NURIENT MANAGEMENT TRIAL ON FOXTAIL MILLET AT SUNDARBAZAR, LAMJUNG

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ABSTRACT

Foxtail millet is an indigenous crop known for its rich nutritive value, drought tolerance ability and low input requirements. Though it is grown in marginal condition, it can give the best production with the proper nutrient management for its cultivation. In this respect, an experiment was conducted in Agronomy farm of Lamjung Campus, Sundarbazar during March-June 2017. The main objective of the experiment was to explore the performance of local foxtail millet under different level of nutrients. The experiment was carried out in Randomized Complete Block Design with three replications and seven treatments viz. FYM 6 t/ha, FYM 6 t/ha+60:30:20 kg NPK/ha, 60:30:20 kg NPK/ha, FYM 6t/ha+30:20kg PK/ha, FYM 6t/ha+60:30 kg NK/ha, FYM 6 t/ha+60:30 kg NP/ha and Control (no fertilizers). Results revealed that highest grain yield (2.47t/ha) (152% higher than control), was obtained from FYM 6 t/ha+60:30:20 kg NPK/ha which was followed by 60:30:20 kg NPK/ha (2.45 t/ha) and were statistically at par with each other. The highest grain yield in FYM 6 t/ha+60:30:20 kg NPK/ha was supported by higher no. of grains per panicle (2870), more test weight (1.79 gm) and more harvest index (19.3%). However, the straw yield (12.6t/ha), biological yield (15.02t/ha) along with B: C ratio was found slightly higher in 60:30:20 kg NPK/ha. The growth characters viz. plant height, flag leaf area and panicle length of all the treatments were significantly higher than Control (T_7). The treatment having balanced plant nutrients (T_2) produced significantly higher yield and can be recommended to mid-hill farmers for obtaining good yield.

Keywords: Fertilizer dose, foxtail millet, growth, yield.

INTRODUCTION

Millets are small seeded cereals that are often termed nutri-cereals or dryland cereals found to be domesticated around 8000 years ago in the highlands of central China (Amgai *et al.*, 2011). They comprise of different types like finger millet, foxtail millet, proso millet, pearl millet including sorghum which are well considered as the crops of antiquity mainly known for their drought resistance, insects, pests and disease resistance (Devi *et al.*, 2011). Foxtail millet (*Setaria italica* (L.) Beauv.) is thought to be indigenous to southern Asia and is considered one of the oldest cultivated millets (Oelke, 1990). In case of Nepal, its cultivation is confined to dry marginal areas in the mid hills districts like Dolpa, Mugu, Bajura, Bajhang and Lamjung. Foxtail millet provides the richness of different amino acids and nutritional minerals taken as food. It contains 12.3g protein, 8.0g fiber, 3.3g mineral, 2.8mg iron, and 31 mg calcium per 100 gm (Sarita & Singh, 2016). They are rich source of phytochemicals and micronutrients; phenolics, tannins that reduce the risk for colon and breast cancer. It provides different health benefits as it improves glycemic control, inhibits hyperinsulinemia and decreases lipid concentrations in patient with type-2 diabetes (Jali *et al.,* 2012). Foxtail millet comes under drought tolerant crop usually grown in the marginal lands having low level of nutrients and organic matter. However, it responses to the amount of fertilizers used and they significantly contribute in yield and yield attributing characters. Fertilizer management is one of the important cost-effective factors known to augment the crop production. The supplementation of fertilizers along with the organic manure plays the key role in overall balance supply of nutrients owing to the better growth and production of the crop. The potential of foxtail millet as rainfed crop has not been fully exploited. Information on optimum and economic dose of fertilizers requirement for higher grain yield and quality is lacking in this millet. Keeping the above points in view the present investigation was initiated to study the effect of fertilizer levels in conjunction with enriched farm yard manure on foxtail millet at midhill of western Nepal.

MATERIALS AND METHODS

A field experiment was conducted during March-June 2017 to evaluate the effect of different nutrient levels on foxtail millet grown under at the Agronomy farm of IAAS, Lamjung Campus. It was laid out in randomized complete block design (RCBD) with three replications comprising of seven treatments viz., FYM 6 t/ha, FYM 6 t/ha+60:30:20 kg NPK/ha, 60:30:20 kg NPK/ha, FYM 6t/ha+30:20kg PK/ha, FYM 6t/ha+60:30 kg NK/ha, FYM 6 t/ha+60:30 kg NP/ha and Control (no fertilizers). The Banjakhet Local variety of foxtail millet available at Banjhakhet, Lamjung was used in this investigation. Seeds were sown on the plots of 2m×2m size in lines with a spacing of 25×10cm with seed rate of 10 kg ha^{-1}. Fertilizer application was done as per the treatments assigned to individual plots. The nitrogen application was done in two splits, 50 % of N, full dose of P and K were applied as a basal and remaining 50 % N, at 30 days after sowing. The phenological observation i.e. maturity days were recorded. Growth observations viz., plant height (cm), no. of effective tillers and leaf area were recorded at harvest. The post harvest observations viz., grain yield (t ha^{-1}), straw yield (t ha^{-1}) and test weight were also recorded. The cost of inputs that were prevailing at the time of their use was considered for working out the economics of various treatment combinations. Benefit-cost ratio was calculated.

The experimental data were subjected to statistical analysis using MSTAT-C 1997. An analysis of variance and DMRT mean separations was done from the reference of Steel and Torrie (1980) and Gomez and Gomez, (1984). ANOVA was done to test the significance of difference for each parameter. Calculation of the significant critical differences at 5% level of significance was made by the mean comparisons. Duncan`s Multiple Range Test (DMRT) was done to find the range for mean separation between the tested treatments.

RESULTS AND DISCUSSION

Days to maturity

The results showed that maturity of the millet was faster in the control (Table 1). This could be due to the absence of nitrogen in these treatments which hastened the maturity. With increasing nitrogen dose, the days to maturity increased. Adam (2004) and Damame *et al.,* (2013) have reported similar results in pearl millet where the maturity days increased with increasing nitrogen. Nitrogen is responsible for prolonged vegetative growth and hence it delayed maturity in the plants treated with nitrogen dose. Delayed maturity is better than early maturity in control as it leads to more assimilation and translocation of those assimilates in the grains in the later stages.

Plant height

The level of different nutrients significantly influenced the plant height (Table 1). Highest plant height (165cm) was observed in treatment FYM 6 tons + 60: 30: 20 kg NPK ha^{-1} compared to all other treatments. Nitrogen promotes the vegetative growth thus, leading to significant increase in plant height. Above results were similar with an experiment performed by V.S. Rathore, P. Singh and R.C Gautam (2006) in pearl millet where maximum height was observed in 100:30:40 kg NPK/ha. Phosphorus enhances the early root development which provided the better absorption of nutrients and resulted in overall growth. Positive response of application of organic manure in combination with nitrogen and phosphorous in terms of plant height were also reported by Awodun *et al.*, (2007).

Number of effective panicles per hectare

The effective panicles per hectare showed significant effect on treatments. The greater number of effective panicles were seen in case of T_2 (FYM 6 tons + 60: 30: 20 kg NPK ha^{-1}) compared to the control, however at par with T_6 (FYM 6 tons + 60: 40: 0 Kg NPK ha^{-1}). The lowest number of effective panicles in case of control can be explained as the nutrient deficient conditions which failed to produce the effective ones. As we supply the plants with nitrogen, it promotes tiller formation and determines the potential number of tillers. Number of tillers increases with increase in nitrogen fertilization and the response is linear. The more number of tillers might be due to the availability of nitrogen which plays the vital role in cell division.

Table 1: Effect of different level of nutrients on phenological, growth and yield attributing characters of foxtail millet at Sundarbazar, Lamjung, 2017

Treatments	Maturity days	Plant height(cm)	Effective panicles/ha
1.FYM 6tha^{-1}	93^{ab}	158.91^{ab}	96.3^{b}
2. FYM 6tha^{-1} + 60:30:20kgNPK ha^{-1}	94^{a}	165.1^{a}	102.5^{a}
3. 60:30:20kgNPK ha^{-1}	91^{cd}	153.94^{b}	88.6^{bc}
4.FYM 6tha^{-1} + 30:20kg PK ha^{-1}	92^{bc}	157.90^{ab}	85^{bc}
5.FYM 6tha^{-1} + 60:30kg NK ha^{-1}	92^{bc}	153.78^{b}	75^{c}
6.FYM 6tha^{-1} + 60:40kg NP ha^{-1}	92^{bc}	160.33^{ab}	100^{a}
7.Control	91^{d}	137.37^{c}	83^{d}
F-test	*	**	**
LSD	1.32	7.2	7.3
CV	5.81	12.61	14.4
GM	91	155.3	92.3

*Note: *= Significant, **= Highly significant, CV=Coefficient of Variation, LSD=Least Significant Difference, GM=Grand Mean*

1000 grain weight

The application of FYM 6 tons + 60: 30: 20 kg NPK ha^{-1} was significantly superior over all the treatments but at par with T_6 (FYM 6 tons + 60: 40: 0 Kg NPK ha^{-1}). It had the highest test weight (1.79g). It indicated that the balanced dose of nutrients viz. FYM and fertilizers NPK was suitable to produce bold grains. Fertilized plants produced significantly heavier seeds compared to those of plants under unfertilized treatments. The 1000-seed weight increased significantly with successive N level that produced healthy and bold grains which might be contributed by the different yield attributes. Similarly, these results are in agreement with those reported by Bhuva and Sharma (2015).

Grain yield

The grain yield showed highly significant difference among the treatments (Table 2). The highest grain yield was obtained from T_2: FYM 6 tons + 60: 30: 20 kg NPK ha-1 (2.467t/ha) which was statistically at par with $T_{3:}$ 60: 30: 20 kg NPK ha^{-1} (2.44) and was followed by $T_{5:}$ FYM 6 tons + 60: 0: 30 kg NPK ha^{-1} (1.74) and T_6: FYM 6 tons + 60: 40: 0 Kg NPK ha^{-1} (2.0). The higher grain yield in T_2 could be attributed to the favorable effect of more number of effective tillers, increased panicle length, more number of grains per panicle and more test weight.

Table 2: Effect of different level of nutrients on yield of foxtail millet at Sundarbazar, Lamjung, 2017

Treatments	Grain yield (tha^{-1})	Straw yield (tha^{-1})	Harvest index	Test weight(g)
1.FYM 6tha^{-1}	1.36^{d}	12.2^{b}	11.5^{d}	1.6^{bc}
2.FYM 6tha^{-1} + 60:30:20kgNPK ha^{-1}	2.46^{a}	10.3^{c}	19.2^{a}	1.79^{a}
3. 60:30:20kgNPK ha^{-1}	2.44a	12.5^{a}	16.2^{b}	1.6^{cd}
4.FYM 6tha^{-1} + 30:20kg PK ha^{-1}	2.13^{b}	10.24^{c}	17.1^{b}	1.5^{d}
5.FYM 6tha^{-1} + 60:30kg NK ha^{-1}	1.74^{c}	10.21^{c}	14.6^{c}	1.72^{ab}
6.FYM 6tha^{-1} + 60:40kg NP ha^{-1}	2.0^{b}	9.6^{d}	17.1^{b}	1.75^{a}
7.Control	0.9^{e}	7.5^{e}	10.06^{e}	1.6^{bc}
F-test	**	**	**	**
LSD	0.24	0.19	1.2	0.07
CV	10.4	13.3	14.65	2.50
GM	1.8	10.3	15.1	1.6

*Note: *= Significant, **= Highly significant, CV=Coefficient of Variation, LSD=Least Significant Difference, GM=Grand Mean*

The balanced supply of FYM and NPK might have increased all the growth parameter, yield attributing characters which ultimately contributed to increase in yields. Nitrogen nutrition increased LAI, chlorophyll content and nutrient uptake. Phosphorus supply increases cytokinin synthesis and supply of photosynthates for flower formation. Ultimately it increases the grain yield. The application of P in combination with N contributed to translocate dry matter and physiological attributes towards yield. Increased grain yields due to varying levels of nutrients in finger millet have also been reported by Munirathnam (2006).

Harvest index

Analysis of variance showed that the harvest index (HI) was significantly different among the treatments. It was observed that HI of T_2: FYM 6 tons + 60: 30: 20 kg NPK ha^{-1} was more (19.265) and it was significantly higher than the other treatments and the control too. The lowest value of HI was seen in the control as it could not supply the essential nutrients to the plant for its growth. As a result, the overall yield of the control plot was low. Meanwhile, the high value of HI in T_2 and T_6 might have been observed as the treatment was supplied with the balanced dose of nutrients which could have attributed to the availability of essential nutrients to the plant to increase the overall yield.

Benefit-cost ratio

Table 3: Cost of cultivation, gross returns, net returns and benefit cost ratio as influenced by the different level of nutrients on foxtail millet at Sundarbazar, Lamjung

Treatments	Cost of cultivation ('000)	Gross returns ('000)	Net returns ('000)	B:C Ratio
T1	75.7^{d}	94.42^{c}	18.7^{c}	1.25^{b}
T2	78.7^{a}	131.1^{a}	52.3^{b}	1.67^{b}
T3	24.7e	137.7^{a}	112.9^{a}	3.12^{a}
T4	77.2^{c}	118.8^{b}	41.5^{b}	1.54^{b}
T5	77.5^{c}	114.6^{b}	37.1^{b}	1.48^{b}
T6	78.08^{b}	132.7^{a}	54.6^{b}	1.70^{b}
T7	21.7^{f}	67.2^{d}	45.5^{b}	0.9^{c}
F-test	**	*	*	**
LSD	320.3	46.09	45.9	1.14
CV	0.1	1.4	2.9	6.9
GM	61.9	113.8	51.84	2.33

*Note: *= Significant, **= Highly significant, CV=Coefficient of Variation, LSD=Least Significant Difference, GM=Grand Mean*

The benefit cost ratio (B: C ratio) was calculated to evaluate the economics of foxtail millet production under different treatments imposed. The highest gross returns were recorded (Rs. 137.7 thousand) in treatment (T_3) receiving 60:30:20 kg NPK ha^{-1} followed by treatment T_2 (Rs.131.7 thousands) which received 6t FYM ha-^{1} along with 60:30:20 kg NPK ha^{-1} and were statistically at par with each other. The least gross returns (Rs. 67.2 thousand) were recorded in control. Higher B: C ratio (3.12) was observed in T_3 followed by T_2 and T_6.

The highest B: C ratio in T_3 was due to the application of NPK only but was devoid of FYM. The cost of FYM was higher in other treatments (Rs. 54,000 ha^{-1}). However, the yield of T_2 and T_3 are more or less equal with each other. The nutrients available for plant allowed for the improved vegetative growth and increased productive tillers which resulted in good grain and straw yield. These results are in line with Mudalagiriyappa *et al*., (2015) who reported that application of 125 per cent customized fertilizer dose recorded higher net returns and B: C ratio.

CONCLUSION

Being an underutilized crop, even the foxtail millet responded to the different level of nutrients. From the present investigation, it is concluded that the balance dose of nutrients (6t FYM ha^{-1}+ 60:30:20kg NPK ha^{-1}) is an efficient and advisable treatment for increasing production with higher grain yield along with high monetary returns.

ACKNOWLEDGEMENT

Authors are grateful to lab technicians, family and friends for their guidance and suggestion during the research period and Institute of Agriculture and Animal Science, Lamjung, Nepal for physical support during the implementation of this project.

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