**Dr. Rima Kumari: Date: 20/08/2020**

Online class and e- content for BSc IIIrd year students

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| Date and Time | Online class medium | E. content topic |
| 20/08/2020  01:00 p.m to 1.50 p.m | Via Google meet  Link: Meeting URL: https://meet.google.com/khs-bhgj-gao | **Photoperiodic induction, Phytochrome** |

**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 un-favourable photoperiods, it will still flower. Flowering will also occur if a plant receives inductive cycles after intervals of un-favourable photoperiods (i.e., discontinuous inductive cycles). This persistence of photo­periodic after effect is called as photoperiodic induction.

i. An increase in the number of inductive cycles results in early flowering of the plant. For instance Xanthium (a short day plant) requires only one inductive cycle and normally flowers after about 64 days. It can be made to flower even after 13 days if it has received 4-8 inductive cycles. In such cases the number of flowers is also increased.

ii. Continuous inductive cycles promote early flowering than discontinuous inductive cycles.

Some of the example of plants which require more than one inductive cycles for sub­sequent flowering are Biloxi soybean (SDP) —2 inductive cycles; Salvia occidentalis (SDP) — 17 inductive cycles; Plantago lanceolata (LDP)—25 inductive cycles.

**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 **florigen** is produced in the leaves which is then translocated to the apical tip, subsequently causing the initiation of floral primordia.

**Nature of the Floral Hormone:**

Although there are firm evidences for the existence of a floral hormone but it has not yet been isolated. Therefore, the nature of this hormone which has been named as florigen is not very clear. But it is quite evident that this hormone is a material substance which can be trans located from leaves to the apical tips situated at other parts of the plant resulting in flowering.

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 trans located from the leaf to the apical tips (or meristems) via phloem in photo-induced plants (Corbesier and Coupland, 2005).

**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. This inhibition of flowering in short-day plants and the stimulation of flowering in long-day plants involves the operation of a proteinaceous pigment called as phytochrome.

i. The pigment phytochrome exists in two different forms:

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

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

ii. These two forms of the pigment are photo chemically inter convertible.

iii. When PR form of the pigment absorbs red light (660-665mp), it is converted into PFR form.

iv. When PFR form of the pigment absorbs far-red light (730-735mp), it is converted into PR form.

v. The PFR form of the pigment gradually changes into PR form in dark.

Darkness

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 PR 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 (730-735mµ) 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 PPR form of the pigment, thus stimu­lating flowering in long-day plants.

Successful purification of intact native phytochrome (from etiolated oat seedlings) was first re­ported by Vierstra and Quail in 1983. The native phytochrome is a soluble protein with a molecular weight of about 250 kDa. It’s a homodimer of two identical polypeptides each with a molecular weight of about 125 kDa.

Each polypeptide has a prosthetic group called as chromophore which is covalently linked to the polypeptide via a sulphur atom (Thioether Linkage) in the cysteine residue of the polypeptide. The protein part of the phytochrome is called as apoprotein. Apoprotein along with chromophore constitute holoprotein.

The chromophore of phytochrome is an open tetrapyrrole which is related to phycocyanobilin in structure and therefore, more recently this chromophore has been called as phytochromobilin. The structures of chromophores or the prosthetic groups of PR and PFR fomis of phytochrome which are cis and trans isomers of each other respectively, are given in Fig 18.5. The cis-trans isomerization occurs at carbon-15 in response to red and far-red light.

Apart from absorbing red and far-red light, the phytochrome also absorbs blue light. The PR form of phytochrome is blue while PFR form is olive-green in colour. But owing to very low conc. of phytochrome, the colour of this pigment is not visible in plant tissues. (Phytochrome accounts for less than 0.2 % of the total extractable protein in etiolated seedlings).

**Structure of the chromophores**

None of the two components of phytochrome i.e., apoprotein and chromophore, can absorb light alone.

Phytochromes have been detected in wide range of plants in angiosperms, gymnosperms, bryophytes and algae. Dark grown etiolated seedlings are richest sources of phytochrome where this pigment is especially concentrated in apical meristems. (Etiolated seedlings have therefore been used extensively in this connection).

Phytochromes have directly been detected in different parts of seedlings, in roots, cotyledons, hypocotyls, epicotyls, coleoptile, stems, petioles, leaf blades, vegetative buds, floral receptacles, inflorescences, developing fruits and seeds. Presence of phytochrome has also been shown indirectly in other plant materials.

Within the cells, phytochrome exists in nucleus and throughout the cytosol.

The chromophore of phytochrme is synthesized in plastids while apoprotein is synthe­sized on nuclear genome. Assembly of these two components of phytochrome is autocatalytic and occurs in cytosol.

There are two major types of phytochromes in plants, (i) type I and (ii) type II. The type I predominates in etiolated seedlings while type II in green plants and seeds (such as oat seeds). There are minor differences in molecular weight and spectral properties of these two types of phytochromes.

Type I phytochrome is encoded by PHY A gene while type II is encoded by PHY B, PHY C, PHY D and PHY E genes.

The exact mechanism of the action of phytochromes is not very clear. They act probably (a) by controlling active transport of ions and molecules across membranes probably by regulating ATPase activity, (b) by controlling the activity of membrane bound hormones such as gibberellins (c) modulating the activity of membrane bound proteins and (d) by regulating tran­scription of numerous genes involving multiple signal transduction pathways.