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FLORAL SYMPHONY: THE PHYSIOLOGICAL HARMONIES OF PLANT FLOWERING

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INITIATION OF FLOWER PRIMORDIA

The initiation of flower primordia is a major event in the life cycle of a plant in that it involves a shift in the phase of development from vegetative to reproductive processes. The significance of flower initiation has been recognized by botanists for many years. In 1918, Klebs suggested that during the life cycle of plant it passes through several phases of development. Before floral primordia can be initiated, the plant must complete a period of vegetative growth or attain some minimal leaf number. When this condition is attained, the plant is said to be ripe to flower. Ripeness-to-flower is not recognized by any external characteristics, but it can be determined empirically by subjecting plants of varying age (From seedling emergence) to environmental conditions known to induce flowering. In most plants ripeness – to- flower is attained after the plant has produced several leaves.

Attainment of the ripe-to-flower condition does not automatically lead to the initiation of flower primordial. Certain environmental conditions must follow.

These same environmental conditions, if presented to a plant that is not ripe to flower, elicit no flowering response. The importance of temperature and the promotion of reproductive development, a phenomenon referred to as vernalization, were described by Gassner in 1918. About the same time W.W Garner and H. A. Allard (1920) two plant physiologists, found that day length, or the duration of light and dark periods within a 24 hour cycle, also influenced the initiation of flowering.

PHOTOPERIODISM

The plants in order to flower require a certain day length *i.e.*, the relative length of day and night which is called as photoperiod. The response of plants to the photoperiod expressed in the form of flowering is called as photoperiodism.

SHORT DAY PLANTS (SDP)

These plants require a relatively short day light period (usually 8-10 hours) and a continuous dark period of about 14-16 hours for subsequent flowering. Some examples of these plants which are also known as long-

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night-plants are Maryland Mammoth variety of tobacco (*Nicotiana tabacum*), Biloxi variety of Soybeans (*Glycine max*) and Cocklebur (*Xanthium pennsylvanicum).* In short day plants the dark period is critical and must be continuous. If this dark period is interrupted even with a brief exposure of red light (660-665 mµ (µm = 10-6 mm) wavelength), the short day plant will not flower. Maximum inhibition of flowering with red light occurs at about the middle of critical dark period.

- ✓ However, the inhibitory effect of red light can be overcome by a subsequent exposure with far-red light (730-735 mµ (µm = 10-6 mm) wavelength)
- ✓ Interruption of the light period with red light does not have inhibitory effect on flowering in short day plants.
- ✓ Prolongation of the continuous dark period initiates early flowering in short day plants.

LONG DAY PLANTS (LDP)

These plants require a longer day light period (usually 14-16 hours) in a 24 hours cycle for subsequent flowering. Some examples of these plants which are also called as short night plants are *Hyoscyamus niger* (Henbane), *Spinacea* (spinach) *Beta vulgaris* (Sugar beet).

- ✓ In long day plants the light period is critical
- ✓ A brief exposure in the dark period or the prolongation of the light period stimulates flowering in long day plants.

DAY NEUTRAL PLANTS

These plants flower in all photoperiods ranging from 5 hours to 24 hours continuous exposure. Some of the examples of these plants are tomato, cotton, sunflower, cucumber and certain varieties of peas and tobacco. During recent years certain intermediate categories of plants have also been recognized. They are,

LONG SHORT DAY 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 *Bryophyllum.*

SHORT-LONG DAY PLANTS

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*).

PHOTOPERIODIC INDUCTION

Plants may require one or more inductive cycles for flowering. An appropriate photoperiod in 24 hours cycle constitutes one inductive cycle. If a plant which has received sufficient inductive cycles is subsequently placed under unfavorable photoperiods, it will still flower. Flowering will also occur if a plant receives inductive cycles after intervals of unfavorable photoperiods (*i.e.*, discontinuous inductive cycles.) This persistence of photoperiodic after effect is called photoperiodic induction.

PHYTOCHROME

It has already been seen that a brief exposure with red light during critical dark period inhibits flowering in short-day plants and this inhibitory effect can be reversed by a subsequent exposure with far-red light. Similarly, the prolongation of the critical light period or the interruption of the dark period stimulates flowering in long-day plants involves the operation of a proteinaceous pigment called as phytochrome.

The pigment phytochrome exists in two different forms,

(i) Red light absorbing form which is designated as PR and

(ii) Far-red absorbing form which is designated as PFR.

- ✓ When PR form of the pigment absorbs red light (660-665 nm, it is converted into PFR form).
- ✓ When PFR form of the pigment absorbs far-red light (730-735 nm) converted into PR form.
- ✓ The PFR form of the pigment gradually changes into PR form in dark.

It is considered that during the day the PFR form of the pigments is accumulated in the plant which is inhibitory to flowering in short-day plants but is stimulatory in long-day plants. During critical dark period in short-day plants, this form gradually changes into PR form resulting in flowering. A brief exposure with red light will convert this form again into PFR form thus inhibiting flowering. Reversal of the inhibitory effect of red light during critical dark period in SDP by subsequent far-red light exposure is because the PFR form after absorbing far-red light (730-735 nm) will again be converted back into PR form. Prolongation of the critical light period or the interruption of the dark period by red light in long-day plants will result in further accumulation of the PFR form of the pigment, thus stimulating flowering in long-day plants.

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