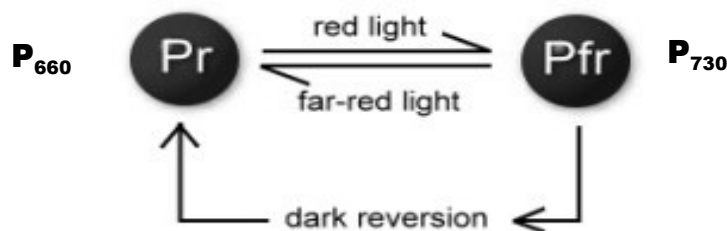


PHOTOPERIODISM AND FLOWERING

23.1 PHYTOCHROME

Phytochrome is a blue proteinaceous pigment composed of two components: a protein and a chromophore - which give its light absorbing properties. **Borthwick and Hendricks** (1946) suggested that phytochrome exists in two forms: a red light absorbing form (P_r), blue green in color and a far red light absorbing form (P_{fr}), light green in color. These two forms are inter convertible and it is located within plasma membrane. Phytochrome is produced in light grown tissues:



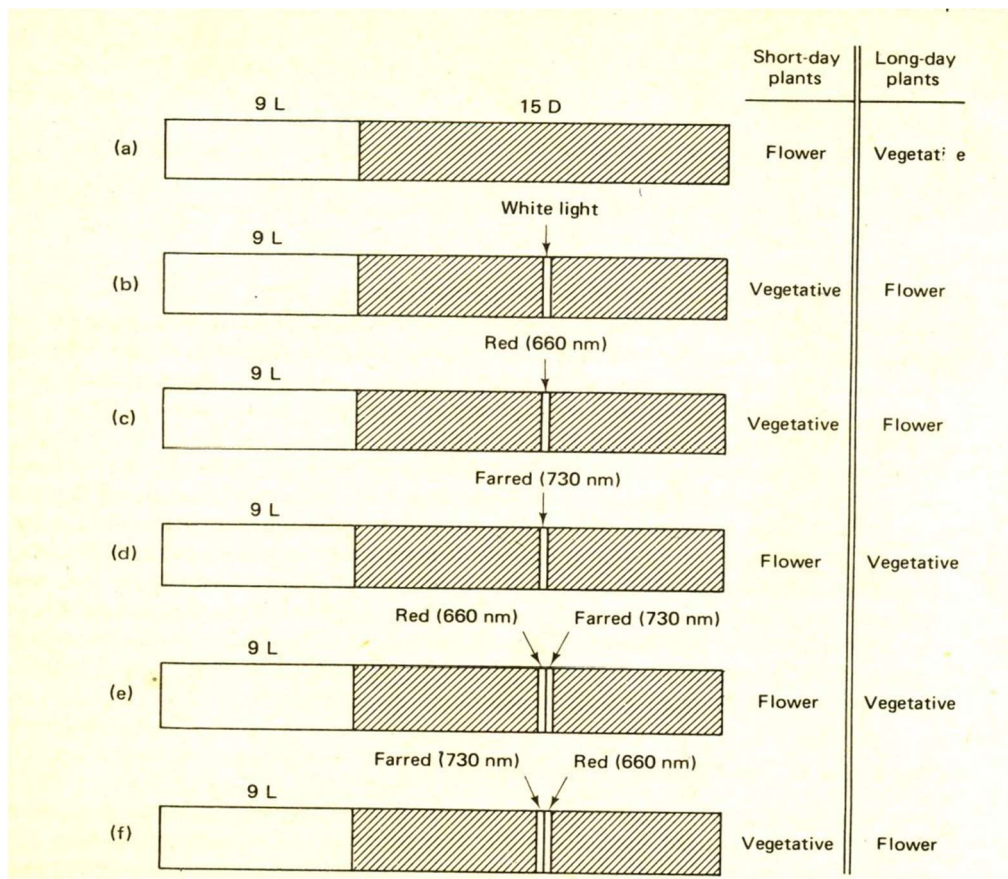
It shows on absorbing red light, P_r form is converted to p_{fr} during day time, while p_{fr} form gradually converted into p_r form in dark on absorbing far red light.

23.1.1 Role of phytochrome in short day plants

At the end of light period the phytochrome is predominantly present in the p_{fr} form and the ratio of p_{fr} to p_r is such that, the formation of the flowering stimulus is prevented. During the long dark period, spontaneous conversion of p_{fr} to p_r takes place or p_{fr} is destroyed, and the ratio of p_{fr} to p_r finally drops to a level where metabolic processes are triggered which leads to the formation of flowering stimulus. This duration represents the critical dark period requirement for the flowering of SDP. It varies from plant to plant. If the dark period is interrupted by flash of red light, p_r is converted to p_{fr} . And the p_{fr} to p_r level is such that the formation of the flower stimulus is prevented.

23.1.2 Role of phytochrome in long day plants

Long day plants require a high ratio of p_{fr} to p_r for the formation of flowering stimulus. Such a high ratio of p_{fr} to p_r is attained at the end of a long day. If the night is too long, p_{fr} reverts to p_r or is destroyed and the flowering stimulus is prevented from being formed. When the night is interrupted by a flash of red light, p_r is converted to p_{fr} , there by raising the ratio of p_{fr} to p_r to a level which allows the flower stimulus to form.



23.2 FLOWERING HORMONES:

Gibberlic acid (GA) seems to play an important role in flowering. It may be directly involved in the formation of florigen.

GA's can substitute for long day requirements and also the cold treatment requirement in several species for its flowering. Auxins are also known to induce flowering in short day pine apple and they are used commercially for this purpose. They have also been found to be effective on long day plant like winter barley and *Hyoscyamus Niger*. Exogenous application of cytokinins is also known to induce flowering in many species, under non-inductive photoperiods including chrysanthemum and *Phorbitis nil*.

23.3 VERNALIZATION AND FLOWERING

It has been noticed that certain plants in addition to an appropriate photoperiod, require low temperature treatment during their early stages of life period for subsequent flowering in the later stages. It was found that winter wheat which is usually sown in winter and flowers in summer can be converted into spring wheat which is sown in spring and flower in summer, if slightly germinated seed are given artificial cold treatment. This conversion of winter variety of wheat into spring variety by low temperature or chilling treatment was termed as Vernalization by Lysenki (1928). Due to low temperature treatment the period of vegetative growth of the plant is reduced resulting into early flowering.

Chourad (1960) defined vernalization as acquisition or acceleration of the ability to flower by a chilling treatment. The optimum temperature for vernalisation is **0 to 5°C**.

The phenomenon of vernalization was studied in several winter annuals Eg. Petkus winter rye (*Secale cereale*), some biennials Eg. Henbane (*Hyoscyamus niger*) and also in certain perennials Eg. Apples (*Pyrus malus*). All the above plants require a low temperature treatment for subsequent flowering. However certain plants such as Petkus winter rye, do not have an absolute cold requirement for flowering. In such cases, the cold temperature only shortens the time of flowering, where as in biennial strain of Henbane the vernalization treatment is absolute and they cannot flower without vernalization.

Perception of Cold Stimulus:

Apical meristem, embryos and actively dividing cells are the potential sites of vernalization. The common feature for vernalization is the presence of actively dividing apical meristems. Hence, vernalization treatment requires.

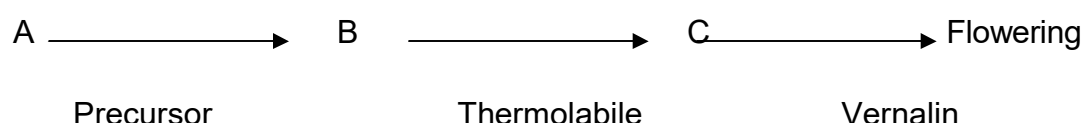
1. Actively dividing apical meristems.
2. Respiration substances such as carbohydrate.
3. Presence of oxygen.
4. Water (40 to 80%)

Presence of Floral Hormone:

The German botanist G. Melcher's (1939) suggested that low temperature induces the formation of a hormone, **vernalin** a hypothetical substance and has not been isolated so far. The cold stimulus can be transmitted from one plant to another by a graft union Eg. Henbane. Here, if a vernalized plant is grafted to an unvernallized plant the later also shows flowering.

Mechanism of vernalization: Hormonal Theory.

Lang and Melcher's (1947) suggested that a precursor A is converted into a thermolabile compound B during cold treatment. Under normal conditions B changes into a stable product (C Vernalin) which causes flowering. But at higher temperature B is converted into D and flowering does not take place due to devernallization. (fig.3). further experiments have shown that vernalin acts in association with the flower inducing stimulus, florigen in order to induce flowering.



Devernalization:

The effect of low temperature treatment for flowering is nullified if the plants are immediately given high temperature treatment. This phenomenon is called devernalization. The degree of devernalization decreases if the duration of the cold treatment has been longer. However, the devernalized plant can be vernalized again by subsequent cold treatment.

Vernalization and gibberellins:

Lang et al (1952) demonstrated that application of GA's can replace the low temperature requirement for vernalization in many plants. Eg. Henbane. This plant remains vegetative and retains its rosette habit during first growing season after passing through the winter period flowers in the next season. The GA's cause such plant to flower even during the first year.

23.4 IMPORTANCE OF VERNALIZATION:

1. Vernalization increases cold resistance in plants.
2. It reduces the vegetative period of development of plants and induces early flowering.
3. Winter varieties of crop plants can be converted into spring varieties by vernalisation.
