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Review Article

REVIEW ON CULTIVATION PRACTICES OF *HARIDRA* (*CURCUMA LONGA* LINN.)

Pratima Dolase[1]*, Vivek Chaudhari[2]

*[1]PG Scholar, [2]Associate Professor, Department of Dravyaguna Vigyan, SSAM, Hadapsar, Maharashtra, India.

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ABSTRACT

Haridra, scientifically known as *Curcuma longa* Linn, is a significant spice and medicinal plant valued for its rhizomes, particularly for their active compound, curcumin. This article explores the cultivation practices of *Haridra*, emphasizing essential aspects such as soil and climate requirements, propagation methods, irrigation, pest and disease management, and post-harvest techniques. Turmeric thrives in well-drained, loamy soils with a pH between 5.0 to 7.5, and requires a warm, humid climate for optimal growth. Propagation primarily occurs through healthy rhizomes, which are planted at specific depths and spacing to maximize yield. Effective irrigation practices, complemented by balanced fertilization and integrated pest management strategies, are crucial for healthy plant development. Post-harvest practices, including proper curing and drying, are essential for maintaining quality and marketability. By implementing these best practices, farmers can enhance productivity, ensuring the sustainability and economic viability of *Haridra* cultivation in the face of increasing global demand as a medicinal as well spice plant.

INTRODUCTION

Haridra, known scientifically as *Curcuma longa*, holds a revered position in Ayurveda, the ancient system of medicine that originated in India. Often referred to as "golden spice," turmeric is celebrated not only for its distinctive flavour and vibrant colour but also for its extensive therapeutic properties. In Ayurveda, *Haridra* is considered a powerful herb, known for its ability to balance the *Doshas -Kapha* and *Pitta*.[1] *Haridra* has antioxidant, hepatoprotective, anti-inflammatory, anti-carcinogenic, and antimicrobial properties, in addition to its use in gastric ulcer (also can cause ulcer at high doses), cardiovascular disease and gastrointestinal disorders, antioxidant and wound healing. [2-8]

The cultivation of *Haridra* is not merely an agricultural practice; we must focus it as a golden spice which is also one of the best medicines described in Ayurveda. Proper cultivation techniques can significantly influence the quality and potency of the rhizomes, which are integral to Ayurvedic formulations.

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This article delves into the traditional and sustainable practices of *Haridra* cultivation, emphasizing the importance of aligning agricultural methods. From selecting the right soil and ensuring optimal planting conditions to using organic pest management strategies, we will explore the holistic approaches that enhance both yield and the medicinal efficacy of turmeric. Additionally, we will discuss the significance of seasonal planting; inter cropping, and the use of natural fertilizers in maintaining soil health and promoting biodiversity.

By integrating Ayurveda into cultivation practices, farmers can not only improve their harvests but also contribute to a sustainable agricultural ecosystem. Join us as we journey through the practices that ensure the successful cultivation of *Haridra*, enriching both the land and the lives it touches.

MATERIALS AND METHODOLOGY

Database selection was done using, scientific databases such as PubMed, Google Scholar, Scopus, and Web of Science to gather relevant literature by using search engines. Also *Samhitas, Nighantus*, published books, peer-reviewed articles, recent studies (preferably within the last 10 years), articles focusing on agronomy, cultivation techniques, pest management, and post-harvest processing. Used keywords like "*Haridra* cultivation," "Curcuma longa," "turmeric farming," and "agronomic practices" to

refine search results. For data extraction information categorized such as: Soil and climatic requirements, propagation methods (e.g., rhizome planting, micropropagation), water management, fertilization practices, pest and disease management, harvesting and post-harvest handling. Summarized findings were from different studies to highlight common practices, innovative techniques, and regional variations. Analysed of current practices and comparative analysis was made. Compared cultivation practices across different geographic regions to identify successful techniques and challenges faced.

Varieties [9]

Commercial varieties distinguished by name of locality in which they are grown like in Assam Deshipatani (have better colour and flavour). In Chennai, Chinna nedan (grows fast and have sweet aroma) perum. In Mumbai, two varieties one hard and bright coloured while other is soft, larger and lighter in colour.

The famous varieties available in market are

Haldi, China scented, Thodopuza, Red streaked, Alleppy, Patna etc. [10]

Other Species

Plants of genus Curcuma belongs to Zingiberaceae / Scitaminae family and is known for their high therapeutic potentials.

Curcuma longa Linn. (*Haridra*)

Curcuma aromatica Salisb. (*Vana Haridra*)

Curcuma amada Roxb. (*Amragandhi Haridra*)

Curcuma angustifolia Roxb.

Curcuma caesia Roxb. (*Kali Haridra*)

Curcuma zedoaria Rosc. (Zedoary)

are known important species among the hundred species seen in different parts of the world.

Other species of curcuma like Curcuma angustifolia, Curcuma leucorhiza, Curcuma amada etc have pale coloured rhizomes, these are utilized in India for production of starch, which is known as "East Indian Arrowroot".[11]

Botanical Description of *Haridra*[12]

Habit: A tall perennial herb

Stem: Large, ovoid, sessile, cylindrical rhizomes. Orange yellow inside

Leaves: Leaves radical, in tufts, very large, often upto 1.5m in length i.e., petiole + blade together, sheathing base, lamina simple, oblong lanceolate tapering towards the base.

Inflorescence: Radical spikes in clusters, peduncle about 15cm or more in length. Flowering portion 10-15cm x 6cm terminal empty bracts i.e., coma tinged with pink, autumnal, flowering bracts pale green.

Flowers: Complete, regular, zygomorphic, epigynous, fragrant, bracteate, bracts of two types sterile ones i.e., forming coma about 5-8cm long, tinged with pink. Flowering bracts 4-6cm long recurved rounded at the tip, pale green, bracts and bracteoles connate below forming pouches in which flowers are produced.

Calyx: Sepals 3, united with three irregular lobes, insignificant.

Corolla: Petals 3, united, forming a tube about 3cm long, the upper half funnel shaped, lobes pale rose in colour, lateral lobes oblong, dorsal longer, ovate concave arching over the fertile stamen.

Androecium: Stamens 5 (2+3). The two laterals of the outer whorl forming oblong obtuse petalloid staminodes as long as corolla lobes, from the inner whorls 2 united forming lip se conspicuous staminode, one of the inner whorl stamen, perfect, filament short, anthers spurred at the base.

Gynaecium: Carpels 3, ovary inferior, syncarpous trifocular with axile placentation, style filiform, stigma bilipped.

Fruit: Capsule-globose

Seeds: Oblong or ovoid usually arillate

Distribution-Trading

It is native of Southern Asia and is grown widely throughout the warmer areas of Indian subcontinent. Indian turmeric is considered best in the world. India is the largest producer of turmeric about 90% of total production along with its consumption and export. Other countries are China, Pakistan, Peru, Bangladesh and Taiwan.[13-14]

In India, the major producers are the states of Orissa, Andhra Pradesh, Maharashtra, Tamil Nadu, Kerala, Assam, Bihar and West Bengal. “Erode”, city from Tamil Nadu (Yellow City /Turmeric City/ Textile City) is the world’s largest producer and trading centre. The city “Sangli” from Maharashtra is second largest and major trading centre of turmeric. Turmeric grown in Kerala is called Alleppey Finger Turmeric (AFT) and is considered best in term of quality.[15-16]

Turmeric in major states of India as follows:[17]

Tamil Nadu: 18%

Orissa: 7%

West Bengal: 4%

Karnataka: 4%

Gujarat: 2%

Maharashtra: 2%

Kerala: 2

Propagation and Cultivation [18]

Climate and Soil

Turmeric thrives in well-drained, fertile, sandy and clayey, black red or alluvial loams, rich in humus and uniform in texture and easily workable. It is not tolerant to water stagnation. In heavy soils, it can be grown in raised beds. Alkaline soils are suitable for turmeric. However, it can tolerate a pH range of 5.0 to

7.5.[19] Turmeric requires a warm and humid climate. The temperature of 30-35°C at early planting stage ensures early and high germination. Similarly the tillering phase, rhizome initiation stage and bulking stage are best at temperature ranges of 25-30°C, 20-25°C and 18-20°C, respectively.

Preparation of Land

The land is dug 4-6 times and plowed to make the soil rise. Fertilizer is added to the last plow. In places where the soil is porous, it is divided into beds with a width of 1-2 meters and a suitable length with a distance of 30cm between the beds for water channels. For irrigated crops and non-porous soils, ridges and furrows are prepared and rhizomes are planted in holes in shallow beds on the ridges or on both sides of the ridges.

The rhizome is divided into two parts, with at least one tuber. Fingers are cut into 4-5cm pieces and can be used as planting material.[19]

When seeds are used, the dormancy of the seeds is broken by soaking the seeds in sulphuric acid (50%) for 10min. and then washing them thoroughly. Germination is generally complete in 2-4 weeks. After 17 days 90% germination was achieved.

Seeds and Sowing

Turmeric can be propagated by seeds and rhizomes, but this is usually done by rhizomes because the use of seeds is not economical in commercial cultivation. The mother rhizomes are used and said as planting material. [20] Studies conducted to determine the most suitable planting material have revealed that generally mother rhizome is the most suitable.

Propagation

The conventional method of propagation has a number of drawbacks, because 2 months dormancy period of rhizomes, only 5-6 plants can be obtained from each rhizome; and a sizeable percentage of the produce has to be put aside as seed material. The optimum spacing for sowing turmeric is 30-35cm x 20cm for beds and s 45-60cm x 25-30cm for ridges and furrows. To overcome these problems tissue culture technique was tried for propagation of some high yielding cultivars.

BARC has developed a technology for micropropagation of turmeric which is a constant source of many plants of equal size throughout the year. This protocol provides good quality disease-free plant material throughout the year and increases the yield of this crop. This technology can also be used to protect the germplasm of various turmeric varieties.[21]

Cultivars and Varieties

There are approximately 30 turmeric varieties grown in India. Among them sorts like Alleppey and Madras (Perianadan) are of first rate industrial importance. Some of the progressed varieties and domestically famous cultivars are: CO-11983, BSR-11986, Krishna, Roma, Suroma, Ranga, Rasmi, Megha Turmeric-1, Suguna, Sudarshana, Suranjana, Duggirala, Kodur, Suvarna, Varna, IISR Prabha, IISR Pratibha, Rajendra Sonia, Tekkurpet, Sugandham, Amalapuram, Erode local, Salem, Moovattupuzha and Lakadong. The Lakadong turmeric variety from the Jaintia Hills district of Meghalaya is considered one of the best turmeric varieties in the world with its curcumin content of around 6.8-7.5%. On a global scale, this variety of turmeric can be called a geographical indication.[22]

Export Potential Varieties

Lakadong	This variety is mainly cultivated at Meghalaya and it contains high percentage of curcumin which is essential for medicinal uses.
Alleppey	Highly coloured variety. It is grown in Kerala and marketed as Alleppey turmeric
Duggirala	A long duration type (9 months), major variety of Andhra Pradesh. Rhizomes are bright yellow in colour. Grown mostly in Guntur district.

Planting

The time of planting turmeric varies according to the cultivar and the agro-climatic conditions of the region. Turmeric is usually planted between mid-April and August. Short cycle varieties are planted in the second half of May, medium cycle varieties in the first half of June, and long cycle varieties between June 15 and July 15. Also, when the fingers are used as seeds, the sowing must be carried out in the first half of July; but with cut mother rhizomes, planting until the first week of August does not affect the yield. Mother rhizomes grow more vigorously than the fingers. In order to economize the cost of planting material, they are used in the proportion of 50:50.

Spacing and seed-rate

Optimum spacing for sowing turmeric is 30-35cm x 20cm for beds and s 45-60cm x 25-30cm for ridges and furrows. Rich black loam soils require wider spacing than light soils. Fingers rhizomes at the rate of 2000-2500kg/ha may be sown depending on the spacing adopted. In mixed cropping the seed-rate is

much less; in fruit gardens it may be as low as 400-500 kg/ha.

Manures and Fertilizers

Turmeric needs heavy manuring; light soils are more heavily manured than heavy soils. Usually 40-50 tonnes of farmyard manure (FYM) is applied as a basal dressing. About 1200-1800kg of groundnut cake is applied in two split doses, the first after planting and the remaining a month and a- half later. Tank silt or cattle or sheep penning is also used to supply the bulky organic manure. NPK fertilizers at 30:30:60 kg/ha may be applied in two split doses at 30 and 60 days after planting. The optimum spacing for sowing turmeric is 30-35cm x 20cm for beds and s 45-60cm x 25-30cm for ridges and furrows.

Irrigation

The critical stages for water requirement of the crop are germination, rhizome initiation and bulking stage. In case irrigation is not received during 130 to 135 days of crop growth, there is drastic reduction in yield and increase in root mass instead of rhizome yield.

In heavy rainfall tracts of the West Coast, turmeric is grown as a rain-fed crop and in other areas as an irrigated crop. During summer, irrigation at 5 day intervals is recommended in case of red loam and at 7-9 days in the case of black loam.

Harvesting

Turmeric crop is generally ready for harvest in 8 months after planting but the long duration varieties take 8 1/2-9 months. The maturity of turmeric crop is indicated by complete drying up of the plant including the base of stem. When mature, dry leaves are cut close to the ground. If necessary, the land is watered, and then the rhizomes are dug up with a crow bar or pick-axe. Where seeds are sown in heaps, harvesting is done by ploughing between the rows. The rhizomes are collected, cleaned of soil and attached roots, and then divided into rounds and fingers. For seed, usually a small part of the field is left to be harvested the following month.

Storage

For seed purpose, the clean rhizomes are heaped in shade and protected with turmeric leaves, or the heap is plastered over with earth combined with cow dung. In some places the plastered heap is also dusted with ash and sprinkled with water occasionally. The remaining produce is cured and stored in large quantities at the assembling centres. Cured turmeric is generally stored in air-tight underground pits, lined and covered by rellu grass (Saccharum spontaneum) or date mats, before the onset of monsoon. These pits are opened after the rains.

Processing or Curing

Boiling

The rhizomes are cooked in water till they turn out to be soft. The cooking should be thorough, as otherwise the product is liable to insect attack. The duration of cooking varies in different localities from c. 30 min. to 6 hrs. Addition of a little cow dung is believed to intensify the colour, perhaps due to alkalinity. The methods and equipment used for boiling vary from tract to tract. Perforated troughs immersed in a boiling pan are used most economically and efficiently as there is less wastage of fuel and time. Each boiling takes about 30 minutes and 700kg of turmeric can be boiled at a time.

Drying

The cooked rhizomes are allowed to cool gradually and spread out to dry in the sun for 10 to 15 days, turning intermittently to ensure uniformity of drying. Alternatively, mechanical dryers are used, maintaining temperatures between 50 and 60°C. The dried rhizomes are either rubbed on a rough floor or trampled upon to eliminate the outer pores and skin after which polished to provide them an appealing colour.

Polishing

Polishing is done in a turmeric polisher with an enlarged metal polishing drum, placed horizontally and rotated by a handle. [23] The drum is covered on the outside with a light wrapping of woven wire to prevent the small pieces from falling through. At the same time it can absorb about 32kg of turmeric and polishing is finished in 30 minutes. The weight loss due to complete polishing is about 5 to 8% and that through polishing is about 2 to 3%.

Colouring

The polished product is subjected to colouring via way of means of dry or wet method. In the dry method, chemicals mainly lead chromate (chemichrome) is dusted on the rhizomes and mixed well, but this is discouraged due to injurious nature of the chemical dye. Therefore, usually wet colouring is preferred. In wet dyeing, yellow dye is mixed with water, the dye solution is sprinkled on a small pile of half-polished rhizomes, and rubbed well. The fruit will dry for a week. Then the product is dried for about a week. The dried rhizomes are taken in a vicker basket which is shaken continuously while a prepared emulsion made from castor seed paste, alum, sodium bisulphite, sulphuric acid and turmeric powder is poured on it. The fingers are then coated with emulsion and dried in the sun. It varies according to the quality and age of the raw bulbs and is between 15 and 25% of new bulbs. Dried and finished turmeric is brittle and has a bright yellow colour.

RESULTS AND DISCUSSION

Results

The review of the literature on *Haridra* (Curcuma longa Linn) highlights its extensive medicinal uses in Ayurveda. The traditional practices in the cultivation of *Haridra* are crucial to its medicinal quality. The review identifies key agricultural practices that enhance the potency of *Haridra*, including soil selection, seasonal planting, and use of organic manure. Varietal differences were noted, with specific varieties such as Lakadong and Alleppey being recognized for their high curcumin content and superior quality.

The examination of the cultivation methods reveals that factors such as climate, soil conditions, and propagation techniques significantly influence yield and quality. For example, turmeric thrives in well-drained, fertile soils with a pH range of 5.0 to 7.5 and requires a warm, humid climate for optimal growth.

DISCUSSION

The review highlights the cultivation practices and revealed factors should be taken into consideration for the best quality and high yield of *Haridra*. The increasing demand for *Haridra* as a medicinal plant and as a spice can be assured by following this cultivation practices with the help of new agro-techniques. For instance, while some studies report the efficacy of high curcumin varieties, others indicate that traditional practices may also yield competitive results, suggesting a need for more standardized research methodologies. This inconsistency points to gaps in understanding the impact of different agricultural practices on the pharmacological properties of turmeric.

In light of these findings, future research should prioritize the exploration of sustainable cultivation practices with modern agricultural techniques. Studies focusing on micropropagation techniques may also enhance the production of disease-free, high-yield turmeric varieties. Furthermore, expanding the geographic study of turmeric cultivation can provide insights into how different environmental conditions influence the herb's therapeutic properties.

CONCLUSION

In conclusion, this review highlights the importance of *Haridra* in both traditional medicine and modern agriculture. By emphasizing sustainable practices and further validating the medicinal properties of turmeric, we can enhance its role in promoting health and well-being while supporting ecological balance.

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***Address for correspondence**
Dr. Pratima Dolase
PG Scholar,
Department of Dravyaguna Vigyan,
SSAM Hadapsar, Maharashtra,
India.
Email:
Dolsepratima97@gmail.com