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YIELD, NUTRIENT CONTENT AND UPTAKE BY SUMMER FODDER PEARL MILLET (*PENNISETUM GLAUCUM* L.) VARIETIES INFLUENCED BY DIFFERENT FYM AND NITROGEN LEVELS UNDER SOUTH GUJARAT CONDITION

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SUMMARY

An experiment was conducted to study the "Effect of varieties, FYM and nitrogen levels on yield, content and uptake of nutrients by summer fodder pearl millet under south Gujarat condition" during summer season of 2020 at the college farm, Navsari Agricultural University, Navsari. The soil of the experimental plots 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 recorded significantly higher plant height at harvest (142.16 cm), green fodder yield (272.69 q/ha), dry matter yield (74.70 q/ha) as well as uptake of nitrogen (74.09 kg/ha), and phosphorus (15.16 kg/ha) over variety GFB-1. Net returns (Rs 60601/ha) and B: C ratio (3.86) was also found maximum under the same variety. Incorporation of 5.0 t FYM/ha significantly increased plant height (142.11 cm) at harvest, green fodder yield (280.38 q/ha), dry matter yield (76.34 q/ha), nitrogen content (1.21 %), phosphorus content (0.238 %) as well as uptake of nitrogen (80.10 kg/ha), phosphorus (15.76 kg/ha) and potash (89.71 kg/ha) over control. The higher net returns (Rs. 62906/ha) and B: C ratio (4.76) was incurred under the application of 5.0 t FYM/ha and control, respectively. An application of 125 % RDN/ha significantly increased plant height at harvest (144.82 cm), green fodder yield (279.32 q/ha), dry matter yield (75.58 q/ha), nitrogen content (1.29 %), phosphorus content (0.245 %), potash content (1.38 %) and uptake of nitrogen (85.02 kg/ha), phosphorus (16.01 kg/ha) and potash (90.33 kg/ha) over 75 % RDN. The maximum net returns (Rs. 62246/ha) and B: C ratios (3.89) were also found under the same treatment.

Key word : FYM, fodder pearl millet, green fodder yield, nutrients content, variety

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. 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. 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. A representative sample was taken separately from each net plot for estimation of N, P and K content in the plant. The samples were first air dry than oven-dried at 70°C ± 28.2 for 24 hrs, powdered by the mechanical grinder. The nitrogen, phosphorus and potash content of fodder sample was determined by modified Kjeldahl method, Vanadomolybdo and Flame photometer method, respectively, suggested by Jackson (1973). The nutrient uptake by the fodder pear millet plant of was calculated by using the following formula.

$$\text{Nutrient uptake by fodder (kg/ha)} = \frac{\text{Nutrient content in plant (\%)} \times \text{Dry fodder yield (kg/ha)}}{100}$$

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 plant height and yield. Plant height at harvest of 142.16 cm was recorded significantly higher under variety GAFB-4 as compare to GFB-1(133.72 cm). The remarkable difference in plant height was 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 1 indicated that the green fodder and dry fodder yield of pearl millet differed significantly with respect to varieties. 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 yields 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.

TABLE 1
Plant height and yield of fodder pearl millet as influenced by varieties, FYM and N levels

Treatments	Plant height at harvest (cm)	Green fodder yield (q/ha)	Dry fodder yield (q/ha)
Varieties (V)			
V_1 : GAFB-4	142.16	272.69	74.70
V_2 : GFB-1	133.72	245.27	67.21
S. Em.±	2.49	6.05	1.73
C. D. at 5%	7.31	17.76	5.09
FYM (F)			
F_0 : Control	133.77	237.59	65.56
F_1 : 5.0 t FYM/ha	142.11	280.38	76.34
S. Em.±	2.49	6.05	1.73
C.D. at 5%	7.31	17.76	5.09
Nitrogen levels (N)			
N_1 : 75% RDN/ha	130.37	235.00	64.89
N_2 : 100% RDN/ha	138.64	262.63	72.39
N_3 : 125% RDN/ha	144.82	279.32	75.58
S. Em.±	3.05	7.41	21.26
C. D. at 5%	8.96	21.76	6.23
Significant Interaction	-	-	-
C.V. %	7.67	9.92	10.38

The data presented in Table 2 clearly indicates that the response of different fodder pearl millet varieties with respect to nitrogen, phosphorus and potassium content was found non-significant. However, N and P content in fodder pearl millet was

TABLE 2
NPK content of fodder pearl millet as influenced by varieties, FYM and N levels

Treatments	N content (%)	P content (%)	K content (%)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Varieties (V)						
V_1 : GAFB-4	1.14	0.234	1.32	74.09	15.16	85.53
V_2 : GFB-1	1.12	0.231	1.36	66.18	13.46	79.08
S. Em.±	0.02	0.004	0.02	2.25	0.39	2.37
C. D. at 5%	NS	NS	NS	6.61	1.14	NS
FYM (F)						
F_0 : Control	1.05	0.226	1.32	60.17	12.86	74.89
F_1 : 5.0 t FYM/ha	1.21	0.238	1.36	80.10	15.76	89.71
S. Em.±	0.02	0.004	0.02	2.25	0.39	2.37
C. D. at 5%	0.06	0.011	NS	6.61	1.14	6.96
Nitrogen levels (N)						
N_1 : 75% RDN/ha	0.98	0.217	1.26	54.95	12.18	70.66
N_2 : 100% RDN/ha	1.12	0.236	1.37	70.43	14.74	85.92
N_3 : 125% RDN/ha	1.29	0.245	1.38	85.02	16.01	90.33
S. Em.±	0.03	0.004	0.03	2.76	0.474	2.90
C. D. at 5%	0.07	0.01	0.08	8.09	1.39	8.52
Significant Interaction	F x N	-	-	-	-	-
C.V. %	7.24	6.63	7.23	13.63	11.48	12.22

found numerically higher under variety GAFB-4 whereas, K content was found higher under GFB-1. The results of present investigation are in close agreement with finding of Meena and Meena (2012) in fodder sorghum and Singh *et al*. (2020) in fodder maize.

The perusal of data presented in Table 3 indicated that the nitrogen and phosphorus uptake by fodder pearl millet was found significant with respect to variety. However, variety failed to record any significant change in potassium uptake by crop. There was significantly higher uptake of nitrogen (74.09 kg/ha) and phosphorus (15.16 kg/ha) by fodder pearl millet recorded with variety GAFB-4. Whereas, numerically higher potassium uptake (85.53 kg/ha) under the same variety. This might be due to the fact that the pearl millet cultivars GAFB-4 had higher nutrient content which coupled with the yield and also better adaptability in low soil fertility condition resulted in higher uptake of nutrients. Similar results were agreement with Meena and Meena (2012) and Kumar and Chaplot (2015) in fodder sorghum and Kumawat *et al*. (2016) and Manjanagouda *et al.* (2017) in fodder pearl millet.

Farm yard manure (FYM)

Data presented in Table 1 revealed that farm yard manure application was found significant variation in plant height. An application of 5.0 t FYM/ha produced significantly higher plant height at harvest of 142.11 cm over control. The improvement in the height 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 1. 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 overall improvement in growth and yield attributing character. Further, incorporation of FYM in to soil not only 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 presented in Table 2 showed that the nitrogen and phosphorus content of pearl millet was found significant with respect to FYM. Whereas, potassium content was found to be non-significant. An application of 5.0 t FYM/ha recorded higher nitrogen (1.21 %), and phosphorus (0.238 %) content in fodder pearl millet over control. However, numerically higher potassium (1.36 %) content in fodder pearl millet was found under same treatments. The higher nutrients content were found with application of FYM because of beside it improves soil physical condition, it might have supplied balance nutrient particularly macro and micro nutrient to the crop. These findings are in harmony with those reported by Meena and Meena (2012) in fodder sorghum and Buriro *et al.* (2014), Kalra and Sharma (2015) and Kumar *et al.* (2016) in fodder maize.

The data furnished in Table 3 showed that variation in uptake of nitrogen, phosphorus and potassium by pearl millet was recorded significantly differed by FYM application. Uptake of nitrogen, phosphorus and potassium by pearl millet (80.10, 15.76 and 89.71 kg/ha, respectively) were recorded

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

significantly higher under the incorporation of 5.0 t FYM/ha over control (60.17, 12.86 and 74.89 kg/ha, respectively). The increase in uptake of nutrients in the organic applied plot may be due to slow release of nutrient from organic manure might have met the fodder crop nutrient requirement during entire crop growth. The results are in accordance with the earlier reports of Duhan (2013) and Bama *et al.* (2013) in fodder sorghum and Kumar *et al*. (2016) in fodder maize.

Nitrogen

The data of furnished in Table 1 clearly indicate that plant height at harvest was increase significantly with increasing in nitrogen levels. An application of 125% RDN/ha was produced significantly higher plant height at harvest (144.82 cm) over control, which was at par with the application of 100% RDN/ha. Significantly lower plant height of 130.37 cm at harvest was observed under control. 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*. (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 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. 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 summarized in Table 2 indicated that nitrogen, phosphorus and potassium content in fodder of pearl millet influenced significantly with the different nitrogen levels. An application of 125 % RDN/ha was recorded significantly higher nitrogen (1.29%), phosphorus (0.25%) and potassium (1.38 %) content of pearl millet over treatment N_1(75% RDN/ha) (0.98%, 0.22% and 1.26%, respectively), which remained statistically at par with the treatments N_2 (100 % RDN/ha) in case of phosphorus and potassium content only. The probable reason might be that the soil was unable to supply nitrogen to the crop in sufficient quantity needed for optimum growth. Application of nitrogen fertilizer cured this deficiency and reflected in the increase in nitrogen content in plant. These results corroborate with the finding of Meena and Meena (2012), Somashekar *et al*. (2014), Singh and Sharma (2015) and Chaudhary *et al.* (2018) and in sorghum and Singh *et al*. (2016) and Manjanagouda *et al*. (2017) in fodder pearl millet.

The data presented in Table 2 clearly showed that variation in uptake of nitrogen, phosphorus and potassium by fodder of pearl millet significantly differed with the application of nitrogen. Uptake of nitrogen (85.02 kg/ha), phosphorus (16.01 kg/ha) and potassium (90.33 kg/ha) by fodder pearl millet were significantly increased with each increasing in successive level of nitrogen and it was higher under the treatment N_3 (125 % RDN/ha) over 75 % RDN/ ha, which remained at par with the treatments N_2 (100 % RDN/ha) in case of uptake of phosphorus and potassium. The probable reason might be that an application of nitrogen fertilizer helps in the increase the nitrogen content in plant. Further application of nitrogen has synergistic effect on uptake other nutrients, which was couple with increase in dry fodder yield altimetry resulted in uptake of major nutrients by crop. Similar results were also found by Meena and Meena (2012), Somashekar *et al.* (2014) and Singh and Sharma (2015) in fodder sorghum and Kumawat *et al*. (2016) and Manjanagouda *et al*. (2017) in fodder pearl millet.

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. The

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) was found 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 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 gross income of 83796.3/ha, net income of Rs. 62246/ha with B: C ratio 3.89 over 75% RDN. 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 higher nutrients content 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 south Gujarat Agro-climatic condition.

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