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EFFECT OF VARIETIES, FYM AND NITROGEN LEVELS ON GROWTH, YIELD AND QUALITY OF SUMMER FODDER PEARL MILLET (*PENNISETUM GLAUCUM L.*) UNDER SOUTH GUJARAT CONDITION

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SUMMARY

A field experiment was conducted during summer season of 2020 at the college farm, Navsari Agricultural University, Navsari, to study the "Effect of varieties, FYM and nitrogen levels on summer fodder pearl millet under south Gujarat condition." The soil of the experimental field was clayey in texture having medium to poor drainage capacity, good water holding capacity, low in available nitrogen and organic carbon, medium in available phosphorus and available potassium. The soil was neutral in reaction with normal electric conductivity. Total twelve treatment combinations comprising of two varieties (V_1: GAFB-4 and V_2 GFB-1), two levels of FYM (F_1: control and F_2: 5.0 t FYM/ ha) and three levels of nitrogen treatment (N_1:75% RDN/ha, N_2: 100% RDN/ha and N_3:125% RDN/ha) were evaluated in factorial randomized block design with three replications. Fodder pearl millet variety GAFB-4 receded significantly higher plant height at 30 DAS (42.65 cm), at harvest (142.16 cm), leaf : stem ratio (0.41), number of leaves per plant (11.61), green fodder yield (272.69 q/ ha), dry matter yield (74.70 q/ha), and crude protein yield (536.0 kg/ha) over variety GFB-1. Net returns (Rs 60601/ha and B: C ratio (3.86) was also found maximum under the same treatments. Incorporation of 5.0 t FYM/ha significantly increase plant height harvest (142.11 cm), leaf: stem ratio (0.41), green fodder yield (280.38 q/ha), dry matter yield (76.34 q/ha), crude protein content (7.54 %) and crude protein yield (579.48 kg/ha) over control. The higher net returns (Rs 84115/ha) and B: C ratio (4.76) was incurred under the application of 5 t FYM/ha and control, respectively. An application of 125 % RDN/ha significantly increase plant height at 30 DAS (44.13 cm) and at harvest (144.82 cm), leaf: stem ratio (0.43), number of leaves per plant (12), green fodder yield (279.32 q/ha), dry matter yield (75.58 q/ha), crude protein content (8.06%), crude protein yield (615.18 kg/ha) and higher net returns (Rs. 62246/ha) and B: C ratio (3.89) over 75 % RDN. over.

Key word : Crude protein, crude fiber, fodder pearl millet, variety, fodder yield

Pearl millet (*Pennisetum glaucum* L.) is the most widely traditionally a dry land crop, which have the capacity to tolerate the higher deficit of the water, commonly known as Bajra, Bajri, Sajja, Combo, Candle millets, Horse millets or Kambam. Pearl millet cultivated mostly in arid and semi-arid regions, characterized by low rainfall, sandy soils with low fertility. It is generally accepted that pearl millet originated in tropical Africa and was subsequently introduced into India. It performs well in soils with high salinity or lower pH. It is a cross pollinated, C_4, warm weather plant. Pearl millet is a quick growing and short duration crop. This crop is not only cultivated for grain, but is also valued for its stover and fodder purpose because of its tillering potential, drought and heat tolerance and high dry matter production (Arya *et al.,* 2013). The stover of pearl millet forms an important source of fodder (particularly in low rainfall regions) accounting for 40-50% of the dry matter intake and is often the only source of feed in dry months. The dual-purpose nature of pearl millet offers both food and fodder security in the arid and semi-arid regions of the country (Ramesh *et al.*, 2006). Tiwana and Puri (2005) opined that fodder pearl millet is excellent for making silage, particularly in regions where long dry spells during the rainy season and it produces higher silage yields with higher protein content than sorghum.

Pearl millet is palatable to livestock, but its nutritive value depends on variety, growing conditions, management and preservation methods. The green fodder of bajra is leafy, palatable and very nutritious feedstock for cattle ensuring good milk yield. It has no HCN content as compared to sorghum and can be fed to cattle at any stage of the crop (Kumar *et al.,* 2012). Now-a-days many new improved cultivars of fodder pearl millet are coming up, therefore it is necessary to study the response of these cultivars to fertilizers especially for nitrogen to harvest potential yield.

The basic concept of use of farm yard manure is the supply of required plant nutrients for sustaining the desired crop productivity with minimum deleterious effect on soil health environment (Balasubramanian, 1999). With a view to reduce the losses and indiscriminate use of chemical fertilizers, substitution of part of the chemical fertilizer by locally available organic sources of nutrients (Farm yard manure) is inevitable. Nitrogen is another production factor being an important constituent of protein and chlorophyll. It imparts dark green colour to plant, promotes vegetative growth and rapid early growth. It improves the quality by increasing the protein content of fodder and governs to considerable degree, the utilization of potassium, phosphorus and other element. Application of nitrogen to fodder crops is the most important way to increase forage production. Although the optimization of nitrogen fertilization is an important aspect in making pearl millet fodder production cost effective, use of nitrogen in excess leads to deterioration of soil health and accumulation of nitrate-N in fodder which is toxic to animals. Therefore, the present investigation was carried out to find out maximum yielding variety with optimum dose of FYM and nitrogen for summer forage pearl millet under south Gujarat.

MATERIALS AND METHODS

The field experiment was conducted during the summer season of the year 2020 at college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. The soil of the experimental field was clayey in texture having medium to poor drainage capacity, good water holding capacity, low in available nitrogen (197.46 kg/ha) and organic carbon (0.44%), medium in available phosphorus (29.47 kg/ha) and available potassium (224.64 kg/ha). The soil was neutral in reaction with normal electric conductivity. Total twelve treatment combinations consisting of two varieties (V_1: GAFB-4 and V_2: GFB-1), two levels of FYM (F_1: control and F_2: 5.0 t FYM/ ha) and three levels of nitrogen (N_1: 75% RDN/ha, N_2: 100% RDN/ha and N_3: 125% RDN/ ha) were evaluated in factorial randomized block design with three replications. Pearl millet varieties were sown with the raw spacing of 30 cm on 20th February and harvested on 16th April, 2020. Other cultural practices and plant protection measures were taken as per recommendations. Nitrogen fertilizer was applied in two splits i.e., half dose at the time of sowing. The remaining half dose of nitrogen was top dressed at 30 DAS. Observations for growth and yield characters were recorded at the time of harvest of pearl millet. The data on stover yield was recorded from the net plot and converted on a hectare basis. The forage nutritive value was analyzed in term of crude protein (CP) and crude fiber using standard methods (A.O.A.C, 1995). The sample of dry matter was well grind and passed through 0.5 mm sieve and was preserved for chemical analysis. The nitrogen content of fodder sample was determined by Kjeldahl method and the value recorded for nitrogen was then multiplied with 6.257 to determine CP of the sample. The gross realization in terms of rupee per hectare was worked out on the basis of straw yields for each treatment and the prices of the produce prevailing in the market. The cost of cultivation for each treatment was worked out by taking the cost of all the operations right from preparatory tillage to harvesting. The net realization was worked out by subtracting the total cost of cultivation from gross realization for each treatment and recorded in rupees per hectare accordingly. The benefit cost ratio was calculated for each treatment using formula given below. The results were analysis statistically to draw suitable interference as per the standard ANOVA techniques suggested by Panse and Sukhatme (1985).

$$\text{BCR} = \frac{\text{Gross realization (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

RESULTS AND DISCUSSION

Varieties

The data furnished in Table 1 indicated that the different fodder pearl millet varieties had a significant effect on all growth and yield attributes. Plant height at 30 DAS (42.65 cm), at harvest (142.16 cm), number of leaves per plant (11.61 leaves/plant) and L:S ratio (0.41) at harvest were recorded significantly higher under variety V_1 (GAFB-4) as compare to V_2 (GFB-1) i.e., 40.99 cm at 30 DAS, 133.72 cm at harvest, 10.51 leaves/ plan and 0.38 leaf: stem ratio, respectively. The remarkable differences in all growth and yield attributes at different growth stages of the crop were observed under the variety GAFB-4 may be due to their better adaptability to the environmental conditions in the region and disparity in genetic makeup of this variety. Similar type of results was also reported by Meena and Meena (2012), Bhoya *et al*. (2014) and Nirmal e*t al.* (2016) in fodder sorghum and Midha *et al.* (2015), Kumawat *et al.* (2016) and Bramhaiah *et al*. (2018) in fodder pearl millet.

The data presented in Table 2 indicated that the green fodder and dry fodder yield of pearl millet differed significantly with respect to variety. Fodder pearl millet variety GAFB-4 produced significantly higher green fodder yield of 272.69 q/ha and dry fodder yield of 74.70 q/ha over variety GFB-1 of 245.27 q/ha and 67.21. q/ha, respectively. The green and dry fodder yield were increase up to the tune of 11.18 and 11.14 % under the variety GAFB-4 over GFB-1, respectively. The higher green and dry fodder yield of fodder pearl millet under the variety GAFB-4 might be due variety GAFB-4 had better partitioning of photosynthates from source to sink might have resulted in higher growth and yield attributes which ultimately increase the fodder yield. The study was in close conformity as observed by Meena and Meena (2012) and Singh and Sumeriya (2012) in fodder sorghum and Damame *et al.* (2013), Midha *et al.* (2015), Kumawat *et al*. (2017) and Shekara *et al.* (2019) in fodder pearl millet.

An appraisal of data presented in Table 2 clearly indicated that varieties did not manifest their significant effect on crude protein and crude fibre content. However, numerically higher value of crude protein content (7.10 %) and crude fibre content (30.45 %) were observed under variety GAFB-4 and GFB-1, respectively. Similarly, data on crude protein yield (Table-2) recorded after harvest of the crop significantly influenced by the different variety. Fodder peal millet variety GAFB-4 was observed significantly higher crude protein yield (536.0 kg/ha) over variety GFB-1 (478.8 kg/ha). The crude protein yield of fodder pearl millet was increased under variety GAFB-4 may be due to higher dry fodder yield produced by same variety. The study was in close conformity as observed by Sheoran *et al.* (2016) and Kumawat *et al.* (2017) in fodder pearl millet and Singh *et al.* (2020) in fodder maize.

Farm yard manure (FYM)

Data presented in Table 1 revealed that farm yard manure application was found significant variation in growth and yield attributes, except plant height at 30 DAS and number of leaves per plant. Non significantly but numerically higher plant height (42.57 cm) at 30 DAS cm and number of leaves per plant (11.11) at harvest were observed due to incorporation of 5.0 t FYM/ha over control. An application of 5.0 t FYM/ha produced significantly higher plant height at harvest of 142.11 cm and L: S Ratio (0.41) over control. The improvement in the height and leaf: stem ratio might be due to additional amount of nutrient supplied as well as beneficial effects of decomposed organic matter that derived in connection with physicochemical properties of the soil. These findings are conformity with the findings of Meena and Meena (2012), Hamdy *et al.* (2015), Chaudhari *et al*. (2017) and Sabhad *et al*. (2020) in fodder sorghum.

The data of green and dry fodder yield of pearl millet influenced remarkably by the different FYM level is presented in Table 2. Significantly higher green fodder yield (280.38 q/ha) and dry fodder yield (76.34 q/ha) were recorded with the application of 5.0 t FYM/ ha over control (237.59 q/ha and 65.56 q/ha, respectively). There was 18.01 and 16.14 % higher green and dry fodder yield produced due to application of 5.0 t FYM/ha over control, respectively. Green and dry fodder yield were recorded higher with the application of FYM might be due to over all improvement in growth and yield attributing character. Further, incorporation of FYM in to soil not only

TABLE 1

Growth parameter of fodder pearl millet as influenced by variety, FYM and nitrogen

Treatments	Plant height (cm)		Leaf : stem ratio	No. of leaves/ plant at harvest
	30 DAS	At harvest		
Varieties (V)				
V_1 : GAFB-4	42.65	142.16	0.41	11.61
V_2 : GFB-1	40.99	133.72	0.38	10.51
S. Em±	0.55	2.49	0.008	0.34
C. D. at 5%	1.62	7.31	0.02	1.01
FYM (F)				
F_0 : Control	41.07	133.77	0.38	11.01
F_1 : 5.0 t FYM/ha	42.57	142.11	0.41	11.11
S. Em±	0.55	2.49	0.008	0.34
C. D. at 5%	NS	7.31	0.02	NS
Nitrogen levels (N)				
N_1 : 75% RDN/ha	39.41	130.37	0.37	10.13
N_2 : 100% RDN/ha	41.93	138.64	0.39	11.04
N_3 : 125% RDN/ha	44.13	144.82	0.43	12.00
S. Em±	0.68	3.05	0.01	0.42
C. D. at 5%	1.99	8.96	0.03	1.23
Significant Interaction-		-	-	-
C.V. %	5.61	7.67	9.35	13.15

continuous supplying additional plant nutrients, particularly macro and micro nutrient, but also helps in improvement of physicochemical and biological properties of soil and thereby uptake of nutrients helps in increase in the photosynthetic activates which resulted in higher accumulation of photosynthates and translocation to sink due to better source sink relationship. These results are already in agreement with those reported by Meena and Meena (2012), Chaudhari *et al.* (2017) and Sabhad *et al.* (2020) in fodder sorghum and Sharma *et al.* (2016) in fodder maize.

The data furnished in Table 2 showed that quality parameter namely crude protein and crude fibre content as well as crude protein yield were recorded after harvest of the fodder pearl millet significantly influenced by the application of FYM, except the crude fibre content. The treatment F_1 (5.0 t FYM/ha) recorded significantly higher crude protein content (7.54%) and crude protein yield (579.48 kg/ha) over control (6.58 % and 435.26 kg/ha, respectively). The probable reason might be positive effect of FYM. FYM is the source of primary, secondary and micronutrients to the plant growth. It is a constant source of energy for heterotrophic microorganisms, helps in increasing the availability of nutrient and quality of crop produce. Similar results were also obtained by Kalra and Sharma (2015) in fodder maize and Meena and Meena (2012) and Sabhad *et al.* (2020) in fodder sorghum. Similarly, higher crude protein yield was recorded with the application of FYM is mainly due to increased dry fodder yield couple with higher nitrogen content in leaves under same treatment. These results are already in agreement with those reported by Kumawat *et al.* (2016) and Shekara *et al.* (2019) in fodder pearl millet. Crude fibre content (30.49%) of fodder pearl millet found non-significantly but numerically higher under control. The results are in accordance with the earlier reports of Kalra and Sharma (2015) and Sharma *et al.* (2016) in fodder maize.

Nitrogen

The mean data of furnished in Table 1 clearly indicate that plant height at periodical interval was increase significantly with increasing in nitrogen levels. Plant height at 30 DAS (44.13 cm) and at harvest (144.82 cm) was observed significantly higher due to application of 125 % RDN/ha over control, which was at par with the application of 100 % RDN/ha at harvest only. Significantly lower plant height of 39.41 cm and 130.37 cm at 30 DAS and at harvest was observed under control, respectively. The increase in the plant height might be due to the positive effect of nitrogen element on plant growth that leads to progressive increase in inter nodal length and consequently plant height. Similar type of results was also reported by Ayub *et al.* (2009), Pareek *et al.*

TABLE 2

Yield and quality of fodder pearl millet as influenced by variety, FYM and nitrogen

Treatments	Green fodder yield (q/ha)	Dry fodder yield (q/ha)	Crude protein content (%)	Crude protein (kg/ha)	Crude fiber (%)
Varieties (V)					
V_1 : GAFB-4	272.69	74.70	7.10	536.0	30.20
V_2 : GFB-1	245.27	67.21	7.02	478.8	30.45
S. Em.±	6.05	1.73	0.12	16.32	0.47
C. D. at 5%	17.76	5.09	NS	47.87	NS
FYM (F)					
F_0 : Control	237.59	65.56	6.58	435.26	30.49
F_1 : 5.0 t FYM/ha	280.38	76.34	7.54	579.48	30.15
S. Em.±	6.05	1.73	0.12	16.32	0.47
C. D. at 5%	17.76	5.09	0.35	47.87	NS
Nitrogen levels (N)					
N_1 : 75% RDN/ha	235.00	64.89	6.11	397.52	32.32
N_2 : 100% RDN/ha	262.63	72.39	7.00	509.40	30.04
N_3 : 125% RDN/ha	279.32	75.58	8.06	615.18	28.60
S. Em.±	7.41	21.26	0.15	19.98	0.58
C. D. at 5%	21.76	6.23	0.43	58.62	1.69
Significant Interaction	-	-	F x N	-	-
C.V. %	9.92	10.38	7.24	13.64	6.59

(2015), Raval *et al*. (2015), Bramhiah *et al*.(2018) and Shekara *et al*. (2019) in fodder sorghum.

An application of 125 and 100 % RDN/ha being at par but recorded significantly higher number of leaves per plant of 12.00 and 11.04 over 75% RDN/ha respectively. The increasing in leafy part due to nitrogen application might have ultimately resulted in higher photosynthetic activities and also production of more photosynthates. This rapidly supplied food growing parts might have helped in improvement of growth and yield attributes. These results are in conformity with the finding of Ayub *et al*. (2007), Ayub *et al*. (2009) and Singh *et al*. (2016) in fodder pearl millet and Nirmal *et al.* (2016) in fodder sorghum. An application of 125 % RDN/ha recorded significantly higher L: S ratio (0.43) over 75% RDN/ha, which was at par with 100% RDN/ha (0.37). The increase in leaf to stem ratio due to the application of higher level of nitrogen can be explained by the fact that nitrogen promotes plant growth which in turn increases number of leaves per plant ultimately increase leaf: stem ratio. Similar conclusion has been derived by Hamdy *et al*. (2015) in fodder sorghum and Bramhiah *et al.* (2018), Pareek *et al.* (2015), Singh *et al*. (2016) and Shekara *et al*. (2019) in fodder pearl millet.

An application of 125 % and 100 % RDN/ha being at par, but produce significantly highest green fodder yield of pearl millet at harvest of 279.32 q/ha and 262.63 q/ha and dry fodder yield at harvest of 75.58 q/ha and 72.39 q/ha over 75 % RDN/ha (235.0 q/ha and 64.89 q/ha), respectively. Increase in green fodder yield of 18.88 and 11.76 per cent due to application of 125 and 100 % RDN/ha over 75 % RDN/ha, respectively. The remarkable increasing in yields with higher levels of nitrogen might be attributed to favorable effect on yield attributes. The increasing in leafy part due to nitrogen application might have ultimately resulted in higher photosynthetic activities and also in production of more photosynthates. Increase in forage yield with increased nitrogen was mainly associated with greater plant height, higher number of leaves per plant and leaf: stem ratio. These results are in conformity with the finding of Ayub *et al*. (2007), Ayub *et al.* (2009), Pareek *et al*. (2015), Raval *et al*. (2015) and Bramhaiah *et al*. (2018) in fodder pearl millet.

The data (Table 2) on crude protein content and crude protein yield were recorded at harvest of the crop was significantly influenced by application of nitrogen. Crude protein content and crude protein yield were increased significantly with each successive increase in level of nitrogen. Crude protein content (8.06 %) and crude protein yield (615.18 kg/ha) were recorded significantly the highest with treatment N_3 (125% RDN/ha) over application of 75 % RDN/ha (6.11 % and 397.52 kg/ha, respectively). Crude protein content increase with nitrogen application might be due to fact that nitrogen being on essential constituent of chlorophyll, protoplasm, protein and nucleic acids and needed for protein synthesis. Crude protein yield recorded higher might be due to higher dry fodder yield coupled with high crude protein content under the application of higher dose of nitrogen. These results are in conformity with the finding of Raval *et al.* (2015), Damame *et al*. (2013), Kumawat *et al*. (2016) and Shekara *et al*. (2019) in fodder pearl millet.

A perusal of data (Table 2) reveals that different nitrogen levels showed their significant influence on crude fiber content. An application of 125 and 100 % RDN/ha being at par but recorded significantly lower crude fiber content of 28.60 and 30.04 per cent as compare to 75 % RDN/ha (32.32 %), respectively. This might be due to less nitrogen supply cause carbohydrate to deposit in to the cells. Higher nitrogen applications accelerate the protein formation from manufacture carbohydrate and also help in reduce the rate of lignification there by maintains the fodder quality. Nitrogen application also increase the protein synthesis and decrease pectin, cellulose and hemi cellulose content, which is major constituents of crude fiber content. These results are in conformity with the finding of Chaudhary *et al*. (2018) in forage sorghum.

ECONOMICS

Data presented in Table 3 revealed that variety V_1 (GAFB-4) incurred maximum gross income of Rs. 81809/ha, net income of Rs. 60601/ha and B: C ratio 3.86 as compare to variety GFB-1.This might be due to higher green fodder yield was observed under same variety. These results are in line with those of Meena and Menna (2012) and Singh and Sumeriya (2012) in fodder sorghum and Kumawat *et al*. (2016) and Sheoran *et al*. (2016) in fodder pearl millet. Data presented in Table 3 indicated that maximum cost of cultivation of Rs. 21209/ha, gross income of Rs. 84115/ha, net income of Rs. 62906/ha with B: C ratio (3.97) under the application of 5.0 t FYM/ha. Whereas, lower cost of cultivation and maximum B: C ratio (4.76) was observed under control. This might be due to application of FYM resulted in higher yield but at the

TABLE 3
Economics of fodder pearl millet as influenced by variety, FYM and nitrogen

Treatments	Total cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	B : C ratio
Varieties (V)				
V_1 : GAFB-4	21209	81809	60601	3.86
V_2 : GFB-1	21209	73582	52374	3.47
FYM (F)				
F_0 : Control	14983	71277	56294	4.76
F_1 : 5.0 t/ha	21209	84115	62906	3.97
Nitrogen levels (N)				
N_1 : 75% RDN/ha	20867	70501	49633	3.38
N_2 : 100% RDN/ha	21209	78791	57582	3.72
N_3 : 125% RDN/ha	21550	83796	62246	3.89

same time cost of cultivation was also increase thus B:C ratio was found lower. The trends of the above results are in close conformity reported by Meena and Meena (2012) in fodder sorghum.

The maximum gross income, net income and B:C ratio was increased with increasing in each successive level of nitrogen (Table 3). An application of 125% RDN/ha recorded maximum net income of Rs. 83796.3/ha with B: C ratio 3.89, followed by N_2 (100% RDN/ha) i.e., Rs. 78790.51/ha and 3.72, respectively. The lowest net income of Rs. 49633/ha along with B: C ratio 3.38 was recorded with N_1 (75% RDN/ha).This might be due to higher level of nitrogen application also increase the yield and income. The trends above results are in close conformity reported by Pareek *et al.* (2015) and Kumawat *et al.* (2017) in fodder pearl millet.

CONCLUSION

It is concluded from the study that GAFB-4 is better fodder pearl millet variety in summer season for the south Gujarat condition over cv. GFB-1. For getting more profitable green and dry fodder yield with better quality as well as considering minimum input cost, summer fodder pearl millet should be fertilized with 100 % RDN/ha and 5.0 t FYM/ha under Agro-climatic conditions of South Gujarat.

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