

Supplementary Table S1. The effect of the interaction between irrigation treatments and organic rates on the all studied traits in the studied seasons.

Season		<i>1st season 2018/2019</i>						<i>2nd season 2019/2020</i>					
Treatment	Trait	TY ₁	GY ₁	SY ₁	TKW ₁	PH ₁	HI ₁	TY ₂	GY ₂	SY ₂	TKW ₂	PH ₂	HI ₂
I₁	O₁	8.47	4.75	3.72	55.98	91.33	56.03	8.61	4.96	3.65	57.87	94.44	57.57
	O₂	8.91	5.18	3.73	59.07	94.22	58.08	9.04	5.36	3.68	60.35	96.22	59.22
	O₃	9.02	5.20	3.82	59.15	96.00	57.64	9.16	5.38	3.78	60.39	98.00	58.65
I₂	O₁	8.35	4.66	3.69	55.85	89.22	55.73	8.49	4.87	3.62	57.72	92.44	57.34
	O₂	8.59	4.90	3.69	58.94	92.22	57.04	8.72	5.11	3.61	60.20	94.22	58.58
	O₃	8.89	5.12	3.78	59.02	94.00	57.51	9.02	5.33	3.70	60.24	96.00	59.00
I₃	O₁	8.03	4.49	3.53	55.69	87.22	55.95	8.16	4.69	3.46	57.59	90.11	57.51
	O₂	8.26	4.77	3.50	58.79	90.22	57.65	8.40	4.96	3.44	60.07	91.89	58.98
	O₃	8.56	5.00	3.57	58.87	92.00	58.35	8.70	5.19	3.51	60.11	93.67	59.66
LSD (I*O)		0.045	NS	NS	NS	NS	NS	0.050	NS	NS	NS	NS	NS
I₁	Zn₁	8.56	4.64	3.92	57.28	88.89	54.24	8.70	4.81	3.88	58.95	91.56	55.34
	Zn₂	8.83	5.13	3.70	57.98	86.78	58.13	8.96	5.31	3.65	59.46	97.44	59.22
	Zn₃	9.01	5.35	3.66	58.94	84.78	59.37	9.15	5.57	3.58	60.19	99.67	60.89
I₂	Zn₁	8.40	4.53	3.87	57.15	94.89	53.91	8.53	4.70	3.83	58.80	89.22	55.17
	Zn₂	8.64	4.94	3.70	57.85	92.89	57.17	8.77	5.05	3.72	59.31	95.44	57.59
	Zn₃	8.80	5.21	3.59	58.81	90.89	59.20	8.93	5.55	3.38	60.04	98.00	62.16
I₃	Zn₁	8.07	4.38	3.69	56.99	97.78	54.28	8.20	4.55	3.65	58.65	86.89	55.49
	Zn₂	8.31	4.80	3.51	57.70	95.78	57.78	8.45	4.90	3.55	59.19	93.11	57.99
	Zn₃	8.47	5.07	3.40	58.66	93.78	59.88	8.61	5.39	3.21	59.92	95.67	62.67
LSD (I*Nano-Zn)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
O₁	Zn₁	8.08	4.20	3.87	54.88	80.44	52.07	8.21	4.38	3.83	57.24	84.00	53.44
	Zn₂	8.31	4.70	3.62	54.98	92.67	56.48	8.45	4.80	3.65	56.57	95.56	56.83
	Zn₃	8.45	5.00	3.45	57.66	94.67	59.14	8.59	5.34	3.25	59.36	97.44	62.15
O₂	Zn₁	8.36	4.57	3.79	58.64	89.67	54.69	8.49	4.73	3.76	59.89	91.33	55.73
	Zn₂	8.60	5.04	3.57	59.02	91.67	58.52	8.73	5.19	3.54	60.41	93.89	59.40
	Zn₃	8.81	5.25	3.57	59.14	95.33	59.56	8.94	5.51	3.43	60.31	97.11	61.65
O₃	Zn₁	8.59	4.78	3.81	57.90	90.33	55.66	8.72	4.95	3.77	59.27	92.33	56.83
	Zn₂	8.86	5.15	3.72	59.53	94.33	58.08	9.00	5.27	3.73	61.00	96.56	58.57
	Zn₃	9.02	5.39	3.63	59.62	97.33	59.76	9.16	5.67	3.49	60.47	98.78	61.92
LSD (O*Nano-Zn)		NS	NS	NS	0.902	1.502	NS	NS	NS	NS	1.025	2.106	NS

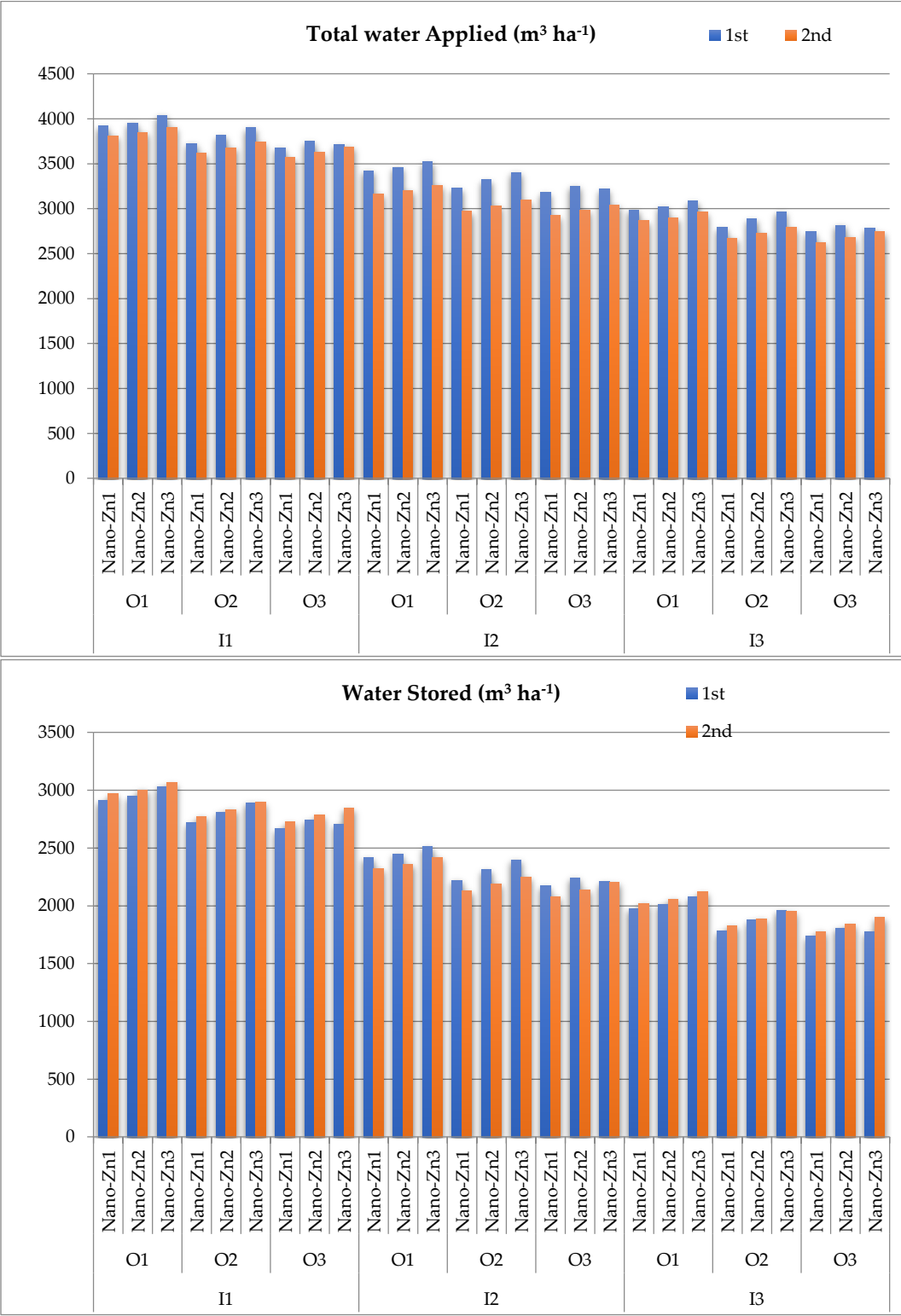
Abbreviations: Biological yield (BY) ton ha⁻¹ (TY), grain yield ton ha⁻¹ (GY), straw yield ton ha⁻¹ (SY), 1000-kernels weight g (TKW), plant height cm (PH), and harvest index% (HI)

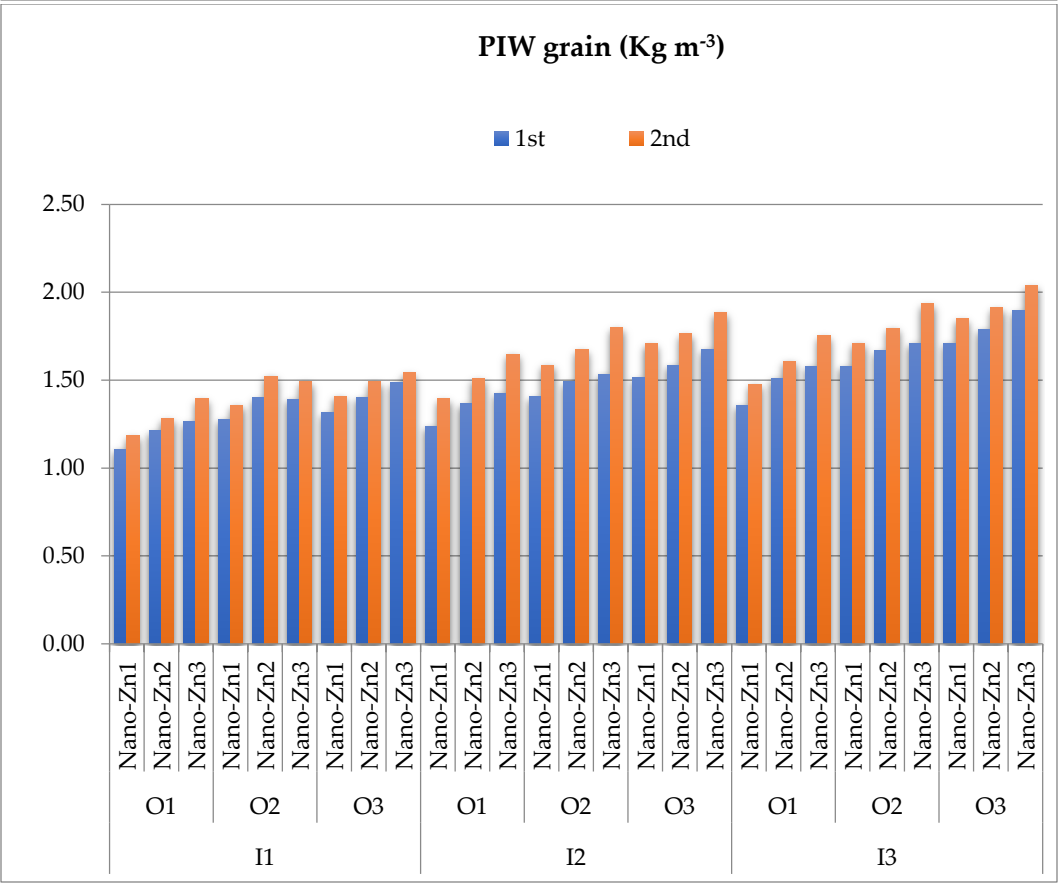
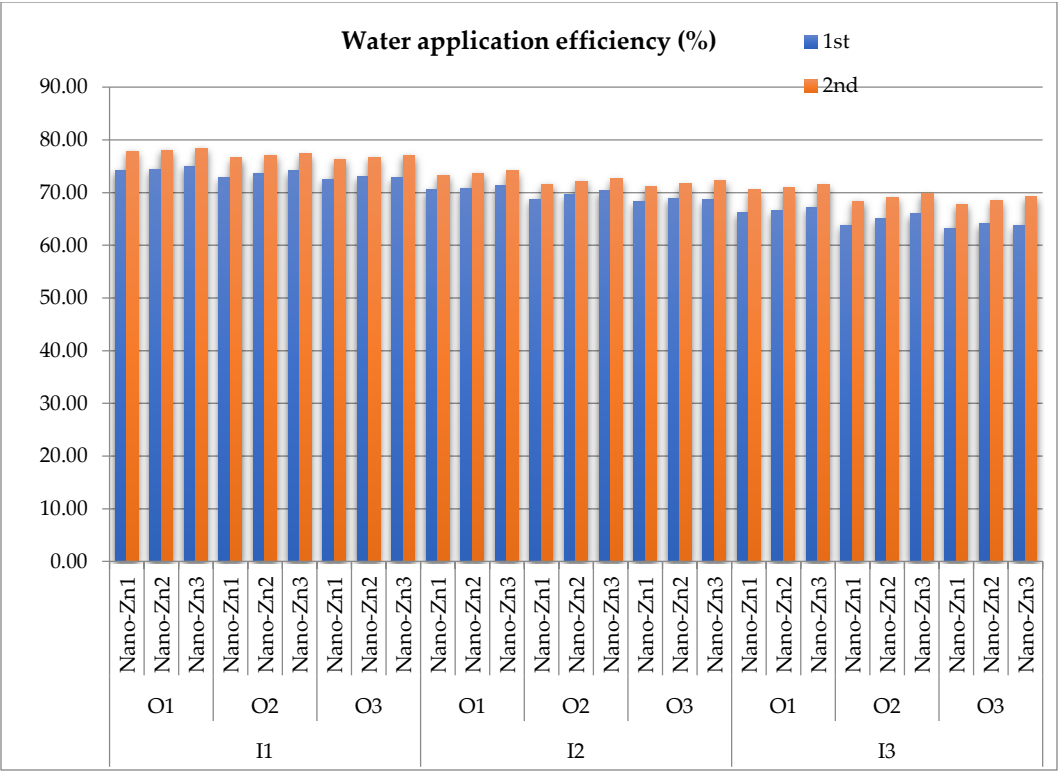
Supplementary Table S2: Effect of the interaction between different organic amendments and nano-Zn foliar spraying concentrations under irrigation supplements on all barley studied traits in 2018/19 and 2019/20 seasons.

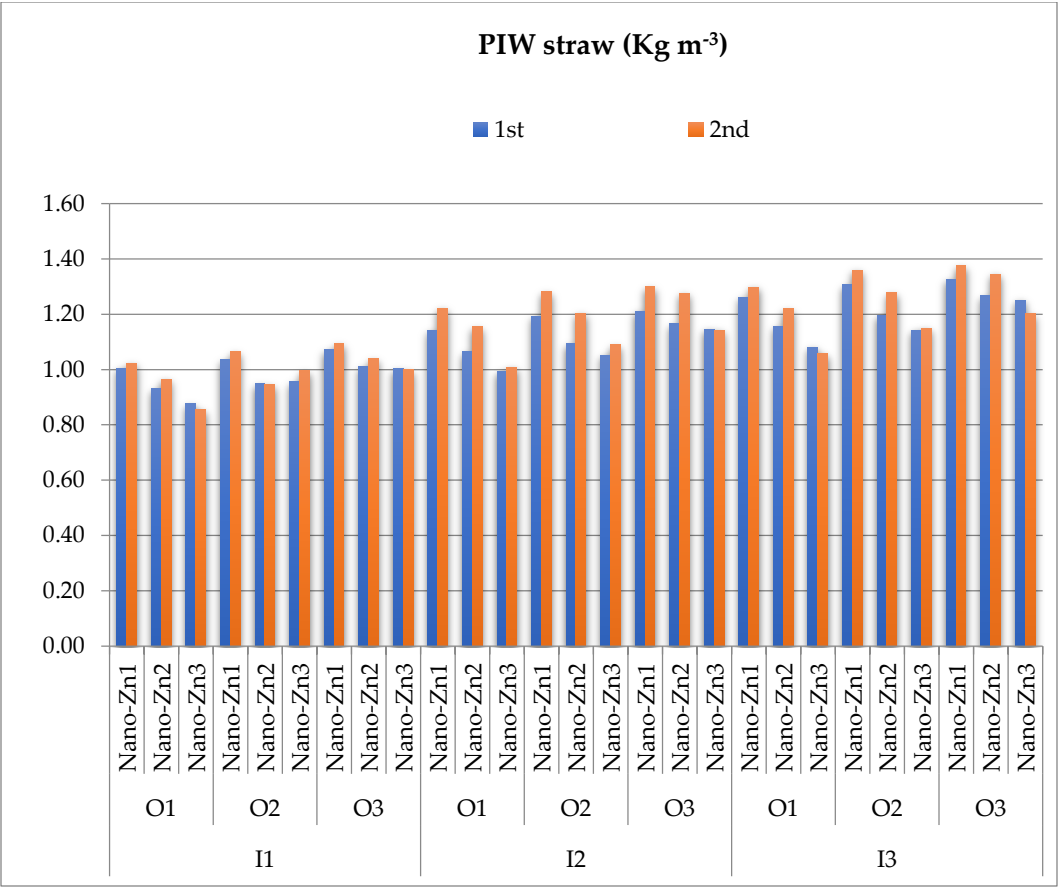
Season		1 st season, 2018/2019							2 nd season, 2019/2020						
Trait Treatment		BY ₁	GY ₁	SY ₁	TKW ₁	PH ₁	HI ₁	BY ₂	GY ₂	SY ₂	TKW ₂	PH ₂	HI ₂		
I ₁	O ₁	Zn ₁	8.27	4.33	3.94	55.02	82.67	52.37	8.41	4.51	3.90	57.40	86.33	53.67	
		Zn ₂	8.48	4.80	3.68	55.12	94.67	56.64	8.62	4.92	3.71	56.70	97.67	57.02	
		Zn ₃	8.65	5.11	3.54	57.8	96.67	59.07	8.79	5.45	3.34	59.51	99.33	62.03	
	O ₂	Zn ₁	8.62	4.76	3.86	58.77	91.67	55.24	8.76	4.91	3.85	60.04	93.67	56.02	
		Zn ₂	8.96	5.34	3.62	59.16	93.67	59.65	9.08	5.60	3.48	60.55	96.00	61.67	
		Zn ₃	9.16	5.43	3.73	59.27	97.33	59.35	9.29	5.57	3.72	60.45	99.00	59.98	
	O ₃	Zn ₁	8.78	4.83	3.94	58.04	92.33	55.09	8.92	5.02	3.90	59.42	94.67	56.32	
		Zn ₂	9.05	5.26	3.79	59.66	96.33	58.11	9.18	5.41	3.77	61.13	98.67	58.98	
		Zn ₃	9.24	5.52	3.73	59.76	99.33	59.70	9.38	5.69	3.69	60.62	100.67	60.66	
	O ₁	Zn ₁	8.14	4.23	3.91	54.89	80.33	52.02	8.28	4.41	3.87	57.24	84.00	53.35	
		Zn ₂	8.39	4.72	3.68	54.99	92.67	56.19	8.53	4.83	3.70	56.56	95.67	56.65	
		Zn ₃	8.52	5.02	3.50	57.66	94.67	58.96	8.65	5.37	3.29	59.35	97.67	62.03	
O ₂		Zn ₁	8.39	4.54	3.85	58.65	89.67	54.12	8.52	4.71	3.81	59.89	91.33	55.37	
		Zn ₂	8.59	4.95	3.63	59.02	91.67	57.68	8.72	5.07	3.65	60.39	94.00	58.10	
		Zn ₃	8.80	5.22	3.58	59.14	95.33	59.32	8.93	5.56	3.37	60.31	97.33	62.27	
I ₂	O ₃	Zn ₁	8.66	4.81	3.85	57.90	90.33	55.59	8.79	4.99	3.80	59.27	92.33	56.78	
		Zn ₂	8.94	5.15	3.79	59.53	94.33	57.62	9.07	5.26	3.81	60.99	96.67	58.03	
		Zn ₃	9.08	5.39	3.69	59.62	97.33	59.33	9.21	5.73	3.48	60.46	99.00	62.19	
	O ₁	Zn ₁	7.82	4.05	3.77	54.73	78.33	51.82	7.95	4.23	3.72	57.09	81.67	53.30	
		Zn ₂	8.07	4.57	3.50	54.84	90.67	56.62	8.20	4.66	3.54	56.44	93.33	56.84	
		Zn ₃	8.19	4.87	3.33	57.51	92.67	59.40	8.33	5.19	3.13	59.23	95.33	62.39	
	O ₂	Zn ₁	8.06	4.41	3.65	58.49	87.67	54.72	8.19	4.57	3.63	59.74	89.00	55.81	
		Zn ₂	8.26	4.81	3.45	58.88	89.67	58.23	8.39	4.90	3.49	60.27	91.67	58.42	
		Zn ₃	8.47	5.08	3.39	59.00	93.33	60.00	8.61	5.40	3.21	60.19	95.00	62.7	
	O ₃	Zn ₁	8.33	4.69	3.64	57.74	88.33	56.30	8.46	4.85	3.61	59.12	90.00	57.38	
		Zn ₂	8.61	5.04	3.57	59.39	92.33	58.49	8.74	5.13	3.61	60.87	94.33	58.71	
		Zn ₃	8.75	5.27	3.48	59.47	95.33	60.25	8.89	5.59	3.3	60.34	96.67	62.91	
LSD (I*O *Nano-Zn)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		

Abbreviations: Biological yield (BY) ton ha⁻¹ (TY), grain yield ton ha⁻¹ (GY), straw yield ton ha⁻¹ (SY), 1000-kernels weight g (TKW), plant height cm (PH), and harvest index% (HI).

Supplementary Figure S1: Total water applied, Stored water, Water application efficiency, and Irrigation water productivity for grain and straw (PIW, kg m⁻³) as affected by different treatments (irrigation supplements, organic amendments, and nano-Zn foliar spraying).







Irrigation supplements * Organic amendments * Nano-Zn foliar spraying