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Burlapping: A sustainable tree plantation technique for future endeavours

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Abstract

Burlapping, the process of relocating mature trees, it is a complex but valuable practice in modern arboriculture and landscaping. This technique, which dates back to ancient civilizations, has evolved through innovations like tree spades, mechanized loaders and containerized planting systems. Tree transplantation serves multiple purposes from preserving ecological heritage and accommodating infrastructure projects to enhancing urban green spaces. The burlapping involves various methods such as bare root, balled and burlapped (B&B), packaged stock, containerized plants and field-potted specimens, each with specific guidelines for planting, maintenance and post-care. Successful transplantation relies heavily on pre-transplant root pruning, proper site and species selection, seasonal timing and consistent aftercare. This comprehensive overview highlights the science, methodology and practical considerations necessary for effective transplantation of trees and maintenance underscoring its critical role in sustainable landscape development.

Keywords: Bare root, balled and Burlapped, packed stock, containerized plants, field-potted plants

1. Introduction

Transplanting trees is an age-old technique, often employed to preserve, maintain or rescue trees that are in danger of being cut down, damaged or destroyed. Burlapping is the process of relocating a mature tree from one location to another. This method involves significant intervention and trees often need time to recover afterward. Due to the expansive shape and spread of a tree's root system, transplantation typically results in the loss of a considerable number of roots. Today, the practice of moving mature trees upright with their full canopies intact and without pruning or bending branches is increasingly common in premium construction projects, especially those with commercial or green heritage value. Remarkably, trees ranging from 50 kilograms to as much as 50 tonnes have successfully been relocated (Sunil, 2024)^[20].

2. History of transplanting

Tree transplantation has been practiced since ancient times, with Egyptians moving large trees by ship as early as 2000 B.C (Campana, 1999)^[2]. Lancelot "Capability" Brown pioneered the horizontal transport of trees using a specially designed machine, enabling the transplantation of advanced trees up to 36 feet tall (Henry, 1828)^[9].

The 18th century saw a surge in large-scale landscaping, with entire hills and mature trees relocated manually. Kew Gardens began its major tree planting in 1761, followed by another wave in 1846. Mechanization later replaced manual labor, revolutionizing tree transplantation. The Barron tree transplanter, developed in the mid-1800s, facilitated the relocation of mature trees at Elvaston Castle (Turner, 2002)^[22].

By the late 1930s, Mc Clenahan Company undertook a major forestation project, transplanting 500 pine trees at Hearst Estate, California (McClenahan, 2002)^[16]. Hydraulic tree diggers were introduced in 1956, transforming nursery operations (Davidson *et al.*, 1999)^[3]. Advancements in arboriculture in the late 1970s helped preserve top soil during transplantation, using mechanized loaders for soil transport (32nd Annual Report, 1978). The 1980s saw the commercialization of tree spades, improving efficiency and reducing costs (Preaus and Whitcomb, 1980)^[19].

In India, tree protection laws such as the Karnataka Preservation of Trees Act (1976), Delhi Preservation of Trees Act (1994) and Goa, Daman and Diu Preservation of Trees Act (1984) regulate transplantation. Notably, the Delhi Government relocated 25 trees in 1972, well before formal legislation (Hindustan Times, Dec. 21, 2019)^[10].

3. Types of tree transplanting

3.1 Bare root

Bare root transplanting is the oldest method used in the nursery and forestry industries for moving trees and shrubs. During the early days of fruit tree production in our country, this was the only technique used and even today it remains valuable despite the rise of balled-and-burlapped (B&B) and container-grown plants. Bare root methods are particularly effective for transplanting deciduous trees and shrubs during their dormant seasons, though they are not suitable for conifers or broad leaf evergreens unless grown in controlled nursery environments with consistent care. One major advantage of the bare root method is its cost efficiency plants transported this way are significantly cheaper than Ball and burlapped specimens.

While bare root plants are less suitable for garden centers, they are commonly used in municipal projects, highway landscaping, orchards, and mail-order nurseries. To ensure successful storage, humidity levels should be kept close to 100%, mimicking underground conditions. However, overwatering must be avoided, as it can lead to root and stem rot. Using mist blowers or lightly spraying storage floors, especially cement ones can help to maintain proper humidity. The most critical period for bare root plants is during transport from the nursery to the planting site. These plants must be well-covered, especially if transported in open trucks. Unfortunately, it's not uncommon to see valuable stock barely covered by inadequate materials like torn burlap or thin plastic sheeting, risking their survival and reducing their value significantly (Flemer, 1982)^[5].

3.2 Balled and Burlapped (B&B)

B&B is a traditional and widely accepted method for transplanting trees. Since both professionals and the general public are accustomed to this technique, it remains a common practice. These trees are easy to obtain and large specimens can be transplanted as long as the appropriate lifting and transporting equipment is available. One key benefit of Ball and Burlapped trees over those grown using other methods is the ability to match the root-ball's soil to the surrounding site, minimizing water movement issues at the soil interface (Harris and Bassuk, 1993)^[7].

However, a significant disadvantage is that more than 95% of a tree's roots are typically lost during the digging process (Gilman, 1988; Watson and Himelick, 1982)^[6, 23]. This loss can be partially addressed with certain horticultural practices like root pruning (Watson and Sydnor, 1987)^[25] or by choosing smaller trees that were previously container-grown. For instance, Harris and Gilman (1992)^[8] found that 51% of the total root length of East Palatka holly was retained 17 months after being transplanted B&B from 1-gallon containers in Florida.

B&B trees also face seasonal limitations. While some nurseries do transport them year-round with great care, the best time for transplanting is when water loss through transpiration is minimal and the tree has a high potential for root regrowth. Unfortunately, these conditions rarely happen at the same time root growth tends to be most vigorous only after the first growth flush hardens (Lee and Hackett, 1976)^[14]. Due to their significantly reduced root systems, maintaining adequate water

availability after transplanting, it is essential (Kozlowski and Davies, 1975)^[12]. B&B trees are quite heavy, moving large landscape specimens requires specialized equipment and trained worker.

3.3 Packed stock

Packaged trees and shrubs are essentially bare root plants whose roots are wrapped in a moist material such as peat moss. These plants should be planted early in the spring, before any new growth begins. Until planting, it's important to store the packing material in a cool, dark and moist environment. Handle these plants in the same manner as typical bare root stock (Sunil, 2024)^[20].

3.4 Containerized Plants

Containerized trees and shrubs begin as bare root specimens that are harvested in either spring or autumn. They are then placed in containers filled with a specially prepared growing medium before being made available for sale (Sunil, 2024)^[20].

3.5 Field-Potted Plants

This category includes nursery stock that was initially grown in the field and later transferred into pots, with the soil ball still intact. However, since field soil isn't ideal for container growth, these plants should be sold and planted during the spring. During both potting and planting, care should be taken to minimize root disturbance (Sunil, 2024)^[20].

3.6 Tree Spade Transplants

A tree spade is a specialized tool used to relocate larger plants by extracting a mound of earth containing the plant and a portion of its roots. Tree spades come in different sizes tailored to the type of tree evergreen or deciduous. Two common types of tree spades are the 90D and 100D models (Sunil, 2024)^[20].

4. Planting Guidelines for Different Types of Nursery Stock

4.1 Bare Root and Packaged Stock

Inspect the plant and trim away any damaged or diseased roots or branches. A planting hole, then add enough backfill soil to position the plant slightly higher than its original nursery depth. Gently tamp the soil and orient the plant so the largest branches face southwest. Spread the roots out evenly and straighten them. As you add soil, lightly raise and lower the plant to eliminate air pockets, avoid clumps, rocks or debris. When the hole is about three-quarters filled, tamp the soil and water deeply to remove any remaining air pockets. Filling the hole with soil, then water thoroughly (Swanson *et al.*, 2019)^[21].

4.2 Balled and Burlapped (B & B) Plants

Place the plant in the hole, ensuring it sits at or just above the depth it was grown in the nursery. Use the root flare and top of the soil ball to guide depth placement. Handle carefully to avoid breaking the soil ball. Fill the hole up to three-quarters and tamp to release trapped air. Cut and remove all twine from the trunk, then pull back burlap from the top and trunk area. Water slowly to saturate the root ball and surrounding soil. Fill the rest of the hole with soil and ensure no burlap remains exposed above ground, as it can wick moisture away from roots. Plant evergreens before October to allow root establishment (Swanson *et al.*, 2019)^[21].

4.3 Container-Grown and Containerized Stock

Remove the container at the planting site, this might involve cutting the pot. All containers, including biodegradable ones,

must be removed completely. Be cautious with newly containerized plants, as their roots may not be well-developed. For root bound plants (where roots circle the inside of the container), gently loosen the roots. Make shallow vertical cuts down the sides and a crisscross cut on the bottom to help roots spread. Plant using the same procedure as B&B stock. Like with other types, avoid planting evergreens past October to ensure proper rooting before winter (Swanson *et al.*, 2019) ^[21].

5. Planting techniques

5.1 Pre-transplant care

Proper handling of the root ball is essential to prevent damage before transplanting. Regardless of the production method, root balls are delicate with B&B trees and those in soft fabric containers being the most vulnerable. Never lift a tree by its trunk, especially B&B trees, due to the weight of the root ball. Secure the tree during transport to prevent root damage.

Before moving, trees should be well-watered and covered to minimize water loss. Ideally, they should be planted immediately upon arrival at the site. If immediate planting isn't possible, water them thoroughly and store them in a sheltered area, away from direct sunlight and strong winds. B&B trees should be healed-in to prevent root ball dehydration. Regular watering must continue until planting is complete.

5.2 Plant and site selection

Choose trees and shrubs suited to the specific conditions of the planting site, as improper placement can lead to plant failure regardless of how well they are planted. Before planting, check soil drainage by digging a hole equal in depth to the planting hole and filling it with water. If the water drains slower than one inch per hour, consider adding drainage to redirect excess water, adjusting the site by raising it (berm construction) or selecting species that tolerate wet conditions. Dig planting holes that are shallow but two to three times wider than the root ball to promote natural horizontal root growth in trees and shrubs. For well-drained soil, match the hole depth to the root ball, while in heavy clay soil with poor drainage, make the hole one to two inches shallower. Cover the exposed top of the root ball with mulch for protection. Avoid digging holes deeper than the root ball or placing loose soil beneath the roots, as compacting over time can cause trees and shrubs to settle too deep (Appleton *et al.*, 2009) ^[1].

5.3 Excavate the hole

Make sure the planting hole is spacious enough to fit the roots without causing damage or distortion. For balled-and-burlapped and container-grown plants, the hole should match the depth of the root ball, while bare-root plants need a slightly deeper hole to properly accommodate their root system (Kumar, 2022) ^[13].

5.4 Soil filling

The soil excavated from the pit serves as the best backfill. While digging, separate the topsoil (upper 6 inches) into one pile and the subsoil into another. Begin refilling with subsoil, then add top soil, ensuring proper irrigation between layers. The soil gently to provide stability, but avoid excessive compacting. Finally, water again to help settle the topsoil (Kumar, 2022) ^[13].

5.5 Planting in site

The tree should be positioned correctly, ensuring it remains upright without tilting. Ideally, it should be oriented similarly to how it was in the donor site (Kumar, 2022) ^[13].

5.6 Elimination of supporting material

Before completing the final backfilling, remove the gunny bag or cloth used to wrap the root ball along with any other supporting materials from the planting hole (Kumar, 2022) ^[13].

5.7 Trimming of affected branches

Branches that sustain damage during transport should be carefully pruned, ensuring cuts are made at the nearest branch bark ridge (Kumar, 2022) ^[13].

5.8 Root ball placement

After the tree is placed, the top of the root ball must remain level with or above the surrounding soil. The trunk flare should be positioned at or slightly higher than the final grade (Kumar, 2022) ^[13].

5.9 Pit refilling

The soil around the tree's base should be compacted firmly to provide stability, while the remaining soil should be gently tamped. Water must be applied to both the root ball and the refill soil to ensure proper hydration at field capacity (Kumar, 2022) ^[13].

6. Post-care of transplanting

6.1 Root pruning

Trees that are root-pruned regularly in nurseries tend to transplant more effectively because their absorbing roots remain close to the trunk, minimizing damage during lifting. This method also promotes root branching and the development of numerous fine roots, which improve the plant's ability to absorb water. In contrast, large trees found in open fields or forests develop long, sparse roots and since many of their absorbing roots are located far from the trunk, they often suffer significant root loss when dug up, making transplantation more difficult. To improve success, such trees should be root-pruned at least two years before moving by digging a trench around them. The distance of the trench from the trunk should depend on the tree's size (Pirone, 1972) ^[18] recommends roughly 5 inches of trench radius per inch of trunk diameter. The excavated soil should be mixed with organic matter such as manure or leaf mold or with fertilizer and returned to the trench. This process restrains the tree's top growth while stimulating the emergence of new roots near the cuts, ultimately producing a compact, fibrous root system with high water-absorbing ability and lower water loss through transpiration. This approach is especially valuable for trees with tap roots and for container-grown specimens whose roots have grown beyond their containers into the surrounding soil (Kozlowski and Davies, 1975) ^[12].

6.2 Mulching

Spread a 2-3 inch-thick layer of mulch around the plant, forming a circle about 6 feet in diameter. Avoid piling mulch directly against the trunk. Instead, make sure it's pulled back at least 4 inches to protect the bark (Nirmala, 2024) ^[17].

6.3 Fertilization

Applying nitrogen in late summer may stimulate new growth, which might not properly harden before winter and could be damaged unless there's a nutrient deficiency. Phosphorus (P) and potassium (K) should be applied in autumn to help the plant better acclimate for winter. Root growth enhancers can also be beneficial during this period (Harris and Bassuk, 1993) ^[7].

6.4 Staking

Most young trees benefit more when left unstaked. Allowing the crown to move naturally encourages the development of sturdier, more resilient trunks compared to those that remain staked for long periods. Staking becomes necessary only when a tree is unstable due to strong winds or has been toppled. A common issue with staking is girdling, where the ties cut into the trunk. This can be avoided by using soft materials like nylon webbing or carpet strips secured to a post with grommets. Conversely, using wire ties too tightly around the trunk can result in severe girdling, potentially leading to the tree's death. The timing of transplanting significantly affects the survival rate of Eldarica pine. Trees planted in late spring, when average temperatures range between 10°C and 20°C showed the highest

survival rates (Etemadi *et al.*, 2013) ^[4]. Palms experiencing prolonged stress from nutrient or water deficiencies often develop a noticeable narrowing in the trunk. This trunk constriction indicates the time frame during which the plant underwent stress (Watson and Himelick, 2013) ^[24].

6.5 Treatment at the transplanting site

Select a site similar to the original. Start preparation 5-7 days before transplanting of tree. Dig a pit (2-3 m size) with at least 2 ft extra space around the root ball. Ensure good drainage, daily watering and treat with antifungal/antibacterial solutions. Fill the pit (1 m depth) with compost, FYM and mother soil to support root establishment.

Table 1: Treatment at the transplanting site (Kshirsagar *et al.*, 2018) ^[11]

Name	Chemical	Active ingredient	Quantity per Tree
Anti-termite	Chlorpyrifos 20% EC	4 ml / 3 L water	8 L
Antibacterial	Bactinash 200	17 g / 3 L	2 L
Antifungal	Carbendazim (Bavistin)	2 g / 3L water	15 L
Root hormone	IBA	20 ppm	20 L
Vermi-compost	---	15-25 kg / pit	---

7. General process for Transplanting

Step:1 Water the soil a day before transplanting to keep the root ball intact and reduce stress on the roots. Dig a hole two to three times wider than the root ball and moisten it.

Step:2 Carefully remove the topsoil from the roots. Extend digging 4 to 6 inches beyond the trench to include newly grown roots, then prune them.

Step:3 Tie the lower branches to prevent interference during digging. Cut around the plant properly before digging underneath the root ball.

Step:4 Place a tarp or burlap beside the ball before completely cutting the roots. Dig underneath to sever the remaining roots.

Step:5 Lift the plant from underneath, never by the trunk. Keep it shaded and ensure the roots remain moist immediately after digging.

Step:6 Cover the plant when transporting it by truck or van. Avoid carrying it in an open vehicle.

Step:7 Planting too shallow exposes roots to temperature fluctuations, while planting too deep can cause rot. Position the tree 2-3 inches higher than the original grade to allow for settling.

Step:8 Stake the tree immediately after transplanting to support the roots. Mulch around it to retain moisture and suppress weed growth.

Step:9 Avoid pruning after transplanting, as the tree is already struggling to maintain its existing foliage.

Step:10 Do not fertilize a newly transplanted tree, as this may cause excessive growth while it is adjusting to new conditions. Fertilization should only be done after one year (Mageshen *et al.*, 2020) ^[15].

8. Fundamental guidelines

1. Tree transplanting is not a routine practice and isn't feasible in all circumstances. It should only be considered in urgent and critical situations to preserve a limited number of trees at risk of early removal.
2. Choosing the right species is crucial. *Ficus sp* thrives, whereas Neem is unsuitable. Species that regenerate efficiently through vegetative propagation show strong potential for survival. Trees reliant on tap roots are not ideal, but those with fibrous or lateral root systems tend to

adapt well.

3. Trees with a smaller girth, preferably under 70 cm, have a higher survival rate and are more manageable for handling and transportation.
4. For trees with a girth of less than 70 cm, the receptor pit should be 2x2x2 meters, while larger trees require pits of 3x3x3 meters, depending on the size of the root ball. A bigger root ball increases the tree's chances of survival.
5. The parent site and receptor site should share similar soil properties and climatic conditions to ensure successful transplantation.
6. Conducting transplanting operations during the rainy season is more favorable, as it helps minimize physiological stress on the trees.
7. The parent site and receptor site should be located as close to each other as possible. For lifting trees with a girth of less than 70 cm, a crane with a minimum capacity of 10 tonnes is required.
8. The pre-treatment trench must be dug to a depth of one meter, with a radius extending 1.5 to 2.0 meters from the base of the tree. Watering should be directed into the trench rather than applied to the tree base or root ball soil.
9. The roots should be exposed to sunlight for the shortest possible duration. A dedicated team must be present at both sites, ensuring daily monitoring of the work.
10. It is essential to remember that a tree is a living system. The success of tree transplantation relies on multiple factors, some of which are beyond human comprehension. Therefore, this technique should be regarded as one of the potential solutions for preserving a tree, given its undeniable significance (Kshirsagar *et al.*, 2018) ^[11].

9. Trees suitable for Burlapping

Ficus religiosa, *Ficus benghalensis*, *Ficus carica*, *Saraca asoca*, *Ziziphus jujuba*, *Terminalia arjuna*, *Dalbergia sissoo*, *Peltophorum*, *Madhuca longifolia*, *Phyllanthus emblica*, *Bombax ceiba*, *Tectona grandis*, *Betula pendula*, *Delonix regia*, *Mangifera indica*, *Pongamia pinnata*, *Oreodoxa regia*, *Phoenix sylvestris* and *Woodeyia bifurcate*, *Artocarpus heterophyllus*, *Tamarindus indica*, *Syzygium cumini*, *Celtis occidentalis*, *Quercus*, *Morus spp*, *pinus spp* (Nirmala, 2024) ^[17].

10. Conclusion

Tree transplantation, though not universally applicable, is an essential technique in preserving mature trees in ecologically and developmentally sensitive areas. Its success depends on numerous factors including species suitability, root system type, girth size, site compatibility and proper planting methods. Pre-transplant care, precise excavation, post-planting maintenance like mulching, watering and minimal pruning, along with adherence to proven horticultural practices, all contribute to higher survival rates. While the process requires skilled labor, specialized equipment and detailed planning, it offers a practical solution to balance urban development with environmental conservation. Recognizing trees as living systems and tailoring transplanting efforts accordingly can help integrate nature into rapidly urbanizing spaces.

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