

agMOOCs

Basic aspects of Temperature and their application in crop production

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In the last class we were seeing the weather element rainfall.

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## **1(c). Basic aspect of temperature and their application in crop production (Dr.T.N. Balasubramanian)**



Air temperature has important role on plant growth and development at all stages(enzymes ,hormones, cell division and their multiplication).

For today's class we will discuss something on the temperature. Temperature means normally it indicates the hotness of your body. Body may be [ph inner 0:20] material or biological material. So the air temperature has important role and plant growth and development. It triggers insane action. It triggers hormone, cell multiplication and why not all. Who say temperature is a general term? Meteorologically in the case of agriculture meteorologically we defined temperature at the different ways.

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## **Types of temperature in crop production**

### **a. Air Temperature**

- Maximum temperature
- Minimum temperature
- Mean temperature

### **b. Soil temperature**

### **c. Cardinal temperature**



One is maximum temperature. This is the maximum possible temperature that occurs in a day may be 2:30 p.m. this maximum temperature occurs. Then another one is minimum temperature, the lowest level that occurs normally 5:30 a.m. in the morning. So the temperature variation difference between the maximum temperature and minimum temperature we call it as the diurnal variation or diurnal temperature, how much difference that occurs between the maximum temperature and minimum temperature. In the case of the temperate countries the minimum is very very difference between these two is very small, but in the case of the tropical situation the difference between maximum temperature and the minimum temperature would be very large that also gets varied with witticism.

Then mean temperature, this is nothing but addition of these two maximum, minimum divided by the two of your particular day. Not only air temperature we are also bothering about the soil temperature for crop protection because soil temperature is very very important to motivate our roots to grow roots, to put forth more small roots so root temperature, microorganism growth and everything, soil is a living body not your dead body, because there it also gets respired. So soil temperature is the triggering point that is what that works very well in the soil. Then cardinal temperature, you are very cordial to other people. So cardinal means the optimum temperature that triggers, that motivates any bio system like plants and animal to grow very well. I like to provide some example for this cardinal temperature.

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## Cardinal temperature for germination of seeds of selected crops(°C)

Crops	Minimum	Optimum	Maximum
Wheat	3- 4.5	25	30-32
Barley	3- 4.5	20	38.40
Oats	4- 5	25	30
Maize	8-10	32-35	40-44
Sorghum	8-10	32-35	40
Rice	10-12	30-32	36-38
Tobacco	13-14	28	35

So cardinal temperature is nothing but the temperature, optimum temperature for any growth, growth means cell division, cell multiplication. So here you can see that for wheat germination here minimum of 3 to 4 point degree centigrade is required, minimum, below that there is no germination. Similarly if the temperature is more than 32 degree centigrade there is no germination of the wheat seeds. How the plant, seeds are getting adapted to the temperature? Here I like to say the temperature means soil temperature, this is very very important. So when the soil temperature has greater link with your air temperature, when the air temperature is more the soil temperature also would be more. It is a dynamic system that is being operated under natural condition.

Now coming to the Barley, I have given different examples. Barley is given, oat is given, maize, sorghum, rice and tobacco. But we could see some interesting radiation between these two. So crops from temperate countries are also given like wheat, barley, oats, and the crop from our tropical situations are also given. You kindly see the minimum temperature requirement for tropical crops like for example maize or sorghum or rice or tobacco, it is 8 to 10 degree centigrade minimum, but if you examine your temperate crops the minimum is 3 degree centigrade. So how crops are getting adapted to the temperature situation is very very important. So cardinal temperature in the absence of the cardinal temperature things will be something different, that's why in the change of the in these coming years there is a climate change. As a result you get a warmer world. When the temperature is warmer means your (inaudible 00:04:37) gets affected. This can be taken as an example for this statement. (Refer Slide Time: 04:44)

## Heat wave(°C)

Category	Deviation from Normal
Normal	(-)1to + 1° C
Above normal	+2° C
Appreciably above normal	+3 to 4° C
Moderate heat wave	+5 to 6° C
Severe heat wave	+7° C and above

**When the normal maximum temperature of the area is 40° C or less**

Now people say in the weather forecast we used to give heat wave is a possible in the coming three to four days. Cold wavy is possible in coming to two to three days. In this case you must understand what is heat wave. What is cold wave? When the normal maximum temperature of the area is 40 degree centigrade or less normal, normal means over years 30 years data, when the 30 years data indicates that is the 40 degree centigrade then here normal heat wave, normal temperature means a plus one to minus one degree centigrade, above normal is plus two centigrade, appreciably above normal means plus 3 to 4 degrees centigrade. We do not worry about all those things. We are worrying about severe heat wave. This is common in northern parts of India as an example where the temperature from the normal is more than seven degree centigrade.

Suppose the normal is a 40 degree centigrade for a particular area the temperature goes above seven degree, 47 degree means that is heat wave. When heat comes means the crop gets affected, people gets affected; so cattle get affected, so we have to take a adoptive strategy to manoeuvre these situations.

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## Cold wave(°C)

Category	Departure from normal
Normal	(-) 1 to +1° C
Below normal	(-)2° C from the normal
Appreciably below normal	(-) 3 to 4° C from the normal
Moderate cold wave	(-)5 to 6° C from the normal
Severe cold wave	(-) 7° C from the normal and below

When the normal minimum temperature of the area is 10°C or more

Coming to the cold wave this is also very very important. See here simply I can say when the normal temperature of the area is 10 degree or more this scale given can be taken. So severe cold wave means if the temperature goes below the normal minus seven degree centigrade, see here in the temperature is 10 degree, say the rolling normal is 20 degree centigrade, example, if you detect seven minutes 13 degree centigrade the temperature 13 degree centigrade, severe cold wave prevails, this also just be carefully consider for doing our agriculture.

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## Instruments used for measuring temperature

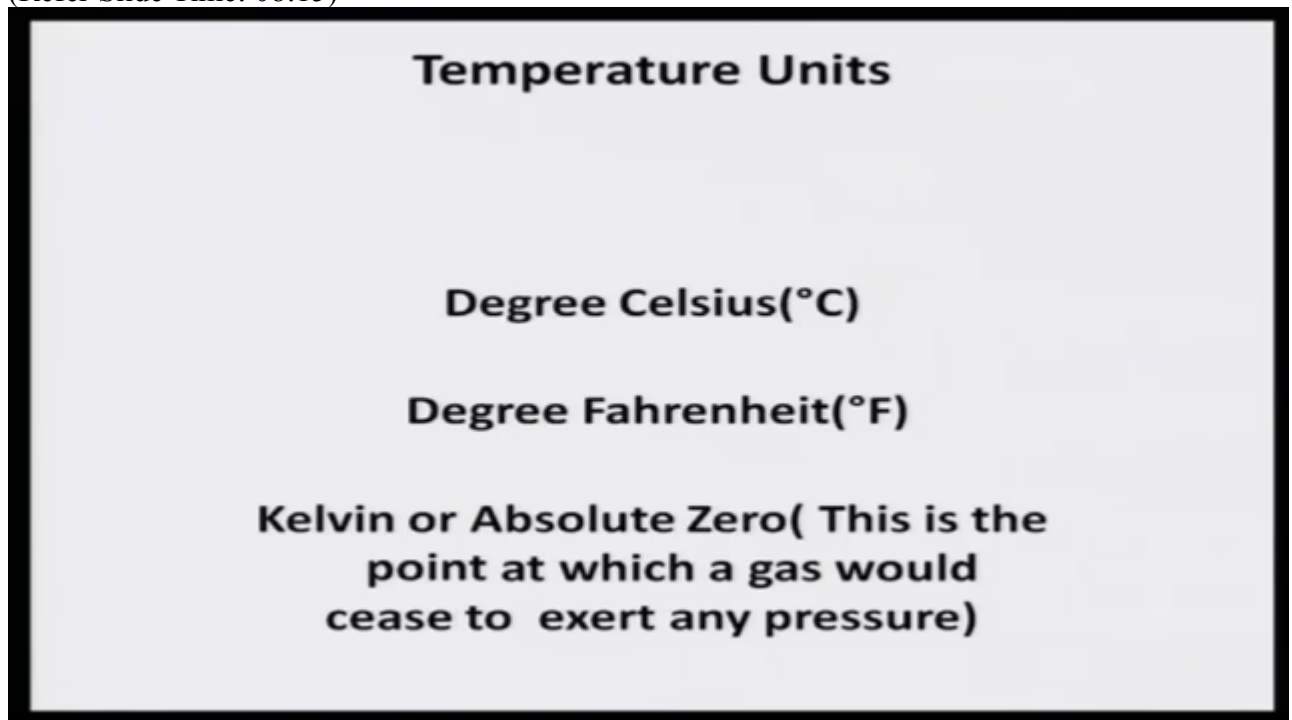
- Maximum thermometer
- Minimum thermometer
- Thermograph
- Infrared thermometer
- Grass minimum thermometer
- Soil thermometer

Now coming to the instruments; what are those instruments. You must be knowing very fully, thoroughly even then it is my duty to explain about some instrument. Maximum thermometer,

it is to record your maximum temperature that prevails in a particular day. Here mercury is used and the minimum thermometer, the minimum lowest temperature that is being recorded by 5:30 a.m. in the morning here (inaudible 00:07:10) used. There is also chart is being used rotating chart by mechanical, so your battery or some system, thermograph. There is also an infrared thermometer, if you show like that it takes the sensing mechanism – it has the sensing mechanism, so by noting their reading you can say that the plant is suffering from water stress or not out on the temperature that the plant has.

Then grass minimum thermometer. This is also very very important, because it is being placed at the 15 centimetre above the ground level. So when the temperature, grass minimum temperature goes below means there is every possibility of getting fast. This is very very important for cold countries as well as far as where the temperature goes below 10 degrees centigrade. Then there are also soil thermometers, 5 centimetre, 10 centimetre, 15 centimetre, 20 centimetre, 30 centimetre, 60 centimetre soil thermometers. These are all some instruments being used to measure the hardness of your body.

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Next one is how the temperature units are expressed because in respect of the rainfall we have used to only single unit, a millimetre. Here people use different. If you go to European country or some other they use Fahrenheit, India centigrade somebody says absolute scale also they used. Degree Celsius is very common. Degree Fahrenheit is also very common. But Kelvin or Absolute Zero, this is really a point at which a gas would choose to accept any process. See in the case of the atmosphere layer you have seen the left side of the column that is atmospheric pressure when it is one above that there no gaseous pressure being accepted. So this is very important. I like to show something on this aspect above.

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## Conversion

$$C = \frac{5}{9}(F - 32)$$

$$F = (C * \frac{9}{5}) + 32$$

In absolute scale  $^{\circ}0$  C becomes 273A

It means  $20^{\circ}$ C is equal to  $20 + 273$   
 $= 293A$

If you want to convert the Fahrenheit degree to centigrade and the equation is given  $\frac{5}{9}$  into  $F$  minus 32 this is very very important. If you want to convert your centigrade to Fahrenheit here also it is given between the brackets centigrade into  $\frac{9}{5}$  plus 32. The absolute scale is very, very important. Absolute scale is zero degree become same. In the case of the absolute scale it is a 273A. Suppose it means that today the temperature is 20 degree centigrade you want the express in absolute scale means it is 293 absolute, because for scientific reason we use in the absolute scale also. So means to understand centigrade, Fahrenheit as well as absolute scale, but in common we use centigrade to express our hotness of your body as temperature. Thank you very much. In the next class we will see some more things.