VIVEKANANDA COLLEGE

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NAAC ACCREDITED 'A' GRADE

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VERNALIZATION

Introduction:

Many plants do not come to flower before they experience a low temperature. These plants remain vegetative during the warm season, receive low temperature during winter, grow further and then bear flowers and fruits. Requirement of low temperature prevents precocious reproductive development in autumn.

So, vernalization is a process where flowering is promoted by cold treatment given to an imbibed (fully hydrated) seed or to a growing plant.

It allows the plant to reach vegetative maturity before reproduction can occur. The condition occurs in winter varieties of some annual food plants (e.g., Wheat, Barley, and Rye), some biennial (e.g., Cabbage, Sugar beet, Carrot) and perennial plants (e.g., *Chrysanthemum*).

The annual winter plants also possess spring varieties. The spring varieties are planted in spring. They come to flower and bear fruits prior to the end of the growing season.

If the winter varieties are sown similarly, they fail to flower and produce fruits before the end of growing season. They are planted in autumn, form seedlings in which form they cover winter. The seedlings resume growth in spring. They bear flowers and fruits in summer.

It was found by Lysenko (1928), a Russian worker that the cold requiring annual and biennial plants can be made to flower in one growing season by providing low temperature treatment to young plants or moistened seeds.

He called the effect of this chilling treatment as vernalization. **Vernalization is, therefore, a process of shortening of the juvenile or vegetative phase and hastening flowering by a previous cold treatment.**

Site for Vernalization:

The stimulus of vernalization is perceived only by the meristematic cells, e.g., shoot tip, embryo tips, root apex, developing leaves, etc..

Requirements of Vernalization:

(i) Low Temperature:

Low temperature required for vernalization is usually 0°—5°. It is 3°—17° in case of biennial Henbane (*Hyoscyamus niger*). Low temperature treatment should not be immediately followed by very high temperature (about 40°C) otherwise the effect of vernalization is lost. The phenomenon is called de-vernalization.

(ii) Period of Low Temperature Treatment:

It varies from a few hours to a few days.

(iii) Age of plants :

Plants differ considerably in the age at which they become sensitive to vernalization. Winter annuals respond to low temperatures very early in their life cycle. They can be vernalized before germination if seeds have imbibed water and become metabolically active. Other plants including most biennials must reach a minimal size before they become sensitive to Vernalization.

(iv) Actively Dividing Cells:

Vernalization does not occur in dry seeds. The seeds must be germinated so that they contain an active embryo. For this the seeds are moistened before exposing them to low temperature. In whole plants, an active meristem is required.

(v) Water:

Proper protoplasmic hydration is must for perceiving the stimulus of vernalization,

(vi) Aerobic Respiration and

(vii) Proper Nourishment.

Mechanism of Vernalization:

Much is not known about the metabolic processes associated with vernalization. Both sugar and oxygen are required to increase the activation of aerobic respiration needed for flowering to occur. Generally the rates of most metabolic reactions decrease with temperature, so the induction of flowering by low temperature seems to be more complex than the simple activation of metabolic pathways. So it has been suggested that Vernalization causes a permanent change in the pattern of gene expression. Possibly the changes in the pattern of DNA methylation can account for altered gene expression induced by vernalization. If non vernalized plants are treated with the DNA- demethylating agent, 5- azacytidine, they flower significantly earlier than untreated plants. Thus, genes that are needed for early flowering could be blocked by DNA methylation in late flowering plant species.

Since, GA can be substituted for the vernalization requirement. Perhaps, a gene that encodes an enzyme in the GA biosynthetic pathway gets demethylated during vernalization.

Vernalizing hormone:

The stimulus received by the actively dividing cells of shoot or embryo tip travels to all parts of the plant and prepares it to flower. Melchers and Lang suggested that a transmissible flowering stimulus is formed as a result of chilling, which is known as **vernalin**, though it has not been isolated so far.

It can be passed from one plant to another through grafting in the case of Henbane but not in others. In some plants cold treatment can be replaced by gibberellins.

Importance of Vernalization:

(i) Vernalization can help in shortening the juvenile or vegetative period of plants and bring about early flowering. It is not only applicable to temperate plants but also to some tropical plants, e.g., Wheat, Rice, Millets, Cotton,

(ii) It increases yield, resistance to cold and diseases, and

(iii) Kernel wrinkles of *Triticale* can be removed by vernalization.

(iv) In India, several rice varieties are developed by vernalization that are able to flower in adverse environmental conditions(such as drought, heavy rainfall etc.).