

Chapter 4 : Special vegetable crops

1. Plant the crops

Planting installation is the first step to ensuring healthy and abundant productivity in horticultural agriculture. This includes planning the land, preparing the soil, selecting crops, and planting seeds or seedlings correctly.

A. Observe and analyze the land

Before planting begins, the land should be carefully planned by observing and analyzing factors such as orientation, slope, water availability, traffic, and ease of access. Plantings should then be arranged so that each plant is placed in an appropriate location according to sunlight, water availability, and intended use, with nearby areas designated for frequently harvested crops, more distant areas for annual vegetables, and diverse zones for trees and perennial plants to maintain environmental diversity.

B. Preparing the land

Preparing the land involves cleaning it of weeds, stones, old plant roots, and any debris that may hinder plant growth, then preparing the soil by plowing to a suitable depth according to the crop type and adding organic matter such as natural compost to improve fertility, while improving drainage in heavy soil by adding sand or mulch, and finally organizing rows or beds with appropriate spacing between plants and using raised beds when necessary to facilitate planting, harvesting, and weed control.

C. Crop planning

Crop planning involves selecting the location for each crop so that plants requiring full sunlight are placed in the brightest areas, while those that tolerate partial shade are placed in less sunny spots. It also includes organizing the space so that fast-growing vegetables are planted close together for easier early harvesting, leaving room for tall or sprawling crops like squash and zucchini to avoid shading shorter plants, and rotating crops annually to reduce soil-borne diseases and nutrient depletion, ensuring healthy growth and continuous production.

D. Selection of crops

crops are selected based on the season (summer, autumn, winter), the needs of the family or market, and the growth duration of the plants. Fast-growing crops are planted for harvest within 30–50 days, while long-growing crops are planted early to ensure continuous production. Examples of fast-growing crops include lettuce, radish, and spinach; medium-growing crops

Chapter 4 : Special vegetable crops

include carrots, green onions, and cabbage; and long-growing crops include tomatoes, zucchini, and potatoes.

E. planting

Sowing or planting includes several methods. First, **direct sowing (Semis direct)** involves planting seeds directly into the prepared rows, taking care to plant them at the appropriate depth for each type (e.g., radishes 1 cm, carrots 1–2 cm). Next is **transplanting (Repiquage)**, where young seedlings are moved from seed trays or pots to the field, maintaining proper spacing between plants and rows. Finally, **planting (Plantation)** involves placing ready-grown plants into the soil, covering the roots well, pressing lightly to secure the plant, and watering immediately after planting to settle the soil around the roots.

F. Crop care

Crop care includes regular watering to maintain soil moisture while avoiding overwatering to prevent root rot, using mulching with straw or organic materials to reduce water evaporation and prevent weed growth, applying natural fertilizer or compost according to the crop's needs, regularly monitoring plants to remove weeds and manage pests and diseases early, and finally, harvesting regularly when crops are mature to promote plant growth and increase productivity.

2. Choice of crops

The choice of crops in horticultural production is the process by which farmers determine the type of crops and the allocation of land for their cultivation. This choice depends on the interaction of various environmental, social, economic, and technical factors and is not a random decision, as these factors influence the types of vegetables grown.

A. Natural Factors (Site écologique)

These are the environmental and climatic conditions of the agricultural site, which determine the suitability of the soil and climate for a particular type of crop. Vegetables require different soil types and water needs, making some crops more successful in certain areas. Example from the study: Cabbage and onions are preferred in coastal areas with sandy, light soils. Lettuce grows more in sandy soils as opposed to heavy soils. Amaranth is widespread in urban and suburban areas due to local demand.

B. Structural factors (Structure & Resources)

Chapter 4 : Special vegetable crops

refer to the availability of land, equipment, and technical resources owned by the farmer, and they influence the farmer's ability to produce certain crops, as larger land areas allow the cultivation of crops that require more space, adequate equipment such as irrigation systems makes it possible to grow water-demanding crops like onions and tomatoes, while limited equipment leads farmers to choose crops with lower technical requirements.

C. Economic and social factors

relate to product prices and ease of marketing, as farmers tend to choose crops that obtain good market prices or have high demand; they also include production costs, since high-cost crops may be avoided or cultivated on smaller areas, as well as access to financial resources such as credit, which supports the production of more expensive or high-value crops.

D. Agronomic technical factors (Exigences agronomiques)

Refer to the plants' resource requirements and cultivation practices, including the length of the growing cycle, as fast-growing crops may be preferred to ensure quick income, while long-cycle crops require more planning and advanced techniques, as well as the amount of labor and technical practices needed, such as spraying and frequent irrigation.

E. Institutional factors (Institutionnels)

relate to the external support received by farmers, such as training and technical advisory services from agricultural support centers, which help farmers choose crops that achieve better productivity, while access to information and technical support enhances farmers' ability to adopt new crops or improve the production of existing ones.

F. Personal factors of the farmer (Personnels)

refer to individual characteristics such as age, which may influence the farmer's willingness to take risks by choosing economically profitable but riskier crops; experience, as more experienced farmers tend to select high-demand crops because they are familiar with their production techniques and markets; and gender, since in some regions crop choice differs by gender due to labor expectations or acceptable levels of risk.

3. Choice of installation method

A. Direct sowing

Direct sowing is a method of planting seeds directly into the soil in the spot where the plant will grow, without using pots or transplanting seedlings after germination. This method follows the natural cycle of plants and is easy to apply in all types of gardens, including raised beds.

Chapter 4 : Special vegetable crops

Direct sowing offers several practical advantages. It respects root development and reduces the stress caused by transplanting, resulting in strong and healthy plants. It also reduces labor, as there is no need for transplanting, saving time, effort, and equipment. This method is beginner-friendly due to its higher tolerance compared to traditional transplanting methods, and it is cost-effective since it does not require potting soil or small germination houses.

This method works particularly well for fast-growing vegetables or those that do not tolerate transplanting, such as radishes, carrots, spinach, peas, beans, lettuce, lamb's lettuce, parsley, and coriander, as these species germinate well in place and adapt quickly to local conditions. Some more sensitive crops, such as tomatoes, eggplants, and peppers, usually require indoor or protected sowing, while squash and other cucurbits should only be sown directly after the risk of frost has passed.

The timing of direct sowing depends on soil temperature and each seed's germination needs. General guidelines are: March–April for radishes, spinach, and peas; May for carrots and lettuce; June–July for green beans and sunflowers; and August–September for autumn radishes and lamb's lettuce. Using a soil thermometer at a depth of about 5 cm helps determine the optimal sowing time.

Direct sowing succeeds in open ground if the soil is healthy and well-structured, while avoiding overworking the soil to protect microorganisms. In raised beds, it is important to choose deep, well-drained soil, watch for rapid drying, and use a light mulch to maintain moisture. To ensure successful direct sowing, a light raking of the soil is sufficient to level the surface and prepare it for germination. Sowing techniques vary by plant type: broadcasting for radishes and leafy greens, row sowing for carrots and spinach, and sowing in small holes for beans and squash. Seeds are usually placed at a depth two to three times their diameter, and fine, regular watering helps maintain soil moisture without washing the seeds away.

Common mistakes to avoid include sowing too early or too late relative to temperature, using unsuitable soil that is too compact or dry, choosing varieties that are not suitable for direct sowing, and neglecting to monitor soil moisture after sowing until seedlings emerge. To protect young seedlings from slugs, birds, and insects, lightweight protective covers, transparent cones, or natural barriers such as shells or ash can be used without relying on chemical pesticides.

Chapter 4 : Special vegetable crops

Direct sowing also supports a sustainable garden. Allowing some plants to set seeds promotes natural self-sowing, using green manure plants enriches the soil and supports soil life, and rotating crops helps maintain nutrient balance in the soil.



Fig.1. Direct sowing. <https://mon-potager-en-carre.fr>

B. Transplanting

Transplanting in gardening refers to the process of moving a young plant (seedling) that has already begun to grow from one location (such as a tray, pot, or nursery bed) into its permanent place in the garden or a larger container. It is a common horticultural technique used after seeds have been started in controlled conditions so that the young plants are stronger and better able to handle outdoor conditions when they are planted in the garden soil.

This method typically involves starting seeds in seed trays, pots, or protected environments (like indoors or in a greenhouse) where temperature, light, and moisture can be carefully managed. After the seedlings have developed sufficiently—usually when they have several true leaves and a healthy root system—they are carefully lifted and planted into the garden soil or into larger containers.

Transplanting gives plants a head start on the growing season because they avoid the more vulnerable early stages outdoors, often resulting in stronger, more uniform growth and allowing gardeners to optimize spacing and overall plant development.

⇔ Seeds in plastic trays (barquettes)

Chapter 4 : Special vegetable crops

In this method, several seeds are sown in small plastic trays with an appropriate depth, with holes at the bottom for water drainage. Its advantages are that it is easy and inexpensive, especially if reused trays are used, and it allows starting many seedlings in a small space. Trays can also be moved easily to optimize light or temperature. The downside is that once seedlings emerge, each plant must be transplanted into individual pots or directly into the garden, and improper drainage can make watering tricky.

⇔ **Seeds in multi-cell trays (plaques alvéolées)**

These trays contain small separate cells for one or a few seeds each. The advantage is that roots do not tangle between seedlings, making transplantation easier and producing more uniform and stronger plants. Each cell usually has drainage holes, allowing better water control. The main drawbacks are that these trays are more expensive than simple trays and take up more space during the germination phase.

⇔ **Seeds in compressed soil blocks (presse-mottes)**

In this technique, soil is compressed into small blocks in which the seeds are sown, reducing the need for plastic containers and promoting strong root growth without tangling. This method saves space, reduces plastic use, and generally helps seedlings establish quickly when transplanted outdoors. The disadvantages are that it is more expensive due to the required equipment, requires very good soil to keep the blocks intact, and the blocks can dry out quickly, making moisture management challenging.

C. Planting: The seedlings, whether purchased or obtained from cuttings, are planted directly in the open ground. For example, potatoes and sweet potatoes

4. Semis, repair or planting corrections

A. semis directs

The best method for direct sowing (semis directs) of vegetables starts with good soil preparation. The land should be cleared of weeds and grass (désherber/sarcler) so they do not compete with the seeds for water and nutrients. The soil should then be loosened and aerated (décompacter et aérer), and organic fertilizer or compost added if the soil is poor, as proper soil preparation directly affects seed germination and plant growth. Next, a suitable location should be chosen, preferably a sunny area since most vegetables require 6 to 8 hours of sunlight per day, while also ensuring that the soil has balanced moisture: if a soil ball feels sticky and

Chapter 4 : Special vegetable crops

releases water, it is too wet; if it crumbles immediately when pressed, it is too dry. Moderately moist soil is ideal for successful seed germination and healthy plant development.

⇔ **Sowing in rows**

To carry out row sowing, use a hoe to draw straight, parallel furrows with a depth of about 2 to 3 cm. To encourage good contact between the seeds and the soil, lightly moisten the bottom of the furrows. Then place the seeds evenly along the entire length and cover them with a thin layer of soil. During dry periods, an additional light watering may be necessary.

⇔ **Broadcast sowing**

A very simple method, broadcast sowing consists of spreading the seeds evenly over the entire surface by gently scattering them in small handfuls. Make sure the distribution is as uniform as possible. After sowing, level the soil and lightly rake the surface to cover the seeds. To ensure good seed-to-soil contact, the surface can be lightly compacted using a roller or, for small areas, a simple board.

Tip: To ensure good germination, keep the soil moist until the young seedlings emerge.

⇔ **Sowing in pockets (hill sowing)**

Pocket sowing involves placing several seeds in the same hole. This technique allows several seedlings to emerge in one spot, after which the most vigorous plant is kept. In practice, this method is easy to apply. Dig furrows or holes 1 to 3 cm deep, depending on the size of the seeds. Then place groups of 4 to 5 seeds in each spot. The spacing between pockets depends on the future size of the plant; for example, if the mature plant reaches 10 cm in width, space the pockets 10 cm apart. Cover the seeds with a thin layer of soil and water lightly, unless it is raining. After emergence, keep only the strongest seedling in each pocket.

Warning: Even though it may be tempting to keep all the seedlings, thinning is essential. Too many plants in the same spot will compete with each other and hinder proper growth.

B. Transplanting

Transplanting involves moving seedlings sown in trays or small pots into larger containers or directly into the ground. This process promotes the development of secondary roots, gives plants more space, and makes them less susceptible to diseases. Seedlings should be transplanted once they have at least two “true” leaves, because waiting too long can cause the roots to become tangled, making transplanting more difficult and potentially slowing growth.

Chapter 4 : Special vegetable crops

To transplant, you generally need individual pots, nutrient-rich potting soil (richer than the soil used for sowing), compost, a small fork or planting tool, labels, and a pencil or stick to make holes.

a. Transplanting methods

⇔ **Transplanting into individual pots begins** by watering the seedlings thoroughly about an hour beforehand to make it easier to remove them from the substrate. The root ball should then be gently lifted with a small fork starting from the edges to preserve the roots. The pots are prepared by filling them with a mixture of potting soil and compost, which is lightly packed. A hole is made in the center using a pencil or stick, and the seedling is placed with its roots or root ball at the base of the stem. The soil is then gently pressed around the plant and watered. The pot should be kept in the shade until the seedling has recovered. For tomatoes, it is recommended to plant them deeper so that roots develop along the stem, making the plant stronger.

⇔ **Le repiquage au jardin**, ou en pleine terre, nécessite un sol préalablement travaillé, désherbé, biné et amendé afin qu'il soit bien meuble. Les premières étapes sont les mêmes que pour le repiquage en godets : il faut préparer les plantules avec soin. Ensuite, on creuse des trous dans la terre aux emplacements et espacements recommandés pour chaque espèce, on installe les plantules et on arrose abondamment avec une pluie fine pour ne pas endommager les jeunes racines.

⇔ **Après le repiquage**, il est normal que les plantules se plissent légèrement ; ce phénomène est temporaire et ne doit pas inquiéter. Si la plante possède beaucoup de feuilles, il peut être utile d'en enlever une ou deux afin de réduire la dépense d'énergie aérienne et de faciliter l'adaptation des racines. Il est également recommandé de garder les plantules à l'ombre après le repiquage pour limiter le stress. Une fois que la plante est bien reprise, elle peut être déplacée à son emplacement définitif, au soleil si nécessaire.

C. Plantation

Choosing a sunny and open location is essential for successful vegetable growing, as vegetables need strong and direct sunlight to grow properly. Trees should be avoided inside the garden and are only acceptable around its outer edges. If trees are present around the garden, it is preferable that they are located on the southern side so their shade does not affect vegetable growth. In urban areas, it is recommended to place the garden behind the house, away from the street, to

Chapter 4 : Special vegetable crops

protect it from polluted dust, or to plant a dense hedge about two meters high between the road and the garden.

The land should be as level as possible to ensure that rainwater or irrigation water remains near the plants. It is also important to identify the type of soil, whether it is heavy soil that retains water and nutrients but is difficult to work with and drains slowly, or light soil that is easy to work with but dries out quickly and loses water. Before planting, the soil must be properly prepared by deep digging and by removing stones, weeds, and roots.

Access to water is another key factor, since vegetables require frequent watering, especially in spring and summer. For this reason, the garden should be located near a water source such as a tap or a rainwater tank. If the water source is far away, it is necessary to have irrigation hoses long enough to reach all parts of the garden. Easy access to the garden is also important, as gardening activities such as sowing, planting, and harvesting take place throughout most of the year.

Regarding space and organization, a garden area of about 80 to 100 square meters is recommended as an ideal starting size for a diverse home vegetable garden. Gardening work is more intensive during two main periods: in spring, particularly March and April for sowing and May and June for planting, and in autumn, especially October and November for the final harvest and soil preparation.

There are specific periods for sowing (under cover or directly in the ground), transplanting, and planting for all vegetable garden plants, as shown in this reference table. However, it is important to keep in mind that, depending on the regions, the local climate of each area, and whether the year is milder, harsher, or earlier than usual, these activities must be adapted accordingly. In addition, different plant varieties do not all start at the same time, making it possible to obtain earlier or later harvests.

Table.1. The periods for sowing (under cover or directly in the ground), transplanting, and planting for all vegetable plants. <https://binette-et-jardin.ouest-france.fr>

Chapter 4 : Special vegetable crops

Month	Sowing under cover	Direct sowing	Planting / Transplanting
January	Eggplant	—	—
February	Eggplant, Carrot, Celery, Chicory, Cauliflower, Cucumber & gherkin, Lettuce, Parsley, Chili pepper, Sweet pepper, Radish, Tomato	Broad bean, Pea	Garlic, Asparagus, Shallot
March	Eggplant, Basil, Carrot, Celery, Chicory, Cauliflower, Cabbage, Cucumber & gherkin, Lettuce, Melon, Chili pepper, Summer leek, Autumn & winter leek, Sweet pepper, Radish, Tomato	Broad bean, Sweet corn, Spring turnip, Onion, Parsnip, Parsley, Tuber parsley, Dandelion, Rocket, Pea	Garlic, Artichoke, Asparagus, Cucumber & gherkin, Shallot, Lettuce, Potato, Tomato
April	Basil, Chicory, Zucchini, Spinach, Fennel, Melon, Chili pepper, Sweet pepper, Tomato	Beetroot, Cardoon, Carrot, Celery, Brussels sprouts, Cauliflower, Cabbage, Garden cress, Lettuce, Sweet corn, Spring turnip, Onion, Parsnip, Parsley, Tuber parsley, Dandelion, Autumn & winter leek, Swiss chard, Pea, Pumpkin, Radish, Rocket, Salsify, Scorzonera, New Zealand spinach	Artichoke, Eggplant, Chicory, Cauliflower, Cabbage, Cucumber & gherkin, Lettuce, Oca, Chili pepper, Leek, Sweet pepper, Potato, Tomato, Jerusalem artichoke

Chapter 4 : Special vegetable crops

May	Carrot, Spinach	Beetroot, Cardoon, Carrot, Celery, Chicory, Brussels sprouts, Cauliflower, Coriander, Zucchini, Garden cress, Endive, Fennel, Bean, Lettuce, Sweet corn, Spring turnip, Parsnip, Watermelon, Parsley, Tuber parsley, Dandelion, Autumn & winter leek, Swiss chard, Pumpkin, Radish, Rocket, Salsify, Scorzonera, New Zealand spinach	Eggplant, Basil, Chicory, Brussels sprouts, Cauliflower, Cabbage, Lettuce, Chili pepper, Ground pear (yacon), Summer leek, Autumn & winter leek, Sweet pepper, Tomato
June	—	Beetroot, Carrot, Chicory, Cucumber & gherkin, Coriander, Garden cress, Endive, Bean, Lettuce, Spring turnip, Parsnip, Watermelon, Parsley, Swiss chard, Radish, Salsify, Scorzonera, New Zealand spinach	Basil, Celery, Brussels sprouts, Cauliflower, Zucchini, Fennel, Chili pepper, Sweet pepper, Autumn & winter leek
July	—	Beetroot, Garden cress, Bean, Lettuce, Lamb's lettuce, Autumn turnip, Parsley, Radish	Celery, Autumn & winter leek
August	—	Cabbage, Garden cress, Lamb's lettuce, Autumn turnip, White onion, Parsley, Rocket	Celery
September	—	Spinach, Lamb's lettuce, Autumn turnip, White onion, Rocket	Cabbage

Chapter 4 : Special vegetable crops

October	Endive, Leek	Tuberous chervil, Pea, Black radish	Garlic, White onion
November	—	Tuberous chervil	Garlic
December	—	—	—

5. Maintaining crops

a) Weeding (Désherbage):

Weeding is one of the most important maintenance tasks because it prevents unwanted plants from taking water and nutrients from the soil. It also helps improve crop growth and overall yield quality.

b) Thinning (Éclaircissage):

Thinning involves removing weak or overcrowded plants in rows after the initial growth stage. This ensures enough space between plants for better air circulation and sunlight exposure, which improves productivity and quality.

c) Regular Irrigation (Arrosage / Irrigation):

Irrigation is essential for crop maintenance, especially for vegetables that require constant water throughout their growth cycle. Insufficient water can slow growth or weaken the crop.

d) Fertilization (Fertilisation):

Adding nutrients to the soil—such as nitrogen (N), phosphorus (P), and potassium (K)—is important to improve soil fertility and increase plant productivity. Fertilization is usually done before planting or during growth stages according to crop needs.

e) Protection from Pests and Animals:

Harmful animals, such as birds, rodents, or insects, can cause significant crop losses. Fields may require protection measures, such as fences, nets, or various pest control methods

6. Precise Diagnosis of Crop Problems

a. Weeds (Mauvaises herbes)

Weeds are unwanted plants that grow among crops and compete with vegetables for light, water, and nutrients. They reduce crop vigor and yields if not controlled. Identification involves noting weed species present, density, growth stages, and effects on the crop. Common weed families found in vegetable systems include Poaceae (grasses), Asteraceae, and Brassicaceae

Chapter 4 : Special vegetable crops

b. Diseases (Maladies)

Plant diseases can be caused by fungi, bacteria, viruses, and physiological disorders.

- ◆ **Fungal diseases:** such as downy mildew (mildiou), powdery mildew (oidium), and botrytis affect leaves, stems, and fruits.
- ◆ **Bacterial and viral** diseases also occur and can stunt or deform plants.

Diagnosis involves observing symptoms (spots, wilting, rot) and sometimes laboratory tests to confirm the pathogen.

c. Insects (Insectes)

Insect pests damage crops by feeding on leaves, stems, roots, flowers, or fruits.

- ◆ Chewing insects (caterpillars, beetles) remove plant tissue.
- ◆ Sap-sucking insects (aphids, whiteflies) weaken plants and may transmit viruses.
- ◆ Nematodes and mites also cause damage belowground or on leaves.

Diagnosis is done by observing pest presence, feeding type, and damage patterns.

d. Nutritional Deficiencies (Carences nutritionnelles)

Plants require a balanced supply of nutrients. Deficiencies occur when elements like nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), or iron (Fe) are insufficient in the soil or unavailable to roots.

Symptoms vary by deficiency:

- ◆ Nitrogen deficiency: pale or yellowing older leaves.
- ◆ Iron deficiency: yellowing between leaf veins.
- ◆ Potassium deficiency: margin chlorosis and leaf scorch.

Diagnosis combines visual symptoms with soil or leaf analysis.

e. Bioclimatic Stress (Stress bioclimatique)

Bioclimatic stress refers to adverse environmental conditions that affect plant growth:

- ◆ Water stress (drought or excess water)
- ◆ Temperature extremes (heatwaves or cold spells)
- ◆ Salinity stress in soils

Chapter 4 : Special vegetable crops

These stressors can cause wilting, reduced growth, leaf burn, or crop failure. Diagnosing bioclimatic stress involves monitoring weather patterns, soil moisture, and plant responses

7. Correct Maintenance Planning Based on Diagnosis

Plant diseases negatively affect plant growth, yield quantity, and crop quality. When diseases are detected late, they can spread rapidly across fields and become difficult and costly to control.

Early disease detection is crucial because it:

- ◆ Allows timely intervention before the disease spreads.
- ◆ Reduces crop losses and economic damage.
- ◆ Minimizes excessive and indiscriminate use of chemical pesticides.
- ◆ Supports environmentally sustainable farming practices.

Practical example:

In tomato cultivation, early detection of powdery mildew can prevent the disease from spreading to the entire field, saving most of the crop and reducing treatment costs.

A. Plant Disease Detection Techniques

a. Molecular Techniques

Molecular methods focus on identifying the **genetic material (DNA or RNA)** of plant pathogens such as fungi, bacteria, and viruses. Key techniques include :

- **PCR (Polymerase Chain Reaction):** A highly accurate method used to detect pathogens even before visible symptoms appear.
- **LAMP (Loop-mediated Isothermal Amplification):** A faster and simpler technique that can be used directly in the field.

⇔ **Advantages of moléculaire techniques:**

- Very high sensitivity and accuracy.
- Enable early diagnosis at the latent stage of infection.
- Help in selecting precise and effective control measures.

b. Imaging and Visual Analysis Techniques

These techniques use **digital imaging tools** to monitor plant health.

- RGB cameras, multispectral, and hyperspectral imaging systems are used to capture images of crops.

Chapter 4 : Special vegetable crops

- Image analysis helps detect subtle changes in leaf color, texture, or reflectance that indicate disease stress before symptoms are visible to the human eye.

Example: In cucumber crops, spectral imaging can identify early leaf discoloration caused by fungal or viral diseases, allowing farmers to intervene early.

c. Drones and Remote Sensing Technologies

Unmanned Aerial Vehicles (UAVs), commonly known as drones, equipped with advanced sensors, are used to monitor large agricultural areas. Benefits include:

- Rapid scanning of large fields.
- Identification of disease hotspots.
- Precise localization of infected areas.

Practical application: In maize fields, drones can detect rust disease in specific zones, enabling targeted treatment instead of spraying the entire field.

B. Plant Disease Management Strategies

Disease detection must be followed by effective management to limit damage and prevent recurrence.

a. Early Intervention

Once a disease is detected, immediate action is required:

- Removal of infected plants or plant parts.
- Application of appropriate pesticides when necessary.
- Adjustment of irrigation and fertilization practices to reduce disease-favorable conditions.

Importance: Early intervention prevents disease spread and significantly reduces yield loss.

b. Precision Agriculture

Precision agriculture uses data from sensors, drones, and imaging tools to guide decision-making. Key features:

- Treatments are applied only where needed.
- Reduced pesticide use and lower production costs.
- Improved crop health and yield quality.

This approach ensures efficient resource use while protecting the environment.

c. Integrated Pest Management (IPM)

Chapter 4 : Special vegetable crops

Integrated Pest Management is a holistic and sustainable approach that combines multiple disease control methods. IPM includes:

- Continuous monitoring and field scouting.
- Preventive measures such as crop rotation and proper spacing.
- Biological control using natural enemies.
- Limited and rational use of chemical pesticides as a last resort.

Advantages of IPM:

- Environmentally friendly.
- Reduces pesticide resistance.
- Ensures long-term crop sustainability.

C. Benefits of Early Detection and Effective Disease Management

- **Reduced yield losses** through timely control.
- **Lower production costs** due to targeted interventions.
- **Environmental protection** by minimizing chemical inputs.
- **Improved food security** through stable and healthy crop production.

8. Execution of maintenance works

The execution of maintenance works in vegetable crops includes all operations aimed at keeping the field in good condition, ensuring optimal plant growth, and reducing losses caused by weeds, diseases, and other agronomic constraints.

A. Weeding and Weed Control

Weeding is an essential part of crop maintenance, aimed at removing unwanted plants that compete with crops for water, light, and nutrients. It can be carried out mechanically, using tools such as hoes or through tilling, manually, or by employing careful ecological methods. The main objectives of weeding are to reduce competition from weeds, improve light access for the crops, and prevent the outbreak of pests and diseases that often develop in weed-infested areas.

B. Soil Work and Aeration

Soil work and aeration, such as light tillage or surface soil preparation, help loosen the soil around plants, facilitate water infiltration, and limit soil compaction. These practices strengthen the root system and enhance nutrient availability, contributing to healthier and more vigorous plant growth.

Chapter 4 : Special vegetable crops

C. Moisture Maintenance and Irrigation

Moisture maintenance and proper irrigation are crucial aspects of crop care. Ensuring that the soil has sufficient moisture, particularly during critical growth stages, supports healthy plant development, while avoiding overwatering helps prevent the occurrence of soil-borne diseases.

D. Tool and Equipment Maintenance

Tool and equipment maintenance is essential for efficient crop care. Keeping manual tools clean and sharp, regularly checking agricultural machinery, and inspecting irrigation systems ensure that all maintenance tasks can be performed effectively and safely.

E. Regular Crop Monitoring

Regular crop monitoring is a crucial part of maintenance work, as it allows farmers to detect early signs of plant stress or disease and adjust interventions based on the actual condition of the field. This proactive approach helps ensure healthy crop growth and prevents potential yield losses.