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Evaluation of Physiological Seed Treatments on Seedling Quality parameters in Turkey Berry (*Solanum torvum* Sw.)

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A B S T R A C T

An experiment was conducted in Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2014–2015 with the aim of improving the germination and seedling quality characters of turkey berry. Both in paper and portray nursery medium, the seeds were germinated only under open atmospheric condition (32ºC and 20ºC during day and night, respectively) when compared to controlled condition (25ºC and 95± 5% RH). On standardization of physiological seed treatment with GA3, ethrel, IAA, thiourea, KNO_3 with different concentration and leaching for 6, 12, 18 and 24h duration expressed that seeds soaked in KNO_3 4% for 24 h by adopting seed to solution ratio of 1:1 volume by volume basis increased the speed of germination by 60 per cent, germination by 15 per cent, root length by 29.5 per cent and shoot length by 45 per cent over untreated seeds. The per cent increase over untreated seed for the dry matter production and vigour index was 68.42 and 65.8 per cent, respectively.

Introduction

Turkey berry (*Solanum torvum*) is a bushy, erect and spiny perennial plant belonging to Solanaceae. It is propagated by seed or branch cuttings taken from high yielding shrubs. Turkey berry also known as a popular traditional vegetable but can't cultivate like other vegetables. It grows best in full sunlight and does well under light shade but cannot survive under a closed forest canopy. Turkey berry single plants, groups and thickets are most frequently seen on roadsides, vacant lots, bushy pastures, recently abandoned farmland, landslides and river banks. Frugivorous birds eat the fruits and spread the seeds. So, area under production is not known (Ramamurthy *et al.*, 2012). It is an important medicinal plant in tropical and subtropical countries, is widely used like food and in folk medicine around the world (Yousaf *et al.*, 2013).

Turkey berry is used horticulturally as a rootstock for eggplant. Grafted plants are very vigorous and tolerate diseases affecting the root system, thus allowing the crop to continue for a second year (Petran and Hoover, 2014). But the seeds didn't germinate uniformly and studies on improvement of germination are very meagre and scanty. In the present scenario of increasing the

vegetable production and productivity to increase the uptake, generate employment and income to the people, quality seeds are required but, constraints are there for getting seeds which high in quality, and high cost of seeds. Production of quality seed and maintenance of high seed germination over the storage period are of most importance in a seed programme. To provide higher quality seeds, many researchers have developed new technologies called seed quality enhancement techniques. The main objective of this technique is to optimize the application of seed treatment products for improving the technical quality of seeds. In view of the above facts, the present study was taken up in turkey berry (*S. torvum*) with the objectives of standardizing the suitable physiological seed treatments.

Materials and Methods

Seeds of turkey berry (*Solanum torvum*) collected from Orchard, Horticultural Collage and Research Institute, Tamil Nadu Agricultural University, Coimbatore formed the base material for this study. The experiments and laboratory evaluations were carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. The S. torvum seeds were subjected to various physiological treatments viz., soaking in GA3, ethrel, IAA and thiourea for 50,100,200 ppm (6, 12, 18, 24 h), soaking in KNO_3 2%, 3% and 4% (6, 12, 18, 24 h) and leaching for 6, 12, 18, 24 h along with control seeds to standardize suitable physiological seed treatment by adopting seed to solution ratio of 1:1 as volume by volume basis by using different durations, kept in germination room maintained with 25 ± 2°C temperature and 90 ± 3% RH for 28 days, normal room temperature and also were sown in nursery along with control. The experiment was carried out with four replications in factorial completely randomised design (FCRD) and evaluated the following seed quality parameters.

Speed of germination

Four replicates of hundred seeds each were used to test the speed of germination of seeds from different treatments in paper medium. The seeds showing radical protrusion were counted daily from fourth day after sowing until twenty days. From the number of seeds germinated on each day, the speed of germination was calculated using the following formula and the results were expressed in number (Maguire, 1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots\ldots\ldots + \frac{X_n - X_{n-1}}{Y_n}$$

X1- Number of seeds germinated at first day
X2- Number of seeds germinated at second day
Xn- Number of seeds germinated on nth day
Y1- Number of days from sowing to first day
Y2- Number of days from sowing to second day
Yn- Number of days from sowing to nth day

Germination (%)

Four replicates of 100 seeds each were germinated by using paper (Between papers) medium under nursery condition. After the test period of 28 days the number of normal seedlings in each replication was counted and expressed in percentage (ISTA, 2007).

Root length (cm)

At the time of germination count, ten normal seedlings were selected at random from each replication and used for measuring the root length of seedlings. Root length was measured from the point of attachment of seed to the tip of primary root. The mean

values were calculated and expressed in centimetre.

Shoot length (cm)

The seedlings used for measuring root length were also used for measuring shoot length. The shoot length was measured from the point of attachment of seed to tip of the leaf and the mean values were expressed in centimetre.

Drymatter production (g seedlings^{-10})

The ten normal seedlings were placed in a paper cover and dried in shade for 24h and then, they were kept in an oven maintained at 80°C for 48h and allowed to cool in a desiccators for 30 minutes. The dried seedlings were weighed and the mean values were expressed in g seedlings-10.

Vigour index

Vigour index values were computed using the following formula and the mean values were expressed in whole number (Abdul-Baki and Anderson, 1973).

Vigour index = Germination percentage x Total seedling length (cm).

Statistical analysis

The data obtained from different experiments were analysed for 'F' test of significance following the methods described by Panse and Sukhatme (1985). Wherever necessary and the per cent values were transformed to angular (arc-sine) values before analysis. The critical differences (CD) were calculated at 5 per cent probability level. The data were tested for statistical signifinance (*). If F test is non-significant, it was indicated as NS.

Results and Discussion

The present study revealed that, seed doesn't germinate under controlled condition and normal room temperature. Treated seeds sown in nursery condition were germinated. Seedling quality parameters showed significant difference was obtained due to physiological treatments and soaking duration. The seeds either soaked with KNO_3 4% or leached with water germinated fastly by registering the value of 2.3 which was followed by other treatments with the value range of 2.1 to 1.9, irrespective of soaking duration. Among the soaking duration, seeds soaked for 18h and 24h showed higher value of 2.0 followed by seeds soaked for 12h and 6h (1.9). The untreated seed germinating slowly this recorded the value of 1.5.

Among the treatments, seeds leached with water recorded highest germination of 86% which was closely followed by seeds soaked with KNO_3 4% (85%) and on par to each other, irrespective of soaking duration. The untreated seeds recorded lowest germination of 73%. Among the soaking duration, seeds soaked for longer duration of 24h showed higher germination (82%) followed by 18h (80%), 12h (79%) and 6h (77%) which were on par to each other (Table 1).

For seedling length, the longest root length was observed in seeds leached with water followed by seeds soaked with KNO_3 4% by registering 5.5 cm and 5.4 cm, respectively irrespective of duration of soaking. The shortest route was noticed in control (4.4 cm). The maximum shoot length was observed in seeds either leached with water or soaked with KNO_3 4% (2.7 cm). The minimum shoot length was observed in control (2.0 cm). Seedlings obtained from seeds soaked with KNO_3 4% (0.0031 mg seedlings-10) followed

by seeds leached with water (0.0030 mg seedlings-10) produced the maximum dry matter, while the minimum was produced in control (0.0019 mg seedlings-10).

The computed vigour index values revealed that, the maximum vigour index was observed in seeds leached with water (701) followed by seeds soaked with KNO_3 4% (654), irrespective of duration of soaking. The lowest was recorded in control (431). Irrespective of treatments, seeds soaked for longer duration of 24h showed maximum vigour value of 583 and minimum was recorded by 6h soaked seeds. The superiority of best treatment was conformed with their interaction (Table 2 and Plate 1). The results stated that seeds treated with KNO_3 4% for 24 h improved the seed germination and quality characters by supplementing required light and temperature for germination of *Solanum torvum* seeds.

The promotion of germination by nitrate treatment has been suggested due to conversion to nitrate within the seed (Hendricks and Taylorson, 1975). Nitrate has been proposed to induce germination by enhancing pentose phosphate pathway activity in the seed through inhibition of catalase and increased oxidation of $NADPH_2$ (Roberts, 1973). Potassium nitrate acts as a substitute for light (Copeland, 1983) and the germination enhancing effect of KNO_3 was attributed to an increase in cytochrome oxidase activity (ISTA, 1976).

Plate.1 Effect of physiological seed treatment on vigour of seedlings

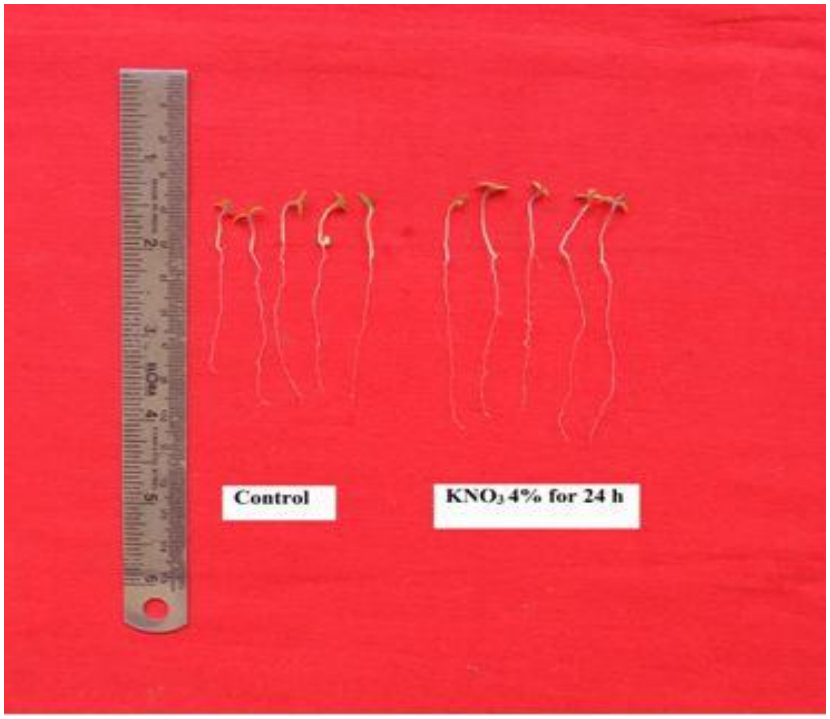

Table.1 Effect of physiological seed treatments on germination (%) in *Solanum torvum*

Treatments (T)	Germination (%)				Mean
	Soaking duration (D)				
	6h	12h	18h	24h	
GA_3 50 ppm	79 (62.73)	80 (63.43)	82 (64.90)	84 (66.42)	**81 (64.16)**
GA_3 100 ppm	80 (63.43)	81 (64.16)	79 (62.73)	85 (67.21)	**81 (64.16)**
GA_3 200 ppm	80 (63.43)	83 (65.65)	85 (67.21)	87 (68.87)	**84 (66.42)**
Ethrel 50 ppm	73 (58.69)	74 (59.34)	72 (58.05)	72 (58.05)	**73 (58.69)**
Ethrel 100 ppm	74 (59.34)	75 (60.00)	75 (60.00)	76 (60.67)	**75 (60.00)**
Ethrel 200 ppm	72 (58.05)	73 (58.69)	74 (59.34)	77 (61.34)	**74 (59.34)**
IAA 50 ppm	73 (58.69)	75 (60.00)	80 (63.43)	81 (64.16)	**77 (61.34)**
IAA 100 ppm	75 (60.00)	77 (61.34)	80 (63.43)	82 (64.90)	**79 (62.73)**
IAA 200 ppm	79 (62.73)	81 (64.16)	80 (63.43)	82 (64.90)	**81 (64.16)**
Thiourea 50 ppm	77 (61.34)	79 (62.73)	80 (63.43)	83 (65.65)	**80 (63.43)**
Thiourea 100 ppm	76 (60.67)	78 (62.03)	81 (64.16)	83 (65.65)	**80 (63.43)**
Thiourea 200 ppm	79 (62.73)	80 (63.43)	83 (65.65)	85 (67.21)	**82 (64.90)**
KNO_3 2%	80 (63.43)	81 (64.16)	82 (64.90)	84 (66.42)	**82 (64.90)**
KNO_3 3%	81 (64.16)	83 (65.65)	84 (66.42)	86 (68.03)	**84 (66.42)**
KNO_3 4%	83 (65.65)	84 (66.42)	86 (68.03)	88 (69.73)	**85 (67.21)**
Leaching	83 (65.65)	85 (67.21)	87 (68.87)	88 (69.73)	**86 (68.03)**
Control	73 (58.69)	73 (58.69)	73 (58.69)	73 (58.69)	**73** (58.69)
Mean	**77 (61.34)**	**79 (62.73)**	**80 (63.43)**	**82 (64.90)**	**76 (60.67)**

	T	D	T x D
SEd	1.50	1.25	1.02
CD (P=0.05)	2.01	2.50	2.01

Table.2 Effect of physiological seed treatments on vigour index in *Solanum torvum*

Treatments (T)	Vigour index				Mean
	Soaking duration (D)				
	6h	12h	18h	24h	
GA_3 50 ppm	510	534	566	604	**553**
GA_3 100 ppm	514	537	526	603	**545**
GA_3 200 ppm	520	557	575	616	**567**
Ethrel 50 ppm	473	501	483	499	**489**
Ethrel 100 ppm	506	514	506	508	**509**
Ethrel 200 ppm	502	500	532	551	**521**
IAA 50 ppm	475	516	541	546	**519**
IAA 100 ppm	503	537	536	551	**532**
IAA 200 ppm	535	552	563	537	**547**
Thiourea 50 ppm	533	509	547	547	**534**
Thiourea 100 ppm	513	545	549	549	**539**
Thiourea 200 ppm	528	540	569	593	**557**
KNO_3 2%	552	577	599	637	**591**
KNO_3 3%	575	613	640	687	**629**
KNO_3 4%	597	632	672	715	**654**
Leaching	651	686	722	743	**701**
Control	431	431	431	431	**431**
Mean	**525**	**546**	**562**	**583**	**554**

	T	D	Tx D
SEd	14.61	12.24	29.22
CD (P=0.05)	29.12	24.42	48.23

It is expressed that it is plausible to have enhanced germination due to KNO_3 which is the outcome of quantitative and qualitative shifts in protein synthesis induces by KNO_3. Dormancy sometimes imposed by paucity of oxygen caused by supra-optimal activity of the citric acid cycle which utilizes all available nitrogen.

Potassium nitrate has been reported to raise the ambient oxygen level by making less oxygen available for citric acid cycle (Bewley and Black, 1982). Copeland (1988) also considered KNO_3 as the most widely used chemical for promoting seed germination and expressed that in rice grass (Oryorpsis) KNO_3 was found to counteract light inhibition and promote the germination and found to interact with temperature for promotion of seed germination. In paddy, KNO_3 soaking was recommended for breaking dormancy of seeds (Anonymous, 1999). The next best treatment was seeds leached with water for 12h by registering increase in germination (12%) and vigour index (59.1%), followed by KNO_3 3% for 24h which might be due to leaching of chemicals present on the seed coat. Similar improvement in seed quality characters was reported by Butola and Badola (2004) in Abgelica glauca and Darrudi *et al.,* (2014) in *Rheum khorasanicum*.

In conclusion, the present study focused the seed treatment with KNO_3 4 % for 24h was superior for seed quality improvement in terms of speed of germination, germination, seedling vigour and dry matter production by supplementing required light and temperature for germination of *S. torvum* seeds and inferred that it is light required and thermoplastic crop.

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