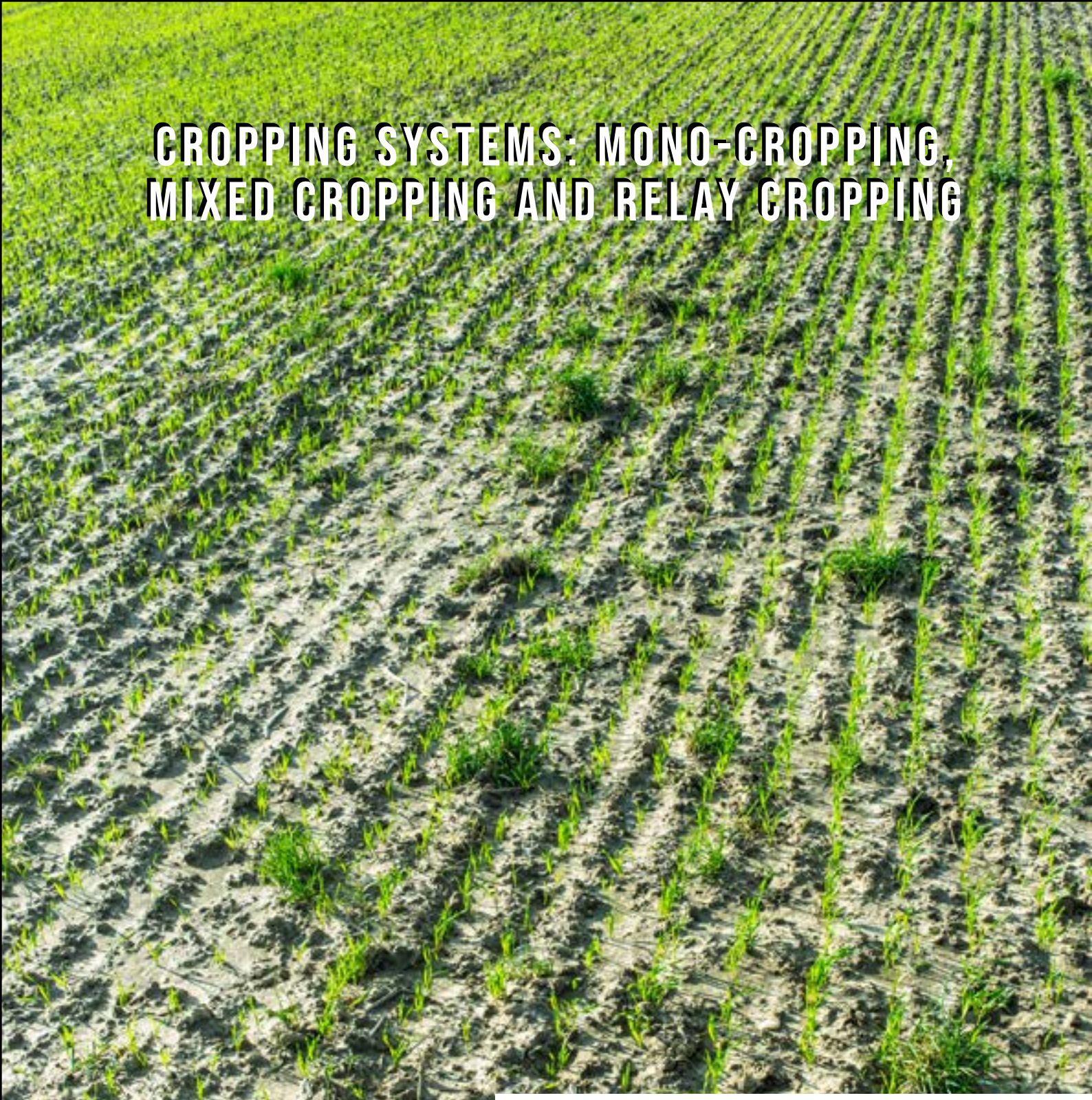

CROPPING SYSTEMS: MONO-CROPPING, MIXED CROPPING AND RELAY CROPPING

Kashish Saini[1], Mohit Kashyap[2], and Chinmaya Sahoo[3]

[1]Dr. KSG Akal College of Agriculture, Eternal University, Baru Sahib, Sirmaur, Himachal Pradesh, India

[2]Department of Soil Science, CSK HPKV, Palampur, HP, India-176062

[3]Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India

In terms of any communication correspondence is pertained to:

mmkashyap222@gmail.com

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Kashish Saini[1], Mohit Kashyap[2], and Chinmaya Sahoo[3]

[1]*Dr. KSG Akal College of Agriculture, Eternal University, Baru Sahib, Sirmaur, Himachal Pradesh, India*

[2]*Department of Soil Science, CSK HPKV, Palampur, HP, India-176062*

[3]*Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India*

In terms of any communication correspondence is pertained to: *mmkashyap222@gmail.com*

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Abstract

Cropping systems play a crucial role in enhancing agricultural productivity and sustainability. This study evaluates three major systems monocropping, mixed cropping, and relay cropping with emphasis on their management practices, advantages, limitations, and ecological implications. A comprehensive review of peer-reviewed literature was undertaken to synthesize information on key parameters such as yield performance, pest dynamics, soil health, and biodiversity. The analysis indicates that monocropping ensures operational efficiency and is well-suited for large-scale mechanized farming; however, it is often associated with higher susceptibility to pests, diseases, and soil degradation. In contrast, mixed cropping improves resource use efficiency, minimizes production risks, and enhances ecological resilience. Relay cropping offers significant potential for maximizing land use efficiency and sustaining productivity across varied agro-climatic conditions. Overall diversified cropping systems demonstrate superior performance in sustainability indicators, highlighting the importance of integrated and location-specific approaches for achieving long-term agricultural resilience and environmental sustainability.

Keywords: Cropping systems, biodiversity, mixed cropping, ecology and agro-climatic.

Introduction

Agricultural production systems have evolved over centuries in response to climatic conditions, resource availability, socio-economic factors, and technological advancement. A cropping system refers to the sequence and arrangement of crops grown on a particular field over time, including management practices associated with planting, harvesting, and resource use (Gliessman, 2014). Sustainable cropping systems are essential for maintaining soil fertility, optimizing resource efficiency, and enhancing resilience against environmental stressors. Among, the diverse cropping systems practiced worldwide, monocropping, mixed cropping, and relay cropping represent distinct strategies with varying ecological, agronomic, and economic implications. Understanding these systems is fundamental for designing resilient agricultural models capable of meeting global food demands.

Key Agronomic Practices:

1. Agronomic practices vary across cropping systems to optimize yields, manage resources, and mitigate risks.

2. For monocropping, key practices include soil testing for precise fertilization, crop rotation every 2-3 years to break pest cycles, and integrated pest management (IPM) using biological controls and selective pesticides.

3. Irrigation scheduling via drip systems conserves water, while tillage practices like no-till reduce erosion (Francis, 1986).

4. In mixed cropping, practices emphasize companion planting for synergy, such as spacing maize and legumes to avoid competition.

5. Nutrient management involves organic amendments like compost, and weed control relies on mulching and manual weeding.

6. Pest management uses trap

crops and natural predators, with harvesting timed to maximize intercrop benefits.

7. Relay cropping requires precise timing: the relay crop (e.g., legumes) is sown 2-4 weeks before the main crop's harvest.

8. Practices include staggered planting to ensure canopy overlap, soil moisture monitoring to prevent water stress, and nutrient application split between crops.

A. Mono-cropping

Monocropping, or sole cropping, involves cultivating a single crop species on a given field during one growing season.

Advantages

1. **Specialized crop management:** Uniform crop requirements simplify irrigation, fertilization, and pest management.

2. **Mechanization suitability:** Large mono-cropped fields enhance the efficiency of tractors and harvesting machinery.

3. **Higher short-term yields:** Focused nutrient and input management can maximize crop-specific performance.

Limitations

1. **Pestanddiseasevulnerability:** Genetic homogeneity increases susceptibility to outbreaks.

2. **Soil nutrient depletion:** Repeated cultivation of the same crop can cause nutrient imbalance and soil exhaustion.

3. **Reduced biodiversity:** Limits beneficial microflora and fauna essential for ecosystem stability.

B. Mixed Cropping

Mixed cropping refers to growing two or more crops simultaneously on the same land without a predetermined row arrangement.

Advantages

1. **Risk reduction:** Failure of one crop may be compensated by another.

2. **Improved resource-use efficiency:** Different crops exploit soil nutrients, sunlight, and water differently.

3. **Enhanced biodiversity:** Supports beneficial insects, improves soil health, and reduces pest outbreaks.

4. **Soil fertility improvement:** Leguminous crops fix atmospheric nitrogen, enriching the soil.

Limitations

1. **Difficult mechanization:** Mixed crops often require manual operations.

2. **Competition for resources:** If not properly planned, crops may compete for water, nutrients, and light.

3. **Complex management:** Requires species compatibility knowledge.

C. Relay Cropping

Relay cropping is a sequential cropping system where a second crop is sown into a standing crop before the first crop is harvested. An example is sowing lentils into standing rice nearing maturity.

Advantages

1. **Efficient resource utilization:** Light, moisture, and soil nutrients are used throughout the season without long fallow periods.

2. **Reduced turnaround time:** Eliminates the need to wait for complete harvesting of the previous crop (Andrews & Kassam, 1976).

3. **Higher land-use efficiency:** Supports intensive agriculture and improves annual productivity.

Limitations

1. **Operational complexity:** Timing of sowing is crucial.

2. **Competition during overlap period:** The young crop may face shading or nutrient stress.

3. **Requires precise agronomic planning:** Not suitable for all crop combinations.

Conclusion

Cropping systems vary widely in their design, ecological impact, and productivity potential. Monocropping is efficient for large-scale mechanized agriculture but poses sustainability challenges due to biodiversity loss and soil degradation. Mixed cropping enhances stability, resilience,

and ecological balance but may limit mechanization options. Relay cropping optimizes temporal use of land resources and improves productivity, particularly in regions with short growing seasons or limited land availability. Sustainable agriculture requires integrating these systems based on local agro-climatic conditions, resource availability, and socio-economic factors. A balanced approach combining ecological benefits of mixed and relay systems with the efficiency of monocropping can support long-term agricultural sustainability and food security.

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