

Pirandai (*Cissus quadrangularis* L.): An Underutilized Medicinal Vegetable Crop with High Nutritional and Therapeutic Potential

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Pirandai (*Cissus quadrangularis* L.) is an underutilized medicinal vegetable crop belonging to the family Vitaceae. It is widely distributed in tropical and subtropical regions, particularly in India, Sri Lanka and Southeast Asia. The crop is well known in traditional systems of medicine such as Siddha and Ayurveda for its therapeutic properties. Its tender succulent stems are consumed as vegetables and used in the preparation of chutney, curry and pickles. Pirandai is rich in calcium, vitamin C, carotenoids, flavonoids and other bioactive compounds with antioxidant and anti-inflammatory activities. It is especially recognized for promoting bone health and accelerating fracture healing. The crop is drought tolerant, requires minimal inputs and can be cultivated under marginal soil conditions, making it suitable for sustainable agriculture. Despite its nutritional and medicinal importance, Pirandai remains underexploited due to limited commercial cultivation and consumer awareness. Increasing demand for functional foods and herbal products has renewed interest in its cultivation and value addition. Therefore, Pirandai has significant potential to contribute to nutritional security, healthcare and livelihood improvement through sustainable cultivation and commercialization.



Origin and Distribution

Cissus quadrangularis L. is believed to have originated in the tropical regions of Africa and was introduced to the Indian subcontinent several centuries ago through natural and human-mediated dispersal. Over time, it became well adapted to the warm climatic conditions of South Asia and is now considered an important indigenous medicinal plant in India. The species is widely distributed across tropical and subtropical regions of Asia and Africa. In India, it occurs naturally in Tamil Nadu, Karnataka, Kerala, Andhra Pradesh, Telangana, Maharashtra, Gujarat, Rajasthan and parts of northern India. Pirandai thrives in dry rocky

hills, scrub forests, field bunds, wastelands and hedgerows where it grows as a perennial climbing succulent. It is also found in Sri Lanka, Bangladesh, Nepal, Pakistan, Myanmar, Thailand and several African countries. Owing to its drought tolerance and adaptability to poor soils, the crop survives well under rainfed conditions. Today, Pirandai is increasingly cultivated in home gardens, herbal farms and medicinal plant nurseries due to its nutritional, medicinal and commercial importance.

Botanical Description

Root System: Pirandai develops a well-branched tap root system with numerous lateral roots. The roots penetrate deeply into the soil, enabling efficient water uptake and enhancing drought tolerance.

Stem: The stem is green, fleshy, succulent and distinctly quadrangular with prominent nodes and internodes. It is the edible and economically important part used for consumption and vegetative propagation.

Leaf Morphology: Leaves are simple, fleshy and broadly ovate to cordate with smooth margins. They are arranged alternately at the nodes and may shed during prolonged dry periods to conserve moisture.

Flower Biology: Flowers are small, greenish-yellow to whitish, bisexual and borne in cymose inflorescences. They are mainly insect-pollinated and bloom during the warm growing season.

Fruit Morphology: The fruit is a small, globose berry that turns reddish-purple to black upon maturity. Each fruit contains a juicy pulp enclosing one to four seeds.

Seed Characters: Seeds are hard, smooth, brown and flattened in shape. Seed propagation is rarely practiced because of poor germination and genetic variability among seedlings.

Chromosome Number: Pirandai is a diploid species with a somatic chromosome number of $2n = 24$. This chromosome complement contributes to normal growth, flowering and reproductive stability.



Soil and Climate

Pirandai thrives well under tropical and subtropical climatic conditions with an optimum temperature of 25–35°C. It is a hardy, drought-tolerant crop that performs well under warm and dry environments. The crop grows best in areas receiving 500–1,000 mm of annual rainfall, provided there is good drainage. It can withstand moisture stress but is sensitive to prolonged waterlogging. Pirandai adapts to a wide range of soils and performs best in well-

drained sandy loam to red loam soils rich in organic matter. A soil **pH of 6.0–7.5** is ideal for optimum growth and nutrient uptake. Full sunlight promotes vigorous stem development and higher biomass production. Owing to its wide adaptability and low input requirement, Pirandai is suitable for cultivation in diverse agro-climatic regions.

Nutritional Composition

Pirandai is a nutrient-rich medicinal vegetable valued for its high nutritional and therapeutic properties. The tender stems are an excellent source of **calcium**, which supports bone strength and fracture healing. They also contain appreciable amounts of **vitamin C, dietary fibre, protein, iron, phosphorus and potassium**, along with small quantities of carbohydrates and essential minerals. In addition to these nutrients, Pirandai is rich in bioactive compounds such as **flavonoids, carotenoids, triterpenoids and phenolic compounds**, which possess antioxidant and anti-inflammatory activities. Regular consumption of Pirandai contributes to improved bone health, digestion and overall nutritional well-being, making it a valuable functional food as well as a medicinal crop.

Cultivars and Varieties

Pirandai (*Cissus quadrangularis* L.) is an underutilized medicinal crop with limited formal breeding programmes. Consequently, no officially released commercial cultivars are available in India. Cultivation primarily depends on locally adapted landraces and farmer-selected ecotypes, which exhibit variation in stem morphology, growth habit, and phytochemical composition. These local types are propagated through stem cuttings and selected based on yield, adaptability, and medicinal value.

Cultivar / Variety	Characteristics
Local Green Type	Possesses thick, succulent, bright green quadrangular stems with vigorous vegetative growth. It produces high biomass and is the most widely cultivated type for culinary and medicinal purposes.
Dark Green Type	Characterized by dark green fleshy stems with excellent drought tolerance and vigorous vine growth. It is well adapted to warm and semi-arid regions and is commonly maintained in herbal gardens.
Thin-Stemmed Type	Features slender four-angled stems with longer internodes and rapid vegetative growth. It is mainly conserved in local germplasm collections and propagated for medicinal applications.
Broad-Stemmed Type	Has thick, fleshy stems with high moisture content and greater stem yield. It is preferred for commercial cultivation because of its robust growth and ease of vegetative propagation.

Propagation

Pirandai (*Cissus quadrangularis* L.) is propagated primarily through **stem cuttings**, which is the most efficient and widely adopted method for commercial cultivation. Healthy, disease-free vines of **8–12 months** age are selected as mother plants, and cuttings of **20–30 cm** length containing **3–5 nodes** are prepared. The cuttings are allowed to dry in shade for **24–48 hours** before planting to minimize rotting and fungal infection. They are planted vertically or slightly inclined with one or two nodes below the soil surface to promote rapid root formation. Under favourable warm and moist conditions, rooting occurs within **2–3 weeks**, resulting in uniform plant establishment. Propagation is generally carried out during the **monsoon season (June–July)** or under irrigated conditions in **February–March**. Seed propagation is rarely practiced due to poor seed availability, low germination, and high genetic variability among seedlings. Consequently, vegetative propagation through stem cuttings remains the preferred method for maintaining genetic uniformity and ensuring higher productivity.

Crop Production Technology

Pirandai (*Cissus quadrangularis* L.) is cultivated successfully under warm tropical and subtropical conditions using vegetative stem cuttings as planting material. The land is

prepared by deep ploughing followed by the incorporation of well-decomposed farmyard manure to improve soil fertility. Cuttings are planted at suitable spacing on ridges or raised beds to ensure proper drainage and aeration. Regular irrigation is provided during the establishment stage, while excessive waterlogging is avoided. Timely weeding, earthing-up, and light pruning promote healthy vine growth and higher biomass production. Organic manures and balanced nutrient application enhance stem yield and medicinal quality. The crop becomes ready for the first harvest about **6–8 months** after planting and can be harvested periodically thereafter under proper crop management.

Nutrient Management

Pirandai (*Cissus quadrangularis* L.) responds well to the application of organic manures and balanced nutrient management. About **10–15 t ha⁻¹ of well-decomposed farmyard manure (FYM)** is incorporated during land preparation to improve soil fertility and structure. A recommended dose of **60:40:40 kg N:P₂O₅:K₂O ha⁻¹** is generally applied, with nitrogen given in split doses to encourage continuous vegetative growth. Supplementing the crop with biofertilizers and micronutrients, wherever required, enhances nutrient uptake and stem yield. Regular addition of organic matter helps maintain soil health and improves the medicinal quality of the harvested stems.

Irrigation and Water Management

Pirandai (*Cissus quadrangularis* L.) requires moderate irrigation for optimum vegetative growth and stem yield. Immediately after planting, irrigation is provided to ensure proper establishment of stem cuttings. Thereafter, watering is scheduled at **7–10-day intervals**, depending on soil type, rainfall, and climatic conditions. The crop is fairly drought tolerant once established but performs best under adequate soil moisture. Waterlogging should be avoided by providing good drainage, as excessive moisture can cause stem rot and poor plant growth. Drip irrigation is recommended for efficient water use, reduced weed growth, and improved crop productivity.

Weed Management

Weed management is essential during the early growth stage of Pirandai (*Cissus quadrangularis* L.) to minimize competition for nutrients, water, and sunlight. The field should be kept weed-free through **2–3 manual weeding** during the first **60–90 days** after planting. Earthing-up after weeding helps improve root development and supports vine growth. Organic mulches such as straw or dry leaves can be applied to suppress weed emergence and conserve soil moisture. Maintaining a clean field throughout the crop period promotes healthy plant growth, higher stem yield, and better-quality medicinal produce.

Major Insect Pests of Pirandai (*Cissus quadrangularis* L.)

Insect Pest	Scientific Name	Nature of Damage
Aphid	<i>Aphis gossypii</i>	Nymphs and adults suck sap from tender shoots and leaves, causing curling, yellowing, and stunted growth. They may also transmit viral diseases.
Mealybug	<i>Planococcus citri</i>	Colonies infest stems and nodes, sucking plant sap and producing honeydew that encourages sooty mould development, reducing plant vigour.
Scale Insect	<i>Coccus viridis</i>	Infests stems and leaves by sucking sap, leading to chlorosis, reduced growth, and weakening of the vines.
Red Spider Mite	<i>Tetranychus urticae</i>	Feeds on the lower leaf surface, causing yellow speckling, leaf bronzing, drying, and premature leaf fall under hot, dry conditions.
Thrips	<i>Thrips tabaci</i>	Scrape and suck plant tissues, resulting in silvery patches, leaf curling, and reduced vegetative growth.
Leaf-Eating Caterpillar	<i>Spodoptera litura</i>	Caterpillars feed on leaves and tender shoots, causing severe defoliation and reduced photosynthetic area.

Major Diseases of Pirandai (*Cissus quadrangularis* L.)

Disease	Causal Organism	Symptoms
Stem Rot	<i>Sclerotium rolfsii</i>	Causes rotting of stems near the collar region, leading to wilting, collapse of vines, and poor plant establishment under waterlogged conditions.
Leaf Spot	<i>Cercospora</i> spp.	Small brown to dark circular lesions develops on leaves, which enlarge and may cause premature leaf drying and reduced photosynthesis.
Powdery Mildew	<i>Erysiphe cichoracearum</i>	White powdery fungal growth appears on leaves and young stems, resulting in leaf yellowing, curling, and reduced plant vigour.
Anthrachnose	<i>Colletotrichum gloeosporioides</i>	Produces dark, sunken lesions on stems and leaves, causing tissue necrosis, dieback, and reduced stem quality under humid conditions.

Harvesting

Pirandai (*Cissus quadrangularis* L.) is usually ready for the first harvest **6–8 months after planting**, depending on the growing conditions. Mature, healthy, succulent stems are harvested manually using a sharp knife or secateurs without damaging the remaining vines. Subsequent harvests can be carried out at **2–3 months intervals** as new shoots develop. Harvesting is preferably done during the cooler hours of the day to minimize moisture loss and maintain stem quality. Regular harvesting encourages fresh vegetative growth and improves overall biomass production. Proper handling after harvest helps preserve the medicinal quality and market value of the stems.

Post Harvest Management

After harvesting, Pirandai (*Cissus quadrangularis* L.) stems are cleaned to remove soil, dried leaves, and damaged portions. The harvested stems are washed with clean water and allowed to surface dry under shade before further processing. Fresh stems are graded based on size, colour, and quality, and then packed in perforated crates or baskets to prevent mechanical damage during transport. For medicinal use, the stems are shade-dried until the moisture content is sufficiently reduced and stored in airtight containers in a cool, dry place. Proper post-harvest handling minimizes quality deterioration, preserves bioactive compounds, and extends the storage life of the produce.

Nutritional Value

Pirandai (*Cissus quadrangularis* L.) is a nutritious medicinal plant valued for its rich mineral and antioxidant content. The succulent stems contain **dietary fibre, carbohydrates, and small amounts of protein**, along with essential minerals such as **calcium, phosphorus, potassium, magnesium, and iron**. It is also a good source of **vitamin C** and contains bioactive compounds including **flavonoids, carotenoids, triterpenoids, and ascorbic acid**. These nutrients contribute to bone health, digestion, antioxidant activity, and overall well-being, making Pirandai an important functional food as well as a medicinal herb.

Medicinal Importance

Pirandai (*Cissus quadrangularis* L.) is an important medicinal plant widely used in traditional systems of medicine such as **Ayurveda, Siddha, and Unani**. It is best known for its ability to **promote bone fracture healing** by stimulating bone regeneration and increasing bone mineralization. The plant possesses **anti-inflammatory, analgesic, antioxidant, antimicrobial, anti-ulcer, and antidiabetic** properties due to the presence of bioactive compounds such as flavonoids, triterpenoids, and phenolic compounds. It is also used to treat **joint pain, osteoporosis, digestive disorders, haemorrhoids, asthma, and menstrual irregularities**. Regular consumption of Pirandai is believed to improve digestion, reduce oxidative stress, and enhance overall health, making it a valuable medicinal and functional food crop.

Value Addition

Pirandai (*Cissus quadrangularis* L.) offers considerable scope for value addition due to its high medicinal and nutritional importance. The fresh stems are processed into **powder, capsules, tablets, herbal extracts, syrups, and health supplements** for pharmaceutical and nutraceutical industries. It is also incorporated into traditional food products such as **thuvaiyal (chutney), pickle, soup mix, and ready-to-cook powders**, enhancing its consumer acceptability. Drying, pulverizing, and proper packaging improve shelf life, facilitate transportation, and increase market value. Value-added products not only provide better economic returns to growers but also promote the commercial utilization of this underutilized medicinal crop.

Economics of Cultivation

Pirandai (*Cissus quadrangularis* L.) is an economically viable medicinal crop because of its **low cultivation cost, minimal input requirement, and high market demand** from herbal and pharmaceutical industries. The crop is propagated through stem cuttings, reducing expenditure on planting materials, and requires comparatively fewer plant protection measures due to its hardy nature. Depending on management practices, a fresh stem yield of **15–25 t ha⁻¹** can be obtained, providing attractive returns to farmers. The harvested stems are sold as fresh produce or processed into value-added products such as powders, capsules, and herbal extracts, which significantly enhance profitability. Owing to its medicinal importance, long harvesting period, and increasing consumer preference for herbal products, Pirandai cultivation offers good income potential and is suitable for small and marginal farmers.

Why is Pirandai an Underutilized Crop?

Despite its high nutritional and medicinal value, *Pirandai* (*Cissus quadrangularis* L.) remains an underutilized crop due to several production and market constraints. The crop has received **limited research attention and breeding efforts**, resulting in the absence of improved cultivars and standardized cultivation practices. Consumer awareness regarding its health benefits is relatively low, restricting market demand to local and traditional communities. Its **perishable nature**, limited post-harvest infrastructure, and inadequate value chain further reduce commercial adoption. In addition, the plant contains calcium oxalate crystals that may cause throat irritation if not processed properly, limiting its acceptance among consumers. Poor marketing support, lack of organized processing industries, and insufficient policy interventions have also contributed to the underutilization of this valuable medicinal plant. Furthermore, **quality planting materials are not readily available**, making large-scale cultivation difficult for farmers. The crop is grown mostly in **home gardens and small herbal farms** rather than under organized commercial production systems. Limited extension services and inadequate dissemination of scientific cultivation technologies have slowed its adoption. There is also a lack of **organized procurement, grading, and export networks**, reducing market opportunities for growers. Although Pirandai possesses significant pharmaceutical and nutraceutical potential, **its commercial processing industry is still in its early stages**. Strengthening research, varietal improvement, value addition, farmer awareness, and market linkages can transform Pirandai into a profitable medicinal crop with substantial domestic and export potential.

Future Scope

Pirandai (*Cissus quadrangularis* L.) possesses immense potential as a future medicinal and functional food crop owing to its rich nutritional composition and wide range of therapeutic properties. Increasing public awareness regarding natural health products and herbal medicines has created new opportunities for the commercial cultivation of this indigenous species. The crop can play an important role in promoting nutritional security, preventive healthcare and sustainable agriculture. Its excellent adaptability to drought-prone and marginal lands makes Pirandai a suitable crop under changing climatic conditions. Large-scale cultivation can provide additional income to small and marginal farmers while

supporting biodiversity conservation. There is considerable scope for developing value-added products such as herbal powders, capsules, nutraceutical formulations, functional beverages, ready-to-cook products and dietary supplements. Expansion of organized cultivation, improved processing technologies and stronger marketing strategies can significantly enhance the economic importance of Pirandai in both domestic and international markets.

Research Needs

Although Pirandai has been widely recognized for its medicinal importance, several research gaps still exist. Collection, conservation and characterization of diverse germplasm should be strengthened to utilize available genetic variability in crop improvement programmes. Development of high-yielding varieties with enhanced medicinal properties, improved biomass production and resistance to pests and diseases should receive greater attention. Standardization of production technologies including planting methods, spacing, nutrient management, irrigation scheduling and harvesting practices is essential to improve productivity. Detailed investigations on phytochemical composition, bioactive compounds and pharmacological activities are required to validate traditional medicinal claims. Greater emphasis should also be given to post-harvest management, value addition, quality standards, processing technologies and export potential. Strengthening farmer awareness, extension activities and market linkages will further promote the commercial cultivation of this valuable medicinal vegetable crop.

Conclusion

Pirandai (*Cissus quadrangularis* L.) is a highly valuable yet underutilized medicinal vegetable crop possessing remarkable nutritional, medicinal and economic importance. Its adaptability to tropical climates, drought tolerance and low input requirement make it an ideal crop for sustainable farming systems. The crop has long been utilized in traditional medicine for promoting bone health, improving digestion and treating various ailments. However, inadequate research, limited commercial cultivation, poor consumer awareness and weak market development have restricted its wider utilization. Promoting scientific cultivation practices, developing improved varieties, encouraging value addition and increasing public awareness can significantly improve the adoption of Pirandai. With continued research and policy support, this indigenous crop has the potential to emerge as an important medicinal vegetable contributing to nutritional security, rural livelihoods and sustainable agricultural development.

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