Growth, yield and economics of fodder grasses at Prayagraj, Uttar Pradesh

Crescimento, rendimento e economia de gramíneas forrageiras em Prayagraj, Uttar Pradesh

Crecimiento, rendimiento y economía de las gramíneas forrajeras en Prayagraj, Uttar Pradesh

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ABSTRACT
To study the growth, yield and economics of fodder grasses at Prayagraj in Uttar Pradesh, experiment was established in July 2022 with three treatments and five replications. In this study planted three fodder grasses viz., *Pennisetum purpurum* × *Pennisetum typhoides* (Hybrid napier), *Brachiaria mutica* (Para grass) and *Stylosanthes hamata* (Stylo). Results indicated that the maximum height was found in T₁: Hybrid Napier 186.60 cm followed by T₂: Para grass 132 cm and minimum in T₃: Stylo 57 cm. The plant population was maximum found in T₃: Stylo 16 followed by T₁: Hybrid Napier and T₂: Para grass 4 whereas number of tillers or branches per meter square found maximum in T₃: Stylo 159.80 followed by T₁: Hybrid Napier 158.60 and minimum in T₂: Para grass 120. The green fodder yield and dry fodder yield was maximum found in T₁: Hybrid
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Napier 860.16 and 266.65 qha\(^{-1}\) followed by T\(_2\): Para grass 438.77 and 122.86 qha\(^{-1}\) and minimum in T\(_3\): Stylo 194.65 and 36.98 qha\(^{-1}\) respectively. The maximum net return was found in T\(_1\): Hybrid Napier Rs. 75,660 followed by T\(_3\): Stylo Rs. 62,505 and minimum in T\(_2\): Para grass Rs. 61,605. The maximum B:C ratio was found in T\(_1\): Hybrid Napier 2.86 followed by T\(_3\): Stylo Rs. 2.61 and minimum in T\(_2\): Para grass Rs. 2.29.

**Keywords:** Growth, yield, economics, fodder, B:C ratio.

**RESUMO**

Para estudar o crescimento, o rendimento e a economia de gramíneas forrageiras em Prayagraj, em Uttar Pradesh, foi realizado um experimento em julho de 2022 com três tratamentos e cinco repetições. Nesse estudo, foram plantadas três gramíneas forrageiras, a saber, Pennisetum purpurum × Pennisetum typhoides (napier híbrido), Brachiaria mutica (capim-pará) e Stylosanthes hamata (Stylo). Os resultados indicaram que a altura máxima foi encontrada em T\(_1\): Hybrid Napier 186,60 cm, seguida por T\(_2\): Para grass 132 cm e mínima em T\(_3\): Stylo 57 cm. A população de plantas foi máxima em T\(_3\): Stylo 16, seguido por T\(_1\): Hybrid Napier e T\(_2\): Para grass 4, enquanto o número de perfilhos ou ramos por metro quadrado foi máximo em T\(_3\): Stylo 159,80, seguido por T\(_1\): Hybrid Napier 158,60 e mínimo em T\(_2\): Para grass 120. O rendimento de forragem verde e o rendimento de forragem seca foram máximos em T\(_1\): Hybrid Napier 860,16 e 266,65 qha\(^{-1}\), seguido por T\(_2\): Para grass 438,77 e 122,86 qha\(^{-1}\) e mínimo em T\(_3\): Stylo 194,65 e 36,98 qha\(^{-1}\), respectivamente. O retorno líquido máximo foi encontrado em T\(_1\): Hybrid Napier Rs. 75,660, seguido por T\(_3\): Stylo Rs. 62,505 e o mínimo em T\(_2\): Para grass Rs. 61,605. A relação B:C máxima foi encontrada em T\(_1\): Hybrid Napier 2,86, seguida por T\(_3\): Stylo Rs. 2,61 e o mínimo em T\(_2\): Para grass Rs. 2,29.

**Palavras-chave:** Crescimento, rendimento, economia, forragem, relação B:C.

**RESUMEN**

Para estudiar el crecimiento, rendimiento y economía de las gramíneas forrajeras en Prayagraj en Uttar Pradesh, se estableció un experimento en julio de 2022 con tres tratamientos y cinco repeticiones. En este estudio se plantaron tres gramíneas forrajeras, a saber, Pennisetum purpurum × Pennisetum typhoides (napier híbrido), Brachiaria mutica (pasto para) y Stylosanthes hamata (Stylo). Los resultados indicaron que la altura máxima se encontró en T\(_1\): Napier híbrido 186,60 cm seguido de T\(_2\): Para grass 132 cm y mínima en T\(_3\): Stylo 57 cm. La población de plantas fue máxima en T\(_3\): Stylo 16, seguido de T\(_1\): Napier híbrido y T\(_2\): Para grass 4, mientras que el número de tallos o ramas por metro cuadrado fue máximo en T\(_3\): Stylo 159,80 seguido de T\(_1\): Hybrid Napier 158,60 y mínimo en T\(_2\): Para grass 120. El rendimiento de forraje verde y seco fue máximo en T\(_1\): Napier híbrido 860,16 y 266,65 qha\(^{-1}\), seguido de T\(_2\): Para grass 438,77 y 122,86 qha\(^{-1}\), y mínimo en T\(_3\): Stylo 194,65 y 122,86 qha\(^{-1}\), respectivamente: Stylo 194,65 y 36,98 qha\(^{-1}\) respectivamente. El rendimiento neto máximo se encontró en T\(_1\): Híbrido Napier Rs. 75,660 seguido de T\(_3\): Stylo Rs. 62,505 y mínimo en T\(_2\): Para grass Rs. 61,605. La máxima relación B:C se encontró en T\(_1\): Híbrido Napier 2,86 seguido de T\(_3\): Stylo Rs. 2,61 y mínima en T\(_2\): Para grass Rs. 2,29.

**Palabras clave:** Crecimiento, rendimiento, economía, forraje, relación B:C.
1 INTRODUCTION

The current tendency in agriculture around the world is to look for cropping systems that are extremely productive, sustainable, and environmentally benign. The success of dairy farms depends on the availability of green fodder with better quality to animals, and it is challenging to sustain the health and milk output of the livestock without supply of the quality green fodder. Grazing land for farming has significantly decreased due to the necessity for space for commercial crops Tudsri et al., (2002). Growing fodder crops alongside legumes has the potential to increase the digestibility and palatability of the fodder It is a fact that feeding accounts for 65–70% of the entire cost of raising livestock. To reduce the cost of feed and fodder resources for sustainable livestock production, green fodder cultivation is an excellent option (Kumar et al., 2018).

The availability of feed and fodder is a major area of concern as there is a gap between its demand and supply in the country. According to Indian Council for Agricultural Research (ICAR)-affiliated National Institute of Animal Nutrition and Physiology (NIANP), the deficit in the requirement and the availability of dry fodder, green fodder and concentrates during 2015 was to the extent of 21%, 26 % and 34 %, respectively. This is likely to increase to 23 %, 40 % and 38 %, respectively, by 2025 (NIANP, 2020). The fodder deficit in India in terms of green fodder, dry fodder, and concentrates was 26 million tonnes (MT), 21 MT, and 34 MT in 2015, which is expected to reach 40 MT, 21 MT, and 38 MT by 2025, respectively (NIANP, 2020). At present, the country is facing a net deficit of 35.6% green fodder, 10.95% dry crop residues and 44% concentrate feed ingredients. At the current level of growth in forage resources, there will be 18.4% deficit in green fodder and 13.2% deficit in dry fodder by the year 2050 (Ginwal et al., 2019).

High crop yield fluctuations result from farmers' inadequate capacity to endure risk and variable rainfall patterns. High erosion from an agricultural field is encouraged by the unexpected onslaught of rain. A field's soil loss can be minimized by using vegetated filter strips to capture silt and monitor nutrient removal. Earlier studies states that grasses can prevent soil loss by satisfying the needs of small ruminants for green feed. However, in order to maintain healthy soils, conserve agronomic inputs, reduce environmental impacts, and produce acceptable yields in the face of rising overall agricultural production costs, optimal management practices must be put into place. In-progress supply of green fodder during the winter season, it is therefore imperative to cultivate fodder grasses with superior quality and higher yield.
2 MATERIAL AND METHODS

The fodder grasses experiment was established in July 2022 at Prayagraj, Uttar Pradesh, India. The GPS coordinate of experiment site 25.49°N 81.85°E, 98 m above msl. Selected fodder grass species for study were *Pennisetum purpurum × Pennisetum typhoides* (Hybrid napier), *Brachiaria mutica* (Para grass) and *Stylosanthes hamata* (Stylo). The spacing of hybrid napier and para grass was 50×50 cm; stylo grass was planted 25×25 cm. The growth performance and yield data were collected in whole year. The experimental design adopted was randomized block design (RBD) with 3 treatments and 5 replications, viz., T₁: Hybrid napier, T₂: Para grass, T₃: Stylo. The growth parameters of fodder crops like plant height (cm), tillers, plant population, leaf area index and yield were taken on harvesting. The details of measurement and calculation methods are given below.

2.1 HEIGHT

The height of randomly selected five plants in each plot was measured from the base of the plant to the tip of the plant at each cutting. The mean value of five plants obtained were expressed as mean plant height (cm) in each treatment.

2.2 TILLERS

The number of tillers per square meter from each tussock per plot was counted at five places by using one-meter square quadrate at the time of each cut of grass and mean of five sampling were expressed as number of tillers per square meter.

2.3 PLANT POPULATION

The number of plants per square meter from each plot were counted at five places by using one-meter square quadrate at the time of each cut of grass and mean of five samples were expressed as number of plants per square meter.

2.4 LEAF AREA INDEX (LAI)

Leaf area (cm²) was measured by leaf area meter. All green leaves of tillers from 2 hills harvested for study of dry matter production was used for measuring leaf area. Leaf area obtained was divided by land area covered by two hills to get the leaf area index (Misra, 1981).
LAI = \frac{\text{leaf area cm}^2}{\text{Land area cm}^2} \tag{1}

2.5 GREEN FODDER YIELD

Total yield for each plot were adjusted by including the fresh weight of samples, taken for various observations. The cut wise as well as total yields of two cuts were expressed as quintal per hectare.

2.6 DRY FODDER YIELD

Fresh forage samples were taken from each plot. After recording the fresh weight, forage crops were kept in electric oven for 3-4 days at temperature of 60°C. The dry weight was measured on digital pan balance. Dry matter content was worked out and then calculate dry fodder yield was with the following relationship.

\[ \text{Dry fodder yield (qha}^{-1}) = \frac{\text{Dry matter content (\%)} \times \text{Green fodder yield (qha}^{-1})}{100} \tag{2} \]

2.7 ECONOMICS

2.7.1 Cost of Cultivation

The expenditure incurred from sowing to harvest including the field preparation, cost of input materials such as seeds, fertilizations, insecticides, pesticides, etc. can be worked out and the labour cost. It is expressed in Rs ha\(^{-1}\).

2.7.2 Gross Return

Total income obtained from multiplication of unit cost of main product as well as by products and its total yield and expressed in Rs ha\(^{-1}\).

2.7.3 Net Return

Net return is obtained by subtracting cost of cultivation from gross return and expressed in Rs ha\(^{-1}\). The Net return calculated as follows:

\[ \text{Net Return} = \text{Gross return} - \text{Total cost of cultivation} \tag{3} \]
2.7.4 Benefit Cost Ratio

Benefit Cost Ratio (BCR) is the ratio of discounted value of benefit and discounted value of cost. It can be expressed as under

\[
\text{Benefit cost ratio (BCR)} = \frac{\text{Net return (Rs.ha}^{-1})}{\text{Cost of cultivation (Rs.ha}^{-1})}
\]

The project is viable when BC Ratio is one or more than one and is unviable when it is less than one.

The data obtained during the study, was analyzed by using standard statistical procedure with the help of computer applying analysis of variance technique OPSTAT application. Standard Error of Mean (SEM) and C.V. were computed in each case by using the critical difference (C.D.) at 5 % level of significance level to test the effects of treatments.

3 RESULT AND DISCUSSION

The growth performance of fodder grasses was shown in table 1. There was significant difference among all the treatments and maximum height was found in T₁: Hybrid Napier 186.60 cm followed by T₂: Para grass 132 cm and minimum in T₃: Stylo 57 cm. The plant population was maximum found in T₃: Stylo 16 followed by T₁: Hybrid Napier and T₂: Para grass 4 whereas maximum number of tillers or branches per meter square was found in T₃: Stylo 159.80 followed by T₁: Hybrid Napier 158.60 and minimum in T₂: Para grass 120. The number of leaves per plant or stick was maximum found in T₃: Stylo 59.60 followed by T₂: Para grass 21.40 and minimum in T₁: Hybrid Napier 12.20 whereas leaf area index was maximum found in T₁: Hybrid Napier 9.80 followed by T₂: Para grass 2.66 and minimum in T₃: Stylo 1.76.

Table 1: Growth of fodder grasses

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Height (cm)</th>
<th>Plant population (m²)</th>
<th>Number of tillers or branches (m²)</th>
<th>Number of leaves per plant/stick</th>
<th>Leaf area index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁: Hybrid Napier</td>
<td>186.60</td>
<td>4</td>
<td>158.60</td>
<td>12.20</td>
<td>9.80</td>
</tr>
<tr>
<td>T₂: Para grass</td>
<td>132.00</td>
<td>4</td>
<td>120.00</td>
<td>21.40</td>
<td>2.66</td>
</tr>
<tr>
<td>T₃: Stylo</td>
<td>57.00</td>
<td>16</td>
<td>159.80</td>
<td>59.60</td>
<td>1.76</td>
</tr>
<tr>
<td>S Em ±</td>
<td>1.42</td>
<td>0.39</td>
<td>1.84</td>
<td>0.79</td>
<td>0.07</td>
</tr>
<tr>
<td>CD (0.05)</td>
<td>4.64</td>
<td>1.26</td>
<td>5.99</td>
<td>2.57</td>
<td>0.23</td>
</tr>
<tr>
<td>CV (%)</td>
<td>2.54</td>
<td>10.83</td>
<td>2.81</td>
<td>5.68</td>
<td>3.39</td>
</tr>
</tbody>
</table>

Source: authors original work
The yield of fodder grasses was shown in table 2 and it found was significant difference among all the treatments. The green fodder yield and dry fodder yield was maximum found in T1: Hybrid Napier 860.16 and 266.65 qha\(^{-1}\) followed by T2: Para grass 438.77 and 122.86 qha\(^{-1}\) and minimum in T3: Stylo 194.65 and 36.98 qha\(^{-1}\) respectively. Similar result was reported by Tudu et al. (2021) in which yield of green fodder of hybrid napier was 183.07 qha\(^{-1}\). Toppo et al., (2021) reported the yield of Hybrid Napier 7.76 t ha\(^{-1}\).

**Table 2: Yield of fodder grasses (qha\(^{-1}\))**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Green fodder yield (qha(^{-1}))</th>
<th>Dry fodder yield (qha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: Hybrid Napier</td>
<td>860.16</td>
<td>266.65</td>
</tr>
<tr>
<td>T2: Para grass</td>
<td>438.77</td>
<td>122.86</td>
</tr>
<tr>
<td>T3: Stylo</td>
<td>194.65</td>
<td>36.98</td>
</tr>
<tr>
<td>S Em ±</td>
<td>9.92</td>
<td>3.09</td>
</tr>
<tr>
<td>CD (0.05)</td>
<td>32.33</td>
<td>10.08</td>
</tr>
<tr>
<td>CV (%)</td>
<td>4.45</td>
<td>4.86</td>
</tr>
</tbody>
</table>

Source: authors original work

Economics of fodder grasses was shown in table 3. The maximum net return was found in T1: Hybrid Napier Rs. 75,660 followed by T3: Stylo Rs. 62.505 and minimum in T2: Para grass Rs. 61,605. The maximum B:C ratio was found in T1: Hybrid Napier 2.86 followed by T3: Stylo Rs. 2.61 and minimum in T2: Para grass Rs. 2.29. Similarly finding was reported by Ahmad and Malik (2022) the B:C ration of stylo (3.39), Brachiaria (2.87) and hybrid napier (3.66) after one year. Amhad et al. (2022) reported the B:C ratio of stylo (2.14), Brachiaria (2.93) and hybrid napier (4.67) after four years.

**Table 3: Economics of fodder grasses per hectare**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Cost of cultivation (Rs.)</th>
<th>Gross return (Rs.)</th>
<th>Net return (Rs.)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: Hybrid Napier</td>
<td>26,450</td>
<td>1,02,110</td>
<td>75,660</td>
<td>2.86</td>
</tr>
<tr>
<td>T2: Para grass</td>
<td>26,845</td>
<td>88,450</td>
<td>61,605</td>
<td>2.29</td>
</tr>
<tr>
<td>T3: Stylo</td>
<td>23,950</td>
<td>86,455</td>
<td>62,505</td>
<td>2.61</td>
</tr>
</tbody>
</table>

Source: authors original work

**4 CONCLUSION**

The finding obtained from the study indicates that among three grass species, Hybrid Napier showed the maximum growth (height and leaf area index). Stylo showed the maximum growth (plant population, number of tillers or branches and number of leaves per plant/stick). The green fodder yield, dry fodder yield, net return and B:C ratio was also found maximum found in T1: Hybrid Napier.
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