Indian Vet. J. September 2025, 102 (9) : 22 - 28

Influence of season and plant age on growth, biomass yield, nutritive value and soil health of Dhaincha (*Sesbania aculeata L.*) under semi-arid conditions

Santhiya D, Bharathy N*, Anandha Prakash Singh D, Vasanthakumar P, Nithya C and Ragul M

Veterinary College and Research Institute
Tamil Nadu Veterinary and Animal Sciences University, Namakkal - 637002, Tamil Nadu

30/25

Abstract

Dhaincha (*Sesbania aculeata L.*) is a fast-growing annual legume with potential as a forage and green manure crop under semi-arid tropical conditions. A field experiment was conducted during winter and summer to study the effect of plant age and season on growth, biomass yield, chemical composition and soil fertility. Plant height increased from 2.50 to 165.00 cm in winter and from 3.17 to 178.50 cm in summer, while fresh biomass yield was higher in summer (38 t ha^{-1}) than winter (33 t ha^{-1}). Dhaincha contained high crude protein (17.49% DM) with low tannin content (1.85 mg g^{-1}), and cultivation improved soil organic carbon and nutrient availability. Summer harvest at flowering was optimal.

Keywords: Dhaincha, Plant age, Soil fertility, Seasonal variation

Introduction

Dhaincha (*Sesbania aculeata L.*), a fast-growing annual legume belonging to the family Fabaceae, is widely cultivated in India as a green manure and forage crop due to its rapid biomass production and adaptability to diverse agro-climatic conditions. It is recognized as one of the most efficient green manure crops in tropical and subtropical regions (Ram and Singh, 2011) and is capable of thriving under adverse soil conditions such as salinity, sodicity, drought and temporary waterlogging (Ramesh and Rathika, 2017). Dhaincha contributes significantly to soil fertility through biological nitrogen fixation and organic matter addition, producing 20 - 25 t ha^{-1} of green biomass and reducing dependence on chemical fertilizers (Ramesh and Rathika, 2017; Rajesh *et al.*, 2017). Incorporation of dhaincha residues improves soil physical properties, microbial activity and nutrient cycling (Chanda *et al.*, 2021).

In addition to its role in green manuring, dhaincha has gained importance as a potential forage crop due to its relatively high crude protein and mineral content when harvested at appropriate growth stages (Masilamani *et al.*, 2021). Agronomic practices such as spacing and nutrient management significantly influence growth and biomass yield (Rajesh *et al.*, 2017), while improved varieties such as TRY-1 released by Tamil Nadu Agricultural University have enhanced its production potential (Anonymous, 2024). However, cultivation of dhaincha has declined in recent decades due to limited availability of quality seed and lack of standardized production practices (Chittapur and Kulkarni, 2003). Therefore, the present study was undertaken to evaluate the effect of plant age and season on growth performance, biomass yield, chemical composition and soil fertility parameters of dhaincha under semi-arid conditions of Tamil Nadu.

MATERIALS AND METHODS

Description of the study area

The study was conducted from November 2024 to April 2025 at the Livestock

*Corresponding author : lpmbharathi@gmail.com

Farm Complex, Veterinary College and Research Institute, Namakkal, Tamil Nadu. The experimental site is located in the north-western agro-climatic zone of Tamil Nadu at 11° and 12°55′ N latitude and 77°28′ and 78°50′ E longitude, with an altitude of 192 m above mean sea level. Cultivation, irrigation and morphological observations were carried out under field conditions. The mean seasonal microclimatic variables recorded at the Agro-Meteorological Field Unit of the institute during winter and summer seasons are presented below:

Microclimatic variables	Winter	Summer
Maximum air temperature (°C)	31.00a ± 0.23	35.93b ± 0.21
Minimum air temperature (°C)	20.23a ± 0.17	24.07b ± 0.16
Maximum Relative humidity (%)	79.38b ± 0.72	74.72a ± 0.72
Minimum Relative humidity (%)	55.75b ± 1.50	48.45a ± 1.36
Total Rainfall (mm)	237.5 ± 0.50	257.02 ± 0.59
Total Rainy days	18	19

[a,b,c]Means with different superscripts in the same row differ significantly (P < 0.05)

Experimental design and crop management

Dhaincha (*Sesbania aculeata L.)* was raised as a green manure crop using a seed rate of 50 kg ha^{-1}. Six plants were randomly selected and tagged from each treatment for recording biometric observations. Growth parameters such as plant height and number of branches per plant were recorded at different growth intervals. For dry matter estimation, herbage from a randomly selected 1 × 1 m quadrat was harvested. The samples were shade dried and subsequently oven dried at 80°C for 72 h to obtain constant weight. Dry matter yield was expressed as kg ha^{-1}.

Soil sampling and analysis

Soil samples were collected from the experimental field before sowing and after harvest for assessment of physical and chemical properties. The soil of the experimental site was classified as red loam. Soil analysis was carried out at the Krishi Vigyan Kendra, Namakkal, and the results are presented in Table 2.

Morphological observations

Morphological parameters including plant height and number of branches per plant were recorded at different growth stages (Tables 3 and 4). Plant height was measured from the base of the stem to the apical tip using a measuring tape. The number of branches per plant was determined by manual counting.

Cutting and biomass yield estimation

The crop was harvested at the flowering stage (45 days after sowing). Plants were cut approximately 15 cm above ground level. Fresh biomass from each plot was weighed immediately after harvest. A representative subsample (about 1000 g) was oven dried at 55°C for 72 h until constant weight to estimate dry matter content. Total dry matter yield was calculated by multiplying plot fresh weight with the dry matter proportion of the subsample.

Chemical analysis of dhaincha fodder

Different forms of dhaincha fodder were analysed for moisture, dry matter, crude protein, ether extract, crude fibre, calcium and phosphorus following standard AOAC procedures (AOAC, 2012; procedures 930.15, 984.13, 2003.06, 962.09, 927.02 and 965.17, respectively). Total ash and acid insoluble ash were estimated as per IS 14827:2000 and IS 14826:2021. The results were expressed on a dry matter basis (Table 5).

RESULTS AND DISCUSSION

Effect of dhaincha cultivation on soil properties

Cultivation of dhaincha (*Sesbania aculeata L.*) resulted in marked improvement in soil chemical properties, while inherent physical characteristics such as soil colour, texture and lime status remained unchanged (Table I). The soil retained its red colour, sandy loam texture and non-calcareous nature, indicating that short-term cultivation of dhaincha does not alter basic soil physical properties, which concurs with earlier reports (Tripathi *et al.*, 2013; Ramesh and Rathika, 2017).

Soil pH decreased from 7.77 to 7.47 after dhaincha incorporation, shifting the soil from slightly alkaline to near-neutral condition. This reduction could be attributed to decomposition of dhaincha biomass and release of organic acids during mineralization, enhancing nutrient availability (Chanda *et al.*, 2021). Electrical conductivity increased marginally from 0.038 to 0.153 dS m^{-1}; however, the soil remained non-saline, indicating no adverse salinity effect.

Organic carbon content increased from 0.47 to 0.50 %, reflecting improved soil organic matter status due to incorporation of legume residues. Similar increases in organic carbon following dhaincha cultivation were reported by Masilamani *et al.* (2021). Available nitrogen increased from 289 to 294 kg ha^{-1}, confirming effective biological nitrogen fixation by dhaincha through Rhizobium association (Ramesh and Rathika, 2017; Rajesh *et al.,* 2017). Available phosphorus increased from 15.68 to 19.32 kg ha^{-1}, possibly due to enhanced microbial activity and organic acid-mediated solubilization (Tripathi *et al.,* 2013). Available potassium increased slightly (98 to 103 kg ha^{-1}), while available sulphur increased substantially from 6.89 to 10.32 mg kg^{-1}, shifting the soil sulphur status from low to medium. Overall, dhaincha cultivation improved soil fertility status, highlighting its role as an effective green manure crop for sustainable soil management.

Effect of plant age and season on growth of dhaincha

Plant height

Plant height increased significantly with advancing plant age in both seasons (Table II). During winter, plant height increased from 2.50 ± 0.22 cm at 7 days to 165.00 ± 1.69 cm at 63 days, whereas in summer it increased from 3.17 ± 0.31 cm to 178.50 ± 1.91 cm over the same period. Higher plant height during summer may be attributed to favourable temperature and enhanced physiological activity. Similar age- and season-dependent increases in plant height were reported by Ramesh and Rathika (2017), Masilamani *et al.* (2021) and Chanda *et al.* (2021).

Number of branches per plant

The number of branches per plant increased progressively with crop age in both seasons (Table III). Winter-grown plants recorded an increase from 1.83 ± 0.31 to 50.00 ± 1.39 branches per plant, while summer-grown plants showed higher branching from 2.33 ± 0.21 to 57.67 ± 0.84 branches per plant. Enhanced branching during summer could be due to better resource utilization and vegetative vigour. These findings are in agreement with Rajesh *et al.* (2017) and Masilamani *et al.* (2021).

Biomass yield of dhaincha

Biomass production was higher during summer compared to winter (Table IV). Fresh biomass yield was 33.0 t ha^{-1} in winter and 38.0 t ha^{-1} in summer, while dry matter yield was 6.6 and 7.6 t DM ha^{-1}, respectively. Higher biomass yield during summer coincided with greater plant height and branching. Similar yields at 60 – 65 days after sowing were reported by Chanda *et*

al. (2021) and Masilamani *et al.* (2021). Ramesh and Rathika (2017) also reported that harvesting dhaincha at flowering ensures optimum biomass production.

Chemical composition of dhaincha

The chemical composition of dhaincha in green, wilted and dried (hay) forms is presented in Table V. Moisture content decreased from 80.10% in green fodder to 9.46 % in dried hay. Crude protein content was highest in green dhaincha (17.49% DM), followed by dried hay (16.18% DM) and wilted fodder (14.88% DM), indicating its suitability as a protein-rich leguminous fodder. Crude fibre content increased with processing (29.35 to 42.19% DM), likely due to concentration of structural carbohydrates following moisture loss. Ether extract and total ash contents decreased with drying, while acid insoluble ash declined from 1.21 to 0.39%, indicating reduced soil contamination. Calcium (1.04–1.94% DM) and phosphorus (0.35–0.44% DM) contents were within recommended levels for small ruminants. Total tannin content was low (1.85 mg g^{-1}), which is considered beneficial for improving protein utilization without adversely affecting intake. These findings are consistent with earlier reports on dhaincha and other leguminous fodders (Rajesh *et al.*, 2017; Masilamani *et al*., 2021; Chanda *et al.,* 2021).

CONCLUSION

The present study demonstrated that dhaincha (*Sesbania aculeata L.)* exhibited significant improvement in growth, biomass yield, nutritive value and soil fertility with advancing plant age, with superior performance during the summer season. Increased plant height and branching resulted in higher biomass production, particularly when harvested at the flowering stage (60–63 days after sowing). The high crude protein content, adequate mineral composition and low tannin concentration indicate that dhaincha is a suitable leguminous fodder for ruminant feeding. Improvement in soil organic carbon and available nutrients further confirms its effectiveness as a green manure crop. During cultivation of dhaincha (*Sesbania aculeata*), the available sulphur content in the soil shows a slight increase. This is mainly due to the addition of organic residues and root exudates, which enhance microbial activity and promote the mineralization of organic sulphur into plant-available forms. However, the increase is generally moderate, as dhaincha contains relatively low sulphur compared to other major nutrients. Even so, its cultivation contributes to improved soil fertility and nutrient availability, including a gradual buildup of available sulphur. Hence, dhaincha can be recommended as a multifunctional crop for sustainable livestock production and integrated farming systems under semi-arid tropical conditions.

REFERENCES

Anonymous (2024). TNAU released varieties. Tamil Nadu Agricultural University. Available at: https://agritech.tnau.ac.in/crop_improvement/crop_imprv_tnau_varieties.html

AOAC (2012). Official methods of analysis. 19th Edn., Association of Official Analytical Chemists, Washington, DC.

Chanda, C.S., Abdullah, R.M., Razzak, A.M. and Sarwar, G.A.K.M. (2021). Morphological and physiological characterization of Sesbania genotypes. *Legume Research,* **44**(9): 1087–1091. doi: 10.18805/LR-4

Chittapur, B.M. and Kulkarni, S.S. (2003). Effect of sowing dates on the performance of sunnhemp. *Journal of Maharashtra Agricultural University*, **28**(3): 331–332.

Masilamani, P., Eevera, T., Ramesh, T. and Venkatesan, S. (2021). Harvesting and threshing methods on seed quality of dhaincha (*Sesbania aculeata*). *Legume Research.* doi: 10.18805/LR-4642

Rajesh, P., Rajapandian, J.S., Sharmili, K., Marimuthu, S. and Suresh Kumar, R. (2017). Effect of spacing and fertilizer levels on yield attributes of dhaincha (*Sesbania aculeata*). *Legume Research*, **40**(6): 1136–1138. doi: 10.18805/LR-3564

Ram, H. and Singh, G. (2011). Growth and seed yield of sunnhemp genotypes as influenced by sowing methods and seed rates. *World Journal of Agricultural Sciences*, **7**(1): 109–112.

Ramesh, T. and Rathika, S. (2017). Optimization of nitrogen dose for green manure incorporated rice under sodic soil. *Madras Agricultural Journal*, **104**(7–9): 221–225. doi: 10.29321/MAJ.2017.000048

Tripathi, M.K., Chaudhary, B. and Bhandari, H.R. (2013). Growth and yield of sunnhemp (*Crotalaria juncea L.*) as influenced by spacing and topping practices. *African Journal of Agricultural Research*, **8**(28): 3744–3749.

Table I Effects of cultivation of Dhaincha on different soil parameters

Soil Properties	Values/Description (Before Dhaicha Cultivation)	Values/Description (After Dhaincha Cultivation)
Soil colour	Red	Red
Soil Texture	Sandy loam	Sandy loam
Lime status	Non Calcareous	Non Calcareous
Soil pH	7.77	7.47
EC (dS m-1)	0.038	0.153
Organic carbon (%)	0.47	0.50
Available Nitrogen (kg ha-1)	289	294
Available Phosphorus (kg ha-1)	15.68	19.32
Available Potassium (kg ha-1)	98	103
Available Sulphur (mg kg-1)	6.89	10.32
Description	Slightly alkaline, non-saline, low in organic carbon, medium in available nitrogen, medium in phosphorus, low in potassium and low in sulphur	Neutral, non-saline, medium in organic carbon, medium in available nitrogen, medium in phosphorus, low in potassium and medium in sulphur

Table II Effect of plant age and season on plant height (cm) of dhaincha (*Sesbania aculeata*)

Plant age (in days)	Winter	Summer
7	2.50 ± 0.22	3.17 ± 0.31
14	6.33 ± 0.67	8.17 ± 0.31
21	11.00 ± 0.58	13.83 ± 0.48
28	21.67 ± 0.88	47.00 ± 2.88
35	51.17 ± 1.05	89.17 ± 1.01
42	78.83 ± 2.55	110.83 ± 2.34
49	129.67 ± 2.22	146.33 ± 1.23
56	149.00 ± 1.06	158.00 ± 1.65
63	165.00 ± 1.69	178.50 ± 1.91

Table III Effect of plant age and season on number of branches of dhaincha (*Sesbania aculeata)*

Plant age (in days)	Winter	Summer
7	1.83 ± 0.31	2.33 ± 0.21
14	4.50 ± 0.22	7.17 ± 0.60
21	7.00 ± 0.37	10.67 ± 0.42
28	11.00 ± 0.58	17.00 ± 0.52
35	17.17 ± 0.60	26.00 ± 1.06
42	22.00 ± 0.58	30.33 ± 0.88
49	30.50 ± 0.76	37.50 ± 1.12
56	37.83 ± 1.17	47.00 ± 0.58
63	50.00 ± 1.39	57.67 ± 0.84

Table IV Effect of plant age and season on biomass production of dhaincha (*Sesbania aculeata*)

Biomass yield	Winter	Summer
Fresh yield (ton/ha)	33 tonnes/ha	38 tonnes/ha
Dry matter yield (ton/ha)	6.6 t DM /ha	7.6 t DM /ha

Table V Chemical composition (%) of different forms of Dhaincha (*Sesbania aculeata*)

Nutrients	Green	Wilted	Dried (hay)
Moisture	80.1	54.11	9.46
Crude protein	17.49	14.88	16.18
Crude fibre	29.35	37.76	42.19
Crude fat	2.86	2.61	2.11
Crude ash	8.84	6.97	6.07
Acid insoluble ash	1.21	0.57	0.39
Calcium	1.71	1.94	1.04
Phosphorus	0.35	0.44	0.44
Salt	2.01	1.33	0.80
Total tannin	1.850 mg/g of dried sample		

Cultivation of Dhaincha