**Fibres from ornamental crops: An alternative to commercial fibres**

**Abstract**The use of plant fibres in industrial applications has traditionally been dominated by fibres from staple crops such as cotton, hemp, and jute. However, the potential of ornamental crops as sources of fibrous materials has garnered increasing interest due to their unique structural properties, sustainability, and ecological benefits. This review comprehensively explores the fibres derived from various ornamental species, including orchids, palms, grasses and woody shrubs, and evaluates their extraction methods, physical and chemical properties, and potential applications. Ornamental plants, often cultivated for their aesthetic appeal, possess fibres that can be utilized in a range of industries, from textiles and handcrafts to eco-friendly packaging and bio-composites. The fibres extracted from these crops are often strong, elastic and biodegradable, offering an alternative to synthetic fibres and conventional natural fibres. Despite the promising characteristics of ornamental fibres, challenges related to large-scale cultivation, fibre extraction, and processing remain a barrier to their widespread use. This review highlights the growing body of research on ornamental crop fibres, discussing key species, such as orchids and palms, and providing insight into their sustainability, commercial potential, and contribution to a circular economy. The review also examines the environmental and economic benefits of utilizing ornamental plants for fibre production, proposing strategies to overcome existing limitations and encouraging further exploration of these underutilized resources. By emphasizing the potential of ornamental crops as viable fibre sources, this paper aims to contribute to the development of sustainable materials and to inspire future research in the field of natural fibres.

**Key words:** Ornamental crops, Plant fibre, Commercial, Economy

**Introduction**

The use of plant fibres in various industries has been a hallmark of human civilization for centuries. While traditionally sourced from staple crops such as cotton, hemp, kenaf, jute, and flax, there is a growing interest in exploring alternative and less conventional sources of fibre, particularly from ornamental crops (Sharma and Das, 2022). Ornamental plants, which are cultivated primarily for aesthetic purposes, often possess unique structural properties that make them potential candidates for fibre extraction (Singh and Patel, 2021). Among these plants, members of the orchid family and other ornamental species stand out due to their diverse range, durability, and adaptability to different environmental conditions(Add reference).

Fibers derived from ornamental crops such as orchids, palms, grasses, and woody shrubs offer new opportunities for sustainable material production (Mohanty *et al*., 2002). These fibres, often regarded as byproducts of ornamental cultivation, hold promise for a variety of applications, from traditional handcrafts to advanced textile industries (Bhatnagar and Sain, 2005). The potential for these fibres lies not only in their aesthetic appeal but also in their strength, elasticity, and biodegradability, positioning them as environmentally friendly alternatives to synthetic fibres and more commonly used natural fibres (Kalia *et al*., 2009).

Despite the intriguing possibilities, the research and commercialization of fibres from ornamental crops have been limited. This is due in part to the lack of large-scale cultivation and harvesting technologies, as well as the limited awareness of the unique properties and potential uses of these fibres (Favier and Berlioz, 2020). Additionally, there are challenges associated with fibre extraction, processing, and standardization, which require further investigation and technological advancements (Zhang and Chen, 2020).

This comprehensive review aims to explore the fibres obtained from ornamental crops, focusing on their extraction methods, properties, and potential applications. The review will examine various ornamental species that have been studied for their fibrous content, highlighting the mechanical, chemical, and physical characteristics of their fibres. Additionally, it will address the ecological and economic benefits of utilizing ornamental plants for fibre production, emphasizing their role in promoting sustainable agricultural practices.

By shedding light on the potential of ornamental crops as fibre sources, this review hopes to inspire further research and innovation in the field of sustainable materials. It will also provide a valuable resource for industries looking to diversify their sources of natural fibres and explore eco-friendly alternatives to conventional materials.

**Potential Ornamental Crops for Fibre Production**

1. ***Musa* sp. (Ornamental Banana)** Ornamental bananas, known for their vibrant foliage and inflorescences belonging to the Musaceae family, are a potential source of high-quality fibres. The pseudo-stem of these plants contains long and strong fibres used in rope, mats, and composite materials (Singh and Patel, 2021). The fibre has high tensile strength, biodegradability, and durability. They are used in textiles, paper, handicrafts, and reinforced composites. However, extraction of these fibres is labour-intensive and low awareness of commercial viability.
2. ***Canna indica* (Indian Shot)** Canna indica, often grown for its striking flowers belongs to the plant family Cannaceae. It also produces fibre from its leaves and stalks. The fibre extracted from this plant is coarse in texture and has moderate strength. In few Southeast Asian countries, they are used to prepare cordage, matting, and eco-friendly packaging. Due to limited research on fibre optimization and processing techniques, they are normally neglected.
3. ***Lilium* sp. (Lilies)** Lilies, belonging to Liliaceae family, are cultivated for their fragrant blooms, yield fibres from their stalks. Fibres are soft, flexible, and biodegradable and used in manufacturing paper and artisanal crafts. Because of its low yield and competition with other fibre crops, they are usually ignored.
4. ***Chrysanthemum* sp.:** Best known for its long-lasting blooms in pots and cut flowers, chrysanthemum stands among the top ten cut flowers. It belongs to the Asteraceae family. The stalks of chrysanthemums, after flowering, are a potential fibre source. Fibre extracted from this plant has moderate strength and resilience. Pulp from this plant is used for making paper and biodegradable packaging. Due to lack of efficient fibre extraction methods, they are usually not considered (Sharma and Das, 2022).
5. **Tuberose (*Polianthes tuberosa* L.)** Tuberose, valued for its fragrant flowers, belonging to the plant family Amaryllidaceae generates significant biomass, including stalks that can be converted into fibres. Fibres extracted from the stems and leaves are light in weight and suitable for non-woven textiles. The fibres are used in making handmade paper, bio-composites, and lightweight packaging. Due to limited studies and scalability concerns, they are not commercially extracted.
6. ***Heliconia* spp. (False Bird-of-Paradise)** Known for their vibrant bracts, Heliconias belonging to Heliconiaceae, also have fibrous stalks. Fibre f this plant is tough and resilient and are used in making rope, mats, and geotextiles (Sharma and Das, 2022). Due to its high moisture content, they are complicated in drying and processing. Hence, they are ignored in fibre industry.
7. ***Nelumbo nucifera* (Lotus)** Lotus, renowned for its sacred and ornamental value belongs to the plant family Nelumbonaceae. It is an emerging source of eco-friendly fibres extracted from its stems. Fibre extracted from the leaf and flower stalks are soft, silky texture, lightweight, and high moisture-wicking ability. They are used in making luxury textiles, scarves, ties, and artisanal clothing which are very costly. But due to its labour-intensive extraction process, low yield and high production costs, extraction of this silky fibre is limited.
8. ***Cortaderia selloana* (Pampas Grass):** Pampas grass, belonging to Poaceae family is popular for its ornamental plumes, produces fibres from its stalks. Fibre from this plant is coarse in texture, lightweight and has good tensile strength. They are used in making paper pulp, mats, and eco-friendly packaging materials (Ververis *et al*., 2004). However, they are available seasonally and has challenges in large-scale processing.
9. ***Yucca* sp.** *Yucca* plants, known for their spiky leaves and drought resistance belong to the family Asparagaceae. They are a source of strong and durable fibres extracted from their leaves. Fibre from this plant has high tensile strength, flexibility and are resistant to decay. In South American countries, the fibres are used in making rope, mats, textiles and cordage. Extraction and processing of fibre from this plant is labour-intensive and has limited scalability for commercial use.
10. **Agave:** Agave is a genus of plants that includes several species known for their tough, fibrous leaves and their ability to thrive in arid climates. Agave fibres are renowned for their strength and durability, making them useful in a variety of industries. The most well-known species for fibre production is *Agave sisalana,* commonly known as sisal. The fibres are used in making rope and twines, textiles, paper and in agriculture for making products like bales of Hay or plant ties. They are also used as used in composite materials, often in combination with plastics or other natural fibres, for automotive and construction applications. These composite materials offer the benefit of being both lightweight and strong. Agave fibres are sometimes used to reinforce concrete or in the creation of insulation materials. Agave fibres are durable, eco-friendly and as compared to other fibre crops, they require less water for growing. Although, Harvesting and extracting the fibres from agave can be labour-intensive and may require specialized equipment. Depending on the scale, processing agave fibres can be costly, particularly in comparison to synthetic alternatives.
11. ***Iris* sp. (Irises)** Iris plants are cultivated for their striking blooms and has traditional significance in Manipur. They belong to the plant family Iridiaceae. They yield fibres from their leaves and stalks. Fibre is of soft texture having moderate strength and good flexibility. They are used in making handmade paper, ropes, and artisanal crafts. Limited yield and challenges in fibre processing techniques is the drawback for its processing.
12. **Ornamental Bamboo (*Bambusoideae* sp.)** Bamboos, belonging to Poaceae family, although commonly associated with construction and furniture, also provides fibres from its stems. Fibre from this plant has high tensile strength, biodegradability and has antimicrobial properties. They are used extensively in textiles, paper and making eco-friendly composites. However, complex extraction process and competition from synthetic fibres is one of its drawbacks in fibre extraction.
13. **Reed (*Phragmites* sp.)** Reeds belongs to Poaceae family and are often found in wetlands. They are a source of coarse fibres from their stalks. Fibres are coarse in texture, lightweight and has high durability. In Manipur, they are used in making mats, ropes, bags and biodegradable packaging. Seasonal availability of this plant species and labour-intensive extraction makes them uncommon.
14. ***Dianella* sp. (Flax Lily)** Flax lilies, belonging to Asphodelaceae family, is valued for their sword-like leaves and ornamental appeal, produce fibres from their leaves. Fibres are strong, flexible and resistant to decay. They are used in making mope, mats and artisanal crafts. Due to its limited scalability and labour-intensive processing, the fibre from this crop is uncommon.
15. ***Nymphaea* sp. (Water Lily)** Water lilies, known for their floating leaves and flowers, belongs to the plant family Nymphaeaceae. They provide fibres from their stems. Fibre extracted from the stem and flower stalk is soft, lightweight and biodegradable. In Thailand and Malaysia, the fibres are used in making handmade paper, ropes and eco-friendly crafts. But due to its seasonal availability and low yield, they are rare.
16. ***Colocasia* spp. (Taro)** Colocasia, belonging to Araceae family are primarily cultivated for its edible corms and ornamental leaves, offers fibres from its petioles and leaves. The fibre is light in weight, flexible and moderately strong. They are also used in making rope, mats and biodegradable packaging. But due to its high moisture content it is complicated in processing.
17. ***Alocasia* sp.** Alocasia, also belonging to Araceae family having large decorative leaves, provides fibres from its petioles just like Colocasia. Fibre is coarse in texture, good tensile strength and is biodegradable. They are used in making cordage, mats and eco-friendly packaging. However, extraction process is labour-intensive and has limited yield.
18. ***Gladiolus* sp.** Gladiolus, one of the most prized ornamental crops belongs to the Iridaceae family. They are known for its vibrant and tall floral spikes, yields fibres from its leaves and stalks. The fibre is of fine texture, moderate tensile strength, and flexibility and are used in making handmade paper, artisanal crafts and light packaging materials (Zhang and Chen, 2020). But due to limited research on fibre properties and extraction methods, they are yet to be explored.
19. **Ornamental Palms (Arecaceae)** Many ornamental palms, widely grown for their tropical aesthetics, produce fibres from their leaves and husks. They belong to the plant family Arecaceae. Fibre from this plant family produce coarse texture, high durability, and resistance to decay. They are used in making ropes, mats, brushes and geotextiles. However, extraction process is labour-intensive and variability in fibre quality.
20. ***Bauhinia* sp. (Orchid Tree)** Bauhinias, belonging to the plant family Fabaceae are recognized for its butterfly-shaped leaves and ornamental flowers, provides fibres from its bark and stems. The fibre is strong, durable, and moderately flexible. They are used in making rope, mats, and paper pulp. However, due to its limited scalability and low awareness of commercial potential, they are usually not extracted (Sharma and Van Sumere, 1992).
21. ***Helianthus annuus* (Sunflower)** Sunflowers, known for their bright blooms and oilseed production belongs to Asteraceae family. It also yields fibres from their stalks which is light in weight, strong, and biodegradable and are used in making rope, mats, and eco-friendly composites. Due to its low yield in fibre and are available only in growing seasons, they are not commercially viable.
22. **Phaius and Other Orchid Species:** *Phaius* is a genus of orchids known for its large, showy flowers and native distribution across Southeast Asia, the Pacific Islands, and parts of Australia. While there is limited widespread commercial exploitation of *Phaius* fibres, there is growing interest in exploring fibres from various orchid species, which can be used in several ways. Fibers from some orchids, such as those from the *Vanda* and *Dendrobium* genera, have been found to be strong and durable. These fibres are often extracted from the pseudobulbs, stems, or leaves of the plants and can be used in making ropes, mats, bags, and other traditional handcrafts. *Vanda* species, for instance, have been studied for their fibrous tissue and their potential to be used in textiles, especially in Southeast Asia. Orchid fibres are generally characterized by their strength and elasticity, which makes them a potential alternative to other natural fibres like hemp, jute, or cotton. While there is potential, the harvesting of orchid fibres has not been widely commercialized, mainly due to challenges like the labour-intensive harvesting process, limited availability of large-scale cultivation of the relevant orchid species, and competition with other fibre-producing plants. However, continued research into sustainable practices and eco-friendly textiles could lead to more widespread use of orchid fibres in the future.
23. **Water hyacinth (*Eichhornia crassipes*)**: Water hyacinth belongs to the plant family Pontederiaceae. This plant has been explored for its beautiful bluish colour flowers and are grown as aquatic ornamentals. The plant has a potential source of fibre for various applications due to its fast growth and high biomass production. Fibres can be used textiles, paper production, or as reinforcement in composites. However, extracting fibres from water hyacinth can be labor-intensive and may require specialized equipment for efficient processing. In Manipur, the fibres are used for making bags and mats. Although water hyacinth is fast-growing and abundant, continuous harvesting is necessary to keep its invasive nature under control, which may involve management costs and efforts.
24. ***Hibiscus* sp.**

Ornamental hibiscus plant fibre, particularly from species like *Hibiscus rosa-sinensis*, is known for its strength, durability, and eco-friendly properties. The fibres are extracted mainly from the stem and are similar in texture to jute. Hibiscus fibres are widely used for making ropes, mats, bags, textiles, and even biodegradable composites. They are lightweight, resistant to moisture, and have high tensile strength, making them a sustainable alternative to synthetic fibres. Additionally, these fibres decompose naturally, reducing environmental pollution. Due to their versatility, hibiscus fibres are increasingly being explored in industries like paper production, geotextiles, and eco-friendly packaging.

1. **Snake plant**

The snake plant (*Sansevieria* species, now classified under *Dracaena*) is a popular ornamental plant known for its air-purifying properties, but it also produces strong, durable fibres. The fibres extracted from snake plant leaves are long, stiff, and resistant to moisture, making them ideal for making ropes, mats, baskets, and even textiles. These fibres are biodegradable and eco-friendly, offering a sustainable alternative to synthetic materials. Due to their high tensile strength, snake plant fibres are sometimes compared to sisal and used in handicrafts and paper production. Their natural resistance to pests and decay further enhances their usability in various industries.

1. **Ornamental pineapple**

Ornamental pineapple fibre, derived from the leaves of ornamental pineapple plants (*Ananas* sp.), is a strong, lightweight, and eco-friendly natural fibre. It has high tensile strength, making it suitable for various applications such as textiles, ropes, mats, paper, and handicrafts. The fibre is biodegradable and serves as a sustainable alternative to synthetic materials. It is also known for its lustrous, silk-like texture, making it a popular choice for luxury fabrics like piña cloth, traditionally used in fine garments. Additionally, pineapple fibre is used in eco-friendly packaging and composite materials, contributing to sustainable industries and waste reduction.

**Advantages of Fibres from Ornamental Crops**

Fibres derived from ornamental crops offer several advantages, including sustainability, durability, and aesthetic appeal. These fibres are often biodegradable and eco-friendly, making them a sustainable alternative to synthetic fibres. Many ornamental plants, such as banana, hibiscus, and palm species, produce strong and resilient fibres suitable for textiles, handicrafts, and ropes. Additionally, they add economic value to ornamental plants, promoting their use beyond decorative purposes. These fibres are also lightweight, breathable, and sometimes naturally resistant to pests and mold, making them ideal for various applications, from fashion to home décor. Their versatility and environmental benefits make them an attractive choice for sustainable industries.

**Challenges in Commercializing Fibres from Ornamental Crops**

Commercializing fibres from ornamental crops faces several challenges, including limited large-scale cultivation, high production costs, and lack of efficient processing technologies. Many ornamental plants are primarily grown for aesthetic purposes rather than fibre extraction, leading to inconsistent supply. Additionally, the extraction and processing of these fibres can be labor-intensive and require specialized techniques, making production costly. Market awareness and demand for such fibres are also relatively low compared to established natural fibres like cotton and jute. Furthermore, competition from synthetic fibres, which are cheaper and mass-produced, poses a significant hurdle. Overcoming these challenges requires investment in research, technology, and market development to promote the viability of ornamental crop fibres in various industries.(Abiola and Kumar, 2019).

**Future Prospects**

The future prospects of fibres from ornamental crops are promising, driven by increasing demand for sustainable and eco-friendly materials. With growing environmental concerns, industries such as fashion, packaging, and construction are exploring biodegradable alternatives to synthetic fibres. Advancements in fibre extraction and processing technologies can enhance efficiency and reduce production costs, making these fibres more competitive. Additionally, government policies promoting sustainability and circular economies can further support commercialization. Research into improving fibre quality and developing innovative applications, such as biocomposites and eco-textiles, will also boost their market potential. With proper investment and awareness, ornamental crop fibres can play a significant role in the future of sustainable industries.

**Conclusion**

Fibres from ornamental crops represent a promising avenue for sustainable innovation in agriculture. By leveraging the aesthetic and functional aspects of these plants, farmers and industries can create new value chains, fostering economic and environmental benefits. However, realizing this potential requires concerted efforts in research, technology development, and market creation.

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**Plate 1:** Different fibre yielding ornamental plants



