Current Journal of Applied Science and Technology

23(5): 1-6, 2017; Article no.CJAST.35659
Previously known as British Journal of Applied Science & Technology
ISSN: 2231-0843, NLM ID: 101664541

Influence of Nutrients on Growth and Yield of Bajra Napier Hybrid Grass

C. Vennila[1*] and V. M. Sankaran[1]

[1]Department of Agronomy, Madras Veterinary College, Chennai 600007, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2017/35659
Editor(s):
(1) Ming-Chih Shih, Department of Health and Nutrition Science, Chinese Culture University, Taiwan.
Reviewers:
(1) Vlado Kovacevic, University J. J. Strossmayer in Osijek, Croatia.
(2) Santosh Kumari, Indian Agricultural Research Institute, India.
(3) Mehmood Ali Noor, Institute of Crop Science, Chinese Academy of Agricultural Sciences, China.
Complete Peer review History: http://www.sciencedomain.org/review-history/20976

Original Research Article

Received 24th July 2017
Accepted 29th August 2017
Published 14th September 2017

ABSTRACT

Fodder crops cultivation in India is gaining momentum to overcome the feed and fodder shortages for the farm animals. Application of nutrients for fodder crops is a rare phenomenon and the package of practices are not adopted by the farmers to increase the productivity. Fodder crops are almost negligible crops in our country. Field experiments were conducted from 2014 to 2016 in sandy soils to study the influence of nutrients on growth and yield of bajra napier hybrid gram. The various nutrients used were organic and inorganic sources. The treatments included organic source of nutrients alone, inorganic sources of nutrients alone and combination of organic and inorganic sources of nutrients with 100% and 50% recommended dose of organic inorganic sources of nutrients given in twelve combinations. Various parameters such as plant height, number of tillers, number of leaves, leaf stem ratio, plant weight and biomass yield were recorded. The results revealed that application of farmyard manure along with 100% recommended close of nutrients, i.e. 150:50:40 kg NPK / ha, applied through drip resulted in higher plant height (143.3 cm and 157.9 cm), number of tiller per plant (26.4 and 31.4), number of leaves per plants (358.7 and 376.3), leaf stem ratio of 0.44 and 0.59, plant weight (1337.2 and (700.6g) and plant biomass (62.5 and 68.0 t ha^{-1}) during 2014-2015 and 2015-2016 respectively. During both the years of experimentation, application of Farmyard Manure at the

**Corresponding author: E-mail: vennilac@rediffmail.com;*

rate of 25t ha^{-1} and 100% recommended dose of nutrients applied basally and the remaining through drip resulted in growth and yield parameter on par with the application of nutrients through drip alone.

Keywords: Bajra napier hybrid grass; organic and inorganic nutrient source; growth parameters; yield.

1. INTRODUCTION

India is basically an agricultural country and nearly three-fourth population depends on agriculture, livestock and allied sectors for livelihood. Nearly 70 percent of country population lives in rural areas. Livestock plays an important role in the rural economy of the country. Livestock is a key source of supplementary income and livelihood especially for small land holdings and landless rural poor households. Indian agriculture is mostly interwined with crop and animal husbandry. However, the productivity of animals is low compared to the world average. One of the main reasons for the low productivity of our livestock is malnutrition, under-nutrition or both, beside the low genetic potential of the animals. India is highly deficient in respect of availability of green fodder, dry fodder and concentrates. The deficit gap of availability vis-à-vis the requirement of green fodder is very huge at 62.76 % and 23.46 % for dry fodder. The deficit of concentrates also found to be more than 30 percent. The fodder and feed deficit varies across states and found more acute and chronic in arid and semi-arid states where farming is highly dependent on rainfall and have large livestock population [1].

Further, agriculture today is plagued with many problems such as pressure on cultivable land due to fragmentation, high level of spatial and temporal variability in rain, dwindling ground water resources, shortage of farm workers to carry out agriculture operations, poor adoption of improved crop management practices and location specific cropping system. The deficiency of green fodders for animals is more pronounced for reduced yield. Hence, it is necessary to include fodder crops along with cultivation of other crops for providing green fodders for the animals.

Various fodder crops are available in the country such as bajra napier hybrid grass, guinea grass, cenchrus, stylosanthus, desmanthus, desmodium, maize, sorghum etc. Among these crops bajra napier hybrid grass is one of the high yielding crops there are various varieties of high yielding bajra napier grass. Out of the various varieties, Co CN [2] is a widely cultivated crop. Bajra Napier hybrid grass is a valuable, high biomass producing tropical grass and is well recognized through out our country for its palatability and good fodder quality. Variety COC (N) 4 is widely cultivated in Tamil Nadu as an irrigated perennial grass. This is a crop that requires higher nitrogen application for its better productivity and to provide palatable fodder throughout the year. It contains 9.5%crude protein, 2.5% oxalate and IVDMD % of 60.65%, and hence supplementation of nutrients both micro and micro nutrients are essential [3].

Mineral nutrition, especially nitrogen contributes to the structural organization of the leaf blade and thereby enhances the quantity and quality of leaves [4]. It is found that, given the increasing amount of nitrogen fertilizer, the increase yield is proportional [5]. Further more, the nitrogen nutrients are essential for the accumulation of sugars, increase the juice content and palatability of crops [6].

However, the application of nutrients to fodder crops is negligible. Only limited studies are available on fodder crops pertaining to the application of nutrients especially nitrogen fertilization in bajra napier hybrid grass. Now a days, more attention is also paid for enhancing the quality of feed and forages in order to enhance the productivity of livestock.

The preamble indicates that, it is reasonable to consider the application of nutrients especially nitrogen nutrient is essential for increasing the quantity and quality of fodder. However, the sources of nitrogen nutrients also play an important role in enhancing the quality and quantity of leaf in fodder crops. We, therefore examined the organic and inorganic sources of nutrients and its levels on the growth and yield of bajra napier hybrid grass.

2. MATERIALS AND METHODS

The experiment was carried out in 2014-2016 at University Research Farm, Tamil Nadu Veterinary and Animal Sciences University, Madhavaram, Chennai. The experimental site is

located at 13.1478°N of latitude, 80.231°E of longitude at an average altitude of 30 m above Mean Sea Level. The temperature ranged between 24.6°C to 42°C. Average rainfall during the study period is 1276.41 mm. Bajra Napier Hybrid grass was established during December 2014 and the fertilization was started as per the schedule given in crop production guide of Tamil Nadu Agricultural University. The soil of the experimental site was sandy with a pH of 7.64, EC of 0.38 dSm-1, Bulk Density of 1.52 g cc-$^{-1}$, soil available nitrogen of 242.8 kg ha^{-1}, soil available phosphorous of 19.6 kg ha-1 and soil available potassium of 182.6 kg ha^{-1}. Bajra napier hybrid grass was irrigated with drip irrigation. The field was applied basally with well decomposed farm yard manure, top dressing of nitrogen was with urea, phosphorous fertilization with single super phosphate and potassium fertilization with muriate of potash. The twelve treatments included organic and inorganic nutrients in combination, organic alone and inorganic alone with various levels and are given in Table 1. The design adopted was completely randomized with three replications. The ingredients of different nutrients present in different sources of nutrients were considered for determination of quantity of nutrients. As the Bajra Napier Hybrid grass is a perennial grass, fertilization was done after every harvest according to the treatment schedule.

The first cutting was made at 75 days after planting and subsequent cutting was carried out at every 45 days interval. Totally 12 harvests were taken from two consecutive years. Five clumps were tagged for making observations. Plant height, number of tillers, number of leaves, leaf stem ratio, green fodder yield and dry matter yield were recorded. The data on the growth and yield parameters from different cuts were pooled and subjected to statistical analysis as per the standard procedures.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Data on growth parameters of bajra Napier hybrid grass is given in Table 1. Application of nutrients with basal application of farm yard manure and 100% recommended dose of nutrients with inorganic fertilizers recorded the higher plant height. However, application of organic and inorganic nutrients at 50 and 100% level recorded higher plant height and were on par with each other. Application of organic and inorganic nutrients alone recorded the least plant height at the time of harvest. The maximum plant height was recorded with application of FYM 25 t ha-1 along with 100% recommended dose of fertilizers during 2014-2015 and 2015-2016 respectively. The increase in plant height may be due to elongation of internodes due to continuous availability of nutrients for the plants. Similar reports were made by [7] in sorghum.

Number of leaves per plant was comparatively lesser during first harvest. Number of leaves per plant was found lesser in plots which had not received nutrients. Application of 25t of FYM along with 100 percentage of recommended dose of fertilizers through drip recorded significantly higher number of leaves per plant. Similarly [8] reported that in hybrid Napier grass, the leaf number increased linearly with increasing nitrogen levels. There was marked difference in number of tillers due to application of nutrients. Significant influence was noticed in number of tillers per plant with application of 25t of FYM and 100 percentage of recommended dose of fertilizers and comparable with application of 25 t of FYM and 50 percentage of recommended dose of fertilizers as basal and remaining 50% of recommended dose of fertilizers through drip.

However, inclusion of farm yard manure along with inorganic source of nutrients improves soil nutrient status and their availability, which is essential for plant growth and development. It also improves the physical, chemical and biological conditions of the soil and ultimately results in better growth [9]. Each incremental level of N enhanced plant heights. Nitrogen increases photosynthetic activity and helps in maintaining higher auxin level which might have resulted in better plant height [10].

3.2 Yield

The yield and leaf stem ratio of bajra napier hybrid grass is depicted in Table 2. Application of FYM 25 t ha^{-1}+ 100% RDF through drip resulted in higher fresh weight per plant but comparable with the application of FYM 25 t ha^{-1}+ 100% RDF (50% NPK as basal + balance through drip). This is followed by application of FYM 25 t ha^{-1}+ 50% RDF (50% NPK as basal + balance through drip), FYM 12.5 t ha^{-1}+ 100% RDF through drip and FYM 12.5 t ha^{-1}+ 100% RDF (50% NPK as basal + balance through drip).

With respect to productivity, application of FYM 25 t ha^{-1}+ 100% RDF through drip resulted in higher plant biomass but comparable with the application of FYM 25 t ha^{-1}+ 100% RDF (50% NPK as basal + balance through drip). This is followed by application of FYM 25 t ha^{-1}+ 50% RDF (50% NPK as basal + balance through drip), FYM 12.5 t ha^{-1}+ 100% RDF through drip and FYM 12.5 t ha^{-1}+ 100% RDF (50% NPK as basal + balance through drip).

N application through drip irrigation had beneficial effect on the green fodder yield because of enhanced crop growth such as plant height, number of tillers and number of leaves which in turn has resulted in higher biomass yield per plant and per hectare. This might be due to the fact that nutrients received through fertigation plots had equal distribution nutrients through out and thereby reducing the loss of nutrients by volatilization and leaching. Hence, continuous availability of soil moisture could result in higher growth parameters, in turn resulting in higher plant biomass. This is in line with the findings of [11]. Higher green fodder yield was the cumulative effect of plant height and leaf area index at later stages of crop growth. Similar results were reported by [12] and [13]. Higher yield of fodder obtained due to addition of N may be attributed to the fact that N is an important constituent of amino acids and chloroplasts which directly influenced plant growth and development through greater photosynthates. Higher leaf area captures more photosynthetically active radiation with higher photosynthesis as there are more number of leaves [14]. Similar findings were also reported by [2] and [15]. Application of either FYM or synthetic fertilizer N or both induced crop to yield more compared to non-fertilized plot. Combined use of FYM and N had synergistic effect on advancing the date of maturity.

Table 1. Treatment details

Treatments (F_1-F_{12}): Farmyard manure (FYM: t ha^{-1}) and 150 N + 50 P_2O_5 + 40 K_2O kg ha^{-1} Recommended dose of fertilizer (RDF) applied as basal and drip fertilization (in percent: 100% = 150 N + 50 P_2O_5 + 40 K_2O kg ha^{-1}, in 50%= 75 N + 25 P_2O_5 + 20 K_2O kg ha^{-1})

	F1	F2	F3*	F4*	F5	F6*	F7*	F8	F9*	F10*	F11	F12
FYM	25.0	12.5	25.0	25.0	25.0	12.5	12.5	12.5	0	0	0	0
RDF%	-	-	50	100	100	50	100	100	50	100	100	0
Basal	-	-	+	+	-	+	+	-	+	+	-	-
Drip	-	-	+	+	+	+	+	+	+	+	+	-

** 50% NPK as basal + balance through drip*

Table 2. Effect of nutrient levels on growth parameters of Bajra Napier hybrid grass variety CO (CN) 4 during 2014-2015 and 2015-2016

Treatments from F1 to F12: Plant height (PH), number of tillers (T) and leaves (L) per plants (NTpP and NLpP, Leaf : stem ratio (LSR), plant weight (PW) and Plant biomass (PB) in two growing seasons (a = 2014/2015, b = 2015/2016)

	PH (cm)		NTpP		NLpP		LSR		PW (g)		PB (t ha^{-1})	
	a	b	a	b	a	b	a	b	a	b	A	b
F1	104.1	125.8	17.2	21.4	271.3	305.6	0.26	0.54	635.4	1042.1	25.4	41.7
F2	109.7	126.8	17.8	20.7	273.6	310.2	0.21	0.42	655.3	896.2	31.8	35.8
F3	141.8	152.1	21.3	23.9	297.3	348.6	0.31	0.59	1203.7	1512.8	56.5	60.5
F4	145.4	156.7	22.8	24.4	302.2	367.7	0.38	0.53	1299.4	1647.5	60.8	65.9
F5	143.3	157.9	26.4	31.4	358.7	396.3	0.44	0.59	1337.2	1700.6	62.5	68.0
F6	140.6	150.3	21.1	23.8	292.6	351.6	0.27	0.46	1175.8	1490.7	54.8	59.6
F7	142.0	153.5	21.2	24.1	298.6	343.7	0.32	0.48	1215.8	1570.9	55.9	62.8
F8	131.4	148.6	20.8	24.2	292.1	318.8	0.37	0.44	1263.0	1608.9	46.9	64.4
F9	105.7	128.8	16.3	21.7	272.0	308.5	0.25	0.52	765.2	1088.7	26.3	43.5
F10	121.6	137.5	18.6	22.3	281.1	308.6	0.24	0.52	895.3	1208.9	37.4	48.4
F11	125.5	138.8	18.8	22.4	281.7	309.7	0.24	0.48	927.2	1248.0	39.1	49.9
F12	95.8	111.3	12.1	18.8	263.7	285.0	0.21	0.52	519.53	751.88	22.6	30.1
S.Ed	4.93	4.85	1.60	1.32	13.68	16.61	-	-	108.29	83.41	7.35	3.33
$CD_{0.05}$	9.81	9.65	3.19	2.63	27.21	33.04	-	-	215.39	165.91	14.88	6.64

There was no significant difference in leaf stem ratio due to different nutrient levels. However, application of FYM 25 t ha^{-1}+ 100% RDF through drip resulted in higher leaf stem ratio during both the years. Leaf stem ratio cannot be altered by external factors like application of nutrients as it is a parameter of genetic control. This corroborates with the findings of [16]. Increase in higher leaf-stem ratio with application of farm yard manure along with inorganic sources of nutrients is indicative of better plant growth and development [9]. Higher availability of N induced photosynthesis and triggered growth and development, as indicated by higher plant height and LAI. Therefore, leaf-to-stem ratio with increase in N levels was higher and leaf growth was better with higher N availability during the later growth stages. These findings are in close agreement with the findings of [17].

4. CONCLUSION

The study indicates that inclusion of organic source of nutrients along with inorganic source of nutrients to bajra napier hybrid grass results in increased growth parameters and yield. Application of recommended dose of nutrients (FYM 25 t ha^{-1} + 150:50:40 kg NPK ha^{-1}) through drip would be an ideal practice to achieve higher growth parameters in turn resulting in higher of bajra napier hybrid grass.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20976