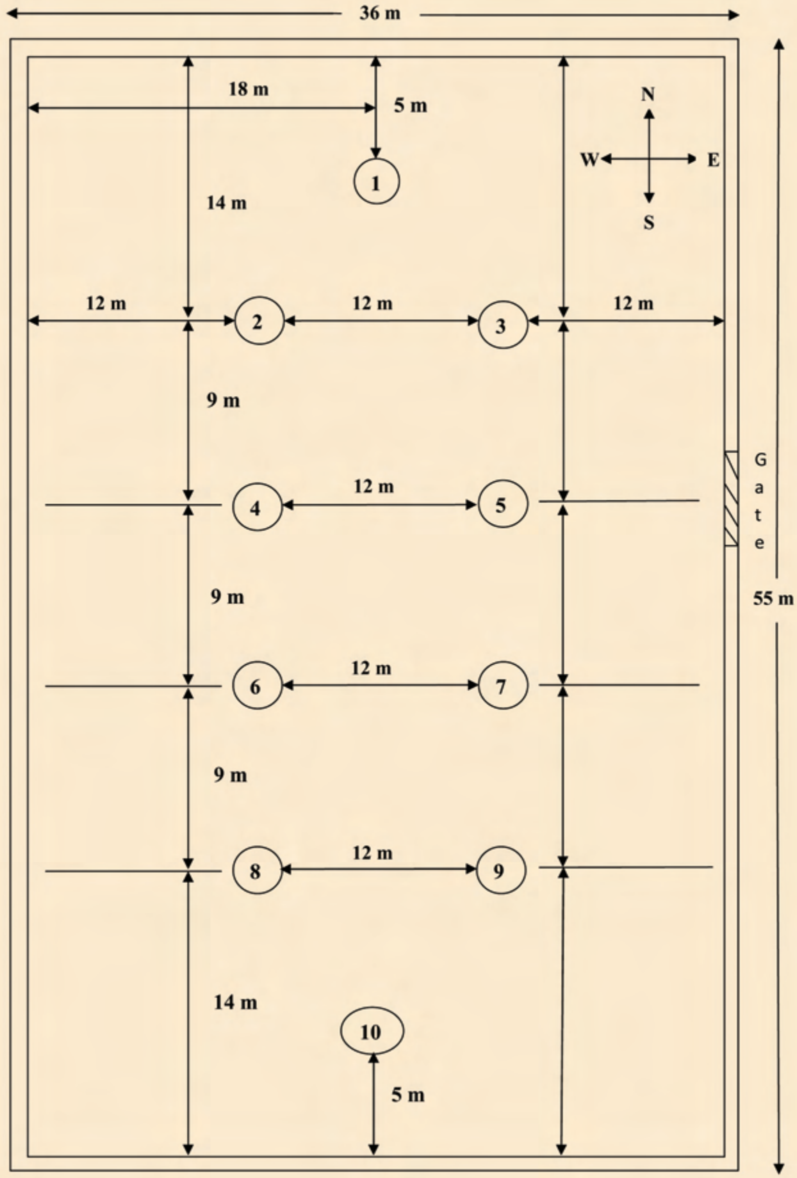
TECHNICAL BULLETIN 01/2014

AGROMETEOROLOGICAL INSTRUMENTS

AICRP on Agrometeorology
Dept. of Agricultural Meteorology
College of Horticulture
Kerala Agricultural University
Vellanikkara - KAU P.O. - 680 656



1. Sunshine recorder
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4. Double Stevenson Screen
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8.Soil thermometers
9. Open pan evaporimeter
10. Dew gauge

Layout of the Agrometeorological observatory

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Agrometeorological Instruments

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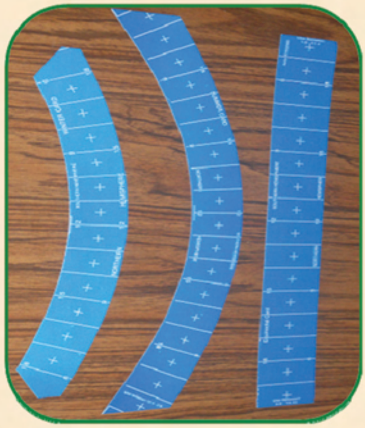
Wind Speed	Anemometer
Maximum Temperature	Maximum Thermometer
Minimum Temperature	Minimum Thermometer
Relative Humidity	Hygrometer
Precipitation	Rain gauge
Evaporation	Evaporation pan
Cloud Cover	Visual observation

SUNSHINE RECORDER



Measurement of bright sunshine hours

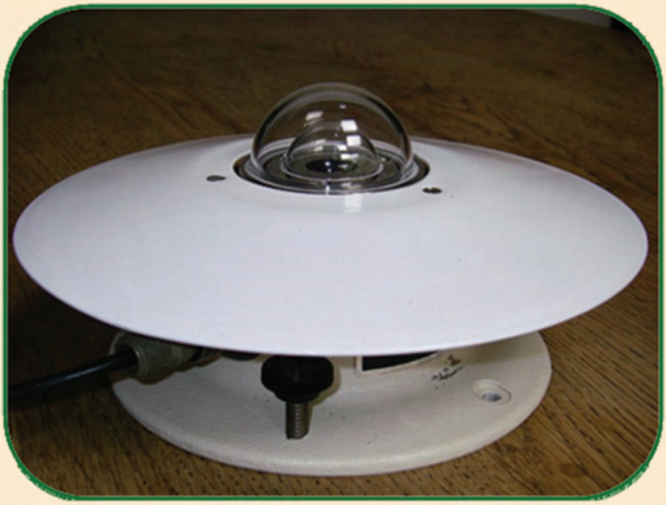
PRINCIPLE:

- It consists of a glass sphere towards which the sun rays are focussed
- This glass sphere burns a trace in a card which is placed at its focal length

DESCRIPTION:

- Three types of cards are used to suit the solar angle in different seasons namely, long curved card in summer, straight card for equinoxes and short curved card for winter
- The whole apparatus is exposed at a height of 10 feet
- Duration of sunshine is determined by measuring the length of burning on the card
- The card should be normally changed after sunset on each day

PYRANOMETER



Measurement of global (direct + diffused) radiation

PRINCIPLE:

- Sensing element of a pyranometer is a thermopile with black and white segments
- Black bands absorb radiation while white bands reflect it
- This temperature difference is sensed by the thermopile and the output of thermopile is linearly related to solar radiation

DESCRIPTION:

- It can be used to measure the reflected short wave radiation by placing in an inverted position
- It can also be used for the measurement of diffused radiations alone by using a semicircular shading ring to screen solar direct rays

CUP ANEMOMETER

Measurement of wind speed

PRINCIPLE:

- The three semi-conical cups are set in motion due to the pressure difference between convex and concave surfaces of the cups
- A cyclometer is attached to the anemometer which indicates the wind speed in $kmhr^{-1}$

DESCRIPTION:

- The anemometer is installed in such a way that the cups are exactly at a height of 10 feet above the ground
- Note down two readings at an interval of 3 minutes and multiply the difference by 20 to get wind speed at the time of observation in $kmhr^{-1}$

WIND VANE

Measurement of wind direction

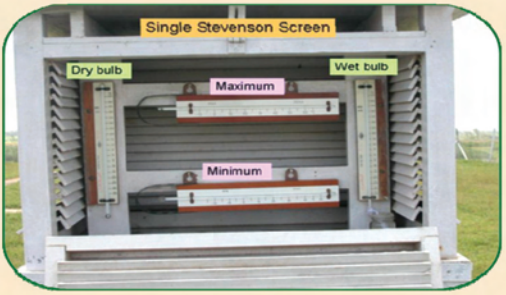
PRINCIPLE:

- The broad and bifurcated fang end of the wind vane offers the greatest resistance to the motion of the air goes to the leeward side
- The pointer of the wind vane indicates the direction from which the wind is coming

DESCRIPTION:

- A rigid cross arm is attached to this wind vane to indicate wind direction as 16 sub-directions of a compass
- Wind vane is installed in such a way that the vane is exactly at 10 feet above the ground

SINGLE STEVENSON SCREEN



Measurement of air temperature

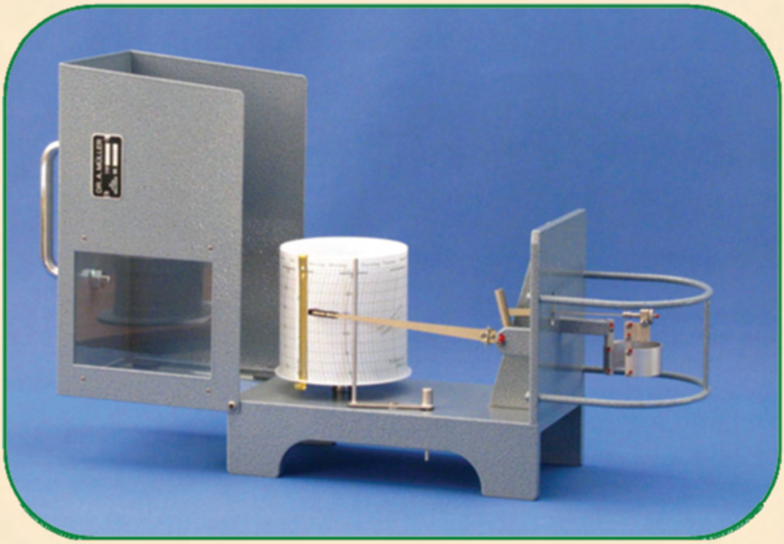
PRINCIPLE:

- ➢ Maximum thermometer
  - ✓ Mercury-in-glass thermometer
  - ✓ Records the maximum temperature of a day
- ➢ Minimum thermometer
  - ✓ Alcohol-in-glass thermometer
  - ✓ Records the lowest temperature of a day
- ➢ Dry bulb thermometer
  - ✓ Mercury-in-glass thermometer
  - ✓ Gives the instantaneous air temperature
- ➢ Wet bulb thermometer
  - ✓ Mercury-in-glass thermometer
  - ✓ Used to find out dew point, vapour pressure and humidity

DESCRIPTION:

- It is a rectangular wooden box with double louvered walls
- Dimension is 56cm x 31cm x 42cm
- It is painted white and have double roof
- It is installed at a height of 4 feet from the ground
- It houses thermometers to record air temperature

THERMOGRAPH



Continuous recording of air temperature

PRINCIPLE:

- It consists of a bimetallic strip made of Invar and Brass
- When temperature changes, the curvature of bimetallic arc increases or decreases due to difference in expansion of two metals
- These changes in bimetallic strip are recorded on a graph paper placed on a rotating drum

DESCRIPTION:

- Thermograph is always placed in Double Stevenson Screen

GRASS MINIMUM THERMOMETER

Measurement of actual minimum temperature experienced by the plants near the ground surface

PRINCIPLE:

- Alcohol-in-glass thermometer with a small index just like in case of minimum thermometer

DESCRIPTION:

- It is also known as terrestrial radiation thermometer
- The thermometer is exposed one inch above the ground surface on its support over the grass plot
- It is kept after sunset for observation and readings are taken just before sunrise
- The reading indicates the possibility of occurrence of ground frosts
- When the instrument records 30° F or 0° C below, a ground frost is likely to occur

SOIL THERMOMETER

Measurement of soil temperature

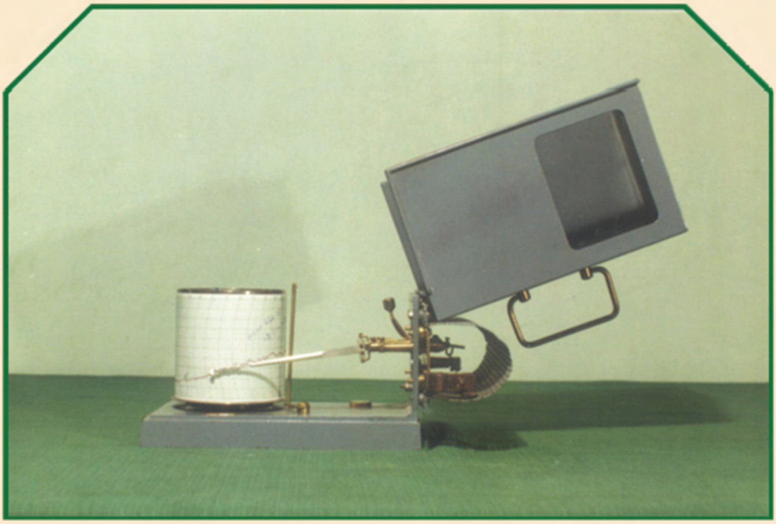
PRINCIPLE:

- Soil thermometers are mercury-in-glass type thermometers

DESCRIPTION:

- The variation of soil temperature with time and depth is measured
- The stem of the thermometer is bent at 120^0 just above the bulb
- The thermometers are placed at 5, 10, 15, 20 and 30 cm depths whereas, the scale is situated above the earth's surface
- They are supported by iron stands which are 45 cm apart and fixed along the east-west line, facing south
- The range of the thermometer is -20° C to + 60° C

HYGROGRAPH



Continuous recording of relative humidity

PRINCIPLE:

- It consists of a bundle of cleaned and de-oiled human hair which is humidity sensitive
- The length of the hair increases with increase in relative humidity in a logarithmic manner
- The changes in the length of hair are fed to a lever mechanism which magnifies the motion and this motion is recorded on a graph paper attached on the clock driven revolving drum

DESCRIPTION:

- Hygrograph is always placed in Double Stevenson Screen
- The circular drum rotates once in 24 hours or once in a week

WHIRLING PSYCHROMETER

Measurement of temperature and relative humidity in the open as well as inside crops at various heights

PRINCIPLE:

- It consists of two mercury-in-glass thermometers (dry bulb and wet bulb thermometers) fixed inside a wooden frame provided with a handle
- Ventilation for the thermometer bulbs is provided by rotating the frame rapidly

DESCRIPTION:

- The psychrometer should be rotated in shade towards the windward direction
- It should be given about 4 rotations per second to obtain desirable wind speed of about 5 meters per second

FRP RAIN GAUGE

Measurement of rainfall

PRINCIPLE:

- It consists of a funnel with an open circular mouth of area 200 cm^2
- Rain water after falling through the funnel gets collected in a reservoir kept inside the body of the instrument
- The rain water collected in the reservoir is measured by means of a standard measuring cylinder

DESCRIPTION:

- The measurement is taken daily at 08:30 hrs 1ST and 14:00 hrs LMT as and when there is a rain

SELF RECORDING RAIN GAUGE

Measurement of duration, amount and intensity of rain

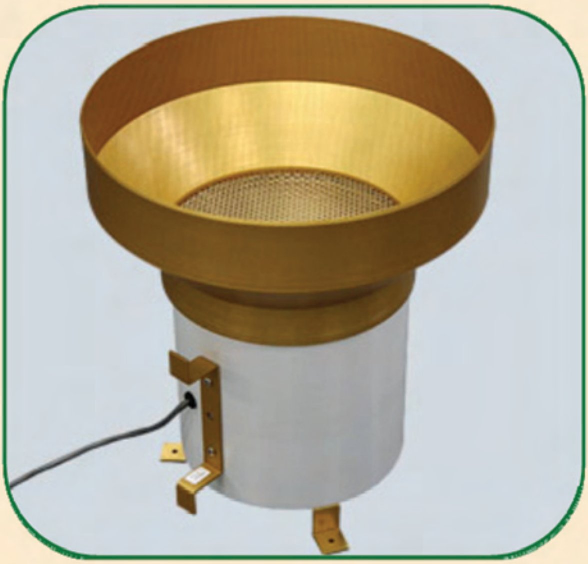
PRINCIPLE:

- Natural siphoning is the principle driving force
- Consists funnel, recording mechanism and receiver
- Receiver consists of float and siphoning chamber
- As the level of water rises in the receiver, the float rises and the pen records on a chart placed on a rotating drum

DESCRIPTION:

- It also gives the time of commencement and cessation of rainfall and intensity
- This instrument can be used to record any highest quantity of rainfall
- The clock work drum revolves once in 24 hrs or 7 days

TIPPING BUCKET RAINGAUGE



Measurement of rainfall in Automatic Weather Station

PRINCIPLE:

- It consists of a pair of buckets and when one bucket is filled with 0.25 mm of rain water, it tips and empties into a cylinder placed below and other bucket comes in position
- As long as precipitation continues, this operation is repeated and an electric pulse is generated each time a bucket tips
- Each tip is counted by the data logger and this is converted to amount of rainfall

DESCRIPTION:

- It is used in automatic weather station
- It consists of a cylindrical receiver of 30 cm diameter with a funnel inside

PAN EVAPORIMETER

Measurement of evaporation

PRINCIPLE:

- The pointed brass is fixed vertically at the centre of the cylindrical stilling well with in the evaporation pan
- At each observation, the water level is brought to the same fixed point by adding water with the help of a graduated measuring cylinder, which is having 1/100th of cross sectional area of the evaporation pan
- One full cylinder of water raises 2 mm height in the pan

DESCRIPTION:

- Pan is painted white and is mounted on a wooden stand and have a diameter of 120.7 cm
- Pan is covered with wire mesh to prevent loss of water by birds, animals etc.

ANEROID BAROMETER

Measurement of atmospheric pressure

PRINCIPLE:

- It consists of an evacuated circular metal box, called as siphon cell which expands or shrinks in response to variations in atmospheric pressure
- These variations are magnified with the help of levers and are communicated through chain and pulley to the pointer and gives direct pressure reading

DESCRIPTION:

- It is a simple portable instrument for pressure determination
- It does not uses any type of liquids for its working
- Aneroid barometer must be set and standardized with the help of a standard mercury barometer

DEW GAUGE

Measurement of dew

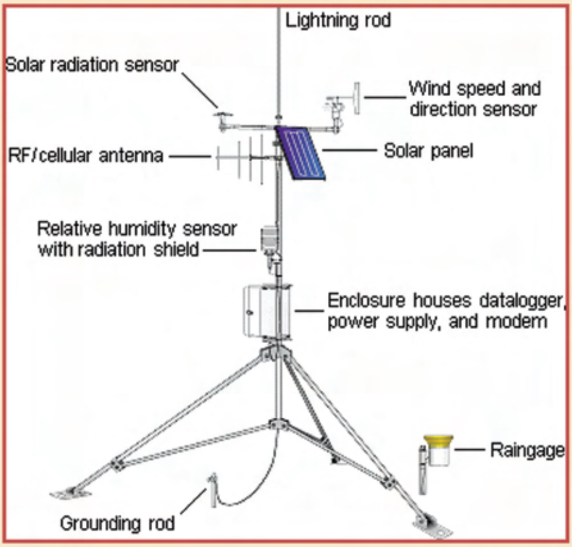
PRINCIPLE:

- Dew gauge is exposed at sunset and at about sunrise, the size and distribution of dew deposited on the gauge is observed and compared with a set of dew photographs
- By knowing the dew scale number, it is possible to measure dew

DESCRIPTION:

- It consists of a rectangular wood block of size 32 x 5 x 2.5 cm coated with special red paint
- It is exposed on special iron support at heights 5, 25, 50 and 100 cm above the ground

Automatic Weather Station



An automatic weather station (AWS) is defined as a "meteorological station at which observations are made and transmitted automatically" (WMO).

PURPOSE

Automatic weather stations are used for increasing the number and reliability of surface observations.

Types of automatic weather stations

Real-time AWS: A station providing data to users of meteorological observations in real time, typically at programmed times, but also in emergency conditions or upon external request.

Off-line AWS: A station recording data on site on internal or external data storage devices possibly combined with a display of actual data. The intervention of an observer is required to send stored data to the remote data user.

An AWS may consist of an integrated AWOS (and data-acquisition system) or a set of autonomous measuring devices connected to a data-collection and transmission unit.

SENSORS

Sensors can be classified as analogue, digital and "intelligent" sensors.

Analogue sensors: Sensor output is commonly in the form of voltage, current, charge, resistance or capacitance. Signal conditioning converts these basic signals into voltage signals.

Digital sensors: Sensors with digital signal outputswith information contained in a bit or group of bits, and sensors with pulse or frequency output.

"Intelligent" sensors/transducers: Sensors including a microprocessor performing basic data-acquisition and processing functions and providing an output in serial digital or parallel form.

Most automatic weather stations have

Thermometer for measuring temperature
Wind vane for measuring wind direction
Barometer for measuring atmospheric pressure
Anemometer for measuring wind speed
Hygrometer for measuring humidity
The data-logger is the heart of the Automatic Weather Station

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