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Agroforestry and plant breeding improvement

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Plant breeding in India focuses on developing improved crops for traits like yield and disease resistance, while agroforestry integrates trees with crops for enhanced productivity, environmental sustainability, and economic benefits. The two fields work together, using improved plant varieties within various agroforestry systems (like agrisilviculture or agri-horticulture) to maximize resource use and create resilient agricultural landscapes. India's National Agroforestry Policy (2014) supports this integration to build climate resilience and achieve food security.

Plant breeding

Goal: To improve crop traits like higher yield, pest and disease resistance, and tolerance to environmental stress through genetic selection and modern techniques.

Indian context: Dilbagh Singh Atwal is recognized as the father of plant breeding in India, and research is driven by a need for sustainable, resilient, and profitable agriculture.

Methods: Includes traditional selection, and modern approaches using genetics and molecular methods to create new varieties.

Agroforestry

Goal: To integrate trees with crops and/or livestock to improve soil fertility, diversify income, and enhance overall land productivity.

Indian context: Prominent systems include agrisilviculture (crops and trees), agri-horticulture (crops and fruit trees), and silvi-pasture (trees and fodder/livestock).

Government support: The National Agroforestry Policy (2014) encourages its adoption for climate resilience and economic benefits.

Benefits: Can lead to increased soil fertility, diverse products (like timber, fuel, and medicines), and economic security for farmers.

Synergy between plant breeding and agroforestry

Improved genetic resources: Plant breeding provides improved crop varieties that are more suited to specific agroforestry systems and environments.

Addressing challenges: Combining advanced plant breeding with traditional agroforestry practices can help address challenges like climate change, pest attacks, and water scarcity.

Farmer-friendly solutions: The integration of both fields helps in developing sustainable and affordable agricultural solutions that are suitable for local conditions.

Wild relatives: The wild relatives of both crops and agroforestry species are valuable genetic resources for breeding programs aiming to develop new, resilient varieties.

Plant breeding improves crops by selecting and modifying them for traits like yield, disease resistance, and climate tolerance, while agroforestry combines trees with crops and livestock to create sustainable systems that improve soil health, reduce erosion, and enhance overall productivity. Improving agroforestry requires breeding for both crops and the trees, focusing on varieties that thrive together and provide ecological and economic benefits, such as drought tolerance, pest resistance, and improved nutrient cycling.

Plant breeding advancements

Modern techniques: Advanced plant breeding utilizes molecular tools like marker-assisted selection (MAS), gene editing (e.g., CRISPR), and genomics to more precisely develop improved varieties.

Targeted traits: Breeders focus on a wide range of traits beyond yield, including enhanced nutritional content, flavor, shelf life, and resistance to pests, diseases, and environmental stresses like drought, heat, and salinity.

AI and data analysis: The use of artificial intelligence (AI) helps analyze large datasets to predict the most promising crosses and shorten breeding cycles.

Agroforestry improvements

Integration with breeding: Plant breeding is crucial for agroforestry by creating crop and tree varieties specifically suited for intercropping. This includes developing crops that can tolerate shade from trees or trees that are faster-growing and more productive.

Ecological benefits: Agroforestry systems improve soil health through increased organic matter from tree roots and reduced erosion from trees binding the soil. Trees can also help with nitrogen fixation and water use efficiency.

Climate resilience: Agroforestry can help with climate change adaptation by providing a more diverse system that is less vulnerable to extreme weather events. For example, crops bred for drought resistance can be planted alongside trees that help regulate the local microclimate.

Carbon sequestration: Integrating trees into agricultural land increases carbon sequestration, as trees store carbon in their biomass and soils.

Economic advantages: Agroforestry can increase overall farm productivity by providing an additional crop (the trees) that can offer shade, fodder, or timber, and can also protect the primary crops from adverse conditions, hedging against a poor harvest.

How agroforestry improves plant breeding

Biodiversity conservation: Agroforestry increases plant and microbial biodiversity, which provides new genetic material and traits for plant breeding programs.

Creation of diverse environments: The varied conditions in agroforestry systems, such as differing soil depths and light levels, can lead to the selection of traits that enhance performance in a broader range of conditions.

Soil and nutrient benefits: Agroforestry practices improve soil health and nutrient availability, creating more favorable conditions for plant growth and development, which allows for the identification and selection of more resilient crop varieties.

How plant breeding improves agroforestry

Breeding for specific traits: Plant breeding can develop specific crops for agroforestry systems, such as high-value nut crops, fruits, and timber species that meet market demands and system needs.

Enhanced resilience: Modern breeding techniques develop crop varieties with improved resistance to pests and diseases, and increased tolerance to heat and drought, which are essential for system survival and productivity.

Improved nutrient and water use: Breeders can develop crops that are more efficient at using soil nutrients and water, which reduces competition between trees and crops in agroforestry systems and improves overall resource use efficiency.

Genetic improvement of trees: Plant breeding can also improve the trees used in agroforestry, selecting for traits like faster growth, better timber quality, and higher fruit yields, as seen in efforts to improve rubber-based systems.

References

1. Alavalapati, J.R.R., Luckert, M.K. and Gill D.S. 1995. Adoption of agroforestry practices: a case study from Andhra Pradesh, India. Agroforest Syst. 32: 1–14.
2. Beillouin, D., Ben-Ari, T., and Makowski, D. 2019. Evidence map of crop diversification strategies at the global scale. Environ. Res. Letters, 14(12): 123001.
3. Bangarwa, K.S. 2002. Plus tree selection and progeny testing for establishment of first generation seed orchard in Dalbergia sissoo Roxb. Indian J. Agroforest., 4: 122–131.
4. Bourke, P.M., Evers, J.B., Bijma, P., van Apeldoorn D.F., Smulders, M.J.M., Kuyper, T.W., Mommer, L. and Bonnema, G. 2021. Breeding beyond monoculture: putting the “intercrop” into crops. Front Plant.Sci. doi.org/10.3389/fpls.2021.734167