International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 118-122

Received: 10-05-2020
Accepted: 12-06-2020

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Study of correlation and path analysis in finger millet. [*Eleusine coracana* (L.) Gaertn]

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DOI: https://doi.org/10.22271/chemi.2020.v8.i4b.9677

Abstract
A field experiment was conducted to study correlation and path analysis in finger millet [*Eleusine coracana* (L.) Gaertn]. Total 158 genotypes of finger millet were sown in a randomized block design with two replications during *kharif* 2017 at College of Agriculture Badnapur Dist. Jalna Maharashtra. The correlation study was undertaken in 158 genotypes of finger millet in order to find out interrelation of different yield components at genotypic and phenotypic level. The genotypic and phenotypic correlation coefficient for fifteen characters seed yield per plant had significant positive association with thousand grain weight, flag leaf sheath length, finger length, finger width, flag leaf sheath width, flag leaf blade width, finger number per panicle, calcium content and iron content is mainly because of increase in one or more of the above characters and selection of genotypes on the basis of these traits will be effective for yield improvement. Path coefficient analysis was carried out to find out the direct and indirect contribution from each of the characters towards seed yield per plant, path coefficient analysis. The genotypic correlation coefficients are being more important only partitioned to direct and indirect effects. The positive direct effect on seed yield per plant were observed for days to 50 per cent flowering (0.1543), flag leaf sheath length (0.1194), flag leaf blade width (0.1351), finger number per panicle (0.2248), finger length (0.1352), finger width (0.1207), days to maturity (0.0334), thousand grain weight (0.1621), calcium content (0.1621) and iron content (0.0283).

Keywords: Finger millet, correlation coefficient, path analysis

Introduction
Finger millet [*Eleusine coracana* (L.) Gaertn.] also known as African millet or *Ragi*, belongs to family Graminae or Poaceae and common name 'Finger millet' is derived from the finger-like branching of the panicle. It is a self pollinated, tetraploid (2n = 36) crop. The crop is native to the Ethiopian highlands of Central Africa and was introduced into Indian sub continent approximately 3000 years ago. The long history of cultivation of finger millet in India under diverse agro-climatic conditions and the associated human and natural selection has resulted in generation of large variability giving India the status of secondary centre of diversity. Finger millet is an important staple food in India. It is particularly high in the minerals calcium, iron, magnesium, phosphorous and potassium. Even though finger millet is not a traditional crop of Marathwada region efforts were made to grow important minor millet. Which is known as 'nutricereal' crop in this region, The first advance estimated area, production and productivity in Maharashtra *kharif* 2017-2018 total area 0.864 lakh ha, production 0.932 lakh tones and productivity 1078 kg/ha (Directorate of Agriculuture, Government of Maharashtra).
The original concept of correlation was given by Galton (1889) [8]. Path analysis is done with the main purpose of understanding the direct and indirect contribution of different characters towards grain yield. The direct contribution of each component to the yield and the indirect effects and its association with other characters cannot be differentiated by simple correlations. It was first developed and described by Wright (1921) as a tool in genetic analysis for deriving the direct and indirect effects of any set of variables themselves related to one another. Later it was employed for crop improvement by Dewey and Lu, (1959) [4]. The study of association among various traits is useful for breeders in selecting genotypes possessing groups of desired traits. It provides basis for selection of superior genotypes from the diverse breeding population. Seed yield is the product of interaction of component traits.

Apart from correlation studies, path coefficient analysis is important to obtain information about how the component characters influence the seed yield through each other.

Materials and Methods

The field experiment was conducted on the field of Section of Agricultural Botany, College of Agriculture, Badnapur. Experimental material comprises of 150 received from ICAR-NBPGR Regional station, Akola and 8 checks grown in two replication with randomized block design during *Kharif*, 2017. Each entry was represented by two rows of 3 meter length. The spacing of 30 cm within rows and 10 cm between the plants was followed. All recommended agronomical cultural practices were carried out to raise a good crop. Observation were recorded based on five randomly selected plants in each genotype in each replication for fifteen important morphological characters *viz.*, days to 50 per cent flowering, plant height (cm), productive tillers per plant, flag leaf sheath length (cm), flag leaf sheath width (cm), flag leaf blade length (cm), flag leaf blade width (cm), finger number per panicle, finger Length (cm), finger width (cm), days to maturity, thousand grain weight (g), seed yield per plant (g), calcium content (mg/100g), iron content (mg/100g).

Results and Discussion

Correlated characters are of interest for three chief reasons, firstly in connection with the genetic cause of correlation through the linkage and pleiotropic action of genes, secondly in connection with the change brought about by selections. It is important to know, how the improvement of one character will cause simultaneous changes in other characters and thirdly in connection with natural selection (Falconer, 1960).

In present investigation, the genotypic correlation seed yield per plant had significant positive association with thousand grain weight (0.4273), flag leaf sheath length (0.2558), finger width (0.2377), flag leaf sheath width (0.2322), flag leaf blade width (0.2066), finger number per panicle (0.1928), calcium content (0.1928), iron content (0.1476) and finger length (0.1460) is mainly because of increase in one or more of the above characters and selection of genotypes on the basis of these traits will be effective for yield improvement. Similar result were reported by Kebere *et al.* (2006) [14] for 1000 test weight, finger number per panicle, Ulaganathan and Nirmalakumari (2014) [19] for flag leaf sheath length, finger width, Bendale *et al.* (2002) [2], Sonnad (2005) [18], John (2007) [12] and Ganapathy *et al*., (2011) [9] for finger length.

Correlation of seed yield per plant with plant height (-0.1612) was negative and significant. Correlation of seed yield per plant with productive tillers per plant was negative at genotypic level, Similar result were reported by Anuradha *et al.* (2013) [1].

Correlation of seed yield per plant with days to 50% flowering (0.0271), days to maturity (0.0464) was non-significant and positive association at genotypic and phenotypic level. Similar result were reported by Dhamdhere *et al.* (2013) [5]. Productive tillers per plant had positive association with seed yield per plant at phenotypic level.

Path analysis provides basis for selection of superior genotypes from the diverse breeding population. Seed yield is the product of interaction of component traits. Apart from correlation studies, path coefficient analysis is important to obtain information about how the component characters influence the seed yield through each other.

It is evident from the data presented in Table 3 that positive direct effect on seed yield per plant were observed for days to 50 per cent flowering (0.1543), flag leaf sheath length (0.1194), flag leaf blade width (0.1351), finger number per panicle (0.2248), finger length (0.1352), finger width (0.1207), days to maturity (0.0334), thousand grain weight (0.1621), calcium content (0.1621) and iron content (0.0283), These traits should be taken into consideration in breeding high yielding varieties in finger millet through selection. Similar results recorded by Kumar *et al*., (2014) [15], Wolie and Dessalegn (2011) [20], Gani and Shinggu (2016) [11] and Kebere *et al.* (2006) [14].

Negative direct effect on seed yield per plant showed by the characters plant height (-0.2804), productive tillers per plant (-0.0124), flag leaf sheath width (-0.1165) and flag leaf blade length (-0.1165). Similar results recorded by Kumar *et al*., (2014) [15] for productive tillers per plant, Anuradha *et al.* (2013) [1] for plant height.

Negative indirect effect on seed yield per plant showed by the characters viz. plant height (-0.1612), productive tillers per plant (-0.0162) and flag leaf blade length (-0.0248) and on the basis of traits selection may not be done for enhancing yield in finger millet genotypes. Similar results were obtained by Kebere-Bezaweletaw *et al.*, (2006) [14] for productive tillers per plant.

Positive indirect effect on seed yield per plant was recorded by characters day to 50% flowering (0.0271), flag leaf sheath width (0.2322), flag leaf sheath length (0.2558), finger number per panicle (0.1998), flag leaf blade width (0.2066), finger length (0.1460), finger width (0.2377), days to maturity (0.0464), thousand grain weight (0.4273), calcium content (0.1928) and iron content (0.1476). Similar results were obtained by Jyothsna *et al*., (2016) [13], Gani *et al*., (2016) [10], Kumar *et al*., (2014) [15], Bothikar *et al*., (2014) [3], Lule *et al*., (2012) [16], Kebere-Bezaweletaw *et al.*, (2006) [14], Anuradha *et al.*, (2013) [1] and Manyasa *et al*., (2016) [17]

Table 1: Estimation of genotypic (above diagonal) correlation coefficients in finger millet.

SN	Days to 50% flowering	Plant height (cm)	Productive tillers per plant	Flag leaf sheath length (cm)	Flag leaf sheath width (cm)	Flag leaf blade length (cm)	Flag leaf blade width (cm)	Finger number per panicle
	1	2	3	4	5	6	7	8
1	1.0000	0.2656**	0.0683	-0.1476**	-0.0016	-0.1122*	0.0508	-0.2019**
2		1.0000	-0.0179	0.0912	-0.1322*	0.2217**	0.1968**	-0.0080
3			1.0000	-0.0667	-0.0927	0.0195	0.0419	-0.0013
4				1.0000	0.2004**	0.2529**	0.1625**	0.0760
5					1.0000	0.3290**	0.5940**	0.3677**
6						1.0000	0.4249**	0.2553**
7							1.0000	0.4649**
8								1.0000
9								
10								

11								
12								
13								
14								
15								

***** Significant at 5 % and ****** Significant at 1 % level of probability or level of significance,

SN	Finger length (cm)	Finger width (cm)	Days to maturity	Thousand grain weight (g)	Calcium content (mg/100gm)	Iron content (mg/100g)	Seed yield per plant
	9	10	11	12	13	14	15
1	-0.1062	-0.0146	0.9488**	0.0143	-0.1206*	-0.0165	0.0271
2	0.1935**	0.0311	0.2154**	-0.0445	0.1045	-0.1328*	-0.1612**
3	0.0527	-0.0135	0.0777	-0.0332	-0.1436*	0.0525	-0.0162
4	0.3952**	0.2055**	-0.1647**	0.2224**	0.0578	0.1072	0.2558**
5	0.3547**	0.2849**	-0.0097	0.0920	0.0728	0.0468	0.2322**
6	0.2659**	0.1480**	-0.1100	-0.1902**	-0.0192	0.0945	-0.0248
7	0.2708**	0.3413**	0.0493	-0.0373	0.0576	0.0523	0.2066**
8	0.2515**	0.0557	-0.1852**	-0.1742**	0.0867	0.0948	0.1998**
9	1.0000	0.1401*	-0.1324*	-0.0968	0.0676	0.1871**	0.1460**
10		1.0000	-0.0272	0.1768**	-0.0469	0.0012	0.2377**
11			1.0000	0.0434	-0.1073	-0.0076	0.0464
12				1.0000	0.1314*	0.0968	0.4273**
13					1.0000	-0.0752	0.1928**
14						1.0000	0.1476**
15							1.0000

***** Significant at 5 % and ****** Significant at 1 % level of probability or level of significance.

Table 2: Estimation of phenotypic (above diagonal) correlation coefficients in finger millet

SN	Days to 50% flowering	Plant height (cm)	Productive tillers per plant	Flag leaf sheath length (cm)	Flag leaf sheath width (cm)	Flag leaf blade length (cm)	Flag leaf blade width (cm)	Finger number per panicle
	1	2	3	4	5	6	7	8
1	1.0000	0.1457 **	0.0523	-0.1277 *	-0.0023	-0.1072	0.0512	-0.1893 **
2		1.0000	-0.0355	0.0815	-0.0718	0.1205 *	0.1246 *	-0.0182
3			1.0000	-0.0394	-0.0825	0.0266	0.0389	-0.0113
4				1.0000	0.1881 **	0.2222 **	0.1385 *	0.0520
5					1.0000	0.2755 **	0.5474 **	0.3405 **
6						1.0000	0.3669 **	0.2143 **
7							1.0000	0.4377 **
8								1.0000
9								
10								
11								
12								
13								
14								
15								

***** Significant at 5 % and ****** Significant at 1 % level of probability or level of significance.

SN	Finger length (cm)	Finger width (cm)	Days to maturity	Thousand grain weight (g)	Seed yield per plant	Calcium content (mg/100gm)	Iron content (mg/100g)
	9	10	11	12	13	14	15
1	-0.0985	0.0180	0.9271 **	0.0191	0.0225	-0.1179 *	-0.0163
2	0.0743	0.0165	0.1406 *	-0.0236	-0.0906	0.0588	-0.0735
3	0.0446	0.0127	0.0644	0.0080	0.0002	-0.1236 *	0.0412
4	0.3538 **	0.1488 **	-0.1368 *	0.1757 **	0.2076 **	0.0501	0.0941
5	0.3399 **	0.2257 **	-0.0091	0.0832	0.2150 **	0.0694	0.0452
6	0.2078 **	0.1187 *	-0.0953	-0.1662 **	-0.0344	-0.0162	0.0856
7	0.2551 **	0.2924 **	0.0499	-0.0421	0.1876 **	0.0545	0.0499
8	0.2322 **	0.0450	-0.1817 **	-0.1698 **	0.1876 **	0.0836	0.0912
9	1.0000	0.1189 *	-0.1275 *	-0.0821	0.1361 *	0.0627	0.1774 **
10		1.0000	-0.0240	0.1147 *	0.1854 **	-0.0382	0.0033
11			1.0000	0.0445	0.0434	-0.1064	-0.0080
12				1.0000	0.3954 **	0.1207 *	0.0882
13					1.0000	0.1873 **	0.1422 *
14						1.0000	-0.0747
15							1.0000

***** Significant at 5 % and ****** Significant at 1 % level of probability or level of significance,

Table 3: Direct and indirect effect of fifteen causal variables on seed yield in finger millet

SN	Days to 50 % flowering	Plant height (cm)	Productive tillers per plant	Flag leaf sheath length (cm)	Flag leaf sheath width (cm)	Flag leaf blade length (cm)	Flag leaf blade width (cm)	Finger number per panicle
	1	2	3	4	5	6	7	8
1	0.1543	0.0410	0.0105	-0.0228	-0.0002	-0.0173	0.0078	-0.0312
2		-0.2804	0.0050	-0.0256	0.0371	-0.0622	-0.0552	0.0022
3			-0.0124	0.0008	0.0012	-0.0002	-0.0005	0.0000
4				0.1194	0.0239	0.0302	0.0194	0.0091
5					-0.1165	-0.0383	-0.0692	-0.0428
6						-0.0249	-0.0106	-0.0064
7							0.1351	0.0628
8								0.2248
9								
10								
11								
12								
13								
14								
15								

SN	Finger length (cm)	Finger width (cm)	Days to maturity	Thousand grain weight (g)	Calcium content (mg/100gm)	Iron content (mg/100g)	correlation with seed yield/plant
	9	10	11	12	13	14	15
1	-0.0164	-0.0023	0.1464	0.0022	-0.0186	-0.0025	0.0271
2	-0.0543	-0.0087	-0.0604	0.0125	-0.0293	0.0372	-0.1612**
3	-0.0007	0.0002	-0.0010	0.0004	0.0018	-0.0007	-0.0162
4	0.0472	0.0245	-0.0197	0.0266	0.0069	0.0128	0.2558**
5	-0.0413	-0.0332	0.0011	-0.0107	-0.0085	-0.0055	0.2322
6	-0.0066	-0.0037	0.0027	0.0047	0.0005	-0.0024	-0.0248
7	0.0366	0.0461	0.0067	-0.0050	0.0078	0.0071	0.2066**
8	0.0566	0.0125	-0.0416	-0.0392	0.0195	0.0213	0.1998**
9	0.1352	0.0189	-0.0179	-0.0131	0.0091	0.0253	0.1460**
10		0.1207	-0.0033	0.0213	-0.0057	0.0001	0.2377**
11			0.0334	0.0015	-0.0036	-0.0003	0.0464
12				0.4021	0.0528	0.0389	0.4273**
13					0.1621	-0.0122	0.1928**
14						0.0283	0.1476**

Residual effect = 0.7850, Underlined figures indicate direct effect.

*, ** indicates significant at 5 and 1 % level of significant respectively

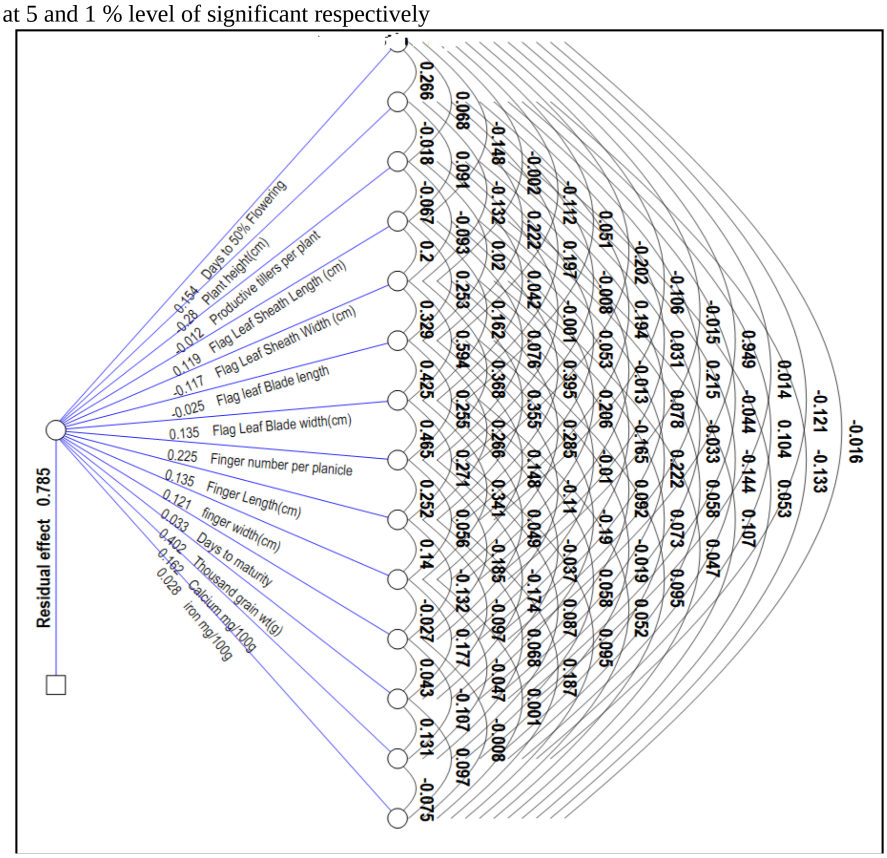

Fig 1: Genotypic path diagram for seed yield per plant (g) in finger millet.

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