VIVEKANANDA COLLEGE

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NAAC ACCREDITED 'A' GRADE

Topic:	PHOTOPERIODISM
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Photoperiodism

Photoperiodism, the functional or behavioral response of an organism to changes of duration in daily, seasonal, or yearly cycles of light and darkness. Photoperiodic reactions can be reasonably predicted, but temperature, nutrition, and other environmental factors also modify an organism's response.

Photoperiodism in Plants:

Most flowering plants have the ability to sense changes in season (i.e. the length of day and night) and flower at the right time. The term "photoperiodism" was first used by Garner and Allard'(1922), while studying the growth and flowering behaviour of *Glycine max* and *Nicotiana tabacum*.

Photoperiod: The recurring cycle of uninterrupted light and dark periods a plant is exposed to; usually 24 hours, with varying ratios of uninterrupted light and dark periods.

Classification of plants based on photoperiodic response:

Plants need exposure to light for a 'critical duration'. This duration is different for different plants. Based on this critical duration, plants can fall into the following three categories:

1. **Long Day Plants (LDP):**
    - These plants flower when the days are longer.

- They require more than the critical duration of light to flower (usually 14-16 hours).
- The light period is very critical in LDP plants. Prolongation of the light period or a brief exposure to light during the dark period boosts flowering in these plants.
- One usually does not find LDP plants in places where the length of a day is too short.
- They are also called ‘Short Night Plants’.
- Examples – spinach, radish, *Hibiscus* etc.

2. Short Day Plants (SDP):

- These plants flower when the days are shorter.
- They need less than the critical duration of light (about 8-10 hours) and a continuous dark period (about 14-16 hours) to flower.
- The dark period is very critical for SDP plants and has to be continuous. These plants will not flower if the dark period is briefly interrupted by light.
- SDP plants are usually not found in places where the length of a day is too long.
- They are also called ‘Long Night Plants’.
- Examples – soybean, tobacco, *Chrysanthemum* etc.

3. Day Neutral Plants (DNP):

➢ These plants do not follow this restriction of critical duration.

➢ In other words, they are ‘neutral’ to the length of day or night.

➢ Examples – tomatoes, pea plants, rose etc

Table showing Photoperiodic responses of some common plants.

Short Day Plants	Long Day Plants	Day Neutral Plants
Chrysanthemums (*Chrysanthemum spp.*)	Barley (*Hordeum vulgare*)	Balsam (*Impatiens balsamina*)
Cocklebur (*Xanthium strumarium*)	Cabbage (*Brassica oleracea*)	Beans (*Phaseolus spp.*)
Cosmos (*Cosmos sulphureus*)	Carrot (*Daucus carota*)	Chillies (*Capsicum annuum*)
Dahlias (*Dahlia variabilis*)	Henbane (*Hyoscyamus niger*)	Cotton (*Gossypium hirsutum*)
Goosefoot (*Chenopodium rubrum*)	Larkspur (*Delphinium ajacis*)	Cucumber (*Cucumis sativus*)
Hemp (*Cannabis sativa*)	Lettuce (*Lactuca sativa*)	Dandelion (*Taraxacum spp.*)
Morning Glory (*Ipomoea purpurea*)	Onion (*Altium cepa*)	Jerusalem artichoke (*Helianthus tuberosus*)
Poinsettia (*Euphorbia pulcherrima*)	Petunia (*Petunia spp.*)	Maize (*Zea mays*)
Rice (*Oryza sativa*)	Poppy (*Papaver somniferum*)	Potato (*Solanum tuberosum*)
Soya beans (*Glycine max*)	Radish (*Raphanus sativus*)	Rhododendrons (*Rhododendron* spp.)
Tobacco (*Nicotiana tabaccum*)	Spinach (*Spinacea oleracea*)	Tobacco (*Nicotiana tabaccum*)
Violets (*Viola papilionacea*)	Wheat (*Triticum aestivum*)	Tomato (*Lycopersicum*)

➢ During recent years certain intermediate categories of plants have also been recognised. They are,

4. **Intermediate plants:** They flower only under day lengths within a certain narrow range (12-14 hrs) and fail to flower under either longer or shorter photoperiods. E.g: *Mikania scandens*

5. **Long Short Day Plants (LSDP) / Ambiphotoperiodic plants:** These are short day plants but must be exposed to long days during early periods of growth for subsequent flowering. Some of the examples of these plants are certain species of *Cestrum.*
6. **Short-Long Day Plants(SLDP):** These are long day plants but must be exposed to short days during early periods of growth for subsequent flowering. Some of the examples of these plants are certain varieties of wheat (*Triticum)* and rye (*Secale*).

Critical photo-period: It is the period or time which is the determining factor for flowering. For e.g a short day plant *Chrysanthemum* flowers only when the day length is shorter than 15 hrs. And so its critical day length is 15hrs. On the other hand barley plants, LDP, flowers only when day length is more than 12hrs so its critical day length is 12 hrs.

Concept of night length monitoring: After the discovery of photoperiodism it was first believed that the length of photoperiod is a determining factor for flowering. However, Hamner and BOnner later proved that it is the length of night but not the day that determines flowering. They showed that *Xanthium strumarium* , a SDP, flowers when the dark period is more than 9 hrs. Regardless of the day length. It was

also shown that even a brief exposure to light during a dark period nullified the effect of darkness. This indicated that the plant is sensing the uninterrupted night period. On the other hand, a brief period of darkness during day time has no effect on flowering in a short day plant. Because of the importance of the dark period in flowers, some plant physiologists prefer to call short and long night plans instead of long and short day plants respectively.

16 hr day 8 hr night → no flowering
16 hr day 16 hr night → flowering
8 hr day 8 hr night → no flowering
8 hr day 16 hr night → flowering

(Fig. 22-3). Diagrammatic explanation showing effects of long and short day treatments on flowering of **Xanthium strumarium.**

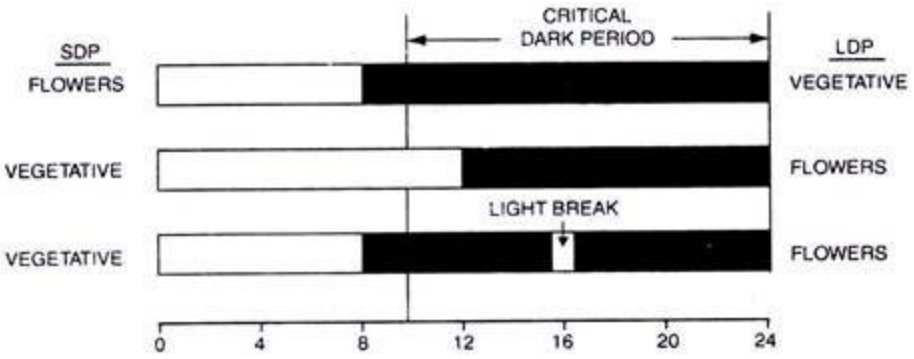

Fig. 22-2. Effect of breaks of light during the dark period on flowering in LDP (long day plant) and SDP (short day plant). Critical dark period is also marked out.

Importance of Photoperiodism:

1. The knowledge of the phenomenon of photoperiodism has been of great practical importance in hybridisation experiments.

2. Although the floral hormone ‘florigen’ has not yet been isolated, the isolation and characterization of this hormone will be of utmost economic importance.

3. The phenomenon of photoperiodism is an excellent example of physiological preconditioning (or after-effect) where an external factor (i.e., the photoperiodic stimulus) induces some physiological changes in the plant the effect of which is not immediately visible. It lingers on in the plant and prepares the latter for a certain process (i.e., flowering) which takes place at a considerably later stage during the life history of the plant.

4. Photoperiodism determines the season in which a particular plant shall come to flower. For example, short-day plants develop flowers in autumn-spring period (e.g., *Dahlia, Xanthium*) while long-day plants produce flowers in summer (e.g., *Amaranthus*).

5. Knowledge of photoperiodic effect is useful in keeping some plants in vegetative phase (e.g., many vegetables) to obtain higher yield of tubers, rhizomes etc., or keep the plant in reproductive phase to yield more flowers and fruits.

6. A plant can be made to flower throughout the year by providing favourable photoperiod.

7. Enable a plant to flower in different seasons thus fruits can be produced during their offseason by controlling photoperiod.