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Effect of seed priming and different growing conditions on germination and seedling vigour of Aonla (*Emblica officinalis* Gaertn.)

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Abstract
An experiment was conducted to assess the effect of different seed priming treatments and growing conditions on seed germination and seedling vigour of Aonla. The experiment was carried out at College of Horticulture, Venkataramannagudem during January 2022 to May 2022 in Factorial Randomised Block Design with 3 replications comprising 16 treatment combinations. Seeds of Aonla were treated with GA_3 at different concentrations of 300, 500 and 700 ppm at different soaking period of 12 and 24 h under shade net and poly house conditions, along with water soaking for 24 h. The experiment results indicated that the combination of seed priming and growing condition with GA_3 @ 500 ppm for 24 hours + poly house recorded minimum number of days to germinate (7.93), maximum germination percentage (81.30%), height of seedling (53.67 cm), vigour index I (4,351.0), vigour index II (1003), chlorophyll content (54.16) and survival percentage (89.32%).

Keywords: Aonla, seed priming, gibberellic acid, growing condition, poly house

Introduction
Aonla botanically *Emblica officinalis* Gaertn. or Indian goose berry having the chromosome number of 2n=28, belongs to family Euphorbiaceae. It is native to tropical south eastern Asia, particularly Indian subcontinent. The fruit is highly nutritive and second richest source of ascorbic acid (400-565 mg/100 g pulp) after Barbados cherry (Singh *et al.*, 2022) [24]. The nutraceutical and therapeutic values of fruits are immense. It is one of the three constituents of the famous Ayurvedic preparation, Triphala, which is prescribed in many digestive disorders (Chopra *et al*., 1958) [4]. It is the basic constituent of Chyavanaprash and Amrit Kalash, the Ayurvedic medicinal preparations.

Aonla can be propagated both by sexual and asexual methods. The seeds of Aonla exhibit a long dormancy period due to the presence of impermeable seed coat which acts as a barrier to seed germination in Aonla (Pawshe *et al*., 1997) [17]. In this context comes seed priming where partial hydration of seeds and metabolic activity is attained in a desirable manner thereby allowing important pre-germination steps to be initiated within the seeds. Since seeds are physiologically closer to germination, primed seeds have increased germination rate, early germination, uniformity in germination, better growth attributes, faster emergence and better establishment (Farooq *et al.*, 2009) [6].

As concerned with Aonla seedlings, nursery is pre-requisite for meeting the quality seedlings demand and nursery management is a potential tool to execute the activity in successful way (Krishnan *et al*., 2014) [10]. Poly house plays a vital role in propagation of various seedlings in nurseries. Congenial climatic conditions under poly house is essential for better germination, early rooting and hardening of seedlings (Copeland and Donald, 1995) [5]. Aonla being a minor fruit crop, no systemic research work has been undertaken for improving the seed germination and seedling growth by using the plant growth regulators under different environmental conditions.

Therefore keeping all these points in view, the present study was undertaken to find out suitability of plant growth regulators with various concentrations and different growing condition in respect of seed germination and seedling growth.

Material and Methods
The present experiment “Studies on effect of seed priming treatments and different growing

conditions on germination and seedling vigour of Aonla (*Emblica officinalis* Gaertn.)" was carried out at College of Horticulture, Venkataramannagudem, Dr. Y.S.R. Horticultural University, West Godavari District. It was conducted during January 2022 to May 2022 and laid out in factorial RBD with three replications. The experiment comprised of eight treatments *i.e.* water soaking for 24 h (G_1), GA_3 300 ppm for 12 h (G_2), GA_3 300 ppm for 24 h (G_3), GA_3 500 ppm for 12 h (G_4), GA_3 500 ppm for 24 h (G_5), GA_3 700 ppm for 12 h (G_6), GA_3 700 ppm for 24 h (G_7), control (G_8) and grown under two environmental conditions *viz.* shade net (C_1) and poly house (C_2). Pre-treated seeds were sown in poly bags which were properly filled, labelled with tags and placed as per design. All cultural operations like regular irrigation, weeding etc. were carried out time to time. Various observations of seedling germination and growth parameters were recorded periodically. Light intensity was also recorded from both shade net and poly house on regular basis from the day of sowing up to 120 DAS using lux meter.

Results and Discussion

Data was recorded on different parameters *viz*., germination parameters and growth parameters of five randomly selected seedlings at regular intervals.

Days taken for initiation of seed germination

Seeds sown with GA_3 @ 500 ppm under poly house (T_{13}) took less number of days (7.93 days) for initiation of seed germination whereas, more number of days (13.87 days) taken for germination were recorded in control sown under shade net (T_8). Minimum days taken for initiation of germination by GA_3 treated seeds might be due to reason that GA_3 activates the hydrolysis of starch and their translocation which facilitated the earlier initiation of germination (Kumari, 2006) [12]. Similar findings on germination were reported by Vasantha *et al.* (2014) [26] and Rajendrakumar (2017) [19] in tamarind. Schutz (1999) reported that optimum temperature in poly house up to 34 °C increased seed germination and seedling growth of *Carex* species.

Germination percentage

Maximum germination per cent (81.30%) was obtained in the combination of seed priming with GA_3 @ 500 ppm for 24 hours under poly house growing condition (T_{13}) and minimum germination per cent (55.60%) was obtained in untreated seedlings (T_8). The increased germination with GA_3 might be due to fact that either GA_3 involved in the activation of cytological enzymes by stimulating amylase enzyme which convert insoluble starch into soluble sugars or might have antagonized the effect of inhibitors present in seeds (Kalyani *et al*., 2014) [9]. Poly house plays a vital role in propagation of various seedlings in nurseries. Congenial climatic conditions under poly house is essential for better germination, early rooting and hardening of seedlings (Copeland and Donald, 1995) [5]. These findings were supported by Rafeeq *et al.* (2020) [18] in *Morus alba* var. Kokuso.

Seedling height (cm)

Maximum seedling height (53.67 cm) was recorded in T_{13} (GA_3 500 ppm for 24 hrs + poly house) whereas, minimum seedling height (35.20 cm) was recorded in the control T_8 (no soaking + Shade net). The increase in height and stem girth as result of GA_3 application might be due to the fact that GA_3 increase somatic uptake of nutrients, causing cell elongation and thus increasing height and girth of the plant (Feucht and Watson, 1958) [7]. These results are in agreement with the findings of Brijwal and Kumar (2014) [3] in guava and Ratan and Reddy (2004) [20] in custard apple. Under poly house conditions seedlings got favourable conditions for their growth. This might be due to the fact that higher temperature during day time trapped short wave radiation in the greenhouse under partially closed conditions (Ganesan, 2002) [8]. Nimje and Shyam (1993) [15] also obtained similar results in tomato.

Vigour index

Highest vigour index I (4,351.0) and vigour index II (1,003.0) were recorded in T_{13} (GA_3 500ppm for 24 hrs + poly house) whereas lowest was recorded in T_8 (control). The highest seedling vigour index in GA_3 was attributed to enlarged embryos, higher rate of metabolic activity and respiration, better utilization and mobilization of metabolites to growth points and higher activity of enzymes. Enzymatic and hormonal mechanism stimulates metabolic process such as sugar mobilization, protein hydrolysis, oxidation *etc*. Similar reports of maximum seedling vigour index by GA_3 treatment were reported by Biradar *et al.* (2005) [12] in guava. The microclimatic conditions inside the poly house favoured the performance of Aonla seedlings in their vegetative characters which contributed to the higher vigour index in poly house seedling. Above results are in line with the findings of Verma *et al*. (2019) [27] in Aonla and Ashok *et al*. (2021) in curry leaf.

Total chlorophyll content (SPAD units)

Interaction of seed priming and growing condition showed the significant difference on chlorophyll content. Seeds treated with GA_3 @ 500 ppm soaked for 24 hours under the growing condition of poly house (T_{13}) recorded highest (54.16 SPAD) chlorophyll content and lowest (42.79 SPAD) in the untreated seeds (T_8). It was reported that GA_3 application has improved various biochemical parameters *viz*., chlorophyll 'a', chlorophyll 'b', carotenoids and leaf area in cashew (Lakshmipathi *et al*., 2017) [13]. Increased chlorophyll content was also due to increased light intensity inside poly house. These results are similar with the findings of the Verma *et al.* (2019) [27] in Aonla and in tomato by Sasirekha *et al*. (2018) [22].

Survival per cent of seedlings (%)

Maximum survival per cent (89.32%) of seedlings was recorded with GA_3 @ 500 ppm for 24 hours + poly house (T_{13}) and lowest was recorded in control (74.60%) under shade net (T_8). Higher germination percentage and higher seedling vigour index under GA_3 treatment may also have played a part in increasing the survival percentage (Brijwal and Kumar, 2013) [3]. These findings are in concordance with the results of Supe *et al.* (2012) [25] and Manekar *et al.* (2011) [14] in Aonla. Interior of the poly house became warm to warmer and temperature remained at optimum level (about 28 °C) for the growth and development of seedlings as a result that the air temperature inside the poly house gradually increased due to the greenhouse effect and paves way for higher survival % of seedlings (Kumari *et al*., 2014) [11]. The results are in conformity with the findings of Verma *et al.* (2019) [27] in Aonla.

Table 1: Effect of seed priming and growing conditions on initiation of germination (days), germination percentage and survival percentage of Aonla

	Treatments	Days taken for initiation of germination	Germination percentage	Survival percentage
T_1	Water soaking for 24 hrs + shade net	12.56	61.30	76.84
T_2	GA_3 300ppm for 12 hrs + shade net	11.54	64.12	80.12
T_3	GA_3 300ppm for 24 hrs + shade net	10.41	73.20	85.10
T_4	GA_3 500ppm for 12 hrs + shade net	9.52	77.40	87.86
T_5	GA_3 500ppm for 24 hrs + shade net	8.44	80.60	89.11
T_6	GA_3 700ppm for 12 hrs + shade net	11.98	68.77	82.42
T_7	GA_3 700ppm for 24 hrs + shade net	11.03	71.60	81.89
T_8	Control + Shade net	11.17	55.60	74.60
T_9	Water soaking for 24 hrs + poly house	12.33	62.40	79.43
T_{10}	GA_3 300ppm for 12 hrs + poly house	11.02	65.23	80.75
T_{11}	GA_3 300ppm for 24 hrs + poly house	10.02	74.80	85.40
T_{12}	GA_3 500ppm for 12 hrs + poly house	8.79	78.30	88.25
T_{13}	GA_3 500ppm for 24 hrs + poly house	7.93	81.30	89.32
T_{14}	GA_3 700ppm for 12 hrs + poly house	11.65	69.52	83.10
T_{15}	GA_3 700ppm for 24 hrs + poly house	10.75	72.30	82.03
T_{16}	Control + poly house	13.41	56.32	75.40
	SE m±	0.027	0.122	0.075
	CD 5% level	0.078	0.355	0.217

Table 2: Effect of seed priming and growing conditions on seedling height, seedling vigour and total chlorophyll content of Aonla 120 DAS

	Treatments	Seedling height (cm)	Vigour index I	Vigour index I	Total chlorophyll content (SPAD)
T_1	Water soaking for 24 hrs + shade net	37.79	2,074.0	366.0	45.44
T_2	GA_3 300ppm for 12 hrs + shade net	39.20	2,304.0	448.0	46.33
T_3	GA_3 300ppm for 24 hrs + shade net	47.30	3,330.0	740.0	50.86
T_4	GA_3 500ppm for 12 hrs + shade net	49.60	3,773.0	847.0	52.47
T_5	GA_3 500ppm for 24 hrs + shade net	52.79	4,240.0	960.0	53.97
T_6	GA_3 700ppm for 12 hrs + shade net	43.40	2,760.0	517.5	49.62
T_7	GA_3 700ppm for 24 hrs + shade net	41.60	2,840.0	556.8	47.27
T_8	Control + Shade net	35.20	1,650.0	247.5	42.79
T_9	Water soaking for 24 hrs + poly house	38.40	2,112.0	384.0	45.99
T_{10}	GA_3 300ppm for 12 hrs + poly house	40.90	2,345.0	466.0	47.13
T_{11}	GA_3 300ppm for 24 hrs + poly house	48.20	3,386.0	785.0	51.78
T_{12}	GA_3 500ppm for 12 hrs + poly house	50.10	3,810.0	883.0	53.12
T_{13}	GA_3 500ppm for 24 hrs + poly house	53.67	4,351.0	1,003.0	54.16
T_{14}	GA_3 700ppm for 12 hrs + poly house	45.34	2,812.0	537.0	51.03
T_{15}	GA_3 700ppm for 24 hrs + poly house	43.60	2,954.0	594.0	48.59
T_{16}	Control + poly house	35.60	1,687.0	258.0	43.90
	SE m±	0.091	13.02	3.71	0.055
	CD 5% level	0.265	37.80	10.77	0.160

Conclusion

Based on the results obtained in the above experiment it could be concluded that, seeds sown by treating with GA_3 @ 500 ppm for 24 hours under the poly house (T_{13}) showed best results with regard to germination parameters, growth parameters, production of vigorous seedlings and higher survival percentage as compared to other seed treatment and growing conditions. The results also revealed that among the growing conditions poly house and among the seed treatment GA_3 (500ppm + 24 h) were proved most promising as compared to others.

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