Lecture-2

Seed Dormancy: Causes and Types

Learning Objectives

- Importance of dormancy
- Types of dormancy

Introduction

Dormancy is a condition where seeds will not germinate even when the environmental conditions such as water, temperature and air are favourable for germination.

- It is observed that seeds of some fruit plants (mango, citrus) germinate immediately after extraction from the fruit under favourable conditions of moisture, temperature and aeration.
- However, in others (apple, pear, cherry) germination does not take place even under favourable conditions. This phenomenon is called as 'dormancy'.
- This is an important survival mechanism for some species because these species do not germinate unless adverse climatic conditions end.
- In some species, chilling temperature for certain period helps in the termination of dormancy. Often dormancy is due to several factors and may persist indefinitely unless certain specific treatments are given.

Types of dormancy: Different types of dormancy include

1. Exogenous Dormancy

- This type of dormancy is imposed by factors outside the embryo.
- In exogenous dormancy, the tissues enclosing the embryo can affect germination by inhibiting water uptake, providing mechanical resistance to embryo expansion and radicle emergence, modifying gaseous exchange (limit oxygen to embryo), preventing leaching of inhibitor from the embryo and supplying inhibitor to the embryo. It is of three types:

a) Physical dormancy (seed coat dormancy): Seed coat or seed covering may become hard, fibrous or mucilaginous (adhesives gum) during dehydration and ripening as a result they become impermeable to water and gases, which prevents the physiological processes initiating germination This type of dormancy is very common in drupe fruits i.e. olive, peach, plum, apricot, cherry etc. (hardened endocarp), walnut and pecan nut (surrounding shell). In various plant families, such as, Leguminosae, the outer seed coat gets hardened and becomes suberized and impervious to water.

b) **Mechanical dormancy**: In some fruits seed covering restricts radicle growth, resulting in dormancy of seeds. Some seed covering structures, such as shells of walnut, pits of stone fruits and stones of olive are too strong to allow the dormant embryo to expand during germination. The water may be absorbed but the difficulty arises in the cementing material as in walnut. Germination in such seeds does not occur until and unless the seed coats are softened either by creating moist and warm conditions during storage or by microbial activity.

c) **Chemical dormancy**: In seeds of some fruits chemicals that accumulate in fruit and seed covering tissues during development and remain with the seed after harvest. It is quite common in fleshy fruits or fruits whose seeds remain in juice as in citrus, cucurbits, stone fruits, pear, grapes and tomatoes. Some of the substances associated with inhibition are various phenols, coumarin and abscisic acid. These substances can strongly inhibit seed germination.

2. Endogenous dormancy

This type of dormancy is imposed by rudimentary or undeveloped embryo at the time of ripening or maturity. This can be of different types such as morphological, physiological, double dormancy and secondary dormancy.

A. Morphological dormancy (Rudimentary and linear embryo): Dormancy occurs in some seeds in which the embryo is not fully developed at the time of seed dissemination. Such seeds do not germinate, if planted immediately after harvesting. Plants with rudimentary embryos produce seeds with little more than a pro-embryo embedded in a massive endosperm at the time of fruit maturation. Enlargement of the embryo occurs after the seeds have imbibed water but, before germination begins. Formation of rudimentary embryo is common in various plant families such as Ranunculaceae (Ranunculus), Papavaraceae (poppy). Some plants of temperate zone like holly and snowberry have also rudimentary embryos.

B. Physiological dormancy

a) Non-deep physiological dormancy: After ripening time is required for seeds in dry storage to lose dormancy. This type of dormancy is often transitory and disappears during dry storage. Temperate fruits such as apple, pear, cherry, peach, plum and apricot, cultivated cereals, vegetables and flower crops, have this type of physiological dormancy which may last for one to six months and disappears with dry storage.

b) Photo dormancy: Seeds that either require light or dark condition to germinate are termed as photo-dormant seeds. It is due to photo-chemically reactive pigment called phytochrome widely present in some plants. When imbibed seeds are exposed to red

light (660-760 nm), the phytochrome changes to red form (P_{fr}), thereby substituting the germination process. However, when seeds are exposed to far-red light (760-800), P_{fr} is changed to P_f which inhibits germination process.

c) Thermo dormancy: Some seeds have specific temperature requirement for their germination, otherwise they remain dormant. Such seeds are called as thermo dormant .For example seeds of lettuce, celery and pansy do not germinate if the temperature is below 25^o C.

Physiological dormancy is of 3 types:

I) Intermediate physiological dormancy: The seeds of some species require a specific period of one-to-three months of chilling, while in an imbibed and aerated state, commonly called as moist chilling. For example, most of temperate fruit seeds require moist chilling to overcome seed dormancy. This requirement led to the standardization of world famous, horticultural practice of stratification. In this process, the seeds are placed between layers of moist sand in boxes and exposed to chilling temperatures (2 to 7^0C) for the period varying from 3-6 months to overcome dormancy.

II) Deep physiological dormancy: Seeds, which usually require a relatively long (>8 weeks) period of moist chilling stratification to relieve dormancy as in peach.

III) **Epicotyl dormancy**: Seeds having separate dormancy conditions for the radicle hypocotyl and epicotyl, is called as epicotyl dormancy e.g. *Lilium, Hepatica antiloba and trillium.*

C. Double dormancy

- In some species, seeds have dormancy due to hard seed coats and dormant embryos.
- For instance, some tree legumes seed coats are impervious and at the same time their embryo are also dormant.
- Such seeds require two years for breaking of dormancy in nature. In the first spring, the microorganisms act upon the seed making it weak and soft and then embryo dormancy is broken by chilling temperature in the winter next year.
- Combination of two or more types of dormancy is known as 'double dormancy'. It can be morpho-physiological i.e. combination of under developed embryo and physiological dormancy or exo-endodormancy i.e. combination of exogenous and endogenous dormancy conditions i.e. hard seed coat (physical plus intermediate physiological dormancy).

D. Secondary dormancy

Secondary dormancy is due to germination conditions. It is a further adaptation to prevent germination of an imbibed seed if other environmental

conditions are not favorable. These conditions can include unfavorably high or low temperature, prolonged darkness and water stress. It is of two types:

I) **Thermo dormancy**: High temperature induced dormancy.

II) **Conditional dormancy**: Change in ability to germinate related to time of the year.

Advantages

1. Permitting germination only when environmental conditions favour seedling survival as in fruit plants of temperate region.
2. Helpful in creation of a "seed bank"
3. Dormancy can also synchronize germination to a particular time of the year.
4. Seed disposal can be facilitated by specialized dormancy conditions. For example modification of seed covering through digestive tract of a bird or other animals.