



Topic 5: Technology and usefull tools

Developed By:



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Soil and Garden Preparation

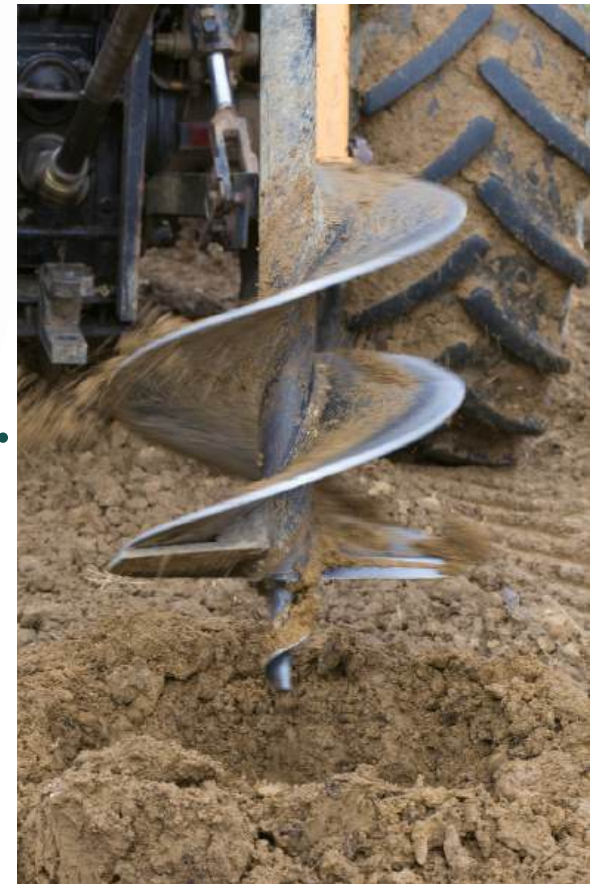
Soil preparation and gardening require a combination of physical tools, sensors, and quality measurements to ensure optimal plant growth and soil health.

Here are some key elements to consider:

- Soil Preparation Tools
- Soil Quality Measurements
- Soil Sensors

Soil Preparation Tools

- **Shovel or spade:** For turning and loosening soil.
- **Rake:** For leveling and smoothing the soil surface.
- **Soil auger or probe:** For taking soil samples at different depths.



Soil Preparation Tools

- **Rototiller or cultivator:** For deeper soil mixing and aeration.
- **Compost or fertilizer spreader:** For evenly distributing organic matter and nutrients.



Soil Quality Measurements

- **Soil texture:** Determine the ratio of sand, silt, and clay using a soil texture test kit.
- **Soil pH:** Measure the acidity or alkalinity of the soil using a pH meter.
- **Soil organic matter:** Assess the amount of decomposed plant and animal matter using a soil test kit.

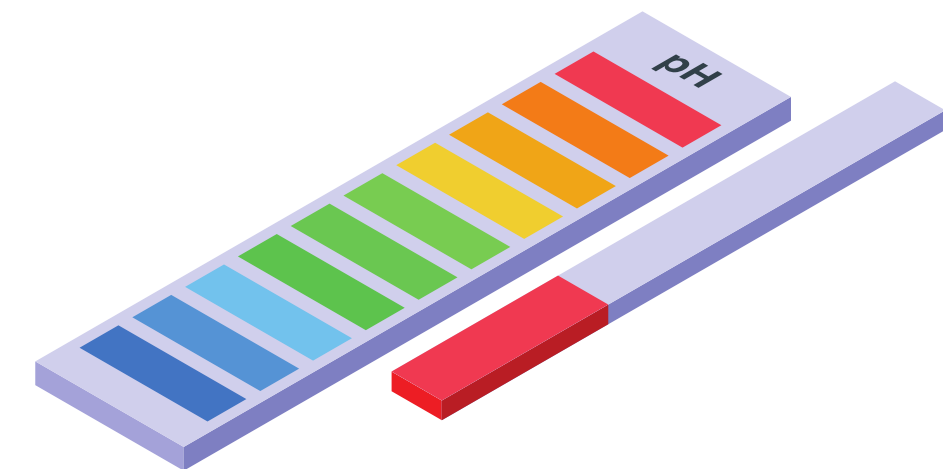
Soil Quality Measurements

- **Soil nutrients:** Test for essential nutrients like nitrogen, phosphorus, and potassium using a soil test kit.
- **Soil compaction:** Measure soil bulk density or use a penetrometer to check for soil compaction.
- **Soil moisture:** Monitor soil moisture levels using sensors like tensiometers, granular matrix sensors, or dielectric sensors.

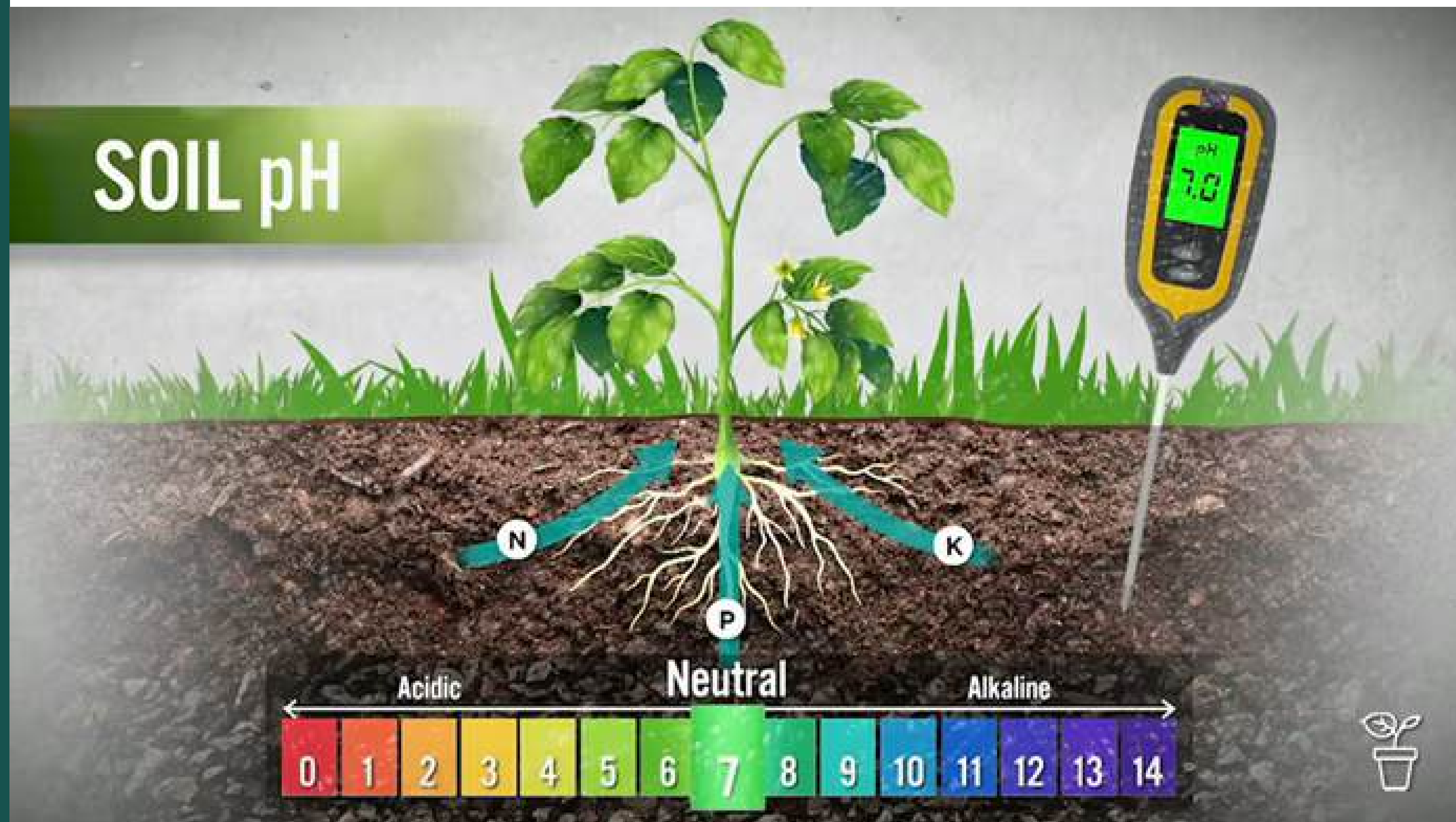
Importance of Soil pH:

Soil pH affects the amount of nutrients and chemicals that are soluble in soil water, and therefore the amount of nutrients available to plants.

Some nutrients are more available under acid conditions while others are more available under alkaline conditions.



Importance of Soil pH:



Importance of Soil pH:

- Most crops have specific pH preferences for optimal growth and nutrient uptake. E.g. potatoes and blueberries prefer acidic soils (pH 4.5-5.5), alfalfa and peas thrive in neutral to slightly alkaline soils (pH 6.0-7.5).
- Soil pH influences nutrient availability by affecting chemical reactions and nutrient solubility. E.g. in acidic soils, aluminum and manganese toxicity may occur, limiting plant growth.
- Soil pH also influences microbial activity and soil structure, further impacting plant growth and soil health.

Types of Soil pH testers:



Types of Soil pH testers:



pH Alkaline	1.0	FOOD Green vegetables, Citrus fruits
	9.0	Mushrooms Soy Milk
	8.5	Tofu Nuts & Rice
	8.0	EMOTIONS Joy Peace Love
Neutral pH	7.5	
	7.0	
Acidic pH	6.5	FOOD Sugar Artificial Sweeteners
	6.0	Alcohol Coffee
	5.5	Meat Dairy products Bread & Cakes
	5.0	
	4.0	EMOTIONS Anger Stress Tiredness Fear
	3.0	



Soil Sensors:

- **Electromagnetic sensors:** Measure soil electrical conductivity to infer soil properties like texture, organic matter, and salinity.
- **Electrochemical sensors:** Detect soil pH, nutrient levels, and other chemical properties.
- **Mechanical sensors:** Assess soil compaction and structure using acoustic or pneumatic methods.
- **Optical sensors:** Measure soil color and reflectance to estimate organic matter and other characteristics.
- **Dielectric sensors:** Determine volumetric water content and soil water potential.



Agro-Tech Sensors in Smart Greenhouses

Significance of Smart Greenhouses

- Smart greenhouses represent a foundation of modern agriculture, offering controlled environment conditions for year-round crop production.

These facilities utilize advanced technologies such as:

- Climate control systems
- LED lighting
- Automated irrigation

By creating a stable and tailored environment, smart greenhouses enable farmers to overcome challenges such as **adverse weather, pests, and diseases.**

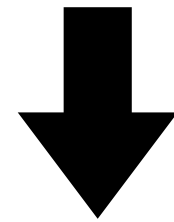


Agro-Tech Sensors in Smart Greenhouses



Role of Agro-Tech Sensors

- **Real-time data** on environmental parameters crucial for crop growth.
- Monitor factors such as **temperature, humidity, light intensity, and soil moisture levels.**



Allowing farmers to fine-tune growing conditions and optimize plant health.



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Environmental Monitoring Parameters

- Soil Quality
- Water Availability
- Light Intensity
- Temperature
- Humidity
- CO2 Levels
- Air Quality
- Wind Speed
- Rainfall Patterns
- Biodiversity Assessment
- Pest and Disease Monitoring
- Nutrient Cycling
- Water Runoff and Erosion
- Energy Consumption
- Waste Management



Tools for Monitoring Environmental Parameters



- **Light Intensity**

Lux Meter: A lux meter measures light intensity, which is essential for plant growth and ecosystem health.



- **Humidity**

Thermo-hygrometer: measures both temperature and humidity, providing a comprehensive view of environmental conditions.



Tools for Monitoring Environmental Parameters



- **CO2 Levels**

CO2 Meter: measures carbon dioxide levels, which are important for plant growth and ecosystem health.



- **Air Quality**

Air Quality Monitor: measures pollutant levels and other air quality parameters, ensuring optimal conditions for human health and ecosystem health.



Tools for Monitoring Environmental Parameters



- **Wind Speed**

Anemometer: measures wind speed and direction, which is important for monitoring environmental conditions and plant growth.



- **Pest and Disease Monitoring**

Pest and Disease Monitoring Kit: includes tools for detecting and monitoring pests and diseases, ensuring optimal conditions for plant growth and ecosystem health.



Tools for Monitoring Environmental Parameters

Pest and Disease Monitoring:

- NOVATRAP for smart pest monitoring

[Novatrap Video](#)



Other Equipment and Tools

- **Soil Testing Kit:** to determine the pH and nutrient levels of soil.
- **Planting Calendar App:** to schedule plantings based on weather and climate conditions.
- **Plant Identification Apps:** to identify plants and provide information on their care and maintenance.



Equipment and Tools

- **Compost Bins:** to manage organic waste and create nutrient-rich soil for plants.
- **Solar-Powered Garden Systems:** such as lights, to provide energy-efficient lighting for gardens.
- **Weather Station:** to provide real-time weather data, helping with irrigation and gardening decisions.



Equipment and Tools

- **Weather Station:** to provide real-time weather data, helping with irrigation and gardening decisions.

[Link to our Weather Station](https://www.wunderground.com/dashboard/pws/INICOS12?cm_ven=localwx_pwsdash)

[https://www.wunderground.com/dashboard/pws/INICOS12?
cm_ven=localwx_pwsdash](https://www.wunderground.com/dashboard/pws/INICOS12?cm_ven=localwx_pwsdash)



Equipment and Tools



- **Rain Barrel:** Rain barrels collect and store rainwater for irrigation and other uses.
- **Drip Irrigation System:** distribute water slowly and efficiently to plants.
- **Smart Irrigation Controllers:** manage watering schedules and optimize water usage.



Automated Fertilization Systems

Automated fertilization systems utilize technology such as:

- Soil sensors
- GPS
- Variable-rate technology to precisely apply fertilizers according to soil nutrient levels and crop requirements.



These systems can adjust application rates in real-time based on data collected from the field:

- Optimizing nutrient use efficiency
- Reducing the risk of over-application or under-application.

Automated Fertilization Systems

Automated fertilization not only improves crop yields but also minimizes environmental pollution by reducing nutrient runoff and leaching.



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Automated Fertilization Systems

Evolution of Fertilization:

- Over the years, fertilization techniques have evolved significantly, transitioning from traditional manual methods to sophisticated automated systems.
- This evolution has been driven by advancements in technology, agricultural science, and the need for greater efficiency and sustainability in food production.



Technologies for Automated Fertilization

Drip Irrigation Systems:

- Deliver water and nutrients directly to the root zone of plants.
- Minimizing water wastage and nutrient runoff.
- Integrating fertilizers into drip systems allows for precise and uniform nutrient application.
- Improving fertilizer efficiency and plant uptake.



Technologies for Automated Fertilization

Fertigation Methods:

- Involves the simultaneous application of water and fertilizers through irrigation systems.
- This method allows for precise control over nutrient delivery, enabling farmers to adjust fertilizer rates and compositions based on crop needs and growth stages.



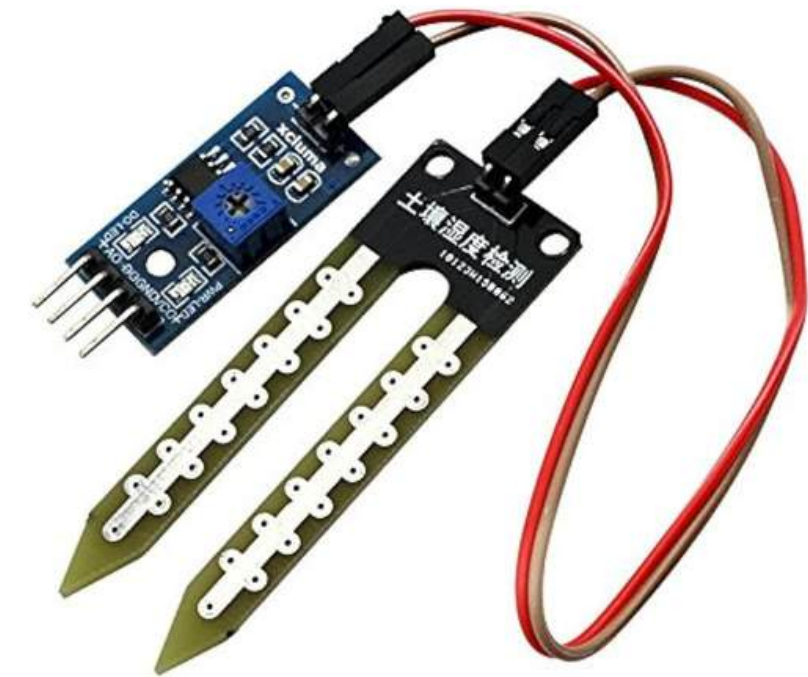
Integration of Sensors and Control Systems

Role of Sensors

- Sensors play a crucial role in automated fertilization systems by providing real-time data on soil conditions, nutrient levels, and crop performance.

Examples of Sensors used to monitor plant health and nutrient status, enabling timely adjustments to fertilization programs:

- Soil moisture sensors
- Nutrient probes
- Leaf sap analyzers



Integration of Sensors and Control Systems

Actuators for Nutrient Delivery

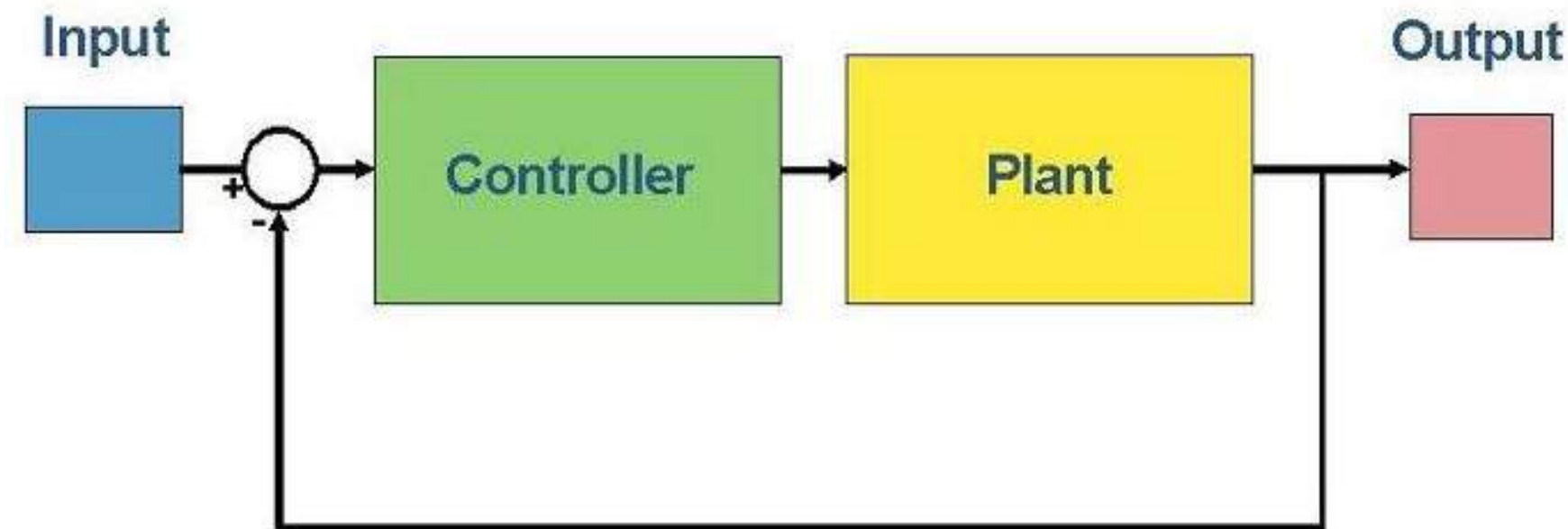
- Actuators control the flow and distribution of fertilizers in automated systems based on sensor inputs.
- Solenoid valves, pumps, and injectors are commonly used actuators for adjusting fertilizer application rates and timings, ensuring accurate nutrient delivery while minimizing waste.



Integration of Sensors and Control Systems

Control Algorithms

- Control algorithms govern the operation of automated fertilization systems, optimizing nutrient delivery based on sensor feedback and predefined setpoints.
- They are employed to regulate fertilizer dosing, maintain desired nutrient concentrations, and adapt to changing environmental conditions:
 - PID controllers
 - Fuzzy logic algorithms
 - Machine learning techniques



Implementation Strategies

System Selection:

- Crop type
- Field size
- Soil characteristics
- Budget constraints



Drip irrigation systems, fertigation equipment, and precision agriculture tools should be chosen based on their suitability for specific farming contexts and objectives.

Implementation Strategies

Fertilization Schedules:

Developing customized fertilization schedules requires careful planning and monitoring of crop nutrient requirements.

- Soil testing
- Plant tissue analysis
- Sensor data are used to determine optimal fertilizer rates, timings, and formulations, ensuring efficient nutrient uptake and crop performance.



Implementation Strategies

Troubleshooting:

Troubleshooting skills are essential for identifying and resolving issues that may arise during the implementation of automated fertilization systems.

Common problems that can impact system performance and crop productivity:

- Clogged emitters
- Sensor malfunctions
- Calibration errors



Selection and Preparation of Seeds Using the Seed Starter Kit with USB Led Lights



How to Use a Seed Starter Kit with USB and LED Lights



Gather Your Supplies

- 1.Seed tray** with individual cells, a **LED light** unit, and a **USB power cable**.
- 2.Potting mix** or **seed starting mix**: to provide the necessary nutrients and drainage for your seedlings.
- 3.Seeds** of your choice: making sure they are suitable for your climate and growing conditions.
- 4.Water spray bottle**: to mist the soil and keep it consistently moist.
- 5.Scissors** or **pruners** (optional): These may be used later to thin out overcrowded seedlings.

Prepare the Seed Tray

- **Inspect the Tray:** Ensure it is **clean** and free of any debris or residue from previous use. This will help **prevent** the introduction of **pests** or **diseases**.
- **Fill the Tray:** Gently fill each individual cell in the seed tray with the **potting mix or seed starting mix**, leaving a small gap of about 1/4 inch at the top of each cell.



Check the pH potting mix or seed starting mix



- Water the potting mix: Pour water into the seed tray and moisten your growing medium.
- Check the pH of the potting mix: Take the pH test paper or a pH meter and put it in the wet potting mix and check if its pH is neutral, acidic or alkaline.
- Ideal pH for starting seed tray is 5.5-7.



Check the pH potting mix or seed starting mix



Plant the Seeds

- **Plant the Seeds:** Using your finger or a pencil, make a small indent in the soil of each cell, about 1/4 to 1/2 inch deep. Carefully place the seeds in each cell and gently cover them with soil, pressing lightly to ensure good seed-to-soil contact.
- **Label the Cells:** Use a permanent marker or small labels to identify the different types of seeds in each cell. This will help you keep track of your plantings.
- **Mist the Soil:** Lightly mist the soil in each cell with the water spray bottle, being careful not to displace the seeds or compact the soil.

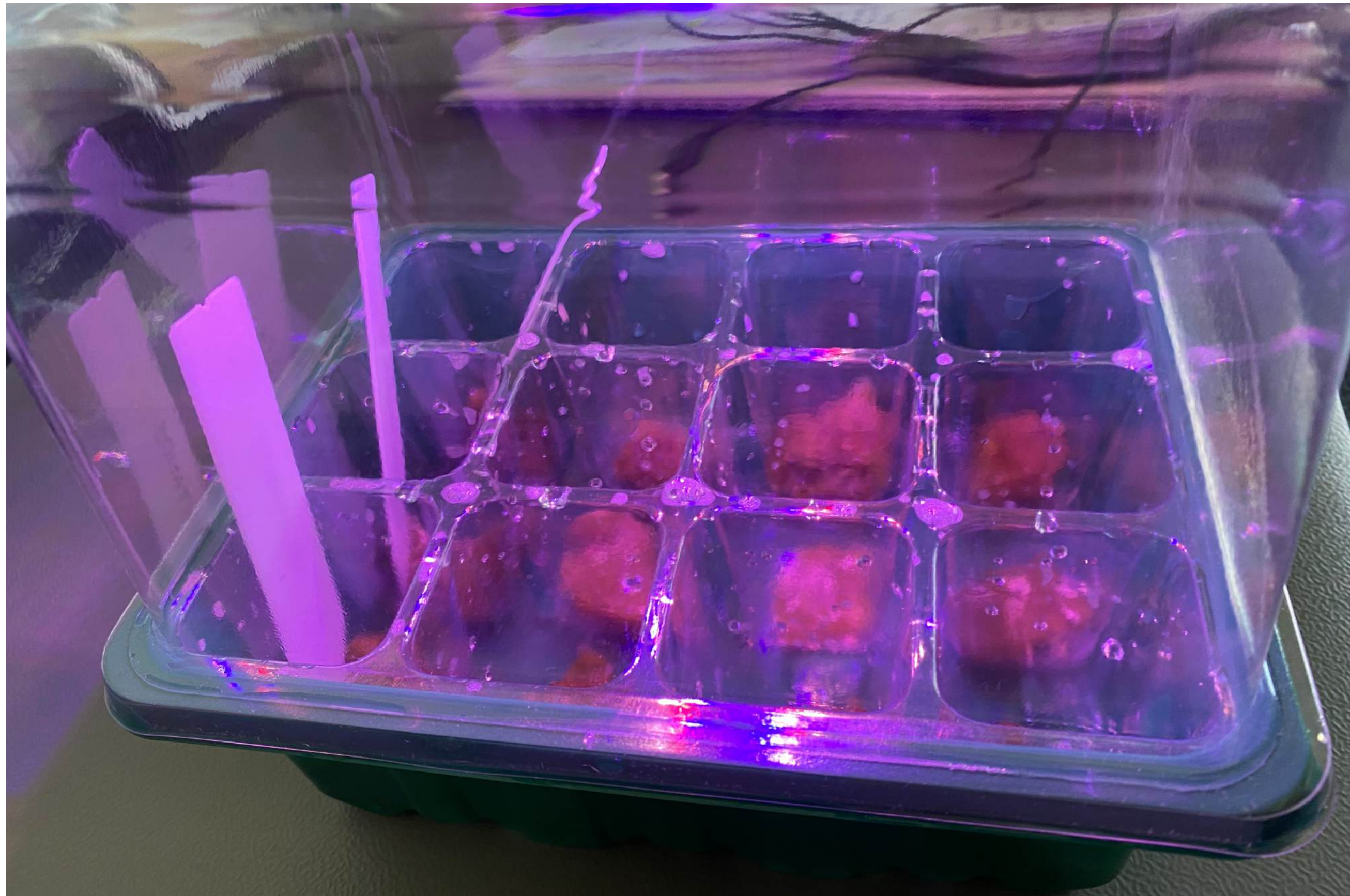
Plant the Seeds



Set up the Lighting

- **Connect the USB Lights:** Locate the USB cable attached to the LED light unit and plug it into a power source, such as a USB wall adapter or a computer USB port.
- **Position the Lights:** Place the LED light unit above the seed tray, adjusting the height as needed to ensure the lights are about 2-4 inches above the soil surface. This distance may need to be adjusted as the seedlings grow.
- **Turn on the Lights:** Switch on the LED lights, and ensure they are providing even coverage across the entire seed tray. The lights should be on for 12-16 hours per day to provide the necessary light for seed germination and seedling growth.

Set up the Lighting



Monitor and Care for the Seedlings

- **Check Soil Moisture:** Regularly check the soil moisture by lightly touching the surface. If the soil feels dry, mist it lightly with the water spray bottle to keep it consistently moist, but avoid overwatering.
- **Adjust Light Height:** As the seedlings grow, periodically check the distance between the LED lights and the soil surface, and adjust the height of the lights accordingly to maintain the 2-4 inch distance.



Monitor and Care for the Seedlings

- **Thin Out Seedlings:** Once the seedlings have their first set of true leaves, use scissors or pruners to thin out any overcrowded or weaker seedlings. Allowing the remaining seedlings to have enough space and resources to grow strong and healthy.
- **Harden Off Seedlings:** Before transplanting the seedlings into your garden, gradually expose them to more sunlight and lower humidity over the course of 7-10 days. This "hardening off" process will help the seedlings adapt to the outdoor environment and reduce transplant shock.

Monitor and Care for the Seedlings



Vertical Garden



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Benefits of Vertical Gardening

- **Space Efficiency:** Maximizes the use of vertical space, allowing for more plants in a smaller area.
- **Improved Airflow:** Better airflow around plants can reduce the risk of disease.
- **Aesthetics:** Enhances visual appeal by creating green walls or living art pieces.
- **Accessibility:** Easier to manage and harvest, reducing the need for bending or kneeling.
- **Microclimate Creation:** Can help regulate temperatures and create a favorable microclimate for plants.



Vertical garden:

- **Height:** The Vertical Carden measures 1.80 meters in height, with 10 levels stacked on top of each other.
- **Stabilization:** This version comes with two supplied wall mounts to stabilize the structure and ensure the safety of the plants as they grow.
- **Planting Capacity:** With its 10 levels, it offers space for up to 21 strawberry plants, allowing for a bountiful harvest in a compact vertical design.
- **Material:** this version is made from durable, weatherproof, and food-safe polypropylene, ensuring longevity and safety for your plants.



Vertical garden (cont)

- **Watering System:** The integrated water-conducting system guarantees perfect watering of all plants on every floor. Water is poured into the top layer, and it distributes evenly throughout the strawberry tree, ensuring optimal hydration for all plants.
- **Leak Protection:** The base serves as a collecting tray for excess irrigation water, preventing water from leaking onto the balcony or terrace and keeping the area dry.



How to Use:

- **Step 1: Unboxing and Setup**

1. **Unboxing:** Unpack all components.
2. **Assembly:** Follow the provided instructions to assemble the vertical “tree”.
3. **Stabilization:** If using the wall mounts for stabilization, attach them securely to a suitable wall surface.

- **Step 2: Planting the Strawberries**

1. **Preparing Soil:** Fill each level with high-quality potting soil, leaving enough space for the plants to grow.
2. **Planting:** Plant the plants in the designated slots, ensuring they are positioned securely and the roots are covered with soil.



How to Use:

- **Step 3: Watering and Maintenance**

1. **Watering System:** Utilize the integrated water system to evenly distribute water by pouring it into the top layer.
2. **Monitoring:** Regularly check the soil moisture and adjust watering frequency to keep the plants hydrated.
3. **Nutrient Care:** add a balanced fertilizer to the water occasionally to provide essential nutrients for healthy plant growth.

- **Step 4: Placement and Sunlight**

1. **Location:** Ensure it receives at least 6-8 hours of sunlight daily for optimal fruit production.
2. **Orientation:** Maximize sunlight exposure while considering factors like wind protection and accessibility for maintenance.

How to Use:

- **Step 5: Harvesting and Care**

1. **Monitoring Growth:** Regularly inspect the plants for signs of pests, diseases, or nutrient deficiencies.
2. **Harvesting:** Harvest ripe strawberries as they mature, gently twisting or cutting them, avoid damaging the stems.
3. **Pruning:** Trim any yellowing or dead leaves, overcrowded growth to promote air circulation and healthy fruit development.

- **Step 6: Maintenance and Storage**

1. **Structural Integrity:** Periodically check the stability of the structure and tighten any loose parts.
2. **Cleaning:** After each growing season, clean thoroughly to remove any debris, old roots, or disease residues.
3. **Storage:** Store in a dry, sheltered location.



Here are some types of plants that can be successfully grown in a Vertical Garden:

1. Herbs:

- Basil
- Parsley
- Mint
- Thyme
- Oregano
- Chives



2. Leafy Greens:

- Lettuce
- Spinach
- Arugula
- Kale



3. Small Fruit Plants:

- Alpine Strawberries
- Small Pepper Varieties
- Cherry Tomatoes



4. Flowers:

- Marigolds
- Nasturtiums
- Petunias



5. Other Edibles:

- Radishes
- Green Onions
- Baby Carrots



When selecting plants to grow in a Vertical Garden, consider the following:

- **Size and Root Structure:** Choose plants with compact root systems that can thrive in the limited soil volume of a vertical planter.
- **Sunlight Requirements:** Ensure that all plants have similar sunlight needs, as the planter will expose them to the same light conditions.
- **Watering Needs:** Select plants that have similar watering requirements to simplify maintenance.

Erdbeeren ✓
strawberries

Kräuter ✓
herbs

Salat ✓
salad

kleines Gemüse ✓
small vegetables

Obst ✓
fruits



Hydroponic Grow Kit



Hydroponic Grow Kit



- Higher productivity compared to traditional soil cultivation, soilless cultivation with nutrient film technology and 36 planting sites can produce more plants, so you can sow more and harvest more.
- The grown vegetables are more nutritious and tastier than conventional soil culture, as oxygen-rich water and nutrients reach the roots.
- It uses vertical space to maximise the growing area. With a size of 100 x 50 x 30 cm, it takes up less space, so you can put it anywhere you want.



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Hydroponic Grow Kit

- **Easy to install:** No need for soil, you just need to install the frame. No smell and no need to work the soil and remove weeds, saving both time and energy.
- **Application:** Suitable for leafy vegetables to grow at home, in the garden and even in the office. E.g. herbs, lettuce, celery, beets, peppers, garlic seedlings, vegetables, flowers, plants, rapeseed, etc.



Watering and Circulation

1.Fill the Reservoir Tank: Fill the reservoir tank with water. The recommended temperature is below 35°C (95°F).

2.Connect the Water Pump: Connect the water pump to the system. The pump should be submerged in water to avoid damage.

3.Circulate the Water:The pump circulates water through the system, providing nutrients to the plants.



Planting and Maintenance

1.Choose Your Plants: Select the plants you want to grow, such as vegetables, herbs, or flowers.

2.Planting: Plant your chosen plants in the plant sites.

3.Lighting: Ensure the system receives at least 4 hours of direct sunlight per day.

4.Monitoring and Maintenance: Regularly check the system for any signs of leakage or damage.



Tips and Precautions

- **Avoid Operating the System Without Water:** The system should always be filled with water to prevent damage to the pump and other components.
- **Use a 20L Water Tank for the Pump:** The manufacturer recommends using a 20L water tank for the pump to ensure optimal performance.
- **Keep the System Clean:** Regularly clean the system to prevent bacterial growth and ensure optimal plant health.



Composting and Recycling



Composting and Recycling

Composting

- Composting is a natural process of recycling organic waste, such as food scraps and yard trimmings, into a nutrient-rich fertilizer for gardens and plants.
- This process involves controlling factors like the balance of "green" and "brown" materials, size of pieces, airflow, moisture, and temperature to create optimal conditions for microorganisms to break down the waste.



Composting Benefits



- **Reduces Landfill Waste:** Composting diverts organic waste from landfills, reducing the amount of trash that needs to be managed.
- **Improves Soil Health:** The resulting compost enriches soil, improving its structure, water retention, and nutrient content.
- **Reduces Greenhouse Gases:** Organic waste in landfills decomposes anaerobically, producing methane, a potent greenhouse gas. Composting reduces methane emissions.
- **Supports Plant Growth:** Compost provides essential nutrients for plants, enhancing garden and agricultural productivity.



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Composting

Compostable Materials

- Fruit and vegetable scraps
- Coffee grounds and filters
- Eggshells
- Yard waste (leaves, grass, branches)
- Paper products
- Tea bags



Non-Compostable Materials

- Meat and dairy products (in home composting, can attract pests)
- Diseased plants
- Pet waste
- Synthetic materials (plastic, metal)
- Treated wood

Types of Composting

- **Home Composting:** Using a compost bin or pile in your backyard.
- **Vermicomposting:** Using worms to decompose organic waste, suitable for indoor composting.
- **Commercial Composting:** Large-scale operations that handle more types of organic waste, including those not suitable for home composting.



Composting and Recycling

Recycling

- Recycling is the process of converting waste materials into new products, preventing the waste of potentially useful materials and reducing the consumption of fresh raw materials.



Recycling

Benefits

- **Conserves Resources:** Recycling reduces the need for raw materials, preserving natural resources.
- **Saves Energy:** Producing goods from recycled materials often requires less energy than manufacturing from virgin materials.
- **Reduces Pollution:** Recycling reduces air and water pollution associated with manufacturing and waste disposal.
- **Decreases Landfill Use:** Diverts materials from landfills, extending their life and reducing the need for new landfill sites.



Recycling

Recyclable Materials

- Paper and cardboard
- Glass bottles and jars
- Metal cans (aluminum, steel)
- Certain plastics (check local guidelines)
- Electronics (e-waste)
- Textiles (fabric, clothing)



Non-Recyclable Materials

- Plastic bags and film (unless specified)
- Styrofoam
- Certain plastics not accepted by local programs
- Contaminated food packaging
- Hazardous materials (batteries, paint)



Recycling Process

- 1. Collection and Sorting:** Waste is collected and sorted by material type.
- 2. Processing:** Materials are cleaned and processed into raw materials.
- 3. Manufacturing:** Recycled raw materials are used to produce new products.
- 4. Purchasing Recycled Products:** Consumers buy products made from recycled materials, completing the recycling loop.



Best Practices

- **Composting:** Keep a balance of green (nitrogen-rich) and brown (carbon-rich) materials. Turn the compost regularly to aerate and speed up decomposition.
- **Recycling:** Clean and dry recyclables before placing them in the bin. Follow local recycling guidelines to avoid contamination.

By incorporating both composting and recycling into daily practices, individuals can significantly reduce their environmental footprint and contribute to a more sustainable future.



FarmBot



FarmBot



- Open-source CNC farming machine designed to automate gardening tasks.
- It aims to enhance precision agriculture, sustainability, and efficiency in small-scale farming.
- Automating tasks such as planting, watering, and weeding.
- FarmBot reduces the need for manual labor and promotes eco-friendly farming practices.



Importance of FarmBot



- **Efficiency:** FarmBot automates planting, watering, and weeding, saving time and effort.
- **Precision:** FarmBot uses advanced technology for precise care, resulting in healthier plants and higher yields.
- **Sustainability:** FarmBot optimizes resource use, reducing water waste and chemical use while lowering carbon footprint.
- **Accessibility:** FarmBot makes gardening accessible to all, including those with limited mobility or experience.



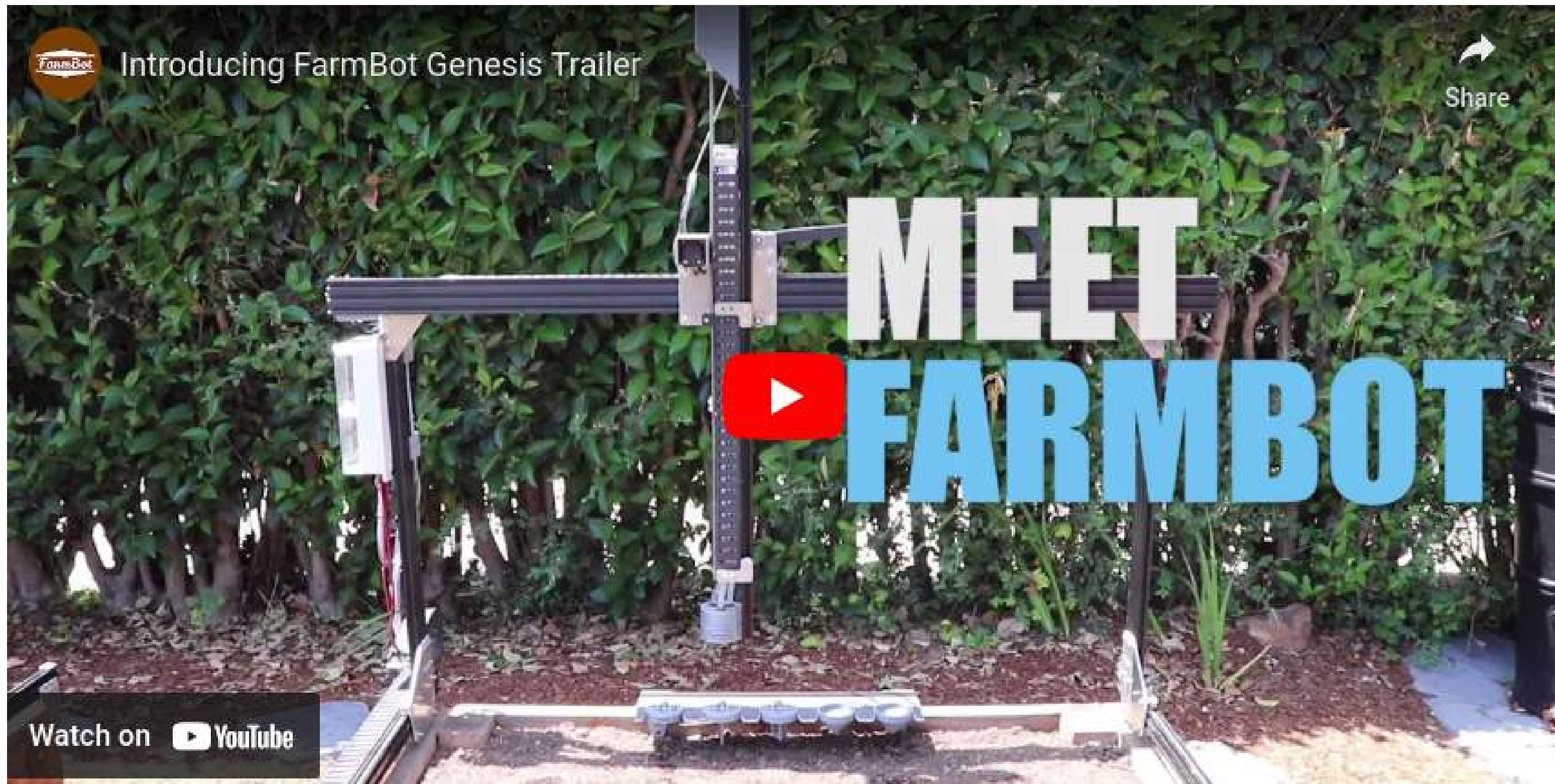
Importance of FarmBot



- **Educational Value:** FarmBot teaches robotics, programming, and sustainable farming in STEM education.
- **Research and Development:** FarmBot supports agricultural research in controlled environments.
- **Community Impact:** FarmBot enhances community gardens with efficient management and sustainable practices.
- **Cost Savings:** FarmBot reduces gardening costs through improved efficiency and yield optimization.



FarmBot





s.m.a.r.t.
greenhouse

THANK
YOU





Our Feedback Form



*It is vital for us to get feedback from you in order for us to improve the training sessions in the future.



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