RESEARCH ARTICLE

EFFECT OF PHYSICAL AND CHEMICAL SEED TREATMENTS ON GERMINATION AND VIGOUR INDEX IN AONLA (*EMBLICA OFFICINALIS*)

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Abstract: *Emblica officinalis* is an important medicinal plant and used as a constituent of ayurvedic and unani medicine. The seed showed dormancy and causes a big challenge in seed germination. Exogenous dormancy is observed due to non imbibitions of water by intact hard seed coat. Enhanced water imbibition rate (0.364-0.395gm/gm dry seeds/day) was observed in mechanically chipped treated seeds on 1st day soaking. The seeds taken under study were subjected to quick seed viability test (TZ) which showed 91-94% seed viability. The low value of electrical conductivity (0.219-0.230µmho/cm) of the seeds leachates, also indicated the high intactness of the seeds. The hot water treatment for 10 minutes recorded better germination (65-75%) as compared to the mechanical (chipping) treatment (35-40%). The chipped seeds treated with 0.5% KNO_3 was found most effective in enhancing germination percentage (95-100), vigour index and speed of germination over the GA_3 and Thiourea treatments. Thus the mechanically chipped seeds followed by imbibition of chemical (GA_3, KNO_3 and Thiourea) solution recorded synergistic action in terms of the better germination and the seedling vigour.

Keywords: *Emblica officinalis*, Dormancy, Germination, Scarification, Imbibition, Vigour index

INTRODUCTION

Emblica officinalis commonly known as aonla in hindi or Indian goose berry in english, belongs to the family Euphorbeaceae. It bears spherical, light green pulpy fruits in a cluster and is one of the richest sources of vitamins C, minerals such as calcium ,phosphorus, iron and magnesium .In traditional medicine it is known as one of the best rejuvenating herbs (Krishnaveni & Mirunalini 2010). All the part of the tree are medically important (Kumara et al., 2007), but the fresh fruit are more important and used as an excellent tonic, antiscorbutic, diuretic, stomachic and laxative. The dried fruits are considered to be a good blood purifier and refrigerant. Aonla fruits are also used in the preparation of Chyawanprash, pickles, jams, juice and in some cosmetics such as hair oil, hair dyes and shampoos and help to improving rural economy. But the seeds of Aonla exhibit a long dormancy period. Long term dormancy also causes a big challenges in germinating seeds to create problem in breeding programs. Thus there is a need to develop a method to break up the seed dormancy artificially. Improvement in germination rate and percentage may enable commercial propagation of this plant from seed instead of cutting .However the seeds of *E. officinalis* do not germinate easily therefore necessary pretreatments are required to overcome dormancy.

MATERIALS AND METHODS

The mature seeds of *Emblica officinalis* were collected from two different sources i.e. NBPGR, Pusa Campus, New Delhi and ANDUA&T, Kumarganj, Ayodhya, UP (lot 1 and lot 2) for this study. The study on imbibitions of water by the intact and chipped seeds, tetrazolium test and electrical conductivity of the seed lechates was carried out to work out the causes of dormancy and the seed viability. The seeds showed high level viability percentage (91-94) as tested with Triphenyl tetrazolium chloride (TZ). The electrical conductivity was also observed to find out the integrity of membranous system of seed which was found low i.e. 0.219 – 0.230 µmho cm^{-1} showing the viability of the seeds.

Mechanical Scarification: In mechanical scarification the surface of the seed were scarified by chipping or rubbing on the rough surface or sand paper.

Hot water treatment:The seeds were soaked in hot water (70^0C) for 10 , 20 and 30 minutes duration.

Chipping + Chemical treatment: The seeds were chipped and then treated with different concentrations of GA_3, KNO_3 and Thiourea for 24 hr. soaking duration.

i. **Gibberelic acid:** seeds were soaked in 100 , 200 and 300 ppm GA_3 concentration for 24 hr and then plated them on the moist filter / tissue paper for germination.
ii. **KNO_3:** seeds were soaked in 0.1%, 0.5% and 1% concentration of KNO_3 for 24 hr.
iii. **Thiourea :** seeds were soaked in 0.1% ,0.5% and 1% thiourea concentration for 24 hr.

Seed germination test: Germination test was conducted with four replicates of 25 seeds each, following the International Seed Testing Association

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(ISTA) method at 27^0C. The germinated seeds were categorized in to normal, abnormal, dead and hard seeds counted every day. Germination percentage was recorded on the basis of normal seedling only. Seeds were considered to have germinated when the radical has emerged out.

Vigour measurement: Vigour index was calculated as the product of seedling vigour (root + shoot length) and germination percentage.

Speed of germination: For calculating the speed of germination the germination counts were taken every 24 hr and seeds were considered germinated when 1 mm radical emerge .An index was computed for each treated lot by dividing the number seedlings removed each day by the day after planting on which they were removed.

$$\text{Speed of germination} = \frac{\text{No of seedling removed daily}}{\text{Days after planting}}$$

Statistical analysis: The data recorded for different parameters were analysed statically by method of analysis of variance as described by Cochran and Cox (1967) under completely randomized block design.

RESULTS AND DISCUSSION

The seeds of *Emblica officinalis* medicinal plants studied under two lots showed very poor germination under favourable germination conditions varying from zero to 10 percent .This nature of the seed dormancy which has also been ascribed to the condition of dormancy as per its definition proposed by Benech *et al.,* (2000).This finding also observed by other scientist regarding the occurrence of dormancy in *Emblica officinalis* (Pawsha *et al.,* 1997; Murugesh *et al*., 1998). The hot water 70^0C soaking treatments for 10 minute duration was significantly effective and enhanced the germination percentage (65-75) over untreated control (0 -5 %), the seedling vigour (5.2-6.0) was also recorded significantly higher than control (4.4 cm), the vigour index was recorded (338-450) and speed of germination (10.65-11.65) which are significantly higher than vigour index (22.0) and speed of germination (0.83) of untreated control. Pawshe *et al.,* (1997) also reported maximum germination in aonla i.e 44 percentage with 60^0C hot water soaking treatment followed by 24 hr. water soaking treatment i.e.33.33 percent compare to control i.e. 18.67 percent germination recorded after 14 days of sowing .This is attributed to the weakening of seed coat and overcoming the physical barriers against the growth of embryo, uptake of water and gaseous exchange.

The seed scarified by chipping treatment recorded significantly increased germination percentage (35-40), seedling vigour (5.8 -6.6 cm),vigour index (203-264) and speed of germination (4.05 -7.05) over untreated control .Out of the chipped seeds soaked in different concentration of GA_3 (100 , 200 and 300 ppm) the concentration of GA_3 (200 ppm) was found significantly superior in term of germination percentage (80-85) and vigour index (528-595) followed by 100 ppm conc .where germination percentage (70-75) vigour index (441-465) and in GA_3 (300 ppm) concentration the germination percentage (60-75), vigour index (390-472) were recorded over control The similar finding were reported by Dhankhar and Singh (1996) about effectiveness of GA_3 (200 ppm) reported the maximum germination percentage 75.98 and 64.14 in laboratory and pots respectively than the control in aonla..The results are also in conformity with the observation made by Manekar *et al.,* (2011) in which GA_3 200 ppm conc. Seed soaking treatment for 24 hrs was the best for increasing seed germination percentage and subsequent growth of aonla seedlings. But Kumari *et al.,* (2007) reported that 500 ppm GA_3 was found to be the most effective treatment and it significantly increased the seed germination (75.50 %). Gurung *et al*., (2014) also recorded maximum germination percentage (74) and higher vigour index in Passion fruits seeds treated with GA_3 500 ppm concentration.GA_3 enhance germination ,because it might have antagonized the effect of inhibitors present in aonla seeds (Kumari *et al.,* 2007) GA_3 also triggers hydrolytic enzyme activities during germination (Dhankar and Singh1996). Laishram *et al.,* (2015) observed that seeds treated with GA_3 500 ppm for 24 hrs produced the highest germination percentage (86) GA_3 might have helped in physically breaching, thereby removing the physiological barriers associated with the impermeable seed coats that causes seed dormancy. In Aonla seeds treated with GA_3 (100 to 200 ppm conc.) the consistent and progressive significant increase in the height of seedling over control was reported by Chandore *et al*.,(2016) which is due to cell elongation leading to increase in seedling height. Chiranjeevi *et al*., (2017) observed that the Aonla seeds pre-soaked with GA_3 200 ppm solution recorded the earliest germination (8.33 days), highest germination percentage (88.88%), faster rate of germination (1.07), maximum seedling height (28.47cm) and highest vigour index of seedling (202.6) compared to other treatment .The highest seedling vigour in GA_3 was attributed to enlarged embryos , higher rate of metabolic activity and respiration, better utilization and mobilization of metabolites to growing points and higher activity of enzymes. Enzymeatic and hormonal mechanism stimulate metabolic process such as sugar mobilization, proteins hydrolysis, oxidation etc. (Earlpuls and Lambeth 1974) which lead to increase in root /shoot length and seedling vigour.

The chipped seeds were treated with different concentration of KNO_3 (0.1, 0.5 and 1.0%) for 24 hrs duration. The 0.5% KNO_3 treatment showed maximum germination percentage (95-100) and vigour index (722-870) followed by 0.1% KNO_3 conc. With germination percentage (75-85), vigour index (585-629) and 1.0% KNO_3 conc. showed germination percentage (70-80), vigour index (609-640).Chiranjeevi *et al.,* (2017) recorded maximum

germination percentage (86.1), faster rate of germination (1.01),maximum seedling height (26.53 cm) seedling vigour (175.94) in 1.0 % KNO_3 treatment followed by 83.33% germination percentage and rate of germination 0.95 and seedling height 25.53, seedling vigour 172.21 in 2.0% KNO_3 over control ie. 52% germination.

The chipped seeds were soaked in different concentration of Thiourea (0.1, 0.5 and 1.0%) for 24 hrs. These all concentrations significantly increased the range of the germination percentage (75-95), seedling vigour (4.8-6.2cm), vigour index (384-513) and speed of germination (13.9-22.3) over the corresponding values of untreated control. The thiourea of 0.1% concentration was found significantly superior over 0.5 and 1.0 percent concentration in terms of germination percentage and speed of germination .Similar finding were reported by Chandore *et al.*, (2016) who observed the maximum seedling height from 55.30 cm to 60.14 cm with an application of thiourea concentration from 1 to 3 percent in aonla seeds.

Table 1. Effect of different pre showing seed treatments on germination, root / shoot length (seedling vigour), vigour index and speed of germination in different seeds lot of Aonla (*Emblica officinalis*).

Treatments	Germination (%)		Shoot length (cm)		Root length (cm)		Total		Vigour index		Speed of germination	
Seeds lot	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	5	0	2.9	0	1.5	0	4.4	0	22.0	0	0.83	0
Scarification (Mechanical)	40	35	4.1	3.5	2.5	2.3	6.6	5.8	264.0	203.0	7.05	4.05
Hot water												
10 min	75	65	3.5	3.2	2.5	2.0	6.0	5.2	450.0	338.0	11.65	10.65
20 min	60	50	2.7	2.9	1.8	1.5	4.5	4.4	270.0	220.0	10.6	9.23
30 min	35	40	3.2	3.0	2.5	2.2	5.7	5.2	199.0	208.0	8.71	7.1
Chipping + Chemical												
GA3 100 ppm	75	70	4.0	3.8	2.2	2.5	6.2	6.3	465.0	441.0	15.15	12.4
200 ppm	80	85	3.7	4.2	2.9	2.8	6.6	7.0	528.0	595.0	17.7	16.8
300 ppm	60	75	4.0	3.9	2.5	2.4	6.5	6.3	390.0	472.5	10.2	12.1
KNO_3 0.1%	75	85	4.5	4.3	3.3	3.1	7.8	7.4	585.0	629.0	11.9	16.1
0.5%	100	95	5.1	4.1	3.6	3.5	8.7	7.6	870.0	722.0	16.8	23.6
1.0%	70	80	4.9	4.7	3.8	3.3	8.7	8.0	609.0	640.0	14.6	15.3
Thiourea 0.1%	95	90	3.2	3.1	2.2	2.0	5.4	5.1	513.0	459.0	18.5	22.3
0.5%	75	85	3.7	3.2	2.5	2.1	6.2	5.3	465.0	450.5	14.4	15.1
1.0%	85	80	3.9	3.3	1.8	1.5	5.7	4.8	484.5	384.0	13.9	14.7
CD at 5%	4.80	4.2	0.265	0.223	0.237	0.137	0.45	0.407	37.58	24.91	0.595	0.787

CONCLUSION

The failure of viable seeds of Aonla to germinate due to non absorption of water indicated that their hard seed coat require seed scarification treatment for facilitating water uptake, gaseous exchange and protrusion of radicle to overcome the seed dormancy .The hot water and chipping treatment of seeds significantly increased the germination, vigour index and speed of germination over control. The chipped seeds treated with different concentration of GA_3, KNO_3 and Thiourea were found effective which significantly enhanced the germination percentage, vigour index and speed of germination over chipped seeds alone and non treated seeds.

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