قسم المحاصيل

Methods of Weed Control

Lecture (3)

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Physical and mechanical methods

Mechanical Weed Management

Mechanical weeding

Physical and mechanical methods

These methods are distinguished into:

a) mechanical

b) manual methods.

Physical method of weed control utilizes manual energy, animal power or fuel to run the implements that dug out the weeds. These methods are as old as agriculture. **The hand hoe** first animal drawn implement invented by **Jethro Tullin 1731.**

This methods include under non chemical method of weed control. Implements used vary from simple to multiple tractor drawn implements.

Advantages with physical method

1. These methods are efficient, cheaper, safer, to crop and no harmful effect to crop and user.
2. Oldest, effective and economical method
3. No special skill is required in adopting physical methods.

Disadvantages with physical method

1. More labour is required, and tire some.
2. Its success depends on its timely operations when the weeds still young
3. Usually operations limited by too wet or too dry conditions

- **Mechanical weed controls are being employed ever since man began to grow crops.**
- **This includes such practices as:**

The mechanical methods include

1. Tillage
2. Hoeing
3. Hand weeding
4. Digging
5. Cheeling
6. Sickling
7. Dredging
8. Cutting
9. Mowing
10. Burning
11. Flooding
12. Mulching
13. Soil Solarisation

1- Tillage

Tillage is done for preparing good seedbed , conservation of soil moisture & weed control. Tillage removes weeds from the soil resulting in their death.

Weed control by tillage method is achieved primarily by:

1) **The burial of small annual weeds with soil thrown over them through the action of tillage tools.**
2) **The disruption of the intimate relation between the weed plant and the soil whereby the soil is loosened around the roots, resulting in disruption of water absorption and death by desiccation.**
3) **Weaken plants through injury of root and stem pruning, reducing their competitiveness or regenerative capacity.**

4) Tillage is done with implements drawn by animals or mechanical engines (Tractors, tillers etc., …) rather than by man. Extensive tillage operations which includes ploughing, discing, harrowing and leveling are undertaken to prepare the soil.

5) These operations promote the germination of weeds through soil turn over and exposure to sunlight which can be destroyed effectively later. In the case of perennials, both top and underground growth is injured or destroyed by tillage.

6) **The control of perennial weeds which has deeper root system is a difficult proposition. Deep rooted perennial like thatch grass (*Imperata cylindrica*), nutgrass (*Cyperus rotunds* L. *) , quack grass *(Agropyron repens) etc. ,* which have food reserves in the underground rhizomes and hence require more cultivation for thorough eradication.**

- **The important tillage implements are:**

1. **The plough-mould board plough, disc plough etc.**
2. **The harrow-disc harrow, blade harrow, spike tooth harrow.**
3. **The cultivator-rotary cultivator, shovel cultivator etc.**
4. **The type of implements needed for most effective weed control depends upon the weed species, the type of underground root system, the age of the weed, the degree of weed infestation, the type of soil, the crop grown etc.**

- **Pre plant tillage** helps in burying the existing weeds. Bring the seeds to the soil surface for germination and their subsequent destruction by suitable secondary tillage implements. Incorporation of pre - plant herbicides.
- **Post plant tillage** (row cultivation) helps in mixing of manures and fertilizers & control of weeds, soil and water conservation.

Pre plant tillage

Inter tillage

2- Hoeing

- **Hoeing is a highly effective means of weed control. With the competitive demands for labour and the availability of more economical tools resulting from our advancing technology the hand-hoe is not as available nor as economical to use as in years past. It is still a common practice, however, to supplement other weed control practices with hand pulling and hoeing in certain row crops such as cotton, soybean and vegetables.**

Hand hoeing

- **Hoeing is most effective against weed seedlings and biennial weed species. In case of perennials, it destroys the top growth with little effect on underground plant parts resulting in re-growth. However, it can be more effective on creeping perennials like *Convolvulus arvensis , Mikania micrantho and Hortulaca oleracea* which have shallow root system.**

The cultivation operation is made manually (hoeing) or mechanically with cultivators.

1. **Hand cultivation (hoeing): The hoe is a hand tool used in farming and gardening**

Hoes are used to:

- **Agitate the surface of the soil around plants to remove weeds.**
- **Create narrow furrows (drills) and shallow trenches for planting seeds and bulbs.**

Depth of hoeing depends on :

Type of soil:

heavy soils need cultivation deeper than light (sandy) and saline soils.

Growth habit:

A deeper root crops such as cotton needs deeper hoeing than shallow root ones such as corn.

Age of crop:

At early growth stage plants should be cultivated shallower, but with advancing in age, hoeing should be done deeper.

Kind of weeds:

Perennials need deeper cultivation than annuals.

Mechanical cultivation:

Mechanical cultivation requires mechanical sowing.

Tools of Mechanical cultivation:

▪Cultivators:

Used: for stirring and pulverizing the soil.

▪Sweep plows:

Used: These plows undercut the materials on the surface and maintain 90-95% of the residues at the surface.

▪Rotary Hoe:

Used: used to catch the weeds and dislodge them from the soil.

MECHANICAL WEEDING DEVICE- THE DIAGONAL WEEDER

Some basic principles of mechanical weed control

- **In-row weeding is essential!**
- **Cultivator rows = planter rows (or some nice fraction)**
  - **Exceptions – tine weeders & rotary hoes**
- **Cultivator must be appropriate for the growth stage of the weeds and crop**
- **Create and maintain a size difference between weeds and crop**

More principles

- When weeds are very dense, cultivators take out a smaller fraction of them
- Increase planting density to compensate for stand loss from in-row machines
  - Especially in small grains
- Good soil drainage helps a lot!
- Chop crop residue if you reduce tillage
- Create a dust mulch

A row crop cultivator – 5 shanks

Brillion high residue cultivator

No inter-row weeds

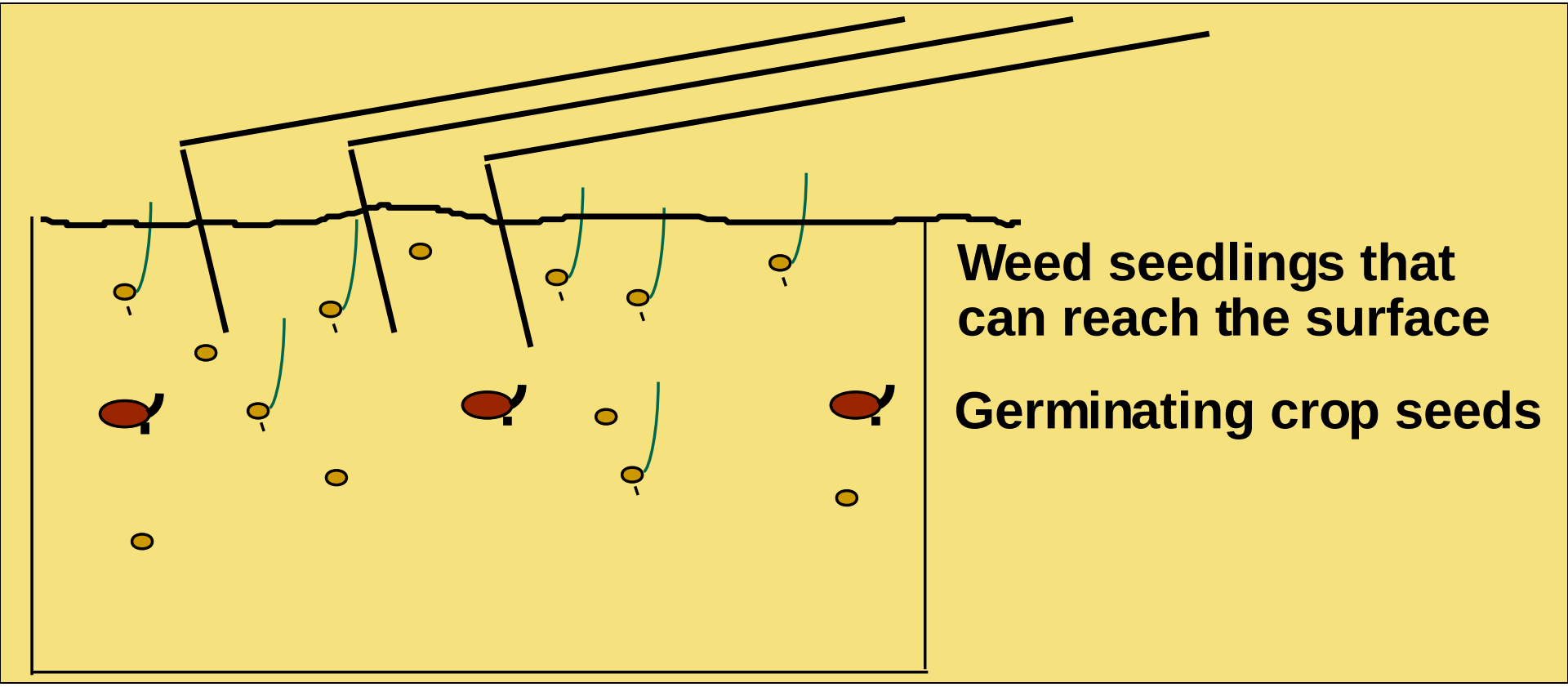
How cultivators kill weeds

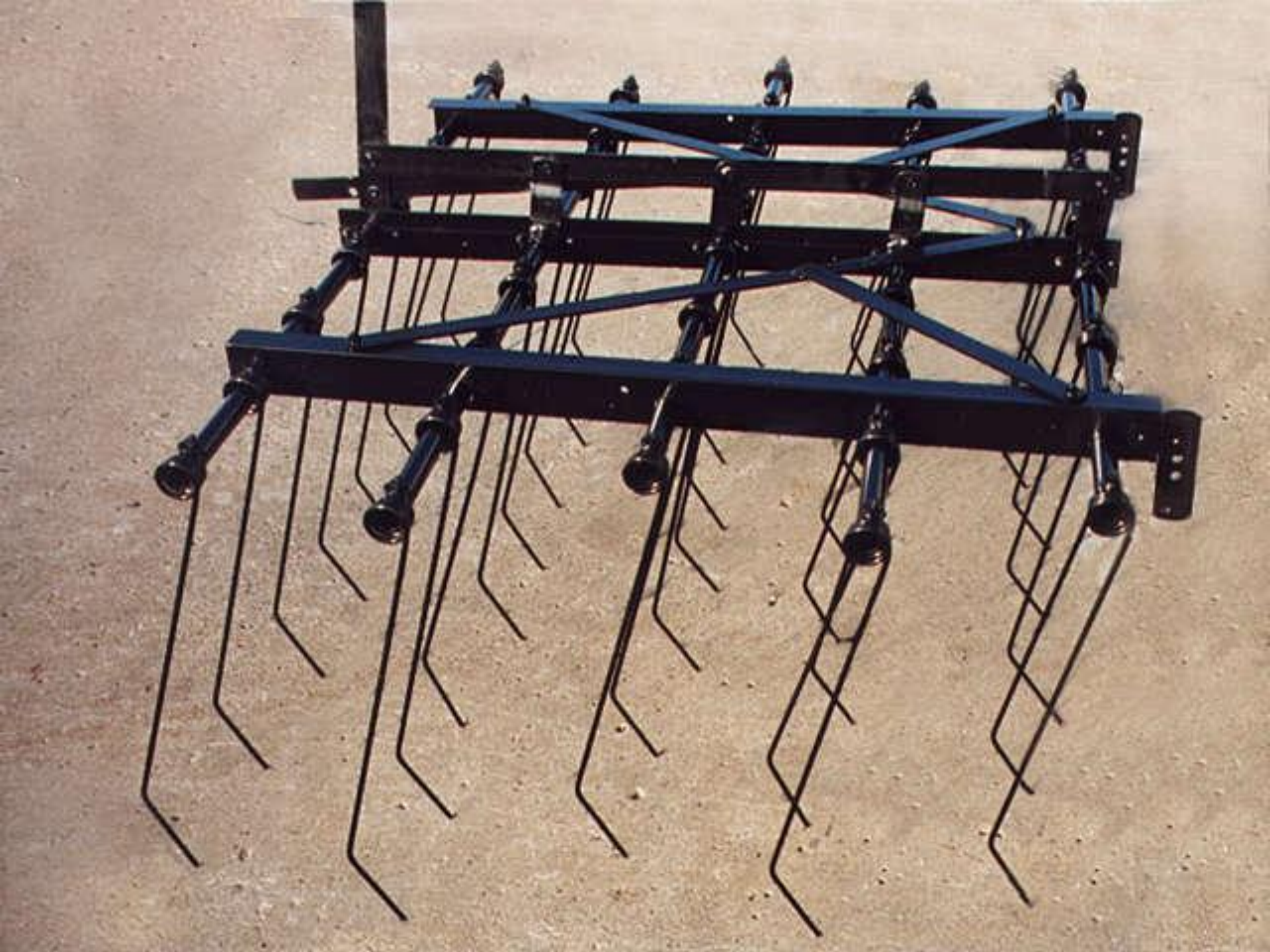
- **Burial**
- **Dismemberment**
  - **Especially, severing root from shoot**
- **Desiccation – want to shake soil free from roots**

Conditions determine what you want to do to the weeds

- Desiccation only works if soil is going to dry.
- If soil is moist, bury the weeds
- Cultivation close to a young crop row -- go for severing roots from shoots

Clean out near-surface weeds without harming the crop





Blind cultivation

When to tine weed

- **Corn – pre-emergence to about 8”**
  - **Avoid acute 60° to 80 ° tines, especially at spike to 2 leaf stage**
- **Soybean, beans – pre-emergence; seedling to 8”**
  - **Avoid crook stage!**
- **Barley, wheat, spelt – pre-emergence; 4 leaf to stem elongation**
- **Oat – pre-emergence; 2 leaf to stem elongation**

Rotary hoe

Minimum tillage rotary hoe

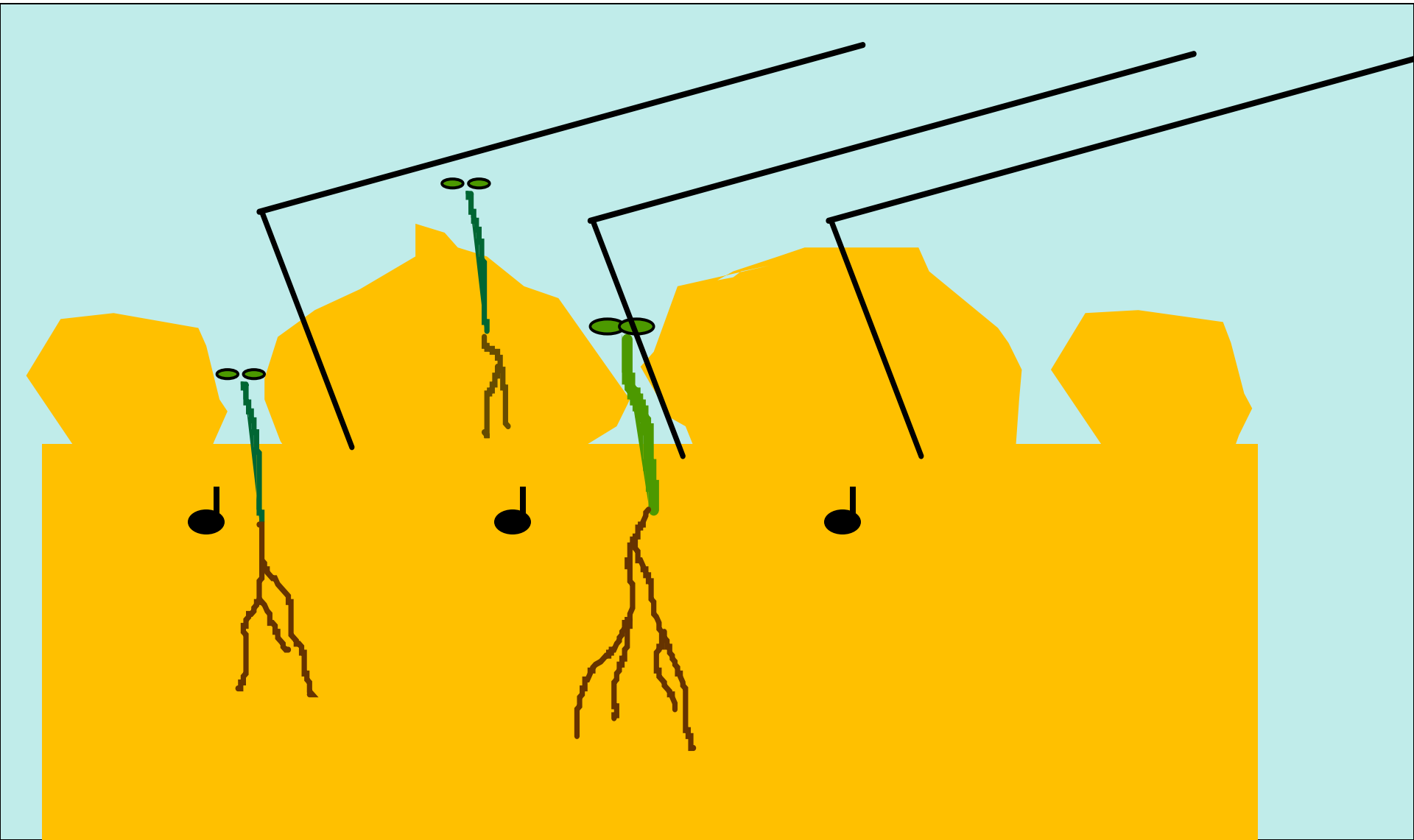
Points about rotary hoeing

- Crop stages – similar to tine weeders
- Weeds must be tiny – small window of opportunity
- Great for breaking crusts
  - Break crusts with rotary hoe, then tine weed
- Gauge wheels
- High speed! – 9 to 12 mph

Tilth matters for cultivation!

- **Loose soil shakes off of roots better**
- **Good tilth allows more uniform coverage of weeds in the crop row**

Clods neutralize in-row tools.



Machines for getting very close to or into the crop row

Basket weeder

Brush hoe

Brush weeder

Buddingh

Einboch

Torsion weeder

forward motion spreads tips

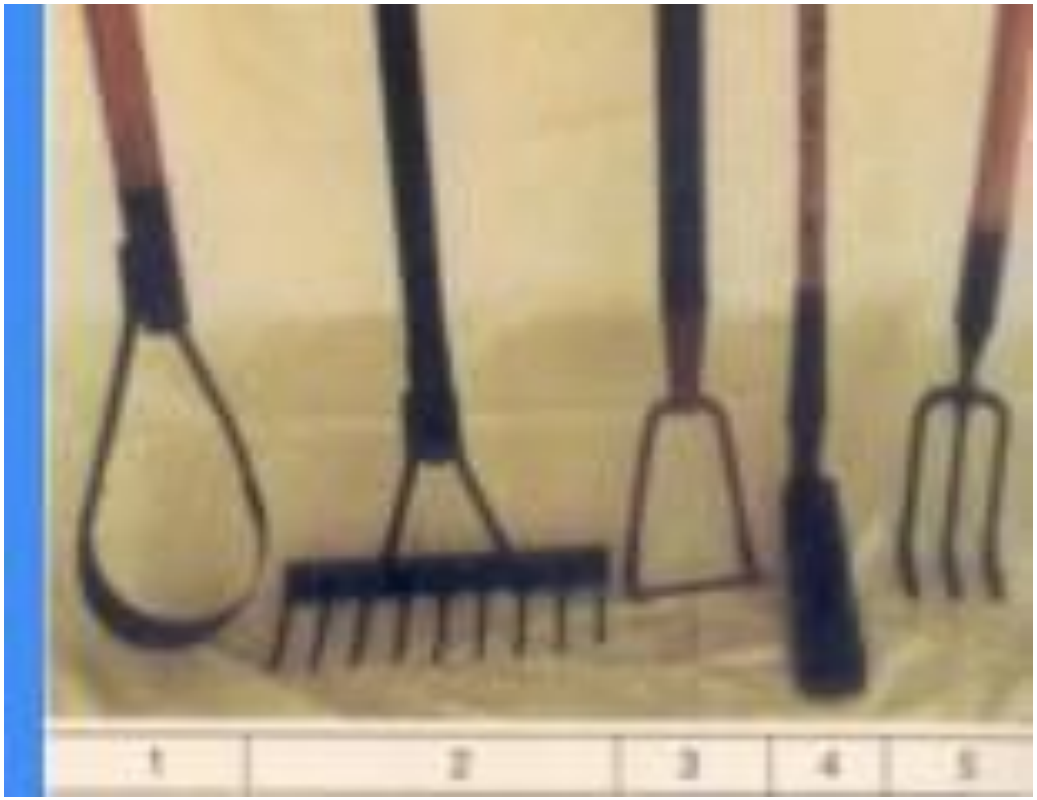
3- Hand weeding

- **Hand weeding is done by physical removal or pulling of weeds or removal by implements like weeders. Long handle weeders like peg type weeder and star type weeder are improved implements which will be useful for efficient control of weeds.**
- **Higher labour is required and is tire some.**

- **Hand weeding in rice with out implements**

HAND WEEDING TOOLS

LONG HANDLED WEEDERS



WHEEL HOE

TWIN WHEEL HOES

ASPEE POWER WEEDER

PROBLEMS OF PHYSICAL METHOD

- **Labour, time consuming, back breaking**
- **Methods**
- **Leading to mechanical injury**
- **Performed only under ideal conditions**

4- Digging

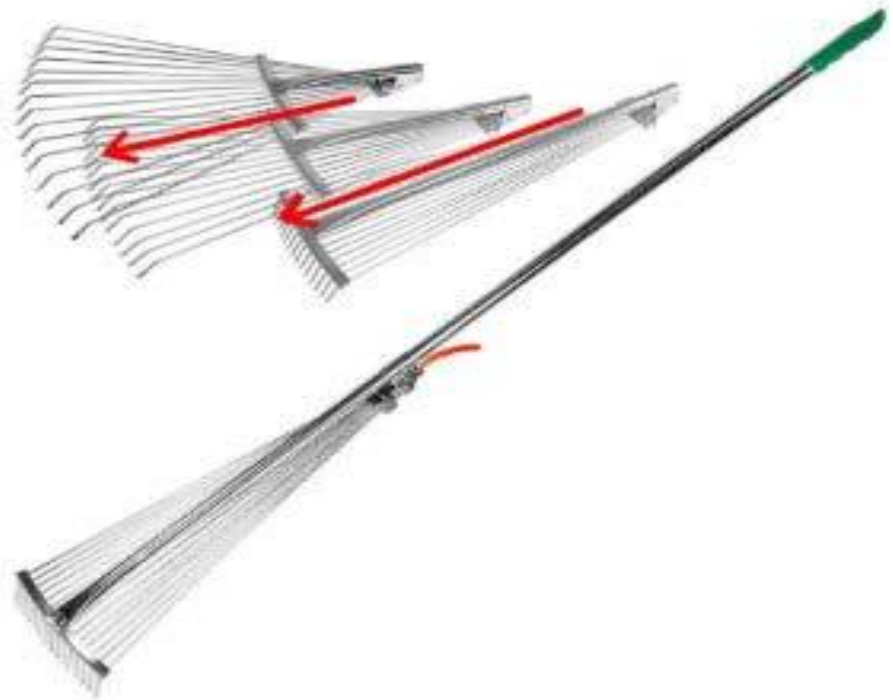
- Digging is useful for **patch or spot control of obnoxious / perennial weeds**. Digging is very useful in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil. Digging is a labour intensive and slow process and hence it is restricted to control perennial weeds like Bermouda grass which cannot be controlled by other methods.

Digging

5- Cheeling

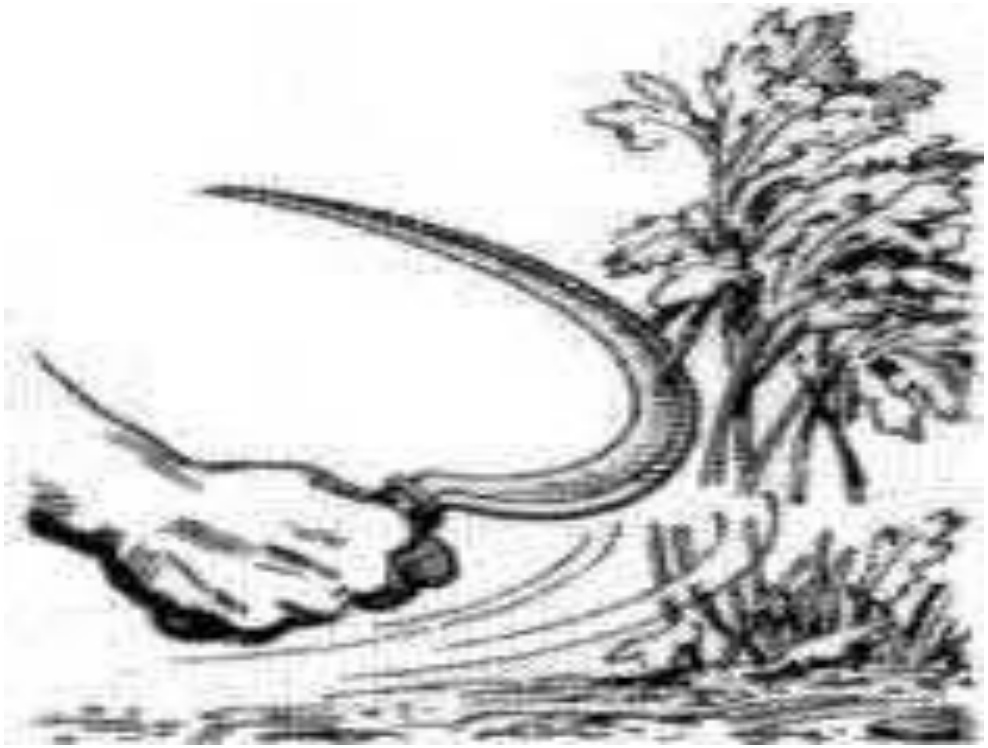
- **Cheeling is done by hand using a cheel hoe similar to a spade, with a long handle. It cuts and scrapes the above ground weed growth at the ground level and rakes it up. It is useful on annuals and biennials. In India it is ure-widely in plantation crops particularly in tea.**

Cheeling implement



6- Sickling

- **Sickling is done to remove the top growth of weeds to prevent seed production and to starve the underground parts. It is useful in sloppy areas where only the tall weed growth is sickled leaving the root system to prevent soil erosion.**



Sickling

7- Dredging

- This is used to control aquatic weeds growing in shallow ditches. Mechanical pulling of aquatic weeds along with their roots & rhizomes from the mud.

Dredging

8- Cutting

- **Cutting is the topping/cutting of the weeds little above ground level. It is done with help of axes and saws. It is mostly practiced against brushes and trees. In aquatics under water weed cutters are used.**

9- Mowing

- **It is cutting of uniform growth from the entire area up to the ground level. It is useful more in non cropped areas than cropped areas. It is primarily used to reduce seed production and to restrict unsightliness or excess weed growth. Mowing is commonly used for these purposes in meadows and pastures, along road sides and in waste places.**

Mowing with lawn mower improves aesthetic value

10- Burning

- **It is cheapest method to eliminate the mature unwanted vegetation in non-cropped areas and range lands. Coagulation of protoplasm occurs with which plant dies. It is used to :**

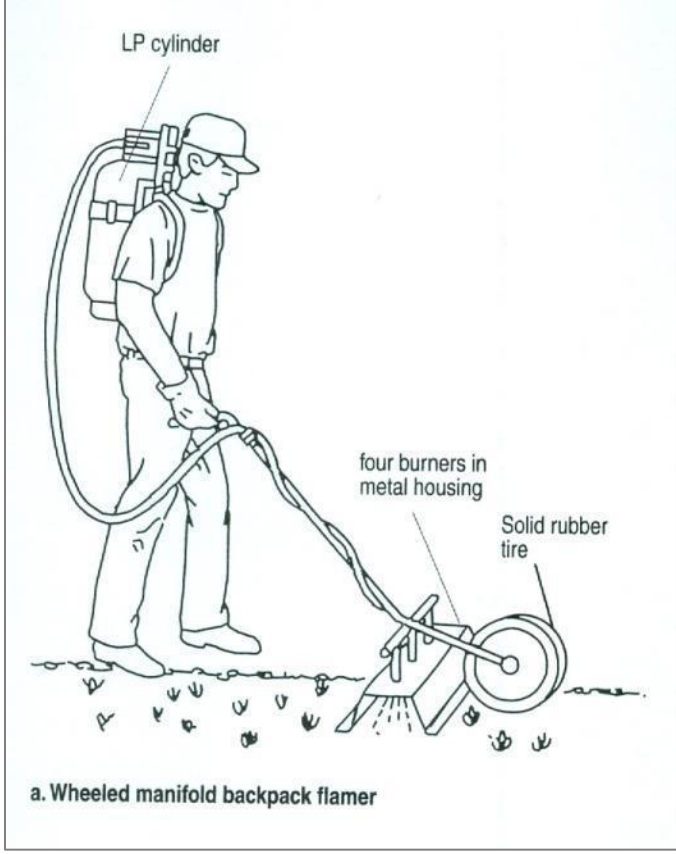
1) **Dispose of accumulated vegetation.**
2) **Destroy dry tops of weeds that have matured**
3) **Kill grass weed growth in situations where cultivation and other common methods are impracticable**
4) **To destroy the buried weed seeds and other propagating plant parts.**

Burning

11- Flaming

- It is the momentary exposure of green weeds to as high as 1000^{o}C from flame throwers to control in row weeds. Eg. Flaming is used in western countries for selective weed control in crops like cotton, sugar cane, soybean and fruit orchards.
- Cotton plants can resist the flame if it is properly controlled and hence flame cultivation is adopted in cotton.
- Dodder is also controlled by flaming in lucern.
- Repeated application of flame to above ground parts destroyed the root system and plant dies.

Flame thrower (Flaming)



a. Wheeled manifold backpack flamer

THERMAL WEED CONTROL Pesticide-free thermic weed control with a weed burner on a potato field in Dithmarschen

In-row flaming

Weeds after flaming

12- Flooding

- **Flooding is an effective means of weed control under certain conditions. Flood kills weeds by depriving the plants of air; thus they die of 'suffocation'' and the inability to carry out photosynthesis. It is an effective means of weed control only when the roots and shoots of the weeds are completely covered or surrounded by the water and when this situation prevails for a sufficiently long period of time.**
- **Its use is limited by soil type and available water and its success is primarily effective in the control of some perennial weeds like *Convolvulus arvensis* and other noxious weeds infesting rice.**

13- Mulching

- **Mulching has smothering effect on weed control by restricting photosynthesis and thus inhibiting top growth.**
- **Polythene Sheets, natural materials like paddy husk, ground nut shells, saw dust etc. are used as mulching material. The thickness should be enough to cut off light (i.e. 10-15 cm).**
- **The efficiency of polythene sheet is more (more polythene) if it is applied in continuous sheet rather than in particle farm. It is effective against annual weeds and perennial weeds like *cynodon dactylon* and *sorghum halopense.* Mulching is used in high value crops like coffee tea plantations by using guatemala grass (*Tripsacum laxum*) and citronella grass (*Cymbopogan spp*)**

- **Prevent seeds** from germinating by blocking light, can smother out some weeds
- **Conserve water**, minimal soil disruption
- Use local resources: straw, fabric, wood, newspaper, plastic
- Be careful of weed seeds in straw or hay

  Avoid hay, unless you know its free of weeds
- Especially good for perennial systems:

  flowers, trees
- Living mulches – ie constant cover of clover on orchard floor

Mulching

Wood chips

Leaves

Shredded paper

Straw

Inter cultivation with blade harrow

Weed management in Organic Potato
IWM: Vegetables and field crops

14- Soil Solarization

It is also called solar **soil heating**. It is effective against weeds which are produced from seeds. It doesn't involve any tillage of the field. Covering the soil with transparent, very thin plastic sheets of 20-25mm **polyethylene (PE) film** during hottest part of summer months for 2-4 weeks. This increases the temperature by 10-12 ^{0}C over the unfilmed control fields.

- **Then weeds seeds are desiccated which are present at top 5 cm soil depth.**

  Eg: *Phaliris minor, Avene* and broad leaved weeds controlled by by Solarization. Where as *Melilotus* sp. Posses hard seed coat is resistant to Solarization treatment.

- **It is an effective method for the control of weeds, soil-borne diseases and insect-pests.**
- **Basic principle**
- **The light received from the sun is in the form of electromagnetic short waves, which easily pass through the transparent polyethylene films and reach the soil. As a result soil is heated up and emits long wave radiation which cannot pass through transparent polythene films and result in trapping of heat**

Solarisation with polyethylene film

INTGRATED WEED MANAGEMEN

- **System approach also called as integrated weed management.**

**Integrated method is a system which brings all feasible methods of weed control harmonizing them into a single and co-ordinated system designed to maintain weeds below those levels at which they cause economic loss".

Principles of Integrated weed management

- 1. IWM place the crop in competitive advantage over the weeds by manipulating the crop habitat by utilizing some biological differences between crops and weeds.
- 2. In IWM measures should be directed to reduce the survival mechanism of weeds in the soil.
- 3. Crop cultural practices should be incorporated to discourage the establishment of the perennial and parasitic weeds. Eg: Crop rotation

- **4. Any individual element of the weed management should be eco friendly and it should not be harmful to the environment.**
- **5. Weed management practices should be flexible to accommodate possible innovations and experiences of progressive farmers.**

Advantages

1. It shifts the crop-weed competition in favour of crop
2. Prevents weed shift towards perennial nature
3. Prevents resistance in weeds to herbicides
4. No danger of herbicide residue in soil or plant
5. No environmental pollution
6. Gives higher net return
7. Suitable for high cropping intensity


THANKS!