Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 06, Issue: 03 (MAY-JUNE, 2026)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Effect of Crop Diversification on Weed Control and Soil Health

*Satvik K. Patel[1], Atul A. Pawar[2], Ujash D. Chaudhary[1] and Pratham V. Patel[3]
[1]M.Sc. Scholar, Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India
[2]M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India
[3]M.Sc. Scholar, Department of Agronomy, College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat, India
*Corresponding Author's email: satvikpatel197@gmail.com

Modern intensive agriculture and monocropping systems have significantly increased food production after the Green Revolution but same time they have also resulted in several ecological and agronomic problems such as weed resistance, nutrient depletion, soil degradation, biodiversity loss and declining productivity. Crop diversification has emerged as a sustainable strategy to overcome these challenges. Crop diversification involves inclusion of different crops through crop rotation, intercropping, cover cropping, mixed cropping and agroforestry systems to improve productivity and ecological stability. Diversified cropping systems suppress weed growth through enhanced crop competition ability, shading effect, allelopathy and efficient resource utilization. Inclusion of legumes such as green gram, black gram, cowpea and soybean effectively reduces weed density and weed dry matter while improving weed control efficiency. Crop diversification also enhances soil health by improving soil organic carbon, nutrient availability, microbial biomass and soil structure. Legume-based systems increase biological nitrogen fixation and improve microbial activity, thereby enhancing soil fertility and sustainability. Research findings from different regions of India and other countries revealed that diversified cropping systems improve yield, conserve natural resources and increase resilience against climatic stress. Therefore, crop diversification is an effective and environmentally sustainable approach for weed management and soil health improvement in modern agriculture.

Keywords: Crop diversification, Weed management, Soil health, Intercropping, Legumes, Soil organic carbon, Sustainable agriculture

Introduction

Agriculture after the Green Revolution achieved remarkable progress in food grain production through the use of high yielding varieties, chemical fertilizers and pesticides. Although these technologies improved productivity and food security but continuous monocropping and intensive cultivation created several problems such as nutrient depletion, weed resistance, environmental pollution, pest outbreaks, decline in soil organic matter and reduction in biodiversity. Continuous cultivation of the same crop also leads to deterioration of soil fertility and sustainability. Crop diversification is considered one of the most important sustainable agricultural practices for overcoming these constraints. It refers to the inclusion or replacement of different crops or cropping systems within an existing farming system to improve productivity, profitability and ecological balance. Diversification may involve crop rotation, intercropping, mixed cropping, cover cropping, relay cropping and agroforestry systems.

Diversified cropping systems improve natural resource utilization, suppress weeds, enhance soil fertility and increase resilience against climatic variability. Inclusion of legumes in diversified systems improves nitrogen fixation and soil biological activity, while multiple crop canopies suppress weed growth through shading and competition. Thus, crop diversification plays a vital role in sustainable agricultural development.

Concept of Crop Diversification

Crop diversification refers to the practice of growing a variety of crops instead of depending on a single crop. According to the Food and Agriculture Organization (FAO, 2017), crop diversification involves the addition of new crops or cropping systems to agricultural production considering economic and ecological benefits.

Crop diversification may occur in temporal or spatial forms:

Temporal Diversification

- Crop rotation
- Relay cropping
- Double cropping
- Catch cropping

Spatial Diversification

- Intercropping
- Mixed cropping
- Alley cropping
- Variety mixture

The major objectives of crop diversification include:

- Increasing farm income
- Improving soil fertility
- Reducing pest and weed incidence
- Conserving natural resources
- Enhancing climate resilience
- Improving biodiversity

Importance of Weed Management

Weeds are among the major biological constraints in crop production and may cause approximately 33 per cent yield losses in crops. They compete with crops for nutrients, water, light and space. Certain weeds also release allelochemicals that inhibit crop growth and act as alternate hosts for pests and diseases. Crop diversification is an important component of integrated weed management. Diversified systems reduce weed infestation through:

- Crop competition
- Rapid canopy coverage
- Resource utilization
- Allelopathic effects
- Soil shading
- Alteration in weed life cycle

Legume crops such as cowpea, soybean and green gram are highly effective in suppressing weeds because of their rapid growth and dense canopy formation.

Effect of Crop Diversification on Weed Control

Diversified cropping systems significantly reduce weed density and weed dry matter accumulation. Intercropping systems create dense crop canopies that intercept solar radiation and reduce weed emergence.

Intercropping and Weed Suppression

Mathukia *et al.* (2015) reported that pearl millet + black gram intercropping significantly reduced monocot, dicot and sedge weed populations and recorded higher weed control efficiency compared to sole pearl millet. Similarly, Naher *et al.* (2021) reported that maize +

mungbean intercropping effectively suppressed weeds because of rapid canopy development and greater ground coverage.

Multi-tier Cropping System

Sankaranarayanan *et al*. (2012) found that cotton + cluster bean + cowpea + dolichos multi-tier system recorded lower weed dry weight and higher weed smothering efficiency compared to sole cotton.

Cover Crops and Green Manuring

Green manure crops such as sunnhemp, dhaincha and cowpea effectively suppress weeds through allelopathic effects and rapid biomass production. Verma *et al.* (2015) reported that Sesbania green manuring in rice row significantly reduced weed dry matter and improved rice yield. Jamwal *et al.* (2022) observed that sunnhemp reduced sedge density and improved weed control efficiency in direct-seeded rice.

Crop Rotation

Crop rotation disrupts weed life cycles and reduces weed seed banks. Rotations involving cereals and legumes reduce dominance of specific weed species and improve crop competitiveness.

Effect of Crop Diversification on Soil Health

Soil health refers to the capacity of soil to function as a living ecosystem that sustains plants, animals and humans. Diversified cropping systems improve physical, chemical and biological properties of soil.

Soil Organic Carbon and Organic Matter

Legume inclusion increases soil organic carbon due to addition of crop residues and root biomass. Parihar *et al.* (2016) observed higher soil organic carbon in maize–chickpea–Sesbania cropping systems. Borase *et al.* (2020) reported that pigeon pea-based systems significantly improved soil organic carbon and microbial biomass.

Nutrient Availability

Crop diversification improves nutrient cycling and nutrient availability. Legume crops fix atmospheric nitrogen and enrich soil fertility. Upadhaya *et al.* (2016) reported higher available nitrogen, phosphorus and potassium in diversified systems involving Maize + Black gram–Chickpea–Sesbania compared to rice–wheat systems.

Soil Microbial Activity

Diversified systems enhance microbial biomass carbon, microbial diversity and beneficial microbial populations. Kumar *et al*. (2021) observed higher soil microbial biomass nitrogen and phosphorus-solubilizing bacteria in jute–rice–green gram systems. Legume root exudates stimulate microbial activity and nutrient mineralization.

Soil Physical Properties

Different root systems improve soil structure, aggregation and porosity. Agroforestry and intercropping systems reduce soil bulk density and improve water infiltration. Singh *et al.* (2021) reported lower bulk density under poplar-based agroforestry systems due to higher organic matter accumulation.

Advantages of Crop Diversification

Crop diversification offers several agronomic and ecological benefits:

- Improves soil fertility and nutrient cycling
- Suppresses weeds naturally
- Reduces dependence on herbicides
- Enhances microbial activity
- Conserves soil and water resources
- Improves biodiversity
- Increases farm income
- Reduces production risk
- Enhances climate resilience
- Improves sustainability of farming systems

Conclusion

Crop diversification under different cropping system inclusion of leguminous crops like cow pea, black gram, green gram, soybean, groundnut etc. as a intercropping, cover cropping and multi-tier cropping system were found effective for remarkable decrease in weed density, weed dry matter production along with increase in weed control efficiency/smothering efficiency. Crop diversification through cropping system and intercropping particularly inclusion of leguminous crops improved soil chemical, physical as well as biological properties.

References

1. Borase, D. N.; Nath, C. P.; Hazra, K. K.; Senthilkumar, M.; Singh, S. S.; Praharaj, C. S.; Singh U. and Kumar, N. (2020). Long-term impact of diversified crop rotations and nutrient management practices on soil microbial functions and soil enzymes activity. *Ecological Indicators*, 114, 106322.
2. FAO. (2017). Crop diversification for sustainable agriculture. Food and Agriculture Organization, Rome.
3. Jamwal, N.; Bochalya, D. K.; Mehta, S.; Attri, M. and Naveena. (2022). Effect of green manuring and herbicides on weed dynamics in direct-seeded rice under sub-tropics of Jammu. *Agricultural Mechanization in Asia, Africa and Latin America*, 53(2), 6792-6798.
4. Kumar, M.; Mitra, S.; Mazumdar, S. P.; Saha, A. R.; Pramanick, B.; Gaber, A.; Alsanie, W. F. and Hossain, A. (2021). Long-term nutrient management impacts on soil organic carbon pools and crop productivity in rice–wheat cropping system. *Agronomy*, 11(8), 1622.
5. Mathukia, R. K.; Mathukia, P. R. and Polara, A. M. (2015). Intercropping and weed management in pearlmillet (*Pennisetum glaucum*) under rainfed condition. *Indian Journal of Weed Science*, 47(4), 379-383.
6. Naher, Q.; Karim, S.; Begum, M. and Hossain, M. (2021). Effect of maize-legume intercropping on weed suppression and yield. *Bangladesh Agronomy Journal*, 24(2), 75-84.
7. Parihar, C. M.; Yadav, M. R.; Jat, S. L.; Singh, A. K.; Kumar, B.; Pradhan, S.; Pooniya, V.; Chaudhary, V.; Jat, M. L.; Jat, R. K. and Yadav, O. P. (2016). Long-term effect of conservation agriculture in maize rotations on total organic carbon, physical and biological properties of a sandy loam soil in north-western Indo-Gangetic Plains. *Soil and Tillage Research*, 161, 116-128.
8. Sankaranarayanan, K.; Nalayini, P. and Praharaj, C. S. (2012). Multi-tier cropping system to enhance resource utilization, profitability and sustainability of Bt cotton (*Gossypium hirsutum*) production system. *Indian Journal of Agricultural Sciences*, 82(12), 1044-1050.
9. Singh, J.; Singh, B. and Sharma, S. (2021). Comparison of soil carbon and nitrogen pools among poplar and eucalyptus-based agroforestry systems in Punjab, India. *Carbon Management*, 12(6), 693-708.
10. Upadhaya, B.; Kishor, K.; Kumar, V.; Kumar, N.; Kumar, S.; Yadav, V. K.; Kumar, R.; Gaber, A.; Laing, A. M.; Brestic, M. and Hossain, A. (2022). Diversification of rice-based cropping system for improving system productivity and soil health in Eastern Gangetic Plains of India. *Agronomy*, 12(10), 2393.
11. Verma, S. K.; Singh, S. B.; Meena, R. N.; Prasad, S. K.; Meena, R. S. and Gaurav. (2015). A review of weed management in India: The need of new directions for sustainable agriculture. *The Bioscan*, 10(1), 253-263.