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Forage production potential and nitrate nitrogen in Napier Bajra hybrid as influenced by nitrogen dose under shaded and un-shaded environments

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Introduction

Dairy farming is an important and prevalent subsidiary occupation along with agriculture in the state of Punjab. But because of declining land holding, the pressure on land is so high that there is little scope of expanding the area under forage crops. Crop intensification either in space (intercropping) or in time (sequential cropping) or both is the feasible option left to the farmers for enhancing the fodder production. The green fodder is deficit by about 25% in the state and there is around 65,000 ha area under Agro-forestry. There is a need to explore possibility of growing fodder crops under shade of trees, as light intensity is one of the major growth resources that determine the productivity of a particular crop (Dodd *et al.*, 2005). Data are also lacking about how fodder crops will respond to different amounts of N fertilization under shade conditions. Napier Bajra is an inter-specific hybrid between bajra (*Pennisetum glaucum*) and napier grass (*P. purpureum*) and combines high quality and faster growth of bajra with the deep root system of napier grass. It is photosensitive and flowers only in winter. Due to this characteristic, it remains in the vegetative stage throughout the year, except in winter, when it is dormant. With these points in mind, the present study was planned to find out the influence of shading in comparison with normal conditions on forage productivity and quality under varying nitrogen levels.

Materials and Methods

The field experiment was conducted at the Research Farm of Department of Forestry and Natural Resources, PAU Ludhiana during 2013 and 2014 in split plot design. The experimental field was loamy sand in texture, neutral in pH (8.3), low in organic carbon (0.31%) medium in available P (17.5 kg/ha) and high in available K (276.2 kg/ha). The main plot treatments comprised of two growing environment *viz.*, shade and un-shaded and five levels of nitrogen (0, 37.5, 56.25, 75.0 & 93.75 kg N/ha/cut) in sub-plots. In case of shaded environment, the Napier Bajra was planted in 6 year old Eucalyptus trees which were planted at as spacing of 5 m × 2 m. Root slips of Napier Bajra hybrid were planted at a spacing of 60 cm × 60 cm in April, 2013.

Results and Discussion

The observations on growth and yield parameters forage productivity and quality was recorded along with agro-meteorological observations. The mean temperature under shaded conditions was 31.3 °C as compared to 34.6 °C under un-shaded conditions (Table 1). The PAR interception under the shaded conditions was less (55.6%) as compared to that under un-shaded conditions (91.2%). The pooled data on growth and yield parameters (Table 2) revealed that growth of the Napier Bajra hybrid was suppressed under shaded conditions. Plant height and tiller per plant were significantly lower under shaded conditions (68.2 cm & 18.7, respectively) than those under un-shaded conditions (86.8 cm & 26.4, respectively). The total green fodder yield of 1317.3 q/ha was recorded under un-shaded conditions which was significantly higher as compared to shaded conditions (1021.2 q/ha). Similar trend was observed in case of dry matter yield. The lower temperature and lower incident PAR must have decreased the rate of photosynthesis and hence dry matter production due to which fodder yield decreased in case of shaded environment as compared to open conditions. This reduction in forage production under tree shade is known to occur due to competitive interaction between trees and fodder crop (Pandey *et al.*, 2011). The data on quality parameters revealed that both crude protein and nitrate-N content were significantly higher under shaded conditions (11.64% & 1452 ppm, respectively) than under un-shaded conditions (8.37% & 776 ppm). This might be due to high soil moisture level associated with the more moderate soil temperature in shade may result in a faster rate of N mineralization, litter breakdown, and turnover of N than that occurs in full sunlight. This increase in N mineralization resulted in higher CP and nitrate-N content under shaded conditions.

Increasing the nitrogen levels resulted in increase in plant height, tiller/plant, green fodder yield, dry matter yield, CP content and nitrate-N content irrespective of the growing environment. Green fodder and dry matter yield increased significantly up to 75 kg N/ha/cut.

Table 1: Average PAR interception, reflection and transmission (%) values under shaded and un-shaded conditions

| Meteorological parameter | Growing environment | |
|--------------------------|---------------------|-----------|
| | Shaded | Un-shaded |
| Air Temperature (°C) | 31.3 | 34.6 |
| PAR Interception (%) | 55.6 | 91.2 |
| PAR Reflection (%) | 7.6 | 3.5 |
| PAR Transmission (%) | 34.2 | 4.8 |

Table 2: Growth, yield and quality of Napier Bajra under shaded and un-shaded conditions at different Nitrogen levels (Pooled data of 2 years)

| N-levels (kg/ha/cut) | Plant height (cm) | | | Tiller/plant | | | Green fodder yield (q/ha) | | |
|----------------------|-------------------------|----------|-------|-------------------|----------|-------|---------------------------|----------|--------|
| | Shade | Un-shade | Mean | Shade | Un-shade | Mean | Shade | Un-shade | Mean |
| 0 | 59.9 | 73.8 | 66.8 | 15.9 | 22.3 | 19.1 | 744.5 | 964.0 | 854.3 |
| 37.50 | 62.5 | 83.6 | 73.0 | 18.3 | 24.8 | 21.5 | 929.0 | 1182.0 | 1055.5 |
| 56.25 | 68.9 | 87.1 | 78.0 | 18.8 | 26.6 | 22.7 | 1088.0 | 1361.0 | 1224.5 |
| 75.00 | 74.1 | 92.5 | 83.3 | 20.0 | 28.4 | 24.2 | 1155.0 | 1492.5 | 1323.8 |
| 93.75 | 75.8 | 97.2 | 86.5 | 20.7 | 30.0 | 25.4 | 1189.5 | 1587.0 | 1388.3 |
| Mean | 68.2 | 86.8 | | 18.7 | 26.4 | | 1021.2 | 1317.3 | |
| CD (5%) | | | | | | | | | |
| Environment | 4.65 | | | 1.67 | | | 48.6 | | |
| N-level | 5.98 | | | 2.36 | | | 68.5 | | |
| Interaction | NS | | | NS | | | NS | | |
| N-levels (kg/ha/cut) | Dry matter yield (q/ha) | | | Crude protein (%) | | | Nitrate-Nitrogen (ppm) | | |
| | Shade | Un-shade | Mean | Shade | Un-shade | Mean | Shade | Un-shade | Mean |
| 0 | 121.6 | 161.4 | 141.5 | 9.85 | 6.82 | 8.33 | 778 | 371 | 574 |
| 37.50 | 151.1 | 197.4 | 174.2 | 11.23 | 7.88 | 9.55 | 1057 | 551 | 804 |
| 56.25 | 177.7 | 230.1 | 203.9 | 11.84 | 8.59 | 10.21 | 1463 | 797 | 1130 |
| 75.00 | 186.3 | 249.5 | 217.9 | 12.49 | 8.93 | 10.71 | 1746 | 884 | 1315 |
| 93.75 | 194.3 | 266.0 | 230.2 | 12.81 | 9.66 | 11.24 | 2214 | 1279 | 1747 |
| Mean | 166.2 | 220.9 | | 11.64 | 8.37 | | 1452 | 776 | |
| CD (5%) | | | | | | | | | |
| Environment | 10.6 | | | 0.79 | | | 256.3 | | |
| N-level | 13.6 | | | 0.92 | | | 412.3 | | |
| Interaction | NS | | | NS | | | NS | | |

Conclusion

From the results of the study it can be concluded that forage yield of Napier Bajra hybrid decreased significantly when grown under tree shades. Though CP content of the fodder increased under shade but there was also significant increase in Nitrate-N content which is considered an anti-quality character in fodder crops. The increase in N-levels increased forage yield up to 75 kg N/ha/cut both under shaded and un-shaded conditions.

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