Effect of Integrated Nutrient Management Practices on Physiological Growth Parameters of Perennial Fodder Crops in custard apple based horti-pastoral system

ABSTRACT

A field experiment was conducted to assess the impact of integrated nutrient management practices on perennial fodders within a custard apple based horti-pastoral system during the *Rabi* season of 2021 at the Agroforestry Research Block of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. The study featured two main plots dedicated to the fodder species *Cenchurus ciliaris* (Anjan grass) and *Megathyrsus maximus* (Guinea grass), while six nutrient management practices along with a control were implemented as sub plots in a split-plot design. Results revealed that *M. maximus* has recorded significantly higher Physiological growth parameters *viz.*, CGR, RGR at different growth stages in first cut. Among the integrated nutrient management practices, higher CGR values were recorded at 45 DAI with the application of75% RDN + 25% N through PGLM (13.47 g m-2 day-1) which was on par with –the application of 75% RDN + 25% N Through PM (12.78 g m-2 day-1) and RGR found non-significant. The experiment concludes that *M. maximus* found best for horti-pastoral system with PGLM or PM supplemental nutrient management.

Keywords: Fodder species, Nutrient management practice, CGR, RGR.

INTRODUCTION

"Cenchrus ciliaris commonly known as Anjan grass in India, stands as a predominant pasture grass" (Dabadghao and Shankarnarayan, 1973). "The *Cenchrus* species demonstrates adaptability to a wide range of soils and environments, owing to its tolerance to drought and high temperatures. It is highly palatable with substantial nutritional value (protein content of 8-10% and digestibility ranging from 60-70%) and serves as a valuable resource for various grazing animals" (Sawal et al., 2009). "*Megathyrsus maximus*, also known as guinea grass, is a perennial, tufted grass with a short, creeping rhizome. This robust grass can attain a height of up to 2 m and is compatible with horticultural crops. It thrives in wastewater and marshy lands, offering a crude protein content ranging from 8-13%" (Prakash et al., 2019). "It is recommended for regions with an annual rainfall between 800 to 1800 mm and well-drained soil of medium to high fertility" (Muir and Jank, 2004).

The country faces deficiencies in the availability of green and dry fodder, posing a challenge to the future development and growth of livestock (Hembram et al., 2016; Jhonsonraju et al., 2023). "Low fertility often results in reduced forage yield, and nutrient management plays a pivotal role in enhancing forage productivity. Integrated nutrient management, utilizing locally available resources like organic manures and green leaf manures, proves beneficial by reducing production costs and enhancing farm system resilience through improved soil fertility in rainfed areas" (Ravi et al., 2009). "A judicious combination of organic manures and chemical fertilizers, tailored to the soil and crop characteristics, not only maximizes crop production and quality but also sustains soil fertility" (Madhavi Lata et al., 2014).

"Organic amendments, such as farmyard manure, are recognized for enhancing soil physical properties. Poultry manure, rich in nitrogen and various micro-nutrients, serves as a readily available nutrient source for crops" (Pratap et al., 2008). "Pongamia green leaf, with its high content of easily mineralizable nitrogen, proves crucial for improving soil physical properties and serves as a nutrient source for low-fertility soils in dryland agriculture" (Ranveer Singh et al., 2013). Therefore, this study was aimed to assess the impact of integrated nutrient management practices on the yield and economic aspects of fodder species in a horti-pastoral system.

MATERIALS AND METHODS

A field experiment titled 'Influence of Integrated Nutrient Management Practices on Perennial Fodder Species in a Custard Apple-Based Horti-Pastoral System' was conducted during the *Rabi* season of 2020-21 at the Agroforestry Research Block, Professor Jayashankar Telangana State Agricultural University, situated in Rajendranagar, Hyderabad, Telangana. The experimental site, located at $17^{o}19^{'}$ N latitude, $78^{o}28^{'}$ E longitude and at an altitude of 555 m above mean sea level, falls under the Southern Telangana agro-climatic zone. Throughout the crop growth period, which extended from October 2020 to February 2021, weekly mean maximum temperature ranged from 27.14 ^{0}C to 31.64 ^{0}C with an average of 29.29 ^{0}C. While the weekly mean minimum temperature ranged from 11.07 ^{0}C to 18.57 ^{0}C with an average of 14.85^{0}C. The total rainfall received during this period was 18.08 mmwith 4 rainy days.

"The soil at the experimental site was identified as sandy loam with a pH of6.70, EC of0.125 dS m^{-1} and organic carbon of0.66%. Soil was medium in available nitrogen (247.2 kg ha^{-1}) and phosphorus (30.65 kg ha^{-1}) while low in available potassium (179.1 kg ha^{-1}). The experiment was designed using a split-plot layout with three replications. The main plot treatments included two fodder species viz. Anjan grass and Guinea grass, and seven integrated nutrient management treatments *viz.*, T_1-Control (no fertilizer and manure), T_2-100% RDF (60:60:40 NPK kg ha^{-1}), T_3-75% RDN + 25% N through PGLM, T_4- 75% RDN + 25% N through NGLM, T_5- 75% RDN + 25% N through SGLM, T_6- 75% RDN + 25% N through PM, T_7 75% RDN + 25% N through FYM were accommodated in sub plots. Phosphorus and potassium were common for all treatments except the control, and organic manure was applied as basal, while nitrogen supplied in three splits after each cutting". [20] Various physiological parameters were computed from the data obtained on the dry weight of different plant parts. Crop growth rate (g m^{-2} day^{-1}) is the rate of dry matter production per unit ground area per unit time and was calculated by using the formula suggested by Watson (1952).

$$CGR = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{1}{A}$$

W_1 = Total dry weight of plant (g) at time t_1, W_2 = Total dry weight of plant (g) at time t_2

$t_2 - t_1$ = time interval (days), A = Land area (m^2)

Relative growth rate (g g^{-1} day^{-1}) is the rate of increase in dry weight per unit time and was calculated by using the formula suggested by Radford (1967).

$$RGR = \frac{Log_e W_2 - Log_e W_1}{t_2 - t_1}$$

W_1 = Total dry weight of plant (g) at time t_1, W_2 = Total dry weight of plant (g) at time t_2

$t_2 - t_1$ = time interval (days)

RESULTS AND DISCUSSION

1. Crop Growth Rate

The data pertaining to the Crop Growth Rate (CGR) of different fodder species under the various nutrient management practices is presented in Table 1 and visually represented in Figure 1. Upon examination of the data, significant differences in CGR at 15, 30, and 45 days after initiation (DAI) were observed between the two fodder species. Guinea grass exhibited the highest CGR at 15 DAI (9.02 g m^{-1} day^{-1}), 30 DAI (9.46 g m^{-1} day^{-1}) and 45 DAI (12.26 g m^{-1} day^{-1}) compared to Anjan grass, which recorded CGR values of 5.39, 7.31, and 9.25 g m^{-1} day^{-1}at 15, 30 and 45 DAI, respectively.

Among the nutrient management practices, at 15 DAI maximum CGR was observed in T_3 -75% RDN + 25% N through PGLM (8.43 g m^{-1} day^{-1}) followed by T_6 -75% RDN + 25% N through PM (8.41 g m^{-1} day^{-1}), T_2 -100% RDF (60:60:40) NPK kg ha^{-1}(7.63 g m^{-1} day^{-1}) and T_7 -75% RDN + 25% N through FYM (7.49 g m^{-1} day^{-1}) which was significantly CGR values than other nutrient treatments and control (5.06 g m^{-1} day^{-1}). Similar trend was also followed at 30 DAI and maximum CGR was recorded in T_3 -75% RDN + 25% N through PGLM (10.0 g m^{-1} day^{-1}) followed by T_6 -75% RDN + 25% N through PM (9.98 g m^{-1} day^{-1}), T_7 -75% RDN + 25% N through FYM (9.40 g m^{-1} day^{-1}) and

T_2 -100% RDF (60:60:40) NPK kg ha^{-1} (9.35 g m^{-1} day^{-1}). At 45 DAI, significantly higher CGR was observed in T_3 -75% RDN + 25% N through PGLM (13.47 g m^{-1} day^{-1}) which was on par with T_6 -75% RDN + 25% N through PM (12.78 g m^{-1} day^{-1}) and significantly higher with each other nutrient treatments and control.

The integration of organic and inorganic nutrition, specifically through PGLM, PM, and FYM sources, resulted in favorable crop growth rates comparable to those recorded with 100% RDF. Increased plant density was found to significantly enhance CGR (Ahmadi et al., 2014), with some researchers attributing the impact of crop growth rate to the plants' photosynthetic area (HabibZadeh et al., 2006). The interaction effect between the type of fodder species and nutrient management practices on crop growth rate was found to be non-significant at all stages.

Table 1. Crop Growth Rate (g m^{-2} day^{-1}) of different fodder species as influenced by integrated nutrient management in horti-pastoral system

Particulars	**15 DAI**	**30 DAI**	**45 DAI (1st cut)**
Fodder species			
1. *Cenchrus ciliaris* (Anjan grass)	5.39	7.31	9.25
2. *Megathyrsus maximus* (Guinea grass)	9.03	9.46	12.26
S.Em +	**0.13**	**0.09**	**0.09**
CD(P=0.05)	**0.78**	**0.52**	**0.59**
Nutrient management			
T_1 -Control (No fertiliser)	5.06	6.32	8.50
T_2 -100% RDF (60:60:40) N-P-K kg ha^{-1}	7.63	9.35	11.61
T_3 -75% RDN + 25% N Through PGLM	8.43	10.00	13.47
T_4 -75% RDN + 25% N Through NGLM	6.59	6.56	9.06
T_5 -75% RDN + 25% N Through SGLM	6.86	7.11	9.85
T_6 -75% RDN + 25% N Through PM	8.41	9.98	12.78
T_7 -75% RDN + 25% N Through FYM	7.49	9.40	10.01
Mean	**7.20**	**8.38**	**10.75**
S.Em +	**0.43**	**0.43**	**0.41**
CD(P=0.05)	**1.27**	**1.26**	**1.20**
Interaction (Main × Sub)			
S.Em +	**0.61**	**0.61**	**0.58**
CD(P=0.05)	**NS**	**NS**	**NS**
Interaction (Sub × Main)			
S.Em +	**0.58**	**0.57**	**0.54**
CD(P=0.05)	**NS**	**NS**	**NS**

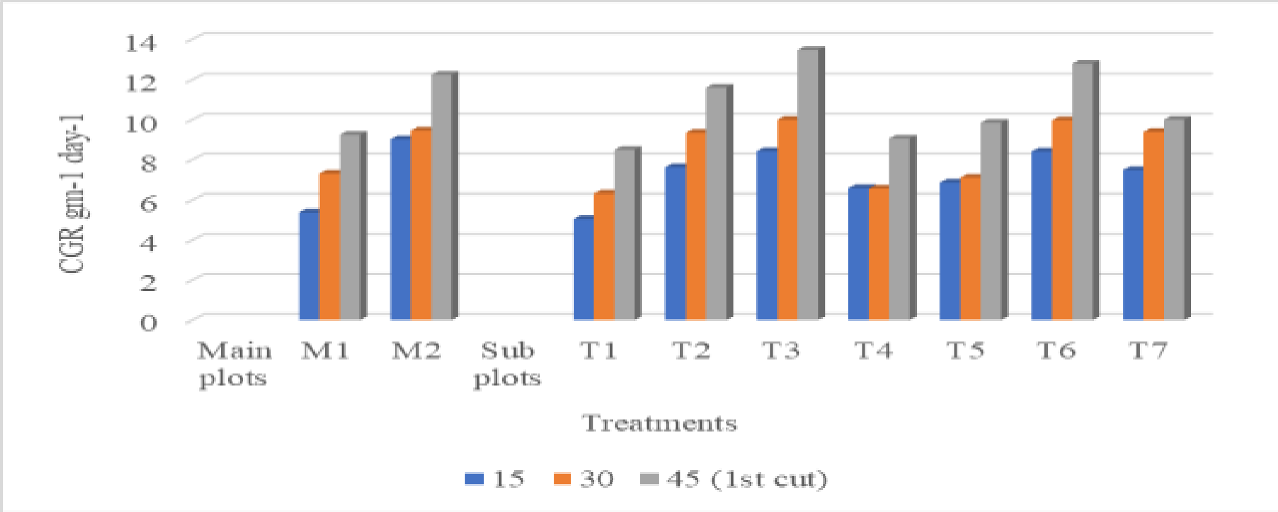

Figure 1. Crop Growth Rate (g m^{-2} day^{-1}) of different fodder species as influenced by integrated nutrient management in horti-pastoral system

2. Relative Growth rate

Data pertaining to relative growth rate (RGR) of different fodder species as influenced by the different nutrient management practices is illustrated in Table 2. Among the two different types of fodder species, significantly higher RGR (g g^{-1} day^{-1}) recorded in guinea grass at 15 DAI (0.142), 30 DAI (0.022) and 45 DAI (0.017) over anjan grass. The ecological advantage of a high RGR is evident as it allows the plant to rapidly increase in size, enabling it to occupy a large space both below and above the ground. Additionally, a high RGR may facilitate the rapid completion of the plant's life cycle (Ahmadi et al., 2014).

Regarding nutrient management practices, the RGR at 15, 30 and 45 DAI was found non-significant at all three stages. This might be due to similar growth rate of two forages under specific nutrient management treatments. All the sources are better in influencing RGR. The interaction effect between the type of fodder and nutrient management practices was also found to be non-significant.

Table 2. Relative Growth Rate (g g^{-1} day^{-1}) of different fodder species as influenced by integrated nutrient management in horti- pastoral system

Particulars	**15 DAI**	**30 DAI**	**45 DAI (1^{st} cut)**
Fodder species			
1. *Cenchrus ciliaris* (Anjan grass)	0.127	0.017	0.017
2. *Megathyrsus maximus* (Guinea grass)	0.142	0.022	0.017
S.Em ±	**0.001**	**0.001**	**0.001**
CD(P=0.05)	**0.006**	**0.003**	**0.003**

(Nutrient management			
T_1 -Control (No fertiliser)	0.124	0.016	0.020
T_2 -100% RDF (60:60:40) N-P-K kg ha^{-1}	0.136	0.020	0.018
T_3 -75% RDN + 25% N Through PGLM	0.139	0.020	0.017
T_4 -75% RDN + 25% N Through NGLM	0.132	0.020	0.018
T_5 -75% RDN + 25% N Through SGLM	0.133	0.021	0.017
T_6 -75% RDN + 25% N Through PM	0.139	0.021	0.016
T_7 -75% RDN + 25% N Through FYM	0.136	0.020	0.015
Mean	**0.134**	**0.0199**	**0.0172**
S.Em ±	**0.004**	**0.001**	**0.001**
CD(P=0.05)	**NS**	**NS**	**NS**
Interaction (Main × Sub)			
S.Em ±	**0.006**	**0.002**	**0.001**
CD(P=0.05)	**NS**	**NS**	**NS**
Interaction (Sub × Main)			
S.Em ±	**0.005**	**0.001**	**0.001**
CD(P=0.05)	**NS**	**NS**	**NS**

CONCLUSION

Based on the findings, it can be concluded that guinea grass with the application of 75% RDN + 25% N through PGLM recorded higher CGR and RGR which was on par with 100% RDF (60:60:40) N-P-K kg ha^{-1}, 75% RDN + 25% N through PM and 75% RDN + 25% N Through FYM. This resulted in increased yields, including total green and dry fodder, as well as favorable economic returns. The study underscores the significance of incorporating organic or green leaf manures in conjunction with chemical fertilizers for sustainable development.

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