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Lakadong turmeric: Package of practice

for organic production, challenges and opportunities

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Turmeric is an important indigenous spice of India, grown widely in different parts of the country. The crop is having huge potential for improving the livelihood security of the farmers through production, processing and value addition. North eastern India being a hot spot of biodiversity, a wider genetic variability has been observed in local landraces of the turmeric for different agro-morphological and quality traits. Amongst them, "Lakadong", a local geographical indication (GI) tag genotype from West Jaintia Hills, Meghalaya, has been found superior for curcumin content of over > 7.0%. There is also wide variability in curcumin content within the genotypes of Lakadong grown in the niche area and to get better prices, there is a need for the selection and multiplication of the planting materials of curcumin-rich genotypes. Moreover, the high-yielding (20–25 t/ha), curcumin-rich (6.6%) genotype Megha Turmeric-1 developed through clonal selection from the Lakadong should be promoted to other parts of the region. Productivity of the crop can also be enhanced by the adoption of a developed organic package of practices. Further, the use of newly developed machinery such as manually operated washer, slicer and hybrid drier can increase the efficiency of the post-harvest operation and farmers can get a better price by improving the quality of the produce.

Keywords: Curcumin, Lakadong, Meghalaya, Organic production,Turmeric

GOLDEN spice turmeric (*Curcuma longa* L.) is an important, widely grown native rhizomatous crop of the Zingiberaceae family. India is the world's leading producer, importer, and consumer of turmeric. In India, it is cultivated in an area of 3.24 lakh hectares and produces 11.61 lakh metric tonnes, which accounts for over 80% of global turmeric production. India is also the major exporter of turmeric, with over a 62% share of world trade in turmeric and earned a foreign exchange of 207.45 million USD through the export of 1.534 lakh tonnes of turmeric and turmeric products in the year 2022–23. The prime export markets for Indian turmeric are Bangladesh, UAE, USA and Malaysia (Ministry of Commerce and Industry 2023). The major turmeric-producing states are Maharashtra, Telangana, Karnataka and Tamil Nadu.

Since ancient times, turmeric has been used to treat inflammatory conditions of various organs, for liver and digestive tract problems, and for wound healing. Curcumin is the key compound responsible for the colour and medicinal properties of turmeric. Curcumin is an orange-yellow dye practically insoluble in water and is synthesised in plants from phenylalanine. It is the main molecule of curcuminoids; the curcuminoids comprise curcumin (77%) as well as include bisdemethoxycurcumin (BDMC) (17%) and demethoxycurcumin (DMC) (6%). Due to the medicinal properties of curcumin and traditional uses in food and cosmetic products, there has been a significant increase in the demand for turmeric by culinary, pharmaceutical and cosmetic industries over the years in national as well as international markets. Due to growing health consciousness, people around the world prefer organically grown products for daily consumption.

Turmeric is one of the leading commercial crops of north eastern India, and it is grown in an area of 0.34 lakh hectares with a production of 1.13 lakh metric tonnes and which accounts for 14.30% and 9.7% of the country's turmeric area and production, respectively (National Horticulture Board 2022). Amongst the north eastern states, Assam, Mizoram and Meghalaya are the leading states in turmeric production. Due to diverse climatic conditions, there is a wide variability in the local landraces of turmeric grown in the region and amongst

Crop of turmeric genotype Lakadong at farmers' field

Harvested rhizome of turmeric genotype Lakadong

them the popular landraces are Maran, Bhola, Jorhat Local (Assam); Reiek Local (Mizoram); and Lakadong, Laskein and Ladaw (Meghalaya). Landrace Lakadong is a native genotype to the Lakadong village in the Laskein block of the west Jantia Hill district of Meghalaya. It is traditionally known as Shynrai or Chyrmit Lakadong in Pnar (Jaintia Hills). Due to its richness in curcumin content, the variety has been given Geographical Indication tag in 2024 by the Geographical Indications Registry in Chennai.

The cultivation of the Lakadong turmeric is concentrated in the Nongbah and Shangpung belts of the west Jantia Hills. The crop covers an area of about 2.98 thousand hectares in the state with a share of 7.73% in the NER during 2020. The production accounted for 18.61 thousand tonnes with a productivity of 6.25 t/ha. A district-wise comparison of area and production for 2019–20 shows that west Jantia Hills has the major acreage with a magnitude of 1.69 thousand hectares, which accounted for 56.84% of the total turmeric area in Meghalaya. West Garo Hills and Ribhoi districts had more than 150 hectares and the remaining districts had less than 150 hectares under the crop. Similarly, the production follows the same pattern. The west Jantia Hills (10.69 thousand tonnes) were the highest producer of turmeric, which accounted for 57.42% of the total state production. It is followed by west Garo Hills (2.47 thousand tonnes) and Ribhoi (1.46 thousand tonnes). Fascinatingly, Ribhoi district showcased the highest productivity (8.02 t/ha) not only at the state level but also at the national level. However, the west Jantia Hills, a significant region for the production of Lakadong turmeric, witnessed productivity of 6.31 t/ha in 2021.To promote turmeric production in the country, several initiatives have been taken by the Government of Meghalaya, such as launching of Lakadong Mission in the year 2018 and recently, establishment of a separate board for turmeric from the Spices Board in the year 2025 by the Government of India with headquarter at Nizamabad (Telangana).

Growth, yield and quality attributes of Lakadong turmeric

As per the distinctiveness, uniformity and stability (DUS) guidelines of the Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA), New Delhi, the characteristics of Lakadong turmeric are presented in the Table 1. Lakadong turmeric has been found to be medium in crop maturity and rich in curcumin contents (7.0–7.8%).

Table 1. DUS characteristics of the Lakadong turmeric

Sl. No.	Characteristics	Value
A. Plant Characteristics		
1	Plant height (cm)	102.80
2	Leaf length (cm)	49.88
3	Leaf width (cm)	13.46
4	Petiole length (cm)	24.10
5	Leaf margin	Plain
6	Leaf disposition	$<45^0$
7	Leaf venation	Close
8	No of leaves/stem	6–8
9	Stem diameter (cm)	2.30
10	No of tillers/plant	2.33
B. Rhizome characteristics		
11	Rhizome length	Medium
12	Rhizome internode	Distant
13	Rhizome habit	Intermediate
14	Rhizome shape	Straight
15	Rhizome inner core colour	Orange
16	Yield/plant (g)	220.0–390.0
17	Yield (q/ha)	15.0
C. Quality traits		
18	Dry matter (%)	18.5–21.8
19	Curcumin (%)	7.0–7.8

Comparative performance of turmeric genotypes under organic production

To assess the comparative performance of the turmeric genotypes under the organic package of practices, six genotypes, including two local landraces

of Lakadong, were evaluated during 2020–22. Amongst the genotypes, the maximum yield was observed in Megha Turmeric-1 (22.5 t/ha), followed by Narendra Haldi-1(20.9 t/ha) and Rajendra Sonia (19.4 t/ha). However, the lowest yield was recorded from the genotype Lakadong-RiBhoi (15.38 t/ha). Further, the dry matter content was maximum in genotype Pragati (21.30%), followed by Lakadong-Jowai (19.68%). Lakadong-Jowai (a collection from west Jaintia Hills) was found superior for the dry matter as well as curcumin content.

Table 2. Comparative performance of turmeric genotypes under mid-hills of Meghalaya

Genotypes	Plant height (cm)	Leaf length (cm)	No. of tillers /plant	No of leaves / plant	Stem dia. (cm)	Petiole length (cm)	Yield (t/ha)	Dry matter (%)	Curcumin content (%)
Megha Turmeric-1	105.60	54.87	3.67	8.67	2.57	21.40	22.50	19.31	6.67
Rajendra Sonia	96.67	54.60	2.67	8.33	2.12	19.90	19.62	18.06	5.70
Narendra Haldi-1	105.50	47.27	3.00	10.67	2.24	19.43	20.95	19.58	5.72
ISSR-Pragati	109.63	53.40	4.00	9.00	2.11	16.87	17.13	21.30	4.95
Lakadong -RiBhoi	107.80	49.60	4.00	6.67	2.20	18.70	15.38	19.65	6.88
Lakadong-Jowai	103.73	51.20	3.00	7.00	2.27	16.70	16.67	20.19	7.23
Mean	104.82	51.82	3.39	8.39	2.25	18.83	18.66	19.68	6.19
CV (%)	2.15	1.52	7.60	11.17	1.45	3.56	8.36	2.92	3.22
CD at 5%	3.16	0.68	0.48	0.75	0.25	1.90	2.30	0.77	0.56

Package of practices for organic production

Climate and soil: Turmeric can be grown in diverse tropical conditions from sea level to 1500 m above sea level, at a temperature range of 20–35°C with an annual rainfall of 1500 mm or more, under rainfed or irrigated conditions. It thrives best in well-drained sandy or clay loam soils with a pH range of 4.5–7.5 with good organic status. The yield and quality of turmeric are highly affected by the weather parameters. GI genotypes, Lakadong of turmeric, are found to be superior in their curcumin content (>7.0%) when they are grown in the niche area (West Jantia Hill) of the Meghalaya where the climate is mild-warm and humid during the growing period (March-December) and soil acidic in nature (pH ≈ 4.8). However, when it is grown in other areas, the curcumin content is affected significantly. Moreover, the improved cultivar Megha Turmeric-1, developed through clonal selection from Lakadong, has been found stable across the location under the multi-location testing trials of the AICRP on Spices.

Planting time: Turmeric is mostly grown in the Jhum field after clearing of the forest (February-March), land preparation (raised beds) after getting the first shower of the season (March-April).

Spacing: The turmeric is grown on the raised beds and the optimum spacing between the beds is kept at 45.0 cm and between plant to plant and row to row at a 30 cm x 30 cm spacing.

Seed rate: About 20–25 q healthy disease-free rhizomes (4–5 cm in length and 25–30 g in weight) are sufficient for one hectare of land.

Seed treatment: To prevent the crops from soil-borne diseases, the seed rhizomes should be treated with *Pseudomonas fluorescens*10 g/kg and *Trichoderma viride* @5 g/kg seed.

Manuring: Turmeric is a long-duration and nutrient-exhaustive crop, which requires a heavy dosage of nutrients to maintain the soil fertility with a higher yield. The application of organic manures in agriculture greatly enhances turmeric yield, quality, and soil health.

Table 3. Per hectare doses of manure and fertilizers and their schedules for organic production of turmeric

Schedule	Neem cake	Rock phosphate	Ash/Sulphate of Potash	Organic manure
Basal	2 tonnes	250 kg	-	Cow dung/ FYM: 20 tonnes
After 45 days	-	-	Ash: 0.5 1 tonnes	Vermicompost: 2 tonnes
After 90 days	-	-	Sulphate of potash: 100 kg	Vermicompost: 2 tonnes

Weeding: The weeds are managed by manual weeding and earthing-up. The 8–12 weeks after planting (WAP) are the critical period of weed competition, therefore, weeding should be done thrice, at 60, 90 and 120 days after planting. Mulching of green leaves @12–15 t/ha right after planting has been found to be an effective way to control weeds. Mulching can also be done with paddy straw and green or dry available weed biomass. For better results, the mulching may be repeated @7.5 t/ha at 40 and 90 days after planting. For proper aeration and development of the rhizomes, the manures should be applied at 45 and 90 days after each weeding and earthing up. The application of cow dung slurry above the mulch enhances the activity of beneficial microbes and nutrient availability.

Irrigation: Turmeric is grown as a rainfed crop in the region. The region falls under a high rainfall area and proper drainage is essential for better yield and protection from diseases.

Mixed farming/crop rotation: As a mixed crop, turmeric can be grown or rotated with chillies, brinjal, okra, colocasia, sweet potato, maize, ragi, French bean, cowpea, etc. enabling the effective nutrient build-up as well as management of the pest or disease. When growing turmeric in a mixed cropping system, it is imperative that all of the crops be produced using organic practices. The crop is partially shade-loving, and it can be grown with cucurbits (bottle gourd/pumpkin) under vertical farming. It also can be grown in intercropping with the plantation crop arecanut.

Plant protection measures

Insect-pest: Shoot borer (*Conogethes punctiferalis* Guenee) is a major pest of turmeric. The crop is damaged by the larvae, which eat the developing shoot after boring into the pseudostem, which causes the shoots to dry out and turn yellow. The presence of pores in the pseudostem through which frass is extruded and withering are the peculiar symptoms of the shoot borer infestation. Spraying Neemgold 0.5% or Neemoil 0.5% or Spinosad 0.5 ml/L water during July-October (at 15-day intervals) is effective against the shoot borer. The shoot borer in ginger and turmeric can also be managed by the use of biopesticides, such as soil application of entomopathogenic nematodes *Heterorhabditis indica* at 5–10 kg/ha in FYM (75–100 kg FYM) or spraying of entomopathogenic fungi *Beauveria bassiana* @2–5 ml/L water or entomopathogenic bacteria *Bacillus thuringiensis* products such as Dipel 0.3% at 15 days intervals during July to October. The light traps attract the adult moths. The use of 3–4 traps/ha has been found effective in managing the pest population by trapping and killing.

Rhizome scale (*Aspidiella hartii* Cockerell) is another important pest of the turmeric, attacking rhizomes, and affecting the yield and quality of the rhizomes by sap-sucking by the adults. In case of severe infestation, the rhizome and buds become shrivelled, and eventually the entire rhizome dries. It can be managed by the use of pest-free seed rhizomes, following crop rotation, and treatment of the rhizomes with hot water (50°C) for 10 minutes before planting.

The root knot and cyst nematodes also damage the crop of turmeric, and they can be managed by the drenching of liquid formulation (@1.0 ml/L water) of *Pochonia chlamydosporia*, a fungal species known for its ability to parasitize the plant-parasitic nematodes, especially root-knot and cyst nematodes.

Diseases:

Rhizome rot: The rhizome rot disease of turmeric is a complex disease and it is caused by soil borne pathogen (*Pythium spp., Fusarium spp., Rhizoctonia spp.*). The disease of rhizome rot can be controlled by selection of healthy rhizomes, treating the seeds, soil solarisation, and applying biocontrol agents like *Trichoderma* or *Pseudomonas* that have multiplied in appropriate carrier media like cocopeat, well-rotted FYM, or neem cake at the time of sowing and at regular intervals.

Foliar disease: Leaf spot (*Colletotrichum capsici*) and Leaf blotch (*Taphrina maculans*) are the two most important foliar diseases of turmeric. The disease appears during the month of August-September due to congenial weather (high temperature and humidity) for the pathogen. Lakadong turmeric has been found to be tolerant of diseases like leaf spots as well as leaf blotches. Spraying of copper oxychloride 0.25% immediately after the appearance of symptoms and at 15-day intervals is effective in controlling the disease.

Harvesting: The crop is ready for harvesting 7 to 9 months after planting, depending on the cultivar. The early, mid- and late-maturity cultivars mature in 7–8, 8–9 and >9 months after planting, respectively. Lakadong is a mid-maturity genotype, and it takes about 8–9 months to mature. The crop should be harvested when leaves are yellowing and gradually drying up.

Yield: The yield of the turmeric depends on the cultivars, and management practices. The average yield of Lakadong turmeric is 12–15 t/ha, while the improved cultivar Megha Turmeric-1 has 20–25 t/ha.

Storage of seed rhizomes: After harvest, the disease-free bold rhizomes are selected, cleaned, and treated with 1% bordeaux mixture for 20 minutes and further stored in pits of convenient size after shade drying. Dry grass/paddy straw should be kept at the bottom and top of the stored rhizome in the pit and sealed by plastering with mud. The rhizomes are taken out 20–25 days before planting.

Challenges and opportunities in organic production

Despite the premium quality of the Lakadong turmeric, as well as huge demand in the domestic as well as international markets, farmers are not getting the premium prices of their produce due to many factors.

- ***Lack of quality planting materials:*** There is wide genetic variability in the quality of the Lakadong turmeric grown in the region. Hence, there is a need for the selection and large-scale production of the quality planting materials of the Lakadong genotypes found superior for the curcumin content in the niche area (Jaintia Hills, Meghalaya). Lakadong being unstable in quality when it is grown in other parts of the region, the stable genotype Megha Turmeric-1 should be promoted as it is also rich in curcumin (6.8%) and higher (20–25 t/ha) in yield. It can be strengthened by participatory production through cluster farming with the help of SHGs/FPO, etc.
- ***Poor cultivation practices:*** Comparatively, the productivity of the crops in the region is very low due to poor agricultural practices, no uses of the inputs like manure and fertilisers, weed management, etc. Hence, there is a need for increasing awareness amongst farmers about good agricultural practices, especially for organic production.

- ***Non-availability of essential inputs:*** There is also a lack of availability of quality inputs, such as bio-fertilisers, bio-pesticides, etc. for the organic production in the growing pockets of turmeric.
- ***Organic certification:*** In Meghalaya, turmeric is produced organically and there is no well-set-up mechanism for the certification of organic products. Despite huge market demand, farmers are not getting the higher prices of organically grown turmeric. Hence, there is a need for the development of a mechanism for the certification of the product.
- ***Price fluctuations:*** Due to the absence of a regulated market,the price of turmeric varied from ₹40–70/kg. Most of the produce is sold by the farmers to the village traders. Farmers can get better prices through the establishment of a regulated markets and their linkage.
- ***High transportation cost:*** Although Lakadong is rich in curcumin content, the farmers of the Meghalaya are getting the average low market price (₹ 179.47/kg) as compared to the higher market price of ₹ 267.0/kg for the GI turmeric Waigaon (Curcumin: >6%) in Maharashtra. This is mainly due to the involvement of the higher transportation costs in the Lakadong turmeric exported from the Meghalaya.
- ***Lack of processing and value addition:*** Based on a household survey (2017–20), only 0.75% of the turmeric is used for local consumption, 20.27% is used for seed purposes and, after the field loss (0.91%), the remaining 78.06% is used for the selling in the markets. Due to poor processing and value addition, most of the turmeric produce is sold as dry flakes (67.28%), fresh rhizomes (29.03%), and only 3.69% as powder. Hence, there is huge scope for the development of the infrastructure for the processing and value addition of turmeric.
- ***Lack of mechanisation:*** Most of the cultural operations as well as post-harvest operations are practised manually, which increases the cost of production with lower efficiency. The ICAR-NEH, Umiam developed improved farm machinery such as manually operated turmeric washer, slicer and hybrid driers that can be promoted to improve the efficiency of post-harvest operation.
- ***Absence of a quality testing facility:*** Due to the lack of a quality testing facility in the growing pockets, farmers and traders are facing a major challenge in getting the premium prices based on export quality. Therefore, the establishment of the quality testing laboratory is very important to realise the premium price by the farmers as well as traders.

SUMMARY

The GI tag variety "Lakadong" turmeric can be a boon for the growers of the Jaintia Hills of Meghalaya through the use of quality planting materials, adoption of good agricultural practices, especially for organic production, use of farm machinery for post-harvest operations, processing and value addition in the growing pockets through cluster approaches involving SHGs, and proper market linkage. Further, the farmers of the other parts of the region can benefit from the adoption of the high-yielding, curcumin-rich stable variety, Megha Turmeric-1.

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