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RESEARCH ARTICLE

Growth, Yield and Economics of Bajra Napier hybrid grass CO (BN) 5 as Influenced by Drip Fertigation

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ABSTRACT

Field experiments were conducted during 2015-16 and 2016-17 at New Area farm, Department of Forage Crops, Tamil Nadu Agricultural University, Coimbatore to optimize the water and nutrient requirement under drip fertigation in Bajra Napier hybrid grass CO (BN) 5. Experiment An experiment was laid out in Randomized Block Design with three replications. The treatments consisted of different irrigation levels and N fertigation levels viz., Paired Row Drip System (PRDS) (60/90 x 50 cm) + Drip at 100 % PE + N fertigation at 75 % Recommended Dose of Fertilizer (RDF) (T1), PRDS (60/90x50 cm) + Drip at 100 % PE + N fertigation at 100 % RDF (T2), PRDS (60/90 x 50 cm) + Drip at 100 % PE + N fertigation at 125 % RDF (T3), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 75 % RDF (T4), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 100 % RDF (T5), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 125 % RDF (T6), Surface irrigation (5 cm depth) + soil application of N at 100 % RDF (Farmers' practice) (T7).Drip irrigations were given based on pan evaporation (PE). The fertilizer dose followed was 150:50:40 kg NPK/ha as basal and 75 kg N /ha after each cut. Results showed that drip irrigation at 125 % PE + N fertigation at 125 % RDN recorded higher number of tillers per plant (29.8), plant height (246.3 cm), green fodder yield (378.7 t/ha/yr), dry matter yield (104.5 t/ha/yr), gross return (Rs. 568097/- /ha/yr.) and net return (Rs. 4,17,180/- /ha/yr.). It was on par with drip irrigation at 125 % PE + N fertigation at 100 % RDN. Hence, drip irrigation at 125 % PE + N fertigation at 100 % RDN was found to be optimum for achieving the maximum growth yield and net return in Bajra Napier hybrid grass CO (BN) 5.

Keywords: *Bajra Napier hybrid grass CO (BN) 5, Drip fertigation, Green fodder yield.*

INTRODUCTION

Livestock play an important role in the rural economy of India by providing employment and supplementary family income. It also provides balanced and nutritional food in the form of milk, meat and egg to the millions of people. India supports nearly 20 per cent of the world's livestock population and 16.8 per cent of human population with only 2.3 per cent of the world's geographical area. The growth rate during the last five decades registered the rising drift in cattle (28.19 %), buffaloes (142.72 %), sheep (83.02 %) and goat (197.76 %) with an overall growth rate of 80.91 % in livestock (Livestock Census, 2012). Although India has very large population of livestock, the productivity of milk and other livestock products are very low when compared to other countries around the world. Low productivity of our livestock can be attributed by factors such as malnutrition, under-nutrition or both, besides the genetic potential of the animals. In order to enhance milk production and meet future demand, crossbred cows should be fed with nutritious green fodder throughout the year (Naik *et al*., 2015). Because, green fodder possess the smoothing effect on the animal body, more palatable provide efficiently utilizable nutrients in natural form and slightly laxative. In order to meet the growing demand of nutritious green fodder for livestock, it is essential to introduce high yielding fodder varieties of grasses, millets and legumes.

Among the cultivated perennial grasses, Bajra Napier hybrid grass has been acclaimed as the highest forage yielder in a unit time and space. Endowed with several unique characteristics, the crop finds an important place in livestock rearing because of its higher biomass yield as well as palatability. The grass has a very high yield potential and maintains its productivity for 4 to 5

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years. In which, Bajra Napier hybrid grass CO (BN) 5 has gained considerable importance in the dairy industry because of its winter hardiness, high crude protein content, high biomass yield, quick sprouting and rejuvenating capacity (Babu *et al*., 2014). Traditional irrigation methods are characterized by high fluctuations in soil-moisture content, as high quantities of water are applied at long intervals. These fluctuations have an adverse effect on plant growth and crop yields. In this juncture, drip fertigation is the state of the art technology that has revolutionized crop production in the 21st century. Drip irrigation systems having the potent to supply optimal range of moisture in the soil at all the times because water is applied directly into the root zone of the plant in precise quantities according to the crop requirements. This promotes water-saving as well as enhances growth and production. When properly designed and managed, drip irrigation has many advantages over other irrigation methods including elimination of surface runoff, high uniformity of water distribution, high water usage efficiency, flexibility in fertilization, prevention of weed growth and plant disease (*Guy Sela, 2017)*. Nutrients are supplied frequently at low concentrations to meet the plants' needs and allow for saving of both water and fertilizers with reduced nitrate losses due to leaching. Keeping these in view, field experiments were conducted to identify the irrigation and nitrogen levels in Bajra Napier hybrid grass CO (BN) 5 under drip fertigation system.

MATERIAL AND METHODS

Field experiments were conducted during 2015-16 and 2016-17 at New Area farm, Department of Forage Crops, Tamil Nadu Agricultural University, Coimbatore to optimize the water and nutrient requirement under drip fertigation in Bajra Napier hybrid grass CO (BN) 5. An experiment was laid out in Randomized Block Design with three replications. The treatments consisted of different irrigation levels and N fertigation levels *viz.*, Paired Row Drip System (PRDS) (60/90 x 50 cm) + Drip at 100 % PE + N fertigation at 75 % Recommended Dose of Fertilizer (RDF) (T_1), PRDS (60/90x50 cm) + Drip at 100 % PE + N fertigation at 100 % RDF (T_2), PRDS (60/90 x 50 cm) + Drip at 100 % PE + N fertigation at 125 % RDF (T_3), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 75 % RDF (T_4), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 100 % RDF (T_5), PRDS (60/90 x 50 cm) + Drip at 125 % PE + N fertigation at 125 % RDF (T_6), Surface irrigation (5 cm depth) + soil application of N at 100 % RDF (Farmers' practice) (T_7). In drip system, crops were accommodated by paired row system with the spacing of 60/90x50 cm. The soil of the experimental field was sandy clay loam in texture with organic carbon percentage of 0.64. The EC and pH of the soil were 0.94 dSm^{-1} and 7.8, respectively. The soil was low in available nitrogen (187 kg ha^{-1}), medium in available phosphorus (12.4 kg ha^{-1}) and high in available potassium (389 kg ha^{-1}).

Drip irrigations were given based on pan evaporation (PE) at three days interval. The fertilizer dose followed was 150:50:40 kg NPK/ha as basal and 75 kg N /ha after each cut. In which, half dose nitrogen full dose of phosphorous and potassium fertilizers were applied as basal and remaining half at 30 days after planting in surface method of irrigation. In drip irrigation plots, the full dose of phosphorous and potassium fertilizers were applied as basal and nitrogen was applied through drip in three equal splits for each cut at ten days interval from the harvest. Fourteen harvests were made in two years. The growth and yield parameters were recorded for all the cuts. The laboratory analysis for estimating the crude protein percentage was done. Total nitrogen content was estimated by micro kjeldahl's method suggested by Humphries (1956) and was multiplied by the factor (6.25) to obtain the crude protein content. Crude protein content was multiplied with dry matter yield to obtain crude protein yield. Cost of cultivation and gross returns for all the treatments were worked out on the basis of prevailing input cost and market price of fodder crops at the time of experimentation. Net return was calculated by deducting costs of cultivation from gross return. Data on various characters studied during the course of investigation was statistically analyzed as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth attributes

The results revealed that growth and yield of Bajra Napier hybrid was varied remarkably with different drip fertigation levels (Table 1). Drip irrigation at 125 % PE + N fertigation at 125 % RDN recorded significantly the highest number of tillers per plant (29.8) and maximum plant height (246.3 cm). It was on par with drip irrigation at 125 % PE + N fertigation at 100 % RDN and drip irrigation at 100 % PE + N fertigation at 125 % RDN. Increased plant height might be attributed to the enhanced supply of moisture and nutrients in general and nitrogen in particular. The higher photosynthetic activity with better moisture and nitrogen supply helps in maintaining higher auxin level which might have resulted in taller plants. The current findings are also in line with the findings of Rajesh Jolad *et al*. (2018). Soni *et al*. (1991) also stated that continuous supply of moisture and nutrients through drip fertigation would be helpful for better establishment of root and shoot system of the plants which in turn promotes the proper outcome of auxiliary buds to produce more tillers. The lowest number of tillers per plant of 21.5 and lowest plant

height of 214.0 cm was recorded with drip irrigation at 100 % PE + N fertigation at 75 % RDN. Relatively lower supply and absorption of nitrogen could be the possible reason for lesser plant height and number of tillers. Similar, views were also expressed by Vennila and Sankaran (2017).

Table 1. Effect of drip fertigation on growth, yield and quality of Bajra Napier hybrid grass CO (BN) 5 (Pooled analysis of cuts 1 to Cut 14)

Treatments	Plant height (cm)	No. of tillers/plant	GFY(t/ha/yr)	DMY(t/ha/yr.)
T_1	214.0	21.5	271.4	78.9
T_2	230.7	25.2	317.9	91.4
T_3	238.0	27.5	346.1	96.9
T_4	218.8	23.9	297.9	85.6
T_5	238.4	28.0	349.8	97.5
T_6	246.3	29.8	378.7	104.5
T_7	229.7	27.8	341.4	88.7
SEd	9.50	0.87	14.70	4.50
CD (0.05)	19.40	1.80	29.60	9.20

Green fodder and dry matter yield

Drip fertigation levels showed a marked variation in green fodder and dry matter yields (Table1). The highest green fodder yield of 378.7 t/ha/yr was recorded with drip irrigation at 125 % PE + N fertigation at 125 % RDN and it was on par with drip irrigation at 125 % PE + N fertigation at 100 % RDN (349.8 t/ha/yr). Nitrogen application through drip irrigation had positive impact on the green fodder yield due to improved crop growth (plant height, number of tillers and number of leaves) which in turn resulted in higher biomass yield per unit area. This might be due to the fact that nutrients received through fertigation plots had uniform and equal distribution of nitrogen throughout the crop growth period and thereby reducing the volatilization and leaching loss. In addition, continuous availability of soil moisture throughout the growth phases could result in higher growth parameters, in turn resulting in higher plant biomass (Vennila and Sankaran, 2017). However, the lowest green fodder yield of 271.4 t/ha/yr was recorded in drip irrigation at 100 % PE + N fertigation at 75 % RDN. Lower fodder yield obtained due to lack of nitrogen may be attributed to the fact that nitrogen is an important constituent of amino acids and chloroplasts which directly influenced plant growth and development through photosynthate production and accumulation. A similar finding was also reported by Surendra and Sharanappa. (2000).

Table 2. Effect of drip fertigation on economics of Bajra Napier hybrid grass (Two years mean)

Treatments	Cost of cultivation (Rs./ha/year)	Gross return (Rs./ha/year)	Net return (Rs./ha/year)	BCR	Water Use (mm)	WUE (kg/ha.mm)
T_1	1,44,767	407027	263521	2.84	1262	216.4
T_2	1,48,692	476864	329870	3.24	1262	253.5
T_3	1,50,918	519120	369378	3.47	1262	276.0
T_4	1,44,767	446821	302054	3.09	1571	197.0
T_5	1,48,692	524692	376000	3.53	1571	231.3
T_6	1,50,918	568097	417180	3.76	1571	250.5
T_7	1,36,386	512100	375714	3.75	1734	204.4
SEd				Data not analyzed statistically		10.5
CD (0.05)						21.4

The dry matter yield was significantly higher and was on par among the drip irrigation at 125 % PE + N fertigation at 125 % RDN and drip irrigation at 125 % PE + N fertigation at 100 % RDN with a yield of 104.5 and 97.5 t/ha/yr, respectively. Optimum supply of nitrogen at all the stages might have facilitated more availability and the absorption of nutrients and drip irrigation plays a major role in improving the water status of the plant. This might be ascribed to the formation of higher quantity of leaf chlorophyll in the leaf tissues which in turn resulted the increased dry matter production. Results of the present experiment also support the earlier observations of Spies *et al*. (1998).

Economics

Data on economics (Table.2) showed that drip irrigation at 125 % PE + N fertigation at 125 % RDN and drip irrigation at 100 % PE + N fertigation at 125 % RDN registered the maximum cost of cultivation of Rs. 1,50,918/- /ha. Lowest cost of cultivation of Rs. 1,36,386/- per hectare was recorded in surface irrigation (5 cm depth) + soil application of N at 100 % RDF. Highest gross return (Rs. 568097/- /ha / yr.) and net return (Rs. 4,17,180/- /ha/yr.) were recorded in drip irrigation at 125% PE + N fertigation at 125% RDN. This may be due to higher fodder yield obtained from this treatment.

Water use and water use efficiency

Water use and water use efficiency were significantly differed with various drip fertigation levels and surface irrigation method (Table 2). Among the treatments, drip irrigation at 100% PE recorded less water requirement of 1254 mm. It was followed by drip irrigation at 125% PE which recorded the water requirement of 1512 mm. This was due to précised application of required water to the root zone and also with reduced conveyance loss. Significantly higher water use efficiency of 276.0 kg/ha.mm was recorded in drip irrigation at 100 % PE + N fertigation at 125 % RDN. It might be due to highest water saving of 480 mm when compared to surface irrigation. It was followed by drip irrigation at 100 % PE + N fertigation at 100 % RDN and drip irrigation at 125 % PE + N fertigation at 100 % RDN which recorded the water use efficiency of 253.5 kg/ha.mm and 250.5 kg/ha.mm, respectively. Lowest water use efficiency of 197 kg/ha.mm was recorded in drip irrigation at 125 % PE + N fertigation at 75 % RDN. This might be due to reduction of green fodder yield resulted by limited nitrogen supply.

CONCLUSION

Paired row drip system (60/90 cm x 50 cm) + drip irrigation at 125% PE + nitrogen fertigation at 100% RDN was found to be a technically viable and economically feasible option for attaining maximum green fodder yield in cumbu napier hybrid grass with the water-saving of 222mm.

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