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Studies on Genetic Parameters, Correlation and Path Analysis for Grain Yield and its Components in Foxtail Millet (*Setaria italica*)

Kamal K. Sharma* and Vasundhara Dangi

Department of Plant Breeding and Genetics, JNKVV College of Agriculture, Rewa, M.P. India

**Corresponding author*

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A B S T R A C T

Present investigation of genetic variability, correlation and path analysis for yield and yield contributing characters in 22 genotypes of foxtail millet was carried out during *kharif*, 2019 at JNKVV, College of agriculture (Rewa, M.P.). Mean value of ear length and grain yield per plant was also observed highest for genotypes SiA-3159. Highest estimates of PCV were observed for harvest index and number of basal tillers per plant and higher GCV were observed for Number of basal tillers per plant and harvest index. High estimates of heritability was recorded for days to maturity,1000 grain weight, plant height and peduncle length and high genetic advance was recorded for number of tillers per plant and 1000 grain yield per plant. The correlation and path coefficient analysis revealed that grain yield per plant had highly significant positive association with harvest index and peduncle length. Similarly path analysis indicated that harvest index had the maximum positive direct effect on grain yield per plant followed by biological yield, peduncle length, 1000 grain weight, day to maturity, plant height, ear length and flag leaf width. While negative effects on grain yield were contributed by day to 50% flowering, flag leaf length and number of tillers per plant.

Introduction

Foxtail millet (*Setaria italica*) is important staple food for millions of people in Southern Europe and Asia. Foxtail millet is diploid species (2n=18), (Baltensperger and Cai, 2004). Foxtail millet was originated in china. Its 100g grains contain protein(12.3g), carbohydrate (60.9g), fat (4.3g), crude fiber (8.0g), minerals (3.3g), calcium (31mg), phosphorus (290mg) (*National Institute of Nutrition*, (NIN), Hyderabad). Foxtail millet is rich in calories that provide energy and strength to the body to perform activities. Foxtail millet is a monocot and annual grass with slim, vertical, leafy stems which can reach a height of 120-200 cm (4-7 feet). The seed head is a dense, hairy panicle and 5-30 cm long. The small seeds, around 2 mm in diameter, are encased in a thin, papery hull which is easily removed after threshing. Seed color varies greatly between genotypes, Morphology and anthesis behaviors make foxtail millet one of the most difficult species to cross pollinate. Foxtail millet is largely self-pollinated, with cross pollination

averaging about 4 percent. The inflorescence is a spike with short side branches bearing spikelet and bristles. Anthesis in Foxtail Millet generally takes place near midnight and in the morning, but varies significantly with the environment. Foxtail millet ranks second in the total world production of small millets. The area, production and productivity of small millets (foxtail millet, kodo millet, little millet and barnyard millet) in India were 6.20 million hectare, 4.42 million tonnes and 714 kg per hectare, respectively (Anonymous 2015-16). In Madhya Pradesh foxtail millet occupies an area of 0.06 thousand hectares, production 1.74 tonnes and productivity 290 kg per hectare (Anonymous 2017-18). At present, foxtail millet is cultivated in Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Rajasthan, Madhya Pradesh and North eastern states. Potentiality of the foxtail millet is not fully exploited in India and yield levels are still very low, indicating a greater scope for crop improvement programme. Genetic diversity is the prime need for any crop improvement programme. Hence the genetic variability in respect of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, Genetic advance as a percentage of mean will be calculated to know the genetic behavior of grain yield and its components in foxtail millet. The path analysis reveals whether the association of characters with yield is due to their direct effect on yield or is a result of their indirect effects via other component characters. Therefore, the present study was conducted in foxtail millet to study the genetic parameters like variability, correlation and path coefficient effects of different yield components on grain yield. To formulate the selection criteria for crop improvement in foxtail millet requires to know positive and negative association of yield contributing traits towards the grain yield in foxtail millet. Correlation studies provide information about behavior of yield contributing traits towards the grain yield per plant, this information is useful to millet breeders for selecting elite genotypes from divers genetic population.

Materials and Methods

In the present study, the estimates of genetic parameters, correlation and path analysis for grain yield and its components in foxtail millet (*Setaria italica*) and it's 22 genotypes for 12 characters including yield and contributing traits during *kharif*2019 at, All India Coordinated Research project on Small Millet, at the College of Agriculture farm Rewa (MP). The design adopted was Randomized Block Design with three replications. Each plot consisted of10 rows of 3 m length with a spacing of 22.5 x 10 cm. the fertilizer dose of 40:40:0 kg NPK/ha and seeds were sown by hand dibbling. Observations were recorded on five plants for 12 yield component characters viz., days to 50% flowering, days to maturity, plant height, number of tillers per plant, flag leaf length, flag leaf width, peduncle length, length of inflorescence, biological yield per plant, harvest index, 1000 grain weight and grain yield per plant. The mean data after computing for each trait was subjected to analysis of variance, genetic parameters of variation, correlation and path analysis. The list of genotypes used in the present study is presented here under.

Results and Discussion

Genetic parameters

The analysis of variance revealed significant difference among the genotypes for all the 12 studied (Table 1). In the present study, the variation among genotypes was estimated as coefficient of variance and the phenotypic coefficient of variance (PCV) was slightly higher in magnitude than genotypic coefficient of variance (GCV) for all the

characters studied indicating the interaction of genotypes with environment (Table 2). Highest estimates of PCV were observed for harvest index and number of basal tillers per plant Similar finding in foxtail millet also reported by Thippeswamy *et al.,* (2017), Shingane *et al.*, (2016), Kavya *et al.*, (2017) and higher GCV were observed for Number of basal tillers per plant and harvest index. Similar finding in foxtail millet also reported by Brunda *et al.,* (2014), Yogeesh *et al.,* (2015).

Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are normally more helpful in predicting grain under selection than heritability estimates alone. In present study, heritability estimates were high and Moderate for all the character under studied *viz.*, day to maturity (83%), 1000 grain weight (80%), plant height (70%), peduncle length (56%), no of tillers per plant (50%), biological yield per plant (41%), flag leaf length (40%), ear length (36%), flag leaf width and grain yield per plant (33%), day to 50% flowering (32%).Similar finding in foxtail millet also reported by Jyothsna *et al.*, (2016), Priyatham *et al.,* (2018), Singmesetti *et al.*, (2018).

Table.1 List of genotypes used in the present investigation

S. No.	Genotypes	S.N.	Genotypes	S.N.	Genotypes
1	SiA-3220	9	SiA-4200	17	FOXTAIL
2	TNSi-337	10	GPUF-3	18	DHFt-109-3-1
3	SiA-3159	11	GPUF-4	19	DHFt-109-3-2
4	IIMR-FXM-2	12	TNSi-363	20	Local Check
5	GPUF-2	13	TNSi-364	21	SiA-3156
6	TNSi-354	14	IIMR Fxm-4	22	DHFt-109-3
7	PKS-22	15	IIMR Fxm-5		
8	SiA-3303	16	IIMR FT-1		

Table.2 Estimation of genetic parameters for different quantitative characters in Foxtail Millet

S.N.	Character	Mean	Range		PCV	GCV	h^2 (bs) %	GA as% of mean
			Min.	Max.				
1	**Days to 50%flowering**	50.51	47.00	53.66	5.58	3.20	33	3.79
2	**Days to maturity**	79.69	74.00	90.00	6.09	5.56	83	10.47
3	**Plant height**	136.44	115.58	149.92	6.56	5.50	70	9.49
4	**No of tillers**	1.44	1.07	1.73	17.24	12.53	50	18.78
5	**Flag leaf length**	32.57	28.34	36.94	7.81	4.99	40	6.57
6	**Flag leaf width**	2.53	2.18	2.80	7.61	4.88	33	6.45
7	**Peduncle length**	26.18	20.06	32.33	11.16	8.36	56	12.92
8	**Ear length**	19.61	16.77	23.78	12.77	7.70	36	9.57
9	**Biological Yield**	16.06	13.86	19.38	12.25	7.93	41	10.57
10	**Harvest index**	30.09	23.00	49.10	17.98	10.10	31	11.70
11	**1000 grain weight**	2.53	2.17	2.90	9.14	8.39	80	15.87
12	**Grain yield per plant**	6.18	5.15	7.36	11.95	6.96	33	8.37

PCV= Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, h^2 = Heritability (broad sense), GA= Genetic advance

Table.3 Genotypic and phenotypic correlation between grain yield and its components in Foxtail Millet

S.N.	Characters		DTF	DTM	PH	NTPP	FLL (cm)	FLW (cm)	PL (cm)	LL (cm)	BYP (g)	1000GW	HI %	GYP (g)
1	DTF	P	1	0.0197	0.3386**	-0.0210	-0.0064	0.2982*	0.1727	0.1041	-0.0132	0.1176	-0.1894	-0.1745
		G	1	-0.0874	0.7907	0.1117	0.2153	0.6920	0.3253	-0.2317	0.0258	0.5010	-0.6835	-03123
2	DTM	P		1	0.1166	0.1567	-0.0149	0.2143	-0.2412	0.4392***	0.0544	-0.0109	0.0071	0.0131
		G		1	0.1642	0.2038	-0.0101	0.2882	-0.3868	0.6825	-0.0696	-0.1007	0.1408	0.1061
3	PH	P			1	0.0329	-0.1937	0.3432**	0.0928	0.2065	0.0348	0.0522	-0.1629	-0.1662
		G			1	-0.0476	-0.3229	0.4613	0.2685	0.3966	-0.1488	-0.0005	-0.1488	-0.0668
4	NTP	P				1	0.0641	0.1284	0.0816	-0.0013	-0.0938	0.0213	-0.1251	-0.1590
		G				1	0.2916	0.1726	0.3165	-0.0365	-0.1804	0.1180	-0.3345	-0.3512
5	FLL	P					1	-0.0797	0.3205**	-0.0204	-0.1882	0.2240	-0.2114	-0.0938
		G					1	-0.0938	0.3739	0.0672	-0.2591	0.5053	-0.5787	-0.3102
6	FLW	P						1	0.0810	0.3114*	-0.2917*	0.0602	-0.0708	-0.0366
		G						1	0.1927	0.4838	-0.3517	-0.2859	0.3434	0.2576
7	PL	P							1	-0.0029	-0.3554**	0.2493*	-0.0581	0.2020
		G							1	0.0452	-0.5231	0.5258	-0.3115	0.2274
8	LI	P								1	0.0839	-0.1383	0.0812	0.0048
		G								1	0.1351	-0.3509	0.6730	0.5846
9	BYP	P									1	0.0883	0.0132	0.1251
		G									1	0.1046	0.0241	0.1339
10	1000GW	P										1	-0.7594***	-0.0967
		G										1	-0.7764	-0.0592
11	HI	P											1	0.7033*
		G											1	0.6817
12	GYP	P												1
		G												1

Table.4 Phenotypic path analysis table

S.N	Character	DTF	DTM	PH	NTPP	FLL (cm)	FLW (cm)	PL (cm)	LL (cm)	BYP (g)	1000GW	HI %	GYP (g)
1	**DTF**	**-0.0363**	-0.0007	-0.0123	0.0008	0.0002	-0.0108	-0.0063	-0.0038	0.0005	-0.0043	0.0069	-0.1745
2	**DTM**	0.0004	**0.0275**	0.0025	0.0034	-0.0003	0.0046	-0.0052	0.0094	0.0012	-0.0002	0.0002	0.0131
3	**PH**	0.0038	0.0013	**0.0111**	0.0004	-0.0022	0.0038	0.0010	0.0023	0.0004	0.0006	-0.0018	-0.1662
4	**NTP**	0.0001	-0.0008	-0.0002	**-0.0049**	-0.0003	-0.0006	-0.0004	0.000	0.0005	-0.0001	0.0006	-0.1590
5	**FLL**	0.0001	0.0003	0.0041	-0.0013	**-0.0210**	0.0017	-0.0067	0.0004	0.0039	-0.0047	0.0044	-0.0938
6	**FLW**	0.0030	0.0021	0.0034	0.0013	-0.0008	**0.0100**	0.0008	0.0031	-0.0029	0.0006	-0.0007	-0.0366
7	**PL**	0.0119	-0.0166	0.0064	0.0056	0.0220	0.0056	**0.0686**	-0.0002	-0.0244	0.0171	-0.0040	0.2020
8	**LL**	0.0010	0.0044	0.0021	0.0000	-0.0002	0.0031	0.0000	**0.0101**	0.0008	-0.0014	0.0008	0.0048
9	**BYP**	-0.0005	0.0021	0.0013	-0.0036	-0.0072	-0.0111	-0.0135	0.0032	**0.0381**	0.0034	0.0005	0.1251
10	**1000GW**	0.1170	-0.0109	0.0519	0.0212	0.2229	0.0599	0.2481	-0.1376	0.0879	**0.9952**	-0.7558	-0.0967
11	**HI**	-0.2751	0.0103	-0.2366	-0.1817	-0.3070	-0.1028	-0.0844	0.1179	0.0192	-1.1029	**1.4522**	0.7033
12	**Partial R2**	0.0063	0.0003	-0.0019	0.0008	0.0020	-0.0004	0.0139	0.0000	0.0048	-0.0963	1.0214	

R SQUARE= 0.9509 RESIDUAL EFFECT = 0.2215

The higher genetic advance recorded for no of tillers per plant (22.05) and moderate for ear length (18.38), grain yield per plant (18.30), harvest index (14.88), 1000 grain weight (12.32), days to maturity (11.70), and for days to 50 % flowering (10.42). Similar finding in foxtail millet also reported by Shingane *et al.*, (2016), Banu *et al.*, (2017), Jamsetji *et al.*, (2015).

Correlation studies

The phenotypic and genotypic correlation coefficients between yield and yield components and inter-relationship among them were estimated and presented in the (Table 3). Correlation studies revealed that grain yield per plant showed highly significant and positive phenotypic correlation with harvest index (0.7033).Days to 50 % flowering had significant positive phenotypic association with plant height, flag leaf width. Days to maturity recorded highly significant positive correlation with ear length. Plant height had the significant positive correlation with flag leaf width. Number of tillers per plant did not showed significant association with grain yield per plant.

Flag leaf length had the significant positive correlation with peduncle length. Flag leaf width had the significant positive correlation with ear length where as significant negative correlation was found with character 1000 grain weight. Peduncle length had significant positive correlation with biological yield where as significant negative correlation was found with character 1000 grain weight. Ear length had negative association with biological yield plant. Biological yield per plant had significant negative correlation with harvest index. Harvest index had significant positive correlation with grain yield per plant. Test weight showed positive association with grain yield per plant. These findings are in accordance with the findings of a Jyothsna *et al.*, (2016).

Path coefficient analysis

The direct and indirect effects of different yield components on grain yield worked out through path analysis at phenotypic levels are presented in the (Table 4). Path coefficient analysis at phenotypic level revealed that harvest index (1.4522) registered the maximum positive direct effect on grain yield per plant followed by biological yield per plant (0.9952), peduncle length (0.0686), 1000 grain weight (0.0381), day to maturity (0.0215), plant height (0.0111), ear length (0.0101) and flag leaf width (0.0100). Similar finding in foxtail millet also reported by Ganapathy *et al.*, (2011), Ramesh *et al.*, (2011).

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