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K Sindhuja
 PG Scholar, Department of
 Vegetable science, College of
 Horticulture, S.K.L.T.S.H.U.,
 Rajendranagar, Hyderabad,
 Telangana, India

S Mallesh
 Assistant Professor, PGIHS,
 S.K.L.T.S.H.U., Mulugu,
 Siddipet, Telangana, India

Prasanna Holajjer
 Senior Scientist, National
 Bureau of Plant Genetic
 Resources, Regional Station,
 Rajendranagar, Hyderabad,
 Telangana, India

G Jyothi
 Scientist, Horticultural Research
 Station, S.K.L.T.S.H.U., Konda
 Mallepally, Telangana, India

S Praneeth
 Scientist, Floricultural Research
 Station, S.K.L.T.S.H.U.,
 Rajendranagar, Hyderabad,
 Telangana, India

Corresponding Author:
K Sindhuja
 PG Scholar, Department of
 Vegetable science, College of
 Horticulture, S.K.L.T.S.H.U.,
 Rajendranagar, Hyderabad,
 Telangana, India

Effect of gibberellic acid (GA₃) treatment on seed germination of turkey berry (*Solanum torvum* Sw.)

K Sindhuja, S Mallesh, Prasanna Holajjer, G Jyothi and S Praneeth

Abstract

Turkey berry (*Solanum torvum* Sw.) is one of the wild form of traditional Solanaceous vegetable. It is widely used as a rootstock in grafting of solanaceous vegetable crops. But in *Solanum torvum*, germination is poor and also it takes more number of days for germination. To overcome the issue of seed germination and to enhance the growth of seedling, seeds were subjected to the seed treatment. The present investigation was carried out with the objective of improving the seed germination of *Solanum torvum* using Gibberellic acid (GA₃). The experiment was conducted at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad during the year 2022-2023. Seeds were collected from ICAR-National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Hyderabad. Factorial Randomized Block Design was used with two factors as concentrations of GA₃ (C) (0 ppm, 250 ppm, 500 ppm, 1000 ppm and 2000 ppm) and duration of the treatment (D) as another factor (6 hours, 12 hours, 18 hours and 24 hours). Among the treatment combinations, GA₃ at 2000 ppm along with 24 hours of soaking resulted in the maximum percentage of germination, root length, shoot length, diameter and minimum number of days for germination.

Keywords: Seed treatment, turkey berry, germination, gibberellic acid (GA₃), soaking duration

Introduction

Turkey berry (*Solanum torvum* Sw.) is an erect perennial shrub which belongs to the family Solanaceae. Fruits are borne in clusters, small, green colour and become yellow on fully ripening. In branchlets, straight to slightly hooked prickles are present. Turkey berry is one of the known traditional vegetables but can't cultivate like other vegetable crops. It grows well in full sunlight condition and it cannot thrive under a closed forest canopy (Sarathkumar *et al.*, 2017) [10]. Steroids, steroid saponins, steroid alkaloids, and phenols are the major chemical constituents of Turkey berry. The stem and root of *S. torvum* have anti-bacterial, anti-viral, anti-inflammatory, anti-tumour, and other medicinally important effects (Yousaf *et al.*, 2013) [13]. *Solanum torvum* is widely used as a rootstock for solanaceous vegetables. *S. torvum* has been reported as bacterial wilt resistant root stock (Rahman *et al.*, 2002; Singh and Gopalkrishnan, 1997) [7, 11]. Grafting on *S. torvum* were completely resistant to bacterial wilt when the pathogen was inoculated even at higher concentrations (Ramesh *et al.*, 2016) [8] and also improved the survival and performance under excess moisture condition (Kumar *et al.*, 2016) [4]. In *S. torvum* seed germination is the major problem which reduces its use as rootstock in grafting of vegetables. To overcome the issue of seed germination and to enhance the growth of seedling, seed treatment must be required. GA₃ has promoting effect on germination and can be used as alternative seed enhancing treatment in *Solanum torvum* (Ozden and Demir (2016) [5]. The present study was carried out with the objective standardizing the concentration Gibberellic acid (GA₃) as well as duration of soaking for improving the seed germination of *Solanum torvum*.

Material and Methods

The present investigation entitled "Effect of Gibberellic acid (GA₃) treatment on seed germination of turkey berry (*Solanum torvum* Sw.)" was carried out at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad during the year 2022-2023. Seeds of Turkey berry (*Solanum torvum* Sw.) were collected from ICAR-National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Hyderabad. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. Factor one includes different concentrations of GA₃ (C): C₁ – 0 ppm, C₂ – 250 ppm, C₃– 500 ppm, C₄ – 1000 ppm and C₅– 2000 ppm.

Factor two includes various durations of seed soaking (D): D₁ – 6 hours, D₂ – 12 hours, D₃ – 18 hours and D₄ – 24 hours. The data with respect to seed germination percentage (%), number of days taken for seed germination, root length (cm), shoot length (cm), root to shoot ratio on length basis and diameter of seedling (mm) were recorded. The obtained data were statistically analyzed as method described by Panse and Sukhatme (1985) [6].

Results and Discussion

The effect of gibberellic acid (GA₃) treatment and duration of seed soaking on seed germination related parameters of *Solanum torvum* seeds are presented in the table 1.

The data pertaining to the germination percentage of seed showed significant differences among the gibberellic acid concentration, soaking duration and the interactions. Among the gibberellic acid concentration, GA₃ at 2000 ppm significantly recorded the maximum germination percentage (74.00%) while the minimum percentage of germination (47.42%) was recorded on GA₃ at 250 ppm. With respect to soaking duration, 24 hours of soaking significantly recorded the maximum germination (79.73%) and the minimum germination was recorded on 6 hours.

In case of interactions, the treatment combination of GA₃ at 2000 ppm along with 24 hours of seed soaking recorded significantly maximum germination percentage (94.00%). The minimum germination (15.67%) was recorded on GA₃ at 250 ppm along with 6 hours of seed soaking. GA₃ break the dormancy and enhance the seed germination within a short period of time (Kabilan *et al.*, 2022) [3]. The results obtained are in close conformity with those results of Ruminska *et al.* (1978) [9], Yogananda *et al.* (2004) [12] in hot pepper, Hayati *et al.* (2005) [1] and Kabilan *et al.* (2022) [3] in chilli.

Seeds treated with GA₃ at 2000 ppm significantly took minimum days for germination (11.42 days) whereas, GA₃ at 250 ppm took maximum number of days for germination (15.33 days). Among the soaking duration, 24 hours of soaking took minimum days (12.07 days) and maximum number of days for seed germination was recorded on 6 hours of soaking. In the interaction effects of gibberellic acid concentration and soaking duration, GA₃ at 2000 ppm along with 24 hours of soaking took minimum days for germination (9.33 days) whereas GA₃ at 250 ppm along with 6 hours of soaking took maximum number of days for seed germination (17.33 days).

The data with respect to root length (cm), shoot length (cm), root to shoot ratio on length basis and diameter of seedling (mm) at 30 and 60 days after sowing are presented in the table 2. Among the gibberellic acid concentrations, seeds treated with GA₃ at 2000 ppm recorded the maximum root length (2.11 cm and 7.53 cm, respectively) and shoot length (1.15 cm and 6.21 cm, respectively) at 30 and 60 days after sowing. The minimum root length (1.68 cm and 5.71 cm, respectively) and shoot length (0.88 cm and 4.68 cm, respectively) was recorded on GA₃ at 0 ppm at 30 and 60 days after sowing.

Regarding soaking duration, 24 hours of soaking recorded the maximum root length (2.05 cm and 6.94 cm, respectively) and shoot length (1.08 cm and 5.69 cm, respectively) whereas, minimum root length (1.73 cm and 5.97 cm, respectively) and shoot length (0.88 cm and 5.21 cm, respectively) was recorded on 6 hours at 30 and 60 days after sowing.

The effects of gibberellic acid concentration and soaking duration showed significant variation among the treatment combinations. The maximum root length (2.33cm and 1.60 cm, respectively) and shoot length (1.27 cm and 6.52 cm, respectively) was recorded on GA₃ at 2000 ppm along with 24 hours of soaking whereas, GA₃ at 0 ppm along with 6 hours of soaking recorded the minimum root length (1.60 cm and 5.46 cm, respectively) and shoot length (0.80 cm and 4.52 cm, respectively) at 30 and 60 days after sowing. The similar findings were reported by Jyoti *et al.* (2016) [2] in tomato and Kabilan *et al.* (2022) [3] in chilli.

Among the different concentrations of gibberellic acid, seeds treated with GA₃ at 2000 ppm recorded the minimum root to shoot ratio (1.83) and the maximum root to shoot ratio (2.07) was recorded on GA₃ at 500 ppm at 30 days after sowing. At 60 days after sowing, GA₃ at 1000 ppm recorded the minimum root to shoot ratio (1.10). With respect to soaking duration, at 30 days after sowing 6 hours of soaking recorded the maximum ratio (1.98) and minimum ratio was recorded on 24 hours of soaking (1.91). At 60 days after sowing, 12 hours of soaking recorded the maximum ratio (1.22) and minimum ratio was recorded on 6 hours (1.15) of soaking.

The effect of gibberellic acid concentration and soaking duration on the *Solanum torvum* seeds showed significant differences among the treatment combinations. At 30 days after sowing, GA₃ at 500 ppm along with 18 hours of soaking recorded the maximum root to shoot ratio (2.14) and minimum was recorded on GA₃ at 2000 ppm along with 12 hours of soaking (1.75). At 60 days after sowing, the minimum root to shoot ratio (1.07) was recorded on GA₃ at 1000 ppm along with 6 hours of soaking whereas, maximum was recorded on GA₃ at 2000 ppm along with 24 hours of soaking (1.31).

Seeds treated with GA₃ at 2000 ppm significantly recorded the maximum diameter (0.94 mm and 2.89 mm, respectively) whereas, the minimum diameter was recorded on GA₃ at 0 ppm (0.68 mm and 2.46 mm, respectively) at 30 and 60 days after sowing. With respect to soaking duration, 24 hours of soaking recorded the maximum diameter (0.86 mm and 2.77 mm, respectively) and 6 hours of soaking recorded the minimum diameter (0.71 mm and 2.60 mm, respectively) at 30 and 60 days after sowing.

In terms of interaction between the gibberellic acid concentration and soaking duration, the maximum diameter was recorded on the treatment combination of GA₃ at 2000 ppm along with 24 hours of soaking (1.04 mm and 2.96 mm, respectively) whereas, GA₃ at 0 ppm along with 6 hours of soaking recorded the minimum diameter (0.61 mm and 2.36 mm, respectively) at 30 and 60 days after sowing.

Table 1: Effect of gibberellic acid (GA₃) treatment and duration of seed soaking on seed germination related parameters of Turkey berry (*Solanum torvum* Sw.) seeds

Factors	Treatment Details	Seed germination percentage (%)		Number of days taken for seed germination (Days)	
Factor I: Gibberellic acid (GA₃) concentration (C)					
C ₁	GA ₃ @ 0 ppm	58.50		15.00	
C ₂	GA ₃ @ 250 ppm	47.42		15.33	
C ₃	GA ₃ @ 500 ppm	51.67		15.17	
C ₄	GA ₃ @ 1000 ppm	62.08		13.83	
C ₅	GA ₃ @ 2000 ppm	74.00		11.42	
SE (m) ±		0.351		0.550	
C.D at 5%		1.010		0.191	
Factor II: Soaking duration (D)					
D ₁	6 hours	34.73		16.40	
D ₂	12 hours	51.20		14.53	
D ₃	18 hours	69.27		13.60	
D ₄	24 hours	79.73		12.07	
SE (m) ±		0.314		0.171	
C.D at 5%		0.903		0.492	
I x II: Interactions					
T ₁	C ₁ D ₁	32.00		17.00	
T ₂	C ₁ D ₂	61.33		15.33	
T ₃	C ₁ D ₃	64.33		15.67	
T ₄	C ₁ D ₄	76.33		12.00	
T ₅	C ₂ D ₁	15.67		17.33	
T ₆	C ₂ D ₂	36.33		15.67	
T ₇	C ₂ D ₃	62.67		14.67	
T ₈	C ₂ D ₄	75.00		13.67	
T ₉	C ₃ D ₁	28.00		16.67	
T ₁₀	C ₃ D ₂	36.00		16.33	
T ₁₁	C ₃ D ₃	67.00		14.67	
T ₁₂	C ₃ D ₄	75.67		13.00	
T ₁₃	C ₄ D ₁	42.00		16.33	
T ₁₄	C ₄ D ₂	58.00		13.67	
T ₁₅	C ₄ D ₃	70.67		13.00	
T ₁₆	C ₄ D ₄	77.67		12.33	
T ₁₇	C ₅ D ₁	56.00		14.67	
T ₁₈	C ₅ D ₂	64.33		11.67	
T ₁₉	C ₅ D ₃	81.67		10.00	
T ₂₀	C ₅ D ₄	94.00		9.33	
SE (m) ±		0.703		0.383	
C.D at 5%		2.020		1.100	

DAS- Days After Sowing

Table 2: Effect of gibberellic acid (GA₃) treatment and duration of seed soaking on seedling parameters of Turkey berry (*Solanum torvum* Sw.) seeds

Factors	Treatment Details	Root length (cm)		Shoot length (cm)		Root to shoot ratio on length basis		Diameter of the seedling (mm)	
		30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Factor I: Gibberellic acid (GA₃) concentration (C)									
C ₁	GA ₃ @ 0 ppm	1.68	5.71	0.88	4.68	1.92	1.22	0.68	2.46
C ₂	GA ₃ @ 250 ppm	1.81	5.85	0.90	4.82	2.01	1.21	0.73	2.62
C ₃	GA ₃ @ 500 ppm	1.91	6.19	0.92	5.52	2.07	1.12	0.71	2.70
C ₄	GA ₃ @ 1000 ppm	2.00	6.71	1.05	6.08	1.92	1.10	0.86	2.77
C ₅	GA ₃ @ 2000 ppm	2.11	7.53	1.15	6.21	1.83	1.21	0.94	2.89
SE (m) ±		0.008	0.022	0.009	0.013	0.017	0.005	0.008	0.006
C.D at 5%		0.022	0.064	0.026	0.038	0.048	0.013	0.022	0.017
Factor II: Soaking duration (D)									
D ₁	6 hours	1.73	5.97	0.88	5.21	1.98	1.15	0.71	2.60
D ₂	12 hours	1.84	6.21	0.96	5.36	1.94	1.16	0.75	2.67
D ₃	18 hours	1.97	6.48	1.01	5.59	1.96	1.16	0.80	2.71
D ₄	24 hours	2.05	6.94	1.08	5.69	1.91	1.22	0.86	2.77
SE (m) ±		0.007	0.020	0.008	0.012	0.015	0.004	0.007	0.005
C.D at 5%		0.020	0.057	0.023	0.034	0.043	0.012	0.020	0.016
I x II: Interactions									
T ₁	C ₁ D ₁	1.60	5.46	0.80	4.52	2.01	1.21	0.61	2.36
T ₂	C ₁ D ₂	1.63	5.60	0.85	4.65	1.91	1.20	0.64	2.42
T ₃	C ₁ D ₃	1.70	5.71	0.91	4.74	1.88	1.21	0.68	2.48

T ₄	C ₁ XD ₄	1.79	6.08	0.95	4.82	1.88	1.26	0.78	2.56
T ₅	C ₂ XD ₁	1.67	5.65	0.83	4.65	2.01	1.21	0.66	2.51
T ₆	C ₂ XD ₂	1.80	5.75	0.87	4.77	2.08	1.21	0.70	2.61
T ₇	C ₂ XD ₃	1.83	5.82	0.92	4.88	1.99	1.19	0.74	2.66
T ₈	C ₂ XD ₄	1.92	6.17	0.98	4.97	1.96	1.24	0.80	2.71
T ₉	C ₃ XD ₁	1.72	6.03	0.86	5.27	2.00	1.14	0.62	2.59
T ₁₀	C ₃ XD ₂	1.82	6.14	0.89	5.48	2.05	1.12	0.67	2.67
T ₁₁	C ₃ XD ₃	2.03	6.24	0.95	5.63	2.14	1.11	0.74	2.74
T ₁₂	C ₃ XD ₄	2.08	6.36	0.99	5.69	2.10	1.12	0.80	2.79
T ₁₃	C ₄ XD ₁	1.81	6.11	0.88	5.71	2.06	1.07	0.82	2.72
T ₁₄	C ₄ XD ₂	1.94	6.34	1.02	5.86	1.91	1.08	0.85	2.75
T ₁₅	C ₄ XD ₃	2.08	6.83	1.08	6.30	1.93	1.09	0.87	2.78
T ₁₆	C ₄ XD ₄	2.15	7.57	1.22	6.45	1.77	1.17	0.90	2.84
T ₁₇	C ₅ XD ₁	1.86	6.57	1.01	5.88	1.85	1.12	0.85	2.81
T ₁₈	C ₅ XD ₂	2.02	7.21	1.15	6.05	1.75	1.19	0.90	2.87
T ₁₉	C ₅ XD ₃	2.21	7.77	1.18	6.41	1.88	1.21	0.97	2.91
T ₂₀	C ₅ XD ₄	2.33	8.54	1.27	6.52	1.83	1.31	1.04	2.96
SE (m) ±		0.015	0.044	0.018	0.027	0.034	0.009	0.015	0.012
C.D at 5%		0.044	0.127	0.051	0.077	0.096	0.027	0.044	0.035

DAS- Days after Sowing

Conclusion

From this study it could be concluded that, seed treatment done by different concentrations of gibberellic acid (GA₃) with various soaking duration were effected the seed germination and seedling growth of *Solanum torvum*. Among the different concentrations of gibberellic acid and seed soaking durations, GA₃ at 2000 ppm along with 24 hours of soaking found better in germination and growth of seedlings. In terms of interactions, GA₃ at 2000 ppm along with 24 hours of soaking recorded the maximum percentage of germination (94.00%) and improved growth of the seedlings of *Solanum torvum*.

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