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Identification of biofortified genotypes of pearl millet [*Pennisetum glaucum* (L.) R. Br.]

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Abstract
The present investigation was undertaken to examine different 50 genotypes pearl millet for determination of biofortified genotypes. The biochemical analysis of parameters was carried out for protein content (g), Iron content (ppm) and zinc content (ppm). It was reported after the analysis the genotype ICMB-13444 was found biofortified.

Keywords: Pearl millet, biofortification, genotypes, food security

1. Introduction
The Pearl Millet is climate resilient and most predominant food source of rural people. While facing challenges like increasing population there is a need of meeting demand of food as well as nutritional security of country. Biofortification is one of the most important processes to avoid 'hidden hunger'. Biofortification is process of increasing the micronutrient content of crop through selective breeding, genetic modification and enriched agronomical cultivation practices. Deficiency of protein, zinc and iron is affecting more than 2 billion people globally and the problem is common in pregnant women and children below age of 5. Anemia is caused due to deficiency of iron (Fe) commonly found in poor countries who consume low quality diet. Possibly it may cause child mortality and physiological disorder (Tako *et al.,* 2015) [2]. Zinc is also one of the important micronutrients which is required for proper growth. Zinc deficiency may cause stunting, increased susceptibility to many infectious diseases, mortality and lowers the mental health.

2. Material and Methods
The field experiment was conducted at the Bajara Research Scheme, College of Agriculture, Dhule, M.S. (India) during *Kharif* 2021. The experiment was carried out under randomized block design with two replications and having 50 genotypes in each replication.

Protein content (%)
The protein content in dry seed per Treatment was determined by estimating the organic nitrogen through the Kjeldahl method outlined. The Seeds sample from each five selected plants per genotype were bulked and seeds are grinded in a mixer grinder and 0.2 g of grinded samples were analyzed in the laboratory for nitrogen content by wet digestion method with the help of Hot plate, further distillated the sample and titrate it with sulphuric acid to calculate nitrogen percentage at department of Soil Science and Agriculture chemistry, College of Agriculture, Dhule. Afterword's per cent protein was calculated by using formula;

Protein (%) = Nitrogen % x 6.25 (For other foods, Thimmaiah, 1999).

Iron content (ppm)
The iron content of all the genotypes of pearl millet were estimated by Atomic Absorption Spectro-Photometer method by using digested aliquot samples of grain same as per protein content.

Zinc Content (ppm)
The zinc content of all the genotypes of pearl millet were estimated by Atomic Absorption Spectro- Photometer method by using digested aliquot samples of grain as like digested sample of protein.

3. Result and Discussion

Iron Content (PPM)

The genotypes exhibited population mean of 68.72 ppm in respect of iron content. The genotypes DHLB-36B (82.21 ppm), DHLB-21B (82.21 ppm), DHLB-31B (82.23 ppm), DHLB-27B (82.37 ppm), DHLB-28B (84.31 ppm), PBLN-2021-212 (85.38 ppm), DHLB-32B (86.16 ppm), DHLB-35B (86.81 ppm), PBLN-2021-209 (88.57 ppm), ICMB-10889 (105.84 ppm), and ICMB-13444 (114.13 ppm) exhibited the maximum limit of iron content. (Table 1 and 2).

Zinc Content (PPM)

The population mean in respect of zinc content was 49.30 ppm. The maximum zinc content was observed in genotypes *viz*, PBLN-2021-210 (56.25 ppm), DHLB-17B (57.19 ppm), PBLN-2021-204 (59.53 ppm), DHLB-23B (60.02 ppm), ICMB-10889 (60.13 ppm), ICMB-13444 (62.32 ppm). (Table 1 and 2).The significantly highest iron and zinc content was recorded by the genotype ICMB-13444 while highest protein content was observed in genotype DHLB-37B (20.91%). The results are in agreement with Anuradha *et al*, 2017 [1].

Protein percent

The general population mean for the protein content of grains was 9.33%. It ranges from 6.12% to12.78%. Significantly low protein content was recorded by the genotype DHLB-8B (6.12%) and DHLB-33B (6.12%) followed by DHLB-23B (6.56%), S-21/16(6.56%), S-21/19(6.56%), ICMB-9544 (6.56%), and PBLN-2021-211(6.56%). Significantly higher protein content was recorded by the genotype DHLB-37B (12.78%) followed by S-20/01 (12.69%) (Table 1 and 2).

Table 1: Iron, zinc and protein content in different genotypes

Sr. No.	Genotype	Iron content mg/100 (g)	Zinc content mg/100 (g)	Protein content (%)	Sr. No.	Genotype	Iron content mg/100 (g)	Zinc content mg/100 (g)	Protein content (%)
1	DHLB-10B	44.59	31.63	7.44	26	S-21/07	59.28	42.30	7.87
2	ICMB-13444	114.13	62.32	10.98	27	S-21/08	68.01	52.03	10.94
3	ICMB-10889	105.84	60.13	10.06	28	S-21/09	65.04	52.71	8.31
4	DHLB-8B	75.42	43.01	6.12	29	S-21/10	43.67	48.78	9.19
5	DHLB-14B	72.75	45.64	10.94	30	S-21/11	47.59	50.21	8.75
6	DHLB-15B	67.07	49.36	8.75	31	S-21/12	64.66	51.87	9.19
7	DHLB-16B	68.15	48.26	10.94	32	S-21/13	50.63	44.68	10.06
8	DHLB-17B	61.06	57.19	11.81	33	S-21/14	60.95	51.53	8.31
9	DHLB-21B	82.21	55.57	10.50	34	S-21/15	66.63	43.98	10.94
10	DHLB-23B	73.84	60.02	6.56	35	S-21/16	40.33	43.84	6.56
11	DHLB-24B	74.33	51.19	8.31	36	S-21/17	74.17	46.98	8.31
12	DHLB-27B	82.37	54.40	10.06	37	S-21/18	62.63	48.42	10.94
13	DHLB-28B	84.31	51.89	8.31	38	S-21/19	69.69	43.93	6.56
14	DHLB-31B	82.23	55.79	7.44	39	S-21/20	76.60	46.05	10.94
15	DHLB-32B	86.16	50.53	10.94	40	ICMB-9544	33.52	27.38	6.56
16	DHLB-33B	77.50	51.66	6.12	41	PBLN-2021-203	68.63	43.15	9.19
17	DHLB-35B	86.81	49.18	11.81	42	PBLN-2021-204	75.88	59.53	11.81
18	DHLB-36B	82.21	49.03	10.06	43	PBLN-2021-205	67.26	48.99	8.31
19	DHLB-37B	75.18	52.01	12.78	44	PBLN-2021-206	70.08	44.14	10.94
20	S-20/01	65.21	44.71	12.69	45	PBLN-2021-207	71.14	55.80	8.31
21	S-21/02	59.51	46.10	9.19	46	PBLN-2021-208	75.32	47.18	10.94
22	S-21/03	60.05	46.58	10.06	47	PBLN-2021-209	88.57	51.86	9.62
23	S-21/04	55.18	47.51	10.94	48	PBLN-2021-210	74.03	56.25	8.31
24	S-21/05	57.39	54.11	7.00	49	PBLN-2021-211	38.07	49.95	6.56
25	S-21/06	44.55	45.79	10.06	50	PBLN-2021-212	85.38	49.73	9.19
						Mean	68.72	49.30	9.33
						S.E.	1.74	1.41	0.47
						C.D. 5%	4.94	4.02	1.35
						C.V.	3.58	4.05	7.20

Table 2: Classification of genotypes for different traits on the basis of population mean and critical differences ($\bar{X}$± C.D. at 5%)

Sr. Number	Name of characters	Specifications		
1	Iron content (ppm) Mean=68.72 C.D. at 5% =4.94	Low (< 63.78)	Medium(63.78-73.66)	High (> 73.66)
		DHLB-10B (44.59), DHLB-17B (61.06), S-21/02 (59.51), S-21/03 (60.05), S-21/04 (55.18), S-21/05 (57.39), S-21/06 (44.55), S-21/07 (59.28), S-21/10 (43.67), S-21/11 (47.59), S-21/13 (50.63), S-21/14 (60.95), S-21/16 (40.33), S-21/18 (62.63), ICMB-9544 (33.52), PBLN-2021-211 (38.07)	DHLB-14B (72.75), DHLB-15B (67.07), DHLB-16B (68.15), S-20/01(65.21),S-21/08 (68.01), S-21/09 (65.04), S-21/12 (64.66), S-21/15 (66.63) PBLN-2021-203 (68.63), S-21/19 (69.69), PBLN-2021-205 (67.26), PBLN-2021-206 (70.08), PBLN-2021-207 (71.14)	ICMB-13444 (114.13), ICMB-10889 (105.84), DHLB-8B (75.42), DHLB-21B (82.21), DHLB-23B (73.84), DHLB-24B (74.33), DHLB-27B (82.37), DHLB-28B (84.31),DHLB-31B (82.23),DHLB-32B (86.16), DHLB-33B (77.50), DHLB-35B (86.81), DHLB-36B (82.21), DHLB-37B (75.18), S-21/17 (74.17), S-21/20 (76.60), PBLN-2021-204 (75.88), PBLN-2021-208 (75.32), PBLN-2021-209 (88.57), PBLN-2021-210 (74.03),PBLN-2021-212 (85.38)
	No of genotypes	16	13	21
	Frequency percentage	32	26	42
2	Zinc content (ppm) Mean=49.30 C.D. at 5% =4.02	Low (<45.28)	Medium (45.28-53.32)	High (>53.32)
		DHLB-10B (31.63), DHLB-8B (43.01), S-21/07 (42.30), S-21/13 (44.68), S-21/15 (43.98), S-21/16 (43.84), S-21/19 (43.93), ICMB-9544 (27.38), PBLN-2021-203 (43.15), PBLN-2021-206 (44.14), S-20/01 44.71	DHLB-14B (45.64), DHLB-15B (49.36), DHLB-16B (48.26), DHLB-24B (51.19), DHLB-28B (51.89), DHLB-32B (50.53), DHLB-33B (51.66), DHLB-35B (49.18), DHLB-36B (49.03), DHLB-37B (52.01), S-21/02 (46.10), S-21/03 (46.58), S-21/04 (47.51), S-21/06 (45.79), S-21/08 (52.03), S-21/09 (52.71), S-21/10 (48.78), S-21/11 (50.21), S-21/12 (51.87), S-21/14 (51.53), S-21/17 (46.98), S-21/18 (48.42), S-21/20 (46.05), PBLN-2021-205 (48.99), PBLN-2021-208 (47.18), PBLN-2021-209 (51.86), PBLN-2021-211 (49.95), PBLN-2021-212 (49.73)	ICMB-13444 (62.32), ICMB-10889 (60.13), DHLB-17B (57.19), DHLB-21B (55.57), DHLB-23B (60.02), DHLB-27B (54.40), DHLB-31B (55.79), S-21/05 54.11 PBLN-2021-204 (59.53), PBLN-2021-207 (55.80), PBLN-2021-210 (56.25)
	No of genotypes	11	28	11
	Frequency percentage	22	56	22
3	Protein content (%) Mean=9.33 C.D. at 5% = 1.35	Low (< 7.98)	Medium (7.98-10.68)	High(>10.68)
		DHLB-10B (7.44), DHLB-8B (6.12), DHLB-23B (6.56), DHLB-31B (7.44), DHLB-33B (6.12), S-21/05 (7.00), S-21/07 (7.87), S-21/16 (6.56), S-21/19 (6.56), ICMB-9544 (6.56), PBLN-2021-211 (6.56)	ICMB-10889(10.06), DHLB-15B (8.75), DHLB-21B (10.50), DHLB-24B (8.31), DHLB-27B (10.06), DHLB-28B (8.31), DHLB-36B (10.06), S-21/02 (9.19), S-21/03 (10.06), S-21/06 (10.06), S-21/09 (8.31), S-21/10 (9.19), S-21/11 (8.75), S-21/12 (9.19), S-21/13 (10.06), S-21/14 (8.31), S-21/17 (8.31), PBLN-2021-203 (9.19), PBLN-2021-205 (8.31), PBLN-2021-207 (8.31), PBLN-2021-209 (9.62), PBLN-2021-210 (8.31), PBLN-2021-212 (9.19)	ICMB-13444 (10.98), DHLB-14B (10.94) DHLB-16B (10.94), DHLB-17B (11.81), DHLB-32B (10.94), DHLB-35B (11.81), DHLB-37B (12.78), S-20/01 (12.69) ,S-21/04 (10.94), S-21/08 (10.94), S-21/18 (10.94), S-21/15 (10.94), S-21/20 (10.94), PBLN-2021-204 (11.81), PBLN-2021-206 (10.94), PBLN-2021-208 (10.94)
	No of genotypes	11	23	16
	Frequency percentage	22	46	32

Identification of promising lines for different characters of pearl millet on RBD

An evaluation of 50 genotypes, of pearl millet for different traits with randomized block design revealed valuable genotypes of various characters for specific breeding objectives. While for selection of traits 1000 seed weight (g), Protein content (%),Iron content (ppm),Zinc content (ppm) the genotypes ICMB-13444 (14.2), DHLB-37B (12.78), ICMB-13444 (114.13), ICMB-13444 (62.32) found superior respectively, and there was not found any at par genotypes for respective traits (Table No.3)

Table 3: Promising Lines Identified for Different Characters in Pearl Millet

Sr. No.	Characters	Specification	Most Promising genotypes (At Par)
1	Days to 50 per cent flowering	< 57.18	PBLN-2021-208 (53), PBLN-2021-212 (53.5), PBLN-2021-205 (54), DHLB-36B (55.5), DHLB-28B (56.5), PBLN-2021-206 (56.5)
2	Days to maturity	<84.74	S-21/13 (66), S-21/05 (67),S-21/06(67), ICMB-9544 (67.5), S-21/12 (68)
3	Plant height at maturity (cm)	<123.68	PBLN-2021-206 (76.67), PBLN-2021-208 (77.27), PBLN-2021-205 (81.42), PBLN-2021-210 (82.42), PBLN-2021-211 (88.03), S-21/13 (89.5), PBLN-2021-209 (90.51), PBLN-2021-204 (90.87), S-21/05 (92.5),S-21/06(93.5)
4	Productive tillers per plant	>3.06	ICMB-10889 (3.6),DHLB-24(3.7), ICMB-13444 (4),DHLB-23B (4.35)
5	Panicle girth (cm)	>13.79	ICMB-13444(21.34)
6	Panicle length (cm)	>21.56	S-21/05 (22.52), S-21/08 (22.53), S-21/13 (22.72), S-21/06 (23.33), S-21/11 (23.45), DHLB-10B (23.5),S-21/09 (24.83),S-21/07(24.87)
7	1000 seed weight (g)	>10.26	ICMB-13444 (14.2)
8	Protein content (%)	>10.68	DHLB-37B (12.78)
9	Iron content (ppm)	>73.66	ICMB-13444 (114.13)
10	Zinc content (ppm)	>53.32	ICMB-13444 (62.32)
11	Grain Yield per plant (g)	>51.98	DHLB-10B (111.17), ICMB-13444 (112.02)
12	Blast severity (%)	<8.80	S-21/05 (1.00),S-21/06 (1.00),S-21/18(1.00), DHLB-27B (1.50),DHLB-36B (1.50),S-21/07(1.50), S-21/11 (1.50),S-21/15 (1.50), DHLB-37B (2.00), S-21/04 (2.00), S-21/08 (2.00), S-21/13(2.50)
13	Downey Mildew (%)	<13.18	S-21/05 (1.00), PBLN-2021-203(1.00), PBLN-2021-206 (1.00), DHLB-31B (1.00),ICMB-9544(1.00), S-21/19 (2.16), S-21/17 (2.16), PBLN-2021-204 (2.67), PBLN-2021-211 (2.67), S-21/07 (2.88), S-21/10 (2.88), DHLB-16B (3.00), PBLN-2021-212 (4.44), S-21/20 (4.67), S-21/18 (6.81)

4. Conclusion

The genotype ICMB-13444 exhibited significantly superior iron and zinc content and hence the genotype is suitable in view of nutritional security to overcome the malnutrition problems especially in females. The genotype DHLB-37B (12.78) exhibited significantly superior for protein content hence the genotype is suitable in view of nutritional security to overcome malnutrition.

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