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Variation in Seed parameters and germination percentage in *Capparis decidua* collected from different locations

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ABSTRACT

Capparis decidua is a medicinal plant native to India with a wide variety of species found in various states of northwestern India. *Capparis decidua* is a densely branched shrub or small tree that grows naturally in arid and semi-arid regions of India. Seeds from different locations in Rajasthan were analyzed for seed quality as well as germination potentials with different treatments. Seed germination through seeds in this species is very less and it's also depend on ripen stage and earliest treatment for germination which vary with edaphic, environmental and other factors. A detailed study is presented in the paper.

Keywords: Traditional medicine; Arid regions; Ethno botany; Medicinal chemistry; Pharmacology; Xerogenic adaptability; Biodiversity hotspot.

1. Introduction

The thousands of medicinal plants used in various traditional systems of India, individually or in combination, have great potential for direct therapeutic effect. Medicinal plants are also a part of modern medicine. Growing as a department (Chishty *et al.*, 2017), the plant is considered a treasure trove of potential medicines and has played a very important role in controlling diet- and disease-related ailments among tribal peoples since ancient times, belongs to *Capparis decidua* in the family Capparidaceae (Dipti *et al.*, 2016). *Capparis decidua* is a dense, bushy, branched, spiky shrub or tree common in arid and semi-arid regions of the country. The tree usually grows in dry, exposed habitats, often in mountain foothills, and in the wild in arid and semi-arid regions of the country. It is mainly distributed in western Rajasthan, Punjab, Gujarat, central regions and Deccan and grows in all kinds of badlands (Kumar *et al.*, 2013). With a total of 44% species of vascular plants, Kair is considered one of the most important floras classified as a biodiversity hotspot. Kair distribution is over 3540 km in the Piedmont plains and Bikaner district of Jodhpur, Rajasthan, with an annual fruit production of about 7,000 tons. People living in desert areas used his *Capparis decidua* for various purposes. Caper buds are wild-picked and cultivated. Cultivated plants are usually thorn less. Cultivation should be done in sunny, well-drained sandy soil. Plant propagation occurs after seeding in autumn or spring. On the other hand, it can even be grown by cuttings of mature trees at 19–24 °C (66–75 °F) in summer (Dipti *et al.*, 2016). This review will be the focus of medicinal chemists, pharmacologists, and phytochemists to help differentiate the bioactive potential and nutra-pharmaceutical uses of this versatile plant.

Kair or Ker, botanically *Capparis decidua* (Forsk.), Edgew. (Synonym ***Capparis aphylla***, Roth) is a perennial woody shrub or small tree found in hot and dry regions of many parts of the world. It is a highly branched, leafless, spiny plant that can grow in a variety of habitats. Excellent for stabilizing dunes and controlling soil erosion from wind and water. Due to its xerogenic adaptability, the plant grows well in the harsh climatic conditions of arid

regions. The berry-shaped immature fruits are rich in carbohydrates, proteins and minerals. The fruit and flower buds are rich in surface wax and the seeds are rich in oil. The unripe fruit is used as raw material for raw vegetables and pickles. Dehydrated fruit is used as an off-season vegetable, alone or in combination with other dehydrated vegetables. Generally appreciated by residents of hot and dry areas. During the summer, many birds and animals seek refuge in the shade of Kea trees to escape the scorching heat. Vigorous vegetative growth occurs from October to June and is browsed by goats, sheep and camels when little or no grass is available on dry pastures.

The country's arid and semi-arid regions are home to the densely bushy, branching, spiny shrub or tree known as *Capparis decidua*. It is a densely branching, spiky plant without leaves that can flourish in a range of environments. Excellent for preventing soil erosion from wind and water and stabilizing dunes. The plant thrives in desert regions' tough climatic circumstances because of its xerogenic tolerance. The berry-like immature fruits are a good source of minerals, proteins, and carbs. Fruit and flower buds have a lot of surface wax, while seeds contain a lot of oil. The unripe fruit is used as a raw ingredient in pickles and raw vegetables. Fruit that has been dehydrated can be eaten alone or in conjunction with other dehydrated vegetables as an out-of-season vegetable. In general, people who live in hot, dry climates appreciate it.

The tree typically grows in dry, exposed habitat that is frequently on foothills, and it grows in natural settings in arid and semi-arid regions of the country. It is primarily distributed in western Rajasthan, Punjab, Gujarat, the Deccan, and the central area, and it grows in all kinds of waste lands (Kumar et al., 2013). There are a total of 44% species of vascular plants, and one of the most prominent floras among them that falls within biodiversity hotspots is kair. Mostly on Rajasthani piedmont plains of Jodhpur and the Bikaner area, kair is distributed over 3540 km, and the fruit is produced annually in about 7,000 tonnes. Desert-dwellers used *Capparis decidua* for a variety of things. Both wild and grown caper plants are used to make caper buds; grown plants typically lack spines. Sunlight and sandy soil with good drainage are used for cultivation. Plants are propagated by seeding them in the fall or spring, or by harvesting ripe wood in the summer at a temperature of 19 to 24 ^{o}C (66 to 75 ^{o}F) (Dipti et al., 2016).

It was abundant more than 50 years ago, but as human and livestock populations continue to grow; it has been over-harvested and eradicated by tractor farming, making it nearly endangered. When demand for planting material exceeded supply, villagers became concerned, and research into its reproduction began. The survival rate of seedlings in the nursery bed was low, and establishment in the field was difficult. Cuttings are difficult to root, so micro propagation technology is attracting attention. The fruit and other plant parts have been reported to have multiple medicinal benefits for heart, stomach, and other ailments. Natural propagation is through seed and root suckers. Vegetative propagation from hardwood cuttings has been largely unsuccessful (Meghwal and Vashishtha 1998). This review details the plant's description, origin, distribution, future range, and potential for cultivation in harsh agro climatic conditions in dry lands. Artificial propagation, colonization, fruit harvesting and sales were discussed.

1.1. Vernacular name: The plant name is available in the following languages

English: *Caper*

Hindi: Karel, karer, karil, karu, kurel, kurrel, lete, satari, karer

Arabic: Hanbag, margh, sodab, tundub

Kannada: Chippuri, karira, kareera, kareeuppina gida, kiruli, nispatley gida, kari uppina gida

Malayalam: Karimulli, karimullu

Marathi: Karil, ker, nevati

Persian: Bergesodab

Sanskrit: Patra, granthila, granthila, gudhapatra, kantaki, karaka, karira, karira, karira, karirah, karirah, kataphala, krakara, krakatha,mriduphala, nigudhapatra, nishpatra, nishpatrika, maruruhu, krishashakha, mar vidahika, marubharuha, shakapushpa, shatakunta, shonapushpa, suphala, tikshnakantaka, tikshnasara, ushnasundara, vishvakpatra, ubhuruha

Tamil: Kulaladondai, sengam, senkam, sirakkali, sirakkali, sengam, kulalatontai, cattiputpam, cattiracoputpam, inaikaravi, cinaikaravicceti, ciracukkilam, cirakakoli, cirakatantai, cirakkoli, cirakkoli, cirakkoli, ciratci, cutakkini, kariram, kelal, kentikam, kuraram, marupurukam 2, palaccaka, vayacca, vayaccam, venu

Talugu: Kariramu

Tibetan: Karira, karira, rgyasnalu, rgya sneu (p& d), uboka (d), upotaka (p), upota kila

Urd: Titali, ab karir, kachia phal

Rajasthan: *Kair, Dhalu*

Fruit: *Laddu*

Rajasthan: *Ker* **(**Jaisalmer district)

Synonym: *Capparis aphylla Roth* (Rathee *et al.*, 2010)

1.2. Habitat: *Capparis decidua* is a medicinal plant native to India with a wide variety of species found in various states of northwestern India. *Capparis decidua* is a densely branched shrub or small tree that grows naturally in arid and semi-arid regions of India. It is found in deserts, especially in Rajasthan, Punjab, Southern Karnataka, Tamil Nadu and Gujarat. Grows on very shallow soils, soils subject to saline irrigation water, or on stable sand dunes. Capparis deciduous plants also have high nutritional value (Chishty *et al.*, 2017).

1.3. Geographical source: *Capparis decidua* occurs in subtropical and tropical regions and other arid regions of South Asia. It is common in arid places in Sindh, Baluchistan, Western Rajasthan, Deccan Peninsula, Egypt, Socotra, Arabia, tropical Africa, India, Tinnebury and Pakistan. It is found in deserts, especially in Rajasthan, Punjab, Sindh, Southern Karnataka, Tamil Nadu and Gujarat. *Capparis decidua* is distributed over 3450 km of vegetation in the Nagaur, Bikaner and Jodhpur districts of Rajasthan (Chishty *et al.*, 2017; Godara *et al.*, 2015). Slightly divided tree or shrub native to waterless areas of Africa, the Middle East, and South Asia including the

Thar Desert, consisting of clusters of slender leafless branches and having small deciduous leaves only on young shoots. You can see it rarely exceeds 5 meters (15 feet) in height. 'Khair' city (one of the largest cities in Aligarh district) has many Kair trees in India. The city is famous for its Kea Tree. New leaves appear in November-January. Bright red flowers bloom in March-April and August-September and mature in May-October. Birds love to eat pink fleshy berries. It is often planted together and produces abundant root suckers. It is very drought tolerant and tolerates some frost.

1.4. Botanical Description: *Capparis decidua* is a densely branched shrub or small tree, 4–5 m high, with sparsely small deciduous leaves, found only on young shoots (Rathee *et al.*, 2010).

(a) Root-*Capparis decidua* has a taproot system. Primary roots grow first, and then secondary branches develop. After one year, many secondary roots are formed, but the primary root remains dominant.

(b) Shoot-*Capparis decidua* is very strongly branched. Each branch is smooth, slender, spiny and columnar. Developed branches of the plant are leafless, only young shoots have leaves. The branches and twigs are usually glossy green, but the bark turns whitish-grey over time.

(c) Leaf-*Capparis decidua* is available in a new chute. The leaves are pointed, pointed and small, about 4-12 mm long and 1-3 mm wide. These are very short petioles or stalk less. New leaves appear from November to January.

(d) Inflorescence-A raceme of the Umbelliferae family having multiple flowers growing from short lateral shoots or old spiny axillary twigs.

(e) Flowers-The flowers are usually red or pink, but may also be yellow with a lateral umbel pattern. Fresh shoots have few flowers, but mature shoots have many flowers. The flowering period is from February to July, with peak flowering in the summer.

(f) Fruit-The fruit is a small, fleshy fruit, glabrous and globose, similar in size and shape to a small cherry, 1 to 2 cm in diameter. The new fruits are greenish in color, turning pink when ripe. The fruit is hard, woody, with a brownish skin 1-2 mm thick. Flower stems are short and fragile. Bitter taste; strong and malodorous. The fruiting period is from March to April, and the fruit blooms from May to July. (g)

(g) Seeds-Seeds globular, 2-5 mm in diameter; dry seeds kidney-shaped, 4-5 mm, 3-4 mm, 1.5-2 mm in length, width and thickness; white-gray fleshy arils (Dahiya, R. et al. 2019).

1.5. Study Objectives: Objective of the present study was to identify better seed source and best treatment for its germination and subsequently producing quality seedlings.

2. Review of literature

Kair [*Capparis decidua* (Forsk.)] is one of the important multipurpose native shrubs in hot and dry ecosystems, with the ability to survive unsupervised and unprotected in diverse habitats. In addition to many socioeconomic and environmental benefits, plants have important pharmacological activities such as hypercholesterolemia, anti-inflammatory and analgesic, ant diabetic, antibacterial, ant plaque, hypertensive, anthelmintic and laxative activity. Because of its many medicinal properties. CAZRI, RRS Jaisalmer has 1000 hectares of grassland with

over 15 densities of Kair besides *Zizyphus, Acacia* and *Prosopis*. Natural populations show great diversity in plant species, growth habits, fruit size, fruit color, spiny habits, plant spread and canopy density, flower color, flowering and fruiting timing. The rich genetic diversity that accompanies is available.

Two different plant species previously came from Kair, a tree form exceeding 5 m in height, while occurring mostly as a shrub. It seems that if you grow it from a seed and leave it as it is, it will become a tree shape. On the other hand, plants exposed to biological disturbance tend to produce more shoots and reproduce by root suckers. Plants with very few or even no spines can be found in nature. Ker blooms all year round. February-March (Ambe Bahar), July-August (Murig Bahar), October-November (Hast Bahar), but only Ambe Bahar has the best quality flowers. It bears much fruit.

A wide variety of flower colors can be found, from bright red to scarlet, although yellow-flowered plants can also be found in natural forests on pasturelands. Soft fruit yields per plant vary widely (100 g to 5.0 kg or more) in natural stands as they depend on biological factors and grazing pressure under grazing conditions. In the summer of 2010, large variations were observed in fruit diameter (10.33–19.71 mm), fruit weight (0.77–5.24 mg), and number of seeds per fruit (3–27). The test weight ranged from 2.08 to 3.15 g (Mahla, H.R. *et al*., 2010).

2.1. Propagation and Establishment

Natural regeneration occurs when seed and root suckers are separated from the parent plant by 4-5 meters (Pareek 1978; Vashishtha 1987). In May and June, birds devour the mature fruits, dispersing the seeds via their waste all over the world. When it rains, seeds dispersed in this way begin to germinate and grow into new plants. The Thar Desert and other arid areas of the nation, however, have difficult environmental conditions that restrict the growth of fresh seedlings. With properly planned raising schedules, seedlings can be developed, but early mortality is high. Ripe fruit should have the pulp removed, the seeds removed, and the fruit should then be dried in the shade. Polyethylene tubes (10 x 25 cm, 200 gauges) can be used to sow seeds. These tubes should be filled equally with sand, clay, and farm yard manure (FYM).

After 15 to 20 days, germination starts, and it can last up to 40 days. The seedling grows extremely slowly during his first year in the nursery. Only then, just in time for the start of the following rainy season, will the seedlings be prepared for sowing in the field. Watering must be done every 15 days during the first year after planting, with the exception of the wet season. They eventually grew into the soil and stopped requiring watering. It is possible to artificially propagate plants using root suckers, however this rarely works. He tried quick dipping treatment with IBA (1000 ppm) on hardwood cuttings in July, but the success rate was quite low (Vashishtha 1987; Meghwal and Vashishtha 1998).

Mass propagation may be accomplished using micro propagation. On a medium enriched with 0.1 mg L^{-1} NAA + 5.0 mg L BAP from Murashige and Skoog (M.S.) (1962), Deora and Shekhawat (1995) kept some shoots from node plants alive. With his M.S. at half intensity and his 4-hour pulse therapy of 100 mg L^{-1} IBA, regenerated shoots rooted the best. Transfer to a semi-concentrated MS without hormones after the liquid medium. 500 mg L-1 of activated charcoal is present in the agar gel medium (Meghwal, P.R. and Tewari, J.C., 2002).

2.2. Vegetative Propagation

It has been shown that *Capparis decidua* naturally reproduces by sending out root suckers up to 5 metres from the plant. The capacity for root suckers is a reliable indicator of regeneration. Another reliable indicator of a plant's capacity for vegetative proliferation is its ability to form shoots. Our attempts to spread the species in 2001–2002 by gathering root suckers, isolating the sprout, and nurturing them in the nursery were only partially successful. It appears that the suckers survive in nature by remaining dependent on the mother plant for a prolonged period of time, and their early separation during our collections has been fatal. Few sprouts that produced shoots and survived up to 1 year in the nursery failed to survive in the field beyond two months.

The experiment to determine the ideal time of year to gather cuttings revealed that different plants sprout cuttings in different ways. In one instance, no sprouting was seen during any of the months, but in another instance, 20–40% sprouting was seen. seven out of the twelve months. This can be a result of genetic diversity or the food supply present in the cuttings. The ideal months seem to be July through September and February through March. But not every collection will operate in the same way. In addition, just one of the 240 cuttings placed in various months actually developed roots. This demonstrates unequivocally that *Capparis decidua* is a difficult to root species and that hormone treatment is required.

Even the usage of the hormones IBA, IAA, LNOA, as well as commercial preparations like Shridex B2 and B, did not produce particularly encouraging outcomes. Hormones, in especially IBA, increased sprouting, but generally speaking, the rooting response was subpar. Meghwal and Vashishtha prior research from 1998 also demonstrated that this species is particularly difficult to root and that the timing of planting had a significant impact on rooting and sprouting. The species was said to have a poor rooting response, and the best results were attained during the rainy season.

Using *Capparis decidua* cuttings that were 15-20 cm long and 1-1.5 cm in diameter and treated with IBA at 3000, 5000, and 7000 ppm alone or in conjunction with 1000 ppm Thiamine (Bhargava et al 2000). The experiment revealed that maximal sprouting (25%) occurs at 5000 ppm IBA.

Deora and Shekhawat created a technique for *Capparis decidua* micro propagation from mature trees utilizing nodal explants (1995). Using nodal explants and seedling explants from cotyledonary nodes, cotyledon, and hypocotyls on MS medium supplemented with bezyladenine (BA 1, 3, and 5 mg/liter), in-viro micro propagation of mature trees was accomplished. It was discovered that rooting media with IBA 1 mg/liter worked best (Meghwal, P.R. and Tewari, J.C., 2002).

3. Materials and Methods

The seeds of *Capparis decidua* were obtained from the different sites namely Ecology division AFRI Plot 1, Jodhpur; Ecological Field Plot 2, AFRI, Jodhpur; Tapra, Teh- Jasol, Balotra, Barmer; Govt. higher school - himtani/bhandiyasa phanta, Barmer; Dudhwa road, Chauhatan, Barmer; Jodhpur Nagaur highway, Karnal Nagaur; Forest nursery, Bithuja, Pachpadra, Barmer and Surana forest range near, power grid, shahapura, Jaipur. The seeds were stored in closed container at about 10°C after cleaning of seeds.

The seed germinationtests were performed in seed germination Laboratory of Silviculture and Forest Management, ICFRE- Arid Forest Research Institute, Jodhpur. Seed Characters, such as Length, width and thickness of the *Capparis decidua* seeds were recorded in millimeter with the help of vernier caliper. With the help of seed counter machine seeds per kilogram were calculated. Laboratory test on the germination response of seeds to pre-germination treatments of Hot water, GA_3 (500 and 1000 ppm) and IBA GA_3 (500 and 1000 ppm) compared to untreated seeds **(**control**)**.

Soaking Hundred seeds in hot water for 15 min. Twenty seeds were also soaked in GA_3 (500 and 1000 ppm) and IBA GA_3 (500 and 1000 ppm) for 6 hours. All the pre- treated and untreated seeds were rinsed thoroughly in distilled water and were placed in germination tray. The experiment was carried out at room temperature in the laboratory. Seeds were considered germinated upon plumule emergence. The number of seeds that germinated was recorded while the percentage seed germination was calculated.

3.1. Formulas for various calculations

A) **GP (Germination percentage)** = (Total number of seeds germinated/total number of seeds tested) ×100

Final Germination Percentage (FGP %) = Final no. of seeds germinated in a seed lot × 100

The higher the FGP value, the greater the germination of a seed population - Scott et al. (1984).

B) **MGT (Mean germination time)** = total (daily germination) × 1 days /total seed sowing

Mean Germination Time (MGT day) =Σf ·x/Σf

f=Seeds germinated on day x

The lower the MGT, the faster a population of seeds has germinated - Orchard (1977).

- First Day of Germination (FDG) day =Day on which the first germination event occurred

Lower FDG values indicate a faster initiation of germination. Kader (1998)

- Last Day of Germination (LDG) day =Day on which the last germination event occurred Lower LDG values indicate a faster ending of germination. Kader (1998)

- Germination Rate Index (GRI) (%/day) =G1/1 + G2/2 +· · ·+ Gx/x

G1=Germination percentage × 100 at the first day after sowing, G2=Germination percentage × 100 at the second day after sowing

C) **AVG MGT (Average Mean germination time)** =Total MGT/Total number of days

D) **GV (Germination Value)** = (Total MGT/total germination) × (GP%/10)

E) **AVG GV (Average Germination Value**) = Total GV/Total number of days

4. Seed germination in *Capparis deciduas*

Seed germination in *Capparis deciduas* were collected from 7 different locations in Rajasthan. They were cleaned dried and stored for further analysis seed mean length, width and mean thickness were recorded. Data analysis

revealed that mean length was in the range of 4.56 mm to 5.46 mm. It was minimum in ecology AFRI, Jodhpur seed lot as 4.56 mm while it was highest as 5.46 mm in seed lot collated from Dudhwa Road, Chauhatan, Barmer. Mean seed width was minimum as 3.91 mm is two seed lots (Ecology field, AFRI, Jodhpur and sindhari-Balotra Road, Barmer) while it was highest as 4.49 mm in Dudhwa Road, Chauhatan Barmer seed lot. Mean thickness was lowest as 2.52 mm in Jodhpur – Nagaur highway, karnal, Nagaur seedlot while it was highest as 3.09 mm in forest nursery, Bithuja, Pachpadra Barmer seed lot.

Germination percentage was calculated with respect to different treatments viz. Hot water, GA3 500 ppm, and GA_3 low pm along with control. In control germination was in the range of 15 to 50 percent. It was 15 percent in Dudhwa Road, Chauhatan, Barmer and Jodhpur- Nagaur highway Karnal, Nagaur seedlots, while it was 50 percent in ecology field, AFRI,, Jodhpur seedlots. Using hot water germination percentage was 10 percent (Jodhpur- Nagaur highway kharnal, Nagaur and forest nursery, Bithuja, Pachpadra, Barmer) seedlots. It was 83.3 percent in sindhari, Before Road, Barmer seed lot.

Using Ga_3 ppm germination was found in the range of 10 to 40 percent. It was 10 Percent in for seedlots (Tapra, Tel- Jasol, Balotra, Barmer and forest nursery, Bithuja, Pachpadra, Barmer seedlot) while it was 40 percent in two seedlots viz, Ecology field, AFRI, Jodhpur and Govt higher sec school, Himtani, Bhadiyana phanta. Under laboratory conditions various parameters related to germination vig. Total MGT, Total GV, average MGT of average GV were also calculated using appeopliale formulas.

Overall germination percentage was in the range of 10 to 83.3 percent. Total MGT was minimum is 16 GA_3 1000 ppm treated seed lot of Jodhpur - Nagaur highway, Karnal, Nagaur and GA_3 500 ppm Seedlot of Tapra, Tehsil Jasol, Balotra, Barmer seed lot. It was maximum in Control treated seedlot of Tapra, Tehsil Josol, Balotra, Barmer seed lot as 82.65. Total GV values are in the range of 17.55 to 1167.9.g. It was lowest as 17.55 in Control treated seed lot of Tapra, Tehsil Jasol, Balotra Barmer while it was highest as 1167.9 is seed lot of forest nursery, Bithuja, Pachpadra, Barmer. Average MGT was lowest in GA_3 1000 ppm seed lot of Jodhpur-Nagaur and GA_3 500 ppm Seed lot of Tapra, Tehsil Jasol, Balotra, Barmer. It was highest as 3.97 in GA_3 1000 ppm treated seedlot of Govt higher sec school, Himtani, Bhadiyana phanta. Average GV valve was minimum as 0.07 in GA_3 1000 ppm treated Seed lot of Dudhwa road, Chauhatan Barmer seed lot while it was maximum as 53.09 in control treated seed lot of forest nursery Bithuja, Pachpadra, Barmer.

5. Discussions

Based on data of Table 1 and 2 it is observed that seed size parameters were different in various locations and it depends on various climatic edaphic and genetic factors. Germination percentage with different treatments was different in seed lots. GA_3 found effective in breaking dormancy and enhancing germination.

6. Conclusion

Based on different seed lots germinations and its effect with different treatments found to provide hypothesis to choose better seed lots. However there was no direct relation between seed size and germination. Factors such as geographical and seasonal variations play an important role in finding seed lot for better germination.

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7. Future Recommendations

The most important step in production forestry is to produce quality seedlings, in nursery having high performance potential. For any kind of seedling production system, type of containers and potting media are key components influencing quality of the seedlings. *Capparis decidua* plant has traditional and pharmacological uses. Plant need more research on its uses to discover different aspect of this plant and various studies on its reproductive biology as well as soil and other factors for survival of its seedling need to be studied.

Table 1. *Capparis decidua* location and seed parameters

S.No.	Location	GPS	Date of Collection	Fresh 100 seed weight	Dry 100 Seed Weight	Seed moisture	Length	Width	Thickness	Seed per kg
1	Ecology division AFRI Plot 1, Jodhpur	N 26°23'27" E 73°03'7.07"	14-01-2021	5.474	4.784	12.61	4.56 ± 0.39	3.91 ± 0.65	2.53 ± 0.32	20903
2	Ecological Field Plot 2, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	27-04-2022	5.874	4.726	19.54	4.95 ± 0.36	4.32 ± 0.41	2.71 ± 0.40	21160
3	Tapra, Teh-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	05-05-2022	7.243	6.149	15.10	4.81 ± 0.28	4.45 ± 0.42	2.89 ± 0.25	16263
4	govt. higher school - himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	05-05-2022	7.102	6.75	4.96	5.21 ± 0.46	4.45 ± 0.42	2.89 ± 0.25	14815
5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	06-05-2022	7.489	6.194	17.29	5.46 ± 0.4	4.49 ± 0.19	3.1 ± 0.18	16145
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	09-05-2022	2.65	2.456	7.32	4.57 ± 0.29	3.53 ± 0.3	2.52 ± 0.29	40717
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	05-05-2022	6.984	5.429	22.27	4.91 ± 0.21	4.45 ± 0.46	3.09 ± 0.22	18420

Table 2. Germination percentage and germination value in *Capparis decidua*

S.No.	Location	GPS	Treatment	Germination Percentage	Total Mean Germination Time	Total Germination Value	Average Mean Germination Time	Average Germination Value
1	Ecology division AFRI	N 26°23'27" E 73°03'7.07"	Control	1	1.62	1.94	0.08	0.09
			Hot water	2	3.44	4.82	0.16	0.23
			GA_3 500 ppm	2	3.44	4.82	0.16	0.23
			GA_3 1000 ppm	2	3.36	5.04	0.16	0.24

			IBA 500 ppm	2	3.27	5.23	0.16	0.25
			IBA 1000 ppm	2	3.27	5.23	0.16	0.25
2	Ecological Field, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	Control	40	80.7	3720.27	3.67	169.1
			Hot water	45	81.4	1204.72	3.7	54.76
			GA_3 500 ppm	20	37.7	188.5	1.71	8.56
			GA_3 1000 ppm	20	37.7	188.5	1.71	8.57
			IBA 500 ppm	15	31.8	127.2	1.45	5.78
			IBA 1000 ppm	15	33.55	352.27	1.52	16.01
3	Tapra, Teh-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	Control	45	82.65	17.55	3.76	0.8
			Hot water	25	47.25	69.85	2.15	3.18
			GA_3 500 ppm	10	16	120	0.73	5.45
			GA_3 1000 ppm	25	53.75	743.54	2.44	33.8
			IBA 500 ppm	10	19.75	148.13	0.9	6.73
4	Govt. higher school - himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	Control	0	0	0	0	0
			Hot water	5	10.4	67.6	0.47	3.07
			GA_3 500 ppm	10	13.55	155.825	0.62	7.08
			GA_3 1000 ppm	0	0	0	0	0
			IBA 500 ppm	10	20.3	142.1	0.92	6.46
			IBA 1000 ppm	5	6.65	23.28	0.3	1.06
5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	Control	15	19.95	69.83	0.91	3.17
			Hot water	20	34.3	360.15	1.56	16.37
			GA_3 500 ppm	25	51.75	554.16	2.35	25.19
			GA_3 1000 ppm	25	32.7	485.05	1.49	0.07
			IBA 500 ppm	15	28.3	311.3	1.29	14.15
			IBA 1000 ppm	20	33.6	352.8	1.53	16.04
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	Control	15	25.15	276.15	1.14	12.55
			Hot water	10	21.65	184.03	0.98	8.37
			GA_3 500 ppm	**25**	**35**	**759.79**	**1.59**	**34.54**
			GA_3 1000 ppm	10	16	120	0.73	5.45
			IBA 500 ppm	5	9.35	51.43	0.43	2.34
			IBA 1000 ppm	0	0	0	0	0
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	Control	30	45.8	1167.9	2.08	53.09
			Hot water	10	20.8	270.4	0.85	12.29
			GA_3 500 ppm	10	18.7	205.7	2.59	9.35
			GA_3 1000 ppm	30	57	285	0.85	12.95
			IBA 500 ppm	10	18.7	205.7	0.85	9.35
			IBA 1000 ppm	0	0	0	0	0

Table 3. Germination percentage using different treatments in *Capparis decidua*

S.No.	Location	GPS	Date of Collection	Control	Hot water	GA3 500 PPM	GA3 1000 PPM	IBA 500 PPM	IBA 1000 PPM
1	Ecology division AFRI	N 26°23'27" E 73°03'7.07"	14-01-2021	1	2	2	2	2	2
2	Ecological Field, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	27-04-2022	40	45	20	20	15	15
3	Tapra, The-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	05-05-2022	45	25	10	25	10	50
4	govt. higher school – himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	05-05-2022	0	5	10	0	10	5
5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	06-05-2022	15	20	25	25	15	20
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	09-05-2022	15	10	**25**	10	5	0
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	05-05-2022	30	10	10	30	10	0
8	Surana forest range near, power grid, Shahpura	N 27°30'42.02" E 73°99'50.93"	13-01-2021	0	0	0	0	0	0

Table 4. Germination Value with different treatments in *Capparis decidua*

S.No.	Location	GPS	Date of Collection	Control	Hot water	GA_3 500 PPM	GA_3 1000 PPM	IBA 500 PPM	IBA 1000 PPM
1	Ecology division AFRI	N 26°23'27" E 73°03'7.07"	14-01-2021	1.94	4.82	4.82	5.04	5.23	5.23
2	Ecological Field, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	27-04-2022	3720.27	1204.72	188.5	188.5	127.2	352.275
3	Tapra, The-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	05-05-2022	17.55	69.85	120	743.54	148.13	1115.33
4	govt. higher school – himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	05-05-2022	0	67.6	155.825	0	142.1	23.28

5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	06-05-2022	69.83	360.15	554.16	485.05	311.3	352.8
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	09-05-2022	276.15	184.03	759.79	120	51.43	0
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	05-05-2022	1167.9	270.4	205.7	285	205.7	0
8	Surana forest range near, power grid, Shahpura, Jaipur	N 27°30'42.02" E 73°99'50.93"	13-01-2021	0	0	0	0	0	0

Table 5. Average Mean Germination Time with different treatments in *Capparis decidua*

S.No.	Location	GPS	Date of Collection	Control	Hot water	GA3 500 PPM	GA3 1000 PPM	IBA 500 PPM	IBA 1000 PPM
1	Ecology division AFRI	N 26°23'27" E 73°03'7.07"	14-01-2021	0.08	0.16	0.16	0.16	0.16	0.16
2	Ecological Field, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	27-04-2022	3.67	3.7	1.713636	1.71	1.45	1.525
3	Tapra, The-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	05-05-2022	3.76	2.15	0.73	2.44	0.9	3.8
4	govt. higher school – himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	05-05-2022	0	0.47	0.62	0	0.92	0.3
5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	06-05-2022	0.91	1.56	2.35	1.49	1.29	1.53
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	09-05-2022	1.14	0.98	1.59	0.73	0.43	0
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	05-05-2022	2.08	0.85	2.59	0.85	0.85	0
8	Surana forest range near, power grid, Shahpura, Jaipur	N 27°30'42.02" E 73°99'50.93"	13-01-2021	0	0	0	0	0	0

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Table 6. Average Germination Value with different treatments in *Capparis decidua*

S.No.	Location	GPS	Date of Collection	Control	Hot water	GA3 500 PPM	GA3 1000 PPM	IBA 500 PPM	IBA 1000 PPM
1	Ecology division AFRI	N 26°23'27" E 73°03'7.07"	14-01-2021	0.09	0.23	0.23	0.24	0.25	0.25
2	Ecological Field, AFRI, Jodhpur	N 26°23'952" E 73°03'455"	27-04-2022	169.1	54.76	8.57	8.57	5.78	16.0125
3	Tapra, The-Jasol, Balotra, Barmer	N 25°42.744' E 72°08.527'	05-05-2022	0.8	3.18	5.45	33.8	6.73	50.7
4	govt. higher school – himtani / bhandiyasa phanta	N 25°55'655" E 72°18'915"	05-05-2022	0	3.07	7.08	0	6.46	1.06
5	Dudhwa road, Chauhatan, Barmer	N 25°34.767' E 71°09.187'	06-05-2022	3.17	16.37	25.19	0.07	14.15	16.04
6	Jodhpur Nagaur highway, Karnal Nagaur	N 27°04.715' E 74°37.579'	09-05-2022	12.55	8.37	34.54	5.45	2.34	0
7	Forest nursery, Bithuja, Pachpadra, Barmer	N 25°48.315' E 72°18.781'	05-05-2022	53.09	12.29	9.35	12.95	9.35	0
8	Surana forest range near, power grid, Shahpura, Jaipur	N 27°30'42.02" E 73°99'50.93"	13-01-2021	0	0	0	0	0	0

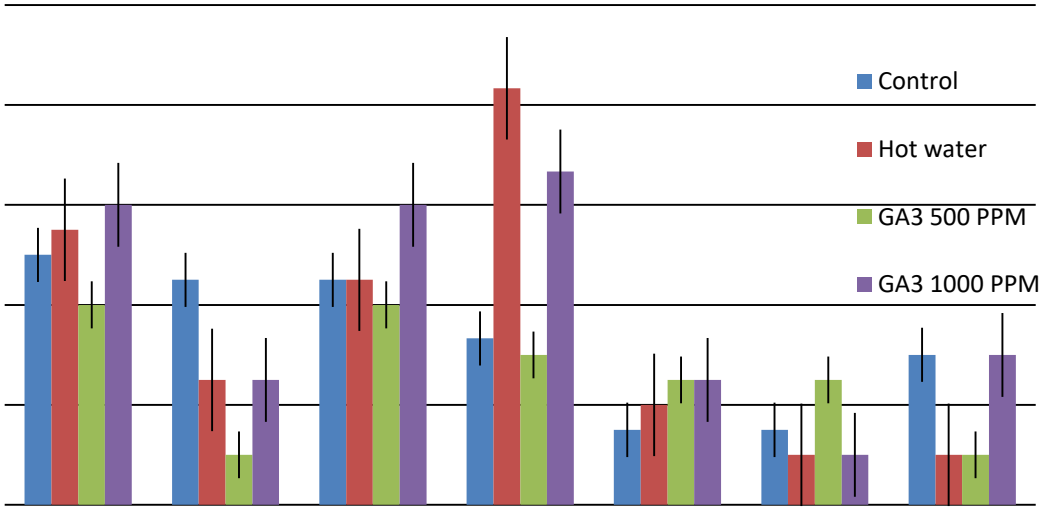

Figure 1. Germination percentage of C. decidua using different pre-treatments

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(a) *Capparis decidua* plant

(b) *Capparis decidua* in flowering

(c) Fruits of *Capparis decidua*

(d) Germination in *Capparis decidua* in Laboratory

Declarations

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Competing Interests Statement

The authors have declared that no potential competing financial, professional or personal interests exist.

Consent for publication

All authors contributed to the manuscript and consented to the publication of this research work.

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References

[1] Bhargava, R., Nath, V., & Pareek, O.P. (2000). Note on the role of plant growth inhibitors in sprouting of *Capparis decidua* cuttings. Current Agriculture, 24(1–2): 131–133.

[2] Chishty, S., & Monika (2017). Medicinal and nutritional importance of *Capparis decidua* (Forssk.) Edgew. (Capparaceae). International Journal of Science and Research, 5: 2319–7064.

[3] Dahiya, R., Vaghela, J.S., & Singh, R.K. (2019). A brief review on Pharmacological and Phytochemical studies of *Capparis decidua*. Advance Pharmaceutical Journal, 4(6): 133–139.

[4] Deora, M.S., & Shekhawat, N.S. (1995). Micro propagation of *Capparis decidua* (Forsk.) Edgew: A tree of arid horticulture, Plant Cell Reports, 15: 278–281.

[5] Dipti & Jaiswal, M.L. (2016). Kartra- An important medicinal plant of arid zone. International Journal of Ayurveda and Pharmaceutical Chemistry, 6(2): 120–130.

[6] Godara, D., & Kaushik, V. (2015). A Method of Isolation of Cappariserol from *Capparis decidua* and antinephrolithiasis activity. American Journal of Advanced Drug Delivery, 3(1): 086–095.

[7] Kader (Al-Mudaris), M., Omari, M., & Hattar, B. (1998). Maximizing germination percentage and speed of four Australian indigenous tree species. Dirasat Agricultural Sciences, 25: 157–169.

[8] Kader (Al-Mudaris), M. (1998). Notes on various parameters recording the speed of seed germination. Journal of Agriculture in the Tropics and Subtropics, 99: 147–154.

[9] Kumar, A., Chawla, R.K., & Kumari, S. (2013). Chemical Investigation of *Capparis decidua* Fruits. International Journal of Chemical Science, 11(4): 1769–1774.

[10] Mahla, H.R., Mertia, R.S., & Sinha, N.K. (2010). Morphological characterization of in-situ variability in kair (*Capparis decidua*) and its management for biodiversity conservation in Thar Desert. Open Access Journal of Medicinal and Aromatic Plants, 1(2).

[11] Meghwal, P.R. (1997). Exploiting underutilized fruits of arid zones. Indian Horticulture, 42(3): 26–28.

[12] Meghwal, P.R., & Tewari, J.C. (2002). Kair (*Capparis decidua* (Forsk.) Edgew.)—A Multipurpose Woody Species for Arid Regions. Forests, Trees and Livelihoods, 12(4): 313–319.

[13] Meghwal, P.R., & Vashishtha, B.B. (1998). Effect of time of planting and auxins on rooting of cutting of ker [*Capparis decidua* Forsk.j. Annals of Arid Zone, 37(4): 401–404.

[14] Murashige, T., & Skoog, F. (1962). A revised medium for rapid growth and bioassay with tobacco tissue culture. Physiol. PI., 15: 473–497.

[15] Orchard, T. (1977). Estimating the parameters of plant seedling emergence. Seed Science and Technology, 5: 61–69.

[16] Pareek, O.P. (1978). Horticultural development in arid regions. Indian Horticulture, 23(2): 25–30.

[17] Rathee, S., Rathee, P., & Rathee, D. (2010). Phytochemical and Pharmacological potential of Kair (*Capparis decidua*). International Journal of Phytomedicine, 2: 10–17.

[18] Scott, S., Jones, R., & Williams, W. (1984). Review of data analysis methods for seed germination. Crop Science, 24: 1192–1199.

[19] Tyagi, P., & Kothari, S.L. (1997). Micro propagation of *Capparis decidua* through in vitro shoot proliferation on nodal explants of mature tree and seedlings explants. J. Biochemistry and Biotechnology, 66: 19–23.

[20] Vashishtha, B.B. (1987). Vegetative propagation of *Capparis decidua.* An of Arid Zones, 26(1&2): 123–124.