

# Effect of Integrated Nutrient Management Practices on Physiological Growth Parameters 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 (*Annona squamosa*) based horti-pastoral system during the *Rabi* season in 2021 at the Agroforestry Research Block of Professor Jayashankar Telangana State Agricultural University, located in Rajendranagar, Hyderabad. The study featured two main plots dedicated to the fodder species *Cenchrus ciliaris* (Anjan grass) and *Megathyrsus maximus* (Guinea grass), while seven nutrient management practices, along with a control, were implemented as subplots using a split-plot design. The experiment was replicated thrice among the four-year-old custard apple tree species. Results revealed that *M. maximus* has recorded significantly higher Physiological growth parameters viz., CGR, RGR at different growth stages in first cut, higher CGR values were recorded at 45 DAI with T3 -75% RDN + 25% N through PGLM (13.47 g m<sup>-2</sup> day<sup>-1</sup>) which was on par with T6 -75% RDN + 25% N Through PM (12.78 g m<sup>-2</sup> day<sup>-1</sup>) 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 out 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. Highly palatable with substantial nutritional value (protein content of 8-10% and digestibility ranging from 60-70%), it 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). 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 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 2021 at the Agroforestry Research Block, Professor Jayashankar Telangana State Agricultural University, situated in Rajendranagar, Hyderabad, Telangana. The experimental site, located at 17°19' N latitude, 78°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 °C to 31.64 °C with an average of 29.29 °C. while the weekly mean minimum temperature ranged from 11.07 °C to 18.57 °C with an average of 14.85°C. The total rainfall during this period was 18.08 mm, occurring over 4 rainy days.

The soil at the experimental site was identified as sandy loam with a pH (6.70), EC (0.125 dS m<sup>-1</sup>) and organic carbon (0.66%). Soil was medium in available nitrogen (247.2 kg ha<sup>-1</sup>) and phosphorus (30.65 kg ha<sup>-1</sup>) while low in available potassium (179.1 kg ha<sup>-1</sup>). The experiment was designed using a split-plot layout with three replications. The main plot treatments included two fodder species, Anjan grass and Guinea grass, and seven integrated nutrient management treatments *viz.*, T<sub>1</sub>-Control (no fertilizer and manure), T<sub>2</sub>-100% RDF (60:60:40 NPK kg ha<sup>-1</sup>), T<sub>3</sub>-75% RDN + 25% N through PGLM, T<sub>4</sub>- 75% RDN + 25% N through NGLM, T<sub>5</sub>- 75% RD N + 25% N through SGLM, T<sub>6</sub>- 75% RDN + 25% N through PM, T<sub>7</sub> 75% RDN + 25% N through FYM. Phosphorus and potassium were common for all treatments except the control, and organic manure was applied as a basal, with nitrogen supplied in three splits after each cutting. Various

physiological parameters were computed from the data obtained on the dry weight of different plant parts. Crop growth rate ( $\text{g m}^{-2} \text{day}^{-1}$ ) 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).

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

$W_1$  = 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 ( $\text{m}^2$ )

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

$$\text{RGR} = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{t_2 - t_1}$$

$W_1$  = 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 ( $\text{g m}^{-1} \text{day}^{-1}$ )

The data pertaining to the Crop Growth Rate (CGR) of different fodder species under the influence of 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 ( $9.02 \text{ g m}^{-1} \text{day}^{-1}$ ), 30 ( $9.46 \text{ g m}^{-1} \text{day}^{-1}$ ), and 45 DAI ( $12.26 \text{ g m}^{-1} \text{day}^{-1}$ ) compared to Anjan grass, which recorded CGR values of 5.39, 7.31, and  $9.25 \text{ g m}^{-1} \text{day}^{-1}$ , respectively.

Among the nutrient management practices, at 15 DAI maximum CGR was observed in  $T_3$  -75% RDN + 25% N through PGLM ( $8.43 \text{ g m}^{-1} \text{day}^{-1}$ ) followed by  $T_6$  -75% RDN + 25% N through PM ( $8.41 \text{ g m}^{-1} \text{day}^{-1}$ ),  $T_2$  -100% RDF (60:60:40) NPK  $\text{kg ha}^{-1}$  ( $7.63 \text{ g m}^{-1} \text{day}^{-1}$ ) and  $T_7$  -75% RDN + 25% N through FYM ( $7.49 \text{ g m}^{-1} \text{day}^{-1}$ ) which was significantly CGR values than other nutrient treatments and control ( $5.06 \text{ g m}^{-1} \text{day}^{-1}$ ). At 30 DAI also follows similar trend with maximum CGR was recorded in  $T_3$  -75% RDN + 25% N through PGLM ( $10.0 \text{ g m}^{-1} \text{day}^{-1}$ ) followed by  $T_6$  -75% RDN + 25% N through PM ( $9.98 \text{ g m}^{-1} \text{day}^{-1}$ ),  $T_7$  -75% RDN + 25% N through FYM ( $9.40 \text{ g m}^{-1} \text{day}^{-1}$ ) and  $T_2$  -100% RDF (60:60:40) NPK  $\text{kg ha}^{-1}$  ( $9.35 \text{ g m}^{-1} \text{day}^{-1}$ ). At 45 DAI significantly higher CGR was observed in  $T_3$  -75% RDN + 25% N through PGLM ( $13.47 \text{ g m}^{-1} \text{day}^{-1}$ ) which was on par with  $T_6$  -75% RDN +

25% N through PM (12.78 g m<sup>-1</sup> day<sup>-1</sup>) 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<sup>-2</sup> day<sup>-1</sup>) of different fodder species as influenced by integrated nutrient management in horti-pastoral system**

	15 DAI	30 DAI	45 DAI (1 <sup>st</sup> cut)
<b>Main plots (Fodder species)</b>			
1. <i>Cenchrus ciliaris</i> (Anjan grass)	5.391	7.31	9.25
2. <i>Megathyrsus maximus</i> (Guinea grass)	9.027	9.46	12.26
<b>S.Em +</b>	<b>0.13</b>	<b>0.09</b>	<b>0.09</b>
<b>CD(P=0.05)</b>	<b>0.78</b>	<b>0.52</b>	<b>0.59</b>
<b>Sub plots (Nutrient management)</b>			
T <sub>1</sub> -Control (No fertiliser)	5.06	6.32	8.50
T <sub>2</sub> -100% RDF (60:60:40) N-P-K kg ha <sup>-1</sup>	7.63	9.35	11.61
T <sub>3</sub> -75% RDN + 25% N Through PGLM	8.43	10.00	13.47
T <sub>4</sub> -75% RDN + 25% N Through NGLM	6.59	6.56	9.06
T <sub>5</sub> -75% RDN + 25% N Through SGLM	6.86	7.11	9.85
T <sub>6</sub> -75% RDN + 25% N Through PM	8.41	9.98	12.78
T <sub>7</sub> -75% RDN + 25% N Through FYM	7.49	9.40	10.01
<b>Mean</b>	<b>7.20</b>	<b>8.38</b>	<b>10.75</b>
<b>S.Em +</b>	<b>0.43</b>	<b>0.43</b>	<b>0.41</b>
<b>CD(P=0.05)</b>	<b>1.27</b>	<b>1.26</b>	<b>1.20</b>
<b>Interaction (Main × Sub)</b>			
<b>S.Em +</b>	<b>0.61</b>	<b>0.61</b>	<b>0.58</b>
<b>CD(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>
<b>Interaction (Sub × Main)</b>			
<b>S.Em +</b>	<b>0.58</b>	<b>0.57</b>	<b>0.54</b>
<b>CD(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

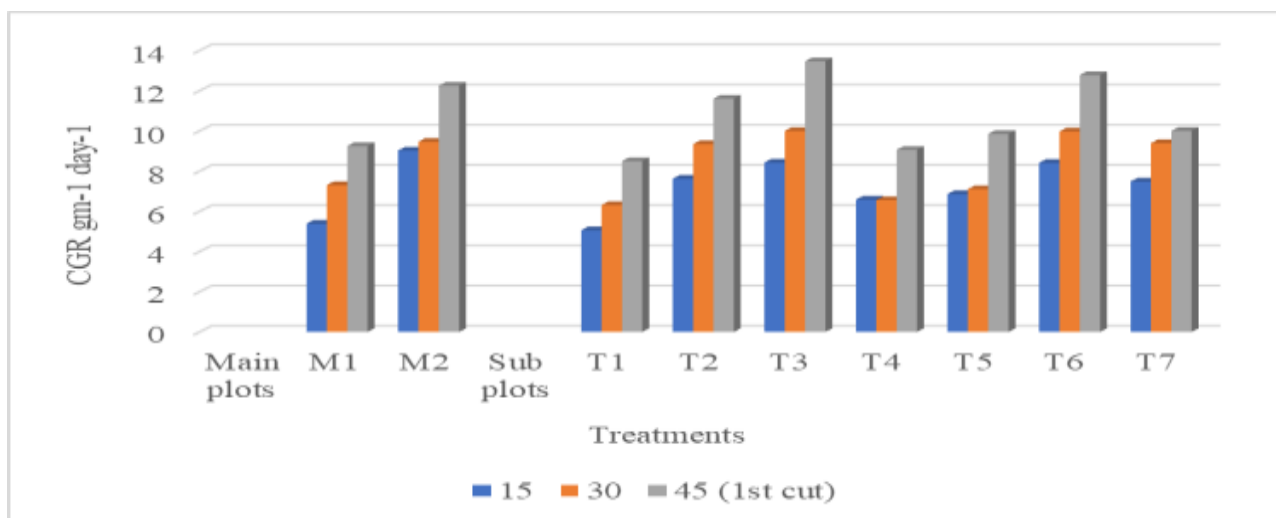


Figure 1. Crop Growth Rate ( $\text{g m}^{-2} \text{ day}^{-1}$ ) of different fodder species as influenced by integrated nutrient management in horti-pastoral system

## 2. Relative Growth rate ( $\text{g g}^{-1} \text{ day}^{-1}$ )

Data pertaining to relative growth rate of different fodder species as influenced by the different nutrient management practices is illustrated in Table 2. Perusal of the data revealed that RGR for two different type of fodder species has been shown that significantly higher RGR recorded in guinea grass at 15, 30 and 45 DAI 0.142, 0.022 and 0.0173  $\text{g g}^{-1} \text{ day}^{-1}$ , respectively 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 ( $\text{g g}^{-1} \text{ day}^{-1}$ ) of different fodder species as influenced by integrated nutrient management in horti- pastoral system**

	15 DAI	30 DAI	45 DAI (1 <sup>st</sup> cut)
<b>Main plots (Fodder species)</b>			
1. <i>Cenchrus ciliaris</i> (Anjan grass)	0.127	0.017	0.0170
2. <i>Megathyrus maximus</i> (Guinea grass)	0.142	0.022	0.0173
<b>S.Em <math>\pm</math></b>	<b>0.001</b>	<b>0.001</b>	<b>0.001</b>
<b>CD(P=0.05)</b>	<b>0.006</b>	<b>0.003</b>	<b>0.003</b>

<b>Sub plots (Nutrient management)</b>			
T <sub>1</sub> -Control (No fertiliser)	0.124	0.016	0.020
T <sub>2</sub> -100% RDF (60:60:40) N-P-K kg ha <sup>-1</sup>	0.136	0.020	0.018
T <sub>3</sub> -75% RDN + 25% N Through PGLM	0.139	0.020	0.017
T <sub>4</sub> -75% RDN + 25% N Through NGLM	0.132	0.020	0.018
T <sub>5</sub> -75% RDN + 25% N Through SGLM	0.133	0.021	0.017
T <sub>6</sub> -75% RDN + 25% N Through PM	0.139	0.021	0.016
T <sub>7</sub> -75% RDN + 25% N Through FYM	0.136	0.020	0.015
<b>Mean</b>	<b>0.134</b>	<b>0.0199</b>	<b>0.0172</b>
<b>S.Em ±</b>	<b>0.004</b>	<b>0.001</b>	<b>0.001</b>
<b>CD(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>
<b>Interaction (Main × Sub)</b>			
<b>S.Em ±</b>	<b>0.006</b>	<b>0.002</b>	<b>0.001</b>
<b>CD(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>
<b>Interaction (Sub × Main)</b>			
<b>S.Em ±</b>	<b>0.005</b>	<b>0.001</b>	<b>0.001</b>
<b>CD(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

## CONCLUSION

Based on the findings, it can be concluded that guinea grass with 75% RDN + 25% N through PGLM recorded higher CGR, RGR which was on par with 100% RDF (60:60:40) N-P-K kg ha<sup>-1</sup>, 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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