



Green Manuring in Cotton: An Eco-Friendly Approach to Improve Crop Growth, Productivity and Soil Fertility

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Green manuring is the process of incorporation of plant biomass in the soil where it is grown or after bringing it from another field to improve soil fertility and nutrient availability. In cotton it is an important process for sustainable production. It helps in nitrogen fixation, recycling of nutrients, enhance soil organic matter and improve condition for crop production. Their efficiency depends on plant species, production of biomass, incorporation time and fertilizer management. Application of balanced nutrients along with green manuring enhance cotton yield, resource-use efficiency and farm profitability while maintaining sustainable environment for cotton production.

Keywords: Green manuring, cotton, soil fertility, nutrient management, sustainability

Introduction

Cotton is known as white gold due to its economic importance in textile industry. It is an important commercial fibre crop. It provides income to millions of farmers. To maintain high cotton productivity, it requires careful management of soil health. Imbalanced use of fertilizer application and continuous cultivation can destroy soil health. Green manuring is a practical approach to overcome these challenges. Green manuring involves of incorporation of plant biomass in the soil where it is grown or after bringing it from another field to improve soil fertility. Example like sunhemp, dhanicha fix atmospheric nitrogen by symbiotic association with soil bacteria. The practice of green manuring in cotton-based cropping systems has received considerable attention because of its potential to maintain soil fertility and crop productivity. Recent research also studies how different green manure species influence cotton yield, soil nutrient status and economic returns.

Green Manuring: A Natural Source of Plant Nutrients

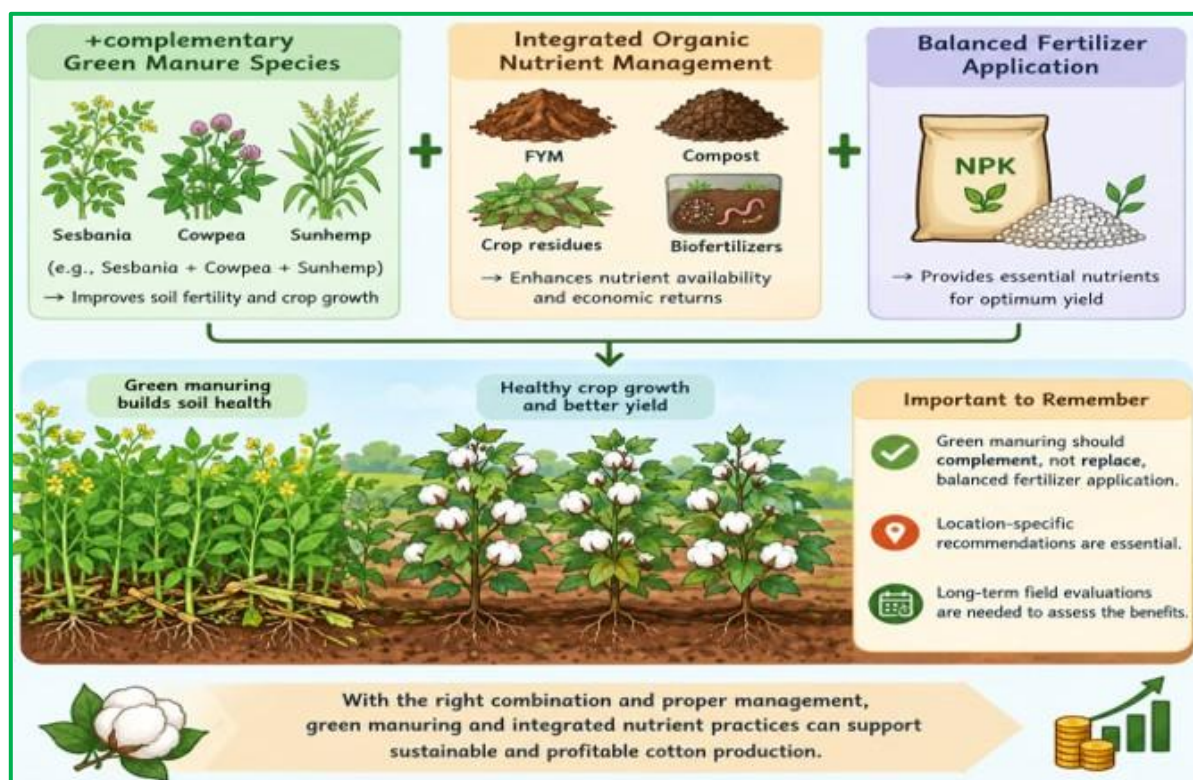
Green manure crops absorb nutrients during their growth and when their biomass is incorporated, they release a certain portion of these nutrients to the soil. The decomposition process releases nutrients in forms that may subsequently become available to cotton plants. Leguminous green manure crops fix atmospheric nitrogen and add nitrogen to the cropping system. The quantity of nitrogen added depends on the plant species, biomass production, growth duration, nodulation and environmental conditions. Green manuring increase soil structure, enhances soil organic carbon and improve soil microbial activity. Some green manure crops produce large amount of biomass while some add more nitrogen while some decompose very quickly. So therefore, growing a suitable combination of species help farmers obtain multiple benefits from a single cropping system.

Effect on Cotton Growth and Development

Green manuring provides suitable soil condition by improving nutrient recycling which helps in increase in plant height, leaf development, branching and dry matter accumulation. It leads to healthy vegetative growth and improved reproductive structure. Green manure crops add nitrogen to soil which helps in leaf formation and chlorophyll development, while phosphorus and potassium support energy transfer, plant metabolism and other physiological functions. Overall, it helps in establishment of healthy canopy, development of strong branches and maintain favourable conditions for boll formation.

Effect on Cotton Yield and Yield-Contributing Characters

Green manure may influence the yield of cotton directly or indirectly by improving nutrient availability and crop growth. It has influence on cotton yield like number of bolls per plant, boll weight, plant population and the proportion of bolls that develop successfully. However, the magnitude of the yield response may differ across the location according to soil type, climate, cotton variety, biomass production and fertilizer management.



(Conceptual illustration of green manuring and integrated nutrient management for sustainable cotton production)

Improvement in Soil Fertility and Nutrient Cycling

Green manuring maintains soil fertility by adding plant biomass to soil and support nutrient recycling. The decomposition of green manure adds nutrients and organic carbon to soil. It improves soil structure and increases stability of soil aggregate. It acts as energy source for soil microorganisms and improves soil biodiversity. The continuous application of addition of organic materials may help maintain soil productivity and reduce the long-term deterioration associated with continuous cropping. Leguminous crops add nitrogen through biological fixation. Overall green manure enhances soil fertility and productivity.

Economic and Environmental Benefits

Green manuring provides economic benefit by increase in crop productivity, nutrient recycling and reduce requirement of fertilizers. It reduces dependency on purchase of organic materials. When the biomass is produced within the farm, transportation costs may also be reduced. But green manuring may require additional planning, seed, labour and time. So, farmer needs to maintain a balance between the cultivation of green manure crops and the opportunity cost of

using the land for another crop. Green manuring also supports environment sustainability by increasing organic matter inputs and reducing nutrient losses.

Practical Considerations for Farmers

For successful green manuring in cotton the selection of green manure crop should be according to the local climate, soil type and production objectives. The green manure crop should be incorporated at an appropriate growth stage, with adequate time for decomposition before cotton sowing. Green manuring should be incorporate with soil testing, balanced fertilizer application, suitable cotton varieties and effective weed and pest management. Local field trials are important for selection of suitable species, management of fertilizers and schedule of incorporation under cotton growing condition.

Future Prospects

Future prospects should be based on identification of green manure species which can perform better under different cotton growing environments. Long-term field experiments are required to assess their effects on soil organic carbon, nutrient-use efficiency, yield stability, fibre quality and farm profitability. More importance should be given should also be given to the interaction between green manure biomass, mineral fertilizer rates and the timing of incorporation. Integrating green manuring with crop-residue recycling, crop rotation and other soil-conservation practices may offer further opportunities to improve the sustainability of cotton-based cropping systems.

Conclusion

Green manuring is an encouraging practice for enhancing growth of cotton, improving the yield and maintaining soil fertility. It improves soil structure, increase organic matter, enhance nutrient recycling and soil microbial activity. Research in cotton-growing regions indicates that the effectiveness of green manuring depends on the species selected, biomass production, incorporation timing and fertilizer management. The combined application of suitable green manure crop can contribute to improved crop growth and yield, while integrated nutrient management using organic sources may enhance farm profitability. However, green manuring should be used with balanced fertilizer application rather than considered a complete substitute. Site-specific recommendations and long-term field studies are necessary to assess its effectiveness and ensure sustainable and profitable cotton production.

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