

Table 2. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on number of spikes m⁻².

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	461.33	473.33	412.00	448.89	520.00	410.00	382.00	437.33
	45	496.00	489.33	408.00	464.44	522.00	396.00	328.00	415.33
	60	499.33	512.00	420.00	477.11	454.00	414.00	452.00	440.00
Mean		485.56	491.56	413.33	463.48	498.67	406.67	387.33	430.89
27	30	497.33	530.67	417.33	481.78	490.00	476.00	398.00	454.67
	45	520.00	526.67	444.00	496.89	450.00	560.00	492.00	500.67
	60	541.33	510.67	453.33	501.78	474.00	412.00	378.00	421.33
Mean		519.56	522.67	438.22	493.48	471.33	482.67	422.67	458.89
23	30	562.67	508.00	410.67	493.78	460.00	404.00	458.00	440.67
	45	525.33	533.33	466.67	508.44	494.00	520.00	480.00	498.00
	60	557.33	478.67	456.00	497.33	492.00	440.00	464.00	465.33
Mean		548.44	506.67	444.44	499.85	482.00	454.67	467.33	468.00
20.7	30	536.00	497.33	450.67	494.67	430.00	410.00	438.00	426.00
	45	553.33	476.00	480.00	503.11	480.00	494.00	450.00	474.67
	60	514.67	525.33	482.67	507.56	564.00	470.00	522.00	518.67
Mean		534.67	499.56	471.11	501.78	491.33	458.00	470.00	473.11
General Mean		522.06	505.11	441.78	----	485.83	450.50	436.83	----
C x T	30	514.33	502.33	422.67	479.78	475.00	425.00	419.00	439.67
	45	523.67	506.33	449.67	493.22	486.50	492.50	437.50	472.17
	60	528.12	506.67	453.00	495.95	496.00	434.00	454.00	461.33
F test and LSD_{0.05}		F test		LSD_{0.05}		F test		LSD_{0.05}	
Zn		*		12.00		*		15.00	
C		*		40.00		*		37.86	
T		Ns		-		**		20.15	
Zn x C		**		45.45		**		40.40	
Zn x T		Ns		-		**		39.82	
C x T		*		40.00		*		38.57	
Zn x C x T		**		95.00		**		81.73	

Where *and ** mean significant at 5 and 1% probability, respectively.
NS means non – significant

Table 3. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on 1000- kernel weight, g.

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	44.47	36.42	46.89	42.60	38.59	41.45	48.59	42.88
	45	31.24	35.90	49.23	38.79	36.45	43.80	49.06	43.10
	60	45.78	38.63	50.78	45.06	53.94	48.06	50.53	50.84
Mean		40.50	36.98	48.97	42.15	43.00	44.44	49.39	45.61
27	30	43.60	36.28	43.81	41.23	39.96	43.59	53.95	45.83
	45	44.47	37.91	46.59	42.99	41.85	42.53	55.30	46.56
	60	45.25	37.51	47.28	43.34	42.84	39.78	52.24	44.95
Mean		44.44	37.23	45.89	42.52	41.55	41.97	53.83	45.78
23	30	46.75	31.89	49.85	42.83	44.25	46.90	53.87	48.34
	45	45.45	37.73	46.95	43.38	43.06	42.79	51.97	45.94
	60	42.10	36.39	49.54	42.68	42.60	46.99	52.38	47.32
Mean		44.77	35.33	48.78	42.96	43.30	45.56	52.74	47.20
20.7	30	44.66	44.37	50.62	46.55	42.41	56.95	53.09	50.82
	45	42.67	41.22	49.13	44.34	46.30	46.68	50.53	47.83
	60	47.18	36.75	49.20	44.38	44.26	44.63	53.09	47.33
Mean		44.83	40.78	49.65	45.09	44.32	49.42	52.24	48.66
General Mean		43.63	37.58	48.32	----	43.04	45.34	52.05	----
C x T	30	44.87	37.24	47.79	43.30	41.30	47.22	52.38	46.97
	45	40.96	38.19	47.97	42.37	41.91	43.95	51.71	45.86
	60	45.08	37.32	49.20	43.86	45.91	44.86	52.06	47.61
F test and LSD_{0.05}		F test			LSD_{0.05}		F test		LSD_{0.05}
Zn		*			1.15		*		2.21
C		**			2.07		**		0.14
T		*			1.20		*		1.56
Zn x C		**			1.27		**		2.15
Zn x T		**			2.26		**		2.80
C x T		**			2.01		**		2.59
Zn x C x T		**			3.99		**		5.48

Where *and ** mean significant at 5 and 1% probability, respectively.

Table 4. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on weight of kernels spike⁻¹.

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	2.31	1.82	2.80	2.31	2.05	2.29	3.10	2.48
	45	2.40	2.23	3.15	2.59	2.14	2.72	3.75	2.87
	60	2.48	2.06	2.70	2.41	3.12	2.94	3.71	3.26
Mean		2.40	2.04	2.88	2.44	2.44	2.65	3.52	2.87
27	30	1.97	2.31	2.73	2.34	2.57	3.04	3.53	3.04
	45	2.36	2.19	3.01	2.52	2.06	3.17	3.71	2.98
	60	2.42	1.90	3.03	2.45	2.42	2.89	3.44	2.92
Mean		2.25	2.13	2.92	2.44	2.35	3.03	3.56	2.98
23	30	2.48	2.21	2.67	2.45	2.34	3.56	3.78	3.23
	45	1.82	2.54	2.80	2.39	2.28	3.39	3.90	3.19
	60	2.00	2.27	3.29	2.52	2.36	3.19	3.18	2.91
Mean		2.10	2.34	2.92	2.45	2.33	3.38	3.62	3.11
20.7	30	2.79	2.72	3.20	2.90	2.25	4.51	3.53	3.43
	45	2.94	3.04	3.05	3.02	2.50	3.50	3.81	3.27
	60	3.19	2.82	3.16	3.06	2.29	3.34	3.65	3.09
Mean		2.97	2.86	3.14	2.99	2.34	3.78	3.67	3.26
General Mean		2.43	2.34	2.97	-----	2.36	3.21	3.59	-----
C x T	30	2.39	2.27	2.85	2.50	2.30	3.35	3.48	3.04
	45	2.38	2.50	3.00	2.63	2.24	3.19	3.79	3.08
	60	2.52	2.26	3.05	2.61	2.55	3.09	3.50	3.04
F test and LSD _{0.05}		F test		LSD _{0.05}		F test		LSD _{0.05}	
Zn		**		0.08		**		0.09	
C		**		0.28		**		0.41	
T		*		0.11		Ns		-	
Zn x C		**		0.12		*		0.45	
Zn x T		Ns		-		**		0.26	
C x T		Ns		-		**		0.23	
Zn x C x T		**		0.40		*		0.56	

Where *and ** mean significant at 5 and 1% probability, respectively.
NS means non – significant

Table 5. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on grain yield (Ardab feddan⁻¹).

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	24.67	22.00	24.60	23.76	18.35	18.25	16.27	17.62
	45	23.00	21.47	18.51	20.99	23.60	17.67	23.47	21.58
	60	23.60	20.73	19.00	21.11	23.52	22.24	27.47	24.41
Mean		23.76	21.40	20.70	21.95	21.82	19.39	22.40	21.20
27	30	22.07	24.60	18.93	21.87	22.45	25.96	26.32	24.91
	45	21.60	23.80	28.13	24.51	24.32	24.08	26.29	24.90
	60	24.07	24.27	25.80	24.71	21.97	27.57	25.05	24.87
Mean		22.58	24.22	24.29	23.70	22.92	25.87	25.89	24.89
23	30	24.73	23.07	25.96	24.59	25.33	24.53	21.84	23.90
	45	21.93	23.20	26.13	23.76	24.80	26.20	25.47	25.49
	60	23.53	24.67	27.20	25.13	24.36	27.47	28.40	26.74
Mean		23.40	23.64	26.43	24.49	24.83	26.07	25.24	25.38
20.7	30	24.27	25.20	26.33	25.27	26.67	25.83	22.67	25.05
	45	24.13	26.20	26.20	25.51	25.32	25.71	25.91	25.64
	60	25.33	25.60	28.67	26.53	27.60	27.60	28.50	27.90
Mean		24.58	25.67	27.07	25.77	26.53	26.38	25.70	26.20
General Mean		23.58	23.73	24.62	-----	24.02	24.43	24.81	-----
C x T	30	23.93	23.72	23.96	23.87	23.20	23.64	21.77	22.87
	45	22.67	23.67	24.74	23.69	24.51	23.41	25.28	24.40
	60	24.13	23.82	25.17	24.37	24.36	26.22	27.36	25.98
F test and LSD _{0.05}		F test			LSD _{0.05}	F test			LSD _{0.05}
Zn		**			0.95	**			1.08
C		*			0.73	*			0.53
T		Ns			-	**			0.81
Zn x C		*			2.20	*			2.68
Zn x T		**			2.09	**			1.77
C x T		Ns			-	**			1.55
Zn x C x T		*			4.00	*			3.77

Where *and ** mean significant at 5 and 1% probability, respectively.
NS means non – significant

Table 6. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on test weight (kg/hectoliter).

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	76.10	73.75	72.85	74.23	77.53	75.13	76.13	76.27
	45	75.35	72.95	72.90	73.73	77.13	76.67	76.30	76.70
	60	74.55	71.75	72.85	73.05	78.60	75.40	77.07	77.02
Mean		75.33	72.82	72.87	73.67	77.76	75.73	76.50	76.66
27	30	75.25	72.25	73.55	73.68	78.13	77.00	77.00	77.38
	45	75.75	73.50	72.55	73.93	79.20	76.40	76.33	77.31
	60	76.60	71.35	73.55	73.83	78.60	74.53	76.67	76.60
Mean		75.87	72.37	73.22	73.82	78.64	75.98	76.67	77.10
23	30	77.50	71.75	72.55	73.93	78.47	77.07	76.07	77.20
	45	76.00	73.25	74.50	74.58	78.20	75.93	75.47	76.53
	60	76.00	72.90	73.70	74.20	78.67	78.00	77.60	78.09
Mean		76.50	72.63	73.58	74.24	78.44	77.00	76.38	77.27
20.7	30	74.30	74.75	77.00	75.35	78.73	76.60	78.33	77.89
	45	76.15	72.80	72.35	73.77	79.00	76.60	75.80	77.13
	60	76.75	73.35	72.70	74.27	79.07	76.40	80.87	78.78
Mean		75.73	73.63	74.02	74.46	78.93	76.53	78.33	77.93
General Mean		75.86	72.86	73.42	----	78.44	76.31	76.97	----
C x T	30	75.79	73.13	73.99	74.30	78.22	76.45	76.88	77.18
	45	75.81	73.13	73.08	74.00	78.38	76.40	75.98	76.92
	60	75.98	72.34	73.20	73.84	78.73	76.08	78.05	77.62
F test and LSD _{0.05}		F test			LSD _{0.05}	F test			LSD _{0.05}
Zn		*			0.45	*			0.80
C		**			0.81	*			1.07
T		*			0.32	*			0.54
Zn x C		Ns			-	Ns			-
Zn x T		**			0.61	*			1.20
C x T		**			0.57	**			0.95
Zn x C x T		**			1.01	*			1.10

Where *and ** mean significant at 5 and 1% probability, respectively.
NS means non – significant

Table 7. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on grains dry gluten content (%).

Seasons		2016/2017				2017/2018			
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11	
Control	30	10.25	8.57	8.94	9.25	9.44	10.11	9.19	9.58
	45	8.47	8.65	8.64	8.59	10.22	9.67	8.89	9.59
	60	9.14	8.61	8.56	8.77	9.81	12.89	8.81	10.51
Mean		9.29	8.61	8.71	8.87	9.83	10.89	8.96	9.89
27	30	8.66	9.98	9.19	9.28	9.41	10.00	11.00	10.14
	45	8.69	9.31	9.97	9.32	9.44	10.52	9.22	9.73
	60	9.73	12.83	9.56	10.71	10.48	12.85	9.89	11.07
Mean		9.03	10.71	9.58	9.77	9.78	11.12	10.04	10.31
23	30	9.39	10.76	9.33	9.83	10.48	14.22	9.07	11.26
	45	8.98	9.67	9.34	9.33	9.81	11.56	9.15	10.17
	60	10.32	10.93	10.26	10.50	13.33	11.85	9.11	11.43
Mean		9.56	10.45	9.64	9.88	11.21	12.54	9.11	10.95
20.7	30	9.25	13.72	9.86	10.94	12.44	8.89	11.44	10.93
	45	9.77	11.06	9.42	10.08	13.37	9.11	9.48	10.65
	60	12.10	11.35	12.64	12.03	14.37	13.74	9.67	12.59
Mean		10.37	12.04	10.64	11.02	13.40	10.58	10.20	11.39
General Mean		9.56	10.45	9.64	----	11.05	11.28	9.58	-----
C x T	30	9.63	11.02	9.38	10.01	10.44	10.81	10.18	10.48
	45	8.98	9.67	9.34	9.33	10.71	10.21	9.19	10.04
	60	10.32	10.93	10.26	10.50	12.00	12.83	9.37	11.40
F test and LSD_{0.05}		F test		LSD_{0.05}		F test		LSD_{0.05}	
Zn		**		0.35		**		0.40	
C		*		1.27		*		1.16	
T		**		0.50		**		0.48	
Zn x C		*		1.63		*		2.32	
Zn x T		**		1.35		Ns		-	
C x T		Ns		-		**		0.87	
Zn x C x T		**		2.63		**		1.91	

Where *and ** mean significant at 5 and 1% probability, respectively.
NS means non – significant

Table 8. Effect of zinc nanoparticles size, bread wheat cultivars, zinc application time and their interactions on fermentation time (minutes).

Seasons		2016/2017				2017/2018					
Zinc nanoparticles size (Zn, nm)	Zinc application time (T, day)	Cultivars (C)			Mean	Cultivars (C)			Mean		
		Sids-1	Sids-12	Gemmeza-11		Sids-1	Sids-12	Gemmeza-11			
Control	30	41.00	34.28	35.76	37.00	37.76	40.44	36.76	38.32		
	45	33.88	34.60	34.56	34.36	40.88	38.68	35.56	38.36		
	60	36.56	34.44	34.24	35.08	39.24	51.56	35.24	42.04		
Mean		37.16	34.44	34.84	35.48	39.32	43.56	35.84	39.56		
27	30	34.64	39.92	36.76	37.12	37.64	40.00	44.00	40.56		
	45	34.76	37.24	39.88	37.28	37.76	42.08	36.88	38.92		
	60	38.92	51.32	38.24	42.84	41.92	51.40	39.56	44.28		
Mean		36.12	42.84	38.32	39.08	39.12	44.48	40.16	41.24		
23	30	37.56	43.04	37.32	39.32	41.92	56.88	36.28	45.04		
	45	35.92	38.68	37.36	37.32	39.24	46.24	36.60	40.68		
	60	41.28	43.72	41.04	42.00	53.32	47.40	36.44	45.72		
Mean		38.24	41.80	38.56	39.52	44.84	50.16	36.44	43.80		
20.7	30	37.00	54.88	39.44	43.76	49.76	35.56	45.76	43.72		
	45	39.08	44.24	37.68	40.32	53.48	36.44	37.92	42.60		
	60	48.40	45.40	50.56	48.12	57.48	54.96	38.68	50.36		
Mean		41.48	48.16	42.56	44.08	53.60	42.32	40.80	45.56		
General Mean		38.24	41.80	38.56	-----	44.20	45.12	38.32	----		
C x T	30	38.52	44.08	37.52	40.04	41.76	43.24	40.72	41.92		
	45	35.92	38.68	37.36	37.32	42.84	40.84	36.76	40.16		
	60	41.28	43.72	41.04	42.00	48.00	51.32	37.48	45.60		
F test and LSD_{0.05}		F test			LSD_{0.05}			F test		LSD_{0.05}	
Zn		*			1.54			**		1.53	
C		*			2.02			**		2.31	
T		*			1.60			**		1.48	
Zn x C		**			3.18			**		3.52	
Zn x T		**			3.13			**		2.96	
C x T		**			2.52			**		2.83	
Zn x C x T		**			5.38			**		5.66	

Where *and ** mean significant at 5 and 1% probability, respectively.