IOCAG 2025 Conference

The 3rd International Online Conference on Agriculture

22–24 October 2025 | Online

MDPI

Grape Pomace Extract as a Biostimulant to Enhance Tomato and Cucumber Seeds Germination Under Salt Stress Conditions

Zineb El bouchikhy[1], Cristina García-Cano[1], Borja Ferrández-Gómez[1], Juana D. Jordá[1], Antonio Sánchez-Sánchez[1] , Mar Cerdán[1]

[1]Department of Biochemistry and Molecular Biology and Edaphology and Agricultural Chemistry, University of Alicante, Alicante, Spain.

INTRODUCTION & AIM

- Meeting the projected **70%** increase in global food production by 2050 is increasingly challenged by salinity stress, a major abiotic constraint that impairs plant growth, productivity, and food security[1].
- Grape pomace (GP) is an agro-industrial by-product rich in bioactive compounds, particularly polyphenols, giving its alkaline extract a strong biostimulant potential to enhance plant tolerance to abiotic stress[2].

This study aims to evaluate the biostimulant potential of grape pomace alkaline extract in enhancing seed germination and establishing stimulation and phytotoxicity thresholds in tomato and cucumber seeds under saline conditions.

METHOD

Preparation of the extract

- Fresh pomace was extracted with KOH under constant stirring for 24 hours at room temperature.
- The mixture was then vacuum-filtered to obtain the extract, referred to as GPe.

Germination Assay Procedure

- Seeds used: Cucumber (*Cucumis sativus* cv. Marketmore 76) and Tomato (*Solanum lycopersicum* cv. Seny F1).
- Growth chamber set at 25°C and 50% relative humidity at dark conditions.

Table 1. Characteristics of the different treatments used in the germination assay of tomato and cucumber.

Treatments	NaCl (mM)	Polyphenols (mM)	GPe (%)
C_n	0	0	0
N1	0	0.10	0.004
N2	0	0.25	0.01
N3	0	0.50	0.02
N4	0	1.0	0.04
C_s	50	0	0
S1	50	0.10	0.004
S2	50	0.25	0.01
S3	50	0.50	0.02
S4	50	1.0	0.04

Germination Parameters

Germination Percentage (GP)
Timson's Germination Index (TGI)
Germination Uniformity Coefficient (GUC)
Mean Germination Time (MGT)
Coefficient of Germination Rate (CVG)

Phytotoxicity Parameters

Relative Seed Germination (RSG)
Relative Root Growth (RRG)
Germination Index (GI)

RESULTS & DISCUSSION

Table 2. Effects of GPe on the germination parameters of tomato seeds under induced salinity stress. Results are expressed as mean ± standard deviation (n = 4). Mean values followed by the same letter within a column do not differ significantly ($p < 0.05$) according to Duncan's test.

Treatments	GP %	TGI (% day^{-1})	GUC	VG (%)	MGT(days)
C_n	95±4ab	66 ± 1.6e	0.0351 ± 0.0012a	33±2d	2.6 ± 0.1b
N1	89±8ab	69 ± 4e	0.0353 ± 0.0005*a*	36.07 ± 1.43e	2.81 ± 0.08bc
N2	94±8ab	70 ± 2e	0.0332 ± 0.003a	40 ± 4f	2.2 ± 0.2a
N3	95±4ab	59.0 ± 0.8cd	0.048±0.002*c*	27 ± 2*c*	3.06 ± 0.3c
N4	89 ± 4ab	46 ± 3a	0.049 ± 0.0012*c*	23 ± 2b	4.3 ± 0.3e
C_S	88 ± 5a	59 ± 2cd	0.045 ± 0.003*c*	22.2 ± 0.3b	4.49 ± 0.06e
S1	88±5a	61 ± 2d	0.040 ± 0.004b	29 ± 2c	3.68 ± 0.11d
S2	98 ± 2b	67 ± 2*e*	0.045 ± 0.002*c*	28 ± 2c	3.7 ± 0.4d
S3	92 ± 7ab	57 ± 4*c*	0.047±0.0008*c*	27±2*c*	4.6 ± 0.3e
S4	94 ± 8ab	52 ± 4 b	0.064 ± 0.006d	18.9 ± 0.9a	5.40 ± 0.08f

Table 3 Effects of GPe on the germination parameters of cucumber seeds under induced salinity stress. Results are expressed as mean ± standard deviation (n = 4). Mean values followed by the same letter within a column do not differ significantly ($p < 0.05$) according to Duncan's test.

Treatments	GP %	TGI (% day-1)	GUC	VG (%)	MGT(days)
Cn	100a	58±5	0.063a	100b	1a
N1	100a	69 ± 4a	0.064 ± 0.001*a*	96 ± 5b	1.04 ± 0.05*a*
N2	100a	70±2	0.063a	100b	1a
N3	100a	59 ± 0.8a	0.064±0.003*a*	96 ± 8b	1.04±0.09*a*
N4	100a	54 ± 3a	0.064 ± 0.001a	98 ± 4b	1.02 ± 0.09*a*
CS	98±5a	59 ± 2a	0.069 ± 0.003b	80 ± 3a	1.21 ± 0.09b
S1	100a	61 ± 2a	0.064 ± 0.001a	98 ± 7b	1.02 ± 0.05a
S2	100a	67±2a	0.063 ± 0.001a	100b	1a
S3	96 ± 9a	57 ± 4a	0.063a	100b	1a
S4	98±5a	52 ± 4a	0.067 ± 0.004b	85 ± 4a	1.14 ± 0.12b

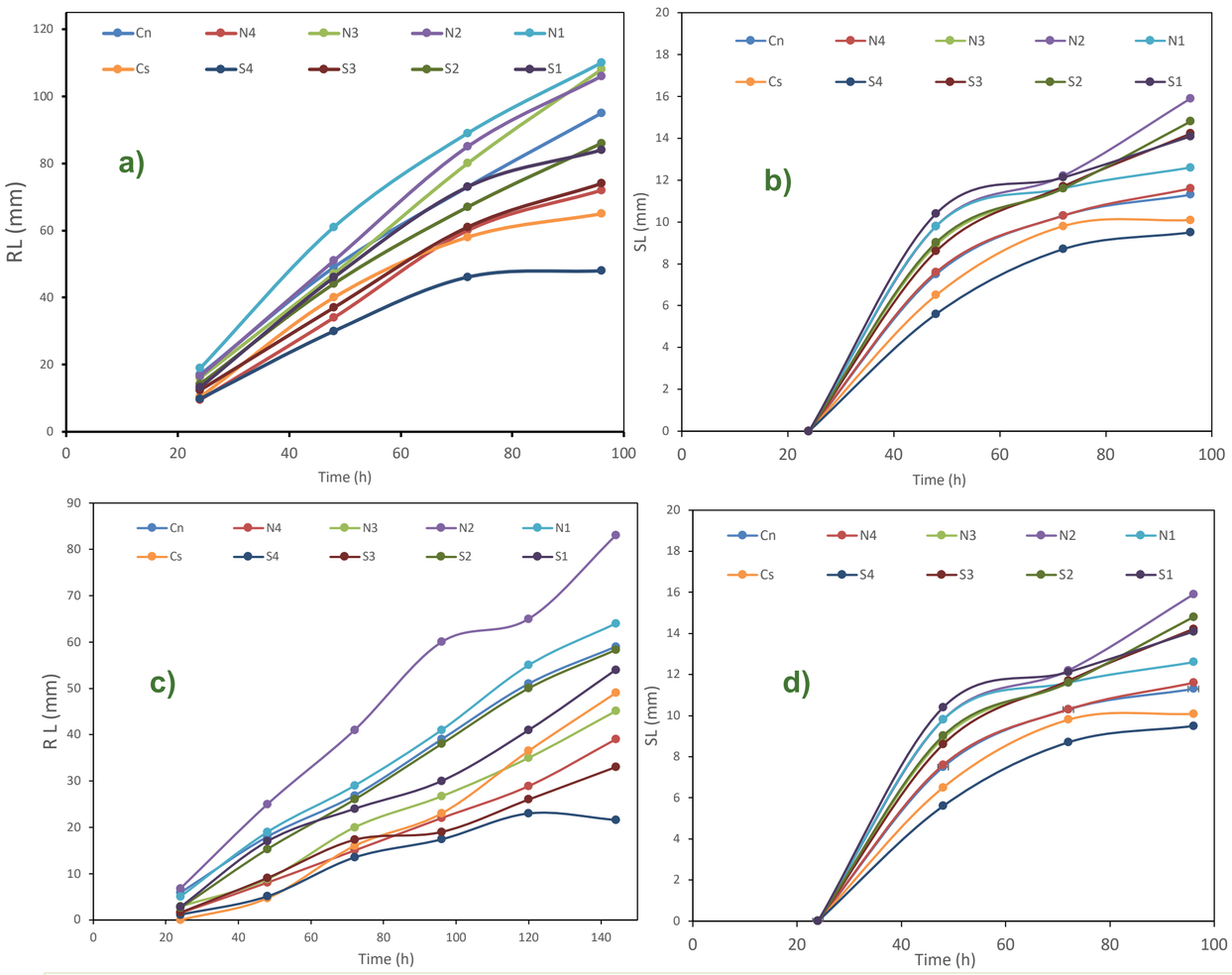

Figure 1. Effect of different concentrations of GPe on seed germination of tomato and cucumber, expressed as root (a, c) and shoot (b, d) length under induced salinity stress.

Table 4. Effect of the different treatments on the phytotoxicity of cucumber and tomato seeds under induced salinity stress. Results are expressed as mean ± standard deviation (n = 4). Mean values followed by the same letter within a column do not differ significantly ($p < 0.05$) according to Duncan's test.

Treatments	Tomato			Cucumber		
	%RRG	%RSG	%IG	%RRG	%RSG	%IG
C_n	100±5d	100±4ab	100±7c	100±4b	100ab	100±4b
N1	115±5ef	98±7ab	112±10d	116±6c	100ab	116±6c
N2	141±2g	103±4bc	146±8f	112±3c	100ab	112±3c
N3	76±3c	100±4ab	76±5b	114±7c	100ab	114 ± 7c
N4	69±2b	94±4a	65±2b	76±3a	100ab	76 ± 3a
C_S	100±6d	100±5ab	100±10c	100±5b	100±5ab	100±7b
S1	112±7e	108±4cd	121±11d	128±3d	102.32±0.01b	131±3d
S2	120±2f	112±5d	134±6e	131±5d	102.32±0.01b	134±5d
S3	69±3b	108±4cd	74±4b	113 ± 7c	96 ± 9a	114 ± 4c
S4	44±2a	101±5ab	44±4a	73 ± 4a	100 ± 5ab	73 ± 6a

FUTURE WORK / REFERENCES

[1].Searchinger, T., Waite, R., Hanson, C., Ranganathan, J., Dumas, P., Matthews, E., & Klirs, C. (2019). *Creating a Sustainable Food Future: a menu of solutions to feed nearly 10 billion people by 2050-final report*.

[2]. Schieber, A., Stintzing, F. C., & Carle, R. (2001). By-products of plant food processing as a source of functional compounds recent developments. *Trends in Food Science & Technology*, *12*(11), 401–413.

CONCLUSION

- **At low concentrations, the alkaline pomace extract stimulates the germination of tomato and cucumber seeds, even under salinity stress.**
- **At high concentrations, the extract exhibits phytotoxic effects, inhibiting germination due to its high polyphenol content.**