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# PHYSIOLOGICAL BASIS OF YIELD VARIATIONS IN HYBRID GRASSES DUE TO SEASONALITY

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**ABSTRACT**

The study revealed significant differences between hybrids for NAR and CGR and they were higher in TNAU CN 2. NAR was the lowest in the first season yet RGR and CGR were the highest in the same season. Regarding RLGR and RSGR, TNAU CN 2 had registered higher values. RLGR was maximum in the first season and minimum in the second season. RSGR was found to be maximum during the third season.

Among the grasses, hybrid cumbu (bajra) x napier grass (*Pennisetum americanum* (L.) Leeke x *P. purpureum* (Schum) finds an important place since it is high yielding, palatable and nutritious. The yield and quality of hybrid bajrax napier grass are largely influenced by the genotypes and environmental conditions besides managment practices. Normally due to the seasonal variations, the reduction in the yield sometimes goes upto 70 per cent (Natarajaratnam, 1983) in the tropics and upto 40 per cent (Monteith, 1972) in the sub-tropics. So far, there has been no attempt to relate the environmental factors which contribute for this marked reduction in the yielding ability. For the said objective, four cumbu (bajra) x napier hybrids and one napier x cumbu (bajra) hybrid were utilised to study the physiological basis of yield variations observed in them at different seasons. The focus was to demarcate the attributes which responded towards higher yield in different seasons with critical evaluation of the various physiological parameters that influenced these varied expressions.

## MATERIALS AND METHODS

A field trial was laid out adopting randomised block design with three replications. The $F_1$ hybrid grasses chosen were CO 1, TNAU CN 2, TNCU CN 3, BN 2 and NB 21. The investigations were carried out in three season cuttings namely (i) 22.2.1984 to 6.4.1984; (ii) 7.4.1984 to 21.5.1984 and (iii) 20.8.1984 to 3.10.1984. The spacing adopted was 50 cm x 50 cm (4 plants $m^{-2}$) The plot size was 2.5 m x 1.0 m.

The recommended package of practices and plant protection measures were followed throughout crop growth period. The growth attributes were observed in five tillers randomly selected from each of the five adjacent hills. Subsequently the mean was worked out for each replication from the data recorded in the above said manner. The observations on net assimilation rate (NAR), relative growth rate (RGR), crop growth rate (CGR), relative leaf growth rate (RLGR) and relative stem growth rate (RSGR) were made at five growth stages viz., 9, 18, 27, 36 and 45 days after cutting.

At the end of each cutting to estimate green matter yield separate plots were maintained and all the hybrids were harvested. Green matter yield was recorded from the whole plot and subsequently yield per unit area was tabulated from the above data.

The weather parameters consisting of rainfall, maximum and minimum temperature, morning and evening relative humidity, solar radiation, total sunshine hours and evapotranspiration were recorded in the respective seasons from the date of

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Table 1. Relative Growth Rate ($g.g^{-1}$ $day^{-1}$), Relative Stem Growth Rate ($g.g^{-1}$ $day^{-1}$), Relative Leaf Growth Rate ($g.g^{-1}$ $day^{-1}$), Crop growth Rate ($g.m^2$ $day^{-1}$) and Net Assimilation Rate ($g.m^2$ $day^{-1}$)

| Season/ Hybrid | Stage mean | | | | |
|---|---|---|---|---|---|
| | RGR | RSGR | RLGR | CGR | NAR |
| First season | | | | | |
| Co 1 | 0.09 | 3.35 | 7.43 | 43.17 | 3.62 |
| TNAU CN 2 | 0.09 | 5.92 | 9.47 | 67.45 | 3.98 |
| TNAU CN 3 | 0.08 | 3.84 | 7.19 | 44.16 | 3.43 |
| BN 2 | 0.09 | 3.95 | 9.45 | 53.59 | 3.17 |
| NB 21 | 0.09 | 5.22 | 8.12 | 53.36 | 3.67 |
| Mean | 0.09 | 4.46 | 8.81 | 52.35 | 3.57 |
| Second season | | | | | |
| Co 1 | 0.09 | 6.64 | 3.80 | 24.03 | 8.02 |
| TNAU CN 2 | 0.07 | 4.23 | 5.72 | 39.42 | 6.42 |
| TNAU CN 3 | 0.07 | 2.78 | 4.01 | 23.79 | 5.91 |
| BN 2 | 0.06 | 3.18 | 4.59 | 26.57 | 4.52 |
| NB 21 | 0.06 | 3.44 | 3.37 | 23.12 | 3.20 |
| Mean | 0.07 | 3.17 | 4.30 | 27.38 | 5.62 |
| Third season | | | | | |
| Co 1 | 0.09 | 3.07 | 5.34 | 33.63 | 3.82 |
| TNAU CN 2 | 0.08 | 8.07 | 9.21 | 68.49 | 6.13 |
| TNAU CN 3 | 0.08 | 4.22 | 5.16 | 36.22 | 6.09 |
| BN 2 | 0.08 | 4.44 | 6.93 | 45.49 | 6.53 |
| NB 21 | 0.07 | 4.23 | 5.35 | 36.35 | 3.45 |
| Mean | 0.08 | 4.80 | 6.40 | 43.88 | 5.20 |
| Hybrid mean | Co. 1 | TNAU CN2 | TNAU CN3 | BN2 | NB 21 |
| RGR | 0.09 | 0.08 | 0.08 | 0.08 | 0.07 |
| RSGR | 2.87 | 6.07 | 3.61 | 3.85 | 4.30 |
| RLGR | 5.53 | 8.93 | 5.46 | 6.99 | 5.62 |
| CGR | 33.61 | 58.45 | 34.64 | 41.80 | 37.53 |
| NAR | 0.15 | 5.51 | 5.14 | 4.74 | 3.44 |
| CD at 5% | 0.01** | 0.87** | 1.30** | 6.76** | 1.06 |
| Hybrid | - | - | 1.68** | 8.65** | - |
| Hybrid, Sseason x Hybrid | - | 1.13** | - | - | 1.37** |
| Stage, Season x Hybrid | 0.01** | 1.01** | - | 7.73** | 1.22** |
| Hybrid x Stage | 0.03** | 2.25** | 1.50** | 17.30** | 2.74** |

starting to the date of cutting. The growing degree days, photothermal units and heliothermal units were also calculated.

## RESULTS AND DISCUSSION

During the first season, the NAR values were consistently lower while the second and

third season values were on par. Hybrids Co 1, TNAU CN 2, TNAU CN 3 and BN 2 were not different from each other. On the other hand NB 21 had shown lowest NAR. Natarajaratnam (1983) registered higher NAR in TNAU CN 2. Season x hybrid interaction was significant (Table 1).

The values on the RGR as influenced by the season were indicative of significant differences. The high value was domonstrated in the first season while the data on the second and third seasons appeared to be on par. The differences among the hybrids were not significant. Season x hybrid interaction was also non-significant (Table 1). Natarajaratnam (1983) in hybrid grass did not trace out any appreciable differences with respect to this attribute in various seasons. A question is always raised whether these growth attributes namely NAR and RGR could function as emprical indicators only while acting significantly sometimes.

The data on CGR was able to show significant differences which were influenced the season. As in the case of other parameters, the maximum value was noticed in the first season while the lowest was demarcated by the second season.

Table 2. Green matter yield ($kg.m^{-2}$)

| Hybrid | Season | | | Mean |
|---|---|---|---|---|
| | First | Second | Third | |
| Co 1 | 21.376 | 4.060 | 20.888 | 15.368 |
| TNAU CN 2 | 33.156 | 13.680 | 31.092 | 25.976 |
| TNAU CN 3 | 19.380 | 11.584 | 21.468 | 17.476 |
| BN 2 | 26.396 | 9.308 | 21.220 | 18.976 |
| NB 21 | 27.276 | 8.716 | 19.892 | 18.628 |
| Mean | 25.516 | 9.468 | 22.868 | - |
| | | | $SE_d$ | CD |
| | Season | | 2.256 | 4.656** |
| | Hybrid | | 2.912 | 6.012* |

Table 3. Weather data

| Weather parameters | Seasons | |
|---|---|---|
| | First | Second |
| Rainfall (mm) | 118.2 | 100.8 |
| Average maximum temperature (°C) | 34.9 | 32.3 |
| Average minimum temperature (°C) | 20.2 | 21.8 |
| Diurnal variation of temperature (°C) | 14.7 | 10.5 |
| Average morning relative humidity (%) | 85.7 | 86.8 |
| Average evening relative humidity (%) | 41.1 | 41.3 |
| Solar radiation (cal. $cm^2$. $min^{-1}$) | 242 | 228 |
| Total sunshine hours | 409 | 372 |
| Total evapotranspiration (mm) | 194 | 238 |
| Mean day length (hrs) | 12.07 | 12.31 |
| Degree days | 789.75 | 767.25 |
| Photothermal unit | 9532.28 | 9444.85 |
| Heliothermal unit | 323007.75 | 285417.60 |

Differences between hybrids were highely significant with the TNAU CN 2 leading in the expression of this character (Table 1). This is in close agreement with the findings of Natarajaratham (1983). A close association between CGR and GMY was observed by Sheehy and Cooper (1973). Season x hybrid interaction was found to be non-significant.

RLGR was maximum in the first season and lowest in the second season. Among the hybrids, TNAU CN 2 had registered higher RLGR. In different growth phases, there was a continuous incease in the growth rate irrespective of the seasons excepting in the second season where there was a small reduction in the third and fourth stages. RLGR values of different stages of growth phases were always higher in the first season. Similar results were reported by Natarajaratnam (1983) for TNAU CN 2. Season x hybrid interaction was found to be non-significant (Table 1).

RSGR was found to be maximum during third season, but the values were on par with the values of the first season. Evenhere, TNAU CN 2 had shown higher stem growth rate as compared to other hybrids. Season x hybrid interaction was significant (Table 1). The data pointed out that during the first season rates of growth in the leaf and stem were markedly higher as compared to other two seasons. Higher productiivity in the TNAU CN 2 was due to higher leaf and stem growth rates observed in this hybrid. According to Natarajaratnam (1983) these growth attributes were greatly influenced by the weather parameters.

The data on GMY are presented in Table 2. The first season had the lowest yield. A reduction of 62.8% could thus be observed. Compared to the second season, the first season had higher mean solar radiation, mean maximum temperature, total sunshine hours and diurnal temperature (Table 3). Larcher (1980) reported that higher diurnal temperature variation was favourable for higher growth rate in plants. The degree days, photothemal units and heliothermal units were also found to be favourably related to higher GMY in the first season. In the second season, all the parameters were found to be in the lower order. The higher yield in the first season was indicated by very high CGR and very high LA. According to Yamada (1975) both LAI and CGR are interrelated. Probably in the first season, the hybrids were able to generate enough LA and had utilized larger percentage of income solar radiation with the result high CGR was obtained. On the other hand in the second season CGR was found to be lowered. The CGR was reduced by nearly 48%. It was clear that the full ground cover was not attained during this season resulting in the less utilization of radiant energy.

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