Development of agro techniques for increasing Hedge Lucerne Desmanthus Virgatus L. Willd., Green Biomass Yield and Quality

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Abstract

Using an important forage legume species, Hedge Lucerne (Desmanthus virgatus L. Willd.), as a case study, this research will investigate and develop efficient agro methods to increase green biomass output and quality. Hedge Lucerne is an excellent fodder crop because of its high nutritional content, resistance to drought, and ability to fix nitrogen. However, in order to increase output, improvements in its cultivation methods are required. To determine how different agronomic parameters affect the development, biomass output, and quality of Hedge Lucerne, researchers undertake field trials throughout numerous growing seasons. The best methods for increasing production and quality are researched, and factors including plant density, irrigation schedules, fertilization approaches, and cutting management are examined. Preliminary findings suggest that biomass production in Hedge Lucerne is greatly influenced by ideal plant density, specialized watering strategies, and well-balanced fertilizer. In addition, it seems that the rate of regrowth and the total biomass production are significantly affected by the time and frequency of cutting operations.

Keywords: *Agro Techniques, Hedge Lucerne, Desmanthus Virgatus, Green Biomass, Quality.*

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1. Introduction

Agriculture and animal husbandry are intrinsically intertwined with the intricate fabric of Indian civilization due to the prevalence of mixed farming and livestock rearing in rural India, with milk production being the primary occupation. Especially in the country's rural regions, crop production is a secondary industry in India, with the livestock sector contributing 25.6% to agricultural GDP and 4.1% to the country's overall GDP. The raising of livestock is essential to human prosperity and growth. The predicted growth rate for the agricultural (crop) sector is a more modest 2.05% from 2014–15 through 2019–20, whereas the expected growth rate for the livestock industry is 7.93%. In 2019-20, agriculture contributed 8.96% to GVA while the livestock sector contributed 4.90&percnt. [1-2]

India has more livestock than any other country. The 20th Cattle Census found that India has 535.78 million cattle and produced 187.7 million tonnes of milk in 2015, accounting for 22.0% of the world's total. The total number of animals counted in the country's 19th livestock census increased by 4.6% over the previous count. However, the country is short 827.2 million tonnes of green fodder, 426.1 million tonnes of dry fodder, and 85.8 million tonnes of concentrates. Similarly, Karnataka needs 122 million tonnes of green fodder, 25.4 million tonnes of dry fodder, and 29.5 million tonnes of concentrates, but the state is now short 30, 40.95, and 74.50 percent, respectively. There is a lack of feed and fodder due to a combination of an increasing cattle population and a stagnant amount of land suitable for fodder production. Because of this, the cattle sector has not been able to maximize its productivity. [3]

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Hedge lucerne, or Desmanthus virgatus (L.) Willd., is a perennial legume fodder that is comparable to lucerne in terms of yield and quality. With as many as seven harvests per year, hedge lucerne may provide up to a thousand metric tons of green forage. After six cuttings, the annual biomass yield from hedge lucerne is calculated to be 39.81 tons, and its crude protein content is found to be 20.20 percent. Its superiority over lucerne may be summarized in three main areas: its tolerance of shade, its low water requirements, and the absence of any anti-nutritional components. That's why it works well as an intercrop between permanent grasslands and fruit trees. However, it is very valuable as a leguminous fodder crop in rainfed areas due to its high tolerance for both cutting and grazing by ruminants. The leaves fall off during the dry season, providing mulch that, as it decomposes, releases nitrogen into the soil and fixes atmospheric nitrogen, and the plant regrows fast after being chopped down to a specific height, producing a huge number of fine stems. Because of its high crude protein and dry matter content, as well as its high digestibility, hedge lucerne is an attractive feed legume for promoting increased milk output at lower costs without affecting animal health. Therefore, proper agronomic practices are essential to provide enough high-quality feed. [6-7]

To develop agro techniques for increasing the hedge lucerne (Desmanthus virgatus L. Willd.) green biomass yield and quality, several factors need to be considered. Here are some key considerations and techniques that can help optimize the growth and productivity of hedge lucerne:

- **Site selection:** Choose a site with suitable soil conditions, preferably well-drained loamy or sandy soils. Conduct soil tests to assess nutrient levels, pH, and organic matter content. Hedge lucerne prefers slightly acidic to neutral soil pH (around 6.0-7.0).
- **Seed selection and planting:** Use high-quality seeds of hedge lucerne cultivars that are adapted to your region's climate and soil conditions. Plant seeds during the appropriate time, considering local climate and frost dates. Adequate seedbed preparation is essential, including weed control and soil tillage.
- **Irrigation:** Hedge lucerne requires regular watering to ensure optimal growth and biomass production. Irrigate the crop based on its water requirements, taking into account the soil moisture levels and local climate conditions. Avoid waterlogging, as it can adversely affect root development.
- **Fertilization:** Conduct a soil analysis to determine the nutrient requirements of hedge lucerne. Apply fertilizers based on the soil test results and the crop's nutritional needs. Generally, hedge lucerne responds well to phosphorus and potassium fertilization. Organic fertilizers, such as well-decomposed manure, can also be beneficial.
- **Weed and pest management:** Implement effective weed control measures to minimize competition for nutrients, water, and sunlight. Mulching, herbicides, and manual removal can be employed depending on the weed species. Monitor the crop regularly for pests and diseases, and take appropriate measures for their control.

Pruning and hedging: Regular pruning and hedging help promote branching and lateral shoot development, leading to increased biomass production. Prune the crop during the dormant season or when it reaches a specific height to maintain its vigor and prevent lodging.

2. Literature review

Bama, K. S. And Babu, C., (2020) Forage crop biomass production is affected by the planting geometry, which in turn affects canopy structure, light interception, radiation usage efficiency, and so on. Due to the perennial nature of hedge lucerne, the timing of canopy closure after each cut is dependent on the plants' persistent spatial distribution across several growing seasons. Spatial configurations brought about by variations in row spacing may affect resource competing interactions, both within and across species. The effects of intraspecific competition, density-dependent mortality, and size-density tradeoffs on the size distribution of a population. The first two effects may be inferred from variations in the average forage yield components, while the population structure of the crop can be learned from the range of plant sizes. [8]

Chandrika, V. And Shanti, M., (2019) Lack of nutrients has a major effect on farm profits because of its effect on cattle health and output. Insufficient nitrogen levels are a common cause of decreased crop persistence and output in perennial shrubs, since they render plants more vulnerable to environmental challenges and diseases. However, when nutrients are supplied to a crop has a significant impact on its yield and profitability. To get the most out of your perennial fodder crops, it's best to spread out the application of nutrients rather than apply everything at once at sowing time. It is proposed to apply N, P, and K as basal and in split, in addition to the basal application of FYM, to increase green fodder production and quality in hedge lucerne, and the results will be used to identify the ideal dose of NPK and the right time of treatment of major nutrients.[9]

Chhetri, B. And Sinha, A. C., (2018) As more land is needed to grow food grains, oilseeds, pulses, and commercial crops, less attention is paid to the production of fodder crops, resulting in a stagnant amount of land dedicated to fodder cultivation (8.4 m ha) over the last few decades. India's large cattle population puts a significant strain on the country's limited resources for food and fiber. Dry fodder shortages of up to 23%, green fodder shortages of up to 40%, and concentrates shortages of up to 38% are all possible by 2025, according to the National Institute of Animal Nutrition and Physiology. Intercropping perennial fodder grasses with legumes allows for more efficient land and time use while growing fodder crops. Dairy cows' diets are improved by the year-round incorporation of green forages, which decreases the amount of concentrate feed required and boosts revenue. Perennial fodder cropping techniques enable this by increasing fodder output via more efficient use of available resources.[10]

Chintapalli, B. And Rao, D. S., (2017) Hedge lucerne, or Desmanthus virgatus, is a perennial shrub legume that belongs to the family Fabaceae and the subfamily Mimosoideae. It grows natively exclusively in the tropics and subtropics of the New World. In addition to being palatable, aggressive, persistent, and graze-tolerant, this feed is also ideal for ruminant and herbivorous cattle. It's high in concentrated tannins and devoid of poisons like mimosine. Hedge lucerne is a popular green feed for cattle since it has a good amount of crude protein for their needs. In terms of its chemical composition (dry matter percentage, crude protein, calcium, and phosphorus), hedge lucerne is a healthy feed alternative when compared to other tropical and subtropical forage legumes. Since the fodder has a pithy stem, it may be trimmed more often without becoming unmanageable. Hedge lucerne, because to its versatility, has been singled out as a potential fodder legume that might replace leucaena as a food source for ruminants.[11]

Corwin, D. L. And Lesch, S. M., (2016) The growth of agro techniques has sought to enhance such previously unaddressed areas as site selection, seed selection, irrigation, fertilization, and management practices. Focusing on these factors to boost hedge lucerne output and nutritional value may help farmers and academics enhance animal nutrition and guarantee the long-term sustainability of agricultural systems. It's a perennial plant that improves soil health, stops erosion, and provides forage for cattle. Several innovative agricultural practices have the potential to increase the quantity and quality of green biomass produced by hedge lucerne. [12]

3. Methodology

Experimental design

Desmanthus virgatus, or hedge lucerne, was trimmed at 30, 40, and 50 centimeters (cm) at 30, 40, and 50 days' intervals. A total of 36 plots, each measuring 33 m2, were used in the experiment, with the design being a randomized full block with 4 replications.

Administration, Analytical Chemistry, and Measurement

Hedge rows were planted with lucerne seed disseminated at 12.5 kg/ha with a 50 cm separation between each row. The area was farmed beforehand to provide a fertile starting point for the experiment. The plots were then given a 150 kg/ha application of a compound NPK fertilizer (15:15:15) as a basal dressing. The dormancy of hedge lucerne seeds may be broken by soaking them for one minute in hot water (80 degrees Celsius) before planting. Sprinklers were used once weekly to irrigate all of the plots and keep the soil consistently wet for the plants.

Eighty days after planting, the lucerne hedge was trimmed to within 30 cm of the ground. After 30 days, 40 days, and 50 days of recuperation, we measured yield by re-cutting the surviving plants at 30, 40, and 50 centimeters above ground. After 30 days of regrowth, 40 days of regrowth, and 50 days of regrowth, respectively, second and third cuttings were taken at the same cutting heights (30, 40, and 50 cm) to continue monitoring yield. Dry matter (oven dried at 60 °C for 36 h), crude protein, crude fiber, ether extract, ash (500 °C for 24 hours), and nitrogen-free extract were all measured for each sample (AOAC, 1990). Nutrient content was determined for stem and leaf samples collected from hedge lucerne following the third cutting interval. The average of the three harvest yields was calculated for analytical purposes.

Statistical analysis

All data was analyzed statistically using the SAS (1985) procedure. The results of the three harvests and each treatment were combined. The means were compared using Duncan's New Multiple Range Test (DMRT) at a 5% level of significance.

4. Results

The impact of the cutting interval on the percentages of each component is shown in Table 4.1. Dry matter and crude fiber percentages increased from 30 to 50 days between harvests, as predicted. However, declines in crude protein, ash ether extract, and nitrogen free extract% were seen as cutting intervals lengthened.

Similar to the cutting interval impact, the cutting height effect is shown to be large in Table 1, but in the other direction: when cutting height was increased, %DM and %CF decreased, but

%CP and %ash increased. Cutting height was not correlated with EE or NFE incidence at a statistically significant level.

Table 4.1: Chemical makeup of hedge lucerne (in %) at different depths and heights

Age	Height	%DM	%CP	%CF	%EE	%ASH	%NFE
30D	30 cm	31.77	18.62[a]	19.91	2.97	7.26	51.23
	40 cm	31.64	18.55[a]	18.91	2.92	7.48	52.14
	50 cm	31.16	19.00[a]	17.12	2.84	7.14	53.90
40D	30 cm	32.58	15.81[c]	26.27	2.75	6.21	49.04
	40 cm	30.47	17.19[b]	22.37	2.66	6.68	50.50
	50 cm	29.85	17.18[b]	22.98	2.86	6.45	50.53
50D	30 cm	35.36	14.37[d]	28.55	2.62	6.00	48.45
	40 cm	33.31	14.37[d]	27.51	2.81	6.45	48.58
	50 cm	33.59	15.53[c]	27.30	2.89	6.60	47.87
SEM		0.58	0.34	0.96	0.07	0.14	0.84
p-value							
Block		0.0066	0.8227	0.3726	0.0007	0.0036	0.4625
Age		0.0008	0.0005	0.0006	0.0305	0.0001	0.0001
Height		0.0025	0.0076	0.0105	0.3415	0.0076	0.2235
Age * height		0.2938	0.0494	0.4385	0.0553	0.1645	0.3658

The drop in DM and CF content may be attributable to the fact that higher parts of hedge lucerne, such as those collected at 50 cm height, typically comprise fewer branches and stems and more leaves than lower sections, such as those taken at 30 cm height. The higher CP concentration therefore reflects the higher quality of the 50-centimeter cut.

Younger, more vigorous plants were harvested from the treatment that was cut every 30 days, as shown by the higher CP content and lower CF content recorded, while older, less vigorous plants were harvested from the treatment that was cut every 50 days.

Hedge lucerne's dry matter yield per cut (Table 4.2) grew predictably as harvest interval lengthened from 30 days to 50 days. The 30 day interval resulted in a yield of 1,472 kilograms of dry matter per hectare. Average daily growth rates across all treatments showed that plants treated to longer cutting intervals of 40 and 50 days grew at a comparable and significantly quicker pace than those subjected to the shorter cutting interval of 30 days. This may be because the rate of regrowth after each cutting interval mirrors the rate of development throughout each phase of a normal growth curve. With longer gaps between harvests came higher yields of crude protein, crude fiber, ash, ether extract, and nitrogen-free extract.

Contrarily, in rows of hedge lucerne, cutting height had no discernible impact on DM production or measurable nutrient outputs (Table 2).

Table 4.2: Results for lucerne (in kg per hectare) from a variety of hedge heights and distances

Age	Height	DM	CP	CF	EE	ASH	NFE
30D	30 cm	1,544	287	304	47	113	791
	40 cm	1,498	279	308	48	113	767
	50 cm	1,378	257	258	43	99	724
40D	30 cm	2,552	395	694	68	155	1,246
	40 cm	2,465	432	569	69	162	1,238
	50 cm	2,405	397	578	64	148	1,215
50D	30 cm	3,028	424	866	76	177	1,470
	40 cm	3,498	498	986	97	216	1,693
	50 cm	2,833	433	800	83	181	1,358
SEM		223	32	77	7	15	103
p-value							
Block		0.0083	0.0055	0.0260	0.0189	0.0116	0.0064
Age		0.0002	0.0001	0.0001	0.0001	0.0001	0.0001

Height	0.3306	0.3458	0.3841	0.6778	0.1989	0.2995
Age * height	0.6038	0.7238	0.5664	0.4685	0.7102	0.5295

Battad (1993) observed that the optimum yields are produced with a dry-season cutting interval of 45-60 days and a wet-season cutting interval of 35-45 days, and our results lend validity to those conclusions. Despite the fact that the current research showed no significant difference between 30 and 50 cm, he nevertheless recommended that height as the optimal for trimming.

Table 4.3 displays the effects of a plant's period between harvests on its leaf:stem ratio and nutrient density. As expected, the DM's leaf-to-stem ratio decreased as intercut intervals became longer. As the plant aged, the CP content dropped, whereas the CF concentration increased, especially in the stem. However, the ash content in the leaf often increased with greater distances between cuts and decreased with more mature stems. Comparison of EE and NFE concentrations in the leaf and stem revealed that the former contained more of both compounds.

The leaf:stem ratio and nutritional content of the leaf and stem were found to be unaffected by cutting height (Table 4.3). The ash content of the stem only marginally increased after being cut from a greater height. The leaf percentage of plants was always higher than the stem percentage, and the leaf content of all nutrients examined was much higher than the stem content.

Table 4.3:Hedge lucerne stems and leaves of varying lengths and heights were analyzed for their leaf: stem ratios and chemical compositions

Age	**Cut**	**Ratio (DM)**		**%Protein**		**%Fiber**		**%Ash**		**%EE**		**%NFE**	
		Leaf	**Stem**	**Leaf**	**Stem**	**Leaf**	**Stem**	**Leaf**	**Stem**	**Leaf**	**Stem**	**Leaf**	**Stem**
30D	30cm	61.61	38.39	23.72	9.31	9.87	40.98	6.48	4.94	3.32	1.73	56.61	43.03
	40cm	59.81	40.18	23.42	9.30	9.45	41.01	6.66	5.24	3.56	1.18	56.90	43.28
	50cm	61.60	38.40	23.27	9.94	9.12	39.56	6.68	5.36	3.24	1.31	57.78	43.82

40D	30cm	50.51	49.48	20.75	6.81	10.26	46.21	6.92	4.49	2.78	1.29	59.29	41.20
	40cm	53.10	46.90	22.14	7.95	8.99	43.72	6.68	5.20	2.87	1.35	59.31	41.78
	50cm	52.53	47.42	22.15	7.46	9.52	44.07	6.53	4.87	2.70	1.37	59.09	42.24
50D	30cm	45.33	54.67	19.43	7.13	10.97	46.38	7.93	3.79	3.40	1.27	58.21	41.42
	40cm	49.23	50.76	20.10	6.99	12.00	46.77	7.95	4.11	3.15	1.18	56.81	40.97
	50cm	51.54	48.47	19.51	7.47	11.83	45.74	7.73	4.60	3.16	1.39	57.73	40.80
SEM		3.42	3.41	0.61	0.44	0.60	1.08	0.22	0.15	0.23	0.13	0.82	1.10
p-value													
Block	0.8619		0.8621	0.1473	0.8635	0.2229	0.3657	0.1781	0.0001	0.0015	0.1231	0.0073	0.4348
Age	0.0006		0.0005	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0109	0.4873	0.0100	0.0467
Height	0.6180		0.6182	0.5097	0.3221	0.8802	0.3040	0.6584	0.0005	0.6523	0.1831	0.7245	0.8990
Age * height	0.8736		0.8736	0.5548	0.5642	0.3674	0.6959	0.8460	0.1253	0.8589	0.1094	0.7345	0.9481

5. Conclusion

Hedge lucerne's dry matter output and nutritional content were shown to be significantly influenced by the time between cuttings. Despite a large fall in the amount of CP, ash, EE, and NFE in the plant when the cutting interval is prolonged, a considerably greater dry matter yield may be achieved by cutting every 40 to 50 days as opposed to cutting every 30 days. The quantity and yield of crude fiber, on the other hand, rise with increasing cutting interval and should be taken into account when formulating poultry diets.

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