



Dr. Blosa Science

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The Science Foundation College
Uganda East Africa
Senior one to senior six
+256 778 633 682, 753 802709
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Crop protection

It is a practice of defending crops from weeds, pests and diseases as well as droughts and floods from the time of planting to the harvest.

Weeds and weed control methods

Weeds are plants that compete with crops for nutrients, water, sunlight and space.

Importance of weeds

Positive importance /advantages

- provide humus and nutrients to the plants after decomposition
- Can be used for mulching
- Some are used as vegetables and source of vitamins
- Can act as soil cover to prevent soil erosion and excessive evaporation
- Are used as animal feeds
- Some fix nitrogen to the soil
- Some are used for medicinal purposes
- Take up and store nutrients thereby preventing leaching.
- Weeds, such as *Chrysanthemum cinerariifolium*, provide insecticide pyrethrum.
- Weeds tap nutrients from deeper soil layers and return them to the surface through litter leading to nutrient recycling
- Habitats for wild life

Negative importance/disadvantages

- Compete with plants for water, light, space, and nutrients and therefore reducing crop yields
- Reduce the quality of crops
- Weeds make pasture unpalatable
- Are host for vectors and pests
- Some weeds are poisonous to livestock and man
- Weeding requires money for weeding
- Block irrigation and drainage channels

- Water weeds suffocate fish, impede fishing and water transport
- The presence of weeds limits farm size.

Effects of weeds on crop production

- Compete with plants for nutrients and light leading to low yield
- Parasitic weeds hinder plant growth
- Weeds lower the quality of crops through contamination e.g. black jack seeds
- Weed control is expensive
- Harbor pests and diseases
- May block irrigation channels
- Some weeds produce poisonous substances that reduce plant growth e.g. striga species.

Qualities/characteristic/factors than make weeds successful competitors

- Rapid rate of growth and maturation
- Drought resistant
- Resistant to pest and disease
- Some are parasitic
- Produce large volume of seed to increase their chance of survival
- Vegetative reproduction allows weeds to develop from any part of the plant
- Weeds employ various mechanisms of dispersal using wind, water, animals and self-dispersal mechanisms.
- Produce poisonous substances to crops
- Can obtain nitrogen from carnivorous behavior
- Are protected by structures such thorns and itching hairs that protect them herbivores.
- Some are resistant to herbicides
- Most demand less nutrients
- Some weed have short life cycles

Methods of weed control

(a) Tillage/cultivation to remove weeds with hand hoe or machines

Benefits/Advantages of weed control by tillage

- It is cheap and affordable especially using a hoe on small plot of land
- Improve soil aeration
- Loosen soil particles for water filtration
- Underground structures such as rhizomes and bulbs can be uprooted and killed.
- Does not pollute the environment
- Allow earthing up of crops such as potatoes
- Requires little skill

- Can be used to control both annual and perennial weeds
- Burying of weeds promotes their decomposition to provide nutrients
- Fast when machines are used

Disadvantages of weed control by tillage

- Destroy soil structure
- Slow and laborious
- Increase water loss through evaporation
- Damage roots and root tubers of the crops
- Promote soil aeration
- Bury and encourage germination of weed seed

(b) Mulching

Advantages of mulching

- Protects the soil from erosion
- Retains moisture in the soil and reduces evaporation
- Reduces the growth of weeds
- Improves the fertility and nutrient content of the soil
- Insulates the soil from extreme temperatures

(c) Lethal wilting with high heat; **Heat** is reflected from hard surfaces to cook weeds to death

(d) Burning of weeds

Advantages of burning as a method of control of weeds

- Quick and effective method of destroying weeds and their seeds
- Add nutrients to the soil
- Kill pests and disease causing organisms
- Non-toxic

Disadvantages of burning weeds as a method of weed control

- Risk of fire to unwanted parts of the farm
- Destroy soil structure
- Releases carbon dioxide that leads to global warming
- Promote leaching of the released nutrients.

(e) Controlled grazing/biological control

This is the control of the pest population below the economical threshold using their natural enemies in form of predator, pathogen, parasite etc.

Advantages of biological control of weeds

- Reducing the pest population by using a natural parasite, predator or pathogen of the pest.
- Does not pollute the environment
- Does not affect soil structure
- Enhancing crop yield by managing pests that damage crops, leading to more productive farming.
- Preventing economic damage to agricultural products.
- cheap

Disadvantages of biological control of weeds

- biological control agents are not selective for weed
- biological control agents do not control all weed
- cannot eliminate weeds with dormant seed

Precautions using a biological control

- carefully matching of climate conditions to ensure that they favor the natural enemy of the pest
- the biological control agent should be specific to the crop pests or weed
- control agent should be released when there is reasonable amounts of the target pest or weed
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(f) Use of herbicides

An herbicide is a substance that is toxic to plants, used to destroy unwanted vegetation or weeds

(a) Classification of herbicides

(i) Pre-emergence herbicides

These are applied to control weeds from surface before crop emerge

Advantages

- Crop emerge in a weed free environment
- The crop grows vigorously and covers the ground before weeds recover.
- If rain water leaches, the herbicide to where the crop seeds is, there may be delayed or incomplete germination.

(ii) Post-emergence herbicide

These are applied after the crop seedlings have emerged out of the soil.

(b) Classification according to mode of action

- (i) **Contact herbicide:** these will kill only the part of the weed with which they come into contact e.g. paraquant (Gramaxone). They are mainly used to kill the shoot system of the weeds.

- (ii) Systemic herbicides: these are absorbed and translocated into the plant and kill the weeds by disrupting the physiology of weed. They are also called translocated herbicides

(c) Classification according to selectivity of herbicide

Selectivity of the herbicides refers to the capacity of a herbicide to be able to kill a given species of weeds and not another plant.

- (i) Selective herbicides kill certain weeds in preference to another.
- (ii) Non-selective herbicides kill all weeds to which they are applied.

Examples of herbicides

- (i) Phenoxyalkanoic acids, such as 2,4-D, which are selective herbicides that kill broadleaf weeds but not grasses.
- (ii) Substituted alkanolic acids, such as dicamba, which are also selective herbicides that control broadleaf weeds in crops like corn and soybeans.
- (iii) Chlorinated aliphatic acids, such as dalapon, which are non-selective herbicides that kill grasses and sedges.
- (iv) Substituted triazines, such as atrazine, which are selective herbicides that inhibit photosynthesis in weeds.
- (v) Substituted triazoles, such as amitrole, which are non-selective herbicides that interfere with the synthesis of chlorophyll and other pigments in plants.

Advantages of using herbicides

- Requires less labor
- Herbicides can be applied before the weeds grow unlike other methods of weed control, it is possible to apply herbicides in the pre-plant and pre-emergence stages.
- Herbicides can get rid of deep-rooted weeds
- Herbicides prevent weeds from growing for a long time
- Herbicides can get rid of structurally similar weeds

Disadvantages of herbicides

- Poisonous to human
- Non-selective herbicide cause injury to crops.
- Lead to herbicide resistant weeds
- Expose soil to soil erosion
- Require high skill in measurement
- Pollute the environment

Precautions when using herbicides

- Read the instructions carefully before using the chemicals.
- Wear protective gears such as gloves, rubber boots, nose masks and overalls.
- Wash your hands clean after using the chemicals and before eating

- Keep the chemicals out of reach of children
- Dispose of empty containers safely from the reach of children and animals.
- Spray crops in the direction of wind
- Trousers with turn ups where granules or dust particles may collect should not be worn during herbicide application
- Wash off spills from the body as soon as possible

Farming practices that encourage weed infestation

- Late planting give room for weeds to sprout before planting
- Continuous tillage destroy soil structure and break down weed rhizomes into many pieces to spread
- Poor spacing; large spacing leave room for weeds
- Not planting crops in line making it difficult to control weeds
- Continuous use of same herbicide leading to resistant weeds
- Mono-cropping encourages the sprouting of the same weed

Precautions to take when using herbicides

- Read the label and instructions carefully before mixing the chemicals.
- Wear protective clothes e.g. overall, gloves masks, rubber boots.
- Trousers with turn ups where granules/dust particles can collect should be avoided.
- Avoid drinking, eating and smoking while spraying
- Do not keep chemicals in unlabeled containers i.e. avoid transferring chemicals to beer bottles, containers etc.
- Keep all chemicals in locked places out of children's reach.
- Dispose of empty containers properly and safely.
- Do not blow blocked nozzles with your mouth.
- Clean any part of the body that comes in contact with the chemicals immediately.

Revision Questions

1. Couch grass can be effectively controlled by
 - A. Hand hoeing
 - B. Burning to kill the shoots
 - C. Spraying with translocated herbicides
 - D. Spraying with contact herbicides
2. Translocated herbicides differ from contact herbicides in that they
 - A. Kill only weed that have emerged
 - B. Require proper wetting of leaves
 - C. Kill the shoot system of the perennials
 - D. Require low volume spray
3. Which of the following weeds can be best controlled by a systemic herbicide?
 - A. Brachiaria species
 - B. Chloris gayana
 - C. Commelina species
 - D. Mperata cylidrica
4. Which of the following implements is not used for primary tillage
 - A. Subsoiler
 - B. Disc plough
 - C. Chisel plough
 - D. Ridger
5. How can a noxious weed such as striga best be controlled? By
 - A. Uprooting and burning
 - B. Crop rotation
 - C. Use of contact- non selective herbicide
 - D. Proper spacing
6. Which of the following herbicides would you advise a farmer to apply on a growing maize crop infested with couch grass?
 - A. Selective, translocated, pre-emergence herbicide
 - B. Selective, translocated, post-emergence herbicide
 - C. Contact, post-emergence, non-selective herbicide
 - D. Translocated post-emergence, non-selective.
7. Crop rotation may control weeds because
 - A. It forms a thick canopy on the soil
 - B. Different crop are affected by different weeds
 - C. Different crops require different form of soil preparation
 - D. Weeds cannot rotate
8. Which of the following weeds can best be controlled by a synthetic herbicide?

- A. Lantana
 - B. Wandering Jew
 - C. Couch grass
 - D. Wild finger millet
9. Which of these weeds is very difficult to control
- A. *Biden pilosa*
 - B. *Galinsoga parviflora*
 - C. *Oxalis latifolia*
 - D. *Solanum incanum*
10. A pre-emergence herbicide is one that is applied before emergence of
- A. Flowers in seeds
 - B. A crop
 - C. Weeds
 - D. Flowers in a crop

Answers to objective questions

1. C 2. C 3.D 4.D 5. 6. B 7. B 8.C 9. C 10. B
11. (a) Distinguish between a systemic and non-systemic herbicide
- A systemic herbicide is that which is absorbed and translocated or transported throughout the whole plants to kill it, whereas, a non-systemic herbicide is that which does not to be translocated to the whole plant in order to kill it
- (b) Explain four factors which influence the selection of a herbicide
- (i) Cost/price of herbicide; farmers prefer herbicides that are cheap
 - (ii) Effectiveness farmers prefer a herbicide that is effective against the weeds
 - (iii) Selectiveness of the herbicide; farmers select those herbicide that are selective especially when weeding
 - (iv) The age/stage of growth of weed determines the effectiveness of a herbicide
 - (v) A farmer selects a herbicide based on previous results or familiarity
 - (vi) Expiry date of herbicide; farmers prefer herbicides with long expiry date
 - (vii) Farmer preference and choice
- (c) Mention four ways in which the effectiveness of a herbicide can achieved.
- (i) Use of the right herbicide for the right weed
 - (ii) Applying the herbicides in right quantities and intervals/mixing herbicides according to manufacturers instructions
 - (iii) Ensuring proper wetting of the leaves
 - (iv) Apply the herbicides after the dew has dried to prevent dilution
 - (v) Apply the herbicide at the correct stage of the weed. Especially old weed tend to resist herbicides

- (vi) Avoid spraying in windy weather to prevent drift i.e. the spray to follow the direction of wind

12. (a) What is meant by integrated control of pest management?

This involves the use of a wider range of skilled and practices to maintain a penitential pest population below the economic injury without harming the environment.

(b) State the advantage of integrated control of pest management?

- it reduces environmental pollution
- ensure complete destruction of the pest at all stages of development
- conservation/protection of important insects such as bees, lady bird beetles, true spiders and rove beetles etc. is achieved.
- Pest infestation can be controlled in the a very short time i.e. quick control pest is achieved.
- In build resistance of some pest to a certain control method is eradicated more than one method is used.
- The system is cost effective in the long run.

(c) Suggest factors that should be considered by a farmer when selecting a method of pest control

- Level of infestation by the pest. This help determine whether it is a necessary take measures and determining the method depending on the population in the garden.
- The type of pest, different pest can effectively be controlled using one or combination of several methods.
- The stage of pest growth. This ensures correct measure to take e.g. some pest become resistant to different kind of chemical at adult stage than at larval stage.
- The effect of weather conditions on the control method to be used. It is for instance a waste of time to spray a crop if it rains soon after.
- Also the farmer should consider availability of any method and its effectiveness experience, the labor available, the technology and economic worthiness of the selected method.

13. (a) How can disease spread in a crop?

- Through wind/air currents blow spores from diseases crop plant.
- Through rain splash
- Contact of plant to plant i.e. disease healthy ones
- Infected plant material/seed/cutting
- Pruning knives, pangas etc. carry disease organism
- Sucking pest injected infected saliva in the plant
- Irrigation water carry disease causing organisms.
- Infected mulches carry some pathogens
- Infected crop waste/previous crop residue
- Infected organic manure

- Contaminated animal to plant contact
- (b) Describe the methods that can be used to control crop diseases
- Plant resistant/tolerant cultivators which withstand disease attack.
 - Weeding to remove plants that may be alternate hosts a disease organism.
 - Draining the soil may prevent water borne diseases.
 - Spraying with recommended chemicals to control e.g. fungicides.
 - Spraying with recommended chemicals to control vectors.
 - Seed dressing to destroy spores on the seed
 - Heat treatment may be given to seeds to kill spores on seeds
 - Diseased parts of plants/whole plants/plant should be destroyed
 - Early planting for crops to escape disease build up.
 - Proper spacing of crops
 - Restrict movement /quarantine areas with diseased crops.
 - Pruning to reduce micro-climate that favor growth of micro-organism
 - Disinfect tools to prevent spread of diseases.
14. (a) Describe the various characteristics that have made weeds most successful in their competition with plants.
- (b) Outline the precautions to be taken by the farmers to ensure safe use of herbicides.
15. (a) Outline the adaptations of water hyacinth for its survival
- Has broad leaves to trap sunlight
 - It reproduces both sexually and asexually to increase the chances of multiplication and survival.
 - Has resistant seeds
 - Easily dispersed by wind and running water
 - Has extensive root system to accumulate mineral salts
 - Has broad leaves to promote transpiration
- (b) Suggest ecological dangers of water hyacinth
- Suffocate aquatic animals
 - Block movement of animals and boats
 - Clogging of drainage
 - Reduce water quality
16. Give reasons to explain why farmers' efforts to eradicate weeds have not been successful (i.e. qualities that make weeds successful competitors).