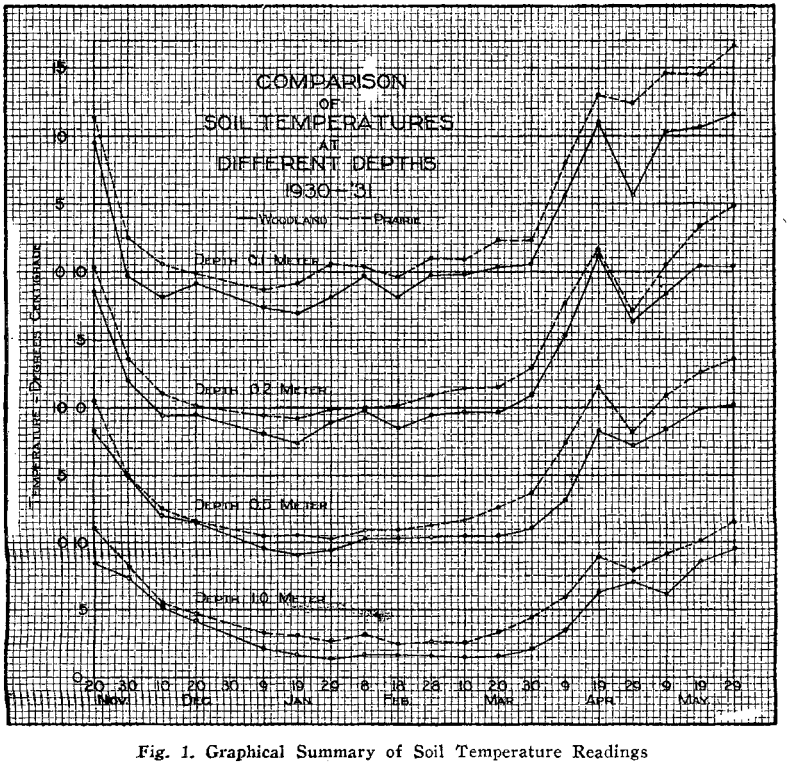

Fig. 1. Graphical Summary of Soil Temperature Readings

includes a graphical summary of soil temperature readings in two stations for one year and a brief discussion of the observed differences.

In this field the early experimental work of Ebermayer (1) is outstanding. In 1867 he described the methods used in obtaining soil temperature readings at forest stations in Bavaria. Six pairs of stations were established with one of each pair in six forest communities and the others in adjacent fields. He found that soil temperature readings at all depths (to 4 feet) were slightly higher in winter and lower in summer in the mesophytic forest than in the open.

The results of soil temperature determinations by workers in Switzerland, France, Austria, Sweden, Finland are summarized by Li (2) as follows:

(a) The mean annual temperature of the soil under a forest cover is lower than that in the open fields at all depths.

(b) The mean seasonal temperature in the spring, summer and autumn is lower in the soil under a forest cover than in an open field. The difference is most marked in the summer. In the winter it is slightly higher in the forest soil than in the open.

In contrast with those results Nesterov (4) working at the Moscow Agricultural Institute states that the soil temperature in native woodland in which some additional trees had been planted is decidedly lower during the winter than is that of the adjacent open station. The forested area studied seems comparable, in protection offered by the stand, to the post climax maple-linden woods in Central Iowa.

In the United States most of the work on the influence of vegetation on soil temperature has been done during the growing season.

However the measurements of Li (3) in a 60 year old white pine stand in the Yale experimental forest at Keene, New Hampshire, extended beyond the growing season into late October. He found that soil temperatures compared to those in an adjacent open area were lower under the forest cover during the growing season and became higher in October. From these data he made the generalization that soil temperature is lower under forest than in the open during the growing season and is higher during the winter.

Materials and Methods

Stations were established in the 30-acre area known as "North Woods" in the northwest corner of the Iowa State College campus. One station was located half way up a north slope (33-35 per

cent) in an area dominated by hard black maple, *Acer saccharum nigrum*, and linden, *Tilia americana*, which is the most mesophytic vegetation of the region. This association, which occurs only along protected stream courses in central Iowa, may be considered post-climax. The maple-linden association on the north slope was well protected on the north by a typical elm-ash-walnut floodplain associes. The south slope across the floodpplain is covered with oak-hickory and shrub communities.

The other station was established on an upland bare area which had been planted to annual crops during previous summers.

In each of the stations an air-soil thormograph was housed in a standard instrument shelter which was placed on the ground. The soil temperature bulb was placed at 0.2 meter and 0.1 meter during different years.

Besides these recording instruments both stations were equipped with four 2″x4″ wooden casings set at depths of 0.1, 0.2, 0.5, and 1.0 meters into which were lowered mercurial thermometers. A rubber covering 5 m.m. in thickness was placed over the mercury bulb of each thermometer to prevent rapid temperature change while reading.

The first year, from December, 1929, to April, 1930, temperatures were recorded twice a day, 8 a.m. and 5 p.m., at each station. Three daily measurements were taken from November, 1930 to June, 1931. Graphs of the ten-day averages of these records are shown in the figure. During the current year although it was not feasible to make regular trips to the stations, the seasonal march of temperature was determined at irregular intervals.

Discussion of Results

A graphical summary of the data for the period of November, 1930, to June, 1931, is given in figure 1. A comparison of the march of soil temperature during the three winters shows some important yearly variations, which do not come within the scope of this paper.

These graphs based on some 3,700 readings over a 200 day period show that the soil temperature in the maple-linden woodland is lower throughout the winter at all depths than in an adjacent bare area. These data are substantiated by records taken during the preceding and the following winters.

In central Iowa the maple-linden post-climax association, because of its low density of stocking, limited extent, and reduced height affords a very poor protection from the prairie winds. In

this it differs markedly from the dense mesophytic forests of the east. Rapid circulation of air together with decreased solar insolation of the wooded area may account for soil temperature being lower in the forest than in open areas.

Furthermore the following summary data and interpretations of the data seem justified:

1. The seasonal amplitude is inversely proportional to the depth of measurement.

2. There is greater fluctuation in temperature at all depths in the bare area than in the forest. The forest cover and slope seem to account for this difference.

3. There is a greater spread or difference between temperatures of the two situations at the lower depths. This spread may be caused by the lag of the forest soil temperatures.

4. Reduced solar insolation by the leafing of the forest trees in the spring causes a greater spread of soil temperature values, compared to the same depths in the bare area.

5. The number of days with temperature below freezing for the winter (1930-31) at 0.1 meters was 42 in the bare area as compared to 118 in the forest. At 0.2 meter depth the soil temperature was below freezing for a period of 42 days in the bare area and of 97 days in the maple-linden woods.

6. According to the experiments of Meginnis the lower temperature near the surface of the forest floor is favorable to germination of hard maple. This temperature relationship seems to be an important factor in seed germination on these maple-linden slopes where reseeding is chiefly black maple.

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