1.1 Mechanical Weeders

Weeding is the operation of removing unwanted plants (weeds) growing along with the main crop, which otherwise compete with the crop for nutrients, water, light, and space. Mechanical weeders are hand- or animal-operated implements (without an engine) used to uproot, cut, or bury weeds between crop rows.

1.2 Need for Weeding

1. Weeds compete with crops for nutrients, moisture, light, and space, reducing crop yield significantly if uncontrolled.

2. Weeds harbour insect pests and disease-causing organisms, acting as alternate hosts.

3. Weeds increase the cost and difficulty of harvesting operations.

4. Timely weeding improves soil aeration around the crop root zone as a secondary benefit.

1.3 Types of Mechanical (Manual/Animal-Drawn) Weeders

1. Hand hoe/khurpi – Simple hand tool used for manual weeding in small areas; effective but highly labour-intensive.

2. Wheel hoe (hand-pushed weeder) – A hand-pushed implement with a wheel and weeding blade/tines; the operator pushes it along crop rows, and the blade cuts/uproots weeds just below the soil surface. Suitable for row crops with adequate row spacing.

3. Cono weeder (rotary hand weeder) – Specifically designed for wetland (paddy) fields; has two conical rotors with weeding blades/lugs that rotate as the weeder is pushed between crop rows in standing water, uprooting weeds and incorporating them into the mud (also improving soil aeration).

4. Star weeder / finger weeder – Has star-shaped or finger-like rotating wheels that dislodge weeds as they roll along the row; used mainly for shallow-rooted weeds in the early crop stage.

5. Blade harrow (manual/animal-drawn) – A horizontal blade attached to a frame, drawn manually or by animals between crop rows; cuts weeds just below the soil surface.

6. Animal-drawn weeders – Similar in function to blade harrows or small cultivator-type tools but drawn by draft animals; used for wider row-spaced crops.

1.4 Working Principle (General)

- The weeder's cutting/uprooting element (blade, rotor, or tines) is guided between crop rows.

- As the implement is pushed or drawn forward, the weeding element either cuts weeds below the soil surface, uproots them, or buries them (as in the cono weeder used in flooded paddy fields).

- Multiple passes may be needed at different crop growth stages, since new weed flushes can emerge after each rain/irrigation event.

1.5 Advantages of Mechanical Weeders

1. Low cost and simple construction, affordable for small and marginal farmers.

2. No fuel requirement (for hand/animal-operated types), making them economical to operate.

3. Reduces drudgery compared to hand weeding with a khurpi.

4. The cono weeder additionally aerates the soil in paddy fields, which can benefit root growth.

5. Environmentally friendly (mechanical weed removal reduces dependency on herbicides).

1.6 Limitations

- Lower field capacity (area covered per day) compared to power-operated or self-propelled weeders.

- Requires uniform row spacing and row alignment for effective use (not suitable for broadcast-sown or closely spaced crops).

- Physically demanding for the operator over long working hours.

- Not effective on weeds very close to the plant within the row (intra-row weeds still often need hand weeding).

2.1 Power Weeders

Power weeders are weeding implements/machines driven by an engine (petrol/diesel) or electric motor, rather than manual or animal power. They are used to increase field capacity and reduce labour requirement in weed control, especially for larger holdings and row crops such as vegetables, sugarcane, cotton, and orchards.

2.2 Types of Power Weeders

1. Based on power source/mobility:

- Self-propelled power weeder – Has its own engine and drive wheels; the operator walks behind and guides it (walking-type) between crop rows.

- Tractor-mounted/PTO-driven weeder – Powered by the tractor's PTO (power take-off); the rotary weeding element is driven through a gearbox/shaft from the tractor engine.

- Riding-type power weeder – The operator rides on the machine; used for larger areas requiring higher field capacity.

2. Based on weeding element:

- Rotary tiller/blade type – A rotating shaft fitted with L-shaped or straight blades cuts and mixes weeds into the soil, similar in principle to a small rotavator but designed for inter-row use.

- Brush-cutter type – A rotating nylon cord or metal blade at high speed cuts weeds/grass at the surface; commonly used in orchards, bunds, and non-crop areas rather than between crop rows.

- Reciprocating blade type – A horizontally reciprocating (back-and-forth) cutter bar cuts weeds close to the ground, similar in action to a sickle bar mower.

2.3 Main Components

1. Engine/motor – Provides power (commonly small petrol engines for walking-type weeders, or PTO drive for tractor-mounted types).

2. Transmission system – Chain, belt, or gear drive that transfers power from the engine to the weeding element and, in self-propelled types, to the ground wheels.

3. Weeding element (rotor/blade/cutter bar) – The working component that cuts or uproots weeds, as described above.

4. Handle/control unit – Allows the operator to guide the machine and control depth/direction (in walking-type weeders).

5. Depth control mechanism – Adjusts the working depth of the rotor/blade to avoid damaging crop roots while effectively removing weeds.

6. Ground wheels/support wheels – Support and guide the machine over the field surface (in self-propelled and tractor-mounted types).

2.4 Working Principle

- The engine/motor drives the weeding element (rotor, blade, or cutter bar) at the required speed through the transmission system.

- As the machine is guided (walked behind, ridden, or tractor-drawn) between crop rows, the weeding element cuts, uproots, or mixes weeds into the soil.

- Depth is adjusted to work effectively on weeds while minimizing damage to crop roots growing nearby.

2.5 Advantages of Power Weeders

1. Much higher field capacity compared to manual/animal-drawn weeders, reducing time and labour requirement.

2. Reduces dependency on manual labour, which is increasingly scarce during peak weeding periods.

3. Better and more uniform weed control compared to manual methods.

4. Versatile — can be adapted (with attachments) for use in orchards, plantation crops, and row crops.

5. Reduces cost of cultivation over time despite higher initial investment.

2.6 Limitations

- Higher initial cost compared to manual/animal-drawn weeders.

- Requires fuel/energy input and regular maintenance (unlike manual weeders).

- Requires trained operators for safe and effective use.

- May not be suitable for very narrow row spacing or very small, fragmented land holdings (unless used through custom hiring).

- Risk of crop damage if depth/alignment is not properly controlled.

3.1: Cultivators

A cultivator is an implement used to stir and loosen the soil around growing crop rows, primarily to control weeds, break surface crusting, and improve soil aeration and moisture infiltration, without disturbing the crop root system significantly. While cultivators are also used as secondary tillage implements before sowing (as noted in Unit I), this chapter focuses on their role as intercultural equipment — operated between crop rows during the standing crop's growth period.

3.2 Functions of a Cultivator in Intercultural Operations

1. Uproots and buries weeds growing between crop rows.

2. Breaks soil crust formed after rain/irrigation, improving aeration.

3. Conserves soil moisture by creating a loose surface mulch that reduces evaporation.

4. Improves water infiltration during subsequent irrigation.

5. Can be combined with side-dressing (band placement) of fertilizer in the same pass, in some cultivator designs.

3.3 Main Components of a Cultivator

1. Main frame – Rigid frame carrying the tynes/shanks; mounted on the tractor's three-point linkage or drawn behind (animal-drawn types).

2. Tynes/shanks – Vertical or curved members that carry the shovels/points into the soil; may be rigid or spring-loaded.

3. Shovels/sweeps (points) – Attached at the bottom of the tynes; the actual soil-engaging tool. Common types:

- Reversible shovel – general-purpose, simple flat point.

- Sweep type – wide, wing-shaped blade that cuts weeds just below the surface over a wider strip, causing minimal soil disturbance and crop root damage.

- Duck-foot type – similar to sweep, shaped for shallow weed cutting.

4. Depth control (wheels or linkage adjustment) – Ensures the working depth is shallow enough to avoid damaging crop roots while effectively controlling weeds.

5. Spring-loaded tynes (in spring cultivators) – Allow the tyne to flex backward and spring back when it hits an obstruction (stone, root), protecting the implement from damage — important when working close to crop rows.

3.4 Types of Cultivators (Relevant to Intercultural Use)

1. **Rigid tyne cultivator** – Tynes fixed rigidly to the frame; suitable for lighter, stone-free soils.

2. Spring-loaded (spring tyne) cultivator – Tynes can flex over obstructions; commonly used in intercultural operations for better protection of both implement and crop.

3. Row-crop cultivator (inter-row cultivator) – Specifically designed with adjustable tyne spacing to match crop row spacing, allowing the cultivator to work precisely between rows of a growing crop (e.g., maize, cotton, sugarcane) without damaging plants.

4. Star wheel/rotary hoe attachment cultivators – Combine rotating star wheels or hoe wheels with cultivator shanks for more thorough weed uprooting between rows.

3.5 Working Principle

- The cultivator is set to the crop's row spacing, with tynes positioned to run between the rows.

- As the implement is drawn through the field, the shovels/sweeps cut through the topsoil at a shallow, controlled depth.

- Weeds are uprooted/cut and left on the surface to dry out (or buried, depending on point type and soil moisture).

- Spring-loaded tynes flex over obstructions, protecting both crop and implement.

- Depth is kept shallow enough to avoid pruning/damaging the crop's lateral root system.

3.6 Advantages

1. Effective weed control between rows with relatively low draft/power requirement (shallow operation).

2. Improves soil aeration and moisture conservation through crust breaking and surface mulching.

3. Row-crop cultivators allow precise operation close to crop rows without significant crop damage.

4. Can be combined with fertilizer side-dressing in some designs, saving a separate pass.

3.7 Limitations

- Requires accurate alignment with crop rows; poor alignment can damage the crop.

- Not effective on intra-row weeds growing very close to individual plants within the row.

- Working depth must be carefully controlled to avoid root pruning, especially as the crop matures and roots spread laterally.

- Limited to crops planted in reasonably straight, uniform rows.