Significance of Phosphate Nano-Fertilizers Foliar Application: A Brief Real-Field Study of Quantitative, Physiological Parameters, and Agro-Ecological Diversity in Sunflower

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Table S1. Basic values of electrical conductivity and the pH of applied nano-fertilizers compared to applied water as a control variant.

	Control Variant with Water	nano/macro-ZnPhos	Nano-Hap
Electrical conductivity (mS.cm^{-1})	0.05 ± 0.001	1.309 ± 0.033	0.087 ± 0.001
pH	7.39 ± 0.005	8.60 ± 0.001	8.56 ± 0.004

Table S2. Comparison of monthly temperature and precipitation characteristics during the vegetation season of 2022 with the long-term norm from 1991 to 2020.

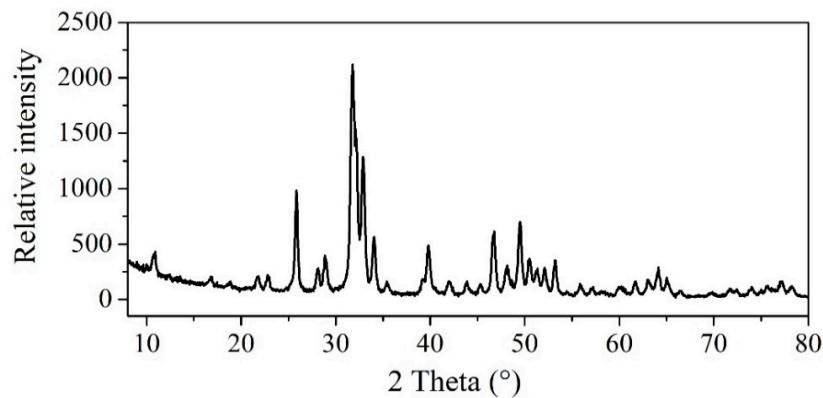| Month	2022 (°C)	Normal 1991-2020 (°C)	Delta t	Characteristic
Air temperature				
April	9.95	11.4	-1.5	Cold
May	18	16	2.0	Warm
June	22.97	19.6	3.4	Extraordinary warm
July	24.35	21.7	2.6	Very warm
August	24.23	21.1	3.1	Extraordinary warm
September	16.33	15.9	0.4	Normal
Precipitation (mm)				
April	69.9	36	194.2	Very wet
May	30.8	59	52.2	Dry
June	53.53	59	90.7	Normal
July	14.3	65	22.0	Extraordinary dry
August	48	55	87.3	Normal
September	42.4	58	73.1	Dry

Figure S1. X-ray diffraction powder patterns of hydroxylapatite formed from Sheelavati fish bone.
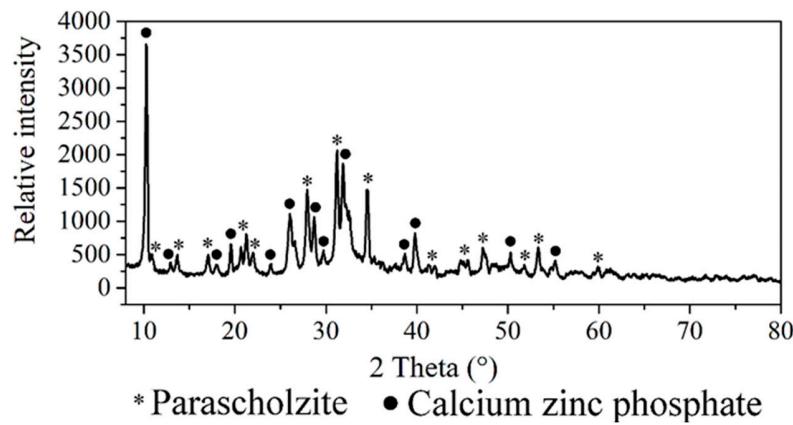

Figure S2. X-ray diffraction powder patterns the mixture of parascholzite and calcium zinc phosphate (nano/macro-ZnPhos) formed by chemical co-precipitation method.

Table S3. Abundance and dominance of the Coleoptera family in the studied treatments with sunflower at the Nitra-Dolná Malanta locality during vegetation season 2022.

Family	1	D1	2	D2	3	D3	Σ	D
Anthicidae	19	5.78	13	4.87	17	4.31	49	4.94
Carabidae	276	83.89	222	83.15	339	85.82	837	84.46
Coccinelidae	4	1.22	2	0.75	3	0.76	9	0.91
Dermestidae	13	3.95	4	1.50	11	2.78	28	2.83
Elateridae	1	0.30	-	-	1	0.25	2	0.11
Latridiidae	1	0.30	3	1.12	2	0.51	6	0.60
Scarabaeidae	-	-	3	1.12	-	-	3	0.31
Staphylinidae	15	4.56	20	7.49	22	5.57	57	5.75
Σ	329	100	267	100	395	100	991	100

1 - Control Variant (No Application); 2 - Nano-HAP (Foliar Applied Variant); 3 - Nano/macro-ZnPhos (Foliar Applied Variant); D1, D2, D3 – Dominance (%); D – Total dominance (%).

Table S4. Abundance and dominance of the *Carabidae* species in the studied treatments with sunflower at the Nitra-Dolná Malanta locality during vegetation season of 2022.

Species	1	D1	2	D2	3	D3	Σ	D
Amara convexiuscula	-	-	3	1.35	-	-	3	0.36
Brachinus crepitans	9	3.26	12	5.41	11	3.24	32	3.82
Brachinus explodens	-	-	1	0.45	-	-	1	0.12
Calathus fuscipes	19	6.88	-	-	18	5.31	37	4.42
Harpalus affinis	-	-	1	0.45	-	-	1	0.12
Poecilus cupreus	7	2.54	10	4.50	4	1.18	21	2.51
Pseudoophonus rufipes	240	86.96	194	87.39	294	86.73	728	86.98
Pterostichus nigrita	1	0.36	-	-	12	3.54	13	1.55
Zabrus tenebrioides	-	-	1	0.45	-	-	1	0.12
Σ	276	100	222	100	339	100	837	100

1 - Control Variant (No Application); 2 - Nano-HAP (Foliar Applied Variant); 3 - Nano/macro-ZnPhos (Foliar Applied Variant); D1, D2, D3 – Dominance (%); D – Total dominance (%).