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Potential survey of Iranian hexaploid landraces and modern cultivated bread wheat for iron, zinc, phytate, and phytate/mineral molar ratio

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Supplementary Tables and Figures

Table S1**.** Analysis of variance and cluster means for Fe, Zn, phytate, and phytate:Fe and phytate:Zn ratios of 109 hexaploid landraces and modern bread wheat cultivars

SOV	df	Mean square			
		Fe [mg/100g]	Phytate:Fe molar ratio	Zn [mg/100g]	Phytate:Zn molar ratio
Cluster	2	226.522**	2685.87**	30.134**	3868.434**
Error	106	3.005	18.699	0.344	27.456
		Means ± SE			
Cluster	1	5.871^{c} ± 0.923	34.453^{c} ± 0.724	5.595^{a} ± 0.122	37.272^{a} ± 0.604
	2	8.179^{b} ± 0.127	22.093^{b} ± 0.368	4.578^{b} ± 0.063	47.427^{b} ± 0.697
	3	12.257^{a} ± 0.174	14.057^{a} ± 1.171	3.549^{c} ± 0.060	60.737^{c} ± 1.517

**significant at $p \leq 0.01$

Values in columns denoted by different letters are significantly different at $p \leq 0.01$.

Table S2**.** Analysis of variance for 10 traits in 14 selected hexaploid landraces (8 low-Fe and 6 high-Fe) at 42 and 70 days after planting (DAP)

	SOV	df	Mean squares									
			RL [m]	RDW [mg]	SDW [mg]	LDW [mg]	Chl a [mg/g]	Chl b [mg/g]	Chl (a+b) [mg/g]	Carotene [mg/g]	Carotenoids [mg/g]	Fv:Fm *100
42-DAP	Hexaploid Landraces	13	0.010**	5.12^{ns}	5.09**	378.96^{ns}	0.090^{ns}	0.013*	0.197*	0.729*	0.716*	4.39^{ns}
	Replication	2	0.004^{ns}	9.60*	3.91^{ns}	421.96^{ns}	0.117^{ns}	0.010^{ns}	0.226^{ns}	0.957^{ns}	0.941^{ns}	6.06^{ns}
	Error	26	0.003	2.709	1.24	180.21	0.047	0.006	0.093	0.336	0.330	3.26
70-DAP	Hexaploid Landraces	13	0.011**	1758.24**	7.86	1755.80^{ns}	0.88**	0.013**	0.180**	0.760**	0.740**	4.38^{ns}
	Replication	2	0.015^{ns}	302.38^{ns}	0.14^{ns}	444.91^{ns}	0.007^{ns}	0.005	0.040^{ns}	0.190^{ns}	0.190^{ns}	6.06^{ns}
	Error	26	0.003	504.95	3.18	936.57	0.017	0.002	0.040	0.140	0.140	3.25

*,**significance at $p \leq 0.05$ and $p \leq 0.01$

Abbreviations: RL = root length, RDW = root dry weight; SDW: stem dry weight, LDW = leaf dry weight, Chl = chlorophyll

Table S3. Root and leaf Fe concentrations in 14 selected hexaploid landraces at 42 and 70 days after planting (DAP)

Hexaploid landraces	42-DAP		70-DAP	
	Root Fe [mg/100 g]	Leaf Fe [mg/100 g]	Root Fe [mg/100 g]	Leaf Fe [mg/100 g]
Halekhani	7.11	8.76	14.22	7.49
Sarouq 4	6.64	5.21	7.15	9.74
Malayer 1	6.00	7.92	11.36	11.80
Eskan Arak 2	8.42	9.56	10.51	10.42
Hoseinabad Arak	5.61	6.87	13.42	17.39
Mashhad 3	9.09	10.54	12.57	9.88
Khoramabad Khouzestan	5.01	8.88	10.26	7.24
Qahqahe Sarouq	5.99	6.22	12.73	11.30
Valadkhani 2	6.39	9.50	12.55	11.06
Posht Tonok Pariyan 2	1.79	14.19	9.38	10.02
Koure Save1	5.37	6.74	11.96	8.28
Mashhad 6	6.17	8.89	10.58	8.14
Hajiabad Kermanshah	4.88	9.89	15.78	10.28
Mashhad 12	6.39	7.93	12.30	10.96

Table S4. Analysis of variance and cluster means for eight traits in 14 selected hexaploid landraces (8 low-Fe and 6 high-Fe) at 42 days after planting (DAP)

	SOV	df	Mean Squares							
			RL [m]	RDW [mg]	SDW [mg]	LDW [mg]	Chl(a+b) [mg/g]	Root Fe [mg/100 g]	Leaf Fe [mg/100 g]	Fv:Fm *100
42-DAP	Cluster	2	0.010*	154.19*	83.75*	371.33*	0.084^{ns}	10.23*	10.58^{ns}	0.452^{ns}
	Error	11	0.002	25.30	19.14	81.77	0.062	1.58	3.81	1.645
			Mean ± SE							
	Cluster	1	0.432^{a} ± 0.019	27.03^{a} ± 2.52	16.36^{a} ± 2.89	50.64^{a} ± 4.03	1.24^{a} ± 0.10	6.13^{a} ± 0.31	7.84^{b} ± 0.46	73.24^{a} ± 0.74
		2	0.419^{a} ±0.007	16.52^{b} ± 1.65	8.63^{b} ± 0.93	34.19^{b} ± 3.66	1.47^{a} ± 0.12	7.09^{a} ± .54	8.16^{ab} ± 0.85	74.68^{a} ± 0.44
		3	0.336^{b} ±0.063	19.59^{ab} ± 1.80	13.56^{ab} ± 1.72	42.94^{ab} ± 5.35	1.25^{a} ± 0.12	3.90^{b} ± 1.05	10.99^{a} ± 1.63	73.10^{a} ± 0.48

^{ns,*}non-significant *and* significant at $p \leq 0.05$, respectively
^{a}Values in columns denoted by the same letters are not statistically different at $p \leq 0.05$
Abbreviations: RL = root length, RDW = root dry weight, SDW = stem dry weight, LDW = leaf dry weight, Chl = chlorophyll

Table S5. Analysis of variance and cluster means for eight traits in 14 selected hexaploid landraces (8 low-Fe and 6 high-Fe) at 70 days after planting (DAP)

	SOV	df	MS							
			RL [m]	RDW [mg]	SDW [mg]	LDW [mg]	Chl(a+b) [mg/g]	Root Fe [mg/100 g]	Leaf Fe [mg/100 g]	Fv:Fm *100
70-DAP	Cluster	2	0.006^{ns}	1701.65*	9.17*	2299.86**	0.234**	2.67^{ns}	18.95*	36.64**
	Error	11	0.003	383.25	1.43	273.52	0.029	4.96	3.93	3.94
			Mean ± SE							
	Cluster	1	0.414^{a} ± 0.019	89.17^{a} ± 8.94	10.17^{a} ± 2.67	122.36^{a} ± 9.40	1.12^{a} ± 0.09	12.71^{a} ± 0.24	12.33^{a} ± 1.71	71.59^{a} ± 1.29
		2	0.354^{a} ± 0.022	55.00^{b} ± 4.00	8.27 ± 1.33	87.38^{ab} ± 5.63	0.82^{ab} ± 0.07	11.27^{a} ± 1.03	10.27^{ab} ± 0.43	68.83^{ab} ± 0.55
		3	0.336^{a} ± 0.043	53.89^{b} ± 20.76	103.93^{a} ± 7.78	75.00 ± 10.14	0.60^{b} ± 0.08	11.69^{a} ± 1.27	7.62^{b} ± 0.27	65.05^{b} ± 1.32

^{ns,*}non-significant *and* significant at $p \leq 0.05$, respectively
^{a}Values in columns denoted by the same letters are not statistically different at $p \leq 0.05$
Abbreviations: RL = root length, RDW = root dry weight, SDW = stem dry weight, LDW = leaf dry weight, Chl = chlorophyll

Iron		
Sample	Concentration	Absorbance
BLANK	0	0
STD1	2.000	0.026
STD2	4.000	0.048
STD3	6.000	0.072
STD4	8.000	0.094
STD5	10.00	0.116

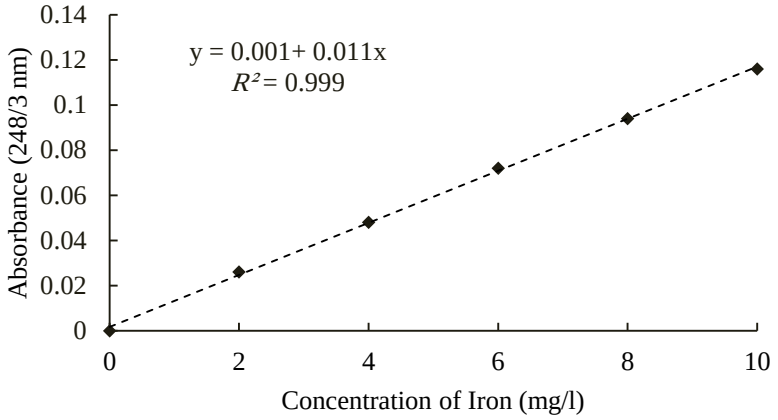

Figure S1. The standard curve used to predict the Fe concentration of known standards versus the standard optical density

Zinc		
Sample	Concentration	Absorbance
BLANK	0	0
STD1	1	0.131
STD2	2	0.264
STD3	3	0.379
STD4	4	0.480
STD5	5	0.577

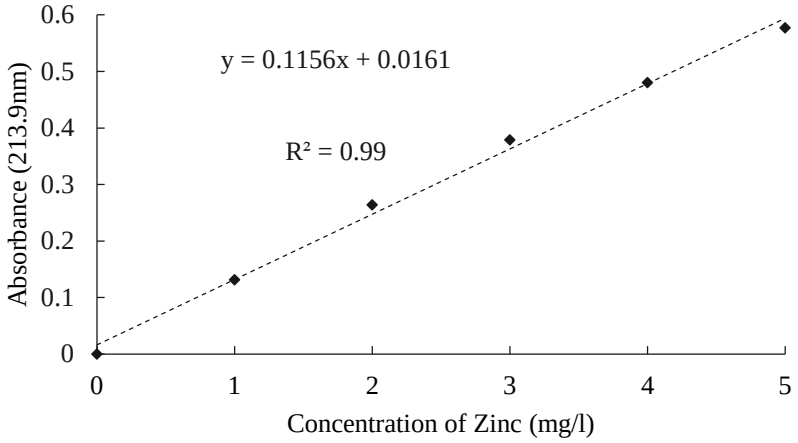

Figure S2. The standard curve used to predict the Zn concentration of known standards versus the standard optical density

Phytate	
Concentration	Absorbance
0	2.744
0.5	2.396
1	2.122
1.5	1.930
2	1.689
2.5	1.492
3	1.244
3.5	1.174

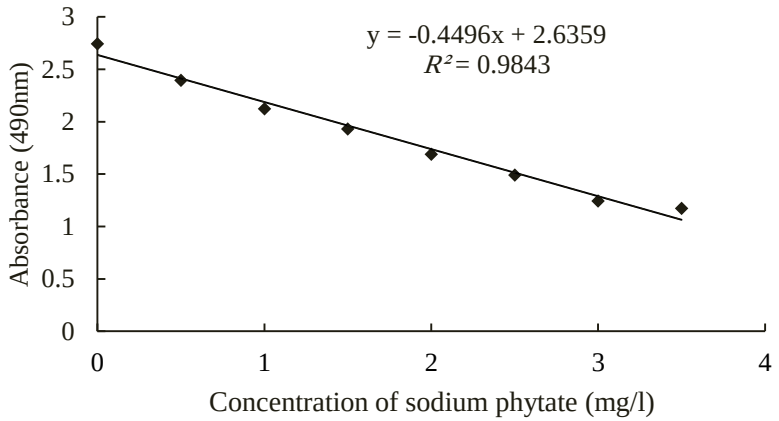

Figure S3. The standard curve used to predict the phytate concentration of known standards versus the standard optical density

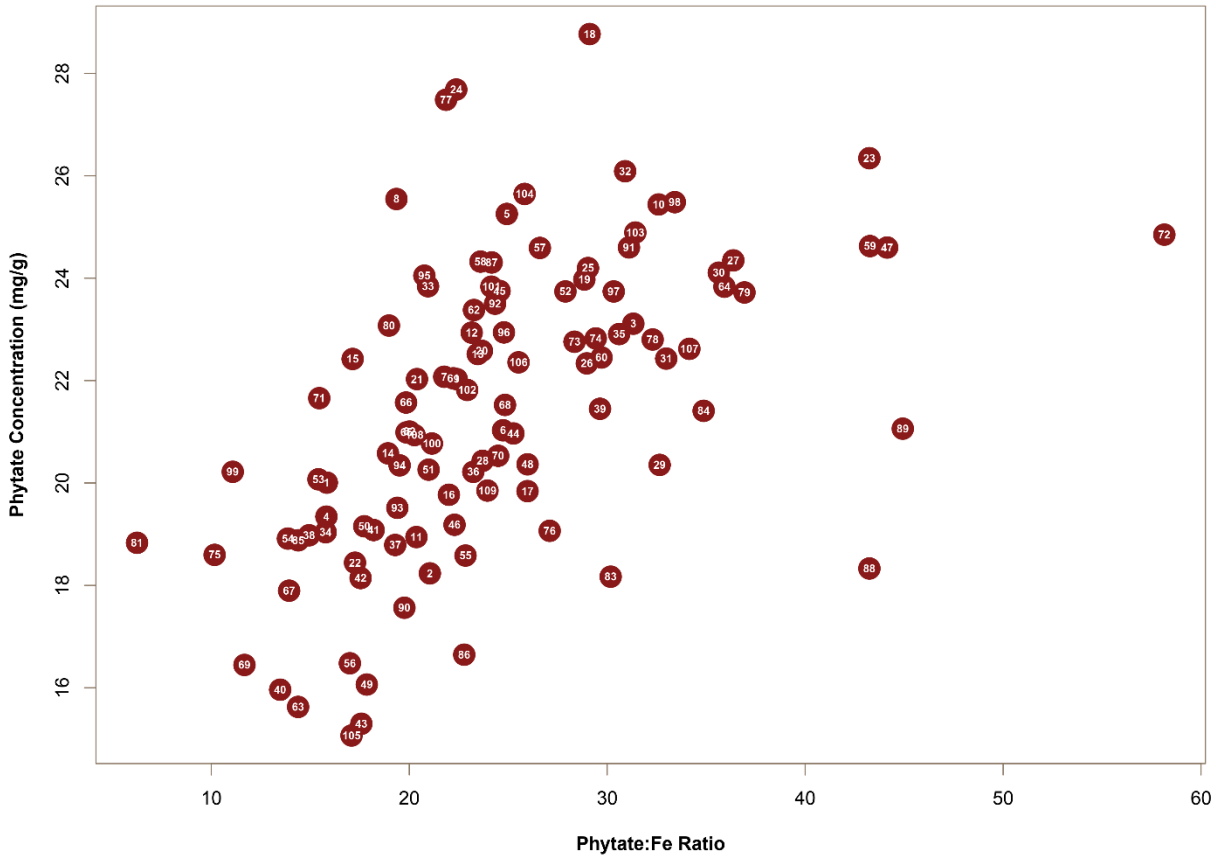

Figure S4. Scatter plot showing the relationships among selected 109 modern bread wheat cultivars and hexaploid landraces in terms of phytate concentration (mg/g) and phytate:Fe molar ratio

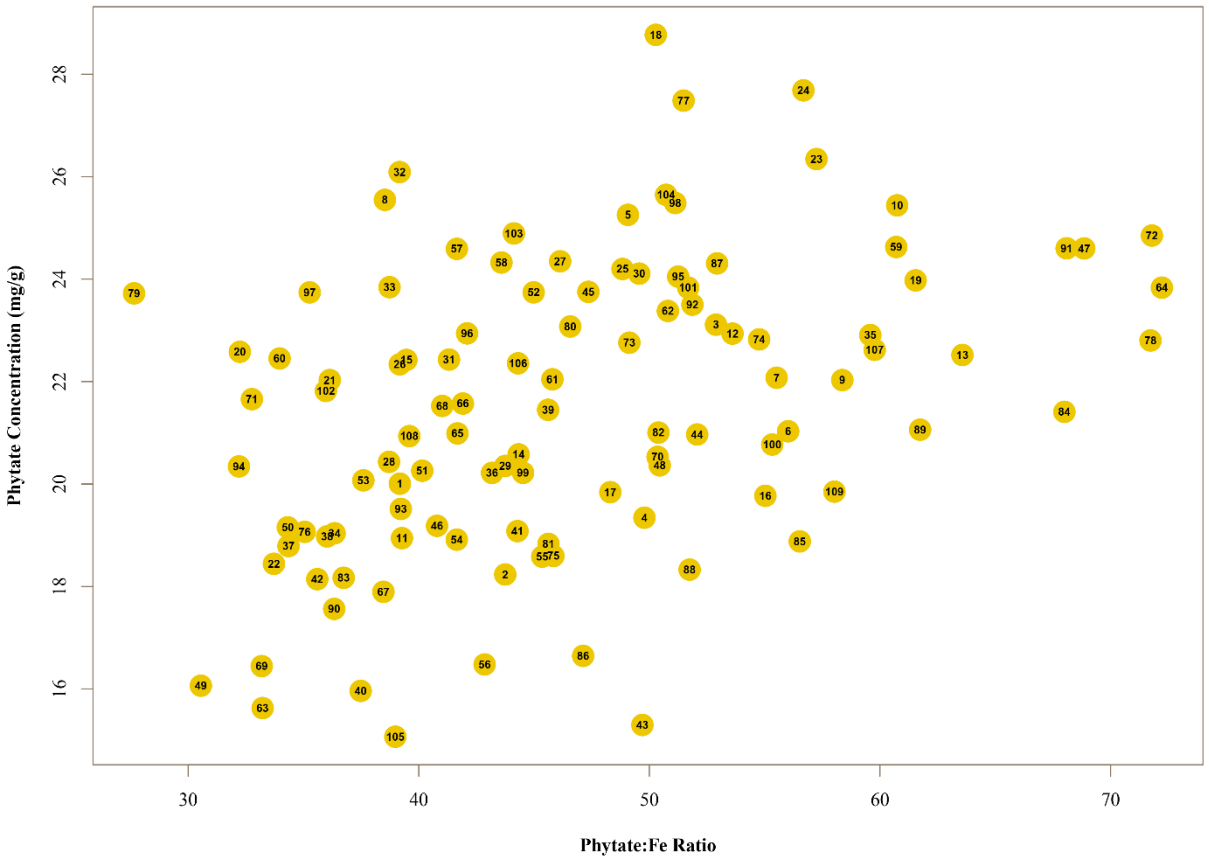

Figure S5. Scatter plot showing the relationships among 109 modern bread wheat cultivars and hexaploid landraces in terms of phytate concentration (mg/g) and phytate:Zn molar ratio