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Effect of different Chemical and Physical Treatments on Germination and Seedling Vigour of Chironji (*Buchanania lanzan* Spreng.)

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Abstract
An experiment was conducted to see the effect of different chemicals and physical treatments on germination and seedling vigour of chironji (*Buchanania lanzan* Spreng.). Result revealed that minimum number of days (29.18 days) for seed germination, number of days for 50 per cent seed germination(36.02 days), maximum germination percentage after 30 days(2%), and germination index (0.94%) were observed in treatment T_7 (mechanical scarification breaking of seed coat through hammering) and treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.) was recorded the maximum value of survival percentage(62.92%), seedling height(6.38 and 9.79 cm), number of leaves per plant(4.11 and 6.16), leaf area(16.75 and 24.07 cm^2), collar diameter (0.18 and 0.29 cm), root length(9.63 and 12.73 cm) at 60 and 90 DAS, respectively. Similarly maximum fresh shoot weight (7.18 g), fresh root weight (3.8 g), shoot and root ratio (0.93), dry shoot weight (4.66 g), dry root weight (1.86 g) and seedling vigour index (682.07) was also notice in treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.) at 90 DAS.

Keywords: Chironji, germination index, seed, vigour, GA_3, scarification

Introduction
Chironji (*Buchanania lanzan* Spreng) is a common agro-forestry and social forestry fruit tree. It has gained a lot of popularity due to its many uses and its ability to survive extreme weather conditions (Chauhan *et al*., 2020) [6]. It belongs to the Anacardiacae family and was first described by Francis Hamilton in 1798. Depending on the region, it is known by various common names, like charoli in Madhya Pradesh, chawar, achar, cuddapah almond in Bengali, piyal in Assam, charu in Oriya and char in Telugu. The species is a native of the Indian sub-continent (Chauhan *et al*., 2012) [7] and is north, western, and central India's tropical deciduous woods are home to this species (Prasad, 2020) [18]. Chironji is a small - to - medium almost evergreen tree with a tiny crown and a short stem that may reach up to 18 meters tall and 1.5 meters spread. Trees of chironji have the same alternate bearing nature as mango trees with flowering in January-February and maturing in April-May (Chauhan *et al*., 2020) [6]. This fruit is under cultivation/underutilized but it has lots of culinary and medicinal properties. Chironji is a good source of oil (52%) (Kumar *et al*., 2012) [14]. The seeds consists of moisture (3.0%), fat (59.0%), protein (19.0-21.6%), carbohydrate (12.1%), fiber (3.8%), calcium (279.0 mg), phosphorus (528.0 mg), iron (8.5 mg), thiamine (0.69 mg), ascorbic acid (5.0 mg), riboflavin (0.53 mg), niacin (1.50 mg) and also contain 34-47% fatty oil and 650 kcal/100g of kernel as caloric value (Siddiqui *et al*., 2014) [20] and may fetch Rs. 800-1000 per kg in market. The gum from the bark is used for treating diarrhea and intercostal pains and leaves are used for promoting wound healing.

Chironji is propagated through seed as well as vegetative method (soft wood grafting, chip budding, root cutting). Germination is one of the main constraints in the propagation and cultivation of chironji because of hard seed coat present on the kernels. Seeds of Anacardiaceae species usually possess physical dormancy type, which is promoted by an impermeable endocarp. Seed germination is broadly affected by two factors i.e. external factors (factors outside the embryo) and internal factors (embryo associated) (Hassani *et al*., 2009) [10].

Chironji seeds are recalcitrant in nature and it losses viability soon after 3 months of harvesting. Such seeds may require special treatments like stratification, scarification, soaking in water, growth regulators etc. for overcoming dormancy.

Materials and Methods

The experiment was conducted during 2020-21 at Research Field of Department of Fruit Science College of Horticulture Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya Gwalior (M.P.). The poly bags experiment was laid out in completely randomized design with three replications. The experiment comprised of thirteen treatment of chemical and physical treatments like, T_1-Soaking in KNO_3 solution (1.5%) for 24 hrs., T_2-Soaking in KNO_3 solution (2.5%) for 24 hrs., T_3-Soaking in H_2SO_4 (5%) for 5 minutes, T_4-Soaking in H_2SO_4 (5%) for 10 minutes, T_5-Soaking in GA_3 (250 ppm) for 24 hrs., T_6-Soaking in GA_3 (500 ppm) for 24 hrs., T_7-Mechanical scarification (breaking of seed coat through hammering), T_8-Hot water treatment 60°C for 20 minutes, T_9-Alternate wetting (36 hrs.) and drying (24 hrs.), T_{10}-Alternate wetting (48 hrs.) and drying (24 hrs.), T_{11}-Soaking in water for 4 days, T_{12}-Soaking in water in 6 days and T_{13}-Control (Normal sowing).

Fresh seeds from fruits were collected from the forest area of Chhattisgarh (Bastar and Jagdalpur). Healthy seeds of uniform size were selected and used for the experiment.

Seeds were sown in 20X15 cm size polythene bags. The polythene bags were punched to improve the drainage and filled with potting mixture which was prepared by mixing one parts of soil, one part of well-rotted FYM and one part of sand.

Before sowing all seeds were treated with chemicals and physical treatment like H_2SO_4, GA_3, KNO_3 and hot water soaking, alternate wetting, water soaking, normal sowing and hard seed coats were broken down by hammering in seeds which are treated with mechanical scarification before sowing.

Germination percentage was determined using the methods given by ISTA (International Seed Testing Association, 1993) [11] and per cent of germinated seeds was calculated on the basis of viable seed as follows:-

$$\text{Germination percentage} = \frac{\text{No. of germinated seeds}}{\text{Total no. of seeds}} \times 100$$

Survival percentage was calculated by using following formula

$$\text{Survival percentage} = \frac{\text{Total no. of alive seedlings}}{\text{Total no. of germinated seedlings}} \times 100$$

Germination index (GI) was calculated as described in the association of official seed analysis (AOSA, 1983) [4] by the following equation:

$$\text{G.I.} = \left[\frac{\text{No. of germinated seed}}{\text{Day to first count}} + \right] + \left[\frac{\text{No. of germinated seed}}{\text{day to last count}}\right]$$

This is calculated by determining the germination percentage and seedling length. Seedling vigour index is calculated by multiplying germination (%) and seedling length (cm) (Abdul-Baki and Anderson, 1973) [1].

Seedling vigour index = Germination % X Seedling length (cm)

Results and Discussion

Studies of seed germination

The germination behavior and morphological characters of seed play a significant role in the seedlings growth in slow growing species like *Buchanania lanzan* Spreng (Chironji).

It is clear from data presented in Table 1 that the minimum number of days for seed germination (29.18 days), number of days for 50 per cent seed germination (36.02 days), maximum germination percentage (2%) after 30 days, highest germination index (0.94%) were recorded in treatment T_7 (mechanical scarification breaking of the seed coat through hammering) and maximum survival percentage (62.92%) was recorded in seeds treated with soaking in GA_3 250 ppm for 24 hrs. (T_5).

Chironji seed suffers from dormancy owing to the presence of water impermeable hard seed coat that prevents entry of water and oxygen within the embryo or because of the presence of germination-inhibitor, they require specific treatment for breaking of seed dormancy (Kumar, 2019) [13]. The treatment mechanically rupturing of stony seed coat with hammer before sowing of seed recorded the highest percentage of germination, taken minimum days for germination (Narayan *et al*., 2014) [17]. Mechanical scarification treatment removed the seed coat there by increased the permeability of air and water through seed which favors the early germination obtained 83 per cent germination by mechanically damaging the seed coat with hammer before sowing of seed (Shukla and Solanki, 2000) [20].

The quick 50% germination of chironji seeds might be attributed to mechanical rupturing of the seed coat by a hammer, which cracks the impermeable layer of hard seed coat and allows water and oxygen to enter the seed allowing the embryo to overcome the mechanical limitation of surrounding tissue, and ultimately germination indexes of *Buchanania lanzan* have increased. It's possible that this is related to an increase in germination rates (Kumar, 2019) [13]. Similar results are also obtained by Alabi *et al*. (2019) [2] in tamarind and Thakur (2015) [22] in peach.

Table 1: Effect of different chemicals and physical treatments on germination studies of Chironji

Treatments	No. of days for seed germination	No. of days for 50 percentage seed germination	Germination percentage after 30 days	Survival percentage	Germination index
T_1	38.07	49.87	0	60.66	0.64
T_2	37.52	49.26	0	61.08	0.68
T_3	32.65	43.4	0	49.08	0.75
T_4	30.09	39.66	0	48.63	0.88
T_5	29.89	36.98	1.86	62.92	0.91
T_6	34.06	45.44	0	62.68	0.73
T_7	29.18	36.02	2	58.76	0.94
T_8	35.36	45.12	0	56.96	0.72
T_9	36.99	47.76	0	55.78	0.65
T_{10}	35.27	46.05	0	56.43	0.61

T_{11}	42.26	57.67	0	52.08	0.49
T_{12}	40.38	56.45	0	54.34	0.6
T_{13}	44.12	60.42	0	32.16	0.47
S.Em (±)	1.62	1.42	0.02	1.60	0.5
CD at 5%	4.71	4.13	0.05	4.65	0.15

Studies on seedling growth

The results of the study revealed that the maximum seedling height (6.38 and 9.79 cm), number of leaves per plant (4.11 and 6.16), leaf area (16.75 and 24.07 cm^2), collar diameter (0.18 and 0.29 cm), longest root length (9.63 and 12.73 cm) at 60 and 90 day after sowing, highest fresh weight of the shoot (7.18 g), fresh weight of root (3.8 g), shoot and root ratio (0.93), dry weight of shoot (4.66 g), dry weight of root (1.86 g) and highest seedling vigour index (682.07) at 90 days after sowing was recorded in treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.).

There, it is evident that the promotion of stem elongation by gibberellic acid is almost entirely due to increase in cell elongation. But it is the total effect of the increased in cell division in apical and sub-apical meristematic regions, greater production of auxin in the said regions (Arne and Mancinelli, 1965) [3] The production of more number of leaves might be due to higher growth of seedlings and also due to activity of GA_3 at the apical meristem resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation (Sen and Ghunti, 1976) [19]. Plant height, number of leaves, number of branches, leaf area, stem diameter, fresh weight of stem, dry weight of stem, and total dry weight in khirni seed treated with Gibberellic acid 200 mg per liter (24 hours soaking) was shown to be the most effective. (Bajaniya *et al*., 2018) [5].

Increase in fresh shoot weight might be attributed to the lengthening of the shoots. The root collects mineral nutrients and water from the media while the shoot fixes carbon dioxide from the air. Plant development source sink relationships and shoot-root relationships are all influenced by phyto-hormones. The present results are in agreement with findings of Maval *et al*. (2020) [16], Joshi *et al*. (2017) [12] in chironji, Chiranjeevi *et al*. (2017) [8] and Lalitha *et al*. (2020) [15] in aonla.

Table 2: Effect of different chemicals and physical treatments on shoot and root studies of Chironji

Treatments	Seedling height (cm)			No. of leaves per plant			Leaf area (cm^2)			Collar diameter (cm)			Root length (cm)		Fresh shoot weight (g)	Fresh root weight (g)	Shoot and root ratio	Dry shoot weight (g)	Dry root weight (g)	Seedling vigour index
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS						
T_1	0	5.75	8.85	0	3.48	5.22	0	14.34	21.38	0	0.15	0.25	8.23	11.26	5.34	3.33	0.78	3.32	1.13	579.09
T_2	0	5.97	9.03	0	3.7	5.54	0	16.01	23.52	0	0.16	0.26	8.33	11.73	5.84	3.42	0.77	2.87	1.51	595.76
T_3	0	4.89	8.01	0	2.62	3.92	0	13.24	18.67	0	0.15	0.24	6.97	10.83	5.24	3.23	0.74	3.6	1.09	508.80
T_4	0	5.21	8.43	0	2.94	4.41	0	14.87	18.92	0	0.15	0.25	9.23	11.93	5.98	3.54	0.76	2.92	1.57	539.89
T_5	0	6.38	9.79	0	4.11	6.16	0	16.75	24.07	0	0.18	0.29	9.63	12.73	7.18	3.8	0.84	4.66	1.86	682.07
T_6	0	6.15	9.26	0	3.88	5.81	0	13.17	19.79	0	0.14	0.25	6.47	10.03	6.11	3.54	0.93	3.17	1.06	637.31
T_7	0	5.42	8.68	0	3.15	4.72	0	14.59	19.11	0	0.17	0.27	9.33	12.17	6.02	3.65	0.71	2.46	1.74	566.05
T_8	0	4.73	7.64	0	2.46	3.69	0	12.93	20.85	0	0.14	0.24	6.37	9.66	5.19	3.18	0.79	2.41	1.07	491.41
T_9	0	4.35	7.23	0	2.33	3.49	0	12.5	22.13	0	0.13	0.23	6.33	9.36	5.16	3.1	0.77	2.7	1.04	445.39
T_{10}	0	4.48	7.51	0	2.19	3.28	0	12.77	19.04	0	0.13	0.24	6.37	9.66	5.19	3.13	0.77	3.16	1.05	474.46
T_{11}	0	3.41	6.52	0	2.08	3.11	0	11.5	17.46	0	0.12	0.23	6.13	9.2	5.11	2.72	0.7	3.09	1.03	383.83
T_{12}	0	3.93	6.87	0	1.99	2.88	0	12.15	21.81	0	0.12	0.23	6.3	9.26	5.15	3.14	0.74	3.15	1.07	408.33
T_{13}	0	3.02	5.91	0	1.8	2.7	0	10.72	17.29	0	0.09	0.22	4.79	8.3	4.91	2.3	0.71	2.2	0.88	326.61
S.Em. (±)	0	0.26	0.34	0	0.19	0.22	0	0.40	0.40	0	0.01	0.01	0.22	0.39	0.21	0.16	0.4	0.17	0.04	27.17
CD at 5%	0	0.77	0.97	0	0.54	0.65	0	1.15	1.17	0	0.02	0.04	0.63	1.15	0.60	0.46	0.12	0.50	0.12	78.99

Conclusion

Based on the results of the experiment, it can be concluded that among different chemical and physical treatments, T_7 (mechanical scarification breaking of seed coat through hammering) was found to be best regarding number of days for seed germination, number of days for 50 per cent seed germination, germination percentage after 30 days, germination index, whereas maximum values regarding to survival percentage, seedling height, number of leaves per plant, leaf area, collar diameter, root length, fresh shoot weight, fresh root weight, shoot and root ratio, dry shoot weight, dry root weight and seedling vigour index (SVI) was noted in treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.).

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