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Effect of nitrogen management on yield and quality of finger millet, *Eleusine coracana* (L) Gaertn

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ABSTRACT

An experiment was conducted at agronomy farm of the Anand Agricultural University, Anand, Gujarat during kharif season of 2019 to study the effect of nitrogen management on yield and quality of finger millet [*Eleusine Coracana* (L) Gaertn]. Treatments comprised four different sources of organic manures viz FYM, vermicompost, NADEP compost and poultry manure used with combination of recommended dose of nitrogen as well as with or without *Azosprillum* as a seedling treatment. Number of fingers per earhead ranged from 6.35 to 8.40; finger length from 5.98 to 7.45 cm, grain yield from 1,993 to 2,677 kg/ha, straw yield from 6,224 to 6,749 kg/ha and test weight from 2.38 to 2.66 g. Application of 25 per cent N through vermicompost + *Azosprillum* + 50 per cent N through fertilizer resulted in higher value of yield attributes and grain and straw yield though this treatment was at par with some other treatments. Significantly higher nitrogen and protein content of finger millet grain was recorded under the same treatment which was at par with treatments 25 per cent N through FYM + *Azosprillum* + 50 per cent N through fertilizer and 25 per cent N through FYM + *Azosprillum* + 50 per cent N through fertilizer. Phosphorus, potash, iron, zinc, copper and manganese content in finger millet grain remained unaffected by different nitrogen management treatments.

Keywords: Finger millet; nitrogen; yield; quality; nutrients; grain; straw; nutriemts

INTRODUCTION

Among various millets, finger millet [*Eleusine coracana* (L) Gaertn] provides staple food in relatively short period and has a pride of place in having the highest productivity among millets. It is the third most widely cultivated millets after pearl millet (*Pennisetum glaucum* L) and foxtail millet (*Setaria italica)* in the semi-arid tropical and subtropical regions of the world.

In India finger millet is cultivated in an area of 1.2 million ha with an annual production of 2.06 million tonnes and average productivity of 1,700 kg/ha. In Gujarat it is prominently cultivated in an area of 0.2 lakh ha producing 0.16 lakh tonnes with average productivity of 800 kg/ha (http://www.indiastat.com). It is important to optimize nutrient management practices and other related factors affecting finger millet cultivation in order to obtain better yields from the potential varieties developed.

Nutrient management is one of the important aspects in crop production and scientists suggest for adopting integration of all possible sources of nutrients to maintain soil health and to produce quality product. Beside nutrients availability, FYM improves soil physical characteristics such as structure, porosity and water holding capacity through increased organic matter content of the soil. Vermicompost is rich in humus forming and nitrogen fixing microorganisms and contains considerable amount of plant nutrients and encourages the plant growth by providing nutrients in the available form. The negative changes of soil developed due to use of the mineral fertilizer usage calls for the use of organic fertilizers such as poultry manure because poultry manure has been found to be richer in nitrogen than other livestock wastes. NADEP composting promotes the healthy environment for the microbes' growth in soil and creates a more nutrient rich soil which enables the higher growth of finger millet. Application of biofertilizers has been found to

increase the crop yield through N fixation and thereby reducing the crop demand for the nitrogen.

Maintaining and improving soil quality is thus crucial if agricultural productivity and environmental quality are to be sustained for future generations. The complementary use of organic manures and chemical fertilizers may probably increase the efficiency of both these inputs and produce quality grain with much environmental safety.

A field trial was undertaken to study the effect of nitrogen management on yield and quality of finger millet at the agronomy farm of the Anand Agricultural University, Anand, Gujarat during kharif season of 2019.

MATERIAL and METHODS

The investigations were conducted at agronomy farm of the Anand Agricultural University, Anand, Gujarat during kharif season of 2019. The soil of the experimental plot was loamy sand in texture having good drainage with 7.21 pH. The soil was low in organic carbon (0.39%) and available nitrogen (191.34 kg/ha) while medium in available phosphorus (36.6 kg/ha) and available potash (201.92 kg/ha). The experiment was laid out in a randomized complete block design replicated four times. There were 9 treatments viz T_1 (RDN 40 kg/ha), T_2 (50% N through FYM + 50% N through fertilizer), T_3 (50% N through vermicompost + 50% N through fertilizer), T_4 (50% N through NADEP compost + 50% N through fertilizer), T_5 (50% N through poultry manure + 50% N through fertilizer), T_6 (25% N through FYM + *Azosprillum* + 50% N through fertilizer), T_7 (25% N through vermicompost + *Azosprillum* + 50% N through fertilizer), T_8 (25% N through FYM + *Azosprillum* + 50% N through fertilizer), T_9 (25% N through poultry manure + *Azosprillum* + 50% N through fertilizer).

The entire quantities of phosphorus 20 kg/ha, 8 kg $ZnSO_4$/ha and 25 kg $FeSO_4$/ha were applied uniformly in experimental plots as basal dose at the time of transplanting. Nitrogen was applied as per recommended treatment through urea and other organic manures. As per recommended practice the 50 per cent nitrogen application was done in two equal splits viz half as basal dose and remaining half 30 days after transplanting. The part of nitrogen application through organic manure in the form of farm yard manure, vermicompost, NADEP compost as well as poultry manure was incorporated in the soil one week before transplanting in respective treatments. At the time of transplanting seedlings were given treatment by root dipping with *Azosprillum* solution for 30 minutes. Finger millet nursery was grown on 18 June with a seed rate of 5 kg/ha while the crop was harvested in the first week of November.

RESULTS and DISCUSSION

Effect of nitrogen management on yield attributes and yield

The yield attributes such as number of fingers, finger length, grain and straw yield and test weight weight were significantly influenced by different nitrogen management treatments (Table 1). Number of fingers per earhead ranged from 6.35 to 8.40; finger length from 5.98 to 7.45 cm, grain yield from 1,993 to 2,677 kg/ha, straw yield from 6,224 to 6,749 kg/ha and test weight from 2.38 to 2.66 g. Significantly higher number of fingers per earhead (8.40) was recorded under treatment T_7 (25% N through vermicompost + *Azosprillum* + 50% N through fertilizer) which was at par with treatments T_6 (25% N through FYM + *Azosprillum* + 50% N through fertilizer), T_1 (RDN 40 kg/ha) and T_3 (50% N through vermicompost + 50% N through fertilizer). Similar trend was observed in length of finger and it was recorded significantly higher (7.45 cm) under treatment T_7 (25% N through vermicompost + *Azosprillum* + 50% N through fertilizer) which was at par with treatments T_6, T_1, T_3 and T_2 (50% N through FYM + 50% N through fertilizer). Increased yield attributes might be due to readily available nitrogen to the crop from inorganic source of fertilizer. At the same time with the help of *Azosprillum,* mineralization of vermicompost might have started which provided better nutrition to crop and better soil environment. Similar results were recorded by Lakshmipathi (2012), Saunshi et al (2014), Sridhara et al (2003) and Prashanth et al (2019).

The treatment T_7 (25% N through vermicompost + *Azosprillum* + 50% N through fertilizer) recorded significantly higher grain yield which was statistically at par with T_6, T_1, T_2 and T_3. T_6 also recorded significantly higher straw yield which was at par with all other treatments except treatments T_4 (50% N through NADEP compost + 50% N through fertilizer), T_5 (50% N through poultry manure + 50% N through fertilizer) and T_9 (25% N through poultry manure + *Azosprillum* + 50% N through fertilizer).

Table 1. Effect of different treatments on growth, yield attributes and yield of finger millet

Treatment	Number of fingers/earhead	Finger length (cm)	Grain yield (kg/ha)	Straw yield (kg/ha)	Test weight (g)
T_1	7.68	6.85	2,410	6,984	2.58
T_2	7.30	6.68	2,390	6,709	2.49
T_3	7.48	6.73	2,373	6,764	2.50
T_4	6.88	6.18	2,309	6,430	2.44
T_5	6.63	6.10	2,154	6,382	2.41
T_6	7.95	7.23	2,570	7,303	2.61
T_7	8.40	7.45	2,677	7,286	2.66
T_8	7.05	6.20	2,321	6,749	2.44
T_9	6.35	5.98	1,993	6,224	2.38
SEm±	0.33	0.31	120	244	0.06
$CD_{0.05}$	0.96	0.92	352	714	0.16
CV (%)	9.00	9.50	10.24	7.24	4.44

Table 2. Effect of different treatments on protein, nitrogen, phosphorous, potassium, iron, zinc, copper and manganese content in finger millet grains

Treatment	Protein (%)	N (%)	P (%)	K (%)	Iron (ppm)	Zinc (ppm)	Copper (ppm)	Manganese (ppm)
T_1	4.33	0.693	0.179	0.652	37.20	38.91	10.33	97.10
T_2	4.24	0.678	0.184	0.687	37.81	38.31	10.51	100.48
T_3	4.38	0.700	0.187	0.694	38.07	38.41	9.78	98.32
T_4	4.46	0.713	0.176	0.648	37.85	39.13	9.90	97.74
T_5	4.18	0.670	0.186	0.727	36.16	38.80	9.53	100.09
T_6	4.68	0.749	0.181	0.716	38.57	39.22	10.17	100.47
T_7	4.81	0.770	0.191	0.720	37.76	39.10	10.35	100.01
T_8	4.53	0.725	0.181	0.670	35.95	38.14	10.70	98.94
T_9	4.23	0.678	0.178	0.711	37.43	38.29	9.55	102.66
SEm±	0.11	0.018	0.003	0.020	1.02	1.01	0.28	2.53
$CD_{0.05}$	0.33	0.053	NS	NS	NS	NS	NS	NS
CV (%)	5.13	5.13	3.61	5.84	5.45	5.24	5.62	5.09

T_1= RDN 40 kg/ha, T_2=50% N through FYM + 50% N through fertilizer, T_3= 50% N through vermicompost + 50% N through fertilizer, T_4=50% N through NADEP compost + 50% N through fertilizer, T_5=50% N through poultry manure + 50% N through fertilizer, T_6=25% N through FYM + *Azosprillum* + 50% N through fertilizer, T_7= 25% N through vermicompost + *Azosprillum* + 50% N through fertilizer, T_8= 25% N through FYM + *Azosprillum* + 50% N through fertilizer, T_9= 25% N through poultry manure + *Azosprillum* + 50% N through fertilizer

Sustainable crop production can be achieved through integrated nutrient management. The application of inorganic fertilizers, organic manures and biofertilizer might have supplied nitrogen in balanced quantity that enabled the finger millet plants to assimilate sufficient photosynthetic products and thus increased dry matter accumulation. With increased dry matter and photosynthetic products coupled with efficient translocation, plant must have produced more ears with increased test weight and ultimately higher grain yield. The synthesis of photosynthates would have been more owing to adequate supply of nitrogen and FYM along with biofertilizer which increased the photosynthetic activity and production of more biomass which ultimately resulted in higher straw yield. These findings are in close agreement with those reported by Govindappa et al (2009), Chaudhari et al (2011), Savita et al (2013), Hatti et al (2018), Kumar et al (2018) and Prashanth et al (2019).

Effect of nitrogen management on protein, nitrogen, phosphorous, potassium, iron, zinc, copper and manganese content in finger millet grains

The data given in Table 2 show that highest protein and N content (4.81 and 0.770% respectively) was recorded due to the treatment T_7 which was at par with the treatments T_6 (4.68 and 0.749% respectively) and T_8 (4.53 and 0.725% respectively). However there was no significant effect of different treatments on phosphorus, potassium, iron, zinc, copper and manganese content of finger millet grains.

CONCLUSION

The study revealed that supply of adequate and readily available nutrient assured yield and quality of finger millet. Organic source of nitrogen either in the form of FYM or vermicompost gave better yield and quality of finger millet in the presence of biofertilizer. Further it may be concluded that application of 25 per cent N through FYM + 50 per cent N through fertilizer along with *Azospirilum* or 25 per cent N through vermicompost + Azosprillum + 50 per cent N through fertilizer or application of recommended dose of nitrogen (40 kg/ha) to finger millet gave higher yield and resulted in better quality of the crop.

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