Standard Operating Procedure (SOP)

NURSERY RAISING AND FIELD PLANTATION OF *CAPPARIS DECIDUA*

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Nursery Raising and Field Plantation of *Capparis decidua*

2026

Submitted to

State Forest Department, Rajasthan

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Disclaimer

This document has been prepared in an academic spirit based on research conducted at ICFRE–Arid Forest Research Institute (AFRI), Jodhpur, and relevant information available in the public domain. The recommendations provided are intended as technical guidance for nursery and plantation practices under arid and semi-arid conditions.

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FOREWORD

It gives me immense pleasure to present the Standard Operating Procedure (SOP) for Nursery Raising and Field Plantation of *Capparis decidua*, prepared by the scientists of the Arid Forest Research Institute (AFRI), Jodhpur. This document is a timely and practical contribution towards strengthening afforestation, restoration, and livelihood based plantation programmes in the arid and semi arid regions of Rajasthan.

Capparis decidua (Kair) is one of the most resilient and ecologically significant native shrub species of the Rajasthan. Its remarkable drought tolerance, deep taproot system, and multipurpose utility make it indispensable for desert rehabilitation, sand dune stabilization, and enhancement of rural livelihoods. Despite its adaptability in natural habitats, field plantations have often faced challenges due to improper nursery techniques, root deformation, and poor establishment under harsh climatic conditions.

This SOP is the outcome of systematic research and field validation carried out at AFRI. It provides scientifically refined, field oriented, and step by step guidelines covering seed collection, pretreatment, containerized nursery production using improved root trainer systems, hardening, field transplantation and post plantation care. The emphasis on root architecture improvement through modified root trainers with extenders represents a significant technological advancement for raising drought resilient planting stock suitable for arid ecosystems. The practical recommendations outlined in this manual will assist Forest Department officials, nursery managers, frontline field staff, and implementing agencies in improving plantation survival and growth performance of Kair under challenging desert conditions. Adoption of these standardized practices will not only enhance afforestation success but also support conservation of valuable germplasm, restoration of degraded lands, and strengthening of rural economies dependent on this important species.

I commend the authors for their dedicated efforts in compiling this comprehensive and user friendly technical guide. I am confident that this SOP will serve as a reliable reference document and will contribute significantly to sustainable desert forestry and ecological restoration initiatives in Rajasthan and other dry regions of the country.

Dr. Ashutosh Kumar Tripathi

Preface

The Standard Operating Procedure (SOP) for Nursery Raising and Field Plantation of *Capparis decidua* has been prepared with the objective of providing clear, practical, and scientifically validated guidelines for successful propagation and establishment of this important arid zone species.

Capparis decidua (Kair) holds immense ecological, economic, and social value in the desert and semi arid regions of Rajasthan. It supports rural livelihoods through fruit collection, provides fodder during drought, contributes to fuelwood supply, and plays a crucial role in stabilizing sand dunes and restoring degraded lands. However, despite its natural hardiness, plantation success has often been limited due to inappropriate nursery practices, root damage during transplantation, and poor early stage moisture management.

This SOP has been developed based on systematic nursery experimentation and field trials conducted at the Arid Forest Research Institute (AFRI), Jodhpur. Special emphasis has been given to improving root architecture through appropriate container design, particularly the use of modified root trainers with extenders to promote deep taproot growth. The document integrates scientific findings with field experience and presents them in a simple, step wise manner so that nursery managers, field foresters, and frontline staff can readily adopt the recommended practices.

The manual covers the entire operational cycle—from seed collection and processing to nursery production, hardening, field transplantation, watering regimes, in situ moisture management, and post-plantation maintenance. By standardizing these procedures, the SOP aims to improve seedling quality, enhance survival rates, and ensure long-term sustainability of Kair plantations under harsh arid conditions.

It is hoped that this document will serve as a practical guide for State Forest Departments, implementing agencies, and all stakeholders engaged in desert afforestation and ecological restoration programmes. Adoption of these scientifically developed protocols will contribute to conservation of native germplasm, restoration of degraded landscapes, and strengthening of livelihood opportunities in arid and semi-arid regions.

Authors

Introduction:

Capparis decidua, locally known as Kair is one of the most dependable native shrub species of the hot arid regions of Rajasthan and adjoining dry areas. It is naturally found growing on sand dunes, rocky pediments, wastelands, and degraded lands where very few other tree or shrub species can survive. Because of its exceptional drought hardiness and multiple uses, it is considered one of the most suitable species for afforestation, desert rehabilitation, and livelihood-based plantations in the Thar Desert.

Kair is well adapted to extreme climatic conditions. It can tolerate very high summer temperatures (45–50°C), very low rainfall, strong winds, poor sandy soils, and prolonged drought. The plant survives mainly because of its strong and deep taproot system, which penetrates several meters into the soil and draws moisture from deeper layers. This deep rooting habit makes the species highly resilient in drylands and suitable for planting in areas where irrigation is limited or not available. Once established the plant requires very little maintenance and can survive under harsh field conditions.

From a field and community perspective, Kair is a multipurpose and livelihood-supporting species. Its immature fruits are widely used as vegetables and pickles and have good market demand. Collection and sale of fruits provide seasonal income to rural families, especially women. The young shoots serve as valuable fodder for camels, goats, and sheep during drought periods when grasses are unavailable. The wood is hard and dense and is commonly used as fuelwood and charcoal. Different plant parts are also used in traditional medicines. Due to these benefits, Kair is closely linked with the rural economy of desert villages.

Ecologically, the species plays an important role in land restoration. It binds soil, stabilizes sand dunes, reduces wind erosion, and improves soil fertility through litter addition. Kair plantations also provide shelter and food for birds and wildlife and help in improving overall vegetation cover in degraded landscapes. It naturally grows in association with other important desert species such as Prosopis cineraria (Khejri), forming the backbone of traditional desert ecosystems. Therefore, its inclusion in afforestation and rehabilitation programmes is highly recommended.

However, despite its importance, raising successful plantations of Kair has been difficult in practice. Forest departments and field staff often face problems such as poor and delayed seed germination, slow early growth, and high mortality after transplanting. The major reason for plantation failure is the plant's early development of a long taproot. When seedlings are raised in polybags or uprooted as bare-root plants, the taproot gets bent or damaged. Such seedlings fail to establish properly after planting and show poor survival in the field. As a result, many earlier plantations have not performed satisfactorily.

Therefore, conventional nursery practices are not suitable for Kair. Scientific nursery methods that protect and promote deep root growth are essential. Containerized root-trainer technology, proper potting media, careful hardening, and moisture conservation measures in the field are necessary to produce sturdy seedlings capable of withstanding drought and transplant shock. Adoption of these improved techniques can significantly enhance survival and growth under arid conditions.

This technical manual has been prepared to provide practical, step-by-step, field-oriented guidelines for nursery production and field establishment of Kair. The aim is to help nursery managers, range officers, and frontline staff produce healthy planting stock with strong root systems and achieve higher survival rates in plantations. Proper implementation of these practices will support large-scale conservation of Kair, restoration of degraded lands, and sustainable livelihood generation in arid and semi-arid regions.

Importance and need for conservation of *Capparis decidua*

The increasing commercial demand for fruits, coupled with overgrazing, fuelwood extraction and habitat degradation, has resulted in shrinking natural populations. Natural regeneration is poor due to seed dormancy and harsh environmental conditions. Consequently, there is an urgent need to standardize nursery and plantation technologies that enable large-scale propagation and restoration of the species. Development of scientific propagation techniques is therefore critical for long-term conservation and sustainable use.

Problems in propagation and afforestation

The seeds of Kair possess a hard and impermeable seed coat that restricts imbibition and leads to erratic and delayed germination. Seedlings develop a long taproot at a very early stage, which makes them highly sensitive to root disturbance. Conventional polybag or bare-root seedlings often exhibit poor survival after transplantation. Slow initial growth and heavy grazing pressure further reduce plantation success. These constraints necessitate containerized production systems and careful field management.

Morphological features:

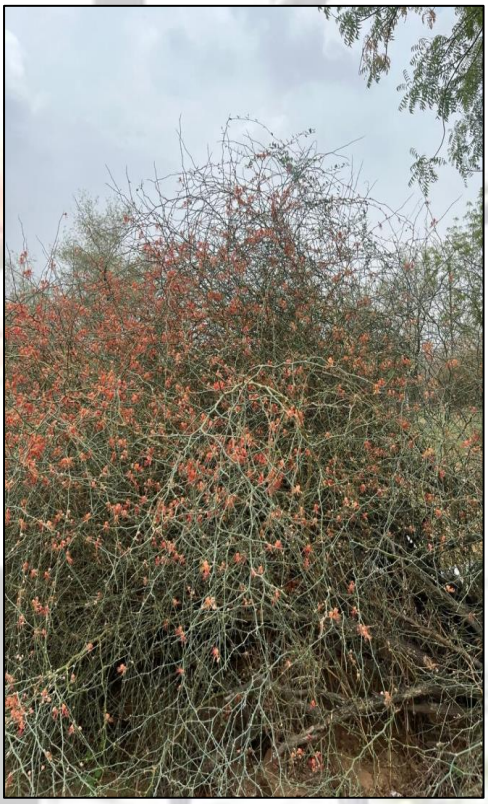
Capparis decidua is a hardy, deciduous, densely branched, leafless shrub or small tree, usually 3–5 m tall, widely adapted to arid and semi-arid environments. Numerous slender, grey-green, vine-like branches that hang in clusters, giving it a bushy and compact appearance easily recognizable in desert landscapes, characterize the plant.

The species develops a strong and deep taproot system that may penetrate up to 3–4 m or more into the soil, enabling access to subsoil moisture and conferring high drought tolerance. Young stems are smooth and green, gradually becoming grey, rough, and corky with age. Branches are tender and waxy, reducing water loss. Leaves are very

small, succulent, and short-lived (caducous), appearing briefly on young shoots during favourable moisture conditions and shedding quickly to minimize transpiration. Paired stipular spines occur at the nodes and act as protection against grazing.

Flowers are borne laterally or terminally in small clusters and are showy, with pink, scarlet-red, or yellow coloration. Each flower has numerous red stamens, making blooming plants highly conspicuous even in the absence of leaves. Fruits are small, globose, smooth berries (about 1–1.5 cm diameter), green when immature and turning red or pink at maturity. The fruits contain sweet pulp with many reniform seeds that are readily dispersed by birds and animals. The species also shows strong coppicing ability and produces root suckers, aiding natural regeneration and resilience after cutting or browsing.

***Capparis decidua* Small tree**



Shrub

Leaf at young stage

Flower

Immature fruit

Mature fruit

Phenology (Seasonal Growth Behaviour)

Kair exhibits a well-defined seasonal growth pattern suited to arid climates. The vegetative phase generally begins with the onset of cooler months (around October) and continues up to early summer. The plant may produce two to three leaf flushes annually—during early monsoon, pre-winter, and winter periods—depending on moisture availability. These temporary leaf flushes enhance photosynthesis and energy storage before the plant reverts to its leafless state.

Flowering typically occurs twice a year, first during March–April and again during July–August**,** followed by fruiting during May–June and September–October. Flowering is usually more profuse on older shoots than on new growth. The species flowers and fruits abundantly even under drought and high temperatures, whereas reproductive output may decline in years with good rainfall. Pollination is mainly insect-mediated, especially by bees and flies.

Overall, the species demonstrates strong adaptation to water stress, with leaf emergence and flowering closely linked to subsoil moisture conditions. Its ability to flower during dry periods and regenerate through coppicing and suckers makes it highly dependable for plantation and restoration programmes in desert ecosystems.

Field Note for Foresters:
Leafless green branches, paired spines, bright red/pink flowers, and red berries during summer are key diagnostic features for quick identification in the field.

Taxonomic Classification (APG IV System)

Kingdom	: Plantae
Clade	: Tracheophytes
Clade	: Angiosperms
Clade	: Eudicots
Clade	: Rosids
Order	: Brassicales
Family	: Capparaceae
Genus	: *Capparis*
Species	**: *C. decidua***

Nursery preparation and field establishment for *Capparis decidua* (Kair)

Nursery preparation:

Site selection

The nursery site should be selected in well drained sandy loam soils with easy access to irrigation water and protection from grazing animals. Raised beds and proper drainage channels are essential to avoid water logging, which can damage young seedlings. The area must receive adequate sunlight to ensure hardening of seedlings. Shade nets may be used temporarily during early germination, but seedlings should gradually acclimatize to full sunlight.

Seed Collection:

Seeds of *Capparis decidua* should be collected from healthy, disease free, and vigorously growing mother plants showing profuse flowering and fruiting. Selection of superior mother plants ensures better seed quality, higher germination percentage, and improved seedling vigour.

The ideal period for seed collection in arid and semi-arid regions is early to peak summer period, generally from March to May**,** depending on local climate and fruiting behaviour. Peak seed maturity is usually observed during April-May**,** which is considered the best time for collection**.** During this period, fruits attain full size, develop characteristic colour, and seeds reach physiological maturity with maximum viability.

Only fully ripe and well developed fruits should be harvested. Immature, shrivelled, diseased, or insect damaged fruits must be avoided. Fruits should preferably be

handpicked or gently shaken onto clean sheets to prevent mechanical injury. For better adaptability and genetic diversity, seeds may be collected from multiple mother plants across different sites.

Mature fruit

Seeds

Seed lots can be evaluated based on seed size, weight, and number of seeds per fruit, as heavier and well filled seeds generally produce more vigorous seedlings and better fieldestablishment.

Seed Processing and cleaning

Immediately after collection, fruits should be soaked in clean water for several hours to soften the pulp. The softened pulp is removed manually by rubbing and washing, and seeds are thoroughly cleaned to remove mucilage and debris. Proper cleaning reduces fungal infection and improves storage life. For grading, a flotation test is recommended. Seeds are placed in water; heavy and viable seeds sink while light, unfilled, or damaged seeds float and should be discarded. The selected seeds are then shade dried under well ventilated conditions until surface moisture is removed. Direct sun drying should be avoided to prevent loss of viability. Dried seeds may be stored in airtight plastic or moisture-proof containers in a cool, dry place until sowing.

Seed pretreatment

Seeds of *Capparis decidua* possess a hard and relatively impermeable seed coat, which restricts water absorption and often results in delayed, erratic, and uneven germination. Therefore, appropriate presowing treatments are essential to enhance imbibition, overcome dormancy, and ensure uniform seedling emergence in the nursery.

Pretreatment requirements vary depending on seed condition. Freshly extracted seeds, having higher physiological activity and better viability, can usually be sown directly after overnight soaking in normal water without the need for strong dormancy-breaking measures. In contrast, stored seeds tend to develop harder seed coats and reduced permeability; therefore, they respond better to growth regulator treatments or extended soaking to improve germination percentage and speed. Presowing treatments may include soaking seeds in clean water for 12–24 hours to soften the seed coat and initiate imbibition, or treating seeds with suitable growth regulators such as gibberellic acid ($GA_3 \approx 1000$ ppm) to promote dormancy breaking and faster, more uniform germination. Where required, auxin-based solutions (e.g., IBA ≈ 1000 ppm)

may also be used to encourage early root initiation and improve initial seedling establishment. water soaking and GA_3 treatment have generally been found effective and are recommended for routine nursery practice to obtain higher and more synchronized germination.

In all cases, treated seeds should be sown immediately after pretreatment, as drying after soaking may reduce effectiveness. Kair seeds exhibit orthodox storage behaviour and retain viability reasonably well under dry and cool conditions; however, germination and seedling vigour gradually decline with time. The highest germination is typically obtained when seeds are used within 3–6 months of collection**,** while acceptable viability may be maintained for up to 9–12 months under proper storage. Beyond one year, a significant reduction in germination and vigour is commonly observed. For best nursery performance, seeds should therefore be used within one year of collection and stored in airtight containers in a cool, dry place with low humidity to maintain viability.

Container specifications for Raising *Capparis decidua* Seedlings

For quality seedling production of *Capparis decidua* under arid and semi arid conditions, both standard HDPE pots and modified root trainer systems can be effectively utilized. Root trainers of 500 cc ,1900 cc (12inch HDPE pots;size 9x8 cm, 30cm length) and 1100 cc volume(500 cc root trainer with 30 cm extender) are recommended exclusively for raising Kair seedlings. Root trainers are preferred containers as it possess vertical ribs and an open base that guide roots downward and prevent coiling. Such a design encourages the development of a straight taproot and fibrous laterals, resulting in improved field survival. Polybags should be avoided as they cause root deformation and poor establishment.

1. HDPE Pots

HDPE pots of 12-inch size (approximately 9 × 8 cm upper dimension and 30 cm length; capacity ~1900 cc) may be used for nursery raising. The extended depth facilitates taproot elongation and supports better root shoot balance during the nursery phase.

2. Standard Root Trainers (500 cc)

Single cell root trainers of 500 cc capacity are commonly used for containerized seedling production. These containers promote air pruning and reduce root spiraling compared to conventional polybags.

3. Modified Root Trainers with PVC Extenders

To enhance root architecture and simulate deeper soil conditions, 500 cc root trainers can be modified by attaching an extender made of cylindrical PVC pipe beneath the root trainer to accommodate the deep taproot, This extension allows deeper root growth and produces robust seedlings capable of withstanding drought stress. The extender is inexpensive and can be fabricated locally, making it suitable for large-scale use.

HDPE Pots

500 cc root trainer

Modified root trainer with extender

Technical Specifications for 500 cc root trainer with extender :

- Extender diameter: 6.3 cm
- Extender length: 30 cm
- Total effective volume after modification: approximately 1100 cc
- Uniform internal diameter to maintain continuous root channel

The PVC extenders should be precisely cut and securely fitted to the base of the root trainer to ensure structural stability and uninterrupted vertical root growth. Drainage holes must be provided at the terminal end of the extender to prevent water stagnation while allowing proper aeration and gravitropic root penetration.

Preparation of modified root trainer by PVC pipe attachment to 500 cc root trianer

Functional Advantages of Modified Root Trainer System

The modified root trainer system is designed to facilitate uninterrupted vertical elongation of the taproot while preventing root coiling and lateral deformation. By effectively mimicking deeper soil profile conditions during the nursery stage, it enables seedlings to develop a well oriented and structurally robust root system. This improvement in root architecture contributes to a better root to shoot balance before transplantation, ensuring enhanced physiological stability. As a result, seedlings exhibit improved drought tolerance and higher survival rates under arid and semiarid

field conditions. Additionally, the system is modular, economical, easy to fabricate, and suitable for large scale implementation, making it a practical and scalable solution for producing high quality, drought resilient *Capparis decidua* planting stock.

Potting mixture and sowing

For raising healthy *Capparis decidua* seedlings in the nursery, proper soil preparation is very important to prevent fungal problems, especially damping-off disease in the early stages. First, all soil components should be cleaned by removing stones, plant residues, and other unwanted materials. To reduce fungal infection, the soil should be sterilized before preparing the potting mix. One simple and effective method is **soil solarization**, where moist soil is spread in a thin layer and covered with a transparent polythene sheet for 3–4 weeks during hot summer days. The heat trapped under the sheet helps kill harmful fungi, weed seeds, and pests.

Seed sowing

Germination of seed

Germinated seedling

As an additional protective measure, beneficial bioagents like *Trichoderma* can be mixed into the soil. These helpful microbes naturally control harmful fungi and improve soil health. After sterilization, the potting mixture should be prepared in a 6:3:1 ratio of river sand, soil, and well-decomposed neem compost. This combination provides good drainage, proper aeration, and enough nutrients for seedling growth. The materials should be mixed thoroughly to get a uniform texture. The prepared mixture should then be filled into containers or root trainers, pressing lightly to remove large air gaps but keeping the soil loose enough for root growth.

Instead of raising seedlings in nursery beds and later transplanting them, seeds should be directly sown in individual containers. This avoids root disturbance and transplant shock. Each seed should be placed about 1–1.5 cm deep and lightly covered with soil. After sowing, gentle watering should be done to keep the soil moist without washing away the seeds. By following these simple steps, healthy and strong seedlings with well-developed roots can be produced, making them better suited for survival in arid and semi-arid field conditions.

Seedling maintenance and hardening

Irrigation: Young seedlings especially those in containers have limited moisture reserve and need frequent watering. Light irrigation is required to keep the growing

medium consistently damp, not waterlogged which can lead to disease. In hot arid climate regular light irrigation ensures th root zone receives adequate moisture without excessive runoff. Weeding and disease monitoring are necessary during nursery growth. Overwatering must be avoided. Hardening involves gradual exposure to full sunlight and reduced irrigation, which prepares seedlings for harsh field conditions. Only sturdy seedlings with adequate height and collar diameter should be selected for planting.

Nursery seedlings of *Capparis decidua*

Insect Pest and Disease Management

For maintaining healthy seedlings and effective insect pest management, appropriate biological control measures should be adopted. *Capparis decidua* is susceptible toward root rot under waterlogged condition. Soil drenching with *Trichoderma* (10-15 ml per litre of water) should be applied to protect seedlings from soil borne fungal diseases and to promote healthy root. Neem oil spray (5 ml per litre of water) should be used at regular interval as a preventive measure against common sucking pests and early stage insect infestations. Where pest incidence is observed, biocontrol agents such as *Beauveria bassiana* and *Metarhizium anisopliae* (10–15 ml per litre of water) should be applied as per requirement. These entomopathogenic fungi help manage a wide range of insect pests in an eco-friendly and sustainable manner, ensuring safe nursery production without harmful chemical residues.

Field transplantation and establishment

Advance Work for Field Transplantation of *Capparis decidua*

Prior to transplantation of nursery-raised seedlings of *Capparis decidua* (Kair), all advance plantation operations should be completed before the onset of monsoon. A well-drained sandy or sandy-loam site should be selected, as the species thrives under arid conditions but is sensitive to water stagnation. The site should be cleared of weeds, shrubs, grasses, and debris to reduce competition for soil moisture. The

plantation layout should be marked at a recommended spacing of about 3 m × 3 m (or as per the objective of plantation). Pits of approximately 45 cm × 45 cm × 45 cm should be dug and exposed to sunlight for aeration. The excavated soil should be mixed thoroughly with organic amendments such as neem leaf manure or well-decomposed farmyard manure (about 3 kg per pit) to improve soil fertility and microbial activity. The pits should then be refilled and allowed to settle with pre-monsoon showers. Adequate fencing must be ensured to protect young seedlings from grazing and biotic interference.

Field Transplantation of *Capparis decidua*

For achieving high transplantation success in Kair **(***Capparis decidua***)**, field planting should preferably be carried out during the post monsoon period**,** when adequate residual soil moisture is available but the risk of water logging has subsided. This timing ensures better root establishment under moist yet well-drained conditions, which are essential for this drought hardy species. Only healthy, disease-free, and well hardened nursery seedlings possessing a straight and well developed taproot system should be selected for transplantation.

Pits of approximately 45 × 45 × 45 cm (or as per site conditions) should be prepared in advance. To improve soil biological activity and enhance establishment, about 1-2 kg of rhizospheric soil collected from the root zone (15–30 cm depth) of mature, naturally growing, healthy Kair plants should be added to each pit. This native soil acts as a natural microbial inoculum containing beneficial rhizospheric microorganisms and mycorrhizal associations adapted to arid ecosystems. The collected soil should be thoroughly mixed with excavated topsoil and well decomposed farmyard manure before refilling the pit. Soil must always be sourced from healthy plants and handled carefully to preserve microbial viability.

For seedlings raised in standard root trainers, light watering should be provided a few hours before lifting to keep the root plug moist and compact. The container should be gently tapped from the base to release the intact soil column, and seedlings should always be handled by holding the root ball rather than the stem to avoid mechanical injury. In seedlings raised in deep root trainers fitted with cylindrical PVC extenders, the extender should be carefully detached, and the elongated soil column containing the taproot should be removed intact by gentle tapping or sliding. The root plug must never be pulled forcefully, as taproot injury can severely reduce establishment success in arid soils.

During planting, the seedling should be positioned upright at the center of the pit, ensuring proper vertical placement of the taproot without bending. The pit should be gradually filled with fine topsoil while gently pressing around the root zone to eliminate air pockets and ensure firm root soil contact. The root collar must remain at ground level. If required, light irrigation may be applied after planting, ensuring that excess water does not accumulate in the pit.

Maintenance of *Capparis decidua* Plantation

Capparis decidua (Kair) is a hardy and drought-tolerant species naturally adapted to arid and semi-arid environments; however, proper watering during the initial establishment stage is essential to ensure higher survival and healthy root development however proper maintenance during the first one to two years is critical for successful establishment of *Capparis decidua*, particularly under arid and semi-arid conditions. The following step wise measures should be adopted:

Watering

Immediately after transplantation 15-20 litres of water per plant should be applied to ensure proper soil settling and root–soil contact. During the first month, irrigation should be provided at 10 day intervals with 15-20 litres per plant. From the second to third month, watering should be reduced to once every 15 days with 10-15 litres per plant to encourage deeper root growth. Between three to six months, irrigation should be given once every 20 to 30 days with 10–15 litres per plant during dry periods. After establishment (6–12 months), watering may only be required during prolonged drought. Overwatering should be strictly avoided to prevent root rot.

Weeding

Regular weeding should be carried out, especially during the first year, to reduce competition for moisture and nutrients. Manual weeding around the plant basin at intervals of 30 to 45 days is generally sufficient. Removal of grasses and invasive weeds near the root zone is particularly important in rainfed conditions.

Mulching

Mulching around the base of the plant using locally available materials such as dry grasses, straw, crop residues, or leaf litter should be practiced to conserve soil moisture, regulate soil temperature, and suppress weed growth. A mulch layer of about 5 to 8 cm thickness around the basin is recommended, keeping slight space near the stem to avoid collar rot.

Basin Formation and Soil Working

Circular basins should be maintained around each plant to facilitate rainwater harvesting and efficient irrigation. Light hoeing or soil stirring at intervals improves aeration, breaks soil crust, and enhances water infiltration, particularly in sandy and compact soils.

Insect and Termite Management

In arid regions, termite attack is common during early establishment. Preventive soil treatment with suitable termiticides as per recommended dosage may be done at the time of planting if infestation risk is high. For ecofriendly management, biological agents such as *Beauveria bassiana* and *Metarhizium anisopliae* may be applied as soil drenching (10–15 ml per litre of water) when required. Neem oil spray (5 ml per litre)

can be used as a preventive measure against sucking pests. Regular monitoring should be conducted to detect early signs of insect or disease incidence.

6. Protection Measures

Fencing should be maintained to prevent grazing and browsing damage. Any damaged or dead plants should be replaced during the next suitable planting season .

Adoption of these systematic maintenance practices ensures stronger root establishment, improved survival percentage, and sustainable growth of *Capparis decidua* plantations under harsh arid and semi-arid conditions.

Flowchart for *Capparis decidua* cultivation

Seed Collection → Seed Processing → Seed Pretreatment →Root trainer preparation → Seed Sowing in Root Trainer → Nursery Maintenance → Hardening → Field Plantation → Maintainence → Monitoring

***Capparis decidua* Nursery Preparation**

Field transplantation and establishment of *Capparis decidua*

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