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Ooha M
Department of Silviculture and Agroforestry, FCRI, Mulugu, Hyderabad, Telangana, India

Dr. Milkuri Chiranjeeva Reddy
Assistant Professor, Department of Silviculture and Agroforestry Forest College and Research Institute, Mulugu, Siddipet, Telangana, India

Mhaiskar Priya Rajendra
Department of Forest Ecology and Climate Science, FCRI, Hyderabad, Telangana, India

Reeja Sundaram
Department of Tree breeding and Improvement, FCRI, Hyderabad, Telangana, India

Dr. Sreedhar Bodiga
Department of Basic and Social Sciences, FCRI, Hyderabad, Telangana, India

Indu Kale
Department of Forestry, IGKV, Raipur, Chhattisgarh, India

Bhargavi CH
Department of Forestry, IGKV, Raipur, Chhattisgarh, India

Rajashekar P
Department of Silviculture and Agroforestry, FCRI, Hyderabad, Telangana, India

Corresponding Author:
Dr. Milkuri Chiranjeeva Reddy
Assistant Professor, Department of Silviculture and Agroforestry Forest College and Research Institute, Mulugu, Siddipet District, Telangana, India

Studies on seed germination and seedling growth of *Strychnos nux-vomica* Linn.

Ooha M, Dr. Milkuri Chiranjeeva Reddy, Mhaiskar Priya Rajendra, Reeja Sundaram, Dr. Sreedhar Bodiga, Indu Kale, Bhargavi CH and Rajashekar P

Abstract
Seed germination and seedling growth of *Strychnos nux-vomica* were studied. The experiment was conducted in the nursery unit of Department of Silviculture and Agroforestry FCRI, Mulugu, Telangana during 2021-2022. The experiment was laid out in completely randomized design (CRD) with nine treatments and three replications. The experiment consisted of nine different pre sowing treatments for *Strychnos nux-vomica* seeds viz; water treatment for 6 hours (T_1), hot water treatment for 6 hours (T_2), IBA of 100 ppm for 24 hours (T_3), IBA of 200 ppm for 24 hours (T_4), GA_3 of 500 ppm for 24 hours (T_5), GA_3 of 1000 ppm for 24 hours (T_6), 25% Conc. H_2SO_4 for 2 minutes (T_7), 25% Conc. H_2SO_4 for 5 minutes (T_8) and Control (T_9). Ninety seeds of *Strychnos nux-vomica* were used for each treatment in three replications and these seeds were sown after treating them with above mentioned treatments on seed bed of 10 m x 1 m with potting media of soil, sand, and FYM in 2:1:1. Amongst all the treatments, seeds of *Strychnos nux-vomica* treated with GA_3 of 1000 ppm for 24 hours was found to be superior over the control and all other treatments in respect of seed germination percentage (67.7%), Germination period (78 days), Germination energy (52.2%), Survival percentage (93.4%) and Shoot length (25.6 cm), Root Length (18 cm), Collar diameter (1.2 cm), Number of leaves (15.67), Dry weight of shoot (1.7 g), Dry weight of root (0.87 g) of seedlings. It was concluded that GA_3 of 1000 ppm for 24 hours promotes good germination and growth of *Strychnos nux-vomica* under Telangana conditions.

Keywords: *Strychnos nux-vomica*, pre-sowing treatments, dormancy, GA_3

Introduction
Strychnos nux-vomica Linn. (Family Loganiaceae) commonly known as strychnine tree is one of the heavily exploited plant of tropical and sub-tropical region (Sarcar and Sarcar 1997) [23]. It is a medium-sized deciduous (sometimes semi-evergreen) tree native to South East Asia and Australia's tropical and subtropical climates. It can be found in wet deciduous and semi-evergreen forests in West Bengal, Bihar, Maharashtra, Odisha, Central and South India up to 500 m amsl (Joy *et al*. 1998) [12].

The plant is much prized in India and world for the poisonous alkaloids strychnine and brucine present in seed and other plant parts (Tewari 2000) [25]. The seeds are bitter and used as aphrodisiac, appetizer, digestive, stimulant and also in the treatment of anaemia, lumbago, asthma, bronchitis, constipation, diabetes, malarial fever, skin disease, paralysis, muscle weakness, insomnia, nervous debility, dyspepsia, diarrhoea, hysteria, mental emotions, epilepsy, chronic constipation, gout, chronic rheumatism, hydrophobia (Victor *et al*. 2016; Bhati *et al.* 2012; Prakasha *et al*. 2010) [2, 20]. The root bark is useful in cholera, snakebite and intermittent fever (Katiyar *et al*. 2010; Chitra *et al.* 2010) [13, 7]. The leaves are applied as poultice in the treatment of chronic wounds and ulcers (Nadkarni 1954) [17].

Because of its enormous medicinal use, most of the seed demand for domestic use and export were collected from forests by the tribal and peoples of economically backward classes. They often lop the branches or cut the trees for collection of fruits (Bodeker, 1997) [5]. The availability of seeds of this species is reducing season by season due to increased exploitation, decreased plant population, habitat destruction and erratic bearing because of climate change (Prakasha *et al*. 2010) [20]. Poor regeneration, ruthless cutting of matured trees for charcoal production and saplings for fire wood, habitat loss and heavy trading of seeds are compelling this poison nut plant to restrict in few areas (Chaubey and Krishnamurthy 2015) [6].

In near future, it may become endangered if adequate measures are taken for ensuring its sufficient natural regeneration and conservation measures.

Currently, there is a need for mass propagation for future plantation along with creating awareness among the indigenous people, villagers and various forest divisions to conserve and protect this valuable species by means of plantation. Hence keeping in view the importance, utility and availability of the species, the present investigation planned to study the effect of pre sowing treatments on seeds in order to break the seed dormancy to increase the germination rate and standardize some pre-sowing treatments for growing of *Strychnos nux-vomica* in Telangana region.

Materials and Methods

The present study was conducted in the Nursery unit of Silviculture and Agroforestry Department, FCRI, Mulugu, Hyderabad, Telangana during 2021-2022. The area is located at 17º72.854' N lat and 78^{0}63.296' E long. The climate of the area is Tropical. Temperature ranges from 18 °C to 42 °C with 905 mm annual rainfall.

Strychnos nux-vomica seeds were collected from Eturnagaram forest area, Bhupalpally district, Telangana in October 2021 and seed dried for one week in a shady area. The pre sowing treatments details were represented under Table 1. Pre-treated seeds were sown on primary bed (10 m x 1 m) with potting media (soil, sand and FYM in ratio of 2:1:1) under shade net conditions. Seed experiment consists of 9 treatments and each treatment replicated thrice with 90 seeds per treatment with CRD design. Seed germination data were collected every day and seedling data were collected at 45 days interval till 3 months and biomass data were collected at 90 days after sowing. One-way Analysis of variance (ANOVA) was carried out to analyse the data. Data were analysed using MS Excel and Statistical (OPSTAT).

Table 1: Pre-sowing treatment details of *Strychnos nux-vomica*

T_1 - Water treatment for 6 hours
T_2- Hot water treatment for 6 hours
T_3- IBA 100 ppm for 24 hours
T_4- IBA 200 ppm for 24 hours
T_5- GA_3 500 ppm for 24 hours
T_6- GA_3 1000 ppm for 24 hours
T_7- 25% Conc. H_2SO_4 for 2 minutes
T_8- 25% Conc. H_2SO_4 for 5 minutes
T_9- Control

Results and Discussions

Germination parameters: Data presented in Table 2. Showed that, significant differences at the 5% level among different treatments applied. The observations showed that the maximum (67.70%) germination percentage was recorded in seeds treated with GA_3 of 1000 ppm for 24 hrs (T_6) and the minimum (28.80%) germination with 25% sulphuric acid for 2 min (T_7). The efficacy of GA_3 treatment in breaking dormancy depends on the concentration and length of incubation (Hidayati *et al*. 2000; Tigabu and Ode´n 2001; Schelin *et al*. 2003) [10, 27].

However, the maximum germination energy (52.20%) was recorded in seeds treated with (T_6) GA_3 of 1000 ppm conversely, the minimum germination energy (21.10%) was recorded in (T_7) *i.e*., seeds treated with 25% sulphuric acid for 2 min. This obtained result goes in line with the findings of Maharana *et al.* (2018) [15] who reported that the seeds of *Gmelina arborea* recorded highest germination energy (35.83%) when treated with GA_3 of 200 ppm and also by Kumar *et al*. (2014) [28] on *Pinus gerardiana* reported that highest germination energy (9.30%) was obtained in seeds treated with GA_3 of 150 ppm for 24 hours.

The shorter germination period (46.00 days) was noticed in the seeds treated with water treatment for 6 hours (T_1) and on the contrary, the longer period of germination (78.00 days) was noticed in the seeds treated with GA_3 of 1000 ppm for 24 hrs (T_6) and 63.00 days was observed in Control. The maximum survival percentage (93.40%) was recorded in (T_6) i.e., treatment with GA_3 of 1000 ppm for 24 hrs while the minimum survival percentage (57.60%) was recorded in (T_7) i.e., 25% Sulphuric acid for 2 minutes compared to Control (76.60%). These results are in agreement with those obtained by Bosale (2014) [3], who recorded that GA_3 treatment had the highest survival percentage (92.27 percent) in *Semecarpus anacardium* seedlings. Manekar (2011) [2] discovered that soaking *Emblica officinalis* seeds in GA_3 200 ppm for 24 hours resulted in the highest seedling survival percentage (92.73 percent).

Table 2: Effect of different pre sowing treatments on Germination parameters of *Strychnos nux-vomica*

Treatments	GP (%)	GE (%)	G.PE(days)	SP (%)
T_1	41.10	35.50	46.00	78.30
T_2	45.50	35.50	67.00	82.90
T_3	48.80	40.00	66.00	75.00
T_4	51.10	41.10	54.00	80.40
T_5	55.50	47.70	63.00	84.00
T_6	67.70	52.20	78.00	93.40
T_7	28.80	21.10	65.00	57.60
T_8	43.30	38.80	69.00	76.90
T_9	33.30	28.80	63.00	76.60
SEm±	1.34	0.97	0.98	1.21
CD(@5%)	5.45	3.97	3.99	4.91

*GP - Germination percentage * GE - Germination energy * G.PE - Germination period * SP- survival percentage * SEm± - Standard error mean * CD (@ 5%) – Critical difference at 5% level of significance

Growth Parameters: Overall results showed significant differences at the 5% level among different treatments applied. Data in Table 3 reveals about the influence of different pre sowing treatments on growth parameters of *Strychnos nux-vomica* seedlings. The maximum root length ((13.67 cm), shoot length (21.3 cm), number of leaves (12), collar diameter (1cm) after 45 days of sowing was observed in (T_6) i.e., GA_3 of 1000 ppm for 24 hours and on contrary minimum root length (8.33 cm), shoot length (11.3 cm), number of leaves (6.3), collar diameter (0.3 cm) were noticed in Control.

The root length, shoot length, number of leaves, collar diameter showed significant increase with increase in number of days and the same trend was followed after 90 days of sowing with maximum root length (18 cm), shoot length (25.6 cm), number of leaves (15.6), collar diameter (1.2 cm) was observed in GA_3 of 1000 ppm for 24 hours (T_6) conversely lowest root length (10.6 cm), shoot length (14.6 cm), number of leaves (9.67), collar diameter (0.53 cm) was recorded in T_9 *i.e*., Control.

Comparison between root length, shoot length, collar diameter, number of leaves of 45 days with 90 days were represented under figure 1-4. Similar works conducted by Banker, 1987 and Bhujbal, 1975 on *Carissa carandas* L. and *Phyllanthus emblica* respectively reported the action of GA_3 induced better shoot length and also supported by

Thounaojam and Dhaduk (2020) [26] where *Buchanania lanzan* seedlings has shown highest shoot length (10 cm) with GA_3 @ 900 mg/l for 24 hrs treatment. Patel *et al*. (2018) [18] who reported that maximum root length (30.43 cm) was recorded in *Pterocarpus santalinus* when treated with 500 ppm GA_3 for 1 day and also Supama *et al*. (1993) [24] in *Gloriosa superba*, Joshi *et al.* (2017) [11] in *Buchanania lanzan* and Krishnan and Kulshekaran (1984) [14] in *Zyzyphus rotundifolia* where GA_3 (200 ppm) induced the maximum number of leaves. The work conducted by Hemalatha and Chaudari (2021) [9] also reported that maximum (2.23 mm) collar diameter was recorded in the *Santalum album* when seeds were treated with GA_3.

Table 3: Effect of different pre sowing treatments on Growth parameters of *Strychnos nux-vomica*

Treatment details	Root length (cm)		Shoot length (cm)		Collar diameter (cm)		No. of leaves		Dry weight of Shoot (g)	Dry weight of Root(g)
	45D	90D	45D	90D	45D	90D	45D	90D	90D	90D
T_1	11.00	15.00	17.00	20.30	0.73	0.93	9.33	13.67	1.40	0.60
T_2	11.30	14.30	17.60	22.00	0.80	1.00	10.00	14.00	1.47	0.70
T_3	12.00	15.30	15.30	20.00	0.73	0.87	8.33	11.67	1.30	0.57
T_4	10.80	14.30	14.60	19.00	0.67	0.87	8.00	12.00	1.27	0.57
T_5	12.50	15.30	20.30	24.60	0.93	1.13	11.00	15.67	1.50	0.83
T_6	13.60	18.00	21.30	25.60	1.00	1.20	12.00	15.00	1.70	0.87
T_7	9.00	11.60	13.30	17.30	0.57	0.77	7.67	11.33	1.27	0.53
T_8	9.30	11.10	17.30	22.30	0.77	0.97	9.67	13.33	1.43	0.60
T_9	8.30	10.60	11.30	14.60	0.33	0.53	6.33	9.67	1.17	0.43
SEm±	0.56	0.87	1.01	0.98	0.08	0.07	0.85	0.88	0.07	0.05
CD (@ 5%)	2.30	3.55	4.12	3.99	0.31	0.30	3.47	3.59	0.29	0.22

For biomass (shoot and root) data was taken at 90 days after sowing. Significantly highest dry weight of Shoot (1.7 g) was recorded in (T_6) soaking of seeds in 1000 ppm GA_3 for 24 hours treatment. While, minimum dry weight of shoot (1.17 g) was recorded in (T_9) i.e., Control. Significantly highest dry weight of root (0.87 g) was recorded in 1000 pm GA_3 for 24 hours (T_6) treatment. While, minimum dry weight of root (0.43 g) was recorded in Control (T_9) treatment.

These results can be very well supported with the findings of Bosale (2014) [3] in *Semecarpus anacardium* seeds when treated with GA_3 250 ppm recorded highest dry weight of shoot (2.01g) and also Sajana (2016) [22] who also reported that highest dry weight of shoot (2.86g) in *Semecarpus anacardium* when treated with GA_3 400 ppm and also in accordance with the study of Pawar *et al*. (2010) [19] on Jatropa where maximum dry weight of shoot was 14.3 g respectively by the treatment of GA_3 and Thounaojam and Dhaduk (2020) [26] on *Buchanania lanzan* with maximum dry weight of shoot (72.45 mg) with GA_3 @300 mg/l for 24 hrs treatment. Bajanya *et al.* (2018), in *Manilkara hexandra* when treated with 200 ppm GA_3 produced highest dry weight of root (0.46g).

Sajana (2016) [22] also reported that *Semecarpus anacardium* seeds treated with GA_3 400 ppm have produced the maximum dry weight of root (6.96 g) and also in accordance with the study of Pawar *et al*. 2010 [19] on Jatropa where maximum dry weight of root was 4.3 g, respectively by the treatment of GA_3 which are in conformity with the present work.

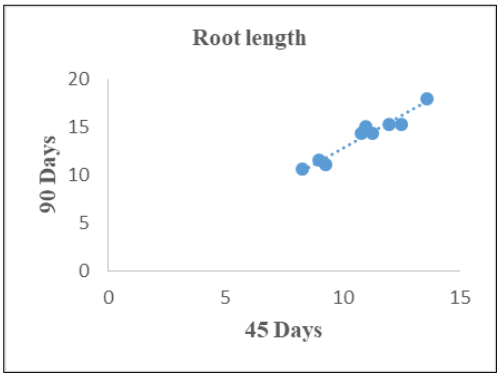

Fig 1: Correlating Root length of 45 days with 90 days

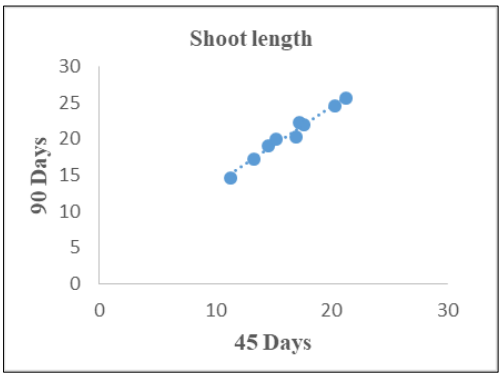

Fig 2: Correlating shoot length of 45 days with 90 days

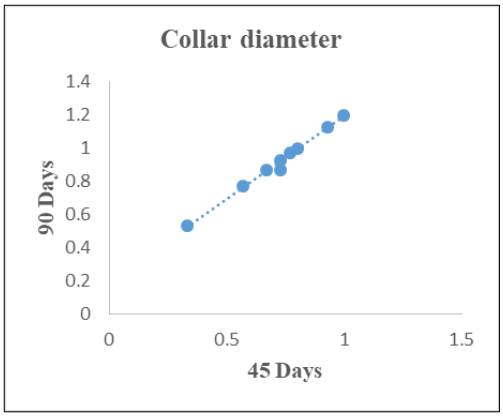

Fig 3: Correlating collar diameter of 45 days with 90 days

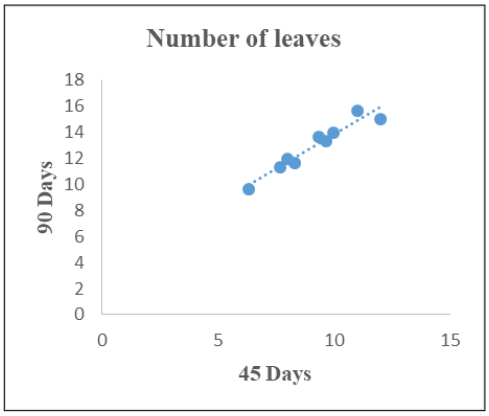

Fig 4: Correlating no. of leaves of 45 days with 90 days

Conclusion

Pre-sowing treatments had significantly influenced the germination parameters and growth parameters of *Strychnos nux-vomica* seedlings. Amongst all the treatments, Seeds of *Strychnos nux-vomica* treated with GA_3 1000 ppm was found to be superior over the other treatments in respect of Germination percentage, Germination period (days), Germination energy (%), Survival percentage and Shoot length(cm), Root Length (cm), Collar diameter(cm), Number of leaf, Dry weight of shoot (g), Dry weight of root (g) of seedlings.

Therefore, it is suggested to apply GA_3 treatment for good germination and growth of *Strychnos nux-vomica* seedlings.

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