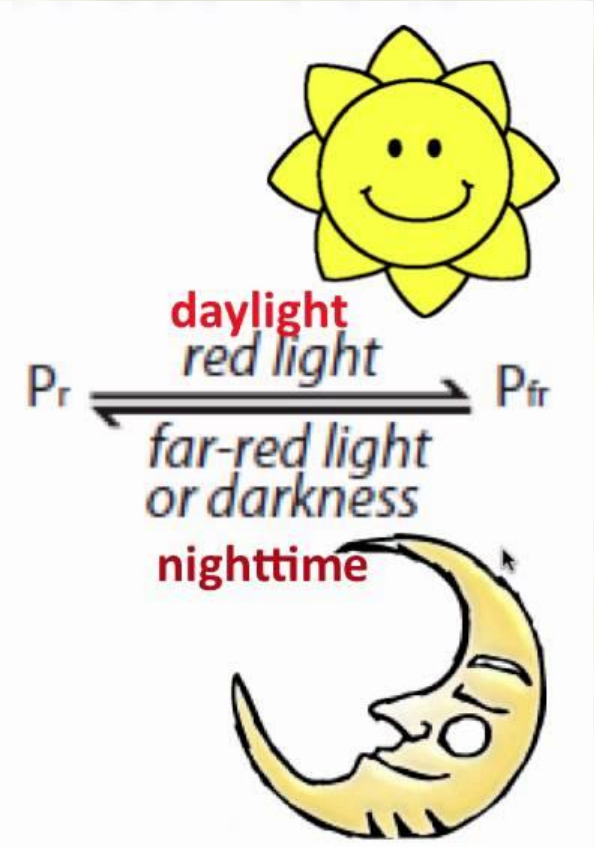
Chaudhary Mahadeo Prasad Degree College
(A Constituent Postgraduate College of Central University of Allahabad

# E LEARNING MODULE BSc II

# PHOTOPERIODISM AND VERNALIZATION

**Dr. Sarita Srivastava**
**Assistant Professor**
**Botany Department**

# PHOTOPERIODISM



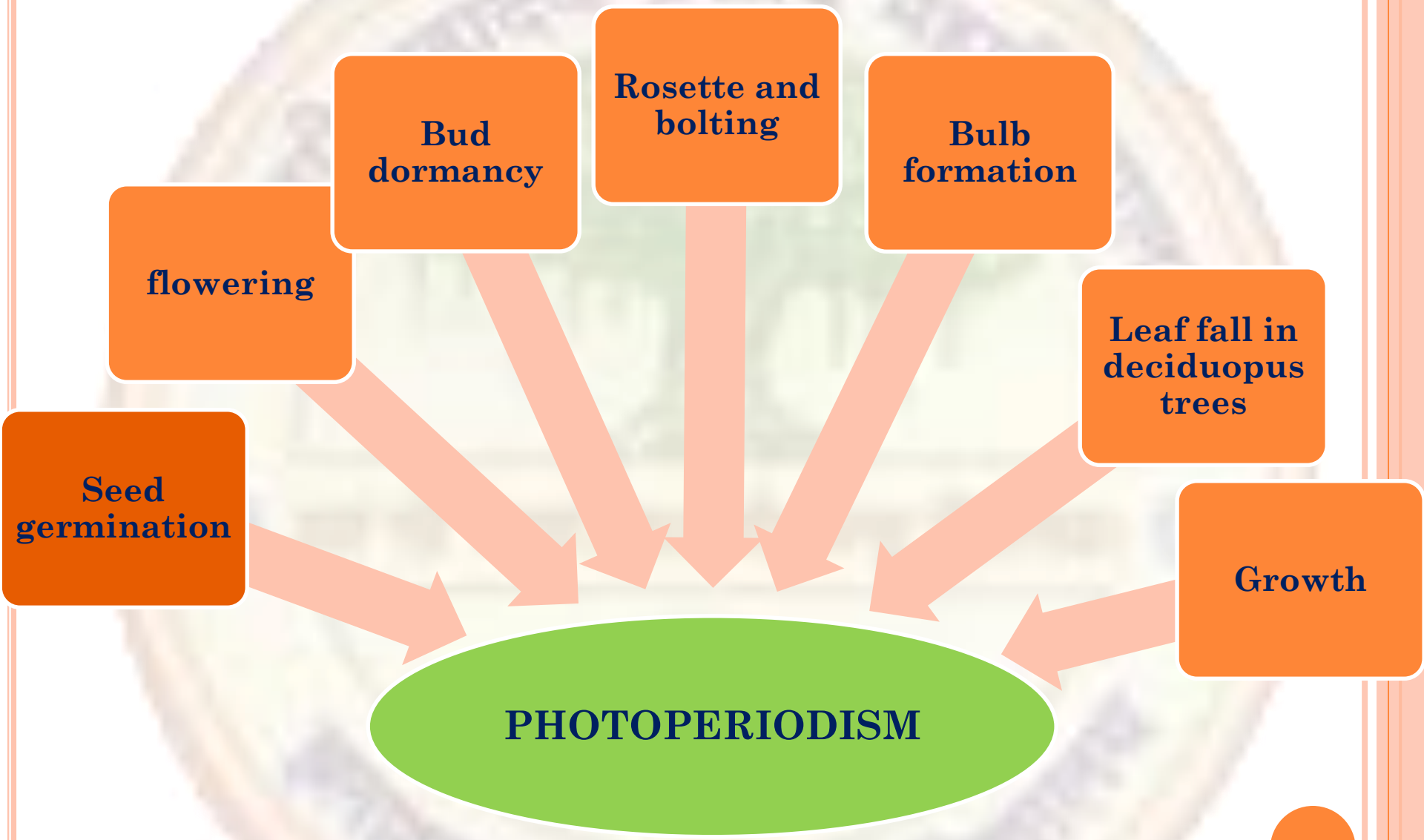

Dr. Sarita Srivastava

Assistant Professor

CMP Degree College University of Allahabad

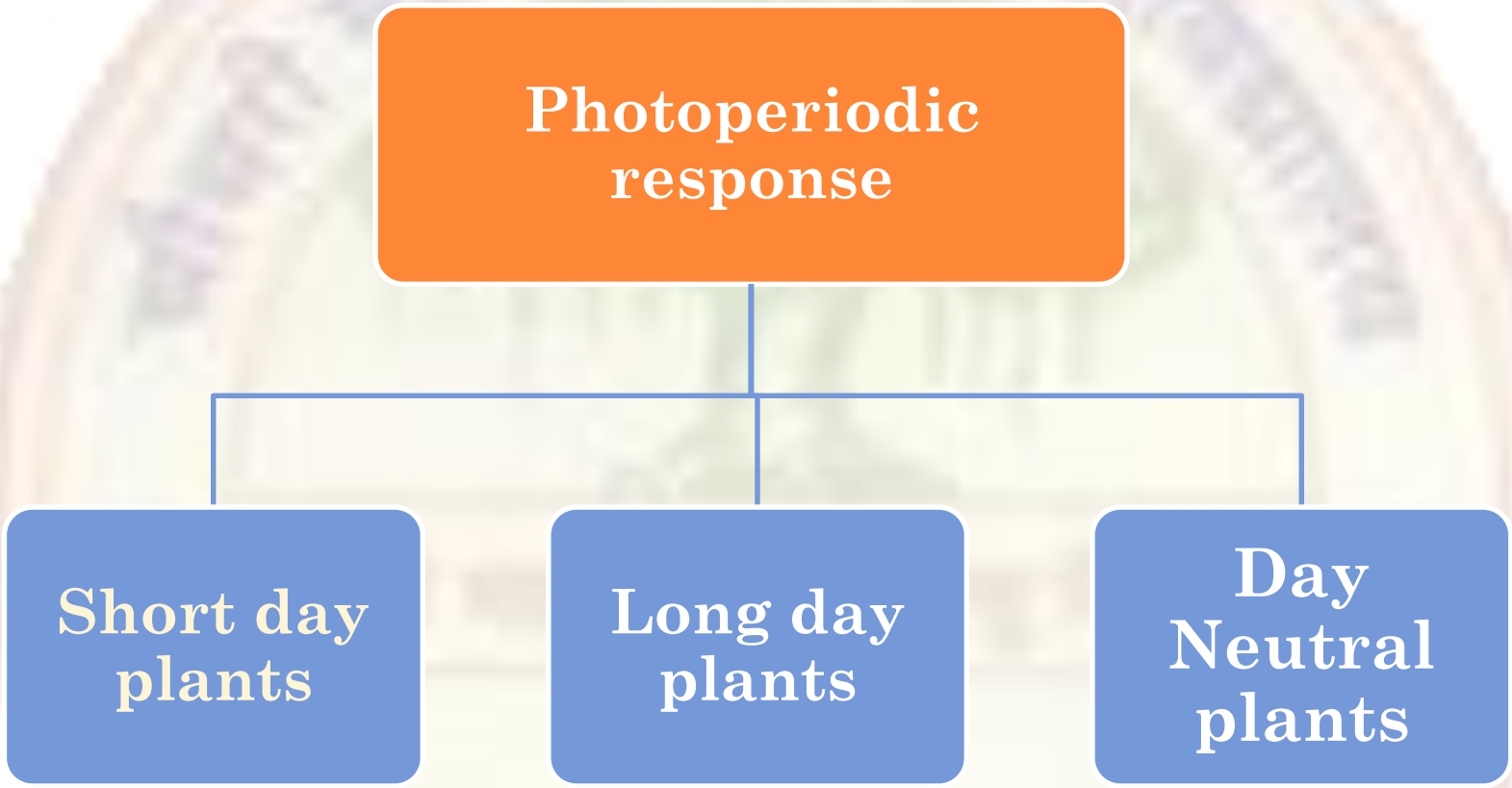
# Definition

- Photoperiodism is the phenomenon of physiological change occurring in plants in response to the relative length of day and night – photoperiod
- Term Photoperiodism was first of all used by Garner and Allard 1920

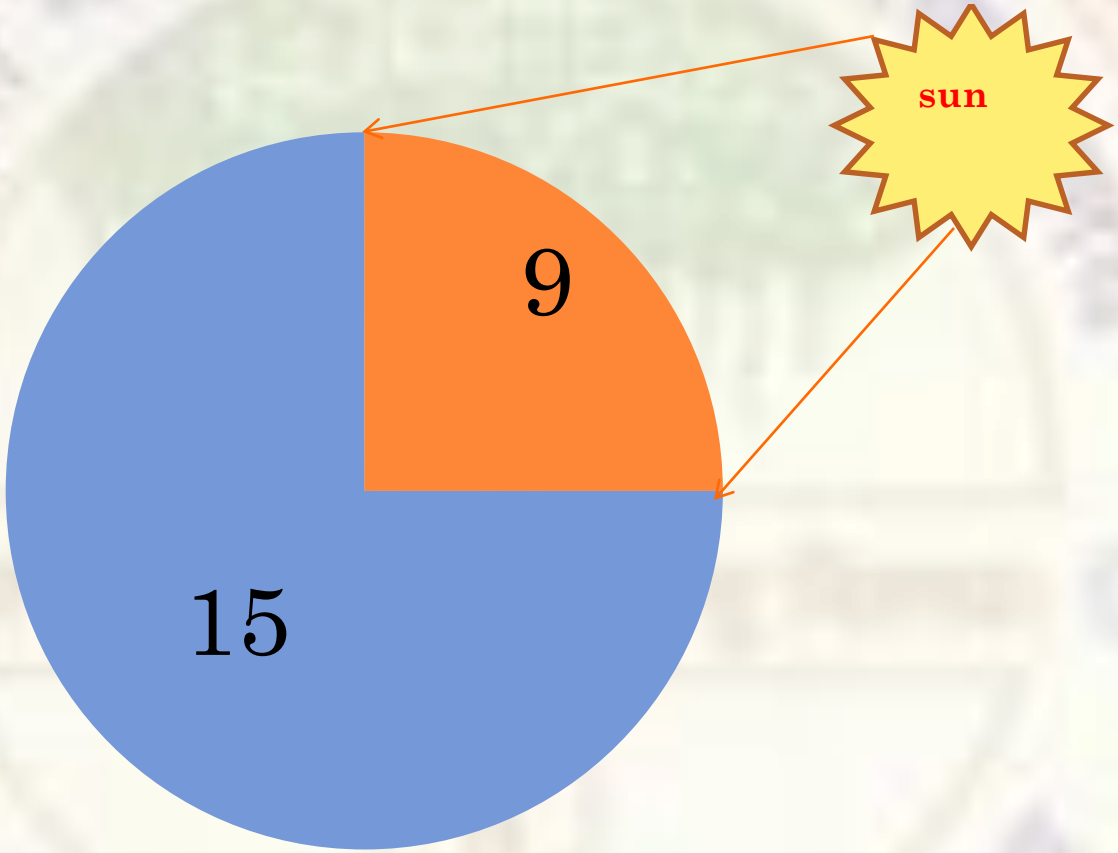

Seed germination
flowering
Bud dormancy
Rosette and bolting
Bulb formation
Leaf fall in deciduopus trees
Growth
PHOTOPERIODISM

# Photoperiodic and flowering

- Garner and Allard noticed that in *Nicotiana tobacco* plants despite profouse vegetative growth failed to flower during summer.
- They have said that the photoperiod in these plants is short day


Photoperiodic response
Short day plants
Long day plants
Day Neutral plants

# SHORT DAY PLANTS

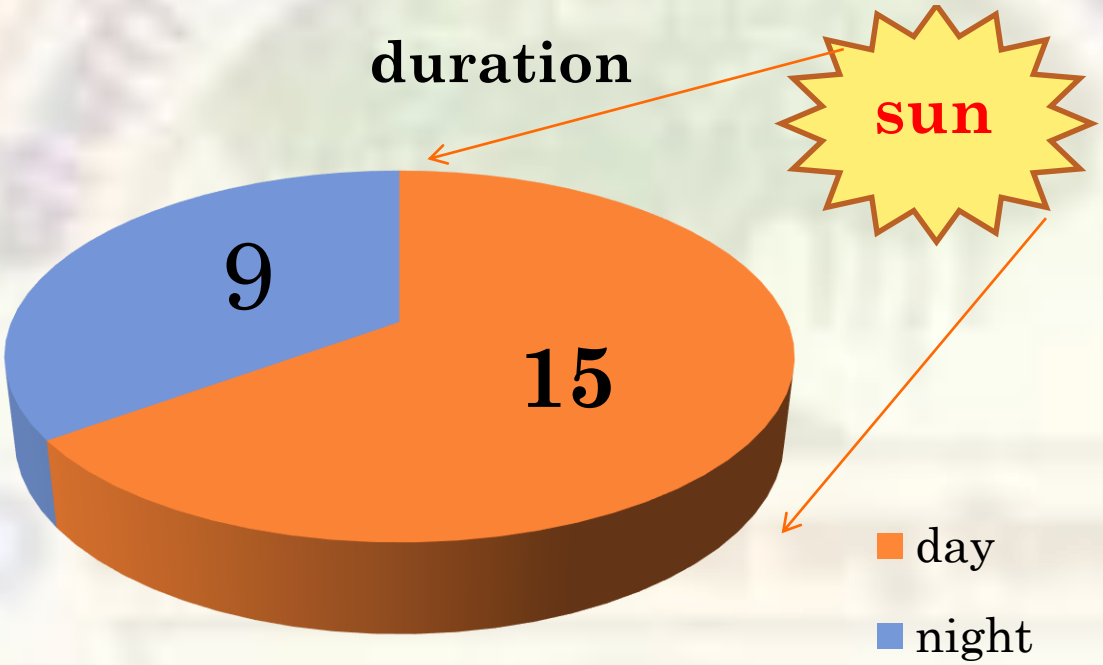



**e.g. *Nicotiana tobaccum*, *Xanthium strumarium* (cocklebur), *Chenopodium rubrum*, *Glycine max* (soyabean), Cosmos, Chrysanthemum**

# Short day plants

- The plant which flower on photoperiods shorter than the critical day length.
- *Nicotiana tobaccum* flowers when the critical day length is less than 12 hrs and dark period is more than 12 hrs.
- Long and the uninterrupted dark period is crucial for flowering.
- Interruption of short light period by dark does not affects flowering
- If the long dark period is interrupted by even a flash of light is inhibits flowering.
- Short day plants are also called as long night plants

# Long day plants

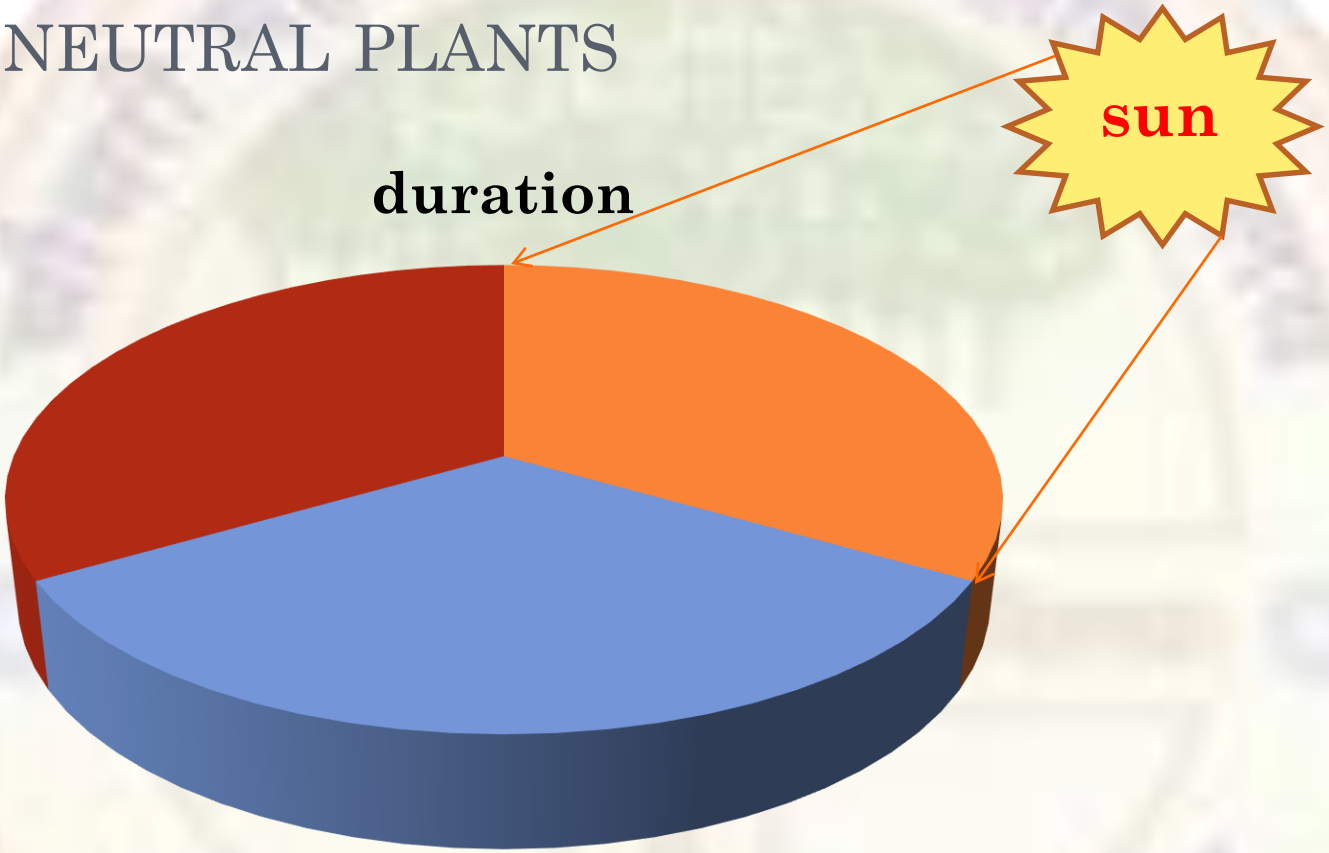



**e.g. *Avena sativa* (oats), *Dianthus superbus* (carnation), radish, spinach, *Hyocyamus niger***

# LONG DAY PLANTS

- The plant in which the flowering is induced by exposure to long days (i.e. the day length is greater than the critical day length are called LDP
- They flower during summers because the long day of summers provide them sufficient photoperiod to flower
- These plants require short dark period. In fact they even don't require a dark period.
- The long dark period is inhibitory in flowering.
- Long day plants can flower under short day conditions if the period of darkness is also reduced
- The flowering in long day plants is not determined by the day length but the short dark period is crucial for flowering therefore these plants are also called as short night plants
- If the short dark period is interrupted by a flash of light they initiate flowering

# Day neutral plants




e.g. *Cucumis sativus*, *Impatiens balsamina*, *Zea Mays*, Tomato

# Day neutral plants

- These plants do not require any specific photoperiod to flower.
- They flower in a photoperiod ranging from few hrs to 24 hrs
- They are aslo known a photo neutral plants or interminate plants

# Difference between

| Short day plants | Long day plants |
| --- | --- |
| Require less than 12 hrs of day length to flower | Plants require photoperiod more than the critical day length |
| Interruption of light period does not inhibit flowering | Interruption of light period inhibits flowering |
| Long uninterrupted dark period is crucial for flowering | Dark period is not critical for flowering |
| No floweringj in alternate cycles of short day and short dark period i.e. 3 hrs day/ 3 hrs dark | Flowering occurs under alternating cycles of short day followed by still shorter periods of dark. |
| Inhibition of flowering under long day conditions is not because the photoperiods are long, but it is because the dark periods are too short | Inhibition of flowering under short day conditions is not because the photoperiods are short, but because the dark periods are too long |

# Is there any light sensetive pigment which is responsible for flowering

- If the long dark period of short day plants if interrupted by a brief exposure of red light  the flowering is inhibited
- But if the exposure of the red light is immediately followed by far red light 730**µm the flowering is promoted**
- **It is concluded that whether the flowering is promoted or inhibited depends upon the last exposure**
- **This simply proves that there is some photo reversible pigment which is responsible for flowering**

| Exposure | Flowering |
|---|---|
| Red light | Inhibits |
| R +fr light | Promotes |
| R + fr+ R | Inhibits |
| R + fr+ R + fr | Flowering |

# Phytochromes named by Butler et al 1959

- Light is absorbed by a photo reversible pigment Phytochrome. Present in leaves
- Phytochrome is a bluish biliprotein which exists in two inter convertible forms
- Inactive form active form

# Phytochromes in SDP

- SDP- Pfr inhibits flowering in SDP. And at the end of each day the Pr is converted into Pfr which inhibits flowering
- During Long dark period the Pfr is converted in to Pr which promotes flowering.
- If the long dark period is interrupted by flash of red light then the Pr is converted to Pfr which inhibits flowering

# Phytochrome in LDP

- Here Pfr from promotes flowering
- Therefore long night period favours conversion of Pr to Pfr.
- If the dark period is greater then the Pfr is again converted into Pr form which inhibits the formation of flowering stimulus

# Flowering stimulus: Florigen

- Chalikhyan 1937 said that Florigen hormone is synthesized in the leaves under favorable phoptoperiodic conditions.
- This hormone is transferred to the growing points where the flowering occurs.
- Florigen hormone is till date not purified
- It is suggested that the growth hormone Gibberellins is associated with flowering in long day plants.
- Chalikhyan suggested that the flowering takes place in two steps

# FLORIGEN SYNTHESIS IN PLANTS

**photosynthesis takes place during photoperiods**

**Photosynthesis provides energy and substrate which is used during Dark period**

**Level of Pfr form is high at the end of light period**

**The level of Pfr is decreased and the level of Pr rises during first few hrs of darkness**

**Level of Pr reaches its maximum limit during the dark period and some precursor is synthesized during this. This leads to synthesis of Florigen hormone**

# Gibberellins and flowering

- Gibberellins are known to help in flowering in long day plants
- There are flowering factors Anthesins .
- Thew flowering hormone is a combination of Giberellins and anthesins
- Short day plants have more gibberellins and less anthesins. Therefore SDP plants do not respond to flowering if Gibberellin is exogenously supplied
- Long day plants have less gibberellins and more anthesins. Exogenous gibberellins help in effect on LDP and they flower

Florigen and Anthesins are till date Hypothetical and not isolated or identified min plants

**Research is on……**

You still have chance to get a Nobel if you discover it

# Vernalization

- Requirement of plants to go through a period of cold before they can flower.

- Vernalization is the process whereby flowering is promoted by a cold treatment given to a fully hydrated seed or to a growing plant.
- Dry seeds do not respond to the cold treatment.
- Due to vernalization the vegetative period of the plant is cut short resulting in an early flowering.
- Also called as yarovization.
- Without the cold treatment, plants that require vernalization show delayed flowering or remain vegetative.
- In many cases these plants grow as rosettes with no elongation of the stem.

# History

- Klippart,1857- first noticed the low temperature requirement for flowering while working with winter wheat and spring wheat.
- Lysenko,1938-used the term vernalization for a low temperature promotion of flowering in plants.
- Chourad ,1960- defined vernaliation as “acquisition or acceleration of the ability to flower by a chilling treatment”.

# Vernalization

- For vernalization the seeds are allowed to germinate for some time and then are given cold treatment 0° C to 5° C.
- The period of cold treatment varies from few days to many weeks.
- After the cold treatment the seedlings are allowed to dry for sometime and then sown.
- Vernalization prepares the plant for flowering.
- The cold stimulus usually perceived by the apical meistems.but in some species all dividing cells of roots and leaves may be the potential sites of vernalization eg.*Leennario biennis.*

- Vernaliztion induces the plant to produce a hormone called vernalin.It was discovered by Melcher(1936).
- The vernalization stimulus can be transmitted from one plant to another through graphting.
- The age of the plant is an important factor in determining the responsiveness of the plant to the cold stimulus and it differs in different species.
- The suitable temperature for vernalization ranges between 1 to 6° c.
- At higher temperature from 7° c onwards response of the plant is decreased.
- A temperature of about 12 to 14° c is most ineffective in vernalizing th plant.

- The vernalization is an aerobic process and requires metabolic energy.
- In the absence of oxygen cold treatment becomes completely inefficient.
- Sufficient amount of water is also essential.
- Vernalization of dry seeds is not possible.

# Devernalization

- The reversion of vernalization by high temperature treatment is called devernalization.
- Devernalization is effected by treating the vernalized seeds or buds with high temperature.
- Lang et al (1957) demonstrated that application of gibberlins can replace the cold treatment for vernalization in certain biennial plants.

# Practical applications

- Due to vernalization the vegetative period of the plant is cut short resulting in an early flowering.
- Vernalization increases the resistance of plants to fungal diseases.
- It increases the cold resistance of plants.
- In the biennials,vernalization induces early flowering and early fruit setting.
- Flowering can be induced by graphting and this feature is used in horticulture.
- It also helps in crop improvement.