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Topic- Role of phytochromes and Florigen

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Role of Phytochrome, Florigen and Phytohormones in Flowering

There are experimental evidence (Hendricks and Borthwick) that only red light (wavelength 660 mμ) is effective in inhibiting flower initiation in short-day plants, when the dark period towards midnight is interrupted with this illumination. This wave length of light at the same time accelerates the growth of stem and root and formation of anthocyanin pigment.

It is more interesting to note that this inhibition of flowering in short day plants can be reversed by treating the plants with far-red light (wave length 730 mμ) (Fig. 5.4). This suggests the existence of a single compound, phytochrome, responsible for photoperiodic action. The phytochrome (probably) exists in two inter convertable forms P730 and P660. When P660 is illuminated with red light (660 mμ) it is transformed to the P730 form.

The P730 form can be converted into the P660 form by far red light (730 mμ). During night P730 is converted into P660 form and hence at the end of day period the predominent form of phytochrome is P730 because sun light contains more red light of 660 mμ) wavelength.

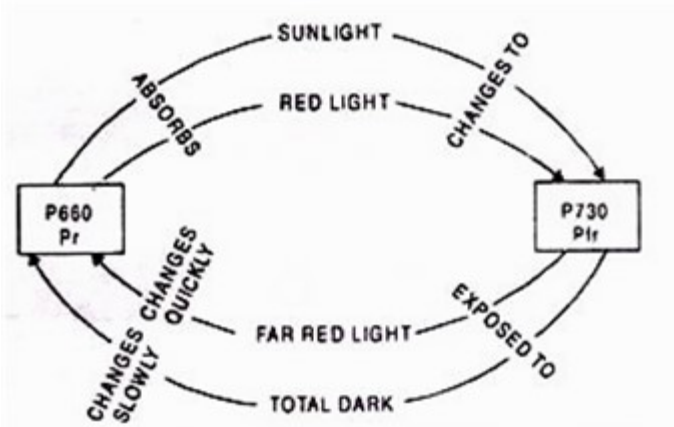

Fig. 5.4. Diagram to depict the phytochrome concept.

In short day plants flowering is initiated when there is sufficient accumulation of P660 and that is the reason why flowering is inhibited in these plants when dark period is interrupted by red light of 660 mμ wavelength which converts P660 form into P730 form (Fig. 5.4). But the manner in which the flowering is initiated by the phytochrome is not yet well understood.

The only facts known about this flowering substance are that it is proteinaceous in nature and most likely acts as an enzyme which initiates the formation of certain hormone or hormones which ultimately bring about the conversion of vegetative primordia into flowering primordia.

Florigen—A Hypothetical Flowering Hormone

Evidence that a flowering hormone "florigen" exists in plants comes from the work of Naylor (1952), who states that a plant can be made to bloom by grafting on it a leaf from another variety, species, genus, or even from another family. A certain parasitic plant which

grows on the roots of red clover is probably never exposed to light and yet it blooms. It is assumed that this parasite obtains its stimulus for flowering from its host.

1. The metabolism of florigen is believed to be phytochrome-mediated.

2. Florigen has never been isolated. It is a hypothetical hormone.

3. The florigen is translocated to the vegetative bud through phloem, where it transforms vegetative but into flower bud.

4. Florigen is a sort of stimulus. Unlike other phytohomones, it is neither growth promoter nor a growth inhibitor.

5. The seat of synthesis and the seat of action of florigen are leaf and shoot tip respectively.

Chailakhyan (1968) demonstrated that the site of perception of light for photoperiodic inductions (stimulus) are the green leaves. This is evident from the fact that a plant from which all leaves have been removed fails to flower even under the inductive light conditions. Further confirmation was obtained from experiments with Xanthium, a short-day plant, in which flowering occurred even when one-eighth of a leaf was exposed to short days.

Photoperiodic induction received by a single leaf or its part in a plant is considered enough to induce flowering. Further, a floral stimulus from an induced leaf in a long or short-day plant can be transmitted or trans-located to another non-induced plant by grafting. Besides, the floral stimulus is not species-specific because grafting an induced twig of Xanthium on to a vegetative soya bean plant can induce the latter to flower.

The nature of the flower-producing stimulus has been widely debated. Some plant physiologists have proposed the existence of a flower-inducing growth hormone, the florigen (Naylor 1952 and Chailakhyan 1968). The metabolism of florigen is believed to be phytochrome-mediated. Unfortunately, the florigen has never been isolated.

The florigen is trans-located via phloem to the vegetative bud primordia which undergo transformation (morphological changes) leading to the production of floral buds.

Four steps are involved in this transformation:

(i) Perception of the stimulus by phytochrome in the leaves (induction);

(ii) Change to new pattern of metabolism in the leaves leading to the production of flowering hormone, the florigen;

(iii) Translocation of florigen (the stimulus) to the bud primordia; and

(iv) Transformation of vegetative bud primordia into floral buds (the response).

Role of Phytohormones in Flowering:

Researchers have indicated that flowering is also regulated by the interplay of the phytohormones, the auxins, gbberellins, cytokinins and ethylene. Application of hormones can substitute for the necessary photoperiod and can initiate floral development in certain plants. It is interesting to note that IAA (auxin) inhibits flowering in most of the plants. An exception, however, is pineapple (Ananas). Gibbereuic acid (GA) can substitute photoperiodic induction in many long day plants. It, however, is almost ineffective in short-day plants except a few such as Impatiens balsamia (Balsam plant).