# II. Cultivated Plants in Their Environment

### Introduction

Cultivated plants thrive under specific environmental conditions, and understanding these requirements is crucial for optimizing crop yields. Each crop has unique needs regarding temperature, precipitation, soil type, and other climatic factors. For instance, rice (Oryza sativa) flourishes in warm, humid environments with abundant water supply, typically requiring temperatures between 25°C and 35°C during its growing season.

In contrast, wheat (Triticum spp.) is well-suited to temperate regions with moderate rainfall and cooler temperatures, often thriving in areas with average temperatures ranging from 10°C to 24°C. Corn (Zea mays), on the other hand, prefers warmer climates with temperatures between 18°C and 27°C and requires well-distributed rainfall throughout its growing period.

Globally, various crops have adapted to specific environmental niches. For example, quinoa (Chenopodium quinoa) is native to the Andean region and grows well in high-altitude areas with cool temperatures and low rainfall. Similarly, sorghum (Sorghum bicolor) is drought-tolerant and thrives in arid and semi-arid regions, making it a staple in parts of Africa and Asia.

Understanding the environmental requirements of different crops is essential for effective agricultural planning and ensuring food security, especially in the face of climate change and evolving weather patterns.

### a. Crop management

Crop management encompasses a suite of agricultural practices aimed at optimizing plant growth, health, and yield while ensuring sustainability and environmental stewardship. It involves strategic decisions and interventions throughout the crop's lifecycle, including soil preparation, planting, irrigation, fertilization, pest and disease control, and harvesting. Effective crop management is tailored to specific crops and their environmental requirements, integrating traditional knowledge with modern technologies to enhance productivity and resilience.



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For instance, rice cultivation in water-abundant regions often employs flooded field systems to suppress weeds and pests, whereas wheat farming in temperate zones focuses on timely sowing and disease-resistant varieties to cope with cooler climates. Corn, thriving in warmer conditions, benefits from practices like precision planting and nutrient management to maximize yields. Additionally, crops like quinoa and sorghum, adapted to high-altitude and arid environments respectively, require specialized management techniques to address challenges such as low rainfall and poor soil fertility.

Modern crop management also emphasizes sustainable practices such as crop rotation, intercropping, and the use of cover crops to maintain soil health and reduce dependency on chemical inputs. Technological advancements, including precision agriculture tools and climate-smart strategies, further enable farmers to make informed decisions, optimize resource use, and adapt to changing environmental conditions. By aligning crop management practices with the specific needs of each crop and its environment, farmers can achieve higher productivity, economic viability, and environmental sustainability.

## b. Crop yield and its components

Crop yield is a critical indicator of agricultural productivity, influenced by a combination of genetic, environmental, and management factors. Understanding the components that contribute to yield and the factors affecting them is essential for optimizing crop production.

### Yield Components

Yield components refer to the individual factors that collectively determine the final harvestable output of a crop. In cereal crops like wheat and rice, these components include the number of grains per plant, grain size, and the overall biomass allocation. For instance, in wheat, the number of **tillers** (a **tiller** is a <u>shoot</u> that arises from the base of a <u>grass</u> plant), grains per spike, and grain weight are crucial determinants of yield. Similarly, in rice, panicle number, grains per panicle, and grain weight play significant roles. These components are influenced by genetic traits and environmental conditions during the plant's growth stages.

### **Factors Affecting Crop Yield**

Several factors impact crop yield, including:

- **Genetic Factors**: The inherent genetic potential of a crop variety determines its capacity for yield. Breeding programs aim to enhance traits like disease resistance, drought tolerance, and nutrient efficiency to improve yields.
- Environmental Conditions: Temperature, rainfall, sunlight, and soil quality significantly affect crop growth and yield. For example, extreme temperatures can impair pollination, while adequate sunlight is essential for photosynthesis.
- Agronomic Practices: Planting density, irrigation, fertilization, and pest management practices directly influence yield. Optimal planting times and appropriate nutrient management can enhance growth and productivity.
- **Biotic and Abiotic Stresses**: Pests, diseases, and environmental stresses like drought or salinity can reduce yield. Implementing integrated pest management and stress-tolerant varieties can mitigate these effects.

Understanding and managing these factors are vital for achieving optimal yields and ensuring food security.

### c. Soil preparation

Soil preparation is a foundational step in agriculture, crucial for creating optimal conditions for seed germination, root development, and overall plant health. It involves a series of practices aimed at enhancing soil structure, fertility, and moisture retention, thereby supporting robust crop growth and maximizing yields.

### **F** Importance of Soil Preparation

Proper soil preparation ensures that the soil is loose and aerated, facilitating better water infiltration and root penetration. It also aids in the removal of weeds and the incorporation of organic matter, which enriches the soil with essential nutrients. These practices collectively contribute to a more favorable environment for crops, leading to improved productivity and sustainability in agricultural systems.



### Stages of Soil Preparation

The process typically involves three main stages: ploughing, leveling, and manuring.

- **Ploughing**: This initial step involves turning and loosening the soil to break up compacted layers, allowing roots to penetrate more easily and enhancing microbial activity.
- Leveling: After ploughing, the soil surface is leveled to ensure uniform water distribution and prevent waterlogging or erosion.
- **Manuring**: The addition of organic matter, such as compost or green manure, improves soil fertility by supplying nutrients and enhancing its structure.

### **Soil Preparation Techniques**

Various techniques are employed depending on the crop requirements and soil conditions:

- **Tillage**: Mechanical agitation of the soil, including primary tillage (deep ploughing) and secondary tillage (harrowing), helps in weed control and soil aeration.
- No-till and Conservation Tillage: These methods minimize soil disturbance, preserving soil structure and moisture, and reducing erosion.
- Use of Soil Amendments: Incorporating materials like lime or gypsum can correct soil pH and improve its physical properties.
- Rolling is an important final step in soil preparation after ploughing and leveling. It involves passing a heavy roller over the field to compact the soil lightly and flatten the surface. Rolling improves seed-to-soil contact, which is crucial for uniform seed germination and strong seedling establishment as well as to encourage sowing and tillering in wheat crops.

*Use of land-rolling technology varies regionally and by crop.* ►



By meticulously preparing the soil through these methods, farmers can create an environment conducive to healthy plant growth, leading to enhanced crop yields and sustainable agricultural practices.

## d. Crop establishment

Crop establishment is a pivotal phase in agriculture, laying the groundwork for successful crop growth and optimal yields. It encompasses the processes involved in ensuring that seeds germinate effectively, seedlings emerge uniformly, and plants develop robustly to withstand environmental stresses. The quality of crop establishment directly influences water and nutrient uptake, weed suppression, and overall crop resilience.

## Sey Factors in Crop Establishment

- 1. Seed Quality and Vigour: High-quality seeds with strong vigour are essential for rapid germination and uniform seedling emergence. Seed vigour determines a seed's ability to perform under various environmental conditions, impacting early plant development and final yield.
- 2. Soil Conditions: Optimal soil preparation ensures adequate aeration, moisture retention, and nutrient availability. Proper tillage practices create a conducive seedbed, facilitating root penetration and reducing compaction.
- 3. **Planting Techniques**: Accurate planting depth and spacing are crucial for uniform crop stands. Precision planting technologies aid in achieving consistent seed placement, enhancing emergence rates and reducing competition among plants.
- 4. Environmental Factors: Temperature, moisture, and light conditions at the time of planting significantly affect germination and early growth. Monitoring weather patterns and adjusting planting schedules accordingly can mitigate adverse effects.
- 5. Weed and Pest Management: Effective control of weeds and pests during the establishment phase prevents competition for resources and reduces the risk of disease transmission, promoting healthier crop development.



By meticulously managing these factors, farmers can enhance crop establishment, leading to improved plant health, resilience, and ultimately, higher agricultural productivity.