

Introduction

Agricultural machinery encompasses all the equipment and techniques used to mechanize agricultural work. It constitutes an essential lever for:

- improving productivity,
- reducing the arduousness of manual labor,
- ensuring better resource management.

In a context of population growth, a shrinking agricultural workforce, and climate variability, the control and adaptation of agricultural machinery are becoming strategic priorities for achieving food security and the sustainability of agricultural systems.

Chapter I. Soil Tillage Equipment

1. Plowing

Ploughing consists of turning over and loosening the soil to a depth generally between 20 and 40 cm, using tools such as a moldboard plough or a disc plough. This operation allows for the incorporation of crop residues, the destruction of weeds, soil aeration, and the preparation of the seedbed.



Fig.1. Plowing with a plowshare

Soil preparation: the plow

Ploughing is the first soil preparation task carried out before sowing. The tractor plough is one of the tillage implements and can be classified as a soil turner because it cuts, lifts, and turns over a layer of soil. The goal is to invert the layers and mix the soil. To achieve the best results, a combination of various factors related to both the terrain and the machine is necessary. The optimal working conditions are when the soil moisture level allows for working with minimal effort and the best possible result. Other factors include the number of working parts, the working depth, and the working width. An important distinction with modern ploughs is between in-furrow and out-of-furrow ploughs:

- ✓ Off-furrow: the tractor is positioned with all four wheels on the flat, untreated part of the soil.
- ✓ In furrow: the tractor is positioned with two wheels on the flat part and two wheels on the furrow created during the previous pass; it is therefore inclined towards the already treated area.

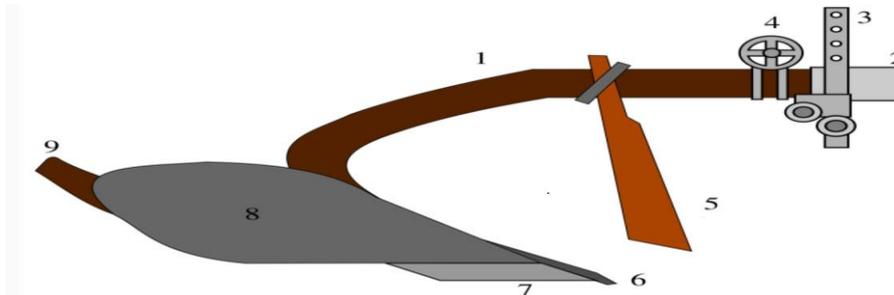


Fig.2. Components of a plowshare

1. Frame (supporting structure)
2. Hitch system (three-point hitch)
3. Height adjustment device (allows adjustment of different working depths)
4. Lateral adjustment device (allows lateral tilting)
5. Coulter (allows vertical cutting of unworked ground; not always present)
6. Point (used for soil penetration)
7. Share (allows horizontal cutting of the clod)
8. Tilt (allows lateral tilting of the clod)
9. Extension (which facilitates tilting)

Types of Ploughs

There are various types of ploughs used depending on the characteristics of the terrain or the soil and climate conditions. Indeed, ploughs can be classified according to the number of sides, the type of work, and the movement. The most common models are:

- Single-furrow plough: mainly used on loose, silty, and sandy soils for light tillage.
- Helical plough: one of the most widespread in Italy, it is used on soils with a high mineral colloid content and a very fine texture. The share cuts the soil, and the helical-shaped side of the plough slides the soil to the side, thus creating the furrow. This allows for gentle handling and turning of the clod to avoid crumbling.
- Rotating plow: it allows the soil to be turned over according to the direction of travel for a greater working speed compared to the traditional fixed single-furrow plow. To change the direction of turning, a 180° rotation is performed at the end of the field



Fig.3. Short moldboard plow



Fig.4. Helical plow



Fig. 5. Ear-turning plow

Disc Plow

1 Operating Principle

A disc plow consists of a set of plow discs of varying sizes, primarily made up of a rotating plate, a plow blade, and a perforated disc. Its operating principle is to cut the soil upside down using a rotating plow disc, thus creating a plowed surface.

2 Areas of Application

The disc plow is mainly used for plowing and cultivating crops in the field. It is suitable for large farms and fallow land, sandy soils, heavily cultivated land, etc.

3 Advantages and Disadvantages

Advantages: The disc plow can plow the soil more deeply and is suitable for working deeper soil layers; it can meet different soil conditions and adapt to the planting needs of various crops.

Disadvantages: The use and operation of a disc plow requires many technical skills, which is difficult for beginners; compared to the disc harrow, the cost of the equipment is higher and the economic capacity of farmers is limited.



Fig. 6. Disc plow

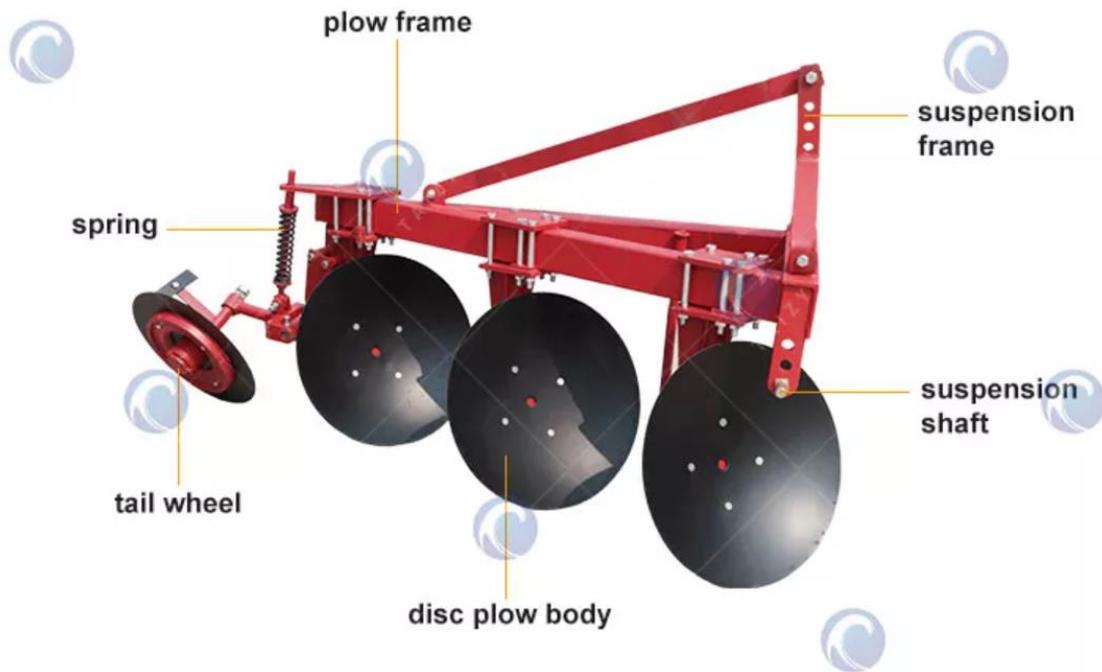


Fig. 7. Different parts of the disc plow

Subsoiling

Subsoiling is a deep tillage operation (40–70 cm) carried out without turning the soil over. Its main objective is to break up the plow pan, improve water infiltration, and promote root development. The tool used is a subsoiler, equipped with robust tines.

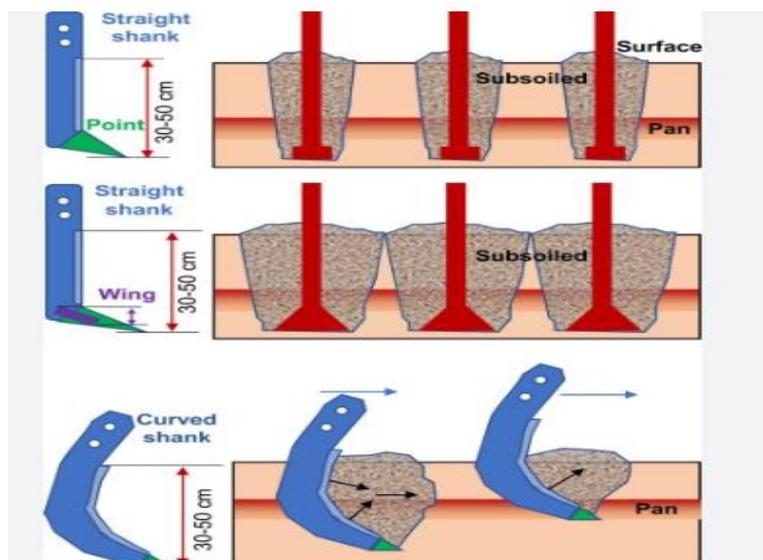


Fig.8. Subsoiling operation



Fig.9. Toothed subsoiler

Decompaction tool

Subsoiling aims to restore soil porosity when it is subjected to excessive compaction, generally caused by the repeated passage of agricultural machinery. This operation is carried out using subsoilers or tools called 'rippers', which loosen the soil without turning over the horizons.



Fig. 10. Decompaction tool (ripper).

Chapter II. Shallow Tillage

Shallow Tillage: Surface Cultivation

Shallow tillage involves working the soil at a shallow depth, generally less than 15 cm, for purposes such as mechanical weed control, firming the soil to promote capillary action, warming the soil for spring sowing, or incorporating crop residues. Specialized tools such as disc harrows, tine cultivators, or wide-tine cultivators are used to perform this task. This practice helps preserve soil structure and reduces fuel consumption compared to deep plowing.

Objectives of Shallow Tillage

- **Mechanical Weeding:**

Eliminate weeds by uprooting them and working 100% of the surface for effective removal.

- **Seedbed Preparation:**

Prepare a quality surface for planting crops. Firming the soil with rollers levels the ground and improves seed-to-soil contact.

- **Soil Warming:**

Help warm the soil to allow for faster establishment of spring crops.

- **Incorporate Crop Residue:**

Incorporate and mix straw and other crop residues into the topsoil.

Advantages

- **Preservation of soil structure:**

This method preserves the natural soil layers and protects against erosion.

- **Stimulation of soil life:**

- Promotes the development of soil microorganisms that improve soil structure, plant growth, and the decomposition of organic matter.

- **Fuel economy:**

Diesel consumption per hectare is relatively low because the work is carried out at a shallow depth.

Commonly used tools

- **Tines equipped with wide shares:**

These tools are recommended for effectively uprooting weeds across the entire surface.

- **Disc harrows:**

Often used for shallow tillage, they mix the soil to a depth of approximately 10 cm.

- **Rollers:**

Used after shallow tillage to level the soil, break up clods, and compact the earth.

The main shallow tillage tools are disc harrows, harrows, cultivators (especially vibro-cultivators and tine harrows), and rotary tillers. These tools are designed to prepare seedbeds, incorporate crop residues, and control weeds without deep tillage.

Disc harrows

- **Function:** To loosen the soil and mix in surface residues.
- **Use:** Shallow tillage, seedbed preparation, or incorporation of catch crops.

- **Opposite Light Disc Harrow**

It offers unbiased traction, high operational efficiency, reasonable power utilization, and a strong ability to penetrate and compact the soil. The soil surface is flat after harrowing, and the soil is loose. The opposite light disc harrow is suitable for heavy soils, fallow land, and weedy areas. Opposite light disc harrow combined with high power.



Fig.11. Opposite Light Disc Harrow

- **Lightweight Mounted Disc Harrow**

This type of harrow is primarily suited for breaking up soil after plowing, preparing the soil before sowing, loosening the soil, mixing soil and fertilizer, and performing stubble cultivation

in light soils. The machine features a well-designed structure, robustness and durability, ease of use, simple maintenance, strong soil breaking capacity, and a smooth soil surface after raking.

The corresponding power output is slightly lower, and the cutting depth of the lightweight mounted disc harrow is shallower than that of the other two types.



Fig. 12. Lightweight Mounted Disc Harrow

Mounted disc harrow for intermediate tillage

The mounted intermediate disc harrow features notched blades, while the rear harrow unit uses disc harrow blades. It is suitable for pre-plowing stubble cultivation on dry farmland, for breaking up the soil after plowing, and for thinning the soil with a harrow instead of a plow. The rake blades in this series are of high quality and have a long service life. The entire machine boasts attractive lines, various colors, and a full range of options, compatible with four-wheel tractors of different power ratings. The flat surface meets the requirements of intensive farming.



Fig.13. Mounted disc harrow for intermediate tillage

A tine cultivator

is an agricultural tillage tool designed to loosen and aerate the soil deeply after harvest, without turning it over like a traditional plow. It is also known as a stubble cultivator and consists of a frame to which several rows of robust tines are attached.

How it works:

- The tines penetrate the soil to crack and lift it, breaking up the compacted layer (plough pan) formed by years of machinery and plowing.
- Unlike disc harrows or plows, it leaves most of the crop residue on the surface, a characteristic of conservation tillage.
- Some models are equipped with rollers or other rear attachments to level the surface and refine the soil.

Objectives and Benefits

Using a tine cultivator offers several agronomic advantages:

- Improved soil structure: By breaking up compacted layers, it promotes better water infiltration and aeration, which is essential for root development.
- Residue management: It facilitates the decomposition of crop residues and their incorporation into the top few centimeters of soil, thus enriching the organic matter.
- Weed control: The cultivator destroys weeds after harvest and encourages seed germination, creating a "false seedbed" that allows for better weed control later on.

- Pest control: It disrupts the life cycle of certain pests, such as slugs, by burying surface residues where they find refuge.
- Seedbed preparation: It prepares the soil for subsequent crops, whether main or cover crops.

Types of Tines

There are different types of tine cultivators, the choice of which depends on soil conditions and agronomic objectives:

- Rigid tines: Often used for more intense and deeper soil loosening.
- Vibrating tines: Better suited for shallower and lighter tillage.
- Spiral or spring tines: Allow for better penetration and resistance to obstacles.



Fig. 14. 7-tine cultivator/harrow

The chisel plow is a cultivator with rigid tines for stubble cultivation and deep tillage, while the harrow is a tool for shallower cultivation. The rotavator (or rotary tiller) mixes the soil deeply with its rotating blades, and the cover crop (disc cultivator) uses discs for versatile work, both shallow and deep, with good residue incorporation. The tine cultivator, on the other hand, is distinguished by its deep tillage without soil inversion, making it similar to the chisel plow, but often heavier and used with powerful tractors.

Chisel Plow

- Function: Deep tillage (up to 30 cm) and stubble cultivation, often to prepare seedbeds.
- Characteristics: Rigid tines, no moving parts.
- Advantages: Multi-level soil fracturing and preservation of surface organic matter through stubble grouping.



Fig.15. Chisel Plow

Harrow

- Function: Shallow tillage, often for secondary tillage or seedbed preparation.
- Characteristics: Tines (long and thin) or discs, often with high work rates.
- Advantages: Breaks up the soil surface, distributes residues, and helps create a high-quality stale seedbed.



Fig.16. Harrow

Rotary Tiller

- Function: Primary and secondary tillage, ideal for intensive residue mixing.
- Characteristics: Rotating blades, a tool that works deeper.
- Advantages: Effective for aerating the soil and burying crop residues.



Fig.17. Rotary Tiller

Cover Crop Disc Harrow

- Function: Versatile, used for medium and deep tillage, as well as for surface mineralization and weed control.
- Characteristics: Composed of interlocking or independent disc tines.
- Advantages: Excellent for mixing and burying crop residues and suitable for all types of soil.



Fig. 18. Cover Crop Disc Harrow

Difference between a tine cultivator and a chisel plow

- Tine cultivator: This is a more general term for a cultivator with tines, while a chisel plow is a type of cultivator with rigid tines, designed to work the soil deeply without turning it over.
- Chisel plow: In comparison, the chisel plow is often heavier than simpler tine cultivators, and it is sometimes equipped with rollers to compact the soil after cultivation.
- Tine cultivator vs. cover crop: The tine cultivator is better suited to clay and loam soils, while the cover crop (disc) is more versatile and efficient at incorporating crop residues and working the soil deeply, even on difficult terrain.

Chapter III. Agricultural Seeding Machinery

Seeding and planting equipment can be classified into four groups: multi-seed drills, precision seed drills, planters, and transplanter.

Row or Multi-Seed Drills

Row drills (or multi-seed drills, or grain drills) are tools that allow for the regular sowing of almost all seeds used in large-scale farming in equidistant rows and at a uniform depth.

- There are semi-mounted drills, trailed drills (which are heavier and can have a larger hopper capacity), and drills integrated into a tillage implement.
- Seed delivery between the distribution units and the coulters can be achieved either by gravity or by airflow through flexible feed pipes. In the latter case, the sown width can be greater than the hopper capacity.

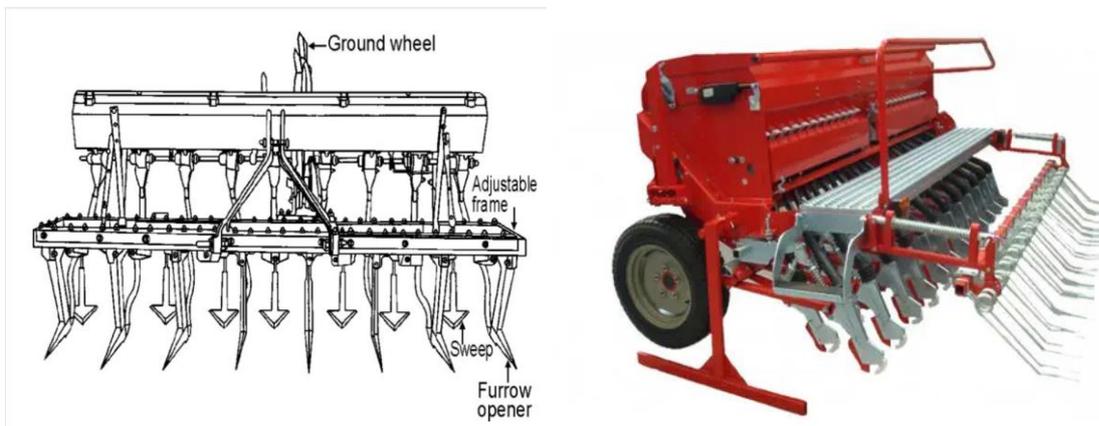


Fig. 19. Multi-Seed Drills

Assembly

- This is the reservoir that connects to the distribution units and contains the seeds to be sown.
- For gravity-fed seed drills, it has a trapezoidal cross-section and a capacity of 100 to 200 liters per meter of seeding width.
- The feed ports of the metering units can be closed off by sliding valves to stop the supply to certain metering units.

- Seed drills with pneumatic transport have a cone-shaped or pyramid-shaped hopper.
1. Distribution units: a series of cylinders
 2. Drop tubes: these connect the distribution units to the seed delivery units.
 3. Seeding and covering components: Seeding components: the coulter, the single disc, and the double disc. The covering components close the furrow behind the coulters or discs.
 4. Accessory equipment: Track eradicators (tines), the marking device (disc), the tramline system (tracer discs allow for the identification of unseeded rows before emergence).
 5. Electronic control equipment: The seeding rate, seeding depth, and tramline can be controlled electronically.

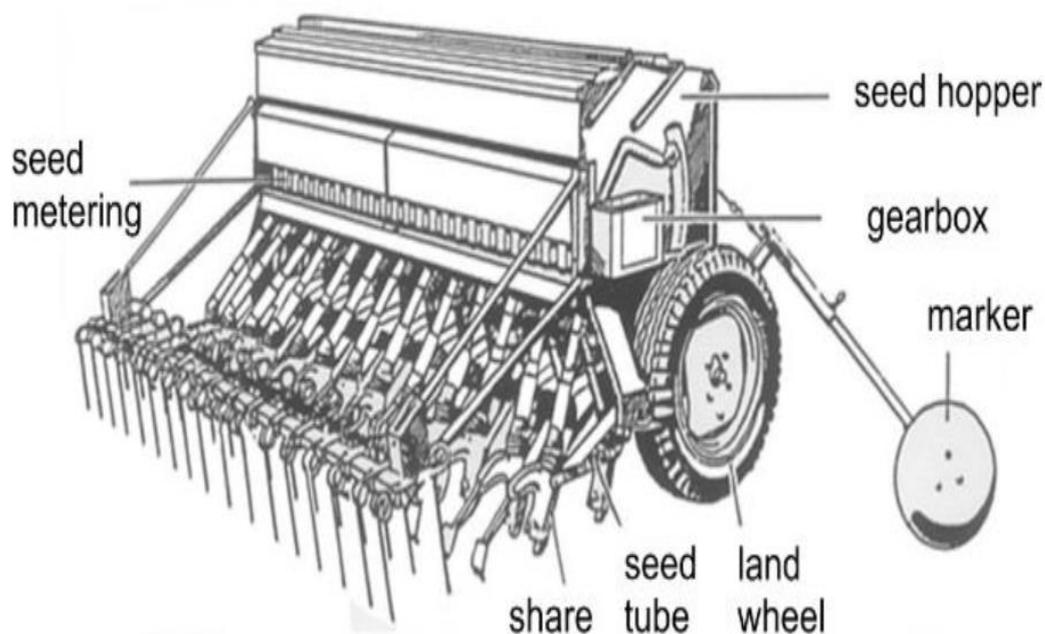


Fig. 20. Different parts of the seed drills

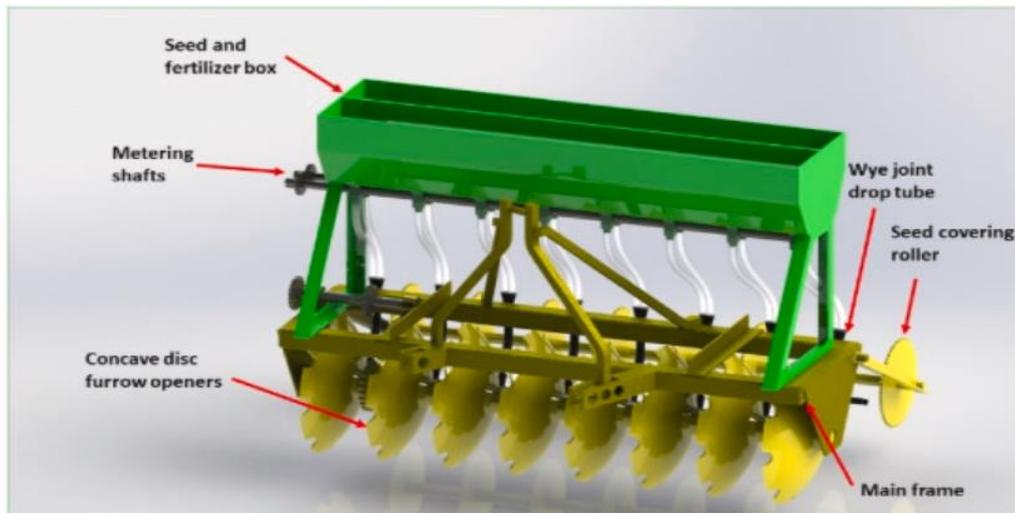


Fig. 21. Another type of row seeder

Precision seed drill

Precision-seed drills or precision drills allow seeds to be placed one by one in a line at a regular spacing previously defined. They are used for crops with row spacing greater than 25 cm and requiring precise seed placement, such as corn, beans, peas, tomatoes, but also market garden and flower crops.

The classification of precision seed drills takes into account the method of seed distribution (mechanical or pneumatic). Pneumatic seed drills are the most widespread due to their good adaptability to all seed sizes.

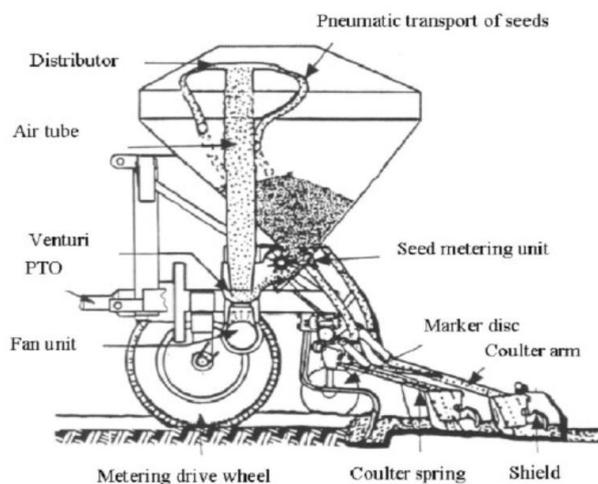
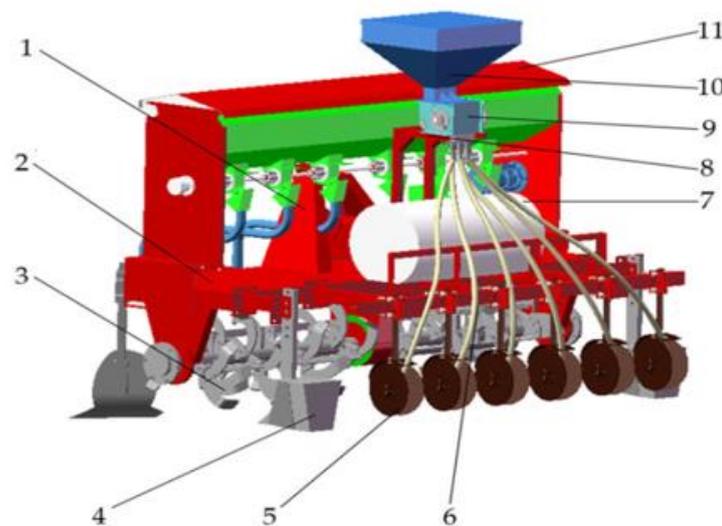


Fig.22. Row pneumatic corn seeder planter machine

- The seeds, stored in the hopper, are deposited at the desired depth in a furrow by the distribution components (cell discs, injectors, etc.) under the effect of gravity or pneumatic assistance.
- Before the furrow is opened by the coulter (or, less frequently, by a disc), a front wheel, possibly equipped with a clod-breaker, levels the seedbed.
- As soon as the seed is deposited by the coulter, rollers located at the rear firm the soil (to ensure good seed-to-soil contact) and close the seedbed, bringing back the soil pushed aside by the clod-breaker.
- To ensure consistent sowing depth, the seeding units are mounted to the frame by a deformable parallelogram linkage that remains parallel to the ground.



(1) three-point hitch, (2) main frame, (3) rotary tillage device, (4) ditching opening device, (5) double disc opener, (6) seed tube, (7) pesticide tank, (8) installation position of accelerometer, (9) centralized seed-metering device, (10) seed box, and (11) fertilizer discharging device.

Fig.23. Structure of row seed drills

Types of Precision Seed Drills

There are two types of precision seed drills: mechanically distributed and pneumatically distributed.

In mechanically distributed seed drills, seed selection is purely mechanical. As they rotate, discs (horizontal, vertical, or angled) equipped with cells the size of the seeds to be sown pick up seeds and deliver them to the coulter where they are released by gravity.

In contrast, in pneumatically distributed seed drills, seed selection is always pneumatically assisted.

Precision seed drill settings

The row spacing, depending on the crop being sown, the arrangement on the frame, and the number of seeding units can be adjusted.

Seeding density: the rotation speed and the number of cells in the distribution units are variable.

Seeding depth: is adjustable by the position of the coulter and the front or rear wheels of the seeding unit.

Tracer settings: $D = (E(N+1)-V)/2$, where D = distance between the marker disc and the axis of the last seeding unit; N = number of seeding units; V = front track width of the tractor (distance between the axes of the front wheels); and E = spacing between seeding units.

Planter

Potato planters are tools used to plant seed potatoes of various sizes at consistent spacing and depths without damaging the sprouts.

They consist of one or more planting units mounted on a semi-mounted (up to 3 rows) or trailed (4 to 6 rows) frame.



Fig.24.Potato planters

Planter Types

Planters can be grouped according to:

Manual feeding is used for early plantings with developed seedlings. Each seedling is placed in a compartment of the distributor. Automatic feeding can be achieved through various systems:

1. Chain or bucket systems.
2. Conveyor aligner systems.
3. Disc and extractor finger systems.

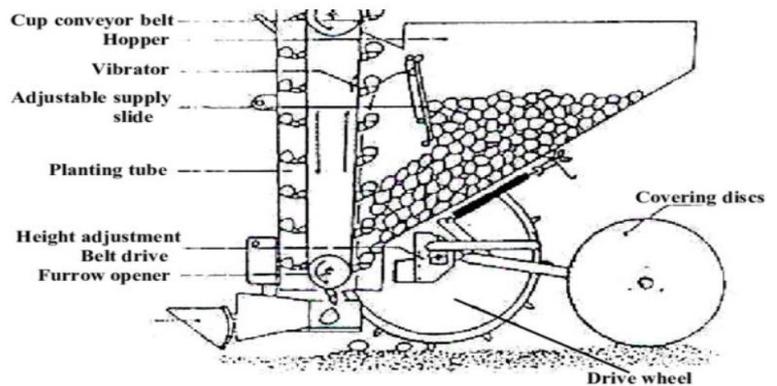


Fig.25. Conventional potato planter. ([Nahed Khairy Ismail](#), 2007)

Components of a Planter

A planter consists of:

- A profiled frame, similar to a tool carrier, which allows the planting units to be moved to adjust the row spacing (between 55 and 90 cm).
- A hopper: this is the container, with a variable capacity depending on the number of units it can serve.
- Regarding the distribution system: there are manual and automatic feeders.
- The manual feeder can be vertical rotary (the tubers are placed one by one in notches or cups, held in place during rotation, and released at ground level) or horizontal (the tubers are placed on a compartmentalized tray rotating inside a drum with a window that opens onto the delivery tube).
- The automatic feeder can consist of a belt or chain with cups (the tuber is taken from the bottom of the hopper), a system with a conveyor-aligner (the tubers are aligned on a belt with adjustable rotation speed. This system is used particularly with pre-germinated seed potatoes), or a system with discs and extractor fingers.
- Planting and covering devices: a ridging plow opens the furrow in which the seed potatoes will be placed.

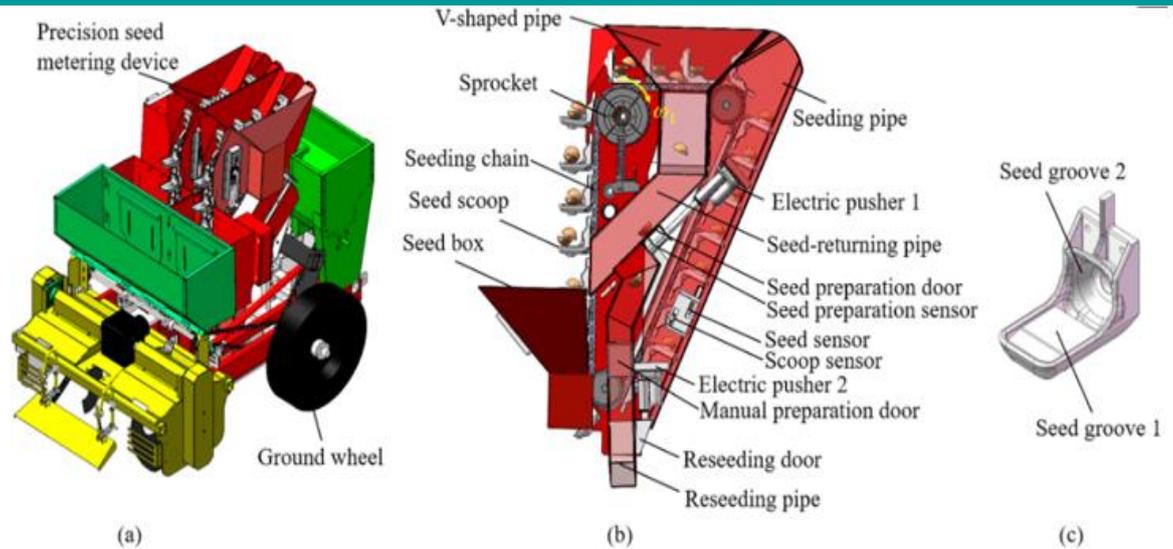


Fig.25. (a) Schematic diagram of precision potato planter; (b) structure of right precision seed metering device; (c) schematic diagram of seed scoop.

Wang, J., Liao, M., Xia, H., Chen, R., Li, J., Li, J., & Yang, J. (2024)

Planter Settings

- ❑ Adjusting plant spacing in the row: The distributor is equipped with a series of gears that allow its rotation speed to be changed, thus adjusting the seed placement rate for a given forward speed.
- ❑ Adjusting row spacing on multi-row machines: The elements can be moved laterally on the frame to vary the distance between rows.
- ❑ Adjusting planting depth and overlap: The furrow openers are attached to the frame by brackets that allow for quick adjustment of their depth. The height, spacing, angle, and pressure of the covering discs can all be adjusted.

Transplanter

Transplanters are manually operated planting aids capable of correctly placing seedlings in the soil while protecting the fragile parts of the young plant (roots, stems, leaves) as much as possible. These machines are generally attached to the tractor's three-point hitch, transported, and resting on their own wheels while working.

They consist of a frame supporting one to six planting units, each corresponding to a seat, allowing someone to manually feed the corresponding distribution mechanism. Depending on the crops being planted and the machines, the rate can range from 1,000 to 2,500 plants per person per hour.

There are different distribution systems:

1. Circular distributors with converging discs
2. Distributors with wheels and clamps
3. Belt distributors



Fig.26. **Transplanter**

Automatic Planters

These are towed or self-propelled machines designed for the mechanical planting of mini-soils contained in trays.

- ✓ The planting elements can be slid apart on the base frame; their drive is provided by a gearbox connected to the machine's front wheels.
- ✓ A positioning system ensures the horizontal and vertical movement of the trays.
- ✓ The soil plugs are ejected three at a time by pushers and transferred by grippers to the planting unit's hoppers.
- ✓ The planting unit consists of an endless chain carrying opening hoppers that receive the soil plugs. A turning disc receives the plugs deposited by the hoppers, then they are gripped by a planting disc and finally released in synchronization with two press wheels that firm the soil.



Fig.27. Automatic planters

Chapter IV. Plant Protection and Fertilization Equipment

Introduction

The most commonly used plant protection and fertilization equipment includes sprayers, manure spreaders, slurry spreaders, and fertilizer applicators. Plant protection products and liquid fertilizers are applied using sprayers, while solid fertilizers are applied using fertilizer applicators. Slurry and manure spreaders are designed for spreading various farm fertilizers. Dust applicators and atomizers are also used for applying plant protection products.

Sprayer

A sprayer is used to apply a specific dose of plant protection products or liquid fertilizers in the form of fine droplets, distributing them evenly over a target (the soil, cultivated plants, weeds, etc.). Sprayers can be trailed, semi-mounted, or mounted (on the front or rear of a tractor), and some are self-propelled.



Fig.27. Sprayers

Construction and Operating Principles

Every sprayer consists of the following basic components:

1. Tank: a storage unit for the product with variable capacity, self-propelled sprayers having the largest capacities.

2. Distribution System: this is a pump whose role is to: (i) draw a given quantity of liquid from the tank and deliver it to the liquid transfer system under a specific pressure, (ii) agitate the liquid in the tank, (iii) fill the sprayer (on smaller machines, as a second pump handles this operation on larger machines).
3. Liquid Transfer System: the boom is the pipe supporting the nozzles and is fixed to a frame or boom support (itself attached to a frame) which allows the boom to be articulated and adjusted in height.
4. Liquid-droplet division system: calibrated nozzles and orifices distributed along the boom control the spray pattern, its distribution on the target, and the size and number of droplets.
5. Droplet transfer system: the droplets must acquire sufficient kinetic energy to reach their target. Projected jet transport: the droplets are transported using the kinetic energy stored during liquid division. Air-driven jet transport: an airflow carries the droplets to their target.
6. Regulation system: automatic systems such as forward speed-proportional flow control or tractor engine speed-proportional flow control are frequently installed to regulate and maintain a constant spray rate.

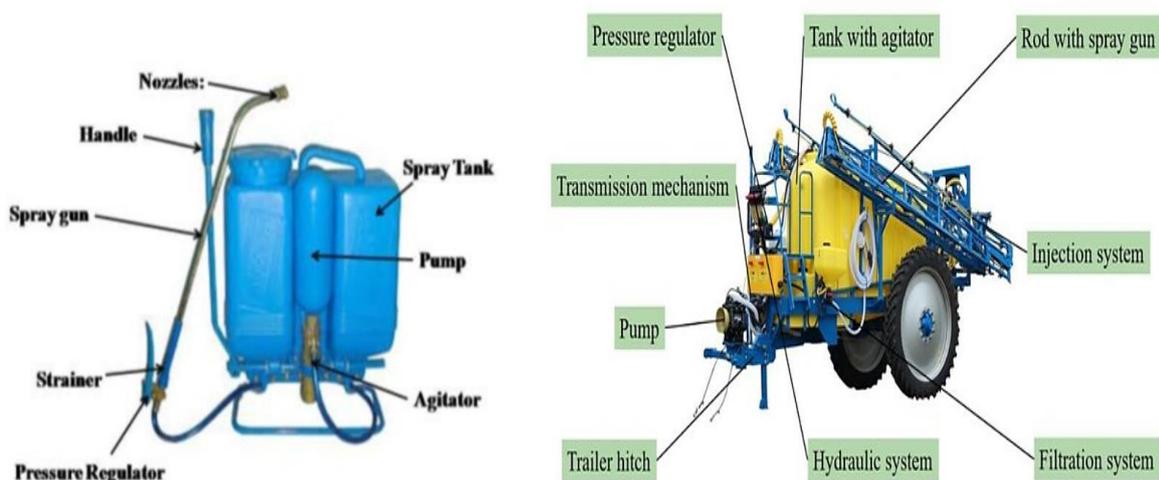


Fig. 29. Different parts of agricultural sprayer

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Different Types of Sprayers

We distinguish between liquid pressure and jet sprayers, centrifugal sprayers, and pneumatic sprayers.

1. Liquid pressure and jet sprayers: the potential energy of the liquid, pressurized by the pump, is used to transform it into droplets (division by liquid pressure) and to transport these droplets to the target (transport by jet) via nozzles.
2. Centrifugal sprayers, used in large-scale farming for low-volume applications (50 to 100 L/ha), utilize centrifugal force and jet transport.
3. Pneumatic sprayers: an airflow divides the spray jet and carries the formed droplets. These devices are notably used in viticulture.

Manure spreader

Manure spreaders, semi-mounted trailers equipped with a spreading device, are, as their name suggests, designed to spread manure on a plot of land. These manure applications are calculated according to the crop's needs and the manure's composition (organic matter and nitrogen content).

Components and Operation

The spreaders consist of a storage tank, a feeding system, and a spreading system.

1. **Tank:** The tanks are semi-mounted, fixed to a one- or two-axle chassis, and can hold between 3 and 15 tons of manure.
2. **Feeding System:** Metal bars fixed to endless chains form a moving floor that advances the manure towards the distribution components.
3. **Spreading Systems:** Depending on the spreading system, we distinguish between:
 - ✓ **Rear-projection spreaders:** These horizontal or vertical rotors, equipped with dispersing elements (tines, claws, serrated discs, helical augers, etc.), are driven by the tractor's power take-off (PTO) and are designed to shred and then spread the manure. The system can be supplemented by a spreader or a spreading table.
 - ✓ **Side-projection spreaders:** These are designed for spreading semi-liquid manure (thick slurry, poultry droppings).

Slurry spreader

Slurry spreaders, also called "slurry tankers," mix the slurry in the pit, draw it off, and spread it.

Some models are even equipped with an injection system that can be attached to the rear of the spreader.

1. Tank: Generally cylindrical, it can store between 3,000 and 20,000 liters of slurry. The hinged or removable rear wall allows for cleaning the interior.
2. Pump: This is a lobe or vane pump that can operate alternately as a compressor (pressurizing the manure during spreading) or as a vacuum pump (creating a vacuum before filling the tank) thanks to a reversing valve system. The pump operates only on air and never comes into contact with the slurry.
3. Spreading and Incorporation System
 - a. Sheet spreaders
 - b. Booms with trailing hoses
4. Incorporation System
 - a. Injectors for arable land resemble chisel-type cultivators. The advantage of this device is the ability to cultivate crops while applying slurry without emitting unpleasant odors.
 - b. Pasture injectors are equipped with discs or blades that open furrows and deposit the manure at a depth of 10 to 15 cm in the soil.

Fertilizer spreader

Fertilizer spreaders allow a specific quantity of solid fertilizer to be spread over a part (localized spreading) or more often over the entire (generalized spreading) of the plot.

Components

The basic components of any fertilizer spreader are:

1. A connection system for the tractor; spreaders can be mounted, semi-mounted, or trailed.
2. A hopper in which the fertilizer particles are stored.

3. A distribution system that ensures the fertilizer is spread on the soil.

- ✓ To maintain a constant rate, the spreading rate must be proportional to the forward speed, driven by one of the spreader's wheels.

4. A transfer system and discharge points are present on some types of spreaders.

Different Types of Fertilizer Spreaders

1. Centrifugal Fertilizer Spreaders

These are the most commonly used machines (for general spreading) due to their low cost, simplicity, and high efficiency. However, they are quite tricky to adjust precisely.

They are generally mounted (hopper capacity: 400 to 2000 liters) or semi-mounted (hopper capacity: up to 10,000 liters).

2. Pneumatic Fertilizer Spreaders

These can be mounted, semi-mounted (hopper capacity: 600 to 800 liters), or trailed (capacity up to 6000 liters).

These machines are more expensive and require more maintenance, but offer high application accuracy even over large areas and regardless of the fertilizer type.

3. Fertilizer Placement Distributors

By adapting placement sleeves to the diffusers, conventional pneumatic distributors can be used for localized fertilization.

They deliver fertilizer to the surface in continuous bands a few centimeters from the plants.

Placement distributors can also be used in combination with a conventional row seeder or a precision seeder.

In this case, one or two hoppers are connected to the seeder and supply each seed row via the seed tubes.



Fig. 30. Different Types of Fertilizer Spreaders

Powder Sprayers

Powder sprayers are sprayers, but their use is rather delicate. Simpler than other machines, they produce very fine powders, making their operation somewhat tricky.



Fig.31. Powder Sprayers

Components

Powdering machines typically consist of:

1. A hopper containing the powder reservoir with a lid.
2. An agitator.
3. An outlet grid.
4. A fan, operated by a lever, an axle (an iron piece that passes through the wheel hub), or a motor, which blows the powder into one or more pipes.

Advantages of Powdering Machines

Powdering machines offer the following advantages:

Reduced quantity of product to be transported; 20 to 30 kg of powder replaces one ton of slurry.

Short working time.

Disadvantages of Powdering Machines

The product's high dispersion and poor adhesion reduce treatment efficiency.

Atomizers

Atomizers mix pressurized air with pressurized liquids. They have the advantage of requiring much less liquid than a sprayer.



Fig.32. Atomizers

