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Articles invited for Indian Journal of Arecanut, Spices and Medicinal Plants

Indian Journal of Arecanut, Spices and Medicinal Plants is a quarterly publications in English released by the Directorate of Arecanut & Spices Development, Calicut, Ministry of Agriculture and Farmers Welfare, Government of India, dealing with the development of Arecanut, Spices, Medicinal & Aromatic Plants in the Country. It has wide circulation among farmers, Extension Workers, Scientists, Exporters, Industrialists etc.

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Indian Journal of Arecanut, Spices & Medicinal Plants Vol. 26 (1) 3-10 (2024)

EVOLUTION OF SEED SPICE FARMING IN INDIA: INTEGRATING TRADITION WITH INNOVATION

Aruna T.N[1]., P.K. Sahoo[2], D.K. Kushwaha[3], Soumya Krishnan. V[1]

Abstract

Seed spices play a crucial role in the Indian spice economy, contributing significantly to both area and production shares of the nation's total spices. However, traditional methods of seed spice cultivation are often labour-intensive, time-consuming, and face challenges in terms of efficiency and productivity. This article explores the transformational approach towards enhancing seed spice crop productivity through advanced technologies. From seedbed preparation to harvesting, various stages of cultivation are examined, highlighting the challenges faced by conventional farming operations and the potential solutions offered by modern agricultural techniques. The adoption of driverless systems, robotics, precision agriculture, and sustainable practices are discussed as key components in revolutionizing seed spice cultivation. By leveraging these advanced technologies, there is a significant opportunity to increase efficiency, improve quality, and ensure the long-term sustainability of the seed spice sector in India.

Keywords: Seed spices crops, Mechanization level, Automation, Precession.

Introduction

Seed spice are the crops having seed as main economical part, used in whole or value added form for imparting flavour, aroma and pungency to food. Other than culinary they are widely used in Pharma and other industries for carminative and preservative purposes. As result of diverse agro climatic conditions India produces more than 20 seed spices. Cumin, coriander, dill seeds, fenugreek and fennel are the major seed spices cultivated in the country. Different states are known for different spices but seed spices are mostly grown in Rajasthan and Gujarat with more than 80 per cent contribution (Singh and Solanki, 2015). India, world's largest producer and exporter of spices produced 7.07 million tonnes of spices, coming from 3.52 Mha area during 2015-16 (Anonymous, 2017). Seed spices play a crucial role in Indian spice economy contributing 50.31 and 21.30 per cent area and production share to nation's total spices. Individually chillies, cumin, coriander, garlic and fenugreek are the largest grown spices in India with 23.05, 22.79, 17.48, 8.39 and 6.42 per cent area share to total spice and 21.88, 7.25, 8.06, 23.07 and 3.56 per cent production share to total spices production, respectively. Spices are high export earning commodity to Indian economy. During 2015-16, India exported 8.43 lakh tonnes spices valued at 2.633 million US$, comes around 12.21 per cent to domestic production. Spice export is very concentrated, out of the 22 spices which are commercially cultivated in the country, 10 contributed around 90 per cent total export earnings. In last three decades scenario of spice production as well as export underwent significant transformation. India exports only 15% of its production annually to meet 50–60% of world demand (Anonymous, 2021). Thus, it is essential to increase the productivity of seed spice crops. The promptness of farm activities is seen to be more important in getting optimal yields from various crops, which is made feasible by farm mechanisation (Tiwari *et al.*, 2019). Thus, mechanization has been identified as a major factor in increasing agricultural productivity worldwide. The mechanization level of horticultural crops (Fig.1), which include, fruit, medicinal, ornamental, spice, and seed spices crops, in various agriculture operations,

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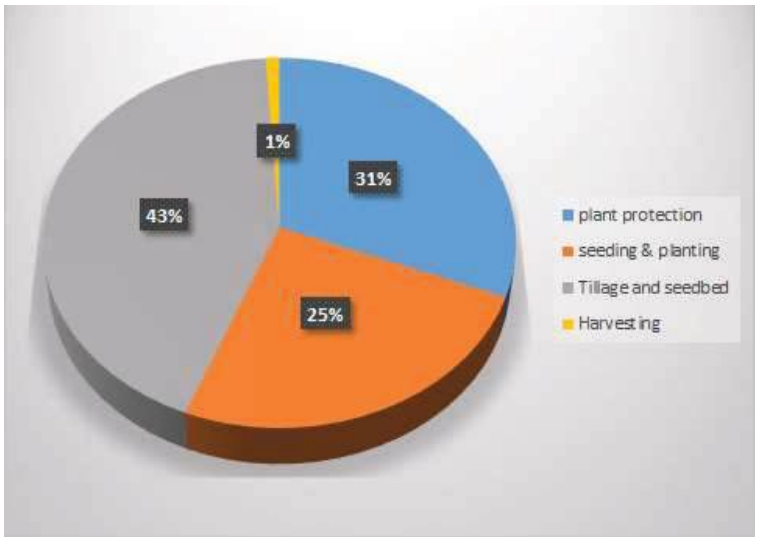

Fig.1. Level of mechanization in horticultural crops

i.e., seedbed preparation, sowing, weed and pest control was 60-70%, 30-40% and 40-50%. Whereas the level of mechanization in harvesting was less than 1% (Tiwari *et al.*, 2019). There is a low level of mechanization in seed spices crops for different agricultural operations, especially in the case of harvesting.

Conventional methods of farm operations in seed spices crops and transformation approach for enhancing seed spices crops productivity

Most of the farm operations in the seed spices can usually done by the manual methods, which leads to more time-consuming, labour intensive, and classified as moderately heavy work. Implementing the right machinery and tools in the cultivation of seed spices can significantly enhance productivity and efficiency. In the realm of seed spices cultivation, significant advancements have been made in various operational stages, leveraging technology to enhance efficiency and yield. The transformation in farm operations of the seed spice crop cultivation represents a progressive approach aimed at enhancing efficiency, productivity, and sustainability in agricultural practices. Traditionally, many farm operations in seed spice cultivation relied on manual methods, which were time-consuming, labour-intensive, and classified as moderately heavy work (Yadav *et al.*, 2007). However, by incorporating modern techniques and machinery, significant improvements can be achieved throughout the entire cultivation process.

Seed bed preparation for seed spices crops

The first step in seed spice cultivation is preparing the seed bed to create an optimal growing environment. Seed bed preparation is a critical step in establishing a conducive environment for seed spices crops often require a fine tilth for optimal germination. Traditionally, farmers use animal-drawn ploughs to initially break the soil. This is followed by manual breaking of soil clods using hand tools such as hoes and rakes. The soil is repeatedly worked to achieve the desired fineness. Ploughs, such as mouldboard or disc ploughs, are commonly used for the initial soil turning. They are effective in breaking up the soil, incorporating organic matter, and uprooting weeds. Following ploughing, harrows (like disc or tine harrows) are employed to further break down soil clumps and smooth the soil surface, preparing a fine seedbed crucial for many spice crops (Kepner *et al.*, 1978). Rotavator or rotary tillers can also be used at this stage to achieve a fine tilth, enhancing soil aeration and moisture retention – key factors for seed germination (Hunt, 1983). Advanced ploughing equipment like chisel ploughs or sub soilers can be used for deep tillage, which helps in breaking up compacted layers of soil, thereby improving aeration and water infiltration (Lal *et al.*, 2020). Post ploughing, harrows, such as power harrows or rotary hoes, are effective in creating a fine tilth, which is essential for small-seeded spice crops. These implements break soil

clods and remove weeds, ensuring a smooth and levelled seedbed.

Seed bed preparation has been revolutionized with implements like driverless tractor, laser land levellers, rotary tillers, and subsoilers. The adoption of driverless tractors (Oscar *et al.*, 2023), highlighted by has been a game-changer in seed bed preparation, bringing precision and efficiency to a previously labour-intensive process. These autonomous vehicles can be programmed for specific tasks like ploughing, ensuring uniform soil texture and depth, crucial for seed spices. Laser land levellers (Chen *et al.*, 2022) have significantly improved the evenness of the field surface. This is particularly important for spices like coriander, where even germination and water distribution are key. Jagvir, (2006) emphasize the role of rotary tillers and subsoilers in preparing the soil. Rotary tillers create a fine tilth suited for small seeds, while subsoilers break up deeper soil compaction, promoting better root growth and water infiltration.

Sowing / Planting of seed spices crops

Conventionally, sowing of seed spices is through broadcasting by hand is common, though it requires skill to achieve even distribution. In some regions, farmers use a 'pora' or a 'kera' (traditional hand-held seed drills) for sowing smaller seeds like cumin or mustard. These tools allow better control over seed depth and spacing compared to broadcasting. Seed rates and sowing times are based on generational knowledge and local climatic conditions. Uniform and precise sowing is crucial in seed spice cultivation. Seed drills are widely used for this purpose, ensuring consistent depth and spacing of seeds. Precision seed drills are particularly advantageous as they improve germination rates and optimize plant density (Ivancan *et al.*, 2004; Xia *et al.*, 2011)

Fig.2: Transformation in seed bed preparation of seed spice crops

The sowing process has seen a shift towards precision agriculture. Vacuum planters and pneumatic seed drills (Singh *et al.*, 2005; Kumar *et al.*, 2015 and Pareek *et al.*, 2023) offer precise seed placement and depth control, crucial for uniform crop growth. The use of GPS technology in

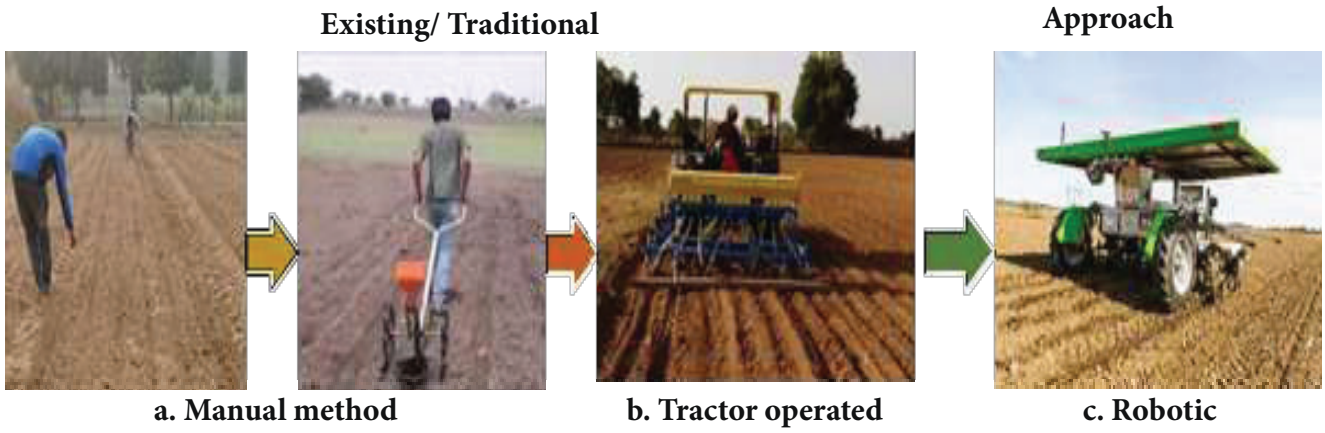

Fig.3: Transformation in sowing operation of seed spice crops

sowing equipment (He *et al.*, 2021) allows farmers to maintain exact row spacing and planting patterns. This technology not only optimizes plant density but also facilitates subsequent farm operations like weeding and harvesting.

Plant protection in seed spices crops

Similarly, conventional plant protection for seed spices primarily involves manual weeding, which is labour-intensive but crucial for these often low-growing crops. Farmers also use traditional knowledge of crop rotations and intercropping to naturally reduce pest populations. For instance, growing certain spices alongside legumes can enhance soil fertility and deter pests. Homemade natural pesticides, like extracts of neem or other locally available plants, are commonly used. The use of sprayers for the application of herbicides, pesticides, and fungicides is a critical aspect of plant protection in seed spice cultivation. Implement-mounted or tractor-mounted sprayers ensure efficient and even application of chemicals (Pramod *et al.*, 2023; Valla and Yadav, 2023). For mechanical weed control, cultivators are effective, offering a sustainable alternative to chemical methods. These cultivators can be adjusted to suit the row spacing and growth stage of the crop (Hussain *et al.*, 2018).

In the domain of plant protection, automated sprayers and drones (Yallappa *et al.*, 2017; Zhang *et al.*, 2023) ensure precision application of targeted pesticides and herbicides, minimizing chemical usage and environmental impact and reducing exposure risks. Drones are particularly effective in large or difficult-to-reach areas. Additionally, sensor-based technology (Subramanian *et al.*, 2021; Abbas *et al.*, 2023) is being used for early detection of diseases and pests, allowing for timely and precise interventions, which is critical in maintaining the health of spice crops.

Harvesting of seed spices crops

Traditional harvesting is predominantly a manual process. Farmers use hand tools like sickles to harvest the crops (Alam, 2007; Lal *et al.*, 2014). Manual harvesting is time- consuming, labour intensive, and classified as moderately heavy work (Yadav *et al.*, 2007). The labour intensive harvesting operation incurs additional expenditures, reducing farmer profits. As a consequence, a mechanical harvesting method is required to deal with the rising area of crop producing land (Kiran *et al.*, 2017). This method is labour-intensive but allows for selective harvesting, which is crucial for many seed spices that mature unevenly. Threshing is also typically done by hand or using simple tools, a process that is time-consuming but gentle on the seeds. Drying is done naturally, with the harvested spices spread out in thin layers under the sun, which requires careful monitoring to prevent overexposure or moisture ingress.

Harvesting techniques have evolved with the introduction of semi-automated harvesters and robotic picking systems (Iida *et al.*, 2013; Silwal *et al.*, 2017; Xiong *et al.*, 2020). These technologies ensure gentle handling of crops, minimizing damage and optimizing yield. This approach not only improves efficiency but also reduces the labour-intensive nature of traditional harvesting (Eberhardt and Vollrath, 2016; Zhang *et al.*, 2019).

Existing/ Traditional **Approach**

a. Manual method **b. Tractor operated** **c. Drone sprayer**

Fig.4: Transformation in crop protection/operations for seed spice crops

Fig.5: Transformation in Harvesting of the seed spice crops

Challenges in conventional farming operations in seed spices cultivation

In the seed spices cultivation, from seedbed preparation to harvesting faces numerous challenges, impacting efficiency, quality, and profitability (Alam *et al.,* 2007; Manisha *et al.,* 2021). Each stage presents limitations across various methods, including manual labour, animal power, and tractor-based tools. Seedbed preparation relies on manual labour or animal-drawn implements, resulting in slow progress, limited area coverage, and potentially uneven tilth, while tractor-powered solutions offer faster coverage but come with drawbacks such as high initial investment, fuel dependence, and risk of soil compaction (Kumar *et al.,* 2023). Despite the potential for faster coverage, tractor-powered solutions come with their own set of drawbacks, including high initial investments, dependence on fuel, and risks of soil compaction (Mehta *et al.,* 2014; Kumar *et al.,* 2023). Similar challenges persist during sowing, crop protection, and harvesting stages, exacerbating issues related to accuracy, effectiveness, and labour intensity. Moreover, beyond these individual stages, concerns such as access to water, irrigation efficiency, and post-harvest handling further compound the complexities of seed spice cultivation. To address these multifaceted challenges and ensure the sustainable success of seed spice cultivation, it is imperative to explore innovative solutions, including improved tools, mechanization tailored to specific crops, and the adoption of sustainable practices. Additionally, investing in research for resilient crop varieties and providing education and training for farmers on modern farming techniques will be essential for overcoming these hurdles and driving positive changes in the industry.

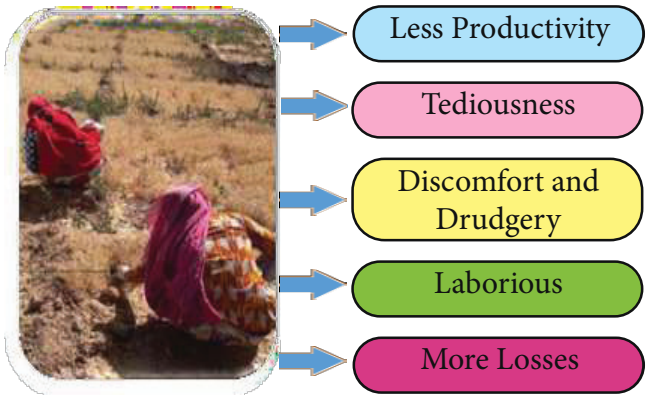

Fig.6. Challenges in conventional methods of seed spices crops cultivation

Scope of advanced technologies in cultivation of seed spice crops

Traditional seed spice cultivation faces numerous limitations, impacting efficiency, quality, and sustainability. Advanced technologies, including driverless systems and robotics, offer a ray of hope, holding immense potential to revolutionize various stages of the cultivation process, from seedbed preparation to harvesting and beyond. Enhanced precision and efficiency are achieved through techniques like precision agriculture, where driverless tractors, robotic planters, and drone-based soil analysis promise pinpoint accuracy in seedbed preparation, sowing, and resource management, optimizing yield and minimizing waste (Iida et *al.,* 2013; Silwal *et al.,* 2017; Xiong *et al.,* 2020; Oscar *et al.,* 2023). AI-powered solutions further enhance precision, with seed drills guided by AI algorithms and robotic weeders equipped with image recognition ensuring optimal seeding depth, targeted weed control, and reduced reliance on herbicides (Wu *et al.,* 2020; Singh *et al.,* 2015). Additionally, deploying teams of small

robots for tasks like weed control, irrigation, and data collection through swarm robotics offers efficient solutions while minimizing soil disturbance (Zhang *et al.,* 2022; Sharifnasab *et al.,* 2023.). Sustainable practices and environmental protection are furthered by wireless sensor networks enabling real-time monitoring of soil moisture and nutrient levels, facilitating precision irrigation and reducing water waste and environmental impact. Moreover, drone-based spraying allows targeted application of pesticides and fungicides, minimizing environmental impact and ensuring optimal pest control compared to traditional methods (Yallappa *et al.,* 2017; Subramanian *et al.,* 2021; Zhang *et al.,* 2023; Abbas *et al.,* 2023). Utilizing natural enemies of pests delivered by drones or robots offers a sustainable alternative to harmful chemicals, promoting ecological balance. Improved quality and reduced losses are achieved through robotic harvesters equipped with advanced grippers and sorting mechanisms, selectively harvesting mature seeds, minimizing damage, and ensuring consistent product quality (Iida *et al.,* 2013; Silwal *et al.,* 2017; Xiong *et al.,* 2020). Additionally, AI-powered drying and storage systems optimize drying parameters and storage conditions based on sensor data and machine learning, minimizing post-harvest losses and preserving spice quality. Despite the vast scope of advanced technologies, challenges such as initial investment costs, infrastructure development, and access to skilled personnel remain. Collaborative efforts between researchers, farmers, policymakers, and technology developers are crucial to overcome these hurdles and make these advancements accessible and affordable for the seed spice sector. Embracing these innovations has the potential to transform seed spice cultivation into a more efficient, sustainable, and productive endeavor, ensuring the long-term success of this vital agricultural sector while safeguarding the environment and human well- being.

Conclusion

The adoption of advanced technologies holds immense potential for transforming seed spice cultivation in India. Significant improvements in efficiency, production, and sustainability could be accomplished by addressing the limitations of conventional farming methods and adopting novel technologies such as autonomous systems, robots, and precision agriculture. However, challenges such as initial investment costs, infrastructure development, and access to skilled personnel must be overcome through collaborative efforts between stakeholders. Through the integration of advanced technologies and sustainable practices, the seed spices sector can thrive, ensuring the continued success of this vital agricultural industry while safeguarding the environment and supporting the livelihoods of farmers.

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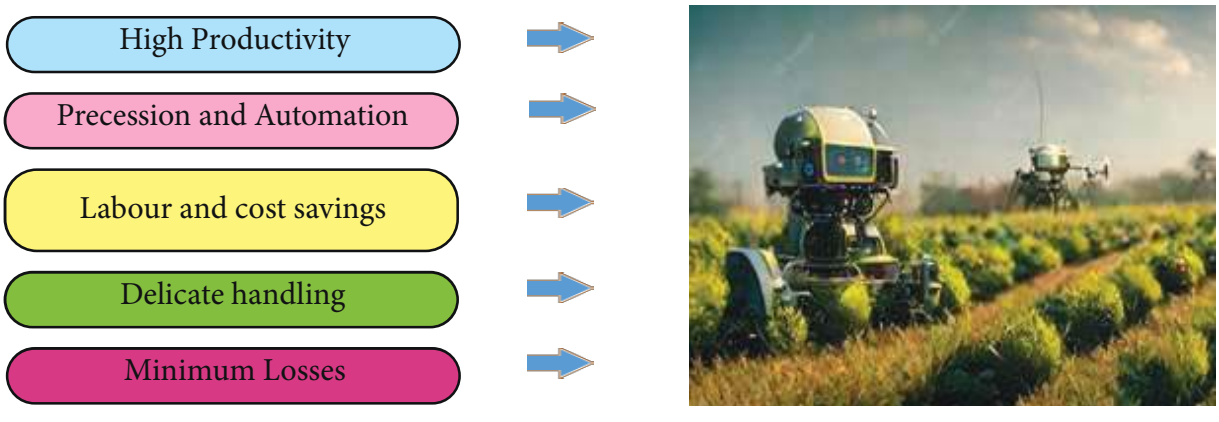

Fig.7. Scope of advanced technologies in seed spices crop cultivation

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IMPORTANCE AND CULTIVATION OF BYADAGI CHILLI (*Capsicum annuum* L.) IN KARNATAKA - AN OVERVIEW

Srinivasappa, K. N. and Pallavi Wani*

Spices are used for the seasoning of foods, among them, Chilli is one important spice used all over the world in one form or the other. Chilli (*Capsicum annuum* var. *annuum*) belongs to the genus capsicum under the solanaceae family with chromosome number 2n = 24. Chilli is the most important spice and commercial crop of India due to its pungency, taste, appealing colour and flavor as a spice. Chillies are native of Peru and Mexico. The pungency is due to alkaloid capsaicin. It is also grown for industrial purpose for extraction of oleoresin. Green fruit of chilli is one of the richest sources of anti-oxidant and vitamin – C. Pungency in chilli is present in placenta and pericarp of fruit.

India is the world's top producer and exporter of chilli. The major chilli producing states in India are Telangana, Karnataka, Madhya Pradesh, Orissa, Gujarat, Assam, Punjab, Rajastan, Uttar Pradesh and Mizoram. Approximately 33 per cent of India's entire chilli production comes from Telangana. The prominent types of chilli cultivated in India are Kashmiri, Guntur, Jwala, Byadagi, Boria, Sankeshwar, Naga and Bhut Jolokia, Mathania, Bhavnagri, Kanthari, Longi, Ramnad Mundu, and Fhani.

In India, due to continuous cultivation of *Capsicum sp.* for about 500 years and the crop being often cross pollinated, number of landraces has been evolved. Among landraces, Byadagi chilli for colour and Naga Jalokia for pungency have gained popularity with potential industrial importance. One popular species of chilli that is grown in Karnataka is Byadagi. Byadagi chilli, named after town Byadagi in Haveri district, is grown in Dharwad, Gadag, Bagalkot, Belagavi, and parts of Chitradurga, Davangere, and Chikkamagaluru districts. The Byadagi chilli has demand in the food, cosmetics, beverages, pharmaceuticals, and textile industries. It is also exported as oleoresin to the US, Europe, and West Asian countries (Reddy and Ponnam, 2023).

Byadagi chilli

Byadagi chilli is a famous variety of chilli grown in Karnataka state. The Byadagi chilli plant grows to a height of 1 m with a spread of 1 m. Leaves are thin and light green in colour. It is a branching type. Fruits attain deep red colour on maturity and develop wrinkles on the surface. Byadagi chilli is a long (12-15 cm) and thin, bright red variety of chilli characterised by wrinkles on the pods. Byadagi chillies are famous for its aroma and deep red colour. Byadagi chillies have the highest colour values of 80-130 ASTA colour units. Byadagi chillies have mild pungency and moderate seed content. The capsaicin (which gives hot and spicy kick to chillies) content of Byadagi chillies varies from 0.8 to 1.3 per cent. Byadagi chillies have been tagged with Geographical Indication (GI application No. 129) product of Karnataka. There is huge demand for oleoresin extracted from Bydagi chillies across the globe especially USA, Japan and European countries. Apart from oleoresin, there are more than 25 industries in Byadagi that produce powder and supply to several masala manufacturers and now Byadagi area is known for several small-scale industries based on chilli cultivation providing lot of employment opportunities. The GI status will help to get higher prices and high net income to the farmers and also at international market.

Chilli yield ranges from 0.5 to 1.25 MT/ ha in the districts such as Bellary, Raichur, and Gulbarga where Guntur variety was cultivated previously, have switched to growing Byadagi variety chillies, which has higher oleoresin content and an optimum yield ranges from 3.75-5.00 MT/ha.

Varieties of Byadagi chilli

There are mainaly two varieties of Byadagi chillies grown. They are, Byadagi Kaddi and Byadagi Dabbi.

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Fig. 1. Matured and dried Byadagi chillies

Byadagi Dabbi

The Byadagi Dabbi is suitable for green as well as dry chilli purpose. The fruits are of medium length (8-10 cm), a little curved at the apex and slightly bulged at the base of the calyx (Fig.2a). This variety possesses the highest colour value and mild in pungency. It is more susceptible to pests and diseases.

Byadagi Kaddi

The Byadagi Kaddi (*Capsicum annum* var. *Acuminatum Fing*) has a fruit length of 10-15 cm with negligible pungency. It is slender, linear, light green in colour, and the colour turn to deep red at maturity and develops the characteristic wrinkles at the ripening stage. This variety possesses the highest colour value (Fig 2b). It has its calyx covering its pod, and is reasonably resistant to pests and diseases.


Fig. 2a. Byadagi Dabbi


Fig. 2b. Byadagi Kaddi

Area and production

India contributes around 43 per cent of world chilli production. India is the largest producer of chilli crop, which is grown over an area of 7.32 lakh hectares with an annual production of 19.88 lakh tonnes with the productivity of 2716 kg/ha (Anon, 2021). The important states growing chilli are Andhra Pradesh, Karnataka, Orissa, Maharashtra, West Bengal, Rajasthan and Tamil Nadu. Karnataka ranks second in area with 1.67 lakh hectares and Production of 1.06 lakh tonnes of dry chilli after Andhra Pradesh. (Anon, 2021). Northern Karnataka is an important chilli growing area and it is highly concentrated in the districts like Dharwad, Gadag, Haveri, Koppal, Bellary, Raichur, Kalaburagi and Belagavi. The districts of Bellary, Dharwad and Haveri contribute to 46 per cent of the State's area and 38 per cent of the State's production.

India leads in Chilli exports

India is the only country where many varieties of chilli with different quality factors are grown and it earns tremendous foreign exchange by the export of chilli, oleoresin (of low, medium or high pungency) and chilli powder. Among different chilli cultivars Byadagi, a local land race is the most popular variety known for its mild pungency, fruit colour, aroma, oleoresin content and other characteristics. These properties have made it an exportable produce across the globe. As per the estimates, the export of chilli from India was 81 thousand crores, of which Karnataka exports 49.18 crores (DGCIS, 2022). Nearly 75 per cent of Byadagi chillies sold in the market are exported in either direct or indirect forms mostly to Europe, America and Middle East countries.

Export: Byadagi chilli traders of Karnataka are mainly supplying Byadagi chilli to the leading exporters located at Cochin, Kerala and in turn, after value addition, products like Paprika Oleoresin are exported. There is huge demand for

oleoresin extracted from Byadagi chillies across the globe especially USA, Japan and European countries.

Importance of Byadagi chillies

Chilli from India is highly regarded for its rich colour and degree of pungency worldwide. Pungency and color are the two primary features that determine the quality of chilli fruits. Capsaicinoids are a vital class of phenolic compounds found in members of the Capsicum genus. Capsaicin is extensively employed as both a flavor enhancer and preservative in food formulations. Additionally, it serves as an active component in packaging film and functional food applications (Rezazadeh *et al.,* 2023). Red chilli has been considered as a very good source for natural carotenoids. Coloring compound in byadagi chilli due to capsanthin is a natural red dye of the xanthophylls class of carotenoids and it is the most crucial carotenoid pigment. Due to its potent antioxidant effects, capsanthin has been shown to have various health benefits, including chemopreventive, antitumor, skin photoprotective, anti-inflammatory, and anti-diabetic properties (Kennedy *et al.,* 2022).

Byadagi chilli is mainly consumed as ground spice powder in many Indian foods. Byadagi chilli is preferred in many preprations such as pickles, masala products, chutney and chilli powder as it allows bringing out the best colour naturally.

Byadagi chilli is heavily used in extraction of oil called oleoresin. Oleoresin is concentrated form of the spice consisting of the volatile essential oil and the non-volatile resinous fraction representing the flavour and taste of the spice. They are obtained mainly by solvent extraction from the spice. About 50 litre of oleoresin can be extracted from about 1 metric tonne of chillies. The oleoresin is used as colouring agent in production of cheese, sauces, spice mixtures, *etc.* It is also used in confectioneries, cosmetic industry, beverage industry for toning of fresh wine, meat industry, pharmaceutical industry, poultry and cattle feed industry and as a dye in textile industry.

Market Potential

Dry chilli farming is more beneficial than green chilli farming because there is still a strong market demand for it. Byadagi chillies are dried and processed by growers are typically sold in gunny bags weighing 30-40 kg. Dried Byadagi chillies are available in a variety of types in the market, including Byadagi chillies with stems, Byadagi chillies without stems, crushed dried red chilli flakes and dried red chilli powder. The dried whole chilli (with and without stem), chilli powder (ground and crushed), chilli paste, chilly chutney and chilli seeds are all products of the Byadagi chilli. It is still in high demand in the oleoresin industries.

The oleoresin manufacturers in international (Sri Lanka, Bangladesh, America, Europe, Nepal, Indonesia, Mexico) market are using Byadagi chillies as a substitute for paprika. The traders are mainly supplying Byadagi chilli to the leading exporters located at Cochin (Kerala), Tamil Nadu, West Bengal and in turn, after value addition, product like Paprika Oleoresin is exported.

Quality of Byadagi chilli

The name Byadagi is associated with Byadagi Chilli with its deep red color with (American Spice Trade Association or ASTA) color unit values of 160 to 300 and thus has higher color compared to any other type of chilli in India. The chilli is wrinkled and the quality also depends upon the wrinkled chillies, the higher the wrinkle, higher is the quality. Thus, the price offered for red chilli is associated with ASTA color units and higher the ASTA color unit, higher is the price. When compared with other chilli varieties, the use of plant protection chemicals for Byadagi chilli is low. With the modest content of capsaicin, its relatively low pungency, unique flavor, as also having the GI tag (129), the Byadagi chilli, has high demand for both as spice and as oleoresin (Hiremath *et. al.,* 2020). The oleoresin (oil) from Byadagi chilli is popular and used in cosmetics, food preparations, in pharmaceuticals *etc.* Seeds of chilli are rich in oil (16-25 %) which is profound in linoleic acid (68-72 %) and palmitic

acid (13-15 %) content. Seed oil has various applications in healthcare and anti-aging. Capsaicin and other capsaicinoids have a vast clinical and pharmacological application due to strong biological activity for the treatment of neurological and musculoskeletal pain, and oxidative and inflammatory disease situation (Poornima *et. al.*, 2024).

long raised beds of one metre width with 30 cm wide with drinage channels in between the beds or by pro-tray method. The seed rate for Byadagi chilli for transplanting is 1.0-1.25 kg/ha. 40-45 days old seedlings are transplanted on raised beds, during the months of May-June at the spacing of 60 ×60 cm.

Fig. 3. Oleoresin extraction from dry chilli

Crop Cultivarion

Geographical Requirements

The Byadagi chilli crop requires a warm and humid climate during the growing period and dry weather during the period of maturation of fruits. Byadagi chilli can be grown in varied soil types but well drained loamy soils (black and red lateritic soils rich in potash having a pH of 5.5-6.5) is ideal. Byadagi Chilli can be grown in tropics and sub tropical regions receiving 500 – 800 mm annual rainfall. The ideal temperature requirement between 20–38° C with warm humid conditions which improve the growth while dry conditions enhance maturity.

Planting methods

Transplanting is the most common method of sowing Byadagi chillies although direct sowing in lines is followed under rainfed conditions. In direct sowing, seeds are sown on a well prepared field during the end of March to first 2 weeks of April with the seed rate of about 2.5 kg/ha. The gap filling and thinning operations are conducted 4-5 weeks after sowing. In transplanting of seedlings, seeds were grown in the nursery on conveniently

Yield and quality of chilli can be enhanced with the use of improved cultivation practices such as mulching, drip irrigation and fertigation, use of integrated pest and disease management.

Harvesting

The flowering of Byadagi chilli commences 40 days after transplanting with a peak flower production from 60 to 80 days after transplanting. There are 2 peaks of flowering in Byadagi chillies at 50 and 70 days of transplanting. On an average, Byadagi chilli produces about 200 flowers per plant. Harvesting season for Byadagi chillies starts from November to January. The fruits are plucked by hand in the ripe or nearly ripe stages along with the fruit stalks at regular intervals. The fruits are generally picked when they turn bright red colour. The number of pickings varies from 6-10 distributed over a period of 3-4 months. Harvesting should be done at the right stage of maturity and it depends on the market need. Fully grown immature chillies are harvested for selling freshly harvested chillies (vegetable purposes) in local market. Fully mature red chillies are harvested for canning purpose. Fully matured red chillies are harvested for canning purpose.

Fully matured ripe dry fruits are harvested for making powder.

India is the only country where many varieties of chilli with different growing conditions are prevailing for quality production and it earns tremendous foreign exchange by the export of chilli, oleoresin and chilli powder. Among different chilli cultivars Byadagi, a local land race

Fig. 4. Byadagi chillies after harvest at the farm

is the most popular variety known for its mild pungency, fruit colour, aroma, oleoresin content and other good characteristics.

Challenges for Byadagi chilli

The Murda leaf curl disease has intensified in conventional areas of Byadagi chilli thereby reducing the area under chilli substantially in Karnataka. The chilli leaf curl complex (Murda complex) is caused by leaf curl gemini virus (CLCV) transmitted by chilli mite (*Polyphagotarsonemus latus*), whitefly (*Bemisia tabaci*) and thrips (*Scirtothrips dorsalis*) and the

Fig. 5. Leaf curl infected plant

control measures are complicated as more than one agent is involved in causing and spreading the disease (Reddy *et.al.,* 2014).

Summary

Byadagi chilli is commercial spice crop having wide industrial applications. Development of good agricultural practices specific to areas of cultivation will help in sustainable chilli production. Byadagi chilli is preferred as it allows bringing out the best colour naturally and at the same time, avoiding their products being too pungent for consumption. Achievements made so far in chilli improvement and furthur multidisciplinary approaches will help in transforming chilli cultivation into more sustainable and economical way to keep Indian chillies at pride globally.

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A PATENTED GINGEROL PRODUCT FROM KAU GINGER VARIETY KARTHIKA

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An Indian patent is granted to Kerala Agricultural University and Arjuna Natural Private Ltd., Aluva for developing a stable gingerol product from the ginger variety "Karthika" released from Kerala Agricultural University. This patent is the outcome of a collaborative research project undertaken by KAU and Arjuna Natural, a leading manufacturer of plant-based active compounds, with funding from the Department of Biotechnology, Biotechnology Industry Research Assistance Council, Govt. of India, New Delhi. The research project was undertaken at the Centre for Plant Biotechnology and Molecular Biology, College of Agriculture, Vellanikkara from 2014-2017.

Ginger finds a wide range of applications in traditional medicine and also in the nutraceutical and health food industries. Of the various bioactive compounds present in ginger, gingerol is the most potent and pharmacologically active compound and possesses anti- inflammatory, analgesic, antidiabetic, antipyretic, gastroprotective, cardiotonic and antihepatotoxic activities. Low recovery of gingerol from raw materials and non-stability of gingerol in the final product are the problems faced by the industry involved in product development with gingerol.

Kerala Agricultural University has released a high gingerol variety "Karthika" in 2010. The variety is a single plant selection from somaclones of cultivar Maran, ideal for cultivation both as pure and intercrop, tolerant to soft rot and bacterial wilt diseases. The average fresh yield is 19T/ha with a potential of 27T/ha. The dry recovery is 21.6 per cent with an oleoresin yield of 7.2 per cent, of which 21.3 per cent is gingerols. The purity of gingerol in the variety is good for developing a stable gingerol product with 8-9 per cent total gingerol.

The patent has been granted for the stable dry gingerol product in powder form and for the process of developing the product, for a period of twenty years commencing from 17/5/2018. The process consists of making purified oleoresin from Karthika dry ginger rhizomes, removing shogaols from the purified ginger oleoresin to obtain gingerol enriched extract with 80-90 per cent total gingerol and further converting the extract to dry powder form with 8-9 per cent total gingerol by weight and less than 1.0 per cent shogaol by weight. With the development of a new stable dry gingerol product in powder form from the variety Karthika, the problems faced by the industry in product development could be rectified and also, the cost of production of standardized gingerol composition could be reduced.

The developed product if commercialized, can be used as a nutraceutical / pharmaceutical ingredient which has high market potential in India and abroad. For commercialization of the product, dry ginger of the high gingerol-yielding variety Karthika is required in bulk quantities without any pesticide residues. Good Agricultural Practices (GAP) have to be followed in cultivation to produce quality clean dry ginger. Once the product is commercialized, there will be a sustainable income for farmers /SHGs/FPOs involved in the production process and for the industry and institution.

The leading scientists involved in the development of the product are Dr. M. R. Shylaja from KAU and Dr. Merina Benny from Arjuna Natural Private Ltd. Other scientists involved in the research are Dr.Samuel Mathew, Dr. P. A. Nazeem, Dr.Benny Antony and Dr. E. V. Nybe.

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सेलरी – पंजाब की परिस्थितियों में मुख्य सस्य क्रियाएँ

रजिन्दर कुमार, अमनप्रीत और तायशी तोलमा*

अजमोद (सेलरी) एक वार्षिक और बारहमासी पौधा है। इसका वैज्ञानिक नाम *एपियम ग्रेवोलेंस* एल है जो एपियासी परिवार से संबंधित है। इस परिवार को अमबलीफेरी भी कहते है। अजमोद (सेलरी) एक बहुमूल्य जड़ी–बूटी वाला सुगंधित पौधा है। ऐसा माना जाता है कि पहली खेती भूमध्यसागरीय क्षेत्र में हुई थी। सेलरी को पंजाब में आमतौर पर करनौली कहा जाता है। पंजाब सेलरी बीज उत्पादन में न केवल भारत में बल्कि वैश्विक स्तर पर प्रसिद्ध है। पंजाब राज्य में सेलरी की खेती लगभग 4568 हैक्टेयर जमीन पर की जाती है। पंजाब में सेलरी मुख्य रूप से अमृतसर, तरन–तारन, गुरदासपुर ज़िलों में और पटियाला ज़िले के कुछ हिस्सों में ही इसकी पैदावार की जाती है। सेलरी को यहाँ मुख्य रूप से बीज उत्पादन के लिए ही लगाया जाता है। इनकी कीमत इनसे निकलने वाले आवश्यक तेल पर निर्भर करती है। जिसकी मात्रा 2–3 प्रतिशत होती है। इस तेल को विभिन्न प्रकार की औषधियों में प्रयोग किया जाता है। सेलरी को आम तौर पर एक सब्जी के रूप में बीजों, ओलियोरेसिन और आवश्यक तेल के लिए उगाया जाता है।

यह पौधा अपने विभिन्न जैविक गुणों के साथ प्राकृतिक रूप से पाए जाने वाले सक्रिय पदार्थों के एक महान स्रोत के रूप में कार्य कर सकता है। यह परिसरीय पौधा विभिन्न मौलिक बायो–सक्रिय घटकों में समृद्धि करता है, जैसे कि फ्लैवोनॉइड्स, फेनॉलिक एसिड, फ्यूरोकुमेरिन्स, टरपेनॉइड्स और फ्थालाइड्स, जो कई स्वास्थ्य लाभ प्रदान करते हैं। फ्थालाइड्स को सेलरी की खास खुशबू को उत्पन्न करने के लिए जिम्मेदार माना जाता है। सेलरी में उच्च रक्तचाप, एंटीऑक्सीडेंट, एंटी–कैंसर, एंटी–इन्फ्लेमेटरी, एंटी–रेडमेटॉइड, एंटी–डायबिटीज और न्युरो प्रोटेक्टिव गुण होते हैं। ये गुण सेलरी को स्वास्थ्य के लाभकारी बनाते हैं और इसे आयुर्वेदिक और प्राकृतिक चिकित्सा में महत्वपूर्ण भूमिका देते हैं। सेलरी की पत्तियों में पोटैशियम, केल्शियम, मैग्नीशियम और आयरन जैसे खनिज होते हैं। इसलिए सेलरी की पत्तियों को सलाद के रूप में खाने से शरीर में खनिज तत्वों की आवश्यकताओं को पूरा किया जा सकता है। सेलरी का रस प्राकृतिक तौर पर लीवर और किडनी को शुद्ध करने के रूप में माना जाता है, साथ ही तंतु और एड्रिनल ग्रंथि का समर्थन करता है; रक्त शुद्धिकरण करता है, रेयूमेटिक और गाउट के खिलाफ सहायक है, एंटीसेप्टिक गुण रखता है, और खासकर उन व्यक्तियों में रक्तचाप को नियंत्रित करने में मदद करता है जो हाइपरटेंशन से पीड़ित हैं। सेलरी का रस आपके आहार में शामिल करना बेहतर स्वास्थ्य के लिए सकारात्मक योजना हो सकता है। सूखे और पके हुए सेलरी के बीजों का उपयोग विभिन्न खाद्य और पेयों के स्वाद को बढ़ाने के लिए एक मसाला के रूप में किया जाता है। ये बीज उत्तेजक और कार्मिनेटिव गुण रखते हैं और इन्हें पारंपरिक चिकित्सा प्रणालियों में एवंम् नर्व टॉनिक के रूप में उपयोग किया जाता है। इस के साथ–2 सेलरी बीज तेल को विभिन्न व्यंजनों में स्वाद बढ़ाने के लिए और सुगंध और फामस्युटिकल सेक्टर में उपयोग किया जाता है।

सेलरी के बीज और इससे बने पदार्थ यूरोपीय राष्ट्रों में उच्च मांग में हैं, जहां वे चिकित्सा उत्पादों में प्रमुख रूप से उपयुक्त हैं, सेलरी की खेती किसानों के लिए एक लाभकारी प्रयास हो सकती है, जिससे उनकी अधिक आय की संभावना बढ़ जाती है। इसके अतिरिक्त, इसकी खेती देश की विदेशी मुद्रा भंडार में सार्थक योगदान कर सकती हैं उन्नत सस्य क्रियाओं का अधिग्रहण करने से सेलरी की उपज में और भी वृद्धि हो सकती है, जिससे किसानों को अधिक आय हो सकती है।

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जलवायु और भूमि की आवश्यकताऐं

यह ठंड में फलने फूलने वाली फसल है और मुख्य रूप से पंजाब में रबी मौसम के दौरान उगाई जाती है। अच्छे पौध विकास एवं पुष्पन के लिए मध्यम ठंडा एवं शुष्क जलवायु इसकी कृषि के लिए अनुकूल होता है। सेलरी को धारित (Clay), उर्वर और 6 से 7 पी एच के बीच की दोमट मृदा, जिसमें उचित जल निकास एवं पर्याप्त जैविक मात्रा इसकी खेती के लिए उपयुक्त है। विपरीत, वे मिट्टियाँ जो खारी, क्षरीय हों या जलभराव की संभावना हो, उन्हें सेलरी की खेती की दृष्टि से अनुकूल नही माना जाता।

उन्नत किस्में

पंजाब सेलरी 1: सेलरी की यह किस्म अधिक उत्पादन देने में सक्षम है। इसका उत्पादन 12–13 क्विंटल प्रति हैक्टेयर तक होता है। इसके बीच में आवश्यक तेल की मात्रा 1.9 प्रतिशत है और कुल तेल की मात्रा 20 प्रतिषत होती है। ये बीज भूरे रंग, विशेष गंध और तेज स्वाद से विशिष्ट होते हैं। इस किस्म को मार्च महीने में सफेद फूल आने शुरू हो जाते हैं और रोपाई करने के लगभग 140–150 दिन के आसपास पक कर कटने के लिए तैयार हो जाती है।

सब्जी मटर + सेलरी की रिले क्रॉपिंग– पिछले वर्ष की सेलरी की फसल के गिरे हुए बीज अगले वर्ष स्वयं ही खेत में उग आते हैं। संक्षेप में, अगर संकुचित अवधि (short duration) की मटर की बात है तो सुझाव है कि इन प्राकृतिक रूप से उगे हुए सेलरी पौधों को खेत में संरक्षित रखें। इसके लिए, पिछले वर्ष की सेलरी के खेतों में 60 सेंटीमीटर की ऊँचाई की मेड़ो (ridges) पर दो पंक्तियाँ मटर बोएं।

एक से 2 बार (1–2) मटर की हरित फलियां तोड़ने (picking) के बाद जब पौधा उखाड़ लिया जाए तो सेलरी की एक गुड़ाई कर दें। मूल्यांकन करे कि पौधों की संख्या अधिक है या क्या किसी जगह को भरने की आवश्यकता है, और यदि आवश्यक हो, तो पर्याप्त पौधों की संख्या को सुनिश्चित करें। इसके पश्चात् सिंचाई कर दें। मिश्रित खेती में जहां मटर और सेलरी दोनों हैं, पहले मटर के लिए जरूरी सस्य क्रियाऐं करें। तत्पश्चात् मटर के पौधों को उखाड़ने के बाद, सेलरी के लिए शश्य क्रियाऐं की जाये।

नर्सरी के माध्यम से फसल उत्पन्न करना

बीज की मात्रा एवं नर्सरी की बिजाई– सेलरी की खेती के लिए एक अन्य तकनीक भी है जिसमें नर्सरी से उगाए गए पौधों को खेत में प्रत्यारोपण किया जाता है। स्वस्थ और समरूप पौधे एक भरपूर (प्रचुर) उपज हासिल करने के लिए आवश्यक होते हैं। जो कि विकास और समकालिक परिपक्वता के लिये आवश्यक होती है। नर्सरी बोने के लिए सही समय सितंबर के मध्य से अक्टूबर के मध्य तक है। एक हेक्टेयर क्षेत्र के लिए पर्याप्त पौधे उगाने के लिए लगभग 1 किलोग्राम बीज की आवश्यकता होती है।

नर्सरी की तैयारी

सेलरी की नर्सरी उगाने के लिए एक अच्छी उर्वरा षक्ति, खरपतवार मुक्त और समतल भूमि का चयन करें। मिट्टी को अच्छे स्तर पर लाने के लिए 4–5 बार हल के साथ जुताई करें और जुताई के बाद पाटा चलाएं। सेलरी की पनीरी तैयार किए गए नर्सरी बैड़ों पर लगाई जाती है। बैड़ आम तौर पर 8 मीटर लम्बाई x 1.25 मीटर चौड़ाई (10 मीटर^2) के बनाएं। एक हेक्टेयर के लिए ऐसे 20 बैड़ों की जरूरत रहती है। सिंचाई के लिए प्रत्येक बैड के दोनों तरफ छोटी–2 नाली बनाएं। अच्छी सिंचित नर्सरी के लिए प्रति बैड़ 20–25 किलो अच्छी तरह से सड़ी हुई गोबर की खाद या कम्पोस्ट डालें। इसके साथ 75 ग्राम कैलशियम अमोनीयम नाईट्रेट (CAN) या 40 ग्राम यूरिया और 75 ग्राम सिंगल सुपर फासफेट डालें। इन्हें मिट्टी में अच्छी तरह से मिला लें। प्रत्येक बैड़ में 50 ग्राम सेलरी का बीज बोएं और इसे गोबर खाद और मिट्टी के मिश्रण की पतली परत से ढक दें। बिजाई के तुरंत बाद फुहारे से सिंचाई कर दें। शीर्घ और स्वस्थ अंकुरण को प्रोत्साहित करने और खरपतवार को उगने से रोकने के लिए प्रत्येक बैड़ पर 4–6 किलो धान की पराली से मल्चिंग करें। पराली को

5–10 दिन बाद (उपरांत) जब बीज अंकुरण शुरू हो जाए तो हटा दें। इसके 15 दिन उपरांत 100 ग्राम (CAN) किसान खाद या 55 ग्राम यूरिया प्रति बैड़ डाल दें। यदि पौध का विकास रूका हुआ या कम दिखता है, तो लगभग एक महीने के बाद प्रत्येक बेड के लिए 100 ग्राम किसान खाद या 55 ग्राम यूरिया की एक अतिरिक्त मात्रा डाल दें। पौध 60–70 दिन में प्रत्यारोपण के लिए तैयार हो जाएगी। सामान्य विकास के लिए नियमित अंतराल पर सिंचाई प्रदान करें और नर्सरी को खरपतवार से मुक्त रखने के लिए सावधानीपूर्वक देखभाल करें।

रोपाई का सही समय व विधि

सेलरी के पौधों को नवंबर के मध्य से दिसंबर के अखिर तक प्रत्यारोपण (स्थापित) किया जा सकता है। उखाड़ने से पहले और रोपाई के दिन नर्सरी को हलकी सिंचाई प्रदान करना सुझावित है ताकि पौधों को प्रतिस्थापन के दौरान जड़ों की क्षति से बचाया जा सके और रोपाई के बाद खेत में सफलतापूर्वक चल जाएं।

स्वस्थ विकास और समरूप परिपक्वता को बढ़ावा देने के लिए सुनिश्चित करें कि आप समान आकार और आयु के स्वस्थ पौधे प्रतिस्थापित कर रहे हैं। रोपाई के लिए पंक्ति से पंक्ति की दूरी 45 सेंटीमीटर रखें ओर पौधे से पौधे की दूरी 25 सेंटीमीटर बनाए रखें। अगर रोपाई पश्चात् कोई पौधे न चले (मर जाएं) तो उन रिक्त स्थानों को तुरंत तंदरूस्त पौधों से भर दें ताकि अधिकतम पौधों की घनता सुनिश्चित हो।

उर्वरक डालने की विधि

ध्यान रहे रासायनिक उर्वरक मिट्टी परीक्षण के आधार पर ही उपयोग करें। यदि मृदा परीक्षण की रिर्पोट उपलब्ध नहीं है और मध्यम उर्वरता की मिट्टी है तो प्रति हेक्टेयर 100 किलोग्राम नाइट्रोजन और 40 किलोग्राम फास्फोरस खेत में डाले। पौधों को रोपाई के समय, नाइट्रोजन की आधी मात्रा और पूरा फास्फोरस डाल दें। बचा हुआ आधा नाइट्रोजन, रोपण के 45 दिन और 75 दिन के बाद दो बराबर हिस्सों में खेत में डाल दें।

खरपतवार नियंत्रण

सेलरी के प्रारंभिक धीमे विकास और पंक्तियों और पौधों के बीच अधिक दूरी होने के कारण खरपतवार शीघ्र पैदा हो जाते हैं और बढ़ने लगते हैं। अगर यह अनियंत्रित रहें तो उपज और फसल की गुणवता दोनों को कम कर सकते हैं। इस समस्या का समाधान करने के लिए यह आवश्यक है कि 2–3 बार निराई करें और पहिऐ वाली निराई यंत्र (व्हील हैंड हो) का प्रयोग करें।

सिंचाई प्रबंधन

सेलरी का पौधा पर्याप्त नमी भरी स्थितियों में अच्छी तरह से फलता है, लेकिन अधिक जल स्थिरता इसकी वृद्धि में रूकावट डाल सकती है। पौधों को अच्छी तरह से स्थापित करने के लिए पहली सिंचाई को प्रत्यारोपण के तुरंत बाद दें। इसके बाद, फसल को नियमित, हल्की सिंचाई प्रदान करें। मिट्टी के प्रकार और वर्षा के आधार पर सिंचाईयों को समायोजित करें। सबसे अधिक संभावित उत्पाद को प्राप्त करने के लिए फूल आने और बीज निर्माण के समय में पर्याप्त नमी का होना महत्वपूर्ण है।

कटाई और गहाई– सेलरी की कटाई का कार्य उपज की संभावित उत्पन्नता के लिए महत्वपूर्ण है। कटाई की विलम्बता से बीज के झड़ने जैसी समस्यों का सामना करना पड़ सकता है। इसके परिणामस्वरूप उपज हानि हो सकती है। फसल कटाई के लिए तब तैयार होती है जब अधिकतम फूलों (umbel) का रंग हल्का भूरा हो जाऐ जो सामान्यतः प्रत्यारोपण से 140–150 दिनों के बाद होता है। बीजों को झड़ने से बचाने के लिए फसल की कटाई प्रातःकाल के समय में ही सुनिश्चित करें। कटाई के तुरंत बाद, पौधों को गहाई वाले स्थान पर पहुँचाएं क्योंकि सेलरी के बीज अत्याधिक हल्के होते हैं, इसलिए इन्हें उच्च हवा वेग के दौरान छटकने और छलने का काम न करें। बीजों को भंडारण से पहले कुछ समय के लिए सुखा लें। उत्पाद को बेचने से पहले वर्तमान बाजार मूल्य की जानकारी प्राप्त करना अनिवार्य है। यदि बाजार मूल्य आशाजनक नहीं है, तो इसे कुछ समय के लिए सुरक्षित रूप से भंडारित किया जा सकता है।

क्रमांक (S.No.)	सेलरी की मूल्य वर्धित सामग्री (Value added material)
1.	बाष्पशील तेल (बीज तेल 2–3%) Volatile oil (seed contains 2-3% oil)
2.	बीज ओलिओरेसिन Seed oleoresins
3.	सेलरी वसायुक्त तेल (बीज वसायुक्त तेल 17–18%) Celery fatty oil (seed contains 17-18% fatty oil)
4.	सेलरी मिर्च (Celery pepper)
5.	सेलरी साल्ट (Celery salt)

स्त्रोत– नेशनल हॉर्टिकल्चर बोर्ड 2021

सेलरी के उपयोग

सेलरी अपने बहुत सारे व्यापक उपयोगों के लिए मशहूर है। सेलरी के पत्ते, डंठल, तना और बीज सभी इसके वाणिज्यिक भाग हैं। लेकिन भारत में सेलरी केवल बीज उत्पादन के लिए ही उगाई जाती है।

पत्ते/डंठल– सेलरी के पत्ते व डंठल मनुष्य की सेहत के लिए बहुत ही फायदेमंद हैं, इन्हें सब्जी के रूप में, जैसे–सलाद, जूस, सूप जैसे कई तरह से खाने में इस्तेमाल किया जाता है। इसके पत्तों में प्रचुर मात्रा में खनिज होते हैं। जैसे कैलश्यिम, फासफोरस और लोहे के साथ–2 बहुत सारे आवश्यक (पोषक तत्व है) विटामिन होते हैं।

बीज– सेलरी के बीज, बहुत छोटे, भूरे से गहरे–भूरे रंग के होते हैं, इनमें तेज़ सुखद गंध होती है। इनका स्वाद गर्म और हल्का कड़वा (तीखा) होता है। आकार में छोटे होने के बावजूद, सेलरी के बीज अत्यधिक पोषण मूल्य वाले होते हैं और कई स्वास्थ्य लाभ प्रदान करते हैं। इन बीजों का उपयोग आमतौर पर खाना पकाने के मसाले के रूप में किया जाता है। सेलरी के बीज कैलोरी में कम होते हैं और वे अपेक्षाकृत समान मात्रा में कार्बोहाइड्रेट्स, प्रोटीन और वसा प्रदान करते हैं।

पूरे बीज विभिन्न उच्च मूल्य उत्पादों, जैसे इसका तेल और ओलिओरेजिन्स, खाद्य और पेय उद्योग में स्वाद बढ़ाने के लिए और इत्र के रूप में उपयोग होते हैं। सेलरी के बीज अपने औषधीय गुणों को अपनी विशिष्ट विशेषताओं से प्राप्त करते हैं।

सेलरी का आवश्यक तेल– सेलरी बीजों का प्रमुख कार्यकारी तत्व सेलरी बीजों का तेल है; जिसे महत्वपूर्ण तत्व के रूप में माना जाता है। यह तेल अपनी श्रेश्ठ गुणवत्ता और अधिक वाणिज्यिक महत्त्व के लिए पसंद किया जाता है सेलरी बीज का तेल एक गरम, तीखा और दीर्घकालीन सुगंध से चरित है। इसका प्रमुख उपयोग विभिन्न भोजनों का स्वाद बढ़ाने में है, जिसमें सूप, मांस, आचार और सब्जी का जूस (रस) शामिल हैं। इस तेल का सौगंधित और औषधि उद्योग में अनुप्रयोग होता है।

सेलरी ओलिओरेन्सि– इसे तरल सेलरी बीज के रूप में माना जाता है, इसे सेलरी का अर्क निकालने और स्वाद मिलावट के पदार्थ के रूप में निर्यात के लिए बीज़ों की तुलना में कहीं अधिक सुगम माना गया है। यह एक हर्बल, हल्का कड़वा स्वाद वाला (Free flowing green liquid) तरल है। और मूल रूप से सेलरी में मौजूद सुगंधित तेल, औरगैनिक सॉल्यूबल रेज़िन और मूल मसाले में मौजूद अन्य संबंधित सामग्रियों से बना है। भारतीय प्रकार का सेलरी ओलिओरेज़िन एक आकर्षक नींबू जैसी सुगंध और सहजीव हर्बल जड़ी–बूटी स्वभाव होने की रिपोर्ट की गई है।

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KING CHILLI: AN IMPORTANT SPICE CROP OF NORTHEAST INDIA

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Introduction

Chilli, a ubiquitous ingredient in Indian cuisine, holds a significant place in the agricultural landscape of the country. India is the world's largest producer and consumer of chillies, contributing approximately 25% to the global production. The North-eastern region of India, in particular, is renowned for its unique variety of chilli known as the "King Chilli." It is also called by different names, in Manipur King Chilli is called *Umorokor Uo-morok*. Chilies, Naga King chilli in Nagaland and Bhut Jolokia in Assam. The King Chilli, also known as the Ghost Pepper, is a cultivar of *Capsicum chinense* and is considered one of the world's hottest chilli peppers. This spice crop thrives in the hilly terrain and favourable climatic conditions of the Northeast, making it an important component of the region's agricultural identity. The cultivation of King Chilli has been a part of the traditional agricultural practices in the Northeast for centuries. The chilli's popularity has only grown over time, with its unique pungency and vibrant colour being highly sought after both domestically and internationally (Singh *et al.*, 2020). India's diverse chilli varieties, including the King Chilli, are a testament to the country's rich agricultural heritage. The cultivation of this spice crop not only contributes to the local economy but also plays a significant role in the culinary traditions and cultural identity of the Northeast. King chilli is classified under the Solanaceae family. King chilli was officially recognized as the hottest chilli in the world by Guinness World Records in September 2006, with a measurement of 1,001,304 Scoville Heat Units. Capsaicin and dihydrocapsaicin are the compounds responsible for pungency in King chilli.

It is short perennial crop and grows to a height of about 1.0-1.5m. King chilli exhibits a remarkable variation in terms of colours, sizes and fruit textures. Colour of King chilli is light green to dark green at immature stage and as they mature, colour change into light red, bright red and even chocolate hues. The texture of these fruits can range from crumpled to semi-smooth, sometimes appearing gloomy with fleshy tissue. The shape of fruit is sub-conical to conical with length of 5-9 cm and width of 2-3 cm. Their surface is characterized by roughness, wrinkles and spikes. It is consumed as fresh vegetable, dried, flakes, powdered form, sauces and pickles.

Fig. 1: King chilli field at Sibilong, Tamenglong district, Manipur

The size of mature peppers ranges from 60 to 85 mm (2.4 to 3.3 in) in length and 25 to 30 mm (1.0 to 1.2 in) in width, and they come in red, yellow, orange, or chocolate colours. The unselected variety of King chilli from India exhibits significant variability, manifesting in diverse fruit sizes and fruit yield per plant. King chilli pods have a distinctive form and an exceptionally thin skin, setting them apart from other peppers. Nevertheless, the red fruit variety can be classified into two distinct types: the fruit with a rough, dented surface and the fruit with

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a smooth surface. The coarse fruit plants exhibit greater height and possess delicate branches, whilst the sleek fruit plants produce a higher quantity of fruit and have a more condensed structure with robust branches. The germination process typically lasts for approximately 7 to 12 days when the temperature is maintained between 32 to 38°C.

King chilli has been employed in diverse medicinal treatments, including alleviating headaches, addressing night blindness, spondylitis, digestive disorders and mitigating chronic congestion. King chilli holds promise for diverse medicinal applications such as pain relief, cancer prevention, weight reduction, gastrointestinal benefits, anti-inflammatory properties, antioxidant activity etc. This makes king chilli for commercial capsaicin extraction with potential utility in pharmaceutical industries. It is not only used as food items but also used as anti-venom for spider and snakes' bites. It is also used as defence spray. The demand for King chilli is exceptionally strong in both domestic and foreign markets because to its intense pungency and alluring aroma.

Cultivation aspects of King Chilli

Soil and climate

The crop is adaptable to several soil types, although it thrives best in deep, well-drained sandy loam or clay loam soil. The soil should possess a substantial amount of organic matter and maintain a pH level between 5.5 and 6.0. It thrives at elevations of up to 1000 meters above mean sea level (MSL). The growth and development of King chilli berries are adversely impacted by water logging and excessive rains.

King chilli thrives well in temperature ranges from 20°C to 30°C. King chilli thrives in monsoon climatic conditions with consistently high humidity levels. The rainfall requirements for cultivation range from 1200 to 4000 mm

Table 1: Morphological characters of king chilli

Characters		Observations
Plant height	:	45–120 cm (17–47 inches)
Stem color	:	Green
Leaf color	:	Green
Leaf length	:	10.65–14.25 cm
Leaf width	:	5.4–7.5 cm
Pedicels per axil	:	2
Corolla color	:	Yellow green
Anther color	:	Pale blue
Annular constriction	:	Present below calyx
Fruit color at maturity	:	Red is the most common, with orange, yellow and chocolate as rarer varieties
Fruit shape	:	Sub-conical to conical
Fruit length	:	5.95–8.54 cm
Fruit width at shoulder	:	2.5–2.95 cm
Fruit weight	:	6.95–8.97 g
Fruit surface	:	Rough, uneven or smooth
Seed color	:	Light tan
1000 seed weight	:	4.1–5.2 g
Seeds per fruit	:	19–35
Hypocotyl color	:	Green
Cotyledonous leaf shape	:	Deltoid

per annum. King chilli requires partial shade for optimum growth and development. Hence cultivation should be done under permanent shade trees or in agro-shade net. The growth and development of King chilli berries are adversely impacted by water logging and excessive rains.

Nursery preparation, sowing and cultivation practices:

The nursery bed is prepared using vermicompost, garden soil, and sand in equal volumes (1:1:1). The process of seed treatment involves subjecting the seeds to hot water treatment at a temperature range of 45-50°C for 30 minutes. After this, any excess water is drained off and the seeds are then treated with either *Trichoderma viridi* or *T. harzianum*, which are dried in a shaded area for 30 minutes. The recommended seeding rate for sowing is 100-200 g/ha. The optimal period for sowing seeds is during the months of December to January. Nursery beds with a width of 1 m can be constructed to a suitable length. Seeds are sown on the well-prepared nursery beds. Subsequently, the beds are covered with hay as a means to retain moisture and inhibit the growth of weeds. The seeds typically undergo germination within a span of 7 to 10 days. The nursery should be watered every other day or when it becomes very dry. Damping off is a disease that occurs at the nursery stage. However, the application of *T. viridi* or *T. harzianum* to the seeds can prevent not only damping off, but also several other diseases.

The field should be thoroughly prepared after ploughing to get a good tilth. It is recommended to apply well decomposed farmyard manure or vermicompost in pits or holes one week before transplanting. It is also important to expose it to sunlight. Transplantation can be carried out between February and April using seedlings that are 1-2 months old. The recommended spacing is 1×1 m^2, allowing for a total of 10,000 plants per hectare. Seedlings should be irrigated promptly after transplantation or might be transplanted on a day with precipitation as needed. Since crops are transplanted during the rainy season, it is necessary to do weeding at the appropriate time.

Plant protection measures and management:

Plant protection methods and management - King chilli is susceptible to various diseases and pests. Anthracnose and fruit rot, which is caused by the fungal pathogen *Colletotrichum capsici*. The twigs undergo necrosis, starting at the tip and progressing lower. The fruits have sunken areas with black edges. Bacterial wilt and Bacterial leaf spot of chilli are caused by the bacterium *Ralstonia solanacearum*. Chilli leaf curl (caused by Tobacco leaf curl virus) is characterised by small-sized leaves, stunted growth, low or no fruit production.

Disease management:

To avoid diseases, the seeds can be treated with *Trichoderma* sp. and *Psuedomonas* sp. at a rate of 10 g/kg of seed. Careful seed selection and use of phytosanitary measures will effectively control chilli infections. Removing damaged plants promptly will effectively manage the spread of the diseases. Wherever the disease is severe, it is advisable to use cultivars that possess disease tolerance. Pruning and eradication of infected plants are effective measures to control the spread of the mosaic virus. To achieve optimal disease management, it is recommended to use a concentration of 10 g *Trichoderma* or *Pseudomonas* sp. per litre of water for spraying. It is advisable to treat the seeds with *Trichoderma* at 10 g/ kg of seeds. Infested plants should be uprooted and burned. To prevent the white fly, which is a vector for viral illness transmission, one can use an early spray of Neem Oil at a concentration of 5ml per litre of water. It is recommended to cultivate the resilient/ tolerant cultivars.

Regarding insect pest management, the prominent insects are aphids, spider mites, and fruit borers. Apply a solution of Neem oil at a concentration of 5 ml/L of water after the fruit has formed to prevent the development of fruit borer larvae and manage the aphid population at the point where it becomes economically significant. Yellow Sticky Traps are highly effective for accurately monitoring the presence of thrips, green hopper, white flies, and leaf miners. To effectively use the yellow sticky cards traps, position them in the field slightly above the canopy, ensuring

they face away from the direction of the wind. Secure the traps on top of bamboo sticks. For a moderate infestation, it is recommended to use 8 Yellow Sticky Traps per 1000 sq. m. In the case of a strong infestation, it is advised to increase the number of traps to 10 per 1000 square meter. Each hectare requires a total of 80-100 traps. Monitor the traps regularly, with a minimum frequency of twice per week.

Harvesting and post-harvest management:

In plain area, the usual peak harvesting time of king chilli is May-July period and in hilly areas harvesting starts from July - September period. When the fruits become fully red or orange, it is ready for harvest. The interval of picking varies from 15-20 days depend up on the climate, growth and development of fruit.

After harvesting the chillies are to be processed immediately to avoid fungal growth. King chillis have a soft texture and with high water content hence its quality deteriorated overtime. Usually, the king chillies are dried under sunlight or by smoking. But at the same time smoking makes the chillies become blackish in colour; thus, reducing the market value of the end product. To overcome this problem some progressive farmers are installed modern dryers to get quality products in a safe and hygienic way. To get 1 kg of dried chilli 7.5 kg of fresh fruits are required. Nowadays dried King Chilli fetches about Rs. 2100/- per kg and quality seed fetch Rs. 30,000/- per kg. These figures clearly show the demand of the product in domestic and international market.

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OVERVIEW OF PROPAGATION IN NUTMEG WITH EMPHASIS ON BIOTECHNOLOGICAL ADVANCES

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Introduction

Nutmeg is an aromatic spice, native to Maluku Island, Indonesia. Scientifically known as *Myristica fragrans,* nutmeg was discovered by the Portuguese in 1512 and the Dutch propagated the importance of its seed. Nutmeg originated from a latin word *nux muscatus,* which means "musky nut" (Gupta and Rajpurohit, 2011). This musky nut has a rich history. It was highly prized in medieval Europe and was a major driver of the spice trade. It played a significant role in colonial expansion and trade routes for its importance in food preparations and medicine. The nutmeg tree produces fruits that contain elongated seeds called nutmeg enveloped in a red aril called mace. Both seeds and aril are part of a special spice preparation called "*Garam Masala*" in Indian cuisine. Indonesia and Grenada are among the top producers of nutmeg. The spice is also grown in other tropical regions, including parts of the Caribbean, India, and Sri Lanka.

Nutmeg is an annual spice cultivated globally for food flavouring, oil application, and traditional medicines (Gupta *et al.,* 2013). It has been recognized for its diverse array of phytochemicals, including essential oils, lignans, and malabaricones from ancient times. These compounds have demonstrated significant pharmacological potential, with recent studies highlighting their tumoricidal, antibacterial, cardioprotective, cytotoxic, and antioxidant activities (Mazzio *et al.*, 2009; Yanti *et al.*, 2008; Kareem *et al.*, 2009; Duan *et al.*, 2009). Recent research shows that its extracts possess antioxidant, superoxide scavenging, cytotoxic, anti-ulcer, and nematicidal activities. However, there is a growing need for a detailed characterization of nutmeg plants for their recognition as crucial medicinal plants in the market (Mishra *et. al.,* 2016).

In 2011, the global export volume of nutmeg seeds and aril reached a high of 15,501 tons (http://www.fao.org/). International trade regulations primarily focus on these products' use as spices in Western countries, ensuring that essential components like steam volatile oil (essential oil), fixed oil, proteins, cellulose, pentosans, starch, resin, and minerals are present (http://www.fao.org/3/x5047E/x5047E0a.htm). Nutmeg cultivation in India holds significant potential due to favourable climatic conditions in certain regions. However, the industry faces challenges including those related to the production of authentic medicinal products. Conventional propagation methods for *Myristica fragrans* are inadequate due to the recalcitrant nature of their seeds, long growth period, and a scarcity of propagules. This inadequacy fails to meet the growing demands of the herbal and pharmaceutical industries. *In vitro* propagation techniques in this regard offer a promising solution for increasing the availability of plant material, ensuring a consistent supply of biomass for medicinal compound production, and providing aid for the conservation of these valuable species to ensure their sustainable use.

Botanical description

Nutmeg is an evergreen tropical tree of the Myristicaceae family, which consists of about 520 species (Herve and Annick, 2003; Christenhusz and Byng, 2016) The nutmeg tree can grow up to 10 to 20 meters (33 to 66 feet) in height, with a dense canopy of dark green, glossy leaves. These leaves are simple, alternate, and elliptical, measuring about 5 to 15 centimetres long. The tree produces small, bell-shaped, pale-yellow flowers, which are either male or female, with male trees usually more abundant than female trees. The

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fruit of the nutmeg tree is a fleshy, pale-yellow drupe, resembling an apricot, which splits open when ripe to reveal a single seed encased in a red aril. The seed is the actual nutmeg spice, while the aril, which is dried and ground, is known as mace. Nutmeg seeds are oval-shaped, about 2 to 3 centimetres long, with a dark brown shell and a lighter brown, mottled interior (Naeem *et al.*, 2016).

Pharmacological importance

Ancient Chinese and Indian medicine include nutmeg oil to treat digestive and nervous system disorders. Nutmeg contains 10% essential oils which give a distinctive sweet fragrance and contribute to its medicinal uses. The essential oils include terpenes and their derivatives along with phenylpropanes like myristicin, safrole, and elemicin (Widelski and Kukula-Koch 2017). The compounds elemicin and myristicin in nutmeg have stimulating and calming effects on the brain. Eugenol, another compound in nutmeg, is used in dentistry to relieve toothache, while nutmeg oil is applied to reduce rheumatic and muscular pain. A decoction made of nutmeg when mixed with honey helps to alleviate gastritis, nausea, and indigestion (Naeem *et. al.*, 2016). Recent research has shown that mace lignin, a component of nutmeg, can be used as a skin-whitening agent due to its ability to inhibit melanin production (United States Patent Hwang *et. al.*, 2015).

Nutmeg contains various compounds known for their antioxidant and health-promoting properties. Nutmeg contains compounds like β-caryophyllene and eugenol (a volatile colourless to yellowish liquid), which have strong antioxidant properties due to their ability to donate hydrogen atoms easily. These hydrogen atoms are removed by peroxy radicals that form during oxidative stress, enhancing nutmeg's antioxidant capabilities. Eugenol also boosts antioxidant activity by increasing the function of antioxidant enzymes (Gupta and Rajpurohit 2011). Additionally, lignan derivatives in nutmeg seeds are metabolised to produce a catechol structure which further acts as an effective antioxidant (Calliste *et al.*, 2010). Moreover, lignans (polyphenols) found in fresh nutmeg and mace have properties that can modify immune responses and protect against radiation. These lignans help protect DNA from radiation-induced damage and inhibit cell proliferation by causing cell cycle arrest and promoting apoptosis. They also protect splenocytes (a type of white blood cell) from radiation damage by reducing DNA fragmentation, without being toxic to the cells (Checker *et al.*, 2008).

Essential oils and extracts of nutmeg have been found to have strong antimicrobial effects against various fungi and bacteria. Research showed that a chloroform extract of nutmeg has myristic acid and trimyristin compounds that are effective against gram-negative and gram-positive bacteria, identifying as the main antibacterial compounds in nutmeg seeds (Narasimhan *et al.*, 2006). Further, antifungal properties, particularly in suppressing wheat leaf rust and rice blast have been reported by lignans present in nutmeg seeds (Cho *et al.*, 2007). Compounds like carvacrol, γ-cymene, α-pinene, β-pinene, and β-caryophyllene in nutmeg essential oil have been reported to have antimicrobial activity. Some plant phenolics also contribute to these effects. Specifically, β-caryophyllene is noted for its antifungal and anti-inflammatory properties. α-pinene and β-pinene, which are monoterpene hydrocarbons, act as antimicrobial agents by disrupting cell membranes (Dorman and Deans, 2000). Carvacrol, another key antimicrobial compound, damages cell membranes, leading to increased permeability and a decrease in ATP levels. γ-Cymene, a precursor of carvacrol, enhances the membrane-weakening effects of carvacrol, although it has only weak antibacterial activity on its own. The overall antimicrobial activity is believed to result from a combination of both major and minor compounds in the essential oils, with minor compounds potentially influencing the effects of the major ones.

The essential oil from nutmeg is also known to inhibit enzymes involved in metabolizing carcinogens, helping to protect against liver damage and cancer. Research showed that oral administration of mace prevents cancer development and liver damage in mice (Kyriakis *et al.*, 1994). Further reports on nutmeg established the anti-inflammatory properties of its essential oil, similar to those of non-steroidal anti-inflammatory drugs (NSAIDs). However,

this effect is mainly observed in petroleum ether extracts of nutmeg (Olajide *et al.,* 2000). Nutmeg extract has also been found to activate an enzyme involved in treating metabolic disorders like type-2 diabetes and obesity. Several compounds isolated from nutmeg have shown strong activity in stimulating this enzyme, suggesting that nutmeg may be useful in developing treatments for these conditions (Nguyen *et al.,* 2010).

Climatic requirements

Nutmeg thrives in tropical climates with high humidity and well-distributed rainfall. Nutmeg requires a warm climate with temperatures ranging from 20°C to 30°C and well-drained, fertile soil. It grows best in sandy loam or clay loam soils rich in organic matter, with a pH of 5.5 to 7.0. The tree prefers partial shade, especially in its early years, and requires protection from strong winds (Naeem *et al.,* 2016).

Propagation

Propagation through seeds

Nutmeg trees are typically propagated from seeds, which should be fresh and sown soon after harvesting to ensure good germination. The seeds are usually planted in nursery beds or pots and later transplanted to the field when the seedlings are 6 to 12 months old. The trees are dioecious, meaning that male and female flowers are borne on separate trees. Therefore, it is essential to plant a mix of male and female trees to ensure pollination and fruit production. A typical plantation needed a 10% male population to ensure adequate pollination (Sharma and Armstrong 2013). However, propagation through seeds results in a 1:1 ratio, making the determination of plant sex only possible after flowering, which takes 5-6 years and poses challenges for efficient cultivation (Kaihatu *et al.,* 2021).

Vegetative propagation

Grafting is a more effective way to grow nutmeg trees for commercial purposes. This involves preparation of rootstocks and treatment of seeds to improve seedling growth. For grafting, scions (shoots) from vertically grown branches are preferred over side branches because they help produce better-shaped plants and allow for different planting densities. Among grafting methods, epicotyl grafting is the most common for both cultivated and wild nutmeg varieties. Epicotyl grafting can be done throughout the year, but the best results occur when the seedlings are 20-30 days old. The success of this method also depends on factors like the age of the scion sticks (Krishnamoorthy and Mathew, 1985). Another grafting method, softwood grafting, involves keeping one terminal leaf on the scion stick, which helps the apical bud to swell, leading to a 70% success rate. However, the success of softwood grafting varies depending on the variety of the scion, with narrower leaves and longer petioles giving better results (Haldankar *et al*., 2003). Currently, most grafting methods employ seedlings as rootstocks because there is no effective method for clonal propagation through cutting or layering. Approach grafting is another technique that can be done year-round and has shown success rates of 40% to 100% on both cultivated and wild nutmeg rootstocks, however, the mortality rate after separating the grafts is high, especially with wild rootstocks (Haldankar *et al*., 1999). The growth habit of nutmeg, with its orthotropic (vertical) main shoot and plagiotropic (lateral) side shoots, influences the plant's vertical or spreading growth, depending on the scion material used in grafting. However, the limited availability of orthotropic shoots necessitates exploring alternative propagation techniques.

Budding techniques have been tested but with limited success. For instance, using the fork method on three-year-old rootstocks only resulted in a 30% success rate, making it unsuitable for commercial use. This low success rate is thought to be due to phenolic compounds in the plant, which interfere with the budding process by blocking vessels and preventing proper tissue development (Beena and Kurian, 1996). Green chip budding is a promising technique for propagating cultivated nutmeg, with a success rate of 90% to 100%. However, this method is especially effective for producing vertically growing plants and depends on the climate (Varghese and Mathew, 2019).

***In vitro* propagation**

In vitro propagation techniques could be a game changer to produce true-to-type nutmeg

plants that are available year-round. Tissue culture is a crucial technique in plant propagation, allowing for the growth of plant cells, tissues, or organs under sterile conditions on a nutrient-culture medium. This method is especially important for species that face challenges with traditional propagation methods, such as nutmeg. Further, the *in vitro* propagation technique helps to produce high-yielding and climate-resilient nutmeg rootstocks. Although the tissue culture holds a grip in propagating herbaceous plants cultivating woody plants is still challenging, and research on tropical woody angiosperms, such as fruit and nut trees, has significantly lagged behind that of herbaceous plants. This is primarily due to the limited availability of explants, the release of polyphenolic compounds, and poor germination rates. Our understanding of *in vitro* propagation techniques for the Myristicaceae family remains limited. However, significant research has been carried out on micropropagation of nutmeg plants. The first and foremost challenge in the *in vitro* propagation of nutmeg is the proper establishment of nutmeg cultures. In culture establishment, surface sterilization is the vital step, yet challenging, as seen in a study that after surface sterilization only 33% of cultures survived due to fungal contamination and tissue necrosis, indicating a need for better sterilization methods (Antony, 2008). The presence of polyphenols, which can lead to reduced explant survival, was mitigated by initial dark incubation in a charcoal-containing medium, resulting in a 30% culture establishment success rate. Nodal segments without leaf blades were found to be the most effective explants for culture establishment, particularly when collected in the summer, as this season showed the highest success rate due to lower microbial contamination. The study also explored the influence of carbon sources and organic additives on shoot elongation and proliferation, with mixed results, indicating further research is needed. Micrografting, involving the use of *in vitro*-produced scions and rootstocks, faced challenges due to bacterial and fungal contamination, with grafts surviving only two weeks. The study suggests that refining micrografting techniques, including controlling microbial contamination and utilizing humid bottles for initial seedling establishment, could improve success rates. Future research should focus on enhancing culture establishment, overcoming the recalcitrance of multiple shoot induction, and refining both *in vitro* and *in vivo* micrografting techniques to optimize nutmeg propagation for commercial cultivation (Antony, 2008).

In another research, it was demonstrated that direct somatic embryogenesis in nutmeg plants can be achieved from intact and fragmented zygotic embryos. However, the survival of these cultured tissues is often compromised by the toxic metabolites leached from the explants into the culture medium. To address this, activated charcoal is incorporated into the medium at concentrations of 0.3-0.5% (w/v). The activated charcoal adsorbs and sequesters the inhibitory metabolites, preventing browning and necrosis of the explants and resulting in high-frequency somatic embryogenesis. Germination of these somatic embryos from zygotic embryos was successfully achieved in media with NAA, and direct somatic embryo formation was obtained from leaf explants of juvenile plants in MS media with kinetin, 2,4-D, and NAA (Iyer *et al.*, 2009). These embryonic cultures of nutmeg are used for continuous in vitro production of bioactive phytochemicals. The metabolite profiling of long-term embryogenic cultures, established from zygotic embryos showed the presence of various monoterpenes and essential oils such as α & β-pinene, myristicin, safrole, methyl eugenol, and beta-sitosterol. The essential oil composition varied with the age of the cultures, with 3-week-old cultures containing a rich variety of monoterpenes. The spent charcoal medium from these embryogenic cultures demonstrated strong antimicrobial activity against pathogens like *Salmonella typhi* and *Staphylococcus aureus.* This was the first report of in vitro production of phytochemicals by embryogenic mass. The findings of this research also suggested that both the embryogenic cultures and the spent charcoal medium could be valuable sources of pharmacologically important products and provide a foundation for further biotechnological research on this rare, medicinal species, including its conservation through cryopreservation (Iyer *et al.*, 2009).

In an earlier study on *in vitro* proliferation of nutmeg aril by tissue culture, it was reported that the mace tissue from unopened fruit when used as explants, cultures grown in light showed no growth and eventually dried up after 30 days. In contrast, cultures incubated in darkness exhibited growth, indicating that darkness is essential for mace tissue growth. On a specific growth medium (Woody Plant Medium), 20% of the explants developed callus, but growth was slow. However, with different supplements like NAA and BA, growth improved significantly in 70-90% of the cultures, leading to the proliferation of tissue that retained the natural reddish colour of mace. This newly grown tissue increased tenfold in weight within two weeks. Sensory and chemical evaluations showed that the cultured tissue maintained the flavour and zest of natural mace, although the oil yield was lower. Despite some differences in chemical composition, the study concluded that mace could be successfully multiplied using tissue culture, potentially serving as a substitute for commercial mace and as a source of myristicin, a compound with anticarcinogenic properties (Nirmal Babu *et al.*, 1992).

Conclusion

Nutmeg, with its rich historical, cultural, and medicinal legacy, has long been a cornerstone in the global food and medicine markets. The evergreen nutmeg tree thrives in tropical climates and produces seeds that are prized for their use in cooking and traditional remedies. Nutmeg is packed with essential oils and compounds like myristicin and eugenol, which have been proven to offer health benefits, such as antioxidant, antimicrobial, and anti-inflammatory effects. However, cultivating nutmeg comes with its challenges. Traditional methods are limited by the plant's slow growth and the need to balance male and female trees for optimal yield. Additionally, pests and diseases can threaten nutmeg plantations, reducing both the quantity and quality of the spice. To overcome these obstacles, modern techniques like *in vitro* propagation are being explored. These methods have shown promise in producing healthy nutmeg plants and valuable bioactive compounds in controlled environments. While the initial results are encouraging, further research is essential to refine these techniques and address issues like contamination and plant survival. With continued innovation, nutmeg can be cultivated more efficiently and sustainably, preserving its significance for future generations.

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सुपारी और मसाले के लिए अप्रैल-जून, 2024 के कृषि कार्य

सुपारी

पौधशाला

- रोज़ होस/ स्प्रिंग्लर/ फाइन मिस्टिंग से सिंचाई करें।
- पत्ती दाग का नियंत्रण करें।
- एक या दो गर्मकालीन वर्षा मिलने पर पौधशाला में छ़ॉव कम करें।
- अनंकुरित बैगों को छोड़ दें।
- नियमित रूप से निराई करें।
- डाइ बैक और अन्य किसी प्रकार के रोगों का प्रबंधन करें।
- चानलों की सफाई करके पर्याप्त जल निकासी का बंदोबस्त करें।
- क़ॉलर सड़न औऱ पर्ण चित्ती रोग का नियंत्रण करें।

नया बाग

- निराई जारी रखा जाए।
- मई महीने के दौरान स्थल चुनकर नए बागान बनाना शुरू करें। ज़मीन की गर्मी कम करने के लिए रोपाई के 2-3 हफ्ते पहले 60 घन सेंटी मीटर के आकार वाले गड्ढे खोदकर रखना चाहिए। खोदते समय सतही मिट्टी और नीचे की मिट्टी अलग से रखें। रोपाई के 1 हफ्ते पहले 5-10 कि.ग्रा. गोबर की खाद और आधे भाग तक सतही मिट्टी भरा दें। पौदों को गड्ढे के मध्य में रोपाई करके चारों ओर दबाकर पलवार करके छ़ॉव दें।
- जून में अच्छी तरह जल निकासित मिट्टी में बागों को तैयार करना शुरू करें।
- दक्षिण-पश्चिम मानसून की शुरूआत से या जून के प्रथम सप्ताह में प्रतिरोपाई करें।
- गड्ढे खोदते समय कतारें उत्तर-दक्षिण दिशा में बनाया जाए क्योंकि उत्तर-दक्षिण लाइन में पश्चिम की ओर 35° कोन में करने से सूर्याघात कम हो जाता है।
- दक्षिण औऱ दक्षिण- पश्चिम भाग में पर्याप्त छ़ॉव पेड़ों की रोपाई करें।
- रोपाई के बाद हरे पत्तों से गड्ढों का पल्वार करें।
- प्लेइटड नारियल के पत्तों से पौधों को छ़ॉव दें और अंतर फसल के रूप में केले की रोपाई करें।
- सनहेंप (हरे पत्तों) के बीज 20 कि.ग्रा. एकड की दर से रोपाई करके खरपतवार बढ़ने से रोका जा सकता है।

पुराना बागान

- सिंचित बागों में अप्रैल के अंत में मिट्टी खोदकर उर्वरकों की पहली मात्रा का प्रयोग करें।
- बढ़िया अवशोषण के लिए उर्वरकों के प्रयोग के बाद अच्छी तरह सिंचाई करें।
- माइट, पेंटाटोमिड बग और स्केल प्राणियों का नियंत्रण करें।
- सिंचित बागों में यदि अप्रैल में उर्वरकों की पहली मात्रा का प्रयोग नहीं किया जाए तो मई में कर सकता है।
- वर्षा सिंचित बागों में काफी वर्षा मिलने के बाद 35ग्राम नत्रजन,15 ग्राम फोसफोरस और 50ग्राम पोटाश प्रति पेड़ की दर से उर्वरक दें।
- सूखे मौसम, मिट्टी के प्रकार और पानी की लभ्यता के अनुसार 3-5 दिनों के अंतराल में सिंचाई करें।
- आवरण फसल के रूप में *माइमोसा इन्विसा, स्टाइलोसान्तस ग्रेसिल्लस, कालप्पोगोनियम*

मुकुनोइडस, प्यूरेरिया जावानिका आदि का बीजारोपण अप्रैल-मई में वर्षा के प्रारंभ में किया जा सकता है। इस के लिए प्रति हेक्टर क्रमशः 15 कि.ग्रा, 9 कि.ग्रा., 11 कि.ग्रा. और 11 कि.ग्रा. बीज आवश्यक है। अक्तूबर में इसको काटकर मिट्टी में शामिल करें।

- दक्षिण-पश्चिम मानसून शुरू होने से पहले सूखे पत्ते और रोग संक्रमित पेड़ों को हटाना चाहिए। अच्छी तरह वर्षा मिलने वाले इलाकों में फाइटोफ्थोरा से संबंघित समस्याओं (कलिका गलन, मुकुट सड़न, फल सड़न और पाद गलन) के समाधान के लिए रोग निवारक उपाय के रूप में 1% बोर्डाक्स मिश्रण छिड़का दें।
- जड़ वेधकों के नियंत्रण हेतु पेड़ों के आधार के मिट्टी 10-15 से.मी. की गहराई में खोदकर क्लोरपाइरीफोस 0.04 प्रतिशत का घोल का छिड़काव दो बार करें, पहला दक्षिण-पश्चिम मानसून की शुरुआत के ठीक पहले मई में और अगला सितंबर-अक्तूबर में मानसून समाप्त होने के साथ। कीटों के पूर्ण उन्मूलन के लिए इसका प्रयोग 2 या 3 वर्षों तक दोहराए।
- ड्रिप लाइन को बागों से हटाकर मानसूनोत्तर काल में उपयोग करने के लिए सुरक्षित रखा जाए। इससे पाइप और ट्यूबों को मिट्टी में पडे रहकर खराब होने से बचाया जा सकता है।
- सुपारी के बागों में वर्षा मौसम में जल निकास की पर्याप्त सुविधाएँ उपलब्ध कराई जाए। इसके लिए नई नालियाँ खोल दें या पुरानी नालियों की गहराई बढ़ाए, जिससे कि नालियाँ पौधों के आधार के नीचे से 25 से 30 सेंटी मीटर तक गहरा हों।
- पुराने बागों को पुनरुज्जीवित करने के लिए 3 से 4 वर्षा के दौरान नियमित रूप से प्रतिरोपाई करें। यदि पुराने बाग में पौधों का आधिक्य है तो कम उत्पादन वाले पौधों को निकाल दें।
- उच्च नमी के साथ तेज धूप और बारिश होने से फल गलन रोग संक्रमण होने की संभावना है। रोग निवारक उपाय के रूप में गुच्छों में 1% बोर्डो मिश्रण छिड़कना चाहिए। इस छिड़काव अच्छे धूप वाले दिनों में सूक्ष्म फुहार के साथ करें जिससे कि पौधों के संपूर्ण सतह पर फफूँदनाशी का एक संरक्षण कवच रहें।
- रासायनिक तरीका के अलावा याँत्रिक तरीके जैसे गुच्छों को पोलिथीन से आवरण करना भी रोग का प्रकोप एवं फैलाव के नियंत्रण के लिए प्रभावपूर्ण सिद्ध हुआ है।

काली मिर्च

पौधशाला

- आवश्यक अंतराल पर सिंचाई करें।
- पाक्षिक अंतराल पर पौधों को स्यूडोमोनास फ्लूरोसेंस P1 (2%) से उपचार करें।
- यदि फाइटोफ्तोरा रोग तीव्र है तो 0.03% पोटासियम फोस्फोनेट या मेटालाक्सिल 0.02% का छिड़काव करें।
- मीली बग का संक्रमण है तो 0.075% क्लोरपाइरीफोस से उपचार करें।
- गाल थ्रिप्य या स्केल कीट के नियंत्रण के लिए 0.2% डिमेथोएट का छिड़काव करें।
- जून में पौधे मुख्य बागों में रोपाई के लिए तैयार हो जाएगा। इसके लिए वाइरस रहित स्वस्थ रोपण सामग्रियाँ चुन लें।

नया बाग

- सहारे वाले पेड़ों की रोपाई करें। मुरुक्कु (*एरिथ्रीना इंडिका*) कारयम या किलिंजिल (*गरुगा पिन्नेट्टा), ऐलान्थस* वर्ग, *ग्लिरिसिडिया* वर्ग आदि सहारे वाले पेड़ों के लिए उपयुक्त है। उच्च ऊँचाई वाले इलाकों में दलाप *(लिथोस्पेर्मा)* और

सिल्वर ओक *(ग्रेविलियो रोबस्टा)* सहारे वाले पेड़ों के रूप में सफलतापूर्वक प्रयोग किया जाता है। काली मिर्च लगाने से 2-3 वर्ष पूर्व सिल्वर ओक के पौद लगाना चाहिए।

- मैदानी इलाकों में पौधों के बीच 3x3 मीटर और ढलान में 2 मीटर की जगह छोड़ना चाहिए एवं कतारों के बीच 4 मीटर ।
- मानसून प्रारंभ होने तक सहारे वाले पेड़ों की सिंचाई करें।
- सहारे वाले पेड़ों से 15 से.मी. की दूरी पर इसके उत्तरी भाग में 50 x 50 x 50 से.मी. आकार के गड्ढे खोद लें। गड्ढों को ऊपर मिट्टी और कंपोस्ट या अच्छी तरह सड़े हुए गोबर 5 कि.ग्रा. प्रति गड्ढे की दर से ढ़ेर बनाकर रखना चाहिए।
- सहारे वाले पेड़ों से 30 से.मी. की दूरी पर गड्ढों में 2-3 जडकलमों की रोपाई करें।
- जडकलमों के चारों ओर मिट्टी के ढेर बनाकर अच्छी तरह दबाकर रखे ताकि पौधों के आस पास पानी का जमाव न हो।
- जड़कलमों के बढ़ने वाले भागों को बेलों को आधार से बांध लें।
- यदि खुले बाग है तो या बारिश नहीं है तो पौधों को छॉव दें।

उर्वरक देना

- सिफारिश के अनुसार उर्वरकों की मात्रा NPK 50:50:50 ग्राम प्रति बेल की दर पर प्रति वर्ष देना चाहिए।
- दो वर्ष वाले पौधों को दो तिहाई मात्रा और तीसरे वर्ष से लेकर पूरी मात्रा दें।
- दूसरे वर्ष में जहाँ मिट्टी में ज़िंक या मग्नीशियम की मात्रा कम है, वहाँ 0.25% ज़िक सल्फेट औऱ मग्नीशियम सल्फेट 150 ग्राम प्रति बेल की दर पर मिट्टी में प्रयोग करें।

बाग

- अप्रैल में तुड़ाई के बाद मानसून प्रारंभ होने तक हफ्ते में एक बार के क्रम में 40-50 लीटर पानी प्रति बेल की दर पर सिंचाई करें।
- बेलों के आधार में पर्याप्त पल्वार करें।

फाइटो सानिटेशन

- रोग संक्रमित सभी मृत बोलों को जड़ तंत्र के साथ निकालकर जला दें।
- भूस्तारियों को मानसून के प्रारंभ से काट-छाँट करके बेलों से बाँध लें।
- सहारे वाले पेड़ों की शाखाएँ काटकर काफी धूप प्रदान करें और नमी बनने से बचा लें।
- जहाँ पानी के जमाव की समस्या है, वहाँ सतह में निम्न भागों में जल निकास का प्रबंधन करें।

उर्वरक

- कुछ मानसून पूर्व वर्षा मिलने पर खाद एवं उर्वरक देना शुरू करें।
- जैवीक खाद के रूप में गोबर या कंपोस्ट 10 कि.ग्रा.प्रति बेल की दर पर प्रयोग करें।
- नीम खली 1 कि.ग्रा. प्रति बेल की दर पर प्रयोग करें।
- एकांतर वर्ष में चूने का प्रयोग 500 ग्राम प्रति बेल की दर पर करें।
- एसोस्पोरिलम 100 ग्राम प्रति बेल की दर पर करें।

पौध संरक्षण

- मानसून वर्षा मिलने के बाद सभी बेलों के आधार से 45-50 से.मी.की दूरी पर चारों ओर 0.2% कॉपर ओक्सीक्लोराइड 5-10 लीटर प्रति बेल की दर पर उपचार करें। पत्तों में 1% बोर्डाक्स मिश्रण का छिड़का दें या 0.3%

पोटाशियम फोसफोनेट से मिट्टी औऱ पत्तों को उपचार करें।

- फल गलन रोग के नियंत्रण के लिए मानसून के पहले जहाँ पोटाशियम फोसफोनेट का प्रयोग करता है, वहाँ काली मिर्च के बेलों को VAM(AMF) ट्राइकोडेर्मा और स्यूडोमोनास फ्लूरोसेन्स P1 से उपचारित करके रखें।

सिंचाई

- मानसून शुरू होने तक हफ्ते में एक बार 40-50 लीटर प्रति बेल की दर पर सिंचाई करें।

अदरक और हल्दी

अप्रैल-मई में वर्षा मिलने के बाद अदरक और हल्दी की रोपाई की जाए। अदरक के लिए मूल मात्रा के रूप में गोबर की खाद 25-30 टन और उर्वरक 50कि.ग्रा.फोसफोरस और 25 कि.ग्रा.पोटाश तथा हल्दी के लिए 30 कि.ग्रा.फोसफोरस और 30 कि.ग्रा.पोटाश प्रति हेक्टेयर की दर पर प्रयोग करें। हल्दी के मामले में रोपाई के समय ज़िंक 5 कि.ग्रा. प्रति हेक्टेयर और तेल खली जैसे जैवीक खाद भी 2 टन प्रति हेक्टेयर की दर पर प्रयोग करें। ऐसी स्थिति में फार्म यार्ड खाद की मात्रा कम कर सकता है। कॉयर खाद 2.5 टन प्रति हेक्टेयर के साथ गोबर, जैवीक खाद (एसोस्पिरिलम) और NPK की आधी मात्रा का एकीकृत प्रयोग भी किया जाए ।

अदरक बीज 1200-1800 कि.ग्रा. प्रति हेक्टेयर और हल्दी के बीज 2500 कि.ग्रा. प्रति हेक्टेयर की दर पर प्रयोग करें।

अदरक के बीज प्रकंदों को 0.3% मान्कोज़ेब (3 ग्राम प्रति लीटर पानी) में 30 मिनट तक उपचारित करके 3-4 घंटे तक छाया में सुखाने के बाद रोपाई करें। कतारों के बीच 20-25 से.मी. की दूरी छोड़कर रोपाई करना चाहिए। बीज प्रकंदों को हाथ-कुदाली से बनाए गए छोटे गड्ढों में सड़े गोबर और मिट्टी के हल्के परत भरकर रोपित करके मिट्टी से ढ़ँक लें। रोपाई के समय नीमखली 2 टन प्रति हेक्टेयर की दर पर प्रयोग करने पर अदरक कंद को गलन रोग से बचा सकता है और उपज में वृद्धि भी होती है । रोपाई के तुरंत बाद 15 टन प्रति हेक्टेयर की दर पर हरे पत्तों से पल्वार करना अनिवार्य है और यदि आवश्यक है तो 40-50 दिनों के बाद 7.5 टन प्रति हेक्टेयर की दर पर दुबारा पल्वार करें।

प्रो-ट्रे तरीके के द्वारा अदरक के स्वस्थ रोपण सामग्रियों का उत्पादन

अदरक के अच्छे रोपण सामग्रियों के उत्पादन के लिए कम लागत और व्यय पर अदरक के एकल कली मुकुल (लगभग 5ग्राम) के प्रयोग करके प्रतिरोपाई तकनीक विकसित किया गया। इस प्रकार विकसित अदरक के पौधों की पैदावार परंपरागत खेती तरीके के बराबर है। इस तरीके में प्रो-ट्रे में एकल कली मुकुल बीज प्रकंदों की रोपाई करके 30-40 दिनों के बाद बागों में प्रतिरोपाई करता है। स्वस्थ रोपण सामग्रियों के उत्पादन एवं बीज प्रकंदों के कम मात्रा में प्रयोग और अंततः बीज सामग्री पर होनेवाला व्यय कम होना इस तकनीक का लाभ है।

यदि कृषक हल्दी /अदरक की रोपाई फरवरी के अंत या मार्च के आरंभ में की जाती है, वे इस विधि को फरवरी के प्रथम सप्ताह से ही शुरू कर सकते हैं।

प्रो-ट्रे में अदरक आंख अंकुरणों का उत्पादन

अदरक के एक आंख अंकुरणों के उत्पादन में शामिल चरण निम्नानुसार हैं। इसे मुख्य खेत में रोपाई के एक महीने पहले शुरू करना चाहिए।

- बीज के लिए अदरक के साफ, स्वस्थ एवं दृढ़

बीज प्रकंदों को चुन लें।

- बीज प्रकंदों को एक आंख अंकुरण वाले 5-7 ग्राम के प्रकंदों के रूप में काटता है।
- बीज प्रकंदों को मैंकोज़ेब (0.3%) में 30 मिनट तक उपचारित करें।
- प्रो-ट्रे में पीजीपीआर (PGPR)/ ट्राइकोडेर्मा 10 ग्राम प्रति कि.ग्रा. मिश्रण की दर से परिपोषित आंशिक रूप से सड़े हुए कॉयर पित्त (coir pith) और केंचुआ खाद (75:25) के नर्सरी मीडियम भरा दें।
- एक आंख अंकुरणों को प्रो-ट्रे में रोपाई करें।
- प्रो-ट्रे को छॉव-जाल-गृह में रखकर आंशिक छाया दें।
- आवश्यकतानुसार रोस क्यान से या उचित स्प्रिंग्लर से सिंचाई करें।
- 30-40 दिनों से पौदे बागों में प्रतिरोपाई के लिए तैयार हो जाते है।

प्रो-ट्रे में हल्दी आंख अंकुरणों का उत्पादन

हल्दी के एक आंख अंकुरणों के उत्पादन में शामिल चरण निम्नानुसार हैं। इसे मुख्य खेत में रोपाई के एक महीने पहले शुरू करना चाहिए।

- बीज के लिए स्वस्थ फिंगर प्रकंदों को चुन लें।
- बीज प्रकंदों को 1-11/2 महीने छाया में रखकर प्रकंदों सिकुड़ने तक सुखाना चाहिए।
- बीज प्रकंदों को कार्बन्डाजिम (0.3%) + क्विनालफोस (0.1%) में 30 मिनट तक उपचारित करें।
- बीज प्रकंदों को एक आंख अंकुरण वाले 5-7 ग्राम के छोटे प्रकंदों के रूप में काटते है।
- एक आंख अंकुरणों को नारियल पेड़ के पत्तियों से बनी चटाई में स्टोर करें और इसे कोको पीट (0.5% ह्युमिक एसिड से उपचारित) से कवर करें।
- क्यारियों में पानी छिडककर 4 दिन तक रखें।
- प्रो-ट्रे में पीजीपीआर (PGPR)/ ट्राइकोडेर्मा 10 ग्राम प्रति कि.ग्रा. मिश्रण की दर से परिपोषित आंशिक रूप से सड़े हुए कॉयर पित्त (coir pith) और केंचुआ खाद (70:30) नर्सरी मीडियम भरा दें।
- एक आंख अंकुरणों को प्रो-ट्रे में रोपाई करें।
- प्रो-ट्रे को 7 दिनों तक पोलिथीन शीट से कवर करके आंख अंकुरित होने के लिए निरीक्षण करें या समान अंकुर के लिए पूर्व- अंकुरित आंख का रोपण करें।
- नियमित रूप से पानी छिडककर 50% छाया में रखें।
- पत्तियों के उभरने के बाद ह्युमिक एसिड (0.5%) का छिडकाव करें।
- 30-35 दिनों में पौधे बागों में प्रतिरोपाई के लिए तैयार हो जाते है।

वृक्ष मसाले

नए पौधों की रोपाई के लिए दक्षिण-पश्चिम मानसून की शुरूआत से 90 से.मी. की गहरी गढ्डे खोदना चाहिए। रोपाई के समय लौंग पौधों के बीच

	नत्रजन ग्राम	फॉसफोरस ग्राम	पोटाश ग्राम	
लौंग	150	125	375	**15 वर्ष पुरने पेडों को (प्रति पेड)**
जायफल	250	125	500	**15 वर्ष पुरने पेडों को (प्रति पेड)**
दालचीनी	100	90	100	10 **वर्ष पुरने पेडों को (प्रति पेड)**

छोटे पौधों को उर्वरकों का प्रयोग क्रमिक मात्रा में करें।

पेड़ के आधार तने से उपयुक्त दूरी पर बनाए गए गड्ढों में उर्वरकों का प्रयोग करें।

में 6x6 मीटर, जायफल में 8x8 मीटर, दालचीनी में 2x2 मीटर की जगह छोड़ना चाहिए। गढ्डों में सतही मिट्टी और कंपोस्ट या अच्छी तरह सड़े हुए गोबर से भर देना चाहिए। पर्याप्त मात्रा में वर्षा मिलने पर रोपाई करें।

मिर्च

मिर्च एक प्रतिरोपित फसल है। पौधशालाओं में बीजों की बुआई करके एक माह के बाद पौधों को मुख्य बागों में प्रतिरोपित किया जाता है। बुआई के लिए 90-100 से.मी. चौडी और सुविधानुसार लंबी ऊँची क्यारियाँ तैयार करके अच्छी तरह सड़े हुए कार्बनिक खाद मिला देता है। प्रमाणित एवं स्वस्थ बीजों को चुनकर एक हेक्टेयर के लिए 1.0-1.5 कि.ग्रा. बीजों को कप्टान, थीरम या कार्बेन्ड़ाजिम 2-3 ग्राम प्रति कि.ग्रा. बीज की दर से उपचार करके एक हेक्टायर में प्रतिरोपण के लिए बुआई की जाती है। बुआई के बाद, हरे पत्तों से पळ्वार करके रोज सुबह रोस-क्यान से सिंचाई करें। बीजों के अंकुरण के तुरंत बाद पळवार को हटाना चाहिए। प्रतिरोपण के एक हफ्ता पहले सिंचाई कम करना चाहिए औऱ प्रतिरोपण के एक दिन पहले अच्छी तरह सिंचाई करें। प्रधान खेतों में 75:40:25 कि.ग्राम नत्रजन, फॉसफोरस और पोटाश प्रति ह्क्टेयर की दर से उर्वरकों का प्रयोग करें। प्रतिरोपण के पूर्व नत्रजन और पोटाश की आधी मात्रा और फॉसफोरस की पूरी मात्रा मूल खुराक के रूप में प्रयोग करें।

FARM OPERATIONS FOR ARECANUT AND SPICES
APRIL - JUNE, 2024

ARECANUT

Nursery

- Daily watering- hose/sprinkler/fine misting.
- Control leaf spot disease.
- Shade may be reduced in the nursery on receipt of one to two good summer showers.
- Discard the ungerminated bags.
- Regular removal of weeds.
- Monitoring for incidence of any diseases especially die back disease.
- Providing sufficient drainage and cleaning of channels.
- Control of collar rot and leaf blight.

Young garden

- Weeding may be continued.
- During May, selection of site and laying out for new plantation to be done. Pits of 60 cm^3 should be taken 2-3 weeks before planting to ward off the field heat. While digging top and bottom soils should be heaped separately. Pit should be half filled with top soil and 5-10 kg Farm Yard Manure (FYM) one week before planting. Seedlings should be planted in the centre of the pit, pressed around, mulched and shaded.
- Establishment of garden in well drained soil during the month of June.
- Take up transplanting in the beginning of south-west monsoon or the first week of June.
- While digging the pits, the rows may be aligned in north-south direction by deflecting the north-south line at an angle of 35^0 towards west to minimize sun scorching.
- Suitable shade trees may be planted on southern and south-west side.
- After planting, pit should be mulched with green leaves.
- Cover the seedlings with plaited coconut leaves and grow shade crops like banana in the interspaces.
- Sunhemp (green manure crop) seeds @ 20 kg/ acre may also be sown in the interspaces as a soil reclamation measure and to avoid weed growth especially in the gardens without much overhead shade.

Old garden

- Forking and application of first dose of fertilizers at the end of April in the irrigated garden.
- Irrigate sufficiently after fertilizer application for efficient absorption.
- Control mites, pentatomid bugs and scale insects.
- If first dose of fertilizers were not given during April, it can be given in May in irrigated arecanut gardens.
- Application of first dose of fertilizers to supply 35g N, 15g P_2O_5 and 50g K_2O per palm can be taken up in rainfed gardens after receipt of sufficient showers.
- Irrigate palms during hot and dry periods at regular intervals of 3-5 days depending upon the soil type and availability of water for irrigation.
- Sow seeds of green manure cover crops such as *Mimosa invisia, Stylosanthes gracilles, Calapagonium muconoides* and *Pueraria javanica*, in April-May with onset of pre-monsoon rains. The seed rate required per hectare is 15 kg, 9 kg, 11 kg and 11 kg respectively. These crops may be cut and incorporated during October.
- Before the onset of south-west monsoon, dried leaves and diseased palms should be removed. 1% Bordeaux mixture may be sprayed as a prophylactic measure to avoid Phytophthora related problems (bud rot, crown rot, fruit rot and foot rot) in high rainfall areas.
- For management of rootgrubs, loosen soil around the base of palms at a depth of 10-15cm, drench with chloropyriphos 0.04 per

cent suspension twice, one in May just before the onset of southwest monsoon and again in September- October towards the end of the monsoon. Repeat application for 2 or 3 years consecutively to secure a complete eradication of the pest.

- During the month of June, remove drip lines from the garden, roll back and keep safely for use during post monsoon season. This will prevent the pipes/tubes from soiling and clogging.
- Adequate drainage should be provided in the arecanut gardens during the rainy season. Open new drains or deepen and clean the existing ones so that the channel should be 25-30 cm deeper than the bottom of the plant base.
- To rejuvenate old gardens, underplanting/ replanting may be taken up in a phased manner over a period of 3 to 4 years. If the existing garden is irregularly spaced, thin out old, unproductive palms.
- High humidity alternating with bright sun shine and rain favour the incidence of Fruit rot. Prophylactic spraying with 1% Bordeaux mixture will provide adequate protection to the bunches against disease incidence. Spraying operations may be undertaken on clear sunny days with a very fine spray so as to give a protective coverage on the entire nut surface with fungicides.
- Besides the chemical control, mechanical method of control of the disease by protecting the bunches through polythene covering is found to be very much effective in checking the incidence and spread of the disease.

BLACK PEPPER

Nursery

- Continue watering at the required frequency
- Spraying and drenching the plants with *Pseudomonas fluorescens* P1 (2%) at fortnightly interval.
- In case of a Phytophthora disease outbreak, spray with 0.3% Potassium Phosphonate or Metalaxyl 0.2% at fortnightly interval. Alternatively spray with 1% Bordeaux mixture and drench with 0.2% Copper Oxychloride.
- In case of an incidence of mealy bugs drench with 0.075% of Chlorpyriphos.
- In case of the incidence of gall thrips or scale insects spray 0.2% Dimethoate
- During the month of June, the plants will be ready for planting in the main field. Select only virus free healthy planting material.

New plantation

- Standards may be planted. Murukku (*Erythrina indica*), Karayam or Kilingil (*Garuga pinnata*), *Ailanthus* sp., *Glyricidia sp. etc.* are suitable standards for growing pepper. In high altitude areas, Dadap (*E. lithosperma*) and silver oak (*Grevillea robusta*) can be successfully used as standards for pepper. Seedlings of silver oak are to be planted 2-3 years before planting pepper.
- The spacing recommended is 3 x 3 m on plain lands. On sloppy land 2m between plants in rows across the slope and 4 m between rows.
- Irrigate the standards till the monsoon starts.
- Prepare pits on the northern side of standards, 15 cm away from it. The pit size should be 50 x 50 x 50 cm. Fill the pits with a mixture of topsoil and compost or well rotten cattle manure @ 5 kg/pit mixed with above mentioned biocontrol agents.
- Plant 2-3 rooted cuttings in the pits at a distance of about 30 cm away from the standards.
- Press the soil around the cuttings to form a small mound slopping outward and away from the cuttings to prevent water stagnation around the plants.
- The growing portions of the cuttings are to be trailed and tied to the standards.
- Provide shade to the plants, if the land is exposed and if there is a break in the rainfall.

Manuring

- Apply recommended dose of fertilizer @ NPK 50:50:150 g/vine/year. Half of the dose to be given during June.
- Second year plants to be given only two-third of the dose, and full dose of fertilizers from 3rd year onwards.

- In soil that are deficient in Zinc or magnesium, foliar spray of 0.25% Zinc Sulphate and soil application of 150 g/vine of magnesium sulphate is recommended.

Plantation

- During the month of April after harvest, start irrigating the vines @ 40-50 litres of water per vine once in a week till monsoon starts.
- Ensure proper mulch at the base of the vine.

Phytosanitation

- Remove all infected or dead vines along with the root system, and burnt off.
- Runner shoots are to be pruned or tied back to vines before the onset of monsoon.
- The branches of support trees may be lopped off to allow penetration of sunlight and avoid build up of humidity.
- Wherever water stagnation is a problem, effective drainage of both surface and sub-surface to be ensured.

Manuring

- Manuring and fertilization to be done with the receipt of few pre-monsoon showers.
- Organic manures in the form of cattle manure or compost @ 10kg/vine may be applied.
- Neem cake @ 1 kg/vine is also recommended.
- Lime applied @ 500 g / vine in alternate years.
- Apply *Azospirillum* @ 100 g/vine for N_2 fixation.

Plant protection

- After receipt of monsoon showers, basins of all vines are to be drenched overradius of 45-50 cm with 0.2% copper oxychloride (COC) at the rate 5-10 litres per vines. A foliar spray with 1% Bordeaux mixture is also given or drenching the soil and foliar spray with 0.3% Potassium phosphonate.
- When potassium phosphonate is used, pepper vine can be inoculated with VAM (AMF), *Trichoderma* and *Pseudomonas fluorescens* P1 during pre-monsoon period to control foot rot disease.

Irrigation

- Continue irrigation @ 40-50 litres/vine once in a week, till the monsoon starts.

GINGER AND TURMERIC

Planting of Ginger and Turmeric may be taken up with the receipt of showers in April-May. Basal application of cattle manure @ 25 to 30 tonnes and fertilizers to supply 50 kg P_2O_5 and 25 kg K_2O for Ginger and 30 kg each of P_2O_5 and K_2O for Turmeric per hectare may be done. In the case of Turmeric, Zinc @ 5 kg/ha may also be applied at the time of planting and organic manures like oil cakes can also be applied @ 2 t/ha. In such case, the dosage of FYM can be reduced. Integrated application of coir compost (@ 2.5 t/ha) combined with FYM, biofertilizer (*Azospirillum*) and half recommended dose of NPK is also recommended.

A seed rate of 1200-1800 kg per ha for Ginger and 2500 kg per ha for Turmeric may be adopted.

The Ginger seed rhizomes are treated with mancozeb 0.3% (3 g/L of water) for 30 minutes, shade dried for 3-4 hours and planted at a spacing of 20-25 cm along the rows and 20-25 cm between the rows. The seed rhizome bits are placed in shallow pits prepared with a hand hoe and covered with well decomposed farm yard manure and a thin layer of soil and levelled. Application of neem cake @ 2 tonnes/ha at the time of planting helps in reducing the incidence of rhizome rot disease/ nematode of Ginger to a certain extent and increasing the yield. Mulching with green leaves @ 15 tonnes per ha immediately after planting and @7.5 tonnes per ha again 40 to 50 days after planting is necessary.

RAPID MULTIPLICATION OF TURMERIC/ GINGER USING SINGLE BUD RHIZOME (TRANSPLANTING TECHNOLOGY)

A transplanting technique in Turmeric/ Ginger by using single bud sprouts (about 5 g) has been standardized to produce good quality planting material with reduced cost. The yield level of Turmeric/Ginger transplants is on-par with conventional planting system. The technique

involves raising transplants from single sprout seed rhizomes in the pro-tray and planted in the field after 30-40 days. The advantages of this technology are production of healthy planting materials and reduction in seed rhizome quantity and eventually reduced cost on seeds.

If the farmers are going to plant Ginger/ Turmeric during the end of February to early March, they may start this method first week of February itself.

Ginger Budling production in protrays

The steps involved in production of single bud sprouts of ginger as follows. It should start one month before planting in main field.

- Select clean, healthy and firm ginger rhizomes for seed purpose.
- Cut the seed rhizomes into single buds with small piece of rhizomes weighing 5-7 g.
- Treat the single bud sprouts with mancozeb 0.3% for 30 min before planting.
- Fill the pro-trays with nursery medium containing partially decomposed coir pith and vermicompost (75:25), enriched with PGPR/*Trichoderma* 10g/kg of mixture.
- Plant the single bud sprouts in protrays.
- Provide partial shade to the protrays by keeping them in shade nets .
- Adopt need based irrigation with rose can or by using suitable sprinklers.
- Seedlings will be ready within 30-40 days for transplanting.

Turmeric Budling production in protrays

The steps involved in production of single bud sprouts of turmeric are as follows. It should start one month before planting in main field.

- Select healthy finger rhizomes for seed purpose.
- The seed rhizomes are allowed to dry for 1 – 1½ months under shade till the shrinkage of rhizome.
- Treat the seed rhizomes with carbendazim (0.3%) + quinalphos (0.1%)
- The seed rhizomes are cut into single buds with small piece of rhizomes weighing 5-7 g.
- Store single bud rhizome pieces on palm mat and cover it with coco peat (0.5% humic acid treated).
- Sprinkle water on bed and keep it for 4 days
- Fill the pro-trays with nursery medium containing partially decomposed coir pith and vermicompost (70:30), enriched with PGPR/*Trichoderma* @ 10g/kg of mixture.
- Plant the single bud sprouts in protrays.
- Cover the protrays with polythene sheet for 7 days and observe for sprouting of buds or planting of pre-spouted single bud for uniform seedlings.
- Sprinkle water regularly and keep under 50% shade.
- After emergence of a leaf, spray humic acid (0.5 %).
- Transplants will be ready within 30 - 35 days for transplanting.

TREE SPICES

Pits of 90 cm cube may be dug with the on set of South-West monsoon for fresh planting. A spacing of 6 m x 6 m for Clove, 8 m x 8 m for Nutmeg and 2 m x 2 m for Cinnamon may be adopted. The pits may be filled with top soil and compost or well decomposed cattle manure.

	N gm	P_2O_5 gm	K_2O gm	
Clove	150	125	375	Per plant of 15 years old
Nutmeg	250	125	500	Per plant of 15 years old
Cinnamon	100	90	100	Per plant of 10 years old

Fertilizers may ba applied in graded doses for young plants. The manures may be applied in shallow trenches dug sufficiently away from the base of the tree.

Planting may be done after the receipt of sufficient rains.

Irrigation may continue till the receipt of regular rains. With the receipt of sufficient summer showers, 40 to 50 kg cattle manure or compost and fertilizers to supply N, $P_2 O_5$ and K_2O at the following rates may be applied.

CHILLI

Chilli is a transplanted crop. Seeds are sown in the nursery and one month old seedlings are transplanted in the main field. For sowing the seeds, raised seed beds of 90 to 100 cm width and of convenient length are prepared to which well decomposed organic matter has to be incorporated. Certified and healthy seeds of selected varieties about 1.0 –1.5 kg treated with Captan or Thiram or Carbendazim @ 2-3 gm/ kg seed should be sown for transplanting of seedlings in 1 ha. After sowing the seeds, mulch the beds with green leaves and irrigate with a rose-can carefully daily in the morning as well as evening. Remove the mulch immediately after germination of the seeds. Restrict irrigation one week before transplanting and irrigate heavily on previous day of transplanting. A fertilizer dose of 75:40:25 kg N, P2 O5, K2O/ha may be given in the main field. Half of Nitrogen, full Phosphorous and half Potash may be applied as basal dose before transplanting.

बाजार समीक्षा
(अक्टूबर से दिसंबर, 2023)

सुपारी

अक्टूबर से दिसंबर 2023 की अवधि के दौरान प्रमुख बाजारों में सुपारी की कीमत में मामूली गिरावट देखी गई। केरल में, कोझिकोड बाजार में सूखी सुपारी की कीमत में गिरावट का रुख देखा गया। इसके विपरीत, कोचीन बाजार में स्थिर से लेकर स्थिर मूल्य आंदोलन दर्ज किया गया। इस बीच, सिरसी (कर्नाटक राज्य) और पणजी (गोवा राज्य) बाजारों में भी सुपारी की कीमतों में मामूली गिरावट देखी गई। विशेष रूप से, कर्नाटक के सिरसी बाजार में, कीमतें अक्टूबर में 39,688 रुपये प्रति क्विंटल से गिरकर दिसंबर में 38,093 रुपये प्रति क्विंटल हो गईं।

काली मिर्च

समीक्षाधीन अवधि के दौरान, अधिकांश प्रमुख बाजारों में काली मिर्च की कीमतों में गिरावट का रुख रहा। कोचीन टर्मिनल बाजार में, मालाबार गारबल्ड ब्लैक पेपर (एमजी-1) की कीमत में ₹1,600 प्रति क्विंटल की कमी दर्ज की गई। इसी तरह, कोझिकोड बाजार में गिरावट देखी गई, जहां नादन काली मिर्च की कीमतों में ₹2,400 प्रति क्विंटल की गिरावट आई। हालांकि, कोट्टायम बाजार में मिश्रित रुझान दिखा, जहां इस अवधि के दौरान कीमतों में उतार-चढ़ाव रहा। समीक्षा अवधि के दौरान कोट्टायम में औसतन कीमतें ₹61,538 प्रति क्विंटल रहीं।

अदरक

अक्टूबर से दिसंबर 2023 की अवधि के दौरान, प्रमुख बाजारों में सूखी अदरक की कीमतें स्थिर रहीं। कोच्चि बाजार में, समीक्षाधीन अवधि के दौरान कीमतें ₹33,000 प्रति क्विंटल पर स्थिर रहीं। कोझिकोड बाजार में भी इसी तरह का रुझान देखा गया, जहाँ सूखी अदरक की कीमतें लगातार ₹33,500 प्रति क्विंटल पर बनी रहीं।

मिर्च

अधिकांश बाजारों में सूखी मिर्च की कीमतों में मिला-जुला रुख देखने को मिला। खास तौर पर गुंटूर बाजार में समीक्षाधीन अवधि में ₹4000 रुपये प्रति क्विंटल की कमी दर्ज की गई। ब्याडागी बाजार में डब्बी और कड्डी दोनों ही किस्म की मिर्च की कीमतों में बढ़ोतरी दर्ज की गई। समीक्षाधीन अवधि में डब्बी मिर्च की कीमतें ₹42,209 रुपये प्रति क्विंटल से बढ़कर ₹43,679 रुपये प्रति क्विंटल और कड्डी मिर्च की कीमतें ₹33,509 रुपये प्रति क्विंटल से बढ़कर ₹44,000 रुपये प्रति क्विंटल हो गईं।

हल्दी

समीक्षा अवधि के दौरान प्रमुख बाजारों में हल्दी की कीमतों में मिला-जुला रुख देखने को मिला। निजामाबाद बाजार में, हल्दी (फिंगर) की कीमत अक्टूबर के पहले सप्ताहांत में ₹11,922 प्रति क्विंटल से शुरू हुई, तिमाही के दौरान इसमें उतार-चढ़ाव होता रहा और दिसंबर के अंत तक यह घटकर ₹10,425 प्रति क्विंटल रह गई। कोचीन बाजार में कीमतों में स्थिरता देखी गई, जहां पूरी अवधि के दौरान दरें ₹13,000 प्रति क्विंटल पर स्थिर रहीं। इस बीच, सलेम और इरोड दोनों बाजारों में तिमाही

के दौरान ₹500 प्रति क्विंटल की मामूली वृद्धि दर्ज की गई।

लहसुन

समीक्षाधीन तिमाही के दौरान लगभग सभी प्रमुख बाजारों में लहसुन की कीमतों में तेजी से वृद्धि हुई। मध्य प्रदेश (एमपी) के एक प्रमुख लहसुन उत्पादक क्षेत्र मंदसौर में, कीमतों में उल्लेखनीय वृद्धि देखी गई, जो इस अवधि में ₹9,800 से बढ़कर ₹20,000 प्रति क्विंटल हो गई। यह तेज वृद्धि मुख्य रूप से 2022-23 फसल सीजन के दौरान कम उत्पादन के कारण हुई, जिससे बाजार में आपूर्ति कम हुई और कीमतों पर दबाव बढ़ा।

बीज मसाले

बीज मसालों में, जीरे की कीमतों में उत्पादक और उपभोक्ता दोनों बाजारों में भारी गिरावट आई, जबकि समीक्षाधीन तिमाही के दौरान धनिया की कीमतों में तेजी दर्ज की गई। देश की सबसे बड़ी जीरा मंडी ऊंझा में जीरे की कीमतें ₹56,000 प्रति क्विंटल से गिरकर ₹30,250 प्रति क्विंटल पर आ गईं। इसी अवधि में मध्य प्रदेश के गुना बाजार में धनिया की कीमतें ₹5,925 से बढ़कर ₹6,475 प्रति क्विंटल हो गईं।

जायफल, जावित्री और लौंग

समीक्षाधीन तिमाही के दौरान, छिलके वाले जायफल ने मिश्रित मूल्य प्रवृत्ति प्रदर्शित की, जबकि छिलके रहित जायफल में ₹2,000 प्रति क्विंटल की गिरावट दर्ज की गई। जावित्री की कीमतों में इस पूरी अवधि के दौरान मिश्रित प्रवृत्ति रही। लौंग की कीमतें स्थिर से लेकर मजबूत रहीं, जो समीक्षा अवधि के दौरान ₹1,05,000 प्रति क्विंटल पर रहीं। भारत के प्रमुख बाजार केंद्रों में दर्ज किए गए सप्ताहांत के सुपारी और मसालों के थोक मूल्य निम्नलिखित तालिकाओं में संलग्न हैं।

MARKET REVIEW
(October to December, 2023)

ARECANUT

The price trend of arecanut across major markets showed a marginal decline during the period from October to December, 2023. In Kerala, the price of dry arecanut in the Kozhikode market exhibited a declining trend. In contrast, the Cochin market recorded a steady to firm price movement. Meanwhile, Sirsi (Karnataka State) and Panaji (Goa State) markets also experienced a marginal decline in arecanut prices. Specifically, in the Sirsi market of Karnataka, prices fell from ₹39,688 per quintal in October to ₹38,093 per quintal in December.

BLACK PEPPER

During the period under review, black pepper prices exhibited a declining trend across most of the major markets. In the Cochin terminal market, the price of Malabar Garbled Black Pepper (MG-1) recorded a decrease of ₹1,600 per quintal. Similarly, the Kozhikode market witnessed a decline, with prices falling by ₹2,400 per quintal for Naadan Black Pepper. However, the Kottayam market showed a mixed trend, with prices fluctuating during the period. On average, prices in Kottayam ruled at ₹61,538 per quintal during the review period.

GINGER

During the period from October to December 2023, dry ginger prices remained stable across major markets. In the Kochi market, prices held steady at ₹33,000 per quintal throughout the period under review. A similar trend was observed in the Kozhikode market, where prices of dry ginger ruled consistently at ₹33,500 per quintal.

CHILLY

Dry chilli prices experienced a mixed trend across most markets. Specifically, in the Guntur market, there was a decline of ₹4,000 per quintal within the review period. The Byadagi market recorded an increase in the price of both Dubby and Kaddi variety of Chilli. The prices of Dubby chilli increased from ₹42,209/ quintal to ₹43,679/quintal and that of Kaddi chilli increased from₹33,509/ quintal to ₹44,000/quintal during the period under review.

TURMERIC

Turmeric prices exhibited a mixed trend across key markets during the review period. In the Nizamabad market, the price of turmeric (finger) started at ₹11,922 per quintal in first weekend of October, fluctuated through the quarter, and declined to ₹10,425 per quintal by the end of December. The Cochin market showed price stability, with rates holding steady at ₹13,000 per quintal throughout the period. Meanwhile, both the Salem and Erode markets recorded a modest increase of ₹500 per quintal over the quarter.

GARLIC

Garlic prices increased sharply in almost all the major markets during the quarter under review. In Mandsaur, a key garlic-producing region in Madhya Pradesh (MP), prices showed a significant upward trend, increasing from ₹9,800 to ₹20,000 per quintal over the period. This steep rise was primarily due to lower production during the 2022–23 crop season, leading to tighter market supplies and increased price pressure.

SEED SPICES

Among seed spices, cumin prices declined sharply across both producing and consumer markets, while coriander prices registered an upward trend during the quarter under review. In Unjha, the largest cumin market in the country, prices of cumin dropped significantly from ₹56,000 per quintal to ₹30,250 per quintal. Coriander prices in Guna market of MP increased from ₹5,925 to ₹6,475 per quintal over the same period.

NUTMEG, MACE & CLOVES

During the quarter under review, nutmeg with shell exhibited a mixed price trend, while nutmeg without shell recorded a decline of ₹2,000 per quintal. Mace prices followed a mixed trend throughout the period. Clove prices remained steady to firm, ruling at ₹1,05,000 per quintal during the review period.

Week-end wholesale prices of arecanut and spices recorded in the major market centers of India are appended in the following tables.

WEEKLY WHOLESALE PRICES OF ARECANUT

KERALA **(Rs /quintal)**

Month	Week	Kochi	Kozhikode	Thalassery	Kasaragod
		Dry	Dry New		Dry (Old)
Oct-23	1st	29500	38000	38200	43000
	2nd	29500	37500	38200	42000
	3rd	29500	37400	37400	41000
	4th	29500	37600	38000	41000
Nov-23	1st	29500	38000	38200	41500
	2nd	29500	37800	38200	42000
	3rd	29500	37800	38400	41500
	4th	29500	37800	38200	41500
Dec-23	1st	29500	37500	38000	42000
	2nd	29500	37000	37500	40500
	3rd	29500	37000	37500	40500
	4th	29500	37000	36000	42000
	5th	29500	36000	36000	40000

Source: District Economics and Statistics Office, Ernakulam, Kasargod; Regional Statistical Office, Kozhikode.

TAMIL NADU & GOA **(Rs /quintal)**

Month	Week	Chennai	Shimoga	Sirsi	Panaji
		Rashi	Dry New	Chali	Chali (old)
Oct-23	1st	36000	43596	39688	39500
	2nd	36000	45269	39784	38700
	3rd	36000	46099	39737	39500
	4th	36000	46069	39824	39500
Nov-23	1st	36000	45059	39773	39500
	2nd	36000	45769	39488	36500
	3rd	36000	45698	39603	38500
	4th	36000	45759	39180	36500
Dec-23	1st	36000	45559	38883	38500
	2nd	36000	46089	38805	38500
	3rd	36000	46059	38539	38500
	4th	36000	46858	37697	38500
	5th	36000	47192	38093	38500

Source: Economics & Statistics, Chennai, Agmarknet.gov.in; Directorate of Marketing, Goa

WEEKLY WHOLESALE PRICES OF BLACK PEPPER (Rs /Qunital)

Month	Week	Kochi		Kozhikode		Kottayam
		MG-1	Ungarbled	Nadan	Wayanadan	
Oct-23	1st	63200	61100	60100	61100	61000
	2nd	62900	61100	60000	61000	62000
	3rd	62800	60700	59600	60600	60000
	4th	62900	60900	59800	60800	61000
Nov-23	1st	61600	60100	58800	59800	60000
	2nd	60500	58400	58000	59000	59000
	3rd	61700	59600	58200	59200	64000
	4th	60500	59700	58200	59200	60000
Dec-23	1st	61400	59300	57600	58600	65000
	2nd	61500	59600	57800	58800	63000
	3rd	61300	59400	58000	58500	63000
	4th	60500	58600	57300	58300	61000
	5th	61600	59400	57700	58700	61000

Source: IPSTA. Kochi; District Economics & Statistics, Kottayam ;Regional Statistical Office, Kozhikode

WEEKLY WHOLESALE PRICES OF GINGER (Rs /Quintal)

Month	Week	Kozhikode		Kochi	Chennai
		Dry	Fresh	Dry	Dry (white)
Oct-23	1st	33500	5000	33000	36000
	2nd	33500	8000	33000	36000
	3rd	33500	8000	33000	36000
	4th	33500	8000	33000	36000
Nov-23	1st	33500	8000	33000	35000
	2nd	33500	8000	33000	36000
	3rd	33500	8000	33000	36000
	4th	33500	7500	33000	36000
Dec-23	1st	33500	6000	33000	36000
	2nd	33500	6000	33000	35000
	3rd	33500	6000	33000	35000
	4th	33500	7500	33000	35000
	5th	33500	7000	33000	35000

Source: Regional Statistical Office, Kozhikode; Economics & Statistics, Ernakulam; Dept of Economics & Statistics, Chennai

WEEKLY WHOLESALE PRICES OF CHILLI (Rs /Quintal)

Month	Week	Guntur	Byadagi		Delhi	Chennai	
			Dabbi	Kaddi		Ramnad	Samba-II
Oct-23	1st	23000	42209	33509	25400	18900	26000
	2nd	21500	42509	33529	25400	18900	26000
	3rd	22000	42609	34569	25400	18900	26000
	4th	21000	42569	34609	25400	18900	26000
Nov-23	1st	22000	45009	35119	25000	27000	18900
	2nd	23500	45109	37159	25000	27500	19500
	3rd	20000	45509	37699	25000	27500	20000
	4th	22000	46209	37809	25000	27500	20000
Dec-23	1st	22000	45699	37229	25000	27500	20000
	2nd	23000	45009	38509	25400	27500	20000
	3rd	22500	43509	41699	25400	27500	20000
	4th	22000	44029	43679	25400	27500	20000
	5th	19000	43679	44000	25400	27500	20000

Source: Agmarketnet.gov.in, Directorate of Marketing, Delhi; Dept. of Economics and Statistics, Chennai.

WEEKLY WHOLESALE PRICES OF TURMERIC (Rs /Quintal)

Month	Week	Nizamabad	Kochi	Chennai		Delhi
		Finger	Dry	Erode	Salem	Nizamabad
Oct-23	1st	11922	13000	13500	17000	12300
	2nd	7100	13000	13500	17000	12250
	3rd	7500	13000	13500	16500	12250
	4th	11240	13000	13500	16500	12250
Nov-23	1st	11000	13000	13000	17000	12000
	2nd	11000	13000	13000	17000	12000
	3rd	9006	13000	13500	17000	12000
	4th	10680	13000	13500	17000	12000
Dec-23	1st	10506	13000	14000	17500	11200
	2nd	10560	13000	14000	17500	11200
	3rd	11727	13000	14000	17500	11200
	4th	10925	13000	14000	17500	11200
	5th	10425	13000	14000	17500	11200

Source: Agmarknet.gov.in; Dept of Economics and Statistics, Chennai; Economics and Statistics, Kochi; Dept of Agricultural Marketing, New Delhi

WEEKLY WHOLESALE PRICES OF MAJOR SEED SPICES & GARLIC (Rs /Quintal)

Month	Week	Coriander	Cumin		Garlic
			Chennai	Unjha	
		Bangalore	No.1	FAQ	Mandsaur
Oct-23	1st	5925	64000	56000	9800
	2nd	5850	64000	53500	9000
	3rd	5850	64000	53000	10050
	4th	5850	62000	46500	10200
Nov-23	1st	6100	59000	40000	10800
	2nd	6050	57000	43875	11000
	3rd	6100	55000	43775	12650
	4th	6550	55000	44750	15475
Dec-23	1st	6575	50000	44250	19000
	2nd	6100	50000	36750	17750
	3rd	6350	50000	37925	16500
	4th	6475	50000	37125	14000
	5th	6475	49000	30250	20000

Source: Agmarknet.gov.in; and Dept of Economics & Statistics, Chennai

WEEKLY WHOLESALE PRICES OF NUTMEG & CLOVE (Rs /Quintal)

Month	Week	Thrissur			
		Nutmeg		Mace	Cloves
		With shell	Without shell	Yellow	
Oct-23	1st	23000	44000	150000	105000
	2nd	24000	43000	150000	105000
	3rd	23000	42500	150000	105000
	4th	23000	42500	150000	105000
Nov-23	1st	23000	43000	140000	105000
	2nd	23000	42000	140000	105000
	3rd	22000	41000	140000	105000
	4th	22500	43000	140000	105000
Dec-23	1st	23000	43000	140000	105000
	2nd	22000	42500	145000	105000
	3rd	28000	42500	150000	105000
	4th	23000	42000	150000	105000
	5th	23000	42000	145000	105000

Source: Economics and Statistics, Thrissur.

STATISTICS 2022-23

1. All India Final Estimates of Area, Production and Productivity of Spices, Arecanut and Betel Leaves

Crops	2022-23 (FINAL)		
	Area ('000 ha)	Production ('000 tonnes)	Yield (kg/ha)
Black Pepper	299.053	117.067	391
Ginger (Fresh)	190.959	2201.187	11527
Red Chillies	851.607	2782.009	3267
Turmeric (Dry)	320.782	1169.982	3647
Garlic	386.832	3239.453	8374
Cardamoms	86.516	36.212	419
Coriander	710.613	973.973	1371
Cumin	937.596	577.273	616
Fennel	88.299	151.937	1721
Fenugreek	145.363	229.841	1581
Ajwan	43.098	39.019	905
Dill/Celery	31.836	42.826	1345
Cinnamon/Tejpat	2.207	4.999	2265
Nutmeg	24.250	18.094	746
Clove	1.952	1.270	651
Tamarind	38.855	151.282	3894
Vanilla	0.105	0.065	619
Mint (Mentha)	347.461	35.117	101
Saffron	3.435	0.0025	1
Curry Leaf	4.144	58.548	14128
SPICES (TOTAL)	**4514.963**	**11830.157**	**2620**
Arecanut	**938.158**	**1368.939**	**1459**
Betel Leaves	**31.141**	**706.108**	**22675**

2. State-wise Final Estimates of Area, Production and Productivity of Arecanut

State	2022-23 Final		
	Area ('000 ha)	Production ('000 tonnes)	Yield (kg/ha)
Andhra Pradesh	3.374	20.244	6000
Arunachal Pradesh	0.827	3.679	4449
Assam	67.353	41.854	621
Goa	2.081	3.963	1904
Karnataka	674.81	1024.117	1518
Kerala	94.553	98.527	1042
Maharashtra	3.56	4.176	1173
Meghalaya	34.41	51.65	1501
Mizoram	21.418	33.54	1566
Nagaland	0.232	1.352	5828
Odisha	0.642	1.601	2494
Tamil Nadu	10.782	21.889	2030
Tripura	7.335	24.975	3405
West Bengal	12.493	24.791	1984
Andaman & Nicobar Islands	4.247	12.519	2948
Pondicherry	0.041	0.062	1512
All India	**938.158**	**1368.939**	**1459**

3. State-wise Final Estimates of Area and Production of Betel Leaves

State	2021-22 (Final)		2022-23 (Final)	
	Area ('000 ha)	Production ('000 tonnes)	Area ('000 ha)	Production ('000 tonnes)
Andhra Pradesh	2.138	51.322	1.816	25.424
Assam	0.205	1.998	0.205	1.998
Goa	0.001	0.000	0.001	0.000
Karnataka	3.828	14.563	3.173	24.787
Kerala	0.243	8.653	0.207	7.051
Madhya Pradesh	0.573	0.355	0.609	0.356
Maharashtra	-	-	0.023	0.006
Nagaland	0.125	0.439	0.147	0.763
Odisha	2.741	41.055	2.741	41.055
Rajasthan	0.015	0.553	0.146	0.350
Tamil Nadu	1.562	24.933	1.550	21.700
Telangana	0.008	0.127	0.008	0.127
Tripura	0.584	7.942	0.567	7.632
Uttar Pradesh	0.265	21.245	0.265	21.245
West Bengal	20.315	559.120	19.681	553.560
Pondicherry	-	-	0.002	0.054
TOTAL	**32.603**	**732.305**	**31.141**	**706.108**

4. Item-wise Export of Spices from India 2022-23

Item	Quantity (tonnes)	Value (Rs Lakhs)	Value (Million US $)
Pepper	17,958	72,686	90.46
Cardamom (Small)	7,352	87,515	108.91
Cardamom (Large)	1,883	13,720	17.07
Chilli	516,177	1,044,412	1,299.76
Ginger	50,885	43,246	53.82
Turmeric	170,085	166,699	207.46
Coriander	54,481	66,501	82.76
Cumin	186,509	419,360	521.89
Celery	5,248	7,756	9.65
Fennel	21,201	31,437	39.12
Fenugreek	35,055	26,680	33.20
Other Seeds (1)	57,431	48,089	59.85
Garlic	57,346	24,580	30.59
Nutmeg & Mace	3,447	22,128	27.54
Other Spices (2)	116,269	193,701	241.06
Curry Powder/ Paste	57,924	141,689	176.33
Spice Oils & Oleoresins	18,398	408,551	508.44
Mint Products (3)	26,708	357,386	444.77
Total (Including others)	**1,404,357**	**3,176,138**	**3,952.68**

(1) Include bishops weed (ajwan seed), dill seed, poppy seed, aniseed, mustard etc.
(2) Include asafoetida, cinnamon, cassia, cambodge, saffron, spices (nes) etc.
(3) Include menthol, menthol crystals and other mint oils.

Source: Spices Board India

5. Item-wise Export of Spices from India 2022-23

Item	Quantity (tonnes)	Value (Rs Lakhs)	Value (Million US $)
Pepper (1)	35905	134024	167.50
Cardamom (Small)	567	5092	6.36
Cardamom (Large)	9403	48840	61.04
Chilli / Paprika	2698	6860	8.57
Ginger Fresh / Dry	32172	18154	22.69
Turmeric	16769	19579	24.27
Coriander	31383	20962	26.20
Cumin Black / White	2013	4396	5.49
Others Seeds (2)	1490	1712	2.14
Poppy Seed	24728	64250	80.30
Garlic	3014	2497	3.12
Clove	17986	83828	104.77
Nutmeg	1234	6363	7.95
Mace	2169	27184	33.97
Cassia	38545	87120	108.88
Star Anise	6741	37141	46.42
Other Spices (3)	109070	123776	154.69
Spices Oils & Oleoresins	4756	106440	133.03
Mint Products (4)	4474	48653	60.81
Caraway/Fennel	10927	19873	24.84
Tamarind	1058	2057	2.57
Cinnamon	2192	7217	9.02
Asafoetida	1441	150362	187.92
Curry Powder/Paste	7960	20372	25.46
Herbal Spices (5)	8206	10960	13.70
TOTAL	**376900**	**1057712**	**1321.91**

1. Include white pepper, light pepper and black pepper
2. Include mustard, celery, ajwan, juniper berry, fenugreek, dill and badian
3. Include saffron, kokam, vanilla, spices husk/spent and spices nes
4. Include menthol, menthol crystals and other mint oils.
5. Include basil, hyasop, rose mary, sage, savory, mint, incl. leaves (all species), garcinia and greater galangal etc.

Source: Spices Board India

STATEMENT OF OWNERSHIP AND OTHER PARTICULARS ABOUT THE JOURNAL "INDIAN JOURNAL OF ARECANUT, SPICES AND MEDICINAL PLANTS"

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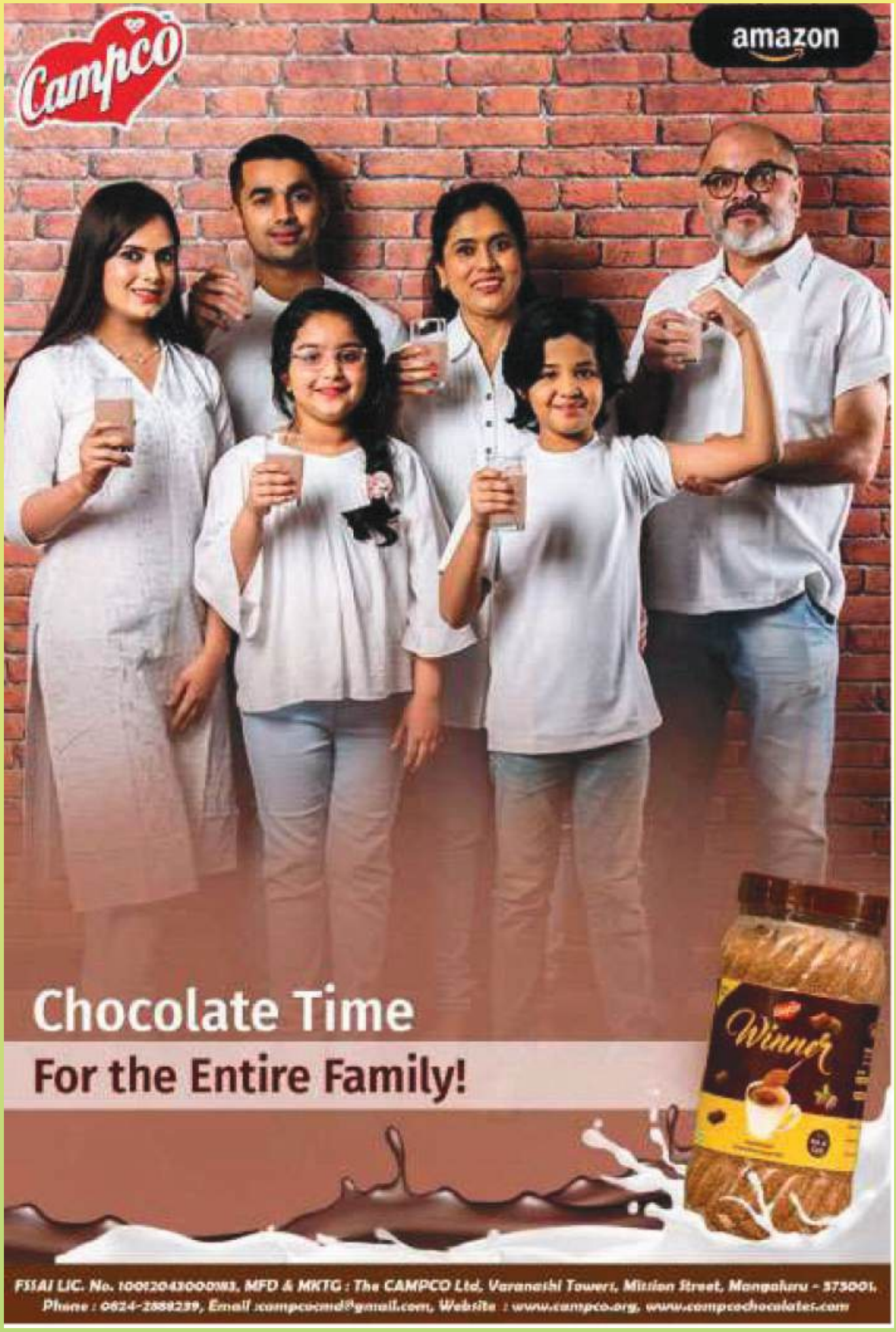
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