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Agrometeorological Observatory - Establishment and General Maintenance

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In recent years, the impact of climate on agricultural production has been gaining importance in the context of global climate change. Higher accuracy in weather data is essential for data analysis to draw valid conclusions scientifically and subsequently to develop climate resilient technologies. Numerous agrometeorological weather stations have been established in many parts of the country to record weather data for various uses. Hence, the real time weather parameters in agrometeorological observatories need to be recorded with utmost care without deviation from recording the actual weather condition. This can be achieved only by proper maintenance of the agrometeorological observatory so that the influence of external/surrounding factors is reduced to the maximum extent. This paper discussed various types of agrometeorological observatories, instruments for recording various weather parameters, guide lines for establishment of agrometeorological observatory and its maintenance that simulate the surrounding agro-ecological conditions.

1. Introduction

'Weather' is a crucial factor that directly influences the crop growth from sowing to maturity stage. Further, weather determines the success or failure of agricultural production through its effects on soil, plant growth and development; pest and diseases; and yield and also animal growth and development during various phases. The recording and analysis of meteorological data in scientific research has been gaining importance especially in the context of climate change and increased incidence of extreme weather events. Hence, there is a need for high precision in recording data to draw proper scientific conclusions. The intra- and day-to-day variations in weather parameters can be studied by setting up an Agro-meteorological observatory near the experimental area (Murthy et al., 2019).

Agro-meteorological observatory is a network of various meteorological instruments installed in a symmetric way over a site, which is a true representative of the crop-soil-weather/climatic

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conditions of that area. Various weather parameters are measured using instruments at stipulated time interval (Yadav et al., 2012). The important weather parameters are solar radiation, air temperature, soil temperature, relative humidity, evaporation, rainfall, sunshine hours, wind direction and speed, evaporation and cloud cover etc. The observations for a long period can be analyzed statistically for obtaining crop-weather relationships.

The World Meteorological Organization (WMO) classified agromet observatories/stations into four categories *viz.*, Principal, Ordinary, Auxiliary and Specific purpose agromet observatories (Table 1).

Table 1: Salient features of different types of agrometeorological stations

Sl. No.	Agrometeorological station (AMS)	Salient features
1.	Principal AMS	• Provides meteorological data viz., soil moisture, soil temperature, potential evapotranspiration, etc. • Biological information such as crop phenology, onset and spread of plant diseases. • Research in Agrometeorology is carried out. • Equipped with Instrumental facilities for higher range and more frequency of observations. • Focus on fundamental investigations in regional/country level research issues.
2.	Ordinary AMS	• Provides meteorological data viz., soil moisture, soil temperature, potential evapotranspiration, etc. • Biological information such as crop phenology, onset and spread of plant diseases. • Equipped to assist in location specific research studies.
3.	Auxilliary AMS	• Provides meteorological data viz., soil moisture, soil temperature, potential evapotranspiration, etc. • Biological information such as crop phenology, onset and spread of plant diseases.
4.	Specific purpose AMS	• Set up temporarily/permanently to record one/several variables/phenomenon.

2. Essential Instruments in Agro-meteorological Observatory

2.1. Sunshine Recorder

It measures the sun shine hours per day. It works on the principle of convex lens. It should be installed on a concrete pillar of 3.05 m height above the ground with steps. The base should be perfectly horizontal and the groove of the recorder should be oriented in E-W direction (Figure 1). Record cards need to be inserted in the three pairs of grooves in the spherical depending on the season of the year (Table 2).

Figure 1: Sunshine recorder

Table 2: Types of sunshine record cards and time of use

S l . No.	Name of card	Type of card	Time of use	Remarks
1.	Summer card	Long-curved card	13th April to 31st August	Inserted in bottom slot
2.	Winter card	Short-curved card	13th October to end of February	Inserted in top slot
3.	Equinoctial card	Straight card	1st March to 12th April 1st September to 12th October	Inserted in mid slot

2.2. Wind Vane

It is used to record the wind direction i.e. the direction from which the wind blows and approaches the station. It is installed on a platform fixed at the top of a pillar of height 3.05 m which is at a distance of 9–10 m from Stevenson's screen (Figure 2).

2.3. Robinson Cup Anemometer

It measures the average wind velocity during 24 hours. It is installed on a platform fixed at the top of a pillar height of 3.05 m above the ground level with steps to the south of the Stevenson's screen (Figure 3).

Figure 2: Wind vane

2.4. Stevenson Screen

It is a unit which is used to accommodate the four thermometers *viz.* maximum, minimum, dry bulb and wet bub thermometers. The maximum and minimum thermometers should be placed horizontally with their bulbs tilted slightly downwards. The dry and wet bulb thermometers should be placed vertically (Figure 4). The bulb of the wet bulb thermometer should be covered with a muslin cloth and it should be kept wet by a thread, one end of which is fixed to the muslin and other end is kept in the distilled water in a bottle. In Double Stevenson screen, thermograph, hygrograph and barograph instruments can be placed besides maximum, minimum, dry and wet bulb thermometers.

Figure 3: Cup anemometer

Figure 4: Stevenson screen

2.5. Open Pan Evaporimeter

It is used to measure evaporation from free water surface. Its base should be placed on a perfectly horizontal wooden platform. The ground beneath the wooden platform should be weed free for the air movement (Figure 5).

Figure 5: USWB pan evaporimeter

2.6. Rainguage

It is used to measure total amount of rainfall manually that occurs during last 24 hours. It should be fixed on a concrete platform of size 600 mm x 600 mm x 600 mm sunk into the ground (Figure 6). The rim of the funnel should be horizontal and exactly 300 mm above the ground level. The rainguage should be between Stevenson screen and the self-recording rain gauge.

Figure 6: Rainguage

2.7. Self-recording Rainguage

It is used to record the total amount of rainfall as well as the duration of the rainfall. It should be fixed on a concrete platform and the rim of the funnel should be horizontal (Figure 7). It should be 2-3 m away from an ordinary rain gauge. The self recording rainguage gives hourly rainfall during particular time period, where non-recording rainguage gives only total rainfall occurred.

Figure 7: Self-recoding rainguage

2.8. Soil Thermometers

These are used to measure the soil temperature at different depths. The thermometers are to be supported with iron stand and protect them with rod fence (Figure 8). Generally, the thermometers are placed to record soil temperature at 5,10,15,20 and 30 cm depth. A bend of 120^{O} angle just above the bulb and rest of the stem being straight facilitates the bulb being placed in horizontal position as well as reading of the scale.

3. Site Selection Criteria for Agro-meteorological Observatory

• Should be a flat rectangular plot and should not lie on concrete, asphalt or crushed rock with 55 m and 36 m in north-south and east-west directions, respectively.

Figure 8: Soil thermometers

• Must be representative of climate, soils and cropping conditions of the area and should be located at the centre of the farm.

• Must be free from water logging and easily accessible throughout the year.

• Should be away from hills, buildings, streams and trees to avoid shade, shield or channel effects, electrical and telephonic lines.

• Should be away from steep slopes, water bodies and frequent irrigation.

• The distance between the rain gauge and obstacles should be as far as possible four times the height of the obstacle.

The selected site need to be wire fenced to a height of 1.5 m to with a gate and lock arrangement to protect from the trespassers, animals and rodents etc. from theft/ damage to the cables.

3.1. Layout Plan of an Agricultural Meteorological Observatory

The Agro-meteorological observatory has to be established with standard meteorological instruments that are reliable, accurate, high precisions, simple, robust and easy for operation and maintenance. All the instruments should be installed in accordance with the norms of Nation concerned and WMO so as to have uniformity for comparison of weather data from place to place over the globe. The standard layout with all instruments and distances are shown in Figure 9.

3.2. Guidelines for Installation of Instruments in the Observatory

(i) The exposure of one instrument should not affect the other instruments by causing shadows.

Eg: Stevenson screen should not affect the soil thermometers with its shadow.

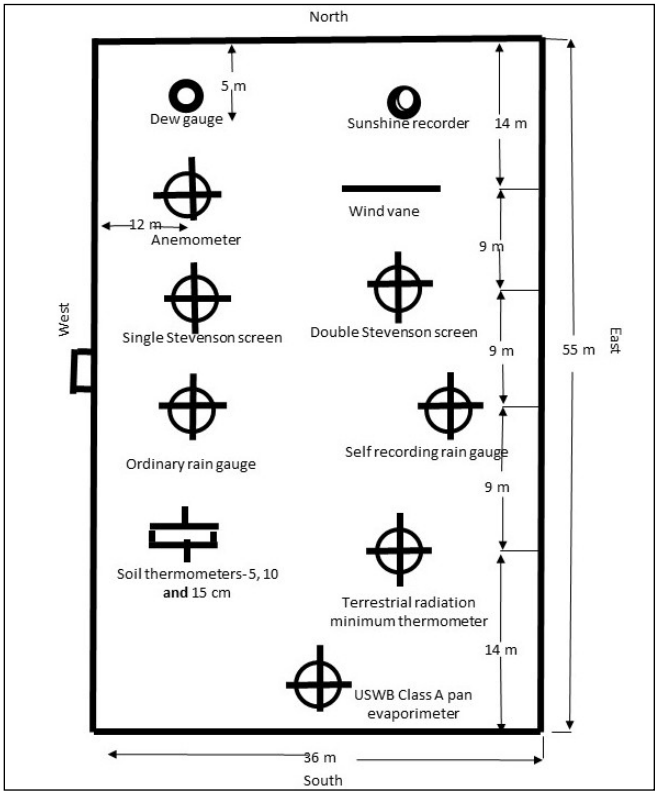

Figure 9: Layout plan of Agro-meteorological observatory (IMD)

(ii) The opening face of the Stevenson screen should be North in Northern hemisphere and South in Southern hemisphere. This is because the direct solar radiation should not fall on the instruments.

(iii) The soil thermometers should always face South in Northern hemisphere and vice versa in Southern hemisphere.

The weather data recorded has far wider application and hence, the exact location of the observatory should be noted or depicted with latitude, longitude and elevation (height above mean sea level).

3.3. Weather Data Recording Hours

Since weather parameters vary with time, it is necessary that the parameters are to be recorded at a particular time on every occasion. At Agromet observatories, the observations should be recorded at 07:00 and 14:00 hours local mean time (LMT), except evaporation and rainfall which are recorded at 08:30 hours IST (Ahmad et al.,

2017). The sunshine hours are to be recorded as per local apparent time (LAT) and the recording cards must be replaced after sunset.

3.4. General Maintenance Instructions

➢ The soil surface in the observatory should be covered always with thin grass of approximate height of not more than 2.5cm.

➢ The site should not be ploughed or worked with rotary mulcher or any such equipment as barren ground causes increased ground radiation. The grass should be periodically trimmed either manually or using lawn mower.

➢ The thermometers should be kept clean and the bulbs bright. If water has condensed on any of the thermometers it should be wiped off and several minutes allowed to lapse before the readings are taken.

➢ The grass around the rainguage should be kept short. No shrubs or plants or trees should be allowed to grow round the guage and around as well as inside the observatory.

➢ Wind instruments (wind vane and anemometer) should be cleaned and oiled once a fortnight in dusty weather and once a month in the rainy season.

➢ The evaporation pan has to be emptied and cleaned monthly. If the grass cannot be kept green and mown, then the area around the pan should be kept bare with a herbicide.

➢ If any instruments run by solar panels (radiation panels), the radiation shields are to be cleaned frequently to record accurate data.

4. Conclusion

The crop-weather relationships, development of pest/ disease forewarning systems utilize the weather data and hence right weather data helps in drawing valid scientific conclusions which help farmers as well as policy makers in taking right decisions. As weather data is recorded in open field (agrometeorological observatory), the influence of external factors/operations taken up in agrometeorological observatory maintenance should be minimized to the maximum extent by following the guidelines scrupulously to get reliable data.

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