

SESBANIA ACULEATA: A GREEN GOLD FOR SUSTAINABLE AGRICULTURE

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ABSTRACT



Dhaincha (Sesbania aculeata) is a fast-growing leguminous crop with considerable potential to promote sustainable and resource-efficient agriculture. Beyond its traditional use as green manure, it contributes to biological nitrogen fixation, biomass production, nutrient recycling and soil organic matter enrichment. Its multiple applications include green manuring, brown manuring, cover cropping, mulching and weed suppression. Its tolerance to saline conditions makes it valuable for selected salt-affected soils, while young biomass can supplement green fodder for livestock. These diverse benefits make Dhaincha a “Green Gold” for improving soil health, farm resilience and long-term agricultural sustainability.

KEYWORDS: Biological nitrogen fixation, Dhaincha, Green manuring, Soil health, Sustainable agriculture

INTRODUCTION

Modern agriculture has substantially increased crop yields; however, intensive cropping, rising fertilizer costs, declining soil fertility and environmental concerns continue to pose significant challenges. These issues have renewed interest in sustainable nutrient management practices, particularly green manuring (Rani et al., 2022). Among green manure crops, Dhaincha (*Sesbania aculeata*) is a versatile option because of its rapid biomass production, ability to fix atmospheric nitrogen through symbiosis with soil microorganisms, and capacity to contribute organic matter to the soil.

Its benefits extend beyond soil fertility to include nutrient recycling, weed suppression, soil protection and potential livestock-feed supplementation. Thus, Dhaincha is more than a green manure crop; it is a valuable agricultural resource that can support soil health, crop and livestock production, and farm resilience. Its multifunctional role makes it a promising component of sustainable farming systems.

DHAINCHA AT A GLANCE

Dhaincha (*Sesbania aculeata*) is a fast-growing leguminous plant belonging to the family Fabaceae. It is widely valued as a green manure crop because it produces substantial biomass within a relatively short period and fixes atmospheric nitrogen through root nodules. When incorporated into the soil, its biomass supplies organic matter and nitrogen and can support microbial activity and nutrient cycling.

Dhaincha is particularly useful in rice-based and other intensive cropping systems. Depending on crop establishment and management, it can also suppress weeds, protect the soil surface and recycle nutrients. Tender biomass may serve as supplementary green fodder under appropriate feeding practices.

Its relatively low input requirements and multiple functions make Dhaincha a practical option for improving soil fertility and supporting sustainable agriculture. By contributing biologically fixed nitrogen and organic residues, it may reduce dependence on external nitrogen fertilizers and improve nutrient-use efficiency.

Table 1. Biomass production and nitrogen contribution of selected green manure and leguminous crops

Crop	Botanical name	Dry matter accumulation (t ha ⁻¹)	Nitrogen contribution (kg ha ⁻¹)
Dhaincha	<i>Sesbania aculeata</i>	23.2	80–140
Cowpea	<i>Vigna unguiculata</i>	23.2	40–70
Sunn hemp	<i>Crotalaria juncea</i>	30.6	80–100
Mung bean (moong)	<i>Vigna radiata</i>	25.0	25–50
Cluster bean	<i>Cyamopsis tetragonoloba</i>	3.2	40–60

Source: TNAU Agritech Portal (n.d.); values reproduced from the supplied draft and requiring verification against the original source.

GREEN BIOMASS TO SOIL WEALTH

Dhaincha's value lies not only in its ability to fix atmospheric nitrogen but also in the benefits obtained when its biomass is returned to the soil. The crop is commonly incorporated during the vegetative stage, often around 45–60 days after sowing, depending on crop growth, local conditions and the requirements of the succeeding crop.

Following incorporation, soil microorganisms decompose the plant residues and gradually release nutrients into the soil. The relatively low carbon-to-nitrogen ratio of young Dhaincha biomass can favour decomposition and nitrogen mineralization. Its residues also contribute organic matter and provide substrates for soil microorganisms.

Nitrogen release depends on biomass quality, soil temperature, moisture, aeration and microbial activity. Consequently, the timing of incorporation is important for synchronizing nutrient availability with the nutrient requirements of the subsequent crop. Incorporating Dhaincha sufficiently before crop establishment, where appropriate, can help improve nutrient availability and reduce the risk of a mismatch between nitrogen release and crop demand (Rani et al., 2022).

Through these processes, Dhaincha converts green biomass into a valuable source of nutrients and organic matter, contributing to soil fertility and the sustainability of intensive cropping systems.



Fig. 1. Dhaincha (*Sesbania aculeata*) growing as a green manure crop

DHAINCHA: MORE THAN A GREEN MANURE

Dhaincha offers several benefits beyond improving soil fertility. Its rapid growth, biomass production and adaptability make it useful for soil protection, weed suppression, nutrient recycling and selected livestock-feeding applications. Its major uses are summarized below.

1. **Weed suppression:** A rapidly developing canopy can suppress weeds by competing for sunlight, water, space and nutrients. The degree of suppression depends on crop density, establishment and management.
2. **Soil protection:** Its vegetation provides ground cover, while its roots help stabilize the soil and may reduce erosion.

3. **Mulching and composting:** Harvested biomass can be used as mulch or incorporated into compost, returning organic matter and nutrients to the farming system.
4. **Cover cropping:** Dhaincha can provide ground cover during suitable fallow periods, helping protect the soil surface and improve nutrient cycling.
5. **Brown manuring:** When grown alongside a main crop, such as rice, Dhaincha can be knocked down to form surface residues that suppress weeds and contribute nutrients as they decompose (Melavanki et al., 2024).
6. **Nutrient recycling:** Its root system and biomass contribute to nutrient retention and recycling within the farming system.
7. **Management of selected salt-affected soils:** Dhaincha can tolerate certain saline conditions and contribute organic residues to the soil. Its effectiveness depends on the severity and type of salinity, drainage, irrigation-water quality and other soil-management practices.

These multifunctional uses make Dhaincha a valuable component of integrated soil fertility management and diversified cropping systems.

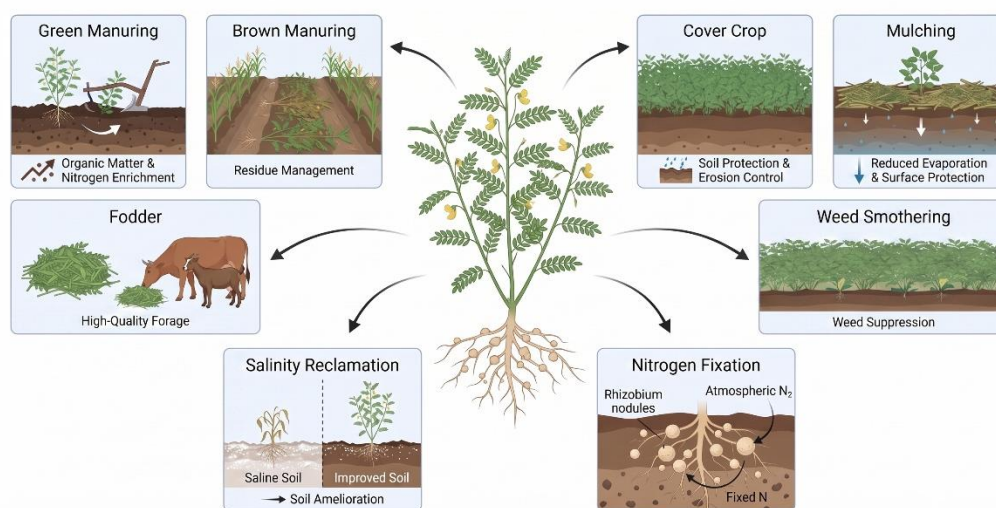


Fig. 2. Multipurpose uses of Dhaincha (*Sesbania aculeata*)

DHAINCHA AS SUPPLEMENTARY GREEN FODDER

Dhaincha may provide supplementary green fodder for cattle, buffaloes, sheep and goats, particularly during periods of limited green-forage availability. Its young biomass can contribute protein and other nutrients to livestock diets, but its suitability depends on the stage of growth, forage composition and the overall feeding system.

Fernandes and Kamble (2011) reported that Dhaincha harvested during the rainy season contained 20.11% crude protein and had an in vitro dry matter digestibility of 71.69%. These findings indicate its potential as a supplementary forage resource under the conditions studied.

For improved tenderness and palatability, Dhaincha may be harvested during the vegetative stage, often around 45–60 days after sowing, depending on growth and local conditions. It should be introduced gradually and fed as part of a balanced ration rather than used as the sole feed. Appropriate feeding recommendations should account for the nutritional requirements of the animal, forage quality and any relevant antinutritional factors.

Thus, the judicious use of Dhaincha as supplementary green fodder can provide an additional benefit by linking soil fertility management with crop–livestock integration.

DHAINCHA IN RICE-BASED FARMING SYSTEMS

Dhaincha is particularly relevant to rice-based cropping systems, where it can be grown before rice establishment and incorporated into the soil as green manure. Its biomass contributes organic matter and biologically fixed nitrogen, potentially improving nutrient availability and supporting soil biological activity.

Green manuring with Dhaincha has been associated with improvements in rice productivity under suitable management conditions. However, the magnitude of any yield increase depends on biomass production, soil fertility, variety, water management, fertilizer application and local climatic conditions. Any general claim of a 10–25% yield increase should therefore be supported by a relevant field study and interpreted according to the conditions under which the results were obtained.

In salt-affected rice-growing areas, Dhaincha may provide additional benefits through biomass production and organic matter inputs. Nevertheless, it should be considered part of an integrated management approach rather than a stand-alone solution for salinity. Effective drainage, appropriate irrigation practices and management of salt accumulation remain essential.

When appropriately integrated into rice-based rotations, Dhaincha can help improve nutrient management, diversify production practices and support the long-term sustainability of intensive farming systems.

DHAINCHA FOR CLIMATE-SMART AGRICULTURE

Dhaincha has potential to contribute to climate-smart agriculture through biological nitrogen fixation, organic matter inputs and improved nutrient cycling. Its incorporation can help reduce reliance on external nitrogen fertilizers when its nitrogen contribution is appropriately accounted for in fertilizer recommendations.

However, its influence on greenhouse-gas emissions, particularly methane (CH_4) and nitrous oxide (N_2O), depends on the production system and management practices. In flooded rice fields, incorporating fresh organic biomass may increase methane production by supplying readily decomposable carbon to soil microorganisms. Conversely, replacing part of the synthetic nitrogen requirement with biologically fixed nitrogen may reduce emissions associated with fertilizer production and, under suitable conditions, nitrogen-related field emissions.

The overall effect depends on biomass quantity and quality, incorporation timing, soil properties, water management and the amount of fertilizer nitrogen applied. Therefore, Dhaincha should not automatically be considered a greenhouse-gas mitigation measure in every situation. Its climate benefits need to be evaluated within the context of the complete cropping system, including changes in methane and nitrous oxide emissions and the potential benefits of improved soil fertility.

Integrating Dhaincha into climate-smart farming strategies requires site-specific management that balances nutrient benefits, crop productivity, water use and environmental outcomes.

CONCLUSION

As agriculture moves towards more sustainable production systems, Dhaincha offers a practical example of how a traditional green manure crop can help address contemporary agricultural challenges. Its ability to fix atmospheric nitrogen, produce substantial biomass, contribute organic matter, suppress weeds and support crop–livestock integration makes it much more than a source of green manure.

When appropriately managed, Dhaincha can improve nutrient cycling and support soil fertility in rice-based and other cropping systems. It may also contribute to supplementary livestock feeding and the management of selected salt-affected soils. Nevertheless, its benefits depend on local growing conditions, biomass management and the requirements of the succeeding crop.

Wider adoption, supported by quality seed, scientific management, farmer awareness and locally appropriate recommendations, can help realize its potential. Although simple in appearance, Dhaincha can contribute to the health of agricultural soils, the productivity of crops and livestock, and the resilience

of farming systems. These multiple benefits make it a promising “Green Gold” for sustainable agriculture.

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