Original Research Article

Correlation and Regression Studies of Growth, Yield Attributes, Yield and Nutrient uptake of foxtail millet under Different Varieties and Landraces

ABSTRACT

Aims: To evaluate the "Correlation and Regression Studies of Growth, Yield Attributes and Yield of foxtail millet (*SetariaItalica* L.)Under Different Varieties and Landraces"

Place and Duration of Study: The experiment was carried out in the *Rabi* season of 2022,atExperimental farm in Karunya Institute of Technology and Sciences, Coimbatore. Experimental field was silty clay loam in texture with medium in available N (273.0 kg/ha), high in available P_2O_5 (21.5 kg/ha), and high in available K_2O (425.0 kg/ha) and lower level of organic carbon (0.29%).

Study design: Randomized Block Design (RBD).

Methodology: The treatments consisted of 8foxtail millet varieties and landraces *viz.*, *T_1 - ATL-1 (Control), T_2 - SiA-3222 (Garuda), T_3 - SiA-3088 (Suryanandhi), T_4 - SiA-3085, T_5 - SiA-3156, T_6 - SiA-3233 (Reynaudu), T_7 - Mookanthathinaiand T_8 - Koranthinai.*

Results: Grain yield was highly significant positive correlation with N uptake (r = 0.996**), DMP at harvest stage (r = 0.984**), K uptake (r = 0.981**), P uptake (r = 0.966**) and straw yield (r = 0.954**).From the regression, N uptake(R^2 = 0.993**), DMP(R^2 = 0.968**) at harvest is the important positive component of grain yield in foxtail millet followed by K uptake (R^2 = 0.962**), P uptake (R^2 = 0.934**) and straw yield (R^2 = 0.911**).

Conclusion: From this study, it was concluded that interms of grain yield of foxtail millet varieties are influenced by the DMP at harvest, Straw yield, N uptake, P uptake and K uptake

Keywords: Correlation; Foxtail millet; Regression; Varieties and landraces

1. INTRODUCTION

Minor millets, also known as Nutri-cereals, encompass important and cultivated varieties such as Finger millet (Ragi), Proso millet (Panivaragu), Foxtail millet (Thenai), little millet (Samai), Barnyard millet (Kudhiraivali), and Kodo millet (Varagu). These millets are rich in vitamins, minerals, dietary energy, insoluble dietary fiber, and phytochemicals with antioxidant properties. They are particularly abundant in micronutrients like Iron, Calcium, and Zinc [2, 3]. However, the market values and modern lifestyle have led to the endangerment and depletion of many minor millet varieties.

Foxtail millet (Setariaitalica L.), also known as Italian millet, belongs to the poaceae family and is native to China. It has an erect leafy stem, reaching a height of 60-75 cm, and an adventitious root system. Foxtail millet thrives in a range of soil types from sandy to heavy clay, with an average required rainfall of 500-700 mm. It cannot tolerate waterlogged conditions or extreme drought. In 100 g of foxtail millet grain, you can find excellent amounts of fiber (8 g), protein (12.3 g), carbohydrates (60.9 g), fat (4.3 g), calcium (31 mg), iron (2.8 mg), phosphorus (290 mg), vitamins, minerals, and food energy ranging from 323-350 Kcal [6, 9].

Foxtail millet ranks second in protein content following Proso millet with 12.50g. In terms of calcium content, foxtail millet ranks third preceded by Pearl millet with 42mg and Wheat with 41mg. Foxtail millet is also known for its high fiber content [1]. Yield enhancement of foxtail millet can be made possible through release of location specific varieties and their adoption at farmers level. Moreover, adoption of appropriate varieties is important to boost productivity of foxtail millet.The aim of the experiment was to investigate the factors influencing yield in terms of growth, yield attributes and nutrient uptake across various varieties and landraces.

2. MATERIAL AND METHODS

2.1 Experimental Location and Climatic Condition

The experiment was conducted during *Rabi* 2022at Experimental Farm, Karunya Institute of Technology and Sciences, Coimbatore. The soil of experimental plot was silty clay loam and slightly alkaline in reaction with pH 7.36 and EC of 0.21 dS/m. The soil was medium in available N (273.0 kg/ha), high in available P_2O_5 (21.5 kg/ha) and available K_2O (425.0 kg/ha). The farm is geographically located at 10° 56' N latitude and 76° 44' E longitude with an altitude of 474 m above the MSL under western agro-climatic region of Tamil Nadu.

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2.2. Design and Treatment Detail

The experiment comprised eight treatments, consisting of different varieties and landraces: T_1 - ATL-1 (Control), T_2 - SiA-3222 (Garuda), T_3 - SiA-3088 (Suryanandhi), T_4 - SiA-3085, T_5 - SiA-3156, T_6 - SiA-3233 (Reynaudu), T_7 - Mookanthathinai and T_8 - Koranthinai. The treatments were arranged in a randomized block design with three replications. Each plot had a gross plot size of 5.1 m × 4.1 m, and five plants were randomly selected within each plot. Standard methods were employed to collect data on growth parameters, yield attributes, and overall yield. The uptake of nitrogen (N), phosphorus (P), and potassium (K) at harvest stage was determined by multiplying the nutrient content with the corresponding dry matter production and expressed as kg ha^{-1}.

2.3 Crop Management

The crop was sown in lines at30 cm× 10 cmspacing using 10 kg/ha seed rate. The recommended dose of 44:22:0NPK kg/ha was applied at the time of sowing. The N was applied through urea and DAP and P through DAP. Weeds were managed by two hand weeding at 15 and 40 DAS and other agronomic practices followed appropriately for all the growth stages of the crop.

2.4 Statistically Analysis

The relationships between yield and various growth parameters, yield attributes, yield, and nutrient uptake (nitrogen, phosphorus, and potassium) were investigated by constructing a correlation matrix using SPSS. The correlation between different parameters, including growth parameters, yield parameters, yield, and nutrient uptake at harvest, ~~was~~weredetermined at a significance level of 1% and 5% using the method described by Panse and Sukhatme [5]. Additionally, simple linear regression equations were calculated for the same independent variable with grain yield [5].

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3. RESULTS

3.1.Correlation

The results from Table 1 reveal several correlations between different factors. Grain yield showed a highly significant positive correlation with nitrogen (N) uptake (r = 0.996**), dry matter production (DMP) at harvest stage (r = 0.984**), potassium (K) uptake (r = 0.981**), phosphorus (P) uptake (r = 0.966**) and straw yield (r = 0.954**). However, it exhibited a highly negative correlation with leaf area index (LAI) at 40 days after sowing (DAS) (r = -0.844**). The straw yield had a negative correlation with LAI at 40 DAS (r = -0.788*) but a highly significant positive correlation with N uptake (r = 0.944**), K uptake (r = 0.941**), P uptake (r = 0.937**), and DMP at harvest stage (r = 0.924**).

Plant height showed a positive correlation with number of tillers (r = 0.819*) and LAI at 40 DAS (r = 0.740*). LAI at 40 DAS had a highly negative correlation with K uptake (r = -0.869**), P uptake (r = -0.861**), N uptake (r = -0.858*) and DMP at harvest stage (r = -0.857**). However, it had a positive correlation with productive tillers (r = 0.716*). LAI at 60 DAS exhibited a highly positive correlation with the number of tillers (r = 0.870**). DMP at harvest stage had a highly significant positive correlation with NPK uptake by crops (r = 0.995**, r = 0.985**, and r = 0.995**, respectively). The number of tillers showed a positive correlation with productive tillers (r = 0.830*).N uptake had a highly significant positive correlation with K uptake (r = 0.991**)andP uptake (r = 0.980**). Similarly, P uptake exhibited a highly significant positive correlation with K uptake (r = 0.996**). From the correlation, indicate that increasing value of one parameter causes significant increment in another parameter.

Table 1. Correlation coefficient between growth, yield components and yield of foxtail millet varieties under Western Zone of Tamil Nadu (*Rabi*, 2022-23)

S.No.	Parameters	Grain yield	Straw yield	Plant height	LAI 40 DAS	LAI 60 DAS	DMP 60 DAS	DMP harvest	No .of tillers	Productive tillers	Test weight	N uptake	P uptake	K uptake
1	Grain yield	1												
2	Straw yield	0.954**	1											
3	Plant height	0.175	0.311	1										
4	LAI 40 DAS	-0.844**	-0.788*	0.148	1									
5	LAI 60 DAS	-0.285	-0.195	0.740*	0.671	1								
6	DMP 60 DAS	0.358	0.470	0.005	-0.272	-0.316	1							
7	DMP harvest	0.984**	0.924**	0.120	-0.857**	-0.330	0.399	1						
8	No .of tillers	-0.216	-0.142	0.819*	0.529	0.870**	-0.254	-0.274	1					
9	Productive tillers	-0.661	-0.597	0.501	0.716*	0.703	-0.517	-0.706	0.830*	1				
10	Test weight	0.116	-0.009	0.441	0.147	0.398	-0.001	0.171	0.583	0.322	1			
11	N uptake	0.996**	0.944**	0.148	-0.858*	-0.316	0.377	0.995**	-0.258	-0.692	0.127	1		
12	P uptake	0.966**	0.937**	0.225	-0.861**	-0.298	0.421	0.985**	-0.213	-0.638	0.187	0.980**	1	
13	K uptake	0.981**	0.941**	0.177	-0.869**	-0.311	0.391	0.995**	-0.245	-0.670	0.154	0.991**	0.996**	1

**= Significant at 1 % level; * =Significant at 5 % leve

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Table 2. Regression coefficients (b) and intercept (a) of different component traits on grain yield of foxtail millet varieties and landraces along with their coefficient of determination (R^2)

S.No.	Characters	Intercept (a)	Regression coefficients (b)	R^2	Regression equation $Y = a + bx$
1	Plant height	1740.54	3.79	0.031	$Y = 1740.54 + 3.79 X_1$
2	LAI 40 DAS	3403.83	-591.11	0.713**	$Y = 3403.83 - 591.11 X_2$
3	LAI 60 DAS	2636.05	-128.77	0.081	$Y = 2636.05 - 128.77 X_3$
4	DMP 60 DAS	1675.03	0.18	0.128	$Y = 1675.03 + 0.18 X_4$
5	DMP harvest	-300.57	0.55	0.968**	$Y = -300.57 + 0.55 X_5$
6	No .of tillers	2545.66	-76.42	0.047	$Y = 2545.66 - 76.42 X_6$
7	Productive tillers	2725.37	-166.16	0.436	$Y = 2725.37 - 166.16 X_7$
8	Test weight	1740.23	155.03	0.013	$Y = 1740.23 + 155.03 X_8$
9	Straw yield	380.76	0.49	0.911**	$Y = 380.76 + 0.49 X_9$
10	N uptake	-306.10	57.16	0.993**	$Y = -306.10 + 57.16 X_{10}$
11	P uptake	426.97	81.53	0.934**	$Y = 426.97 + 81.53 X_{11}$
12	K uptake	94.07	33.21	0.962**	$Y = 426.97 + 81.53 X_{11}$

3.2. Regression

The regression coefficients (b) of different characteristics on yield were calculated and presented in Table 2. The regression coefficients indicated highly significant positive effects (values) for specific characteristics, including plant height, dry matter production (DMP) at 60 days after sowing (DAS), DMP at harvest, test weight, straw yield, nitrogen (N), phosphorus (P) and potassium (K) uptake. These positive regression coefficient values indicated the rate of increase in grain yield due to a one unit increase in the independent variable (plant characteristics). The highest regression coefficient was observed for test weight (155.03), followed by P uptake (81.53), N uptake (57.16), and K uptake (33.21). Conversely, the lowest regression coefficient was found for leaf area index (LAI) at 40 DAS (-591.11), followed by productive tillers (-166.16), LAI at 60 DAS (-128.77), and number of tillers (-76.42). This suggests that every unit increase in DMP at 60 DAS, straw yield, DMP at harvest stage, plant height, K uptake, N uptake, P uptake, and test weight of the crop substantially increased the grain yield by 0.18, 0.49, 0.55, 3.79, 33.21, 57.16, 81.53, and 155.03 kg/ha, respectively.

Hence, the traits of N uptake (R^2 = 0.993**), DMP at harvest (R^2 = 0.968**) were identified as important positive components of grain yield in foxtail millet, followed by K uptake (R^2 = 0.962**), P uptake (R^2 = 0.934**), and straw yield (R^2 = 0.911**). Conversely, LAI at 40 DAS (R^2 = 0.713**) was identified as an important negative component of grain yield.

DISCUSSION

Based on the correlation and regression study, grain yield is highly significantly positively influenced by the Dry matter production at harvest stage, Straw yield, Nitrogen uptake, Phosphorus uptake and Potassium uptakewere depicted in the figure 1.

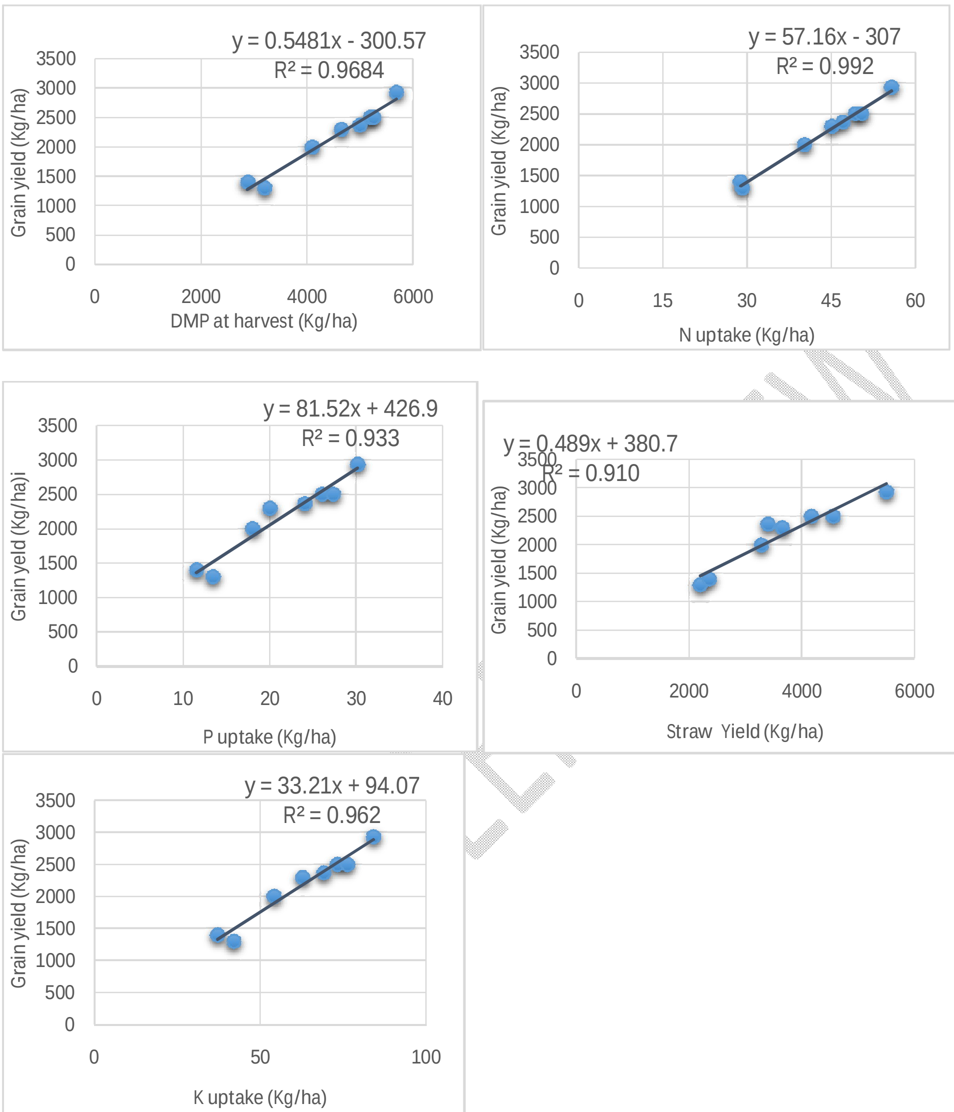

Fig.1. Positive Linear regression relationship of grain yield with DMP, N uptake, P uptake and K uptake at harvest stage and Straw Yield

Increase in dry matter production and straw yield playsa significant role in increasing the assimilatory surface area per plant, resulting in higher biomass accumulation and greater photosynthetic assimilate production. Which, leads to an increase in both economic and biological yield. These findings are in consistent with the results reported by Srinkanyaet al.[7]and Srinkanyaet al.[8] in their studies on foxtail millet. Additionally, nitrogen uptake was found to have a positive and significant influence on phosphorus uptake through rhizosphere acidification,which promotes the solubilization of insoluble phosphates and the release of more orthophosphates into the soil solution. The uptake of potassium showed a similar trend, indicating its contribution to increased dry matter production and ultimately increase the grain yield of foxtail millet varieties and landraces. These findings align with the results reported by Jyothi et al.[4].

4. CONCLUSION

It was concluded that grain yield of foxtail millet varieties and landraces was highly positive and significantly influenced by the growth parameter (dry matter production at harvest stage) and nutrient uptake by crops (NPK uptake at harvest stage).

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