

جدول تکمیلی ۱- صفات اندازه‌گیری شده در ژنوتیپ‌های ذرت تحت شرایط بدون تنش و تنش کادمیوم طی دو سال ۱۳۹۹-۱۴۰۰ و ۱۴۰۰-۱۴۰۱

Supplementary Table 1. Measured traits in maize genotypes under non-stress and cadmium stress conditions in 2020-2021 and 2021-2022

Trait	Abbreviation (Unit)	Measurement method
Days to emergence	DEM (day)	The number of days from seed sowing to emergence of 50% of the seedlings per plot
Days to tasselling	DTA (day)	The number of days from seed sowing to appearance of tassel in 50% of the plants per plot
Days to pollination	DPO (day)	The number of days from seed sowing to pollination in 50% of the plants per each plot
Days to ear emergence	DEE (day)	The number of days from seed sowing to appearance of silk in 50% of the plants per plot
Days to end of pollination	DEPO (day)	The number of days from emergence of tassel to opening of all flowers in the end of tassel and the beginning of browning of the stigma
Days to maturity	DMA (day)	The number of days from seed sowing to maturity (blackening of the joint of the grain and cobe)
Stem diameter	SD (cm)	Stem diameter at 5 cm of the soil surface using a caliper
Leaf number	LN	The number of leaves of the whole plant, except tassel leaf
Leaf number above the ear	LNAE	The number of leaves on above of the ear
Leaf length	LL (cm)	Flag leaf length
Leaf width	LW (cm)	Flag leaf width
Leaf length to width ratio	LL / LW	The ratio of flag leaf length to flag leaf width
Plant height	PHE (cm)	Plant height from the soil surface and from above of the secondary roots to the first tassel branch
Row number per ear	RNE	The number of grain rows per ear
Grain number per row	GNR	The number of grains per row
Ear wood weight	EWW (g)	The weight of ear wood after separating the grains from the ear
Grain yield	GY (g/plant)	Grain weight of all ears of each plant without wood as economic yield
Grain number per main ear	GNME	Total number of grains per main ear
1000-grain weight	TSW (g)	Separating all grains from each ear, measuring the weight of 100-grains, and calculating the weight of 1000-graind via proportionality
Ear wood diameter	EWD (mm)	Ear wood diameter from the middle using a caliper
Grain length	GL (mm)	Grain length using a caliper
Grain width	GW (mm)	Grain width using a caliper
Grain length to width ratio	GL / GW	The ratio of grain length to grain width
Tassel branch number	TBN	The number of tassel branches after complete opening of the tassel

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۱۴۰۰-۱۴۰۱ و ۱۳۹۹-۱۴۰۰

Supplementary Table 2. Simple analysis of variance of the studied traits in maize genotypes under non-stress and cadmium stress conditions in 2020-2021 and 2021-2022

Trait [†]	Mean square			
	First year (2020-2021)		Second year (2021-2022)	
	Non-stress	Cd stress	Non-stress	Cd stress
DEM	1.25 ^{**}	1.01 ^{**}	1.08 ^{**}	0.78 [*]
DTA	40.61 ^{**}	42.94 ^{**}	43.03 ^{**}	44.81 ^{**}
DPO	57.33 ^{**}	48.88 ^{**}	60.62 ^{**}	62.16 ^{**}
DEE	59.90 ^{**}	61.03 ^{**}	59.26 ^{**}	94.86 ^{**}
DEPO	51.16 ^{**}	78.11 ^{**}	72.04 ^{**}	82.03 ^{**}
DMA	74.42 [*]	103.91 ^{**}	77.26 ^{**}	124.68 ^{**}
SD	0.45 ^{**}	0.59 ^{**}	0.48 [*]	0.45 ^{**}
LN	3.97 ^{**}	4.59 ^{**}	4.53 ^{**}	3.95 ^{**}
LNAE	1.34 ^{**}	12.99	1.62 ^{**}	12.75 ^{**}
LL	245.30 ^{**}	232.29 ^{**}	252.51 ^{**}	231.49 ^{**}
LW	4.31 ^{**}	3.79 [*]	4.29 ^{**}	3.56 ^{**}
LL/LW	4.12 ^{**}	5.92 ^{**}	2.70 ^{**}	16.41 ^{**}
PHE	1708.3 ^{**}	2208.28 ^{**}	1652.36 ^{**}	2181.03 ^{**}
RNE	21.84 ^{**}	21.86 ^{**}	21.92 ^{**}	23.12 ^{**}
GNR	133.91 ^{**}	133.58 ^{**}	133.75 ^{**}	133.60 ^{**}
EWV	104.66 ^{**}	104.99 ^{**}	104.24 ^{**}	104.59 ^{**}
GY	4831.03 ^{**}	5299.87 ^{**}	3918.75 ^{**}	3697.23 ^{**}
GNME	30310.80 ^{**}	30079.35 ^{**}	31419.10 ^{**}	28898.09 ^{**}
TSW	16844.6 ^{**}	16690.1 ^{**}	17183.77 ^{**}	16786.26 ^{**}
EWD	235.78 ^{**}	235.62 ^{**}	237.74 ^{**}	243.30 ^{**}
GL	7.624 [*]	7.57 ^{**}	7.74 ^{**}	7.80 ^{**}
GW	5.04 ^{**}	5.28 ^{**}	4.98 ^{**}	4.47 ^{**}
GL/GW	1.21 ^{**}	0.76 ^{**}	1.94 ^{**}	3.23 ^{**}
TBN	51.07 ^{**}	51.30 ^{**}	51.12 ^{**}	51.52 ^{**}

^{ns}, ^{*} and ^{**} Not-significant and significant at 5% and 1% probability levels, respectively.

[†] DEM, days to emergence; DTA, days to tasseling; DPO, days to pollination; DEE, days to ear emergence; DEPO, day to end of pollination; DMA, days to maturity; SD, stem diameter (cm); LN, leaf number; LNAE, leaf number above the ear; LL, leaf length (cm); LW, leaf width (cm); LL/LW, leaf length to width ratio; PHE, plant height (cm); RNE, row number per ear; GNR, grain number per row; EWW, ear wood weight (g); GY, grain yield (g); GNME, grain number per main ear; TSW, 1000-grain weight (g); EWD, ear wood diameter (mm); GL, grain length (mm); GW, grain width (mm); GL/GW, grain length to width ratio; TBN, tassel branch number.

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Supplementary Table 3. Combined analysis of variance of the studied traits in maize genotypes under non-stress and cadmium stress conditions in 2020-2021 and 2021-2022

Source of variation	df	Mean square [†]											
		DEM	DTA	DPO	DEE	DEPO	DMA	SD	LN	LNAE	LL	LW	LL/LW
Environment (E)	1	0.21 ^{n.s}	21606.6 ^{n.s}	589.82 ^{n.s}	4576.01 ^{n.s}	1412.59 ^{n.s}	3494.75 ^{n.s}	40.06 ^{n.s}	808.25 ^{n.s}	1032.65 ^{**}	6829.09 ^{n.s}	658.27 ^{n.s}	692.83 ^{n.s}
Year (Y)	1	85.88 ^{n.s}	914.42 ^{n.s}	28941.69 ^{n.s}	12988.68 ^{n.s}	20185.27 [*]	28161.01 ^{n.s}	11.56 ^{n.s}	15.90 ^{n.s}	653.30 [*]	825.38 ^{n.s}	54.10 ^{n.s}	147.5 ^{n.s}
Y × E	1	22.48 ^{n.s}	5416.86 ^{n.s}	444.68 ^{n.s}	755.42 ^{n.s}	94.94 ^{n.s}	2048.05 ^{n.s}	43.43 ^{**}	845.67 ^{n.s}	0.197 ^{n.s}	4320.39 [*]	632.17 [*]	751.7 ^{**}
Replication (Y × E)	8	102.81	2495.95	2396.49	2368.42	2481.44	2384.84	0.560	1.80	1.47	57.90	0.65	2.54
Genotype (G)	94	3.78 ^{n.s}	164.57 ^{**}	181.49 ^{**}	194.74 ^{**}	194.96 ^{**}	224.47 ^{**}	1.37 ^{**}	8.91 ^{n.s}	14.81 ^{n.s}	614.44 ^{**}	11.12 ^{**}	16.14 [*]
G × E	94	0.17 ^{**}	3.90 ^{**}	27.28 ^{**}	34.13 ^{n.s}	40.01 ^{**}	58.58 ^{n.s}	0.573 ^{**}	7.67 ^{**}	13.65 ^{**}	344.59 ^{**}	4.77 ^{**}	11.35 ^{**}
G × Y	94	0.10 [*]	1.95 ^{n.s}	10.05 ^{n.s}	19.86 ^{n.s}	25.14 ^{n.s}	44.60 ^{n.s}	0.019 ^{n.s}	0.19 ^{n.s}	0.118 ^{n.s}	0.99 ^{n.s}	0.02 ^{n.s}	0.85 ^{n.s}
G × E × Y	94	0.06 ^{n.s}	1.20 ^{n.s}	10.16 ^{n.s}	26.33 ^{n.s}	23.23 ^{n.s}	52.62 ^{n.s}	0.01 ^{n.s}	0.25 ^{n.s}	0.119 ^{n.s}	1.35 ^{n.s}	0.03 ^{n.s}	0.94 ^{n.s}
Error	752	0.55	14.08	28.33	36.34	36.99	61.37	0.1044	1.75	3.66	32.79	0.494	1.84
CV (%)	-	16.44	8.53	8.83	9.24	8.95	8.22	16.11	12.04	36.91	8.51	9.58	14.18
R ² (%)	-	75.81	85.80	76.83	69.78	71.02	65.75	78.50	71.39	61.43	80.07	88.44	76.29

^{n.s}, ^{*} and ^{**} Not-significant and significant at 5% and 1% probability levels, respectively.

[†] DEM, days to emergence; DTA, days to tasseling; DPO, days to pollination; DEE, days to ear emergence; DEPO, day to end of pollination; DMA, days to maturity; SD, stem diameter (cm); LN, leaf number; LNAE, leaf number above the ear; LL, leaf length (cm); LW, leaf width (cm); LL/LW, leaf length to width ratio.

Supplementary Table 3. Continued

جدول تکمیلی ۳- ادامه

Source of variation	df	Mean square [†]											
		PHE	RNE	GNR	EWW	GY	GNME	TSW	EWD	GL	GW	GL/GW	TBN
Environment (E)	1	218447.2 ^{n.s}	17.55 ^{n.s}	892.02 ^{n.s}	221.04 ^{n.s}	8810.27 ^{n.s}	11130.36 ^{n.s}	113363.3 ^{**}	26584.7 ^{n.s}	55.53 ^{n.s}	18.17 ^{n.s}	2.31 ^{n.s}	624.12 ^{n.s}
Year (Y)	1	1225.71 ^{n.s}	117.69 ^{n.s}	153.72 ^{n.s}	0.884 ^{n.s}	55158.61 ^{n.s}	71702.26 ^{n.s}	132063.1 [*]	3186.91 ^{n.s}	15.58 ^{n.s}	118.76 ^{n.s}	39.43 ^{n.s}	83.90 ^{n.s}
Y × E	1	32391.16 ^{n.s}	380.12 ^{n.s}	9.49 ^{n.s}	466.13 ^{n.s}	16359.74 ^{**}	447270.02 [*]	103.77 ^{n.s}	7414.7 ^{n.s}	128.29 ^{n.s}	203.30 ^{n.s}	25.22 ^{n.s}	311.58 [*]
Replication (Y × E)	8	210.99	132.60	668.00	95.07	969.58	70612.23	23679.67	10581.57	45.01	60.51	25.50	44.02
Genotype (G)	94	5330.78 ^{**}	87.62 ^{**}	534.4 ^{**}	419.00 ^{**}	16638.57 ^{**}	119710.2 ^{**}	67306.7 ^{**}	939.59 ^{**}	30.64 ^{**}	19.22 ^{**}	5.87 ^{**}	204.7 ^{**}
G × E	94	2370.95 ^{**}	0.72 ^{**}	0.417 ^{**}	0.05 [*]	323.73 ^{n.s}	373.40 ^{**}	133.4 ^{**}	5.97 ^{**}	0.03 ^{n.s}	0.07 ^{**}	0.19 ^{n.s}	0.05 [*]
G × Y	94	25.88 ^{n.s}	0.20 ^{n.s}	0.016 ^{n.s}	0.04 ^{n.s}	458.24 [*]	100.82 ^{n.s}	36.55 ^{n.s}	2.05 ^{n.s}	0.06 ^{**}	0.035 ^{n.s}	0.39 ^{n.s}	0.03 ^{n.s}
G × E × Y	94	22.37 ^{n.s}	0.205 ^{n.s}	0.02 ^{n.s}	0.04 ^{n.s}	317.11 ^{n.s}	157.04 ^{n.s}	28.00 ^{n.s}	2.11 ^{n.s}	0.03 ^{n.s}	0.03 ^{n.s}	0.32 ^{n.s}	0.03 ^{n.s}
Error	752	278.26	1.49	2.53	1.49	349.76	416.26	132.28	18.70	1.122	0.531	0.577	0.57
CV (%)	-	10.66	11.65	8.17	7.97	21.71	7.13.26	4.58	7.200	15.31	16.95	40.54	6.799
R ² (%)	-	82.25	89.80	96.74	97.32	87.06	97.56	98.55	93.83	80.43	87.40	69.90	97.93

^{n.s}, ^{*} and ^{**} Not-significant and significant at 5% and 1% probability levels, respectively.

[†] PHE, plant height (cm); RNE, row number per ear; GNR, grain number per row; EWW, ear wood weight (g); GY, grain yield (g); GNME, grain number per main ear; TSW, 1000-grain weight (g); EWD, ear wood diameter (mm); GL, grain length (mm); GW, grain width (mm); GL/GW, grain length to width ratio; TBN, tassel branch number.

جدول تکمیلی ۴- ضرایب استاندارد کانونی صفات مورد مطالعه در ژنوتیپ‌های ذرت تحت شرایط بدون تنش و تنش کادمیوم
 Supplementary Table 4. Standardized canonical discriminant function coefficients of the studied traits in maize
 genotypes under non-stress and cadmium stress conditions

Trait [†]	Non-stress conditions			Trait [†]	Cadmium stress conditions		
	1	2	3		1	2	3
DPO	0.662*	-0.029	0.282	DTA	0.526*	0.259	0.021
DEE	0.610*	-0.013	0.282	DPO	0.496*	0.212	0.026
DEPO	0.602*	-0.070	0.341	DEE	0.476*	0.231	0.101
DTA	0.581*	-0.076	0.301	DEPO	0.457*	0.175	0.007
DMA	0.571*	-0.126	0.348	DMA	0.426*	0.167	0.109
LN	0.076*	0.020	-0.048	GW	-0.247*	-0.028	-0.086
GY	-0.061	0.558*	0.117	GNME	-0.211	0.388*	-0.242
GNR	0.066	0.449*	0.075	GY	-0.245	0.360*	-0.193
GNME	-0.022	0.341*	0.016	GNR	-0.080	0.339*	-0.133
EWV	-0.069	0.323*	0.073	GL	-0.025	0.288*	-0.232
TSW	-0.016	0.299*	0.145	GL/GW	0.201	0.249*	-0.040
GL	0.120	0.177*	0.008	EWD	0.009	0.236*	-0.070
LW	0.105	0.164*	-0.115	LN	-0.066	0.207*	0.163
PHE	-0.017	0.126*	0.033	EWV	-0.185	0.213	-0.498*
RNE	-0.076	0.125*	0.027	PHE	-0.071	0.151	0.429*
LNAE	0.003	0.122*	-0.026	LW	-0.032	0.029	0.424*
SD	0.065	0.080*	0.069	LL/LW	-0.147	0.087	-0.283*
GW	-0.055	0.169	0.468*	RNE	-0.013	0.039	-0.269*
GL/GW	0.113	0.013	-0.438*	LL	-0.253	0.180	0.264*
TBN	-0.074	0.079	0.331*	SD	-0.097	0.231	0.254*
LL	0.142	0.167	-0.250*	TBN	0.038	-0.013	0.172*
DEM	-0.011	-0.200	0.213*	LNAE	-0.030	0.029	0.151*
EWD	0.125	0.037	-0.147*	DEM	0.036	-0.018	0.145*
LL/LW	0.032	-0.022	-0.110*	TSW	-0.090	0.093	-0.097*

* Largest absolute correlation between each variable and any discriminant function.

† DEM, days to emergence; DTA, days to tasseling; DPO, days to pollination; DEE, days to ear emergence; DEPO, day to end of pollination; DMA, days to maturity; SD, stem diameter (cm); LN, leaf number; LNAE, leaf number above the ear; LL, leaf length (cm); LW, leaf width (cm); LL/LW, leaf length to width ratio; PHE, plant height (cm); RNE, row number per ear; GNR, grain number per row; EWV, ear wood weight (g); GY, grain yield (g); GNME, grain number per main ear; TSW, 1000-grain weight (g); EWD, ear wood diameter (mm); GL, grain length (mm); GW, grain width (mm); GL/GW, grain length to width ratio; TBN, tassel branch number.