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Correlation studies on seed quality traits in diverse genotypes of finger millet (*Eleusine coracana* (L.) Gaertn)

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A B S T R A C T

The thirty-five diverse genotypes of finger millet including three checks *viz*., PRM-1, PRM-2 and VL-149 for seed quality parameters at seed testing laboratory of the department of seed science and technology, College of Forestry, Ranichauri Campus, V. C. S. G. Uttarakhand University of Horticulture and Forestry. The data on 14 quantitative traits *viz.*, first count, standard germination, root length, shoot length, seedling length, seedling fresh weight, seedling dry weight, relative growth index, vigour index-I and vigour index-II were collected randomly from 10 seedlings form each genotypes. Genotype IC-308884 was highest for seedling length, vigour index-I and vigour index-II. Genotype IC-354383 was observed maximum germination percentage and relative growth index. Analysis of variance revealed highly significant among the germplasm for all the characters. Correlation studies revealed that all the traits of seed quality were associated with each other in terms of vigour. Seedling vigour-II exhibited very strong and positive correlation with seedling dry weight, seedling fresh weight and seedling vigour index-I while seedling vigour index-I showed highly significant and positive correlation with seedling length, root length, shoot length and standard germination. It is manifest that before assessment of seedling vigour, standard germination and seedling dry weight of the seed lots in any genotype could be used to envisage the yield potentiality of that genotype in open field conditions.

Introduction

Finger millet locally known as "Ragi" or "Madua" (*Eleusine coracana* L.) is the most important among small millets and possesses the potentialities to be exploited to meet crying need of dry land farmers (Kumari *et al.,* 2015). Finger millet (*Eleusine coracana* (L.) Gaertn. 2n=4x=36) belongs to the family *Poaceae*, and is widely cultivated in the arid and semi-arid regions of the world. The term *Eleusine* is derived from Eleusis, an old epic city sacred to Demater, the greek deity presiding over agriculture. The term coracana is derived from kurukkan, the singhali name of the grain. It is cultivated mostly as a rainfed crop for its valued food grains, dry fodder and adaptability to wide range of geographical areas (Ulaganathan and Nirmalkumari, 2014). Ragi is commonly called as "Nutritious millet" as the grains are nutritionally superior to many cereals. It contains almost all the nutrients like protein (9.2 per cent), carbohydrates (76.32 per cent) and fat (1.29 per cent). It is very rich in minerals (2.70 per cent) such as calcium (452mg/1000g), iron (3.90 mg/100g) and ash (3.90 per cent) which are the core ingredients of normal human diet (Pandey and Kumar, 2005; Negi *et al.,* 2017). Being rich in protein, iron and calcium, finger millet severs as an important staple food for rural populations in developing tropical countries where calcium deficiency and anaemia are widespread (Owere *et al.,* 2015).

High quality seed is essential and desirable to ensure good crop establishment. For many field crops, one of the main problems observed is poor crop stand establishment of which is influenced by seed quality, adverse climatic condition, poor field management etc. (Maiti *et al.,* 2002). Establishment of seedling is extremely important in determining the yield of crop in short period of time (Misra, 1990 and Misra *et al.,* 2002). The rate and degree of seedling establishment are extremely important factors in determining both yield and time of maturity (Briggs & Aylenfishu, 1979). Therefore, seed quality evolution is essential for a plant breeder to enhance the yield. Seed is the essential element in agriculture upon which the success of any crop production programme depends. Thus, seed quality testing has a great importance for the evaluation of varietal superiority in the given environment (Kumar *et al.,* 2015). Laboratory seed tests aim to provide accurate and reproducible guidance, rather than absolute answers or predictions. Viability, germination and vigour tests all produce results that are usually greater than, and at best equal to, how the seed will actually perform in the field. An appreciation of what viability, germination and vigour measure can help and maximize the understanding of the planting value or storage potential of seed (Kumar *et al.,* 2017).

Materials and methods

The experiment material for the present study was taken to evaluate thirty-five genotypes of finger millet including three checks PRM-1, PRM-2 and VL-149. The experiment was conducted in the seed testing laboratory of the Department of Seed Science and Technology, College of Forestry, V. C. S. G. Uttarakhand University of Horticulture and Forestry. In the present study fifty seeds in four replication were germinated on top of the paper at 25^0C in seed germinator for 14 days. The papers were moistured with 0.2% KNO_3 solution instead of water to break seed dormancy (ISTA, 1996). At final day of germination normal seedling counted which determine the germination percentage. For the determination of seedling length. Ten seedlings were taken from each replication in all the treatment. Theses seedlings were measured with help of scale. Seed vigour index determined with the multiplication of seed germination and

seedling length. For the determination of seedlings vigour 10 seedlings in each replication in all the varieties were dried at 80^0C for twenty four hours in oven. The standard germination test was conducted according to rule of International Seed Testing Association and normal seedlings were expressed as percent germination. Seed vigour index was calculated according to the method (Abdul and Anderson, 1973).

Result and Discussion

Analysis of variance

Analysis of variance revealed highly significant among the germplasm for all the characters such as first count (%), standard germination (%), shoot length (cm), seedling length (cm), seedling fresh weight (g), seedling dry weight (g), relative growth index (RGI), seedling vigour index-I and seedling vigour index-II were presented in Table 1. The mean for the characters were significantly different for all finger millet genotypes.

Mean performance of genotypes for seed quality traits

The genotypes IC-308884 was highest for seedling length, vigour index-I and vigour index-II while the genotype IC-354383 was highest for maximum germination percentage (), relative growth index and mean daily germination. The mean value of various quality parameters for finger millet genotypes in given in Table 2.

The germination per cent one of the most important characteristics of seed to be used for estimation of planting value. Germination seems to be biological process depending on several factors including the differential behaviour of genotypes.

The difference might be due to the genetic makeup of each genotypes. Similar results also reported by Krishnanappa *et al.,* (2001) from 23.00 % to 86.0 % in finger millet and Tzortzakis (2009) from 73.00 % to 91.00%, Kumar *et al.,* (2015) from 44.25 % to 93.75 % in grain amaranth.

Correlation studies

Correlation coefficient which provides symmetrical measurement of degree of association between two variables or characters, help us in understanding the nature and magnitude of association among yield and yield components. The assessment of seed viability and vigour traits by growing the seed samples of different genotypes in the laboratory condition before sowing in main field and further estimation of performance in field conditions enables to establish relationship between seed quality parameters and field performance. With the help of such relations, the potentiality of seed lot of a genotype could be assumed in advance (Panwar *et al.,* 2018). The estimates of correlation coefficients among different pairs of seed quality traits have been presented in Table 3.

The results showed that seedling length exhibited highly significant and positive correlation with root length (0.9484), shoot length (0.8860) and significant positive correlation with first count (0.3746) and standard germination (0.3479) while seedling vigour index-II showed highly significant positive association with seedling dry weight (0.9338), seedling fresh weight (0.6010), seedling vigour index-I (0.4672) and significant positive association with root length (0.4148), seedling length (0.3859) and standard germination (0.3741).

Relative growth index (RGI) showed highly significant and positive correlation with first count (0.9286) followed by standard germination (0.6640), seedling vigour index-I

(0.5421) and significant positive correlation with shoot length (0.3569) and seedling length (0.3478).

Seedling vigour index–I possessed highly significant positive association with seedling length (0.9132), root length (0.8542), shoot length (0.8286), standard germination (0.6929) and first count (0.6580) while standard germination showed highly significant and strong positive correlation with first count (0.8808). Seedling dry weight showed highly significant and positive correlation with seedling fresh weight (0.7273) while shoot length possessed higher positive and significant correlation with root length (0.6958) and significantly positive correlation with first count (0.3794) and standard germination (0.3727). Seedling fresh weight showed highly significant and positive association with seedling length (0.4578) and root length (0.4555). However, root length observed significant positive association with first count (0.3271). Similar results were also observed by Yadav and Dhankar, 2001; Deshraj, 2002; Punia *et al.,* (2006); Kumar *et al.*, (2017) and Panwar *et al.,* (2018).

Table.1 Analysis of Variance (ANOVA) for seed quality traits of finger millet genotypes

Characters	Mean sum of square (MSS)	
	Treatment	Error
Degree of freedom	34	105
First count (%)	150.94**	2.41
Standard germination (%)	165.22**	4.44
Root length (cm)	3.04**	0.00086
Shoot length (cm)	1.39**	0.00352
Seedling length (cm)	7.27**	0.00744
Seedling fresh weight (g)	0.00410**	0.000075
Seedling dry weight (g)	0.00149**	0.00000668
Relative growth index (RGI)	88.09**	5.90
Seedling Vigour Index-I	86631.53**	462.17
Seedling Vigour Index-II	11.06**	0.1261

* Significant at 0.5 % level; ** Significant at 0.0 1 % level

Table.2 Mean performance of finger millet (*Elusine coracana* (L.) Gaertn.) genotypes for seed quality traits

S.No.	Characters Genotypes	First count (%)	Standard germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Seedling Vigour Index-I	Seedling Vigour Index-II	Relative growth index (RGI)
1	IC-308917	38.66	86.00	5.08	3.64	8.73	0.179	0.060	751.06	5.16	44.62
2	IC-520490	41.33	88.66	5.72	4.23	9.95	0.185	0.087	882.85	7.01	46.62
3	EC-130783	29.33	76.66	6.34	3.40	9.93	0.265	0.125	761.52	9.58	38.25
4	IC-308905	35.33	78.66	6.05	4.05	10.10	0.192	0.080	794.82	6.32	44.96
5	IC-354317	36.00	79.33	5.55	3.49	9.05	0.173	0.046	717.72	3.67	45.40
6	IC-3522490	30.66	72.66	5.64	3.67	9.31	0.181	0.074	677.02	5.40	42.16
7	IC-3543177	26.66	70.00	5.96	3.99	9.96	0.287	0.131	690.59	9.10	38.51
8	EC-3522489	37.33	82.00	6.99	4.43	11.43	0.212	0.092	937.47	7.62	45.56
9	EC-522489	40.66	85.33	5.77	4.03	9.80	0.197	0.087	836.48	7.47	47.72
10	IC-308771	37.66	86.66	5.02	3.63	8.65	0.153	0.069	750.27	6.16	43.03
11	IC-354384	28.66	70.66	4.77	2.20	6.97	0.162	0.082	493.06	5.82	40.70
12	EC-522482	33.33	80.66	4.71	3.63	8.34	0.179	0.065	673.43	5.52	41.31
13	IC-354422	45.33	89.33	6.13	4.10	10.24	0.200	0.091	914.79	8.16	50.75
14	IC-308853	25.33	71.33	4.33	3.06	7.40	0.145	0.088	528.08	6.27	35.53
15	IC-354383	52.66	96.66	7.22	3.97	11.21	0.161	0.087	1083.67	8.47	54.47
16	IC-354381	33.00	82.66	4.87	3.77	8.64	0.207	0.093	714.56	7.74	40.88
17	EC-522488	36.66	84.00	5.08	4.01	9.31	0.169	0.064	782.66	5.38	43.66
18	IC-354410	34.00	74.66	6.97	4.01	10.99	0.208	0.069	820.35	5.15	45.72
19	IC-308928	40.00	84.66	6.07	3.54	9.61	0.185	0.085	794.69	7.20	45.83
20	IC-257855	42.66	88.00	4.10	3.08	7.18	0.128	0.078	632.26	6.86	48.49
21	IC-257863	34.66	78.00	5.22	3.12	8.34	0.188	0.074	650.98	5.79	43.64
22	IC-308899	32.66	73.33	5.99	4.10	10.10	0.152	0.064	740.98	4.72	44.57
23	IC-308916	31.33	74.00	6.04	3.82	9.86	0.193	0.065	729.64	4.67	42.35
24	IC-308849	34.66	83.33	6.36	3.97	10.33	0.224	0.104	861.31	8.69	41.65
25	IC-308884	47.33	91.33	7.89	5.00	12.89	0.245	0.125	1177.85	11.47	53.89

26	**IC-308883**	38.66	87.33	5.92	3.96	9.88	0.154	0.070	863.44	6.14	44.27
27	**IC-308853**	30.66	81.33	5.65	3.89	9.54	0.163	0.063	788.98	5.21	39.69
28	**IC-308868**	26.66	77.33	6.38	3.26	9.65	0.169	0.068	746.45	5.25	34.48
29	**IC-308878**	41.33	86.00	5.59	3.05	8.64	0.164	0.063	743.04	5.41	48.05
30	**EC-522495**	42.00	86.66	6.71	4.79	11.50	0.183	0.057	996.94	4.94	48.44
31	**IC-354407**	30.00	80.00	6.97	4.99	11.96	0.195	0.069	973.02	5.61	36.88
32	**EC-522485**	36.66	85.33	6.60	4.15	10.68	0.179	0.084	919.05	7.28	42.63
33	**PRM-1©**	31.33	84.66	6.11	3.07	9.19	0.173	0.091	796.77	7.91	36.12
34	**PRM-2©**	42.00	90.00	7.35	4.70	12.50	0.187	0.095	1084.78	8.58	46.66
35	**VL-149©**	35.00	82.66	5.44	3.50	8.94	0.190	0.086	739.41	7.15	45.19
	GM	36.00	82.00	5.90	3.81	9.72	0.186	0.081	801.43	6.65	43.79
	CV (%)	4.31	2.57	0.49	1.55	0.88	4.655	3.184	2.68	5.33	5.55
	SEM(±)	0.77	1.05	0.01	0.02	0.04	0.004	0.001	10.74	0.17	1.21
	CD at 5%	2.18	2.95	0.04	0.08	0.12	0.012	0.003	30.14	0.49	3.40
	Lowest	25.33	70.00	4.10	2.20	6.97	0.128	0.057	493.06	4.67	34.48
	Highest	52.66	96.66	7.89	4.99	12.89	0.287	0.131	1177.85	11.47	54.47

Table.3 Estimation of correlation coefficient between all the seed quality traits in Finger millet (*Elusine coracana* (L.) Gaertn.) genotypes

Characters	**Standard germination (%)**	**Root length (cm)**	**Shoot length (cm)**	**Seedling length (cm)**	**Seedling fresh weight (g)**	**Seedling dry weight (g)**	**Seedling Vigour Index-I**	**Seedling Vigour Index-II**	**Relative growth index (RGI)**
First count (%)	0.8808**	0.3271*	0.3794*	0.3746*	-0.1275	0.0219	0.6580**	0.3161	0.9286**
Standard germination (%)		0.2886	0.3727*	0.3479*	-0.1747	0.0400	0.6929**	0.3741*	0.6640**
Root length (cm)			0.6958**	0.9484**	0.4555**	0.3162	0.8542**	0.4148*	0.3018
Shoot length (cm)				0.8860**	0.3560*	0.1432	0.8286**	0.2614	0.3569*
Seedling length (cm)					0.4578**	0.2719	0.9132**	0.3859*	0.3478*
Seedling fresh weight (g)						0.7273**	0.2632	0.6010**	-0.0490
Seedling dry weight (g)							0.2349	0.9338**	0.0072
Seedling Vigour Index-I								0.4672**	0.5421**
Seedling Vigour Index-II									0.2322

******significant at 1% level of significance
*****significant at 5% level of significance

An overview of the experimental results of present investigation indicated a wide spectrum of variation with respect to seed quality parameter among all the thirty five diverse genotypes of finger millet. The analysis of variance revealed highly significant among the genotypes for all the seed quality traits. Genotype IC-308884 showed highest seedling length, vigour index-I and vigour index-II among all the genotypes. Correlation coefficient depicts that the prior assessment of standard germination, seedling dry weight and seedling vigour index of the seed lot in any genotype could be used to predict the yield potentiality of that genotype in open field conditions.

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