International Journal of Plant & Soil Science

34(21): 195-201, 2022; Article no.IJPSS.89084
ISSN: 2320-7035

Assessment of Suitable Grass and Legume Fodders for the Development of Pastures under Coconut Garden

S. M. Vinodhini [a], S. D. Sivakumar [a*], R. Karthikeyan [a] and M. Thirunavukkarasu [b]

[a] Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, 641003, India.
[b] Department of Veterinary and Animal Science, Tamil Nadu Agricultural University, Coimbatore, 641003, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i2131255

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/89084

Original Research Article

Received 24 June 2022
Accepted 11 July 2022
Published 12 July 2022

ABSTRACT

Aim: The study was conducted for the evaluation of suitable grass and legume fodders for the development of pastures under coconut garden.
Study Design: Randomized Block Design.
Place and Duration of Study: The field experiment was carried out in Farmer's coconut field, Pollachi, Coimbatore, Tamil Nadu during 2021-2022.
Methodology: Ten different fodder crops were selected which includes six grasses and four leguminous fodders. Stem cuttings of grass fodders and seeds of legume fodders were raised in three replications. 90 Days After Planting (DAP) the observations were taken for the growth parameters of plant height, establishment percentage, green fodder yield. The crop was cut at 90 DAP followed by subsequent cuts at 120 DAP (i.e. 30 Days interval between two cuts). The fodder growth and development were observed in field as well as nutrition dynamics along with other quality parameters which include crude fibre, ash content were analyzed in laboratory.
Results: *Panicum maximum* recorded higher values of plant height (205.00 cm), establishment percentage of 100 % and green fodder yield of 183 t ha^{-1} $year^{-1}$. Other grasses includes *Brachiaria mutica*, *Brachiaria ruziziensis* and *Brachiaria decumbens* had good establishment and yield. Among

**Corresponding author: E-mail: rainfedsiva@yahoo.co.in;*

legumes *Desmodium giganticum* was found to be performed well under shade with plant height of 181.00 cm and green fodder yield of 125 t ha^{-1} year^{-1} followed by *Macroptilium atropurpureum* with 148.00 cm height and green fodder yield of 98.0 t ha^{-1} year^{-1}. *Dichanthium annulatum* had poor establishment under shaded environment. Ash content was high in *Macroptilium atropurpureum* with 21.90%. Crude fibre was observed high in *Dichanthium annulatum* with 41.15%.

Conclusion: *Panicum maximum* and *Brachiaria sp* in grasses as well as *Desmodium giganticum* and *Macroptilium atropurpureum* among legumes were found to perform well under shade in coconut garden.

Keywords: Fodders; shade tolerant fodder crops; pastures under coconut garden; crude fibre; ash content.

1. INTRODUCTION

Livestock contributes to a remarkable existence of rural livelihood and also act as major resource for small and marginal farmers. National economy and socio-economic growth of India is backed by livestock sector [1]. India is blessed with variegated livestock resources. According to the 20th livestock census, the total livestock population is about 535.78 million which has a 4.6 % increase over 2012 census. India shares about 20 % of livestock population in world of which cattle (192.49 billion) and buffalo (109.85 million) population ranks first. Goat (148.88 million) and sheep (74.26 million) population ranks second and third in the world, respectively [2]. With this population of livestock, about 25.6 % of total agricultural and 4.11% of national GDP is brought by this sector in India.

There are good enough livestock resources but also have more constraints that affects the livestock productivity. There are many steps taken to increase the productivity through breeding technologies but care should be taken to boost up the production of feed and fodder resources which are now at sub-optimal level [3]. Livestock production system is characterized by low input and output. Fodder scarcity is major issue that ends up with uneconomical income generation for farmers. There should be an equal increase in production of feed and fodder to meet out the current livestock population which ultimately enhances the livestock productivity.

Dairying could be made economical by production of good quality fodder as these fodder crops are cheapest source of feed for livestock. The present demand for green fodder is 851.3 million tonnes but the supply is only 590.4 million tonnes thus having a net deficit of 30.65%. There would be a net deficit of 186.6 million tonnes (18.43%) in green fodder around 2050 (IGFRI Vision: 2050).Growing population, nutritional requirements and increased economic growth ended up with modifications in cropping pattern with high food grains and cash crops production thus results in the non-availability of fodder for livestock resources. Thus improvised technologies should be adopted to step up fodder production [4]. The land which is not being put to use for cultivation which includes fallows, waste lands, and pastures can be well organized to bring out fodder production. To solve the fodder crisis pastures can be developed to meet out the livestock fodder requirement.

Livestock along with plantation crops shows more advantageous in case of contributing income, diverse land usage, and maintaining soil health [5]. The coconut plant (*Cocos nucifera*) is essential to India's agrarian economy. India is the largest producer of coconut in the world and has a share of about 33.02 %. The area, production and productivity of coconut have an abrupt increase over the last 19 years. About 15 million people of India are reliant on producing, processing and marketing of coconut [6]. Coconut contributes about 15,000 crore rupees to India's GDP and 72 % of total production of coconut is from India [7].

Another advantage of integrating fodder in coconut garden is greater reduction in the cost involved for weed management as the coconut crop is planted very spaciously. There occurs competition for moisture and nutrients thus affecting growth and yield. Nearly 20 % involved in cost of cultivation is utilized for weed management. Hence to reduce the cost incurred for controlling of weeds can be reduced by maintaining effective ground cover which acts a good livestock feed and prevent loss of moisture and nutrients by weeds [8].

2. MATERIALS AND METHODS

The field experiment was conducted under old stand of coconut in Kedimedu village, Pollachi, Coimbatore, Tamil Nadu during December 2021. Treatments consisted of 6 grasses and 4 legumes *viz.,* T_1 – *Cenchrus setigeris*, T_2 – *Panicum maximum*, T_3 – *Brachiaria decumbens*, T_4 – *Brachiaria ruziziensis*, T_5 – *Brachiaria mutica*, T_6 – *Dichanthium annulatum*, T_7 – *Stylosanthes hamata*, T_8 – *Desmanthus virgatus*, T_9 – *Macroptilium atropurpureum* and T_{10} – *Desmodium gangeticum.* The experiment was laid out in randomized block design (RBD) with 10 treatments and each treatment was replicated thrice. Grasses are propagated using stem cuttings and planted at 45 cm x 45 cm spacing. Legumes are propagated using seeds which are treated with hot water to break dormancy and sown at a spacing of 30 cm x 10 cm.

The fodder crops were allowed for harvest at 90 DAP. Then subsequent cut was done at 30 days interval. The growth parameters *viz.,* plant height, establishment percentage and green fodder yield were recorded. During second cut which was done at 120 DAP, the same observations were repeated and recorded. The crops grown under coconut field shaded environment were collected, shade dried and stored for further analysis. Ash content was determined by using muffle furnace method, by keeping the samples in muffle furnace at 600^{o}C for 3 hours according to Chemists and Cunniff [9] and it is expressed in percentage. The mineral nutrients in the crop are analyzed in Inductively Coupled Plasma Mass Spectrophotometry (ICPMS) suggested by Masson *et al.* [10] to determine the nutritional composition of plant samples and expressed in percentage. Crude fibre content was determined as suggested by Goering *et al.* [11]. The estimation was done gravimetrically by successive digestion and washing of a weighed portion of the plant sample with dilute acid and alkali and the material left undigested was taken as crude fibre and expressed in percentage.

3. RESULTS AND DISCUSSION

The nutritional and quality parameters of different grasses and leguminous fodder crops were determined from this experiment. Since the crops were raised under shade of coconut crop, the influence of shade on growth parameters and quality parameters were analyzed. The effect of shade on plant height and establishment percentage is shown in (Fig. 1). *Panicum maximum* (T_2) was found to be taller (205 cm) among grasses (Fig. 2) followed by *Brachiaria mutica* (T_5) with 159 cm (Fig. 3) under shade which was found to be similar with findings of Malaviya *et al.* [12]. Among legumes *Desmodium gangeticum* (T_{10}) was found to be the taller (181 cm) than other legume fodder crops (Fig. 4). This is due to fact that the shading of leaves stimulated the synthesis of gibberellin and auxin thus promoting cell division, elongation of cell, apical dominance and internodal elongation in plants [13]. Wong *et al.* [14] found that at highest light level (50-80 %) under mature coconut field improved the growth of tropical grasses and legumes which include *Panicum maximum*, *Brachiaria mutica* and *Desmodium gangeticum* potentially increased the forage supply. Lowest plant height (104 cm) was recorded in *Dichanthium annulatum* (T_6) among grasses and in legumes *Stylosanthes hamata* (T_7) with 56 cm. Establishment percentage was found to be highest (100 %) in *Panicum maximum* (T_2) which was on par with *Brachiaria ruziziensis*, *Brachiaria mutica* and *Desmanthus virgatus*. The substantial improvement in surface soil temperatures provided by the tree canopy may be crucial for improved seedling survival and establishment [15].

Green fodder yield showed significant variation among the fodder crops under shaded environment (Table 1). Higher yield under shade was recorded in *Panicum maximum* (T_2) about 183 t ha^{-1}year^{-1} followed by *Brachiaria mutica* (T_5) of 140 t ha^{-1}year^{-1}. The microclimate produced by shade directly affects the soil moisture levels, evapo-transpiration, humidity, wind speed, and temperature regime. Therefore, these circumstances are probably have an effect on biomass production. Under shadowing both green and dry biomass of genotypes, increased. It seems that the higher moisture availability in shaded situations balanced the lower light intensity compared to open conditions [16]. Lowest yield was found in *Dichanthium annulatum* (T_6) with 32 t ha^{-1}year^{-1} among grasses. In legumes the higher yield under shaded environment was recorded in *Desmodium gangeticum* (T_{10}) with 125 t ha^{-1}year^{-1}. Similar findings were reported by Stur [17].

Crude fibre and Ash content of different fodder crops were analyzed and given in (Table 2). *Macroptilium atropurpureum* (Fig 5) recorded higher ash content (21.9 %) followed by *Brachiaria mutica* (T_5) with 17.1 %. Similar result was recorded by Mupangwa *et al.* [18]. Lowest ash percentage (9.40 %) was recorded in *Desmanthus virgatus* (T_8). Highest crude fibre content was found in *Dichanthium annulatum*

(T_6) about 41.15 % and lowest content was found in *Desmodium giganticum* (T_{10}) with 25.80%.

The nutritional composition of fodder crops were analyzed and given in the (Table 3). Sodium (Na) content was high (15.20 g kg^{-1}) in *Brachiaria mutica* (T_5). Magnesium (Mg) content was recorded highest in *Macroptilium atropurpureum* (T_9) with 19.13 g kg^{-1} followed by *Desmodium gangeticum* (T_{10}) with 17.42 g kg^{-1}. Phosphorous content (P) content was recorded highest (9.25 g kg^{-1}) in *Macroptilium atropurpureum* (T_9) which was on par with *Desmodium gangeticum* (T_{10}). Iron (Fe) and Calcium (Ca) content were high in *Desmodium gangeticum* (T_{10}) about 5.42 g kg^{-1} and 67.48 g kg^{-1}, respectively. *Brachiaria ruziziensis* (T_4) had registered highest higher Potassium (K) content of 162.48 g kg^{-1} and it was on par with *Brachiaria mutica* (T_5), which was recorded 160.05 g $kg^{-1}$of K content. Nitrogen (N) content in shaded grasses were found to be increased which is similar to the results obtained by Norton *et al.* [19].

Table 1. Effect of shade on growth parameters plant height, establishment percentage (%) in fodder crops

Treatments	Plant height (cm)	Establishment percentage (%)	Green fodder yield (t $ha^{-1}year^{-1}$)
T_1 - *Cenchrus setigeris*	118.00	46.00	70.00
T_2 – *Panicum maximum*	205.00	100.00	183.00
T_3 – *Brachiaria decumbens*	136.00	80.00	75.00
T_4- *Brachiaria ruziziensis*	138.00	100.00	155.00
T_5 – *Brachiaria mutica*	159.00	100.00	140.00
T_6 – *Dichanthium annulatum*	104.00	27.00	32.00
T_7 – *Stylosanthes hamata*	56.00	55.00	52.00
T_8 – *Desmanthus virgatus*	126.00	100.00	70.00
T_9 – *Macroptilium atropurpureum*	148.00	94.00	98.00
T_{10} – *Desmodium giganticum*	181.00	83.00	125.00
SEd	7.42	4.06	10.15
CD(P=0.05)	15.59	8.53	21.32

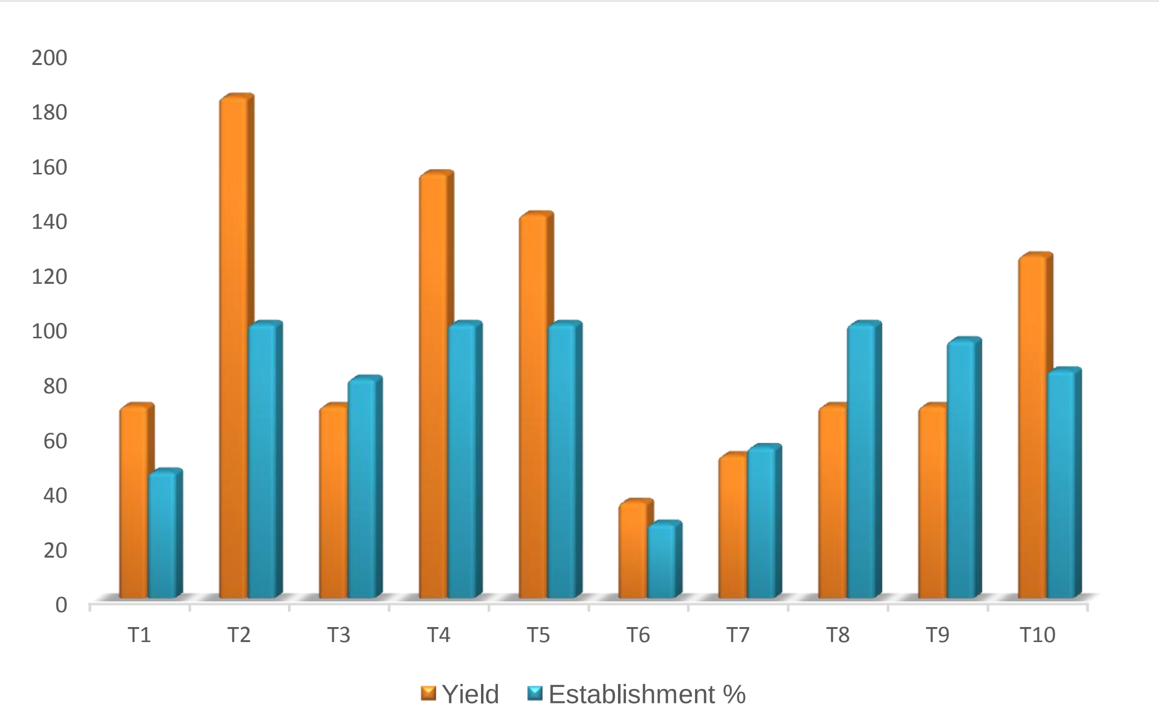

Fig. 1. Effect of Shade on Fodder Growth and Yield

Table 2. Effect of shade on quality parameters ash content, crude fibre in fodder crops

Treatments	Ash content %	Crude fibre %
T_1– *Cenchrus setigeris*	15.60	30.40
T_2 – *Panicum maximum*	15.2	36.18
T_3 – *Brachiaria decumbens*	14.8	25.93
T_4 – *Brachiaria ruziziensis*	15.6	28.50
T_5 – *Brachiaria mutica*	17.1	29.35
T_6 – *Dichanthium annulatum*	12.1	41.15
T_7 – *Stylosanthes hamata*	13.2	37.13
T_8 – *Desmanthus virgatus*	9.4	29.07
T_9 – *Macroptilium atropurpureum*	21.9	26.07
T_{10} – *Desmodium giganticum*	13.5	25.80
SEd	1.07	1.59
CD(P=0.05)	2.24	3.33

Fig. 2. *Panicum maximum*

Fig. 3. *Brachiaria mutica*

Fig. 4. *Desmodium gangeticum*

Fig. 5. *Macroptilium atropurpureum*

Table 3. Effect of shade on nutritional composition sodium, calcium, magnesium, phosphorous, potassium and iron in fodder crops

Treatments	Sodium (g kg^{-1})	Calcium (g kg^{-1})	Magnesium (g kg^{-1})	Phosphorus (g kg^{-1})	Potassium (g kg^{-1})	Iron (g kg^{-1})
T_1 – *Cenchrus setigeris*	1.42	10.90	4.97	3.69	123.34	0.80
T_2 – *Panicum maximum*	0.69	10.65	8.51	5.61	135.16	0.63
T_3 – *Brachiaria decumbens*	0.58	10.59	7.74	7.15	134.89	1.73
T_4 – *Brachiaria ruziziensis*	0.30	14.31	11.32	5.44	160.05	1.85
T_5 – *Brachiaria mutica*	15.20	11.51	6.59	7.42	162.48	1.21
T_6 – *Dichanthium annulatum*	1.01	15.15	5.53	5.59	73.07	3.30
T_7 – *Stylosanthes hamata*	0.29	9.43	1.13	2.76	26.00	0.74
T_8 – *Desmanthus virgatus*	0.55	29.95	12.60	7.33	76.57	4.25
T_9 – *Macroptilium atropurpureum*	1.65	47.09	19.13	9.13	100.91	3.18
T_{10} – *Desmodium giganticum*	1.62	67.48	17.42	9.25	103.35	5.42
SEd	115.05	1667.62	670.93	318.71	6374.23	123.49
CD (P=0.05)	241.72	3503.54	1409.63	669.56	13391.94	259.43

4. CONCLUSION

The results revealed that the study was highly helpful to identify the suitable fodder crops to be grown under old mature coconut garden. This evaluation clearly showed that there are number of fodder legumes and grasses which appear to be promising under shaded environment as well as the species used for the study was found to be shade tolerant and performed well under low light intensity. The study concluded that among fodder grasses *Panicum maximum*, *Brachiaria mutica, Brachiaria decumbens, and Brachiaria ruziziensis* were found to be efficient and in legumes *Desmodium giganticum* and *Macroptilium atropurpureum* were highly recommended under shaded environment especially in coconut garden.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Herrero M, Grace D, Njuki J, Johnson N, Enahoro D, Silvestri S, Rufino MC. The role of livestock's developing countries. The Animal Consortium. 2012;7:s1:3-18.
2. Press Information Bureau- 20th Livestock Census, New Delhi. Department of Animal Husbandry & Dairying. Ministry of Fisheries, Animal Husbandry & Dairying; 2019.
Available:https://pib.gov.in/PressReleasePage.aspx?PRID=1588304
3. Kathiravan G, Selvam S. Analysis of constraints to livestock production in Tamil Nadu. Indian Journal of Animal Research. 2011;45(1):56-59.
4. Vennila C, Sankaran VM. Sustainable fodder production model for enhanced productivity of milch cows in small farmer's holding. Department of Agronomy, Madras Veterinary College, Chennai; 2013.
5. Shelton HM, Humphreys LR, Batello C. Pastures in the plantations of Asia and Pacific: Performance and prospect. Tropical Grasslands. 1987;21(4).
6. Kalidas K, Mahendran K, Akila K. Growth instability and decomposition analysis in India and Tamil Nadu, Western Tamil Nadu, India: A time series comparative approach. Journal of Economics, Management and Trade. 2020;26(3):59-66.
7. Raghavi MD, Sakthi Balaa M, Surender S, Lokesh P, Kalidas K. Review on area,

production and productivity of coconut in India. IMPACT: International Journal of Research in Business Management (IMPACT: IJRBM). 2019;7(1):(1-6). ISSN (P): 2347-4572; ISSN (E): 2321-886X

8. Senarathne SHS, Gunathilake HAJ. Weed management in mature coconut plantations in Sri Lanka. Cocos. 2010;19:93-100.
9. Chemists AOA, Cunniff P. Official methods of analysis association of official analytical chemists. Association of Official Analytical Chemists. 1990;931-40.
10. Masson P, Dalix T, Bussiere S. Determination of Major and trace elements in plant samples by inductively coupled plasma- mass spectrometry. Communications in Soil Science and Plant Analysis. 2010;41(3): 231-43.
11. Goering, H. Keith, Peter J. Van Soest. Forage fiber analyses (apparatus, reagents, procedures, and some applications): US Agricultural Research Service; 1970.
12. Malaviya DR, Baig MJ, Kumar B, Kaushal P. Effect of shade on guinea grass genotypes *Megathyrsus maximus* (Poales:Poaceae).” *Revista De Biologia Tropical*. 2020;68: 563-572.
13. Keuskamp DH, Sasidharan R, Pierik R. Physiological regulation and functional significance of shade avoidance responses to neighbors. Plant Signal Behavior. 2010;5(6):655-662.
14. Wong CC, Rahim H, Mohd Sharudin MA. Shade Tolerance Potential of Some Tropical Forage for Integration with Plantations: L. Grasses. *Mardi Research Bulletin.* 1985;13:225-247.
15. Wilson JR, Wong CC. Effects of shade on some factors influencing nutritive quality of Green panic and Siratro pastures. Australian Journal of Agricultural Science. 1982;33:937-949.
16. Malaviya DR, Baig MJ, Kumar B, Kaushal P. Effects of shade on guinea grass genotypes *Megathyrsus maximus* (Poales: Poaceae). Revista De Biologia Tropical. 2020;68(2):563-572.
17. Stur WW. Screening forage species for shade tolerance- a preliminary report. Forages for plantation crops. ACIAR Proceedings. 1991;32:58-63.
18. Mupangwa JF, Ngongoni NT, Topps JH, Ndlovu P. Chemical composition and dry matter degradability profiles of forage Legumes *Cassia rotundifolia cv*. Wynn, *Lablab purpureus cv.* Highworth and *Macroptilium atropurpureum* cv. Siratro at 8 Weeks of Growth (Pre-Anthesis). Animal and Feed Science Technology. 69(1-3):167-178.
19. Norton B, Wilson J, Shelton K. Hill. The effect of shade on forage quality. Forages for Plantation Crops. Proceedings of a workshop held in Sanur Beach, Bali, Indonesia. 27-29 June 1990. ACIAR proceedings No.32. ACIAR, Canberra, A.C.T. Australia. 1991;83-88.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/89084