Unit 1
MODULE
6

WEED PHYSIOLOGY

I. Introduction

The role of weeds in agricultural systems is relatively huge than a farmer can imagine because they encourage completion for space, sunlight, water, and nutrients with the main crops. They are also potential habitat and hosts for different insect pests and plant diseases. That is why weeds are responsible for significant crop yield losses and for financial losses in agricultural production – in the order of 10% per year worldwide.

Understanding weed biology and ecology is very important in agriculture so that farmers will be able to assess their growth patterns and desirable conditions for propagation for them to be able to adapt a suitable weed management in their cultivation practices. Since weed population dynamics change over the span of time due to introduction of new weed species and development of resistant weeds, continues study and observation is needed so that farmers will be able develop and adapt weed control and management in response to it.

The progress of agricultural sector is brought by the continuous effort for researching and developing technologies that can increase yields and minimize labor and input costs for improved profit. Crop management system is a technology that comprises all planning, establishment, management, and post-harvest to enable to maximize profit and quality of market produce.

One of the things that threaten that quality and profit are weeds. They compete for space, nutrient, sunlight, and water with commercial crops and therefore can affect its productivity as a whole. Due to the weeds' versatility to adapt and evolve, simple and outdated management practices are not enough to eliminate their threat. That is why different kinds of weed management and integration of one or more of them is being carefully planned and applied to be able to manage the growing population of weeds within a field.

II. Learning Objectives

At the end of this module, the students are expected to:

a. Explain the concept of weed population dynamics and its importance to agriculture.
b. Identify the different weed thresholds and their potential damage to the crops with its corresponding weed control measures.
c. Enumerate and describe the different factors that affect weed population and the way they affect it.
d. Define weed management and its importance.
e. Classify and describe the different methods of weed management.
f. Explain the advantages and disadvantages of each methods of weed management.

III. Pre-Test

Read the following questions and encircle the letter of the correct answer.

1. What are the indicators or weed infestation in the field?
    a. the number of weed species present
    b. the density of each weed species
    c. the distribution of the weed species across the field
    d. All of the above
2. What threshold is where the weed population at which the cost of control is equal to the crop value increase from control of the weeds at present?
    a. Damage Threshold
    b. Economic Threshold
    c. Period Threshold
    d. Action Threshold
3. What is the term used to define the weed population at which a negative crop yield response is detected?
    a. Damage Threshold
    b. Economic Threshold
    c. Period Threshold
    d. Action Threshold
4. What factor that affect weed population that includes establishment, growth, reproduction, and life cycles of weed species and weed societies/vegetation?
    a. Environmental Factors
    b. Weed Biology
    c. Cultural Practices
    d. Weed Management

5. What factor can affect weed population in terms of the common farmers' practices in the field that can directly or indirectly reduce weeds?
    a. Environmental Factors
    b. Weed Biology
    c. Cultural Practices
    d. Weed Management
6. What factor can affect weed population that has to do with the abiotic elements like temperature, moisture, light, etc.?
    a. Environmental Factors
    b. Weed Biology
    c. Cultural Practices
    d. Weed Management
7. What weed biology category pertains to the growth behavior and survival duration of weeds?
    a. Life Cycle
    b. Growth Characteristics
    c. Weed Genetics
    d. Reproductive Strategy
8. What type of weed growth characteristics has narrow, upright, parallel-veined leaves, with jointed stems that are usually hollow at the internodes and are circular in cross section?
    a. Broad Leaves
    b. Grasses
    c. Sedges
    d. Ferns
9. What type of weed growth characteristics has stems that are triangular in cross section, solid, and not jointed?
    a. Broad Leaves
    b. Grasses
    c. Sedges
    d. Ferns
10. What type of weed growth characteristics has two leaves emerging upon germination and has a branching network of veins with flowers having distinct petals?
    a. Broad Leaves
    b. Grasses
    c. Sedges
    d. Ferns

11. What method of weed management pertains to the manual removal of weeds and uses big man power? It is the old way of weed management.
    a. Cultural Method
    b. Physical Method
    c. Chemical Method
    d. Biological Method
12. What method of weed management pertains to the use of herbicide to eliminate existing weeds in the field?
    a. Cultural Method
    b. Physical Method
    c. Chemical Method
    d. Biological Method
13. What method of weed management uses living organisms or their body part to damage and kill weeds?
    a. Cultural Method
    b. Physical Method
    c. Chemical Method
    d. Biological Method
14. What method of weed management uses farmers' cultures cultural practices in controlling and eradicating weeds?
    a. Cultural Method
    b. Physical Method
    c. Chemical Method
    d. Biological Method
15. What physical method that is done before crop establishment at digs and breaks the soil to cut, uproot, and bury existing weeds in the field?
    a. Tillage
    b. Hoeing
    c. Sickling
    d. Burning
16. What cultural method applies alternating crop in a rotational pattern to different parts of the field preventing weeds to survive in the changing field conditions?
    a. Field Preparation
    b. Maintenance of optimum crop population
    c. Crop rotation
    d. Intercropping

17. What type of herbicide that only targets a specific group of weed species?
    a. Systemic Type
    b. Contact Type
    c. Selective Type
    d. Non-selective Type
18. What biological method uses plant pathogens to kill weeds?
    a. Natural Enemy
    b. Predator
    c. Biocontrol
    d. Mycoherbicide
19. This weeding method use flame to devour the weeds up to its roots to prevent them from regenerating and propagating in the field?
    a. Mowing
    b. Burning
    c. Flooding
    d. Hand weeding
20. This weeding practice is typical in gardens where grabhoe hand tool is used to cut and dig weeds from the soil.
    a. Tillage
    b. Hoeing
    c. Sickling
    d. Mowing

IV. Discussion

Weed Biology

Weed biology is the study of the establishment, growth, reproduction, and life cycles of weed species and weed societies/vegetation. It is also an integrated science with the aim of minimizing the negative effects, as well as using and developing the positive effects, of weeds.

Life Cycle

Based on life cycle weeds are classified as annuals, biennials and perennials.

1. Annuals
    a. Annuals complete their life cycle from seed in less than one year. There are two types: summer and winter annuals. Summer annuals germinate in the spring, mature, produce flowers and seeds and die before fall. Winter annuals germinate in the fall, overwinter in a seedling or rosette stage, mature, produce flowers and seeds, and die in the spring or early summer. Because of the seedling stage, annual weeds are generally easy to control.
2. Biennials
    a. Biennials generally complete their life cycle in two years. The first year the seeds germinate and form a basal cluster of leaves and a tap root. The plant overwinters in this stage. During the second year the weed produces a flower stalk, sets seed and dies. Examples of biennial weed are evening primrose and wild carrot.
3. Perennials
    a. Perennial weeds live for more than two years. These weeds are the most common in blueberry fields and generally the most difficult to control. Perennial weeds may reproduce primarily by seed (daisy); by both seed and roots (sheep sorrel); or primarily by vegetative means (bunchberry). Many perennial weeds grow in the same manner as the blueberry plant. Therefore, many of the production practices that promote blueberry growth (e.g. pruning) also promote growth of these weeds. Perennials which are low growing and spread vegetatively by interconnected underground root systems are the most difficult to control. Perennial weeds growing above the blueberries may be controlled by wiping or spot treatments with

registered herbicides. Perennial weeds include both woody and herbaceous species.

Growth Characteristics

Growth characteristics of weeds are classified as grasses, broadleaf weeds, ferns and herbaceous or woody weeds.

1. Broadleaf
    a. Broadleaf weeds are annual, biennial or perennial plants which generally have two leaves (cotyledons) emerging upon germination. The leaves normally have a branching network of veins and the flowers have distinct petals.
2. Grasses
    a. Grasses can be annual or perennial plants. They generally have narrow, upright, parallel-veined leaves. Grasses have jointed stems, usually hollow at the internodes and are circular in cross section.
3. Sedges
    a. Sedges are a large group of perennial (rarely annual) grass-like plants which are common in wet, poorly drained soils. Sedge stems are triangular in cross section, solid, and not jointed.

Reproductive Strategy

Based on reproductive strategy weeds are classified as seed, vegetative reproduction.

- Reproduction by seed

    Reproduction by seed is called sexual reproduction. It requires the fertilization of an egg by sperm, usually in the form of pollen. Pollination of the egg in a flower results in formation of seed that is capable of producing a new plant. Seed production varies greatly among and within weed species in part due to environmental variability between years, competition from neighboring plants, and genetic variability.

    Through sexual reproduction abundant and small seeds are produced. Annual and biennial weeds depend on seed production, as the sole means of propagation and survival of perennial weeds are less dependent on this mechanism. For example, while Canada thistle has

been observed to produce as few as 680 seeds per plant, curly dock often produces more than 30,000 seeds per plant.

The seed production capacity of some of the weeds is given in the table:

Ontogeny	Seeds/plant	Name of weed/crop	Seeds/plant
Perennials	16,629	*Amaranthus retroflexus*	1,96,405
Biennials	26,600	*Solanum nigrum*	1,78,000
Annuals	20,832	*Chenopodium album*	72,000
		Trianthema portulacastrum	52,000
		Wheat & Rice	90 to 100

A few weeds may produce seed through apomixis in example without fertilization like ferns, they reproduce by spores.

- Vegetative Reproduction

In vegetative (asexual) reproduction, a new plant develops from a vegetative organ such as a stem, root, or leaf. Several modifications of these organs are common in perennial weeds, such as underground stems (rhizomes), above-ground stems (stolons), bulbs, corms, and tubers. Although vegetative structures generally do not survive as long in the soil as do seeds, very small structures can result in a new plant. Vegetative reproduction can be as prolific as seed production.

Weed Population Dynamics

Weed population dynamics or the change in weed population depicts the growth of weeds within a certain area of habitat. In agriculture, it is important to understand this concept because farmers depend on its information in determining if the distribution and density of the weeds in their crop field is on the level that encourages crop competition. If a certain threshold is reached, necessary counter measures will be considered to be put in action to prevent losses.

The weed infestation in a field is defined by three parameters: **1) the number of species present, 2) the density of each species**, and **3) the distribution of the species across the field**. While the number of species in a field remains relatively constant from year to year, the latter two factors fluctuate widely in response to environment, cultural practices, and weed management tactics. It is the continual changes in weed infestations that make successful weed control such a difficult task to achieve consistently.

The weed seed bank in agricultural fields is made up of many species, but in any given year the infestation typically is dominated by a few species. An Illinois field, (Illinois is a country with rich soil whose major agronomic crop is corn) maintained in a corn-soybean rotation was found to have 25 weed species in the seed bank, yet four species accounted for 85% of the weed population. The species that dominate the infestation are those best adapted to current management practices. As farmers adjust their management program to improve control of the species currently dominating the infestation, they typically

create an opportunity for other species in the seed bank to escape control and become part of the current problem.

Concept of Threshold

The concept of thresholds has many applications in weed science, depending on the response being measured. The most common adjectives used to describe thresholds are **damage, economic, period,** and **action**.

- **Damage threshold** is the term used to define the weed population at which a negative crop yield response is detected.
- An **economic threshold** is the weed population at which the cost of control is equal to the crop value increase from control of the weeds present. Economic threshold may be used to describe short-term effects of weed interference occurring in a single growing season, or multiple-season effects including some cost associated with seed produced by uncontrolled plants.
- **Period threshold** implies that there are times during the crop cycle in which weeds are more or less damaging than at others.
- **Action threshold** is the point at which some control action is initiated, and usually includes economic considerations along with other less tangible factors such as aesthetics, risk aversion, or sociological pressures.

Regardless of the type, thresholds imply that weed effects are population dependent, and as such, allow some type of prediction to be made relative to the consequences of control decisions.

Assessing Weed Population Density

The most accurate way to estimate the weed population of a paddock is to count the number of plants in an area of known size at a number of locations. Use a quadrant, which may be square or circular, to carry out weed plant counts. The number and location of counts needed to estimate the population will vary depending on the distribution pattern.

Sampling and estimating weed density

How big should the quadrant be?

The size of the quadrant will depend on the weed density. Small quadrants ($0.1m^2$) are adequate for weed populations greater than 200 plants per square meter. This would equate to counts above 20 plants per quadrant. For lower weed densities increase the quadrant size (up to $1m^2$) enabling counts between five and 50 plants per quadrant.

Factors that Affect Weed Population

A. Environmental Factors

These parameters consist of environmental factors such as ***soil temperature, soil moisture, light, nitrates concentration, soil pH,*** and the ***gaseous environment of the soil***.

1. Of the many environmental factors that regulate seed behavior under field conditions, **soil temperature** has a primary influence on seed dormancy and germination, affecting both the capacity for germination by regulating dormancy and the rate or speed of germination in non-dormant seeds.

2. **Soil moisture** is a key parameter affecting the seed dormancy status of many species. The loss of primary dormancy does not secure some species germination if moisture demands are not met. For example, adequate water conditions are demanded to promote germination. Regarding weed emergence, although seeds of many species can germinate in a wide range of water potentials, once germination has occurred the emerged seedlings are sensitive to dehydration, and irreversible cellular damage may occur

3. The reaction of seeds to **light** signals can break dormancy. Seeds of several species require light for germination.

4. The role of **nitrates and soil pH** on seed germination and weed emergence has something to do with the seed reaction towards these factors resulting to breaking of dormancy either direct or indirect. Some weed species reacts to nitrate inducing light-sensitivity that results to germination.

5. Oxygen and carbon dioxide are two of the most major biologically active gases in soil. **Oxygen concentration in soil** air does not usually fall below the limit of 19%. During storage of seeds in soil, oxygen can have both detrimental and beneficial effects on the dormancy status of weed seeds. Depending on the type of weed, seed germination can be stimulated or inhibited by increase of oxygen levels or even in its absence under anaerobic condition. While in the **levels of carbon dioxide in soil air**, it ranges between 0.5 and 1%. When soils are flooded, the ratio of carbon dioxide to oxygen typically increases and can have detrimental effects on seed germination and seedling emergence. But in case of elevated carbon dioxide concentrations combined with low oxygen concentrations, it may further strengthen the signal to germinate and promote germination below the surface during periods of high soil moisture content.

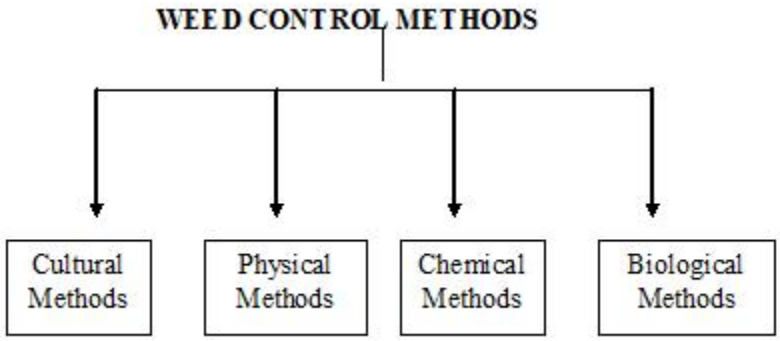
B. Weed Biology

C. Cultural Practices

Several cultural practices like tillage, planting, fertilizer application, irrigation etc., are employed for creating favorable condition for the crop. These practices if used properly, help in controlling weeds. Cultural methods, alone cannot control weeds, but help in reducing weed population.

D. Weed Management

Weed control and weed management are the two terms used in weed science. Weed control is the process of limiting infestation of the weed plant so that crops can be grown profitably. While weed management includes prevention, eradication and control by regulated use, restricting invasion, suppression of growth, prevention of seed production and complete destruction. Thus weed control is one of the aspects of weed management.



For deciding weed control practices to use in a field, farmers need to know the nature and habitat of the weeds in that area, how they react to environmental changes and how they respond to herbicides. Before selecting a method of weed control, one must have much enough information on the number of viable seeds nature of dispersal of seeds, dormancy of seeds, longevity of buried seeds & ability to survive under adverse conditions, life span of the weed, soil textures moisture and (In case of soil applied volatile herbicides the herbicide will be successful only in sandy loam soil but not in clayey soil. Flooding as a method of weed control will be successful only in heavy soil & net in sandy soil) the area to be controlled.

Principles of weed control are;

a) Prevention

b) Eradication

c) Control

d) Management

A. Preventive weed control

It includes every possible method to prevent the introduction or establishment and spread of weeds. Such areas may be local, regional or national in size. No weed control program is successful if adequate preventive measures are not taken to reduce weed infestation. It is a long term planning so that the weeds could be controlled or managed more effectively and economically. Truly, the idiom ‘An ounce of prevention is better than a pound of cure’ is applied in weed management.

1. Use high purity seeds to avoid weed seeds to be sown.

2. Avoid adding weeds to the manure pits that are used for soil fertilization.

3. Clean the farm machinery thoroughly before moving it from one field to another. This is particularly important for seed drills

4. Keep irrigation channels, fence-lines, and un-cropped areas clean.

Weed free crop seeds

It may be produced by following the pre-cautionary measures.

i. Separating crop seeds from weed seeds using manual picking or filtering.

ii. Usage of specific gravity separators.

iii. Use Certified Seeds.

vi. Use of pre-emergence herbicides also helpful in prevention because herbicides will not allow the germination of weeds.

B. Eradication

The complete removal of any weed propagative parts or seeds within the given area is called eradication. Because of its difficulty & high cost, eradication is usually attempted only in smaller areas such as few hectares or few thousand square meters or less. It is an ideal solution but very rare to be accomplished.

C. Control

These are practices that aim to limit, reduce, or inhibit the growth and distribution of weeds within a certain area. It aims to control weed population into a level that cannot impose a threat to the growth and yield of main crops.

D. Weed management

Weed control aims at only putting down the weeds present by some kind of physical or chemical means while weed management is a system approach whereby whole land use planning is done in advance to minimize the very invasion of weeds in aggressive forms and give crop plants a strongly competitive advantage over the weeds.

Weed control methods are grouped into cultural, physical, chemical and biological. Every method of weed control has its own advantages and disadvantages. No single method is successful under all weed situations. Many a time, a combination of these methods gives effective and economic control than a single method.

Cultural Methods

Several cultural practices like tillage, planting, fertilizer application, and irrigation, are employed for creating favorable condition for the crop. These practices when properly done can help in controlling weeds. Cultural methods, alone cannot control weeds, but help in reducing weed population. They should, therefore, be used in combination with other methods.

1. Field preparation

The field will be prepared before sowing by eliminating weeds before it flowers to prevent the scattering of seeds in the area.

2. Summer tillage

This summer practice aims to break soil clods so that growing weeds and their roots will be exposed to sun, letting them wither and die.

3. Maintenance of optimum plant population

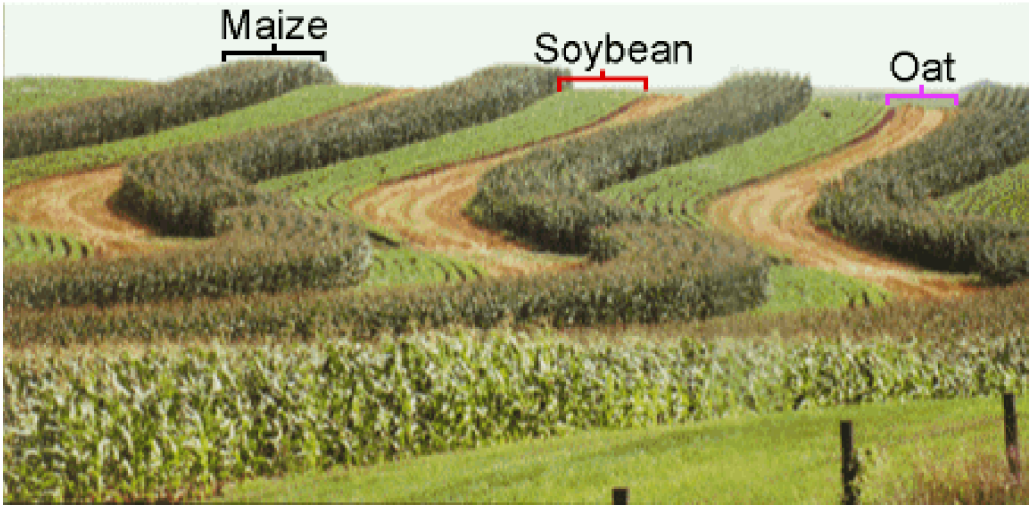
Efficient occupation and spacing in the field can prevent weeds from growing. If crops are distributed equally, no free spaces for weeds to strive and wide crop spacing for weeds to creep in between will be made.

4. Crop rotation

Weeds have preferred environmental and ecological condition for them to grow. If your main crop is a legume, there will be a high possibility for leguminous weeds to grow in the same condition. By adopting crop rotation, the field condition will change during rotation and can therefore help reduce weeds.

5. Growing of intercrops

Intercropping not only diversifies the field ecosystem but can also become an additional competition for weeds making their survival rate decrease significantly.

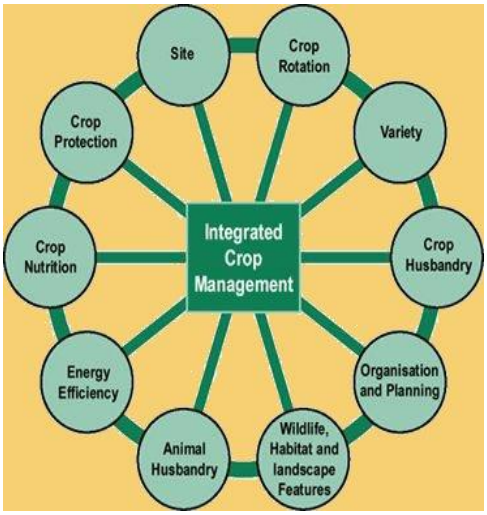


6. Mulching

Mulch is a protective covering of material maintained on soil surface. Mulching prevents weed growth by blocking the light and trapping moisture and humidity within the soil lowering the vigor of weeds.

7. Crop management practices

Good crop management practices that play an important role in weed control are:



a. Vigorous and fast growing crop varieties are better competitors with weeds.

b. Proper placement of fertilizers ensures greater availability of nutrients to crop plants, thus keeping the weeds at a disadvantage.

c. Better irrigation practices to have a good head start over the weeds

d. Proper crop rotation program

e. Higher plant population per unit area results in smothering effect on weed growth.

Advantages of Cultural Method

1. Low cost for weed control
2. Easy to adopt
3. No residual Problem
4. Technical skill is not involved
5. No damage to crops
6. Effective weed control
7. Crop-weed ecosystem is maintained

Disadvantages of Cultural Method

1. Immediate and quick weed control is not possible
2. Weeds are kept under suppressed condition
3. Perennial and problematic weeds cannot be controlled
4. Practical difficulty in adoption

Physical Method

Mechanical or physical methods of weed control are being employed ever since man began to grow crops. The mechanical methods include tillage, hoeing, hand weeding, digging, sickling, mowing, burning, flooding, mulching etc.

1. Tillage

Tillage removes weeds from the soil resulting in their death. It may weaken plants through injury of root and stem pruning, reducing their competitiveness or regenerative capacity. Tillage also buries weeds. Tillage operation includes ploughing, discing, harrowing and leveling which is used to promote the germination of weeds through soil turnover and exposure of seeds to sunlight, which can be destroyed effectively later. In case of perennials, both top and underground growth is injured and destroyed by tillage.

2. Hoeing

Hoe has been the most appropriate and widely used weeding tool for centuries. It is however, still a very useful implement to obtain results effectively and cheaply. It supplements the cultivator in row crops. Hoeing is particularly more effective on annuals and biennials as weed growth can be completely destroyed. In case of perennials, it destroyed the top growth with little effect on underground plant parts resulting in re-growth.

3. Hand weeding

It is done by physical removal or pulling out of weeds by hand or removal by implements called khurpi, which resembles sickle. It is probably the oldest method of controlling weeds and it is still a practical and efficient method of eliminating weeds in cropped and non-cropped lands. It is very effective against annuals, biennials and controls only upper portions of perennials.

4. Digging

Digging is very useful in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil.

5. Sickling and mowing

Sickling is also done by hand with the help of sickle to remove the top growth of weeds to prevent seed production and to starve the underground parts. It is popular in sloppy areas where only the tall weed growth is sickled leaving the root system to hold the soil in place to prevent soil erosion. Mowing is a machine-operated practice mostly done on roadsides and in lawns.

6. Burning

Burning or fire is often an economical and practical means of controlling weeds. It is used to (a) dispose of vegetation (b) destroy dry tops of weeds that have matured (c) kill green weed growth in situations where cultivations and other common methods are impracticable.

7. Flooding

Flooding is successful against weed species sensitive to longer periods of submergence in water. Flooding kills plants by reducing oxygen availability for plant growth. The success of flooding depends upon complete submergence of weeds for longer periods.

Advantages of Mechanical Method

1) Oldest, effective and economical method
2) Large area can be covered in shorter time
3) Safe method for environment
4) Does not involve any skill
5) Weeding is possible in between plants
6) Deep rooted weeds can be controlled effectively

Disadvantages of Mechanical Method

1) Labor consuming
2) Possibility of damaging crop
3) Requires ideal and optimum specific condition

Chemical Method

Herbicides are chemicals capable of killing or inhibiting the growth of plants. It has saved farmers of undue, repeated inter-cultivations and hoeing, and has helped him in obtaining satisfactory weed control where physical methods often fail. These chemicals vary greatly in their (a) molecular structures, (b) mobility within plants, (c) selectivity, (d) fate in soils, and (e) response to environment.

Proper selection of the herbicide, its rate, time, and method of application are very important to obtain the desire degree of weed control and crop selectivity.

Benefits of Herbicides

Herbicides were developed in the western world primarily to overcome the shortage of farm labor for weeding crops. The following are the benefits of herbicides:

1. In monsoon season incessant rainfall may make physical weeding infeasible. Herbicides can be used to ensure freedom of crops from weeds under such a condition. Also, during the early crop growth period when many fields need weeding simultaneously, even in labor-rich countries like India, Pakistan, Bangladesh, Nepal, Nigeria, and Sudan, there is certainly a weeding bottleneck in crop production. The soil applied herbicides can be of great help in these regions in boosting crop production.

2. Herbicides can be employed to control weeds as they emerge from the soli to eliminate weed crop interference even at a very early stage of crop growth. But by physical methods weeds are removed after they have offered considerable competition to the crops, and rarely at the critical time. Thus, herbicides provide benefits of timely weed control.
3. Herbicides can kill many weeds that survive by mimicry, for example, wild oat (*Avena spp.)* in wheat and barnyard grass (*Echinochola spp.)* in rice. Weeds that resemble crop plants usually escape physical weeding.
4. Herbicidal control does not dictate strict row spacing's. In physical weed control, on the other hand, the crop rows have to be sufficiently wide to accommodate weeding implements, else hand weeding and hand-pulling of weeds has to be resorted to.
5. Herbicides bring about longer lasting control of perennial weeds and brushes than is possible with any physical control method. Many modern herbicides can translocate considerably deep in the underground system of weeds and damage them.
6. Herbicides are convenient to use on spiny weeds which cannot be reached manually. When cultivators or hoes are worked hard in an attempt to uproot the established weeds, they may cut many feeding roots of a crop like maize, which are appreciable in the first 10 cm depth of the soil. Their lateral growth fully occupies the inter-row spaces.
7. Herbicides are safe on erodible lands where tillage may accelerate soil and water erosion. Excessive tillage, in any case, spoils soil structure, reduces organic matter content, and depletes moisture status of the soil.
8. Herbicides kill weeds in situ without permitting their dissemination. Tillage on the other hand, may fragment the vegetative parts of the weeds and drag them to new sites.
9. Herbicide sprays easily reach the weeds growing in obstructed situations, such as utility-right-of-way, under fruit trees, and on undulating lands. Some other benefits of using herbicides include (a) fewer labor problems, (b) greater possibility of farm mechanization, (c) easier crop harvesting and (d) lower cost of farm produce. In dry land agriculture, effective herbicidal control ensures higher water use by crops and less crop failures due to drought.

Limitations of Herbicides

Like any other method of weed control, herbicides have their own limitations. But with proper precautions these limitations can be overcome, markedly. Important limitations in the use of herbicides are as follows.

1. In herbicidal control there is no automatic signal to stop a farmer who may be applying the chemical inaccurately till he sees the results in the crops sprayed or in the rotation crops that follow.
2. Even when herbicides are applied accurately, these may interact with environment to produce unintended results. Herbicide drifts, wash-of, and run-off can cause considerable damage to the neighboring crops, leading to unwarranted quarrels.
3. Depending upon the diversity in farming, a variety of herbicides must be stocked on a farm to control weeds in different fields. On the contrary, for physical control of weeds a farmer has to possess only one or two kinds of weeding implements for his entire farm.
4. Above all, herbicidal control requires considerable skill on the part of the user. He must be able to identify his weeds and possess considerable knowledge about herbicides and their proper usages. Sometimes, an error in the use of herbicides can be very costly.
5. In herbicide treated soils, usually, crop failures cannot be made up by planning a different crop of choice. The selection of the replacement crop has to be based on its tolerance to the herbicide already applied.
6. Military use of herbicides is the greatest misfortune of their discovery. In Vietnam, 2,4-D and 2,4,5-T, for example, were used for defoliating forests and crops, leading to miseries to the innocent civilians. In future, the chemical warfare with residual herbicides may be even more devastating, which must be avoided at all costs.

Biological Method

Use of living organisms like insects, disease organisms, herbivorous fish, snails or even competitive plants for the control of weeds is called biological control. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. This method is not useful to control all types of weeds. Introduced weeds are best targets for biological control.

Qualities of bio-agent

1. The bio-agent must feed or affect only one host and not other useful plants.
2. It must be free of predators or parasites.
3. It must readily adapt to environment conditions.
4. The bio-agent must be capable of seeking out itself to the host.
5. It must be able to kill the weed or at least prevent its reproduction in some direct or indirect way.
6. It must possess reproductive capacity sufficient to overtake the increase of its host species, without too much delay.

Advantages

1) Least harm to the environment.
2) No residual effect.
3) Relatively cheaper and comparatively long lasting effect.
4) Will not affect non-targeted plants and safer in usage.

Disadvantages

1) Multiplication is costlier.
2) Control is very slow.
3) Success of control is very limited.
4) Very few host specific bio-agents are available at present.

Mode of action

a. Differential growth habits, competitive ability of crops and varieties prevent weed establishment Eg. Groundnut, cowpea fast growing and so good weed suppresser.

b. Insects kill the plants by exhausting plant food reserves, defoliation, boring and weakening structure of the plant.
c. Pathogenic organisms damage the host plants through enzymatic degradation of cell constituents, production of toxins, disturbance of harmone systems, obstruction in the translocation of food materials and minerals and malfunctioning of physiological processes.

Outstanding and feasible examples of biological weed control

a. Larvae of *Coctoblastis cactorum*, a moth borer, control prickly pear *Opuntia sp*. The larvae tunnel through the plants and destroy it. In India it is controlled by cochineal insects *Dactylopius indicus* and *D. tomentosus.*


a. *Lantana camara* is controlled by larvae of *Crocidosema lantana*, a moth bores into the flower, stems, eat flowers and fruits.
b. *Cuscuta spp*. is controlled by *Melanagromyza cuscutae.*
c. *Cyperus rotundus* - *Bactra verutana* a moth borer
d. *Ludiwigia parviflora* is completely denuded by *Altica cynanea* (steel blue beetle).
e. Herbivorous fish Tilapia controls algae. Common carp, a non-herbivorous fish controls submersed aquatic weeds. It is apparently due to uprooting of plants while in search of food. Snails prefer submersed weeds.

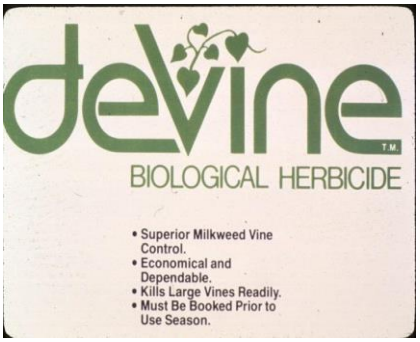
Bio-Herbicides/ Mycoherbicides

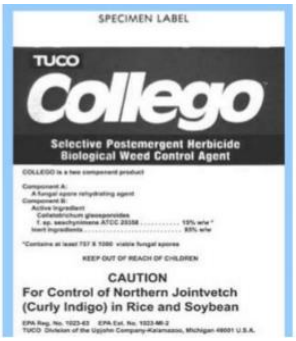
It is defined as the use of plant pathogens which are expected to kill the targeted weeds. These are native pathogen, cultured artificially and sprayed just like post-emergence herbicides each season on target weed, particularly in crop areas. Fungal pathogens of weed have been used to a larger extent than bacterial, viral or nematode pathogens, because, bacteria and virus are unable to actively penetrate the host and require natural opening or vectors to initiate disease in plants.

Here the specific fungal spores or their fermentation product is sprayed against the target weed. Some registered mycoherbicides in western countries are tabulated below.

No Product Content Target weed

1. Devine - A liquid suspension of fungal spores of *Phytophthora palmivora* causes root rot. It is a strangle vine (*Morrenia odorata*) in citrus.
2. Collego – A wettable powder containing fungal spores of *Colletotrichum gloeosporoides* that causes stem and leaf blight. It targets Joint vetch (*Aeschyomone virginica*) in rice, soybean.
3. Bipolaris - A suspension of fungal spores of *Bipolaris sorghicola*. It targets Jhonson grass (*Sorghum halepense*).
4. Biolophos - A microbial toxin produced as fermentation product of *Steptomyces hygroscopicus.* It targets non-specific, general vegetation.





V. Activity

Republic of the Philippines
Bulacan Agricultural State College
San Ildefonso, Bulacan

Name: _____ Date: _____
Year & Course: _____

General Physiology and Toxicology
Laboratory Exercise No. 3
Weeds Vegetative and Reproductive Stage

1. Introduction

Weeds are plant that is out of place, a plant not sown whose desirable features outweigh its desirable features. Weed control aim to decrease weed infestation below the critical level which yield of crops is not affected. Weed management involves the utilization of all feasible methods of prevention and control in a harmonious combination including the maximization of mortality factors to keep the population below the economic threshold level, but at the same time the cost and harmful side effects are kept to the minimum. The aim of management is to shift the crop-weed balance in favor of the crop using any of the weed control method available. Familiarization on the vegetative and reproductive stage of weeds is necessary in controlling weeds.

2. Objectives

To study the vegetative and reproductive stage of weeds

3. Methodology:
   a. Search for the different examples of weeds.
   b. Enumerate at least 100 common weeds in the Philippines.
   c. Draw and label the parts of weeds both internal and external.
   d. Collect weeds and identify the vegetative and reproductive stage.

VI. Summary

- Weed Population Dynamics refers to the growth and distribution of weeds within an area. It is important in agriculture because farmers rely on its information in deciding what course of action they should adapt to be able to control the weed population in a certain degree that will not be costly and will not negatively affect the crop yield.

- Threshold is a term used to measure certain degrees of weed population density and their potential damage to the crops. They are indicators of what weed management or weed control measures should be done to minimize the damage in the field.

- Weed management is a system technology that encompasses prevention, elimination, suppression, and control of weed population in a given area.

- Weed Management has different kinds of methods. These are the cultural, physical, chemical, and biological method.

- Cultural method are all farming practices that are necessary for crop production and management that can reduce the amount of weeds either directly or indirectly. These include field preparation, maintenance of optimum crop population, crop rotation, intercropping, mulching, and crop management.

- Physical or mechanical method involves laborious method of removing weeds. These are tillage, hoeing, handweeding, sickling and mowing, burning, and flooding.

- Chemical method is the use of herbicide to eliminate weeds that are already established in the field. It is beneficial in a sense that it reduces effort, time, and labor to eliminate weeds but it is costly and if not used properly will become harmful to the environment and its inhabitants.

- Biological method is the usage of living organisms or their body parts to attack and kill weeds. It is very environmental friendly for no harmful residues will remain in the soil and it can also promote biodiversity in the field. But it is expensive and also needs professionals to be able to implement and its desired effect is very slow to appear.

VII. References

Books/Manuals:

Bob Hartzler (2000). Weed Population Dynamics. Department of Agronomy: Weed Science. Published by Iowa State University. Retrieved May 20, 2021, from http://extension.agron.iastate.edu/weeds/mgmt/qtr00-1/popdyn.htm

Harold D. Coble, & Mortensen, D. (1992). The Threshold Concept and Its Application to Weed Science. Weed Technology, 6(1), 191-195. Retrieved May 20, 2021, from http://www.jstor.org/stable/3987190

Sally Peltzer (2021). Assessing weed population density. Grains research & development. Retrieved May 20, 2021, from https://www.agric.wa.gov.au/grains-research-development/assessing-weed-population-density

Travlos Ilias, Gazoulis Ioannis, Kanatas Panagiotis, Tsekoura Anastasia, Zannopoulos Stavros, Papastylianou Panayiota (2020). Key Factors Affecting Weed Seeds' Germination, Weed Emergence, and Their Possible Role for the Efficacy of False Seedbed Technique as Weed Management Practice. Frontiers in Agronomy Journal, Vol. 2 p 1. DOI=10.3389/fagro.2020.00001. ISSN=2673-3218. https://www.frontiersin.org/article/10.3389/fagro.2020.00001

Merfield, C. N. (2013). False and Stale Seedbeds: The Most Effective Non-chemical Weed Management Tools for Cropping and Pasture Establishment. Lincoln: The BHU Future Farming Centre, 23.

Internet sources:

https://agritech.tnau.ac.in/agriculture/agri_weedmgt_culturalmethod.html

http://ecoursesonline.iasri.res.in/mod/page/view.php?id=12002#:~:text=Weed%20biology%20is%20the%20study,the%20positive%20effects%2C%20of%20weeds.

https://agritech.tnau.ac.in/agriculture/agri_weedmgt_culturalmethod.html

https://agrimoon.com/wp-content/uploads/Weed-Management.pdf