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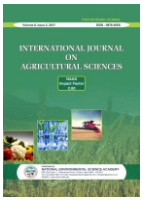

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POTENTIAL OF *MELIA AZEDARACH* L. AS LIVESTOCK FODDER CROP

Firoz Ahmad[1], M. S. Malik[2]* and Abhishek Kumar[1]

Department of Silviculture and Agroforestry
Birsa Agricultural University, Ranchi, Jharkhand (India)

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ABSTRACT

The livestock sector plays an important role in India in terms of ensuring food security and a source of income. Availability of nutritive fodder round the year is a big constraint in India, particularly in Jharkhand which accounts for the low productivity of livestock sector. Agroforestry with fodder trees and browse species has been practiced for a long time here. *Melia azedarach* is a remarkable fodder tree species with its high nutritional fodder value and good biomass production which needs popularisation among farmers and for payment of ecosystem services. The present investigation was carried out to analyze the quality and quantity of Bakain intercropped with fodder crops viz., Stylo, Charabadam, Paragrass and Hybrid Napier in agroforestry system at the Faculty of Forestry, Birsa Agricultural University, Ranchi, Jharkhand during 2019-20. Fodder production in Bakain tree in terms of green and dry leaf biomass, as well as their quality attributes viz., crude protein, crude fiber, acid detergent fiber, neutral detergent fiber, ether extract, ash content, nitrogen free extract were assessed. Five different treatment combinations viz., Bakain + Stylo, Bakain + Charabadam, Bakain + Paragrass, Bakain + Hybrid Napier, and one control plot of Bakain tree was replicated three times and statistically analyzed in Randomized Block Design. The result indicates that sole Bakain tree had the highest green and dry leaf biomass (2.133 and 0.912 kg/tree respectively), CF and NDF (53.63 and 34.84 respectively), whereas, CP, Ash and E.E (12.97, 3.07, 4.13 respectively) found highest in Bakain + Stylo combinations and highest ADF (38.27) was obtained in Bakain + Charabadam combination. However, some combinations of intercrops with Bakain could not be established for the farmers of Jharkhand. The study concludes that intercropping of Bakain with legume grass like Stylo and Charabadam were found to be most beneficial with regards to fodder production both in term of nutritional quality and quantity.

Keywords: Agroforestry, nutritional quality, tree fodder, livestock.

INTRODUCTION

India faces several challenges such as water scarcity, land degradation, poor agriculture and livestock productivity, and vulnerability to climate aberrations. Agriculture and allied sectors are the major sources of income for more than 60% of the rural households residing in these areas (FAO, 2015; 2013). The livestock sector plays an important role in India in terms of ensuring food security and a source of income. It supports the livelihoods of about 69% of farming households in India (National Livestock Policy, 2013). India has the largest livestock population in the world (535.78 million) with 35.9% cattle, 27.8% goats, 20.5% buffaloes, 14% sheep, and 1.7% pigs (20th Livestock census, 2019). India is the largest milk producer globally. However, it's low productivity remains a critical challenge in a country with existing fodder and feed issues. India faces a net deficit of 36% green fodder, 11% dry fodder, and 44% concentrate feed ingredients (IGFRI, 2015). To sustain its livestock sector, the supply of green forage needs to grow at 1.7% annually (IGFRI, 2015). According to the 20th Livestock Census, 2019, India's total livestock population is 535.82 million, up by 4.6% from the previous Census in 2012. Cattle, buffalo, mithun, and yak make up the 302.82 million bovine populations. It is home to 57.3% of the world's buffalo population and 14.7% of the world's cattle population. In the country, there are around 74.26 million sheep and 148.8

*Corresponding author: *mohdshujamalik@yahoo.com*

million goats (20th Livestock Census, 2019). This fodder shortage get increased in dry months (May and October) when the unavailability of fodders increases (Sarwar *et al*., 2002). With the existing genetic pool of livestock, fodders, and forages, livestock production can be improved by 50% by increasing the quality and quantity of available forages or introducing new highly nutritious plant species as livestock fodder. Trees and browse species have been used as livestock fodder for centuries. Tree species like *Leucaena leucocephala*, *Ziziphus jujuba*, *Morus alba*, *Terminalia arjuna*, *Moringa oleifera,* and *Melia azedarach* are being widely studied nowadays.

Melia azedarach is a remarkable species with its high nutritional value and good biomass production. Leaves are lopped for fodder and are highly nutritious. Bakain (Melia azedarach) based agroforestry system could hardly draw attention or interest of the farmers. This species thus is being found to grow along boundaries or in homegarden on areas as small as negligible. The species has the potential not only to improve environmental health but also to provide livelihood security to the farmers of the region because of its multiple uses like timber, fuelwood, fodder, etc. The fuelwood of this species has been reported to have as high calorific value as 5100 kcal kg^{-1} (Orwa et al., 2009 and Sharma and Paul, 2013).

The present study investigated the potential of *Melia azedarach* as livestock fodder crop, forage resources and biomass availability in one of the degraded ecologies (Chotanagpur region) in North-East India. The objectives of the study were to explore the yield and quality of tree leaf as a fodder and to test how the interventions can bridge the gap in forage availability in this fragile region.

MATERIALS AND METHODS

The present study was carried out in the Faculty of Forestry, Birsa Agricultural University, Ranchi, Jharkhand (23°17' N latitude and 85°19' E longitude with an elevation of 651m above mean sea level) during 2019-20. The site experienced warm humid tropical climate, with a mean rainfall of 1358 mm, most of which was received during the month August. The maximum and minimum temperatures during the cropping period were 35.22 and 5.29 respectively during 2019-20. The experiment was conducted in Randomized Block Design with nine treatments replicated thrice. Stylo Charabadam, Brachiaria, and NB Hybride, (together abbreviated as SCBN) were intercropped with six-year-old *Melia azedarach* spaced at 4m x 4m, and each grass were maintained under sole cropping as control, representing each as a treatment. Biomass and quality of Bakain leaf were computed with the following parameters; biomass of green and dry leaves, Crude protein (CP), Crude fibre (CF), Acid Detergent fibre (ADF), Neutral Detergent Fibre (NDF), Ether Extract (EE)/Crude fat, Ash Content (AC) and Nitrogen free extract (NFE).

RESULTS

The results of the present investigation are presented hereunder:

Green leaf biomass

The green leaf biomass was calculated and presented in Table 1, which showed that Sole Bakain had put up maximum green leaf biomass (2.315 kg/tree or 1.334 t/ha) which was significantly superior to other treatment combinations. Bakain grown with legumes like stylo and or charabadam recorded better growth in terms of green leaf biomass (1.555 kg/tree and 1.515 kg/tree respectively) than intercropped with roughages like Para grass and Hybrid Napier (0.650 kg/tree and 0.004 kg/tree respectively). Data showed that the response of Hybrid Napier is very poor in terms of green leaf biomass production due to its poor growth. Hybrid Napier is a heavy feeder of nutrients, which absorbs and create more competition for nutrients and moisture as well as radiation of sun. At the early stage of growth, up to five years of plantation, trees as well as fodder crops root system lies more or less at same levels of soil profile creating competition which resulted in poor growth of tree species. On the other hand, the tree canopy provides shadow, which protects the soil from moisture scarcity during summer and harsh periods.

Further, it can also collaborate on the findings of different crop + legumes combinations. Crop combination of cereal and legumes or legumes in a crop rotation or tree legumes intercropped combination to balances the negative impact of over-exploited agricultural activity leading to significant changes in physical, chemical biological, and biochemical properties of soil. It may alter the composition, distribution, and activities of soil microbial communities and enzymes (Doran, 1980).

Yang *et. al* (2017) investigated the abundance and community structure of N_2-fixing bacteria in a field experiment with three planting patterns (Oat monoculture, O; Soybean-oat intercropping, OSO; Mung bean-oat intercropping, OMO). All the results confirmed that legume-oat intercropping significantly increased the abundance and changed the community composition of N_2-fixing bacteria in oat soils.

Table 1: Bakain leaf biomass production as fodder crop on various intercrops.

Treatments	Green leaf biomass (kg/tree)	Green leaf biomass (t/ha)	Dry leaf biomass (kg/tree)	Dry leaf biomass (t/ha)
Bakain + Stylo	1.555	0.972	0.665	0.416
Bakain + Charabadam	1.151	0.720	0.492	0.308
Bakain + Para grass	0.650	0.406	0.278	0.174
Bakain+ Hybrid Napier	0.004	0.002	0.002	0.001
Sole Bakain	2.135	1.334	0.912	0.570
SEm ±	0.17	0.11	0.07	0.05
LSD at 5%	0.57	0.36	0.25	0.15
CV %	27.30	27.30	27.26	27.30

Dry leaf biomass

The dry leaf biomass was calculated and presented in Table 1, which showed Sole Bakain had more dry leaf biomass (0.912 kg/tree or 0.570 t/ha) which was significantly superior over other treatment combinations. Dry leaf biomass solely depends upon the number of leaf coupled with its thickness and moisture content. Variation in dry leaf biomass was due to the combined effect of all the above mentioned facts. With regard to intercropping, Bakain + Stylo recorded significantly more dry leaf biomass (0.461t/ha) and the lowest was under Bakain + Hybrid Napier (0.001t/ha) which was 99.8 percent lower than Bakain + Stylo.

Quality character of Bakain

The quality character of Bakain in terms of different parameters like Crude protein (CP), Crude fibre (CF), Acid Detergent fibre (ADF), Neutral Detergent Fibre (NDF), Ether Extract (EE)/ Crude fat, Ash Content (AC) and Nitrogen free extract (NFE) were estimated in the lab through standard techniques followed and presented in percent depicted in Table 2.

Crude protein

Data showed that Bakain intercropped with legumes like Stylo & Charabadm recorded more crude protein (12.97% and 12.40% respectively) which were at par with Para grass and Hybrid napier (11.82 % & 10.27 % respectively). More CP content in Bakain intercropped with legumes were due to the effect of nitrogen-fixing bacteria, which made crops as well as trees to absorb more nutrients, especially Nitrogen, resulting in better growth and crude protein content of the fast-growing tree Bakain.

Table 2. Comparative analysis (%) of fodder quality of leaves of Bakain as tree and fodder crop during 2019-20.

Treatments		CP	CF	NDF	ADF	Ash	EE	NFE
Bakain + Stylo		12.97	53.48	30.56	38.21	3.07	4.13	26.36
Bakain + Charabadam		12.40	53.01	31.39	38.27	3.04	3.99	27.55
Bakain + Para grass		11.82	51.90	32.25	37.16	2.99	3.78	29.51
Bakain+ Hybrid Napier		10.27	52.60	33.08	37.67	3.04	2.98	31.12
Sole Bakain		11.53	53.63	34.84	37.67	2.99	4.04	27.81
SEm ±		0.28	0.54	0.47	0.60	0.03	0.45	0.79
LSD at 5%		0.91	NS	1.54	NS	NS	0.64	2.61
CV %		4.04	1.75	2.49	2.74	1.96	2.64	4.79

NFE = Nitrogen Free Extract; CP = crude protein; EE = ether extract; CF = crude fiber; NDF = neutral detergent fiber; ADF = acid detergent fiber.

Crude Fibre
Crude Fibre (CF) content in Sole Bakain and when intercropped with legumes (Stylo & Charabadm) and roughages (Para grass & H. Napier) showed no significant difference. However, Sole Bakain recorded more fibre (53.65 %).

Acid Detergent Fibre
Acid detergent Fibre (ADF) content in Sole Bakain and when intercropped with legumes (Stylo & Charabadm) and roughages (Para grass & H. Napier) showed no significant difference. However, Sole Bakain + Stylo recorded more ADF (38.21 %).

Neutral Detergent Fibre
Data showed that there was significant difference in neutral detergent fibre (NDF) due to intercropping. Here, sole Bakain recorded more NDF (34.84 %) which was *at par* with Bakain + H. Napier (33.08 %).

Ash content
Ash content (AC) in Bakain was not significantly influenced by Bakain as well as inter-cropped combination with legumes & roughes. However, Bakain+ H. Napier recorded more ash content (3.07%).

Ether Extract Crude fat
Ether Extract (EE)/ Crude Fat content in sole Bakain (4.04 %) and Bakain + Stylo (4.13 %) were *at par* to each other and significantly higher than other intercropping combinations. However, no significant differences were recorded in Ether Extract (EE)/ Crude Fat.

Nitrogen Free Extract
Nitrogen free extract (NFE) were calculated. Data showed that the treatment Bakain+ H. Napier recorded significantly higher NFE (31.12 %), while other treatments were *at par* to each other.

CONCLUSION

Bakain based agroforestry system is found suitable for the degraded or waste land. This paper summarizes the information available on strengths and potential advantages of Bakain intercropped with fodder crops. The usage and virtues of Bakain tree as livestock fodder have been widely documented, but many aspects of this plant, from the most convenient agricultural practices to its beneficial or harmful effects for livestock, are still waiting for further research. Intercropping of Bakain with legume grasses like stylo and charabadam were found to be most beneficial in respect to fodder production both in terms of quantity and quality.

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