PROCESSES INVOLVED IN GERMINATION

1. Inbibition of water
2. Activation of Precursors of enzymes
3. Production of Amino Acids, Proteins, etc.
4. Mobilization of food materials

INTERNAL FACTORS AFFECTING SEED GERMINATION

1. Genetic pattern of seeds (genotype)
2. Ecological type of seed population (ecotype)
3. Seed maturity
4. Presence or absence of germination promoting and inhibiting substances
5. General chemical and structural composition of seeds.

OTHER HORMONES

NAME OF HORMONE	EFFECT	SOURCE IN PLANTS
Rhizocaline	For root formation	In leaf
Coumarin	For stem elongation	In roots
Pyhllocaline	For leaf growth	In cotyledon
Florigen	Induces flower formation	In leaf
Traumatic acid	For healing of wound through callus Formation i.e it induces cell division in cells around the wound.	In damaged cells around the wound
Coumarin	Inhibits germination of some seeds Retards growth of roots in some plant species	In plant tissues

COMPARISON OF SOME KNOWN EFFECTS OF PLANT HORMONES

Effect on	IAA	GA	Cytokinin	Ethylene or Chlorohydrin	Abscicic acid
Cell division	Promotes		Promotes		
Cell enlargement in stems	Promotes		Promotes		

Cell enlargement in roots	Indirectly inhibits		Inhibits		
Abscission of parts	Inhibits				Promotes
Bud dormancy		Breaks	Breaks	Breaks	Promotes
Seed dormancy		Breaks	Breaks	Breaks	
Seed germination	Promotes	Promotes			Inhibits
Sexuality in flowers	Promotes	Promotes			
Food store mobilization in seeds		Promotes			
Root initiation	Promotes		Promotes		
Parthenocarpy	Promotes	Promotes			
Onset of flowering		Promotes		Promotes	
Stem elongation or 'bolting'	Promotes	Promotes			
Apical dominance in buds	Promotes		Counteracts		
Leaf expansion		Promotes			
Bud formation			Promotes		
Root elongation			Inhibits	Inhibits	
Cambial activity	Promotes		Promotes		
Fasciation			Promotes		
Senescence or aging			Retards		
Movement of metabolites			Accelerates		
Movement of auxin				Inhibits	

These effects are to be seen in some plant only and may be restricted to certain parts of them.

PHOTOPERIODISM

The influence of day-length on reproduction and vegetative growth was studied by Garner and Allard (1920). According to them some plants require a day-length longer than 12 hours for flowering, while others require less than 12 hours for this purpose. The former are known as long day plants and the latter as short day plants and the plants which are day neutral flower at any day-length. The relation of the time of flowering to the daily length of the period of illumination is known as photoperiodism.

The development of plants as contributed by the relative length of the light and dark periods to which they are exposed, a phenomenon called photoperiodism, is one of the most notable of all reactions of the plants to their environment. The photoperiodism has helped in the control of flowering of a large number of agricultural and horticultural plants.

Artificial shortening of day-length by shading or lengthening by the day-length electric illumination has induced plants to flower either than the normal ones.

Flowering of various annual and biennial plants at different seasons of the year is mainly due to the seasonal day length. In agricultural research this is of particular benefit as by artificial control of day length (daily illumination) two crop varieties which normally flower at different seasons can be made to flower simultaneously so that cross pollination for the purpose of crop improvement can be effected.

Light Duration Effects on Vegetative Growth:

In all parts of the world except the tropics and sub-tropics, marked seasonal changes or variations occur in the lengths of the daily period. The shortest period of the year in latitude 400N corresponding to the areas such as Madrid, Spain, China, Washington DC, is about 8-9 hours of day length while the longest day-length is about 15-16 hours. The same condition occurs in the southern cold zones. In tropical regions, the day-lengths approximate 12 hours all year round.

There has been found dissimilar in day-lengths of the day. Further experimentation on a variety of species soon resulted in the discovery that different kinds of plant react differently to given length of photoperiod the most effectively being on reproductive growth of plants. Flowering in some kinds of plants is favoured by short days, in other kinds by long days and in still some other kinds by a wide range of day-length.

Photoperiodic effects upon reproductive growth may indirectly induce effect upon vegetative growth. Many short day plants exposed to long days grow in height indefinitely, but if exposed to short days vegetative growth in height is soon checked as a result of the differentiation of a terminal inflorescence. Many long day plants on the other hand develop as leaf rosette or bunch when exposed to short days, elongation of flower-bearing sterms occurring only under long day conditions.

Tuberization in a number of species is markedly influenced by the length of the photoperiod. In a number of varieties of potato for example, a few or no tubers form under 16-18 hours photoperiods, while there is a good yield when the plants are exposed to short (8-10hr) photoperiods .This is also true of formation of tuber in helianthus tuberorsus (Jerusalem artichoke).Furthermore, exposure of only one leaf of a plant of this specie to a 9 hour photoperiod while the rest of the plant is under an 18hr photoperiod induces tuber formation just as if the entire plant were exposed to short photoperiod, but exposure of the terminal bud to a 9hr photoperiod while the rest of the plant is at an 18hr photoperiod has no such effect. The leaves are obviously the locus of a photoperiodic reaction, the effects of which are communicated in some manner or another to the underground organs of the plants and influences their development.

The development of bulbs by certain species of plants is markedly influenced by the length of the photoperiod to which the plant is exposed. Bulb formation in most varieties of onions, for example, is favoured by relatively long photoperiods, the minimum effective photoperiod varying from about 12-16hrs according to the variety.

The length of the photoperiod has an important effect on the bud dormancy of many temperate zone woody plants.The short photoperiods of later summer and early fall are factors inducing dormancy in many such species. On the other hand, the long photoperiods of late winter and early spring are factors in breaking the bud dormancy of many such species.

Effect of duration of light on reproductive growth: Some plants flower under short day conditions while some do so under long day-length condition, while others are independent to both. Plants have been classified according to the effects of day-length on their reproductive development. The classifications are based on a 24hr cycle of light and darkness.

a. **Short day plants**
   These are plants which flower when the day-length is below (less than) a certain critical day length. Day lengths in excess of this critical point will keep the short day plant vegetative. The so-called critical day-length differs with different species. Examples of short plants are Nicotiana tabacum, Xanthium pensylvanicum and Glycine max (soy beans), sweet potato, hemp (Canabis sativa).
b. **Long day plants**
   These are plants, which flower after a critical day-length is exceeded. Examples include sugar beet (Beta vulgaris), Spinach (Spinaceae oleracea) and Hyoscyamus niger.
c. **Day neutral**
   These are plants, which flower after a period of vegetative growth, regardless of photoperiod. That is, that range of plants flower readily over a wide range of day-lengths from relatively short photoperiods to continuous illumination. Example include

Tomato (Lycopersicum esculentum), Mirabilis (Four-O-clock), cotton (goossypium), certain varieties of tobacco, pisum salivum (garden pea).

d. **Intermediate plants**
   These are plants, which bloom only under day-length within a certain range and fail to flower under either longer or shorter photoperiods e.g. some varieties of sugar cane.
   The line of demarcations between the range of photoperiods favourable to flowering and the range of those which are not, is much sharper in some kinds of plants than in others.

PHOTOPERIODIC AND PHOTOINDUCTIVE CYCLE

The photoperiodic behavior is an important factor in determining the most favourable-season for raising many crop plants in mid-latitudinal regions. Any photoperiodic cycle which induces initiation of flowers in plants is called a photo-inductive cycle, while one which does not is called a non-photo-inductive cycle. For example, an 8hr photoperiod alternating with a 16hr dark period is possible photo-inductive cycle; for short day cocklebur plants having a critical photoperiod of 15.5hours; a 16-hour photoperiod alternating with 8hr dark period is one possible non-photo-inductive cycle for the plant.

The number of inductive cycles required by any kind of plants vary somewhat depending upon the age of the plant and environmental conditions, especially temperature, radiance and length of the photo-period.

General Mechanism of Photoperiodism:

a. **Locus of Photoperiodism**
   Although the leaves are undoubtedly the principal loci of the photoperiodic reactions in some plants, other organs may fulfill this role at least in part. Some complementary loci may be the bud, or leaf-like cotyledon as in some plants, while in some herbaceous species the stem serve the role especially when in defoliated form.
b. **Presence and Transmission of a Floral Hormone**
   The floral factor produced in photo-inductive leaves is apparently transported with ease in the plant. The floral factor or hormone has been termed florigen. This floral hormone is not species and has the same property in both day and long day plants. The distance over which florigen are transported in plants varies with the kind of plant and environmental conditions to which it is subjected. Translocation occurs in living cells and in petioles and stems through the phloem tissues.
c. **The Role of Gibberellin**
   The levels of gibberellins have been implicated in the production of floral hormone. It is assumed that a high level of gibberellins-like hormone must be maintained in long day plants for the production of florigen. In short day plants, this situation is reversed, a low level of the gibberellins-like hormone being optimum for a flowering response.
d. **Role of Light Quality**

The pigments phytochromes-FR and phytochronme – R sensitive to the Red and Far Red radiation have also been implicated in flower formation. These same pigments have also been implicated in most of the phytomorphogenetical problems.

WEED BIOLOGY

Weeds are plants that interfere with human activity, or in some was intrude upon human welfare. This is a concept of weeds that has originated with humans and within the context of their food production needs. The Oxford English Dictinary (OED) defines a weed as: a herbaceous plant not valued for use or beauty, growing wild and rank, and it is a common knowledge that not all weeds are herbs. Therefore deleting the word 'herbaceous' from the (OED) definition improves it, but no means make the definition technically complete. In addition to human values there are ecological considerations that should be noted when discussing weeds. While a patch of annual and perennial plants mat compete with our crops, and so qualify to be called weeds, these same plants play an important part at crop harvest and during subsequent fallow periods in keeping the soil covered and protected from the erosion action of both rain and wind.

The good and bad sides of weeds were described by Salisbury (1964) as follows: weeds, as a class, have much in common with criminal; when not engaged in their nefarious activities both may have admirable qualities; a thief may be an affectionate husband and father outside business hours; an aggressive weed in one environment may be a charming wild flower in another.

Weeds are important components of our agricultural systems, and are subject to the evolutionary influences that affect crops and animals. De Wet Harlan (1975) have identified three classes of plant; the wild plants that grow naturally outside of human disturbed habitats; the weeds that thrive in habitats that are continuously disturbed by humans; and the domesticates (crops) that are artificially propagated and often require cultivation and care by humans in order to grow and take optimum use of environmental resources. In general the definition of the weed depends on one's perception of the plant in time.

CHARACTERISTICS OF WEEDS:

Weediness has been described as the state or condition of a field in which there is an abundance of weeds. Weediness therefore implies both presence and number of weeds. There are specific characteristics that qualify a plant as a weed. Some of these characteristics are met by some plants, while others, such as those of weedliness are acquired by virtue of a group of plants growing in a given location.

All terrestrial weeds tends to interfere with crop growth and some weeds (aquatic weeds) interfere not only with crop growth but also with use of waterways.

Some workers have outlined the characteristics of weeds as those that are collectively shared by non crop plants which make them weeds. There are some feature that set a weed apart from a crop.

INDIVIDUAL CHARACTERISTICS OF WEEDS:

a. **Harmful to humans, animals and crops:** Weeds with this characteristics may contain poisonous alkaloids e.g. leaves of stinging nettle (Flergaaestuans), and pods of Mucuna pruriers, high level of nitrates (e.g. Amaranthus spp) or parasitic on crops (e.g. Striga spp, Cassytha spp and Buchnera spp).
b. **Wild and rank growth:** Weeds that possess these features are usually of large size. They tend to grow rapidly, and cover extensive areas. Examples of these weeds are Rottebollia cochinchinensis and Andropogon spp.
c. **High reproductive capacity:** Many annual weeds have the ability to produce large quantity of seeds.
d. **Persistence and resistance to control:** Weeds that posses these characteristics have diverse forms and propagates from seed and tubers or rhizome. Examples are purple and yellow nutsedge (Cyperus rotundus and C. asculents respectively) which combine a well-developed tuber system with moderate production of viable seeds.

COLLECTIVE CHARACTERISTICS OF WEED GROUP:

a. **May grow in an undesirable location:** The ability to grow in an undesirable location is a major attribute of most weeds. Consequently weeds are found not only in cultivated fields, but also in tennis courts and other recreational sites. Also they are known to grow through cracks in concrete and asphalt pavements.
b. **May have large population:** Weeds that possess this characteristics tends to grow tensely around economic plants. Such weeds are adapted to overcrowding. Many annual weeds consist of large populations; examples are Euphorbia heterophylla, Ageratum conyzoides and Aspilia Africana. Weeds such as these are able to compete better with crops because of the numerical superiority that the weeds have over the crops with which they are associated.
c. **Human often find them useless, unwanted, undesirable:** Many weeds that show these attribute have morphological feature such as throns, prickles, etc. that make them objectionable. Examples of these weeds are Amaranthus spinosus, Acanthus montanus and Ficus exasperate.
d. **Aggressive:** Many weeds that are aggressive have rapid seedling growth and wide tolerance to edaphic and environmental factors. Many are deep rooted, others have intraspecific variations while others exhibit great plasticity of growth. For example

Euphorbia heteroplylla is very competitive in food legumes such as cowpea and soya beans because of its rapid growth and ability to form canopy over those crops.

ECONOMIC IMPORTANCE OF WEEDS:

It is estimated that some 1800 weeds species cause serious economic losses in crop production, and about 300 of these weed species are responsible for the serious economic losses in cultivated crops throughout the world. While reliable data on yield losses caused by weeds are not readily available in the tropics.

Losses caused by weeds in agriculture represents costs to the farming community, and these can be divided into direct and indirect costs.

DIRECT LOSSES CAUSED BY WEEDS:

- Weed reduce crop yield by interfering with crop growth. This interference includes competition with crops for nutrients, light and water. it also include the introduction of chemical into the soil that will adversely affect the growth of crop plants (allelopathy).
- Weeds reduce the quality of harvested agricultural products. The presence of weeds seeds such as those Rottboellia chinensis in maize or rice. Solanum nigrum in cowpea or soya beans will reduce quality of each of these crops.

Heavy weeds infestation interfere with speedy drying of crops and generally slow down harvest operations, thus increasing cost of harvesting.

Some weeds can be poisonous if eaten by grazing animals. Amaranthus spp. Is an example of a weed which can adversely affect livestock because of the high nitrate content of the shoots.

Presence of weeds can also increase the cost of irrigation through indirect costs in keeping the canals weed free.

The cost of weed control far exceed that of any other crop pest.

INDIRECT LOSSES CAUSED BY WEEDS

Weeds cause many other types of losses in agriculture that cannot be readily related to weeds. These losses are indirect in nature and include the following:

- Weeds serve as alternative hosts for many plant diseases and animal pests (e.g insects, rodents, rodents, birds etc.) that attack crops. Examples of weeds that serve as alternative hosts of arthropods and nematodes are Imperata cylindrical, Amaranthus spinosus, Eleusine indica and Cyperus esculentus.

- The presence of weeds impose a limit on farm size, Farmers generally cultivate only the area that they know from experience they will be able to keep weed free. Inputs are costly, and too large an area creates a serious risk for the farmer.
- The presence of weeds can reduce the economic value of lakes by preventing or liming fishing activities.
- Weeds such as Imperata cylindrical, become fire hazards in the dry season throughout the savanna vegetation zone. Other grasses that poses such danger include Andropogon spp, Pennisetum spp and Hyparrhenia spp. Such bush fire expose the soil to erosin hazards, destroy wild life and impoverish the soil.

BENEFICIAL EFFECTS OF WEEDS:

Many plants species known as weeds have positive values both individually and collectively. Some of the beneficial effects of weeds are:

- Weeds provide a vegetative cover that protects the soil surface against erosive action of rain and wind.
- Weeds play an important part in nutrient recycling
- Weeds add organic matter to the soil both from roots and from the above ground parts.

WEED SEED PRODUCTION:

Weed survive seasons of adverse weather through seed production. Most weeds, particularly annuals, maintain their genetically heritable traits through seed production. The long-lived species tent to produce fewer seeds than the short-lived species that face mocre environmental hazards. Other roles played by the seed in a weed's life cycle have been mentioned and these are:

(a) Spread of weed species (dispersal)
(b) Temporary source of food for the embryo, and
(c) Protection during conditions that are unfavourable for germination (dormancy).

The seed therefore plays important roles in the survival and multiplication of weeds. Weeds seeds are continuously added to agricultural land during each cropping cycle.

Mature weeds shed their seeds on agricultural lands and thus add to the population of weed seeds in or on the soil. Several factors affect the quantity of weed seeds, i.e the seed rain. These factors include damage by animals and adverse weather conditions. Some of the weed seeds that fall on the soil surface may be moved inot the soil profile through

(a) Cracks and fissures in the soil,
(b) Cultivation practices and
(c) Harvesting of root and tuber crops.

Weed seeds that move into the soil profile may remain dormant for many years and may germinate when they are moves to or near the soil surface during land preparation. Some of the weed seeds that are on or in the topsoil may be killed by heat during preplanting bush burning, and by mulching. Germination weed seeds may also be killed by pre-emergence herbicides. Non-dormant weed seeds that escape these actions will germinate and the seedling weeds could be killed by adverse weather conditions, pre- or post-emergence herbicides, mechanical or hole weeding. Only those weed seedlings that escape these actions grow to maturity to produce mature seeds that add to the seed rain. It is this seed rain that replenished the reservoir of viable seeds in the soil. Harper (1977) described this reservoir as the seed bank. It consists of seeds produces in a given area plus weed seeds that have migrated to the area as a result of the action of various agents of dissemination. Seeds in the seed bank always exceed those that germinate because of differences in the dormancy characteristics of all weed seeds in a seed bank.

CHEMICAL COMPOSITION:

Certain weed seeds can be economically valuable for their nutritive qualities. It has been found that seeds of some species had high contents of essential amino acid and the results suggested that these weed seeds could be excellent sources of protein and oil.-

SEED DISPERSAL:

Weed seeds are dispersed in space and in time. Seed dispersal in space involves the physical movement of seeds from one place to another while dispersal in time refers to the capacity of many seeds to remain in a dormant state for a period of time. In the latter case the appearance of seedlings of a given weed species in a habitat is spread over an extended period.

REASONS FOR DISPERSAL IN TIME

- Aeration : Deep-buried weed seeds may go into induced dormancy because of inadequate oxygen supply in the soil. Improvement in aeration therefore favours better seed germination.
- Light: Some seeds either require light for germination or germinate better in light, while others are insensitive to light.In order for light-sensitive seeds to respond to light, they must first imbibe water. Seed of rottboellia cochinchinensis germinate better in light than in darkness.
- Soil nitrate level: High nitrate level in the soil favour germination of weed seeds. Soil nitrate is affected by fertilizer application and by cultivation practices. In laboratory studies, germination of many plant seeds has been improved with potassium nitrate and urea.

Germination Behavior of Weed

Many weed species seeds are subject to dormancy of different kinds, thus causing delayed germination of variable duration. This phenomenon appears more frequently in non-cultivated species. Seed germination is influenced by many internal factors including the genetic pattern of seeds (genotype), the ecological type of seed population (ecotype), seed maturity, presence or absence of germination promoting and inhibiting substances, and the general chemical and structural composition of seeds.