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NAAC ACCREDITED 'A' GRADE



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Perception of the Photoperiodic Stimulus and Presence of a Floral Hormone:

It is now well established that the **photoperiodic stimulus is perceived by the leaves**. As a result, a floral hormone is produced in the leaves which is then translocated to the apical tip, subsequently causing the initiation of floral primordia.

That the photoperiodic stimulus is perceived by the leaves can be shown by simple experiments on cocklebur (*Xanthium pennsylvanicum*), a short day plant.

- Cocklebur plant will flower if it has previously been kept under short-day conditions (Fig. 18.2 A).
- If the plant is defoliated and then kept under short day condition, it will not flower (Fig. 18.2 B).
- Flowering will also occur even if all the leaves of the plant except one leaf have been removed (Fig. 18.2 C).
- If a cocklebur plant, whether intact or defoliated, is kept under long day conditions it will not flower (Fig. 18.2 D, E).
- But, if even one of its leaves is exposed to short day conditions and the rest are under long day photoperiods, flowering will occur (Fig. 18.2 F).

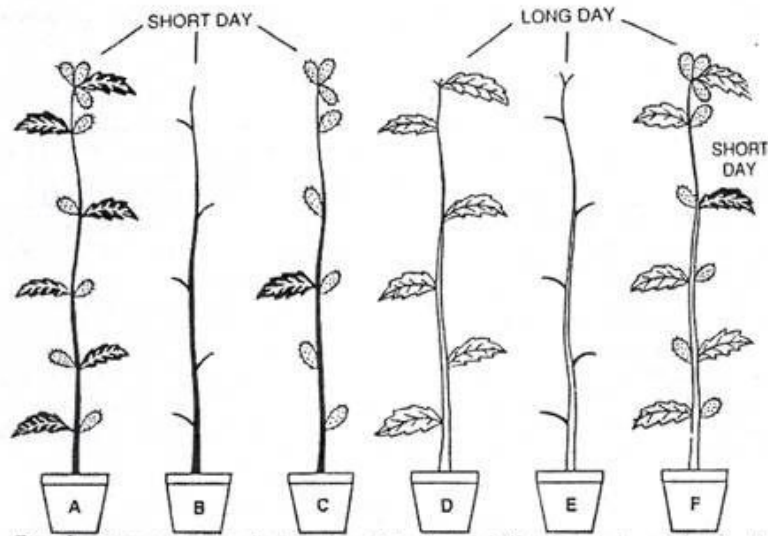


Fig. 18.2. Experiment on cocklebur plants to show that photoperiodic stimulus is perceived by the leaves. Flowering occurs even if a single leaf is exposed to appropriate photoperiod. See text

The photoperiodic stimulus can be transmitted from one branch of the plant to another branch. For example,

- If in a two branched cocklebur plant one branch is exposed to short day and other to long day photoperiod, flowering occurs on both the branches (Fig. 18.3 A).
- Flowering also occurs if one branch is kept under long day conditions and another branch from which all the leaves except one have been removed is exposed to short day condition (Fig. 18.3 B).
- However, if one branch is exposed to long photoperiod and the other has been defoliated under short day condition, flowering will not occur in any of the branches (Fig. 18.3 C).

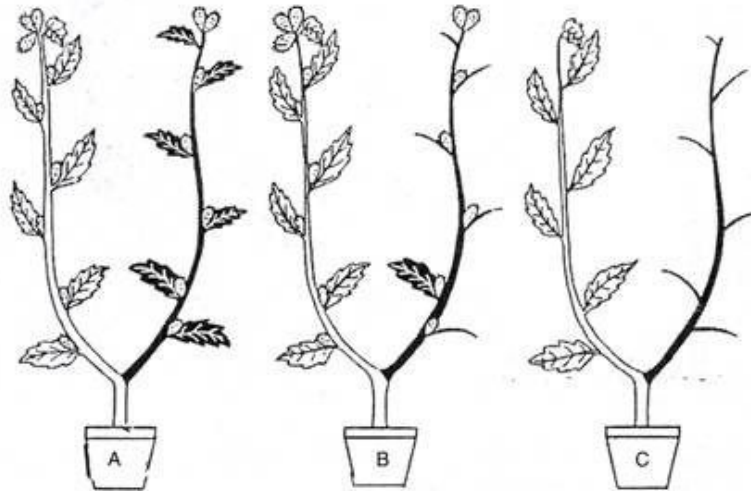


Fig. 18.3. Experiments on cocklebur plants to show that the photoperiodic stimulus can be transmitted from one branch of the plant to another.

Gibberellins and the Flowering Response:

It is often proposed that Pfr stimulates gibberellin production and this GA in turn stimulates the production of floral hormone called florigen.

Importance of GA is due to the following effects of that hormone:

1. External GA can mimic the effect of red light in some cases.
2. GA prompts flowering in some LDPs under short day conditions, mainly rosette plants which bolt before flowering.
3. GA also inhibits flowering in some SDPs.
4. Anti gibberellin nullifies the above effect of GA.
5. Natural GA from induced LDP also causes flowering in non induced plants.

Although GA can induce flowering but they can not be considered to be the primary floral hormone mainly because of the following reasons:

1. In LDPs, vegetative growth and differentiation of floral primordia occur simultaneously but GA on the other hand first stimulates vegetative growth (bolting) and then only floral primordia are formed.
2. GAs have been unable to induce flowering in all short day plants under a non inductive cycle.

Florigen concept:

A mobile molecule that is synthesized in leaves in response to the favourable photoperiod and it migrates through the vascular system to the apical meristem to promote floral initiation.

The name florigen has been proposed by Chailakhyan (1936) for the unknown chemical stimulus acting as floral hormone. The significant evidence of the existence of that substance comes from interspecific grafting experiments.

Grafting experiment of florigen existence:

- Chailakhyan removed the leaves from the upper half of *Chrysanthemum* (SDP) but left the leaves on lower half untouched.
- He then exposed the lower half to a short day- the plant did not flower.
- He concluded that day length does not have an effect directly on the buds but causes the leaves to manufacture a hormone that moves from the leaves to the buds and induce flowering.
- He concluded that floral stimulus is translocated from the leaf of one photo induced plant to another non photo induced plant.
- Florigen is believed to be synthesized in the photo induced leaf and from there moved to the shoot apices for floral evocation , through phloem.

Grafting experiments in cocklebur plants (*Xanthium strumarium*) have even proved that the floral hormone can be trans located from one plant to another. For example,

- if one branched cocklebur plant (Fig. 18.4 A) which has been exposed to short day conditions is grafted to another cocklebur plant kept under long day conditions, flowering occurs on both the plants (Fig. 18.4 B).
- Obviously the floral hormone has been transmitted to the receptor plant through graft union.
- But if a cocklebur plant is grafted to another similar plant both of which have been kept under long day conditions, flowering will not occur on either of the two plants (Fig. 18.4 C).

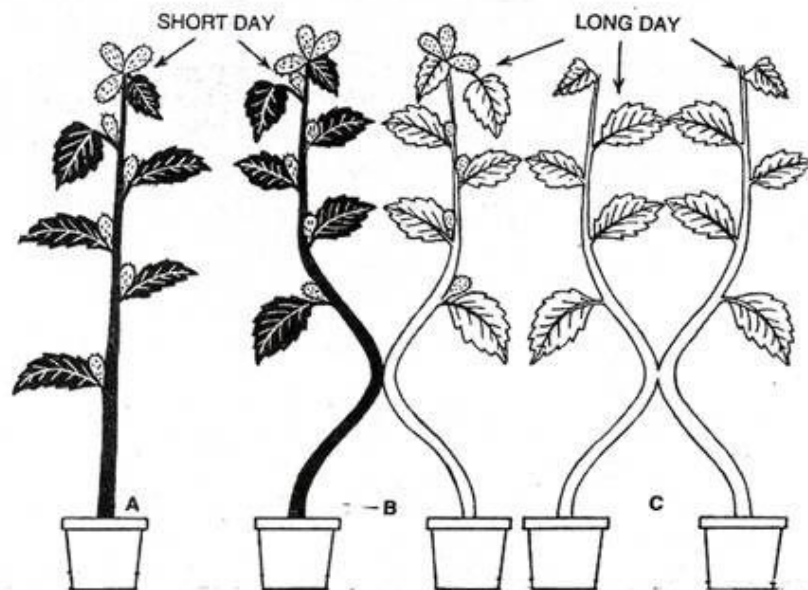


Fig. 18.4. Grafting experiments in cocklebur plants to show the translocation of floral hormone from one plant to another through graft union.

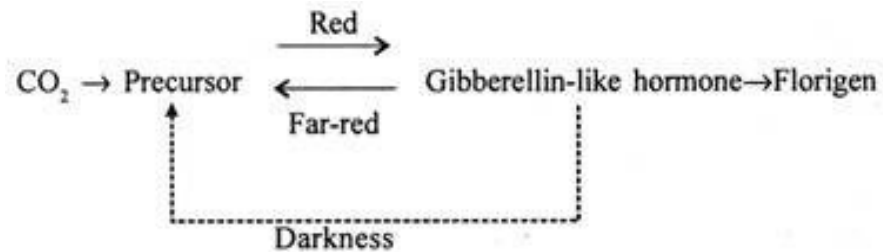
It has also been indicated that the floral hormone may be identical in short-day and long-day plants. For example, grafting experiments between certain long-day plants (eg: *Silene armeria*) and short-day plants (e.g: *Xanthium strumarium*) have shown that flowering occurs on both the plants even if one of them has been kept under non-inductive photoperiods.

But Hamner and Bonner (1938) tested about 246 different kinds of extracts from SDPs, LDPs, and DNP but none had any flower evoking effect in non-inductive plants. So, it is believed that floral stimulus (florigen) may have several components which interact with one another in such a way that some biochemical and cellular changes initiate floral primordia.

Chailakhyan later modified his florigen concept and proposed that

- Florigen is two hormones rather than one, a **gibberellin** and a hypothetical hormone, he called **anthesin**.
- He suggested that LDPs can produce anthesin under any day length but GA only under long days,
- SDPs can produce gibberellins under any day length but anthesin only under short day,
- DNP can produce both anthesin and GA in any day length.
- Thus a plant can flower only when both GA and anthesin are present.

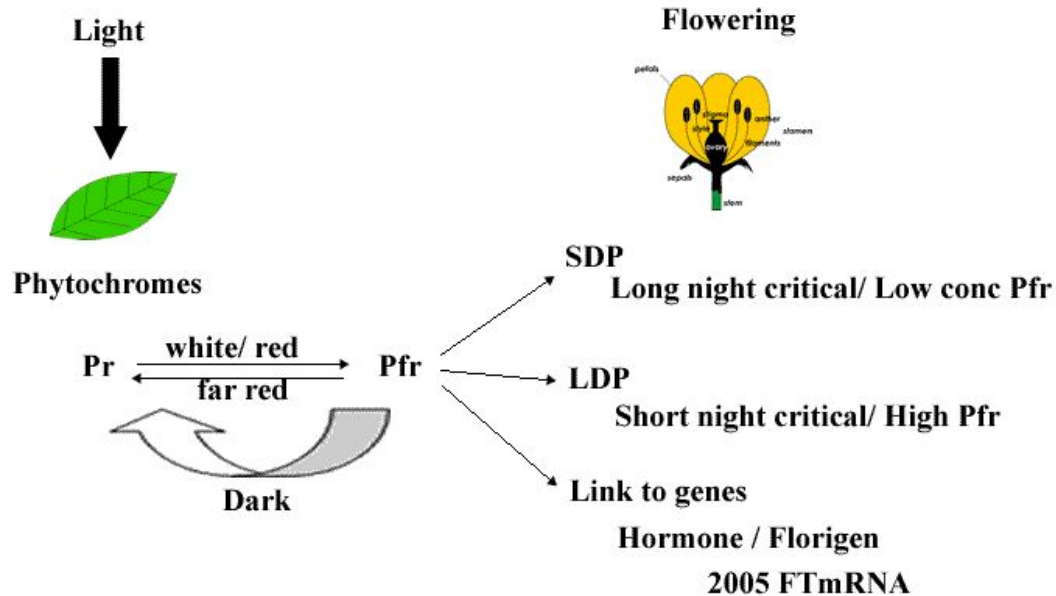
According to a scheme proposed by Brian (1958), a gibberellin like hormone is produced in the leaves during the photoperiod somewhat as follows:



The precursor may be slightly stimulatory or inactive or antagonistic to the gibberellin-like hormone. Red irradiations promote the conversion of the precursor to the gibberellin-like hormone. In the dark there is a slow reconversion of the gibberellin-like hormone to the precursor.

This reconversion is accelerated by far-red irradiations. It is further presumed that high concentration of the gibberellin-like hormone leads to the synthesis of florigen in long-day plants. In short-day plants the synthesis of florigen takes place when the level of gibberellin-like hormone is low. But, flowering eventually follows once the florigen synthesis has taken place in both the cases.

The whole scheme is diagrammatically shown below:



Nature of the Floral Hormone:

Recent researches are indicative of 'florigen' to be a macromolecule unlike other plant growth hormones which are rather small molecules. This macromolecule may possibly be a RNA or protein molecule which is translocated from the leaf to the apical tips (or meristems) via phloem in photo-induced plants (Corbesier and Coupland, 2005).

In *Arabidopsis thaliana*, some researchers have identified this signal as mRNA coded by the *FLOWERING LOCUS T (FT)* gene, others as the resulting *FT* protein. First report of FT mRNA being the signal transducer that moves from leaf to shoot apex. However, in 2007 another group of scientists made a breakthrough saying that it is not the mRNA, but the FT Protein that is transmitted from leaves to shoot, possibly acting as "Florigen".

Here FT acts like a molecular "alarm-clock", evoking a complex genetic scenario, which culminates in flower formation.

