From the Director's Desk

FACTORS AFFECTING SOIL TEMPERATURES

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The temperatures of the soil and air above the soil are vital factors in plant and animal growth. We are well acquainted with above-ground temperature since it affects our own comfort. Quite often we relate this to soil temperature but the two are not always parallel. Wind movement has some control over our **interpretation** of temperature but has little to do with actual soil temperature. So for a while, let's forget about the Weather Bureau and concentrate on the soil surface and below.

All soil reactions have an optimum temperature for activity. Most microbial activity has an optimum temperature of 75° — 90°F. As the temperature goes down the activity decreases, but does not stop until the soil freezes. At 75°F organic matter decomposition is ⅔ as fast as at 90°F. It is only ⅓ as fast at 60°F.

Fall seeding is preferred over spring seeding, because the soils are warmer and germination is faster. White pine seed germination is 10 times better at 76° than at 57°F. There is an upper limit to this effect, coming at 120° — 125°F when most seed are killed. Dry soil temperatures can exceed 150°F.

Sources of soil heat are chemical and biological processes, conductions from within the earth, atomic radiation, and solar radiation. Solar radiation is by far the most pronounced, the others being negligible.

Solar radiation crosses the 93 million miles of space as a broad spectrum of wavelengths. The earth intercepts one part in two billion of the sun's output. As it reaches the earth's atmosphere containing ozone, dust, moisture, etc., some of the wavelengths are absorbed, others scattered and others arrive at the earth's surface. The retained heat depends on the amount of radiation received, the soil color, moisture, compaction and cover.

The amount of radiation received depends on cloudiness, dust in the air or other impeding factors. Clouds reflect an average of 78% of the sun's rays. Other particles in the atmosphere scatter the radiation. When Krakatoa blew up in 1816, the great dust cloud cooled weather in many areas and was a cause for mass migration from New England to the Prairies. The dust had weakened the warming effect of the sun.

Ozone, found 13 to 20 miles up absorbs a great deal of ultraviolet waves and acts as a filter. Water vapor, on the other hand is transparent to ultraviolet but heavily absorbs long wavelengths in the infrared area. In short the earth is well protected.

When sunlight penetrates our natural filter, what happens to it? Part heats the soil surface, part is conducted to lower levels, part heats the air above the soil and part is re-radiated into the atmosphere as long wavelength radiation.

The amount of heat absorption depends in great part to surface color. Listed below is the percentage of incoming radiation reflected by various surfaces:

Fresh snow	80%
Old snow	40%
Sand (avg)	60%
Forests	15%
Fields	10-12%
Black Soil	5%

The angle at which sunlight strikes the surface is also a major factor. Worldwide, the equator receives more perpendicular sunlight than the poles and is hence warmer. In the Northern Hemisphere, the angle of exposure or slope is important. A 45° slope facing the south is warmest on a **yearly** average. In midsummer a south facing angle of 15° is warmest.

Other factors have an influence, however. In the morning soil moisture is highest as is relative humidity, so a high percentage of energy is required for evaporation. By the afternoon, these factors are lower, so more energy is available to heat the soil. With no clouds, then, the Southwest slope is warmer.

Summer (convection) clouds usually form during the daytime, leaving the morning relatively clear. This means more sunlight during the morning hours. When clouds are present, then, the Southeast slope is warmer.

Diurnal, or day and night, temperature variations are also governed by direction of exposure. South slopes have wider variations than north slopes. The temperatures here are higher during the day and lower during the night. Bare soil will be even greater than soil covered with vegetation. Dark soil will vary more than light, and arid regions more than moist.

Grass-cover is a great insulation. It keeps the soil cooler in the spring and summer by blocking incoming radiation. It keeps the soil warmer in the fall and winter by blocking outgoing radiation. Experiments in England show that on a 10 year average, soil under turf is 2° warmer in October and November than bare soil, but only 1° warmer during winter and spring, whilst from May to August they are within 0.5°.

Snow, although reflecting a great amount of sunshine, is valuable in insulating the soil against colder air temperatures during periods of short days. Reflectivity of snow can, of course, be altered by dusting with dark colored materials that will absorb solar energy and convert it to heat.

Dry soils warm easier than wet soils because water has a higher specific heat, about five times that of soil. This means that because a greater amount of heat is required to warm water, wet soils remain cold longer in the spring. Water also conducts heat away from the surface better than air. Wet soils, then, are more difficult to heat and as they warm they transmit heat downward faster than dry soils. The cumulative effect is a cold surface.

Compaction, because it excludes air but not water, is another roadblock to soil warming in the spring.

As we look deeper into the soil profile, we see less and less daily or seasonal temperature variation. The depth where no changes occur is called the neutral layer. On the average in natural soils, the neutral layer for daily temperature fluctuation is 5" deep. The neutral layer for annual variation is 40 feet. At about 30 feet the seasons are reversed; that is, the soil is warmest in January and February and coldest in July and August.

To maintain an energy balance, heat received must be given off. The energy received during the day must eventually be given off — whether it be at night or during the cooler seasons. In arid areas the soil becomes quite warm during the day, but gives off much of the heat at night because there is little atmospheric moisture to intercept the infared radiation away from the surface. With a humid micro-climate over vegetation this rapid radiation cooling produces dew.

When there is high atmospheric humidity and cloud cover, this outgoing radiation is reflected back toward the earth, preventing the rapid cooling and greatly reducing or preventing dew formation. In this situation, the soil temperature will be the least variable.

In summary, the soil temperature variation is best described by table:

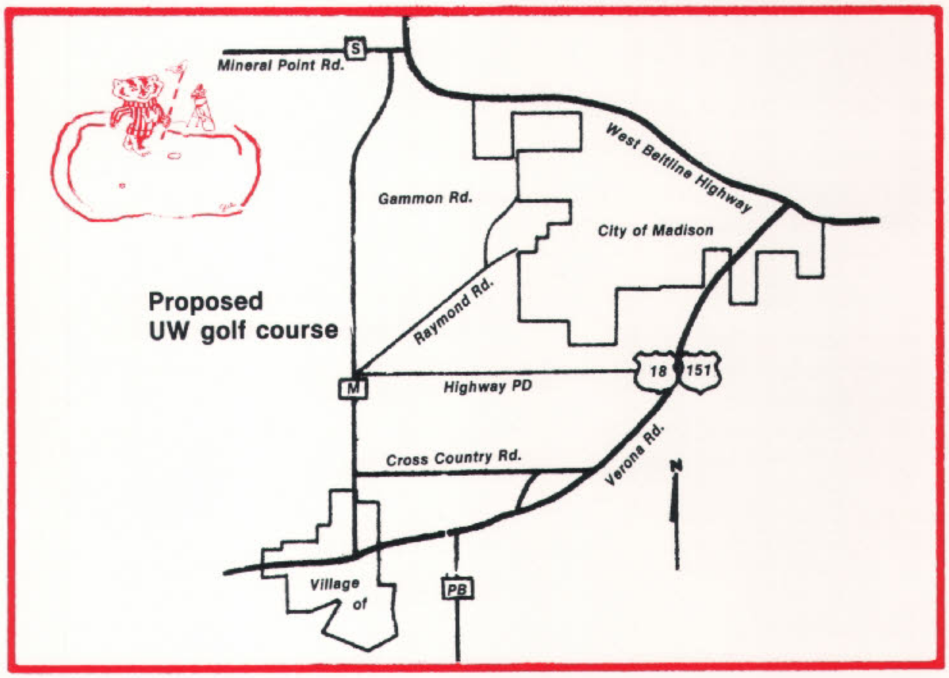
Warmer Soil	Cooler Soil
Dark Color (dry)	Light Color
South Slope	North Slope
Well Drained	Poorly Drained
Uncompacted	Compacted
Bare	Forested or Cropped
Equatorial latitude	Polar latitude

UW DECIDES TO PROCEED WITH CONSTRUCTION OF GOLF COURSE

Chancellor Irving Shain has given approval for construction of a UW—Madison golf course west of Madison. He will include the project in the University's 1987-1989 budget that goes to the governor in January of 1987 and goes into effect on July 1, 1987. He qualified his approval with the requirement that sufficient funds be raised so that a first-class course with the appropriate amenities can be built. The golf course project will have to be approved by the Board of Regents, the State Building Commission and the Legislature, as well as the governor.

The university owns nearly 600 acres of land in the township of Verona and the golf course will be built on a part of that property. The golf course fund started with a donation from the late Carl Dietze of Milwaukee. He was a graduate of the UW—Madison and left money for the project at his death in 1960. The land was donated by Dr. Harry Culver of Chicago.

The golf course has been the subject of controversy for years. Early disputes about the environmental impact of such a project put it on hold. More recently the subject has been money, and whether or not the foundation held enough funds for construction. Several studies have been made, including one by a committee of WGCSA members including Tom Harrison, Bill Roberts, Roger Bell, Jerry Kershasky, Rod Johnson, Pat Norton and Bob Musbach. All but one of the studies indicated a shortage of funds and that was also the conclusion of the WGCSA committee. Currently, the UW Foundation has $2.8 in contributions and pledges, about $1 million short of what is needed to meet university requirements. The UW Foundation is prepared to embark on a fund drive early next year and it is assumed that the golf course project will be part of that overall fund drive.



OUT IN LEFT FIELD? APPARENTLY NOT!

The suggestion presented last summer to change the name of the Wisconsin Golf Course Superintendents Association to the "Wisconsin Golf Course Managers Association" may not be as far out in left field as some think. The Golf Course Superintendents Association of America did an extensive survey of its members last year. The survey generated many interesting statistics, but none more telling to this editor than the one that showed a very high percentage of national members didn't like their title. Forty-five percent of the Superintendents responded, in fact, that they preferred the title "Golf Course Manager." It is a subject that is bound to come up again, soon, at our state level as well as at the national level. It may be something to give careful and deliberate thought to over the upcoming winter months.