Measurement of Grass Surface Temperature at Uturu, Nigeria.

I.U. Chiemeka, Ph.D.

Department of Physics, Abia State University, Uturu, Nigeria.

E-mail: chiemeka_iu@yahoo.co.uk
Telephone: +2348063285560

ABSTRACT

The grass minimum thermometer was used to measure grass temperature at Uturu (Lat. 05.33^{o}N, 06.03^{o}N and Long. 07.10^{o}E, 07.29^{o}E) with an annual mean temperature range of 25.23^{o}C – 27.20^{o}C. The grass thermometer was placed on the grass surface at 6:00 pm (1700GMT) while the daily reading was taken at 10:00 am (0900GMT) the next day throughout the period of study. The temperature data was obtained for a period of five months starting from December 2008 to January 2009, March 2009, and April to May, 2009; representing the Harmattan, dry, and wet seasons, respectively. The results obtained showed that the maximum grass temperature of 24.0^{o}C was recorded in December 2008 while the minimum grass temperature of 18.0^{o}C was recorded in January, April, and May 2009. The mean monthly grass temperatures of 22.31±0.16^{o}C, 20.28±0.24^{o}C, 20.78±0.16^{o}C, 19.76±0.13^{o}C, and 20.72±0.21^{o}C were obtained for the five months, respectively. The mean grass surface temperature obtained for the two months representing the Harmattan (December 2008 and January 2009) is 21.30±0.40^{0}C, while that of the wet season (April and May 2009) is 20.24±0.34^{0}C. It becomes obvious that the grass temperature at Uturu is higher during the Harmattan than the dry (20.78±0.16^{0}C) and wet (20.24±0.34^{0}C) seasons. The result showed that the grass temperature at Uturu is on the average warmer during the Harmattan than it is in the dry season and cooler in the wet season.

(Keywords: grass, grass temperature, temperature, grass minimum thermometer)

INTRODUCTION

According to Chapman (1992), grass is the common word that generally describes monocotyledons green plants. Members of the family Graminae are the “true grasses” and it includes most plants grown as grains for pasture and lawns (turf). They include some specialized crops such as lemon grass as well as many ornamental plants. They include also plants often recognized to be grasses such as a bamboos, maize, and some species of crab grass.

Crucifix (2009) stated that grass temperature is the degree of hotness or coldness of grass recorded in open air ground on short turf, with the bulb of the thermometer just in contact with the tips of the blade of grass. It is also described as the temperature at 5 cm (2 inches) above ground. Ayoade (2004) pointed out that climatologists and meteorologists have dedicated much time to study the grass temperature in a bid to determine the grass temperature of a particular study area. They purposefully carried out these studies in order to know how vegetation actually affects the climate, environment, as well as the activities of farmers, gardeners, and drivers.

Temperature, according to Ayoade (2004), can be defined in terms of movement of molecules such that the more rapid the movement, the higher the temperature. More usually, it is defined in relative terms on the degree of heat a body has. Temperature is the condition that determines the flow of heat from one substance to the other. The temperature of a body is determined by the balance between the incoming and outgoing radiation and its transformation into sensible and latent heat amongst others.

The temperature of a body is measured by a thermometer. Various scales are used to express temperature. These include the Fahrenheit, Centigrade, and the Kelvin (or absolute temperature) scales. Thermometers are differentiated based on the properties of substance that vary with temperature on which they are constructed. These properties include length, pressure and resistance.

Heat itself is energy in transit to or from a body. Chiemeka (2001) opined that heat is energy in process of transfer from a body having a higher temperature to a body with a lower temperature.

Chapman (1992) suggested that cities have modified climate conditions and are warmer and drier than the surrounding and vegetated areas. One of the primary causes of this modification is that in the process of urbanization, vegetated land surfaces are converted into concrete and asphalt surfaces.

Yilmaz (2007) noted that plants improve the environment aesthetics. In addition to their aesthetic aspects, plants play important roles in urban ecosystems by providing canopy effect, water vapor to the environment through evapotranspiration process, air pollutant reduction, carbon emission reduction, storage structural heating, and cooling cost reduction.

The Hong Kong Observatory (2009) embarked on surface meteorological measurements which refer to observations of meteorological elements made near the surface of the Earth with the aid of passive sensors such as barometers, thermometers, and rain gauges. Information on the atmospheric pressure, air temperature, grass temperature, humidity, wind speed and direction, rainfall, and cloud and sea surface temperature is used operationally in day to day weather analysis and forecasting. This information together with surface observations of sunshine duration, global solar radiation, soil, and grass minimum temperature are essential for many fields of studies including climatology, hydrology, agriculture, and civil engineering design.

Yilmaz (2007) carried out detailed research to determine the temperature difference between asphalt, concrete, soil, and grass surface in the city of Erzurum, Turkey. This was done in a bid to infer that grasses, in addition to their aesthetic aspects, also play an important roles in urban ecosystems by providing canopy effect, air pollution reduction, etc. The study showed that asphalt/concrete surface has an average of 28.74^0C for the whole period. Soil surface was warmer, with an average of 22.24^0C, than the grass surface which had an average of 16.95^0C. This shows that grass surface is most advantageous for temperature lowering because of its high reflectivity.

Kyra (2009) observed that grass (depending on the type) like every other cultivated green plant, requires the right soil environment, soil structure, soil pH, and nutrient conditions for it to grow. He observed that like every other grass plant, when grass is cultivated, they photosynthesize among other things.

Attridge (1990) opined that a significant aspect of the plant environment is the quality/amount of light. A plant has an absolute requirement for sunlight for the purpose of photosynthesis, a process which predominantly requires red (R) and blue (B) wavelengths. He also pointed out that grass (which is a green plant) contains a number of light absorbing pigments which vary both in chemical composition and function. They include chlorophyl, carotenoids, anthocyanins, and phytochrome. Attridge (1990) also outlined that a single piece of grass is called a blade and blades, like leaves, are light traps and on this the grass temperature is being determined.

Charles (1987) noted that almost all the Earth's energy comes from the Sun. This energy is called radiant energy. The Sun provides 99.97% of energy used for various purposes on the Earth. The atmosphere also helps to warm the Earth by absorbing, storing, and recycling the Sun's radiant energy. As the Sun energy reaches the atmosphere, part of it is reflected back into space.

The remaining ultraviolet radiation that is neither reflected nor absorbed by the atmosphere reaches the Earth's surface. Here, a greater percentage of it is absorbed by green grass (for use in photosynthesis, photoperiodism, cellular respiration, etc.). Also part of this radiation is reflected back to the space in a process called albedo (the ratio of diffusely reflected to incident electromagnetic radiation). Between the atmosphere and the surface of the leaf, there is an abrupt change in refractive index (n). The optical boundary thus formed between the air (n=1) and the leaf (n = 1.5) causes light beams to be reflected or refracted.

This heat energy which is in form of sunlight that reaches the grass surfaces is either absorbed, transmitted, or reflected giving rise to the grass temperature. This is what we intended to measure and determine at Uturu within the stated months of December 2008 to January 2009 for the Harmattan season, March 2009 for the dry season, and finally April and May 2009 for the rainy season.

According to Attridge (1990), a good knowledge of the grass (plant) temperature of a particular grass as it varies with the three seasons helps one in choosing a definite place, position, or latitude in which it can be successfully planted and cultivated. Also, a good knowledge of the precise albedo value of a particular grass can be used to determine a particular environment which it can well fit to provide its cooling effect. Plant temperatures in excess of 40^{o}C are usually associated with failures of the cooling systems, when stomatal closure in response to water shortage cuts off evaporation and its consequent transpirational cooling.

Bliss (1985) added that the result of very low temperature is reduced net photosynthesis and reduced growth rate since biochemical reaction rates are temperature dependent. The physiological effects of low temperature are quite complex and still rather poorly understood. The measurement of grass surface temperature at Uturu during the Harmattan (Cold North East Trade Winds locally called Harmattan), dry, and wet seasons is of interest from the stand point of environmental impacts.

MATERIALS AND METHODS

The grass minimum thermometer was used to determine the grass surface temperature of *Axonoppus compressus* at the Abia State University, Uturu meteorological station. The thermometer was placed on the turf with the bulb of the thermometer in contact with the tips of the blades of grass. Grass minimum temperature as noted by Crucifix (2009) is the temperature at 5cm (2 inches) above ground. The grass thermometer was placed lying horizontally on the grass surface at 1700GMT (6:00 pm) in a day and read off at 0900GMT (10:00 am) the next day. The minimum grass temperature is usually read after a night. The Lawn Institute (2009) observed that grasses cool the air temperature by absorbing the Sun's heat during the day and release it slowly in the evening thus moderating temperature. The contraction of the alcohol column overnight causes a small indicator with the stem of the thermometer to descend and record the lowest temperature.

The readings were taken daily for a period of five months starting from 1st of December 2008 to 31st of January 2009, March 2009, and April to May 2009 representing the Harmattan, dry, and wet (rainy) seasons, respectively.

The readings were sharply taken since the shade that could be provided by a human body could readily affect the immediate temperature environment of the grass. Daily visits were made to the meteorological station twice per day in the morning at 10:00 am, to measure the temperature data, after which the grass thermometer is stored in the Stevenson screen and in the evening at 6:00 pm to place the thermometer on the grass until the next day.

RESULTS AND DISCUSSION

The daily grass surface temperature measurements at Uturu for the period of study December 2008 to January 2009, March 2009, and April to May 2009 based upon which the monthly mean temperature is calculated is as shown in Table 1.

Table 1: Daily and Monthly Mean Grass Surface Temperature Values (^{0}C) at Uturu.

Harmattan			Dry Season	Wet/Rainy season	
Day	Dec.	Jan.	March	April	May
1	23.00	20.00	22.00	18.00	21.50
2	23.00	22.00	21.00	19.00	22.00
3	23.00	20.00	20.00	20.50	21.20
4	22.00	22.00	20.20	20.00	22.00
5	22.00	22.00	21.00	20.00	20.40
6	22.00	22.00	20.20	20.00	19.20
7	21.00	20.00	20.50	20.00	19.40
8	23.00	18.50	21.00	20.00	20.00
9	22.00	22.00	20.50	20.00	20.20
10	22.00	20.20	21.00	20.00	20.30
11	20.00	22.00	20.50	20.00	20.00
12	23.00	19.00	20.00	20.00	20.20
13	22.00	20.00	19.50	20.50	22.50
14	21.50	20.20	20.40	19.50	19.50
15	22.00	19.00	20.50	20.00	18.00
16	23.00	20.00	19.50	18.00	20.20
17	24.00	22.00	20.00	20.20	20.00
18	24.00	18.00	19.50	20.50	19.50
19	23.00	20.50	20.20	19.00	19.40
20	23.00	18.50	20.50	20.00	22.00
21	20.20	20.50	21.40	18.00	22.00
22	22.00	20.20	22.00	20.00	22.50
23	23.00	18.50	21.00	19.50	22.00
24	22.00	20.50	20.50	19.50	20.20
25	22.00	18.50	20.50	20.00	20.00
26	22.50	18.50	20.50	20.50	20.20
27	22.00	20.00	21.00	20.00	20.20
28	23.00	22.00	21.50	20.00	22.00
29	23.00	20.20	22.20	20.00	22.00
30	21.50	22.00	23.00	20.00	22.00
31	22.00	20.00	22.50	-	22.00
MEAN	22.31	20.28	20.78	19.76	20.72

The grass temperature values obtained throughout the period of study at Uturu at 5cm above the grass ranged from 18.0°C – 24.0°C while the monthly mean grass temperature obtained are 22.31±0.16°C, 20.28±0.24°C, 20.78±0.16°C, 19.76±0.13°C, and 20.72±0.21°C for the months of December 2008, January 2009, March 2009, April 2009, and May 2009, respectively (Table 1). The maximum grass surface temperature of 24.0°C was recorded in December 2008 while the minimum grass temperature of 18.0°C was recorded in the months of January, April, and May 2009.

The mean grass surface temperature obtained for the two months representing the Harmattan (December 2008 and January 2009) was 21.30±0.40°C, while that of the wet season (April and May 2009) was 20.24±0.34°C. It becomes obvious that the grass temperature at Uturu is higher during the Harmattan than the dry (20.78±0.16°C), and wet (20.24±0.34°C) seasons.

Ayoade (2004) noted that the intensity of radiation coming to the Earth is affected by the latitude, altitude of the Sun, distance of the Earth from the Sun, and distribution of land and water. These are the reasons for the variation of the grass surface temperature at Uturu. The greatest intensity of solar radiation is received at the Earth surface during the perihelion towards the 3rd of January when the distance of the Earth from the Sun is shortest and about 146 million km (91 million miles). Beyond this day, the Earth distance from the Sun increases and is highest on the 4th of July, the distance approximately 150 million km (93 million miles). This period is called the aphelion.

Figures 1-5 are the graphs of the variation of the grass surface temperature against day of months at Uturu for the period of study. Figure 1 showed that the maximum grass temperature of 24.0°C in the month of December 2008 was obtained on the 17th and 18th day, while the minimum grass temperature of 20°C was obtained on the 11th day.

Figure 2 revealed that in January 2009, the maximum grass temperature of 22.0°C was obtained on days 2nd, 4th, 5th, 6th, 7th, 28th, and 30th while the minimum grass temperature of 18°C was obtained on the 18th day.

Figure 3 shows that the maximum temperature of 23.0°C was obtained in March on the 30th day while the minimum grass surface temperature of19.50°C was obtained on the 13th, 16th, and 18th day.

Figure 4 indicates that in the month of April 2009, the maximum grass surface temperature of 20.5°C was obtained on the 3rd, 13th, 18th, and 26th day, while the minimum grass temperature of 18.0°C was obtained on the 1st, 16th, and 21st day.

Figure 5 revealed that in May 2009, the maximum grass surface temperature of 22.5°C was recorded on the 13th and 22nd day while the minimum grass surface temperature of 18.0°C was obtained on the 15th day.

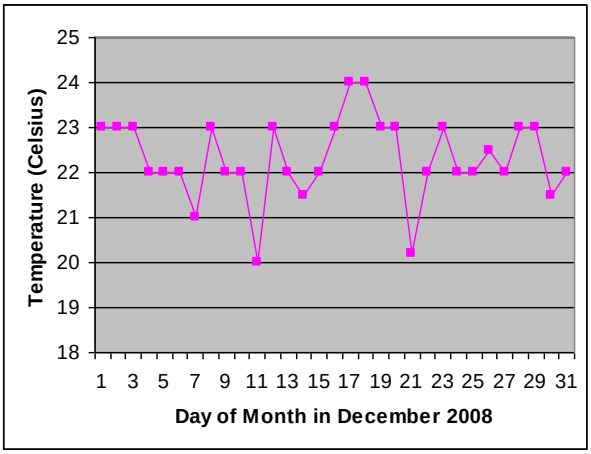

Figure 1: Grass Surface Temperature against Day of Month in December 2008 at Uturu.

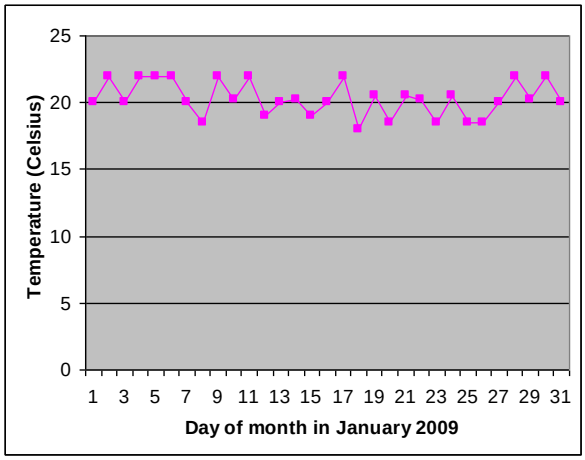

Figure 2: Grass Surface Temperature against Day of Month in January 2009 at Uturu.

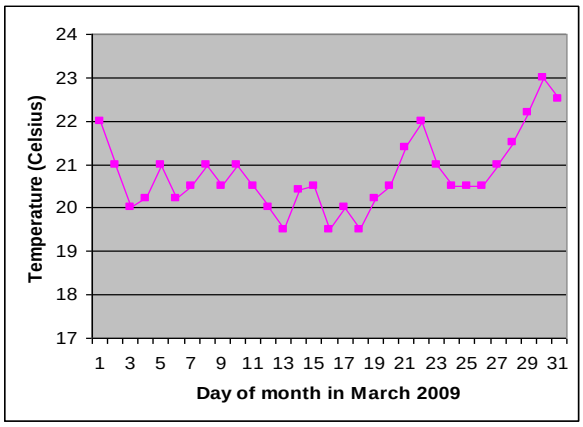

Figure 3: Grass Surface Temperature against Day of Month in March 2009 at Uturu.

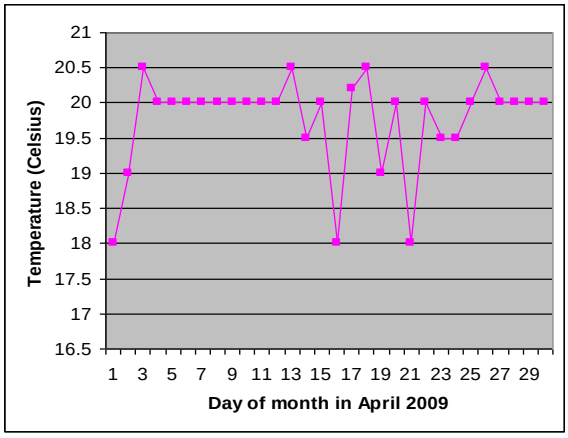

Figure 4: Grass Surface Temperature against Day of Month in April 2009 at Uturu.

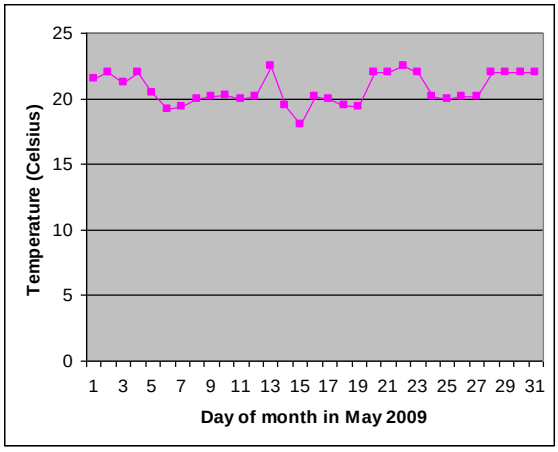

Figure 5: Grass Surface Temperature against Day of Month in May 2009 at Uturu.

Globe (2005) noted that surface temperature is the radiating temperature of the ground surface including grass, bare soil, roads, sidewalks, buildings, and trees, to name a few. The surface temperature affects the amount of long wave (thermal) radiation going to space. The warmer the surface, the more energy it radiates. In order to better understand heat in the environment, scientists take temperature measurements of many different environmental components at a variety of locations. Measurement of surface temperature helps to relate air, soil, and water temperatures and contribute critically to the study of energy cycle. A comparison of the grass surface temperature obtained at Uturu during the period of study and that reported by Chiemeka et al. (2007) showed that grass temperature at Uturu is 78%, 76%, and 74% less for the Harmattan, dry, and wet seasons, respectively.

CONCLUSION

The grass minimum thermometer was used to measure the grass temperature at Uturu, Nigeria (Lat. 05.33^{o}N, 06.03^{o}N and Long. 07.10^{o}E, 07.29^{o}E) with annual mean temperature range of 25.23^{o}C–27.20^{o}C (Chiemeka et al., 2007). The grass thermometer was placed on the grass surface at 6:00 pm (1700GMT) while the daily reading was taken at 10:00 am (0900GMT) the next day throughout the period of study. The temperature data were obtained for a period of five months starting from December 2008 to January 2009, March 2009, and April to May, 2009; representing the Harmattan, dry, and wet seasons, respectively. The result obtained showed that the maximum grass temperature of 24.0^{o}C was recorded in December 2008 while the minimum grass temperature of 18.0^{o}C was recorded in January, April, and May 2009. The mean monthly grass temperatures of 22.31±0.16^{o}C, 20.28±0.24^{o}C, 20.78±0.16^{o}C, 19.76±0.13^{o}C, and 20.72±0.21^{o}C were obtained for the five months, respectively.

The mean grass surface temperature obtained for the two months representing the Harmattan (December 2008 and January 2009) is 21.30±0.40^{0}C, while that of the wet season (April and May 2009) is 20.24±0.34^{0}C. It becomes obvious that the grass temperature at Uturu is higher during the Harmattan than the dry (20.78±0.16^{0}C) and wet (20.24±0.34^{0}C) seasons. The result showed that the grass temperature at Uturu is on the average warmer during the

Harmattan than in the dry season and cooler in the wet season. Lawn (2009) noted that temperature is very important for proper grass growing and grass seed germination. Grass is of immense help in keeping the delicate balance of nature and plays a fundamental role in the lives of humans.

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ABOUT THE AUTHOR

Dr. I.U. Chiemeka, is a member of the Nigerian Institute of Physics and of the faculty of the Department of Physics at Abia State University in Uturu, Nigeria with research interests in atmospheric aerosols, solar radiation, soil temperature, and grass surface temperature studies.

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