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Cultivation, Processing and Uses of Nagarmotha (*Cyperus scariosus* R. Br.) as a Suitable Crop for Marshy Lands

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The sedge plant Nagarmotha, scientifically known as *Cyperus scariosus* R.Br., is a member of the Cyperaceae family and has grown in importance as a crop for agricultural development in marshy and wetland areas. In addition to having a long history of use in South Asian medical systems, this fragrant plant has enormous potential for sustainable agricultural intensification on marginal lands that would otherwise be inappropriate for the development of conventional crops. With climate change, land degradation, and population growth posing previously unheard-of challenges to the global agricultural sector, growing specialty crops like Nagarmotha on economically marginal lands offers a workable way to improve rural livelihoods while preserving environmental sustainability. (M. Sarker et al., 2025). About 6-7% of the Earth's land area is made up of marshy and wetland areas, which are distinguished by anaerobic soil conditions, seasonal or permanent flooding, and poor agricultural value for traditional crops (Okiemute, 2025). These locations have historically been seen as wastelands or sources of illness; however, they contain tremendous potential for specialized agricultural production. Underutilized wetland resources can be transformed into profitable agricultural landscapes by the cultivation of Nagarmotha, which exhibits exceptional adaptation to these difficult conditions and thrives where most traditional crops would fail.

Nagarmotha

Medicinal and aromatic plants (MAPs) like Nagarmotha have unparalleled market prospects due to the global boom in demand for natural, plant-based goods in the pharmaceutical, cosmetic, and traditional medicine industries (Ghosh & Chakraborty, 2025). The global market for medicinal and aromatic plants grew at a pace of 5.4% year, from USD 2.4 billion in 1996 to USD 6.2 billion in 2013 (Parvin et al., 2023). The ecological and financial advantages of growing Nagarmotha on marginal areas, along with this growing market, highlight the significance of extensive research and development projects to improve value-added processing and optimize production methods.

Botanical Classification and Characteristics

Nagarmotha (*Cyperus scariosus* R.Br.) is a perennial sedge characterized by underground tubers that serve as the primary source of aromatic compounds. The plant typically grows to heights of 30-60 cm and produces narrow, grass-like leaves. The tubers, which are the

economically important part of the plant, are small, round, and measure approximately 5-8 mm in diameter. These tubers possess a distinctive aromatic odor and possess a warm, slightly pungent taste, owing to their rich content of essential oils and other bioactive compounds. (Singh et al., 2024)

Ecological Requirements and Land Suitability

Successful Nagarmotha cultivation requires specific ecological conditions that are characteristic of wetland and marshy environments. The plant thrives in areas with high water tables, seasonal flooding, and soils with high organic matter content and acidic to neutral pH conditions. Optimal cultivation occurs in regions characterized by annual precipitation ranging from 1,500 to 2,500 mm, with temperatures between 15°C and 35°C (Liu et al., 2025). The plant can successfully grow in waterlogged conditions that would be prohibitive for most conventional crops, and demonstrates excellent adaptation to soils with elevated levels of aluminum and iron—conditions that typically limit agricultural productivity. Wetland soils typically possess high levels of organic matter, which averages 4-8% in most marshy environments, compared to 1-2% in upland agricultural soils (Cheng, 2020).

Cultivation Practices

Propagation Methods

Nagarmotha can be propagated through both sexual reproduction via seeds and asexual reproduction using tuber segments. However, asexual propagation through tubers is the preferred method in commercial cultivation due to the relatively rapid multiplication rate and the guarantee of genetic uniformity. Tuber segments weighing 1.5-2.5 grams, containing at least one viable bud, can be used as planting material. These tuber segments demonstrate excellent regenerative capacity, with germination rates typically exceeding 85% under optimized conditions (Susilawati et al., 2025).

Land Preparation and Water Management

Land preparation for Nagarmotha cultivation involves minimal mechanical intervention. Excessive tillage should be avoided, as it disrupts soil structure and damages existing microbial communities. Instead, site preparation focuses on clearing competing vegetation and establishing raised planting beds at heights of 20-30 cm above the prevailing water table. These raised beds facilitate drainage during periods of excessive rainfall while maintaining adequate moisture availability during dry seasons.

Nutrient Management and Organic Amendments

Although Nagarmotha demonstrates excellent adaptation to nutrient-limited wetland environments, carefully managed nutrient supplementation can enhance productivity. Organic amendments—particularly composted animal manure, plant residues, and biochar—have demonstrated significant efficacy in improving soil fertility and plant growth parameters while maintaining the organic integrity of production systems. Research on integrated nutrient management systems demonstrates that combinations of organic amendments with judicious mineral fertilizer applications can enhance tuber yield by 25-40% compared to conventional practices (K. R. Sarker et al., 2025).

Pest and Disease Management

Nagarmotha cultivation generally experiences limited incidence of serious pests and diseases, a characteristic attributable to the plant's inherent stress tolerance and the antimicrobial properties of its essential oils. However, common wetland pests—including midge larvae, aquatic snails, and fungal pathogens such as *Alternaria* and *Fusarium* species—may occasionally cause economically significant damage. Integrated pest management strategies, emphasizing cultural practices such as crop rotation, maintenance of appropriate water levels, and removal of infected plant material, provide effective control while minimizing environmental impacts (Greff et al., 2023).

Processing of Nagarmotha

Post-Harvest Handling and Primary Processing

Nagarmotha tubers reach physiological maturity and optimal essential oil content approximately 8-10 months after planting. Harvesting is typically performed during the cool season when environmental stress-induced secondary metabolite accumulation reaches peak levels. Tubers are carefully extracted from waterlogged soil using specialized tools that minimize damage to the delicate plant tissues. Post-harvest losses, estimated at 15-20% when using conventional handling practices, can be substantially reduced through the application of improved post-harvest management technologies (Thakur et al., 2025). Following harvesting, tubers require immediate cleaning to remove adhering soil and plant debris. Gentle washing in clean water, without harsh abrasive treatments that may damage the thin outer layer, preserves the integrity of essential oil-containing glandular structures. Tubers are then air-dried in well-ventilated environments or using controlled-temperature drying chambers at 40-50°C. The drying process typically requires 4-6 weeks to achieve the target moisture content of 8-10%, which facilitates long-term storage stability while preserving the volatile components responsible for therapeutic efficacy.

Distillation

Essential oil extraction, conducted through steam distillation or hydrodistillation processes, yields approximately 2-4% essential oil by dry weight. These essential oils possess marked antimicrobial, anti-inflammatory, and antioxidant properties that facilitate their application in pharmaceutical formulations, cosmetic products, and food preservation (Ailli et al., 2023).

Traditional and Medicinal Uses

Ayurvedic and Traditional Medicine Applications

Nagarmotha occupies a significant position in Ayurvedic medicine, where it is recognized as a cooling, bitter-tasting herb with particular utility in treating conditions characterized by excess heat and inflammation. According to Ayurvedic pharmacopeia, Nagarmotha demonstrates efficacy in relieving fever, skin disorders, urinary tract infections, and digestive disturbances. (Kumar et al., 2021). In traditional South Asian medicine systems, Nagarmotha has been employed as a remedy for gynecological disorders, dysmenorrhea, and conditions associated with aberrant blood circulation. The tubers are traditionally macerated in water or milk to prepare medicinal decoctions, or powdered and incorporated into herbal formulations designed to address specific health conditions. (Lahyaoui et al., 2025).

Pharmacological Activities and Scientific Validation

Essential oil constituents, primarily sesquiterpenes including elemol, sesquicineole, and other oxygenated compounds, have been demonstrated to possess significant antimicrobial activity against both gram-positive and gram-negative bacteria, as well as fungal pathogens (Chrysargyris et al., 2024). These antimicrobial properties support the traditional use of Nagarmotha in wound healing and infection management. The antioxidant potential of Nagarmotha extracts has been documented in multiple investigations, with phenolic and flavonoid constituents contributing substantially to the scavenging of reactive oxygen species. These antioxidant properties are particularly relevant in the management of chronic inflammatory conditions and age-related degenerative diseases. Additionally, Nagarmotha demonstrates anti-inflammatory activity through inhibition of pro-inflammatory cytokine production and suppression of transcription factors involved in inflammatory signaling cascades (Muntean et al., 2025).

Industrial and Cosmetic Applications

The aromatic properties of Nagarmotha have facilitated its incorporation into cosmetic and personal care products. Essential oil-derived constituents are employed as fragrance components in perfumes, colognes, and scented cosmetic formulations, where their warm, distinctive aroma provides distinctive olfactory notes. The antimicrobial and antioxidant properties of Nagarmotha extracts have also enabled their application as natural preservative systems in cosmetic formulations, providing an alternative to synthetic preservatives with

potentially reduced safety concerns (Gavril et al., 2019). In the fragrance industry, Nagarmotha essential oil is valued as a middle note constituent, where it contributes complexity and longevity to fragrance compositions.

Conclusion

Nagarmotha cultivation on marshy lands represents a promising approach to sustainable agricultural intensification in wetland environments, offering substantial benefits across economic, environmental, and social dimensions. The demonstrated capacity of this crop to thrive in challenging environmental conditions while generating significant economic returns positions Nagarmotha as a valuable component of climate-resilient agricultural strategies in developing country contexts. Realizing the full potential of Nagarmotha production requires coordinated investment across research, infrastructure development, institutional strengthening, and market system development. By harnessing the unique capabilities of this specialized crop and integrating cultivation practices with ecosystem conservation objectives, farming communities can transform marginal wetland resources into productive agricultural landscapes while maintaining critical ecosystem services. As global interest in natural, plant-based products continues expanding, Nagarmotha cultivation offers a sustainable livelihood opportunity that reconciles food and income security with environmental conservation and climate resilience objectives.

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