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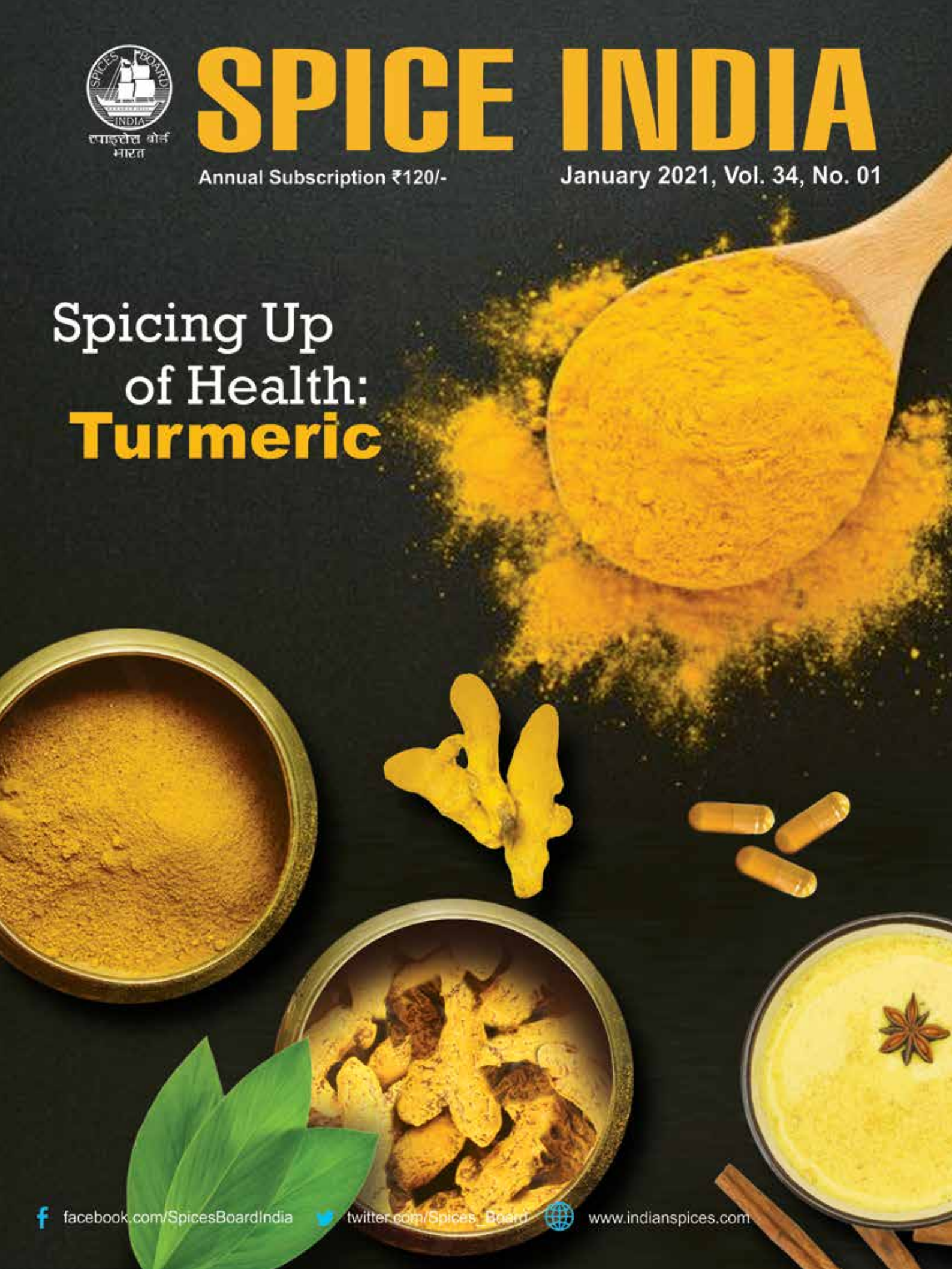
Spicing Up of Health: Turmeric



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Spicing Up of Health: Turmeric

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Turmeric (*Curcuma longa* Linn.), a perennial herb and member of the Zingiberaceae family, is cultivated extensively in Asia; mostly in India and China. It is known as the 'golden spice' as well as the 'spice of life'. India is the major producer, consumer and exporter of turmeric. Turmeric has strong associations with the sociocultural life of Indians that they cannot even think of a day without using turmeric in one form or another.

In India, the earliest mention on the use of medicinal plants is found in 'Rigveda' which was written between 4500-1600 BCE. Turmeric (Haridra) is one such medicinal plant that is explained extensively in ancient Indian texts, especially in the 'Indian material medica' (*Dravyaguna Sastra*). Believed to have originated in the Indo-Malayan region, turmeric reached China by 700 CE, East Africa by 800 CE, West Africa by 1200 CE and history reveals that the

Arab traders carried turmeric with them to Europe in the 13th century. Marco Polo, the famous voyager, wrote about turmeric in 1280 CE as 'I have found a plant that has all the qualities of saffron, but it is a root'. This shows that the western world was unaware of turmeric whereas in all the South Asian countries, turmeric has been in use since ancient times as a spice, food preservative, coloring agent, cosmetic, and in the traditional systems of medicine (Ayurveda, Sidha, Unani, and Tibetan).

In Sanskrit, turmeric has about 55 synonyms that are associated with its religious or medicinal uses, However, the most common used Sanskrit name is 'Haridra', which can be translated as 'the yellow one'. Other famous names used are *Aushadhi, Gauri*, and *Kanchani*. In English, turmeric was also known as the 'yellow root' and 'Indian saffron'. The name turmeric originated from the medieval Latin name 'terra merita' which means deserved earth or meritorious earth. In Indian languages, it is known by various names such as *Haldi* in Hindi, Assamese, and Odia; *Manjal* in Malayalam and Tamil; *Holud* in Bengali; *Halada* in Gujarati; *Halad* in Marathi, *Arishina* in Kannada; *Pasupu* in Telugu, *Haldhor* or *Haldhar* in Punjab and in Urdu as *Haladi*.

The rhizome or underground stem of turmeric is the part used for medicinal purposes as it has numerous biologically active compounds. Among the active compounds, the main constituent group is of three curcuminoids: curcumin (diferuloylmethane), demethoxycurcumin and bisdemethoxycurcumin. Apart from curcuminoids, it also possesses volatile oils/sesquiterpenes (turmerone, atlantone, zingiberone, turmeronol, germacrone, and bisabolene), carbohydrates, protein, resins, and caffeic acid. The yellow-pigmented curcuminoids usually represent 0.3 - 5.4 per cent of the raw turmeric and curcumin, which is the most well studied constituent, makes up approximately 90 per cent of the curcuminoid content in turmeric.

In the traditional systems of medicine in India and China, turmeric has been used as an anti-inflammatory agent, for treatment of jaundice, menstrual difficulties, hematuria, hemorrhage, and colic since time immemorial. However, in the western world serious research on turmeric began only during the early 1920s in Germany. Herbalists consider turmeric as one of the greatest gifts of Mother Nature because of its curative properties and many of the historic uses of turmeric have been scientifically validated with application in modern times. Numerous studies have been carried out with the powder and crude extracts of turmeric for their various biological activities. These include anti-inflammatory, antioxidant, anti-carcinogenic, anti-diabetic, hepatoprotective, anti-rheumatic, cardioprotective, antibacterial, anti-fungal, and antiviral activities.

A brief highlight of the effectiveness of this spice found against various health related issues through clinical studies are mentioned below.

1. **Anti-inflammatory Property:** Curcumin, the active and most potent component of turmeric, is able to decrease inflammation by interacting with many inflammatory processes. On clinical trial, it was found that oral administration of curcumin is as effective as cortisone or phenylbutazone in treating acute inflammation. Turmeric's anti-inflammatory properties may be attributed to its ability to inhibit both biosynthesis of inflammatory prostaglandins from arachidonic acid and neutrophil function during inflammatory states.

2. **Antioxidant Property:** Turmeric possesses antioxidant property due to β – diketone group in the structure of curcumin and this property has been implicated through its various pharmacological trials. Water and fat soluble extracts of turmeric and its curcumin component exhibit strong antioxidant activity at par with vitamin C and E. A study revealed that curcuminoids act as antioxidants which are eight times stronger than Vitamin E and also increase the number and activity of free radical destroying enzymes like superoxide dismutase, catalase and glutathione peroxidase. Thus, antioxidant property of turmeric is very effective in keeping a person in good health condition.

3. **Anti-carcinogenic Property:** There has been substantial clinical research on anti-carcinogenic properties of turmeric against various forms of cancers including colorectal, prostate, oral, blood and breast cancers. Curcumin has been found to possess anti-cancer activities via its effect on a variety of biological pathways involved in mutagenesis, oncogene expression, cell cycle regulation,

apoptosis, tumorigenesis and metastasis. Clinical trial on animals demonstrates inhibition at all the three stages of carcinogenesis - initiation, promotion and progression. During initiation and promotion, curcumin modulates transcription factors controlling phase I and II detoxification of carcinogens; down-regulates pro inflammatory cytokines, free radical-activated transcription factors, arachidonic acid metabolism vicyclooxygenase, lipoxygenase pathways and scavenges free radicals. In both *in vitro* and *in vivo* studies, it was found that turmeric and curcumin are also capable of suppressing the activities of several common mutagens and carcinogens in a variety of cell types. The anti-carcinogenic properties of turmeric and curcumin are due to direct antioxidant and free-radical scavenging properties, as well as their ability to indirectly increase glutathione levels, thereby aiding in hepatic detoxification of mutagens and carcinogens and inhibiting nitrosamine formation. Curcumin also induces apoptosis of cancer cells and inhibits angiogenesis. Clinical trial also revealed that application of both curcumin and turmeric extract during carcinogenesis and promotion resulted in less papilloma production. This indicates that both curcumin and turmeric extracts have anti-cancerous property.

4. **Anti-diabetic Property**: Recent research has provided scientific basis for the traditional use of turmeric in prevention and treatment of diabetes and its associated disorders. The result indicates that turmeric may have an effect on insulin secretion by pancreas. The active principles in the rhizome of turmeric plant viz; curcumin could favorably affect most of the leading aspects of diabetes, including insulin resistance, hyperglycemia, hyperlipidemia, and islet apoptosis and necrosis. Curcumin involved in the process of lower lipid peroxidation by maintaining the activities of antioxidant enzymes like superoxide dismutase, catalase, and glutathione peroxidase at higher levels prevents the deleterious complications of diabetes.

5. **Hepatoprotective Property:** Turmeric is known to have a hepato (liver) protective characteristic similar to 'silymarin'. Studies have demonstrated turmeric's hepatoprotective properties from a variety of hepatotoxic injuries including carbon tetrachloride (CCl^4) galactosamine and acetaminophen

(paracetamol). Its hepatoprotective effect is mainly a result of antioxidant properties and free radical scavenging mechanisms, as well as the ability to indirectly augment glutathione levels, thereby aiding in hepatic detoxification.

6. **Anti-rheumatic and Anti-arthritic Property:** Curcumin, as an anti-inflammatory and antioxidant compound, possesses anti-rheumatic and anti-arthritic properties. Turmeric is useful in relieving the symptoms of osteoarthritis. A clinical trial revealed that when curcuminoids are administered orally in various formulations, significant improvements in arthritic symptoms, such as stiffness, walking pain and joint inflammation, were found. In a trial on comparison of efficacy between curcuminoids and positive controls (nonsteroidal anti-inflammatory drugs [NSAIDs]), the potency of NSAID treatment was not superior to (not significantly different than) that of the curcuminoid preparations, which depicts the tremendous potentiality of curcumin as anti-rheumatic and anti-arthritic.

7. **Cardiovascular Protective Property:** Pharmacological trial on cardiovascular protective properties of turmeric revealed its efficacy on lowering the cholesterol and triglyceride levels, decreasing susceptibility of Low Density Lipoprotein (LDL) to lipid peroxidation and inhibiting platelet aggregation. Turmeric extract's effect on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increased conversion of cholesterol to bile acids in the liver. Inhibition of platelet helps in protection against by *C. longa* constituents is thought to be via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis. The antioxidants in turmeric also prevent damage to arteries by lowering cholesterol, thereby helping to protect against atherosclerosis. As the antioxidant activities of turmeric are not degraded by heat (unlike most vitamins), even using the spice in cooking provides benefits. This shows the immense potentiality of turmeric in protecting cardiovascular system.

8. **Antibacterial Property:** Bacterial infections are very common and prevalent among the important infectious diseases. Clinical studies have revealed that turmeric rhizomes have antibacterial effects. Inhibitory property is due to the curcuminoid and oil. Turmeric suppresses the growth of several bacteria like *Staphylococcus aureus* (causing both community and hospital acquired infections and most important causative agent of bloodstream bacterial infections worldwide), *Streptococcus pneumonia* (causing pneumonia and meningitis and also causes sepsis among children), *Klebsiella pneumonia* (causes wounds or surgical site infections, pneumonia and meningitis), *Pseudomonas aeruginosa* (causes infections of urinary tract, respiratory system, bone and joints as well as dermatitis) and *Escherichia coli* (causes urinary tract infection and cholecystitis). It also acts against *Helicobacter pylori*, which nowadays emerge as drug resistant and possesses ability to establish infections in the human stomach and persist there for several years causing peptic ulcer disease, gastritis and gastric cancer. Researchers revealed that more than half the people worldwide are carrying *H. pylori;* and curcumin is found to be highly effective in complete eradication of *H. pylori* in mice and it also restores *H. pylori* induced gastric damage. Curcumin also exhibited a synergistic effect in combination with some antibiotics, including ampicillin, oxacillin, norfloxacin and ciprofloxacin against Methicillin-Resistant *S. aureus* strain (MRSA).

9. **Anti-fungal Property:** Millions of fungal species can be found worldwide, but only a few are human pathogens. A clinical trial revealed that curcumin has been shown to block the adhesion of *Candida* spp. (adhere to epithelial cell mostly on skin, mucosa of the gastrointestinal tract and mouth. It causes Candidiasis and can become invasive leading to systemic infections of the blood and candidemia) to buccal epithelial cells and thus suppresses its growth. In clinical trial, it was found that curcumin alone or with fluconazole significantly reduce pulmonary damage and fungal burden of *Cryptococcus gattii*. Pharmacological study revealed that curcumin does not directly act as antifungal on *Aspergillus spp*. However, it was shown to reduce the aflatoxin production and acts beneficial on aflatoxin-induced liver and kidney injury in mice and chicken. In a clinical trial, it was found that curcumin inhibited the conidia-derived and mycelial-derived growth of

29 dermatophytes (important group of fungi consisting of over 40 species in the genera of Microsporum, Epidermophyton, and Trichophyton) causing skin infections called tinea or dermatophytosis.

10. **Antiviral Property:** Several studies have reported that turmeric exhibits antiviral properties. A clinical study on use of curcumin against HIV (Human Immunodeficiency Virus), commonly known as AIDS (Acquired Immuno Deficiency Syndrome), revealed that it acts in several ways against HIV, which include inhibition of HIV-1 and HIV-2 proteases, directly targeting the viral protein, inhibition of Tat protein acetylation, and inhibition of HIV-1 Integrase. Furthermore, in patients with HIV, treatment with turmeric represents a promising strategy to minimize side effects of antiretroviral therapy (ART). Curcumin showed anti-influenza activity against influenza viruses PR8, H1N1, and H6N1. In H1N1 and H6N1 sub types, the inhibition of haemagglutinin interaction reflected the direct effect of curcumin on infectivity of viral particles. The use of curcumin against the human RSV (Respiratory Syncytial Virus) infections revealed that it prevented RSV replication and budding from human nasal epithelial cells and at the same time increased the epithelial barrier function, but it did not affect RSV in lung cells. In case of arbovirus *viz.*, Dengue Virus (DENV) and Japanese Encephalitis Virus (JEV), in addition to inhibiting virus entry, curcumin treatment of cells already infected with DENV or JEV resulted in the reduction of intracellular accumulation of viral proteins and reduction of viral particle production. Thus, turmeric in near future may play a crucial role against viral diseases.

In a recent clinical study conducted at Liverpool, it was found that turmeric compounds have the potential to inhibit the SARS-CoV-2 main protease, spike glycoprotein and the RNA dependent RNA polymerase. It also exhibited conspicuous inhibition potential for the main protease of COVID-19 at a level comparable to ritonavir medication. It has been found that the turmeric compounds bind to the Receptor Binding Domain (RBD) of the spike protein like hydroxychloroquine and chloroquine. However, considering the fatal side effects of hydroxychloroquine and chloroquine, the potential use of turmeric compounds to inhibit Covid-19's spike protein becomes more important and the study is under progress.

11. **Anti-asthmatic Property:** Asthma is a chronic inflammatory disease identified by a reversible airflow obstruction and bronchospasm with variable intensity. Curcumin has been widely used in ancient Indian medicine for allergy and asthma treatment. Presently, several studies have found that curcumin has a powerful activity both *in vitro* and *in vivo* against asthma by enhancing upregulation of the epithelial barrier function and without cytotoxicity. It is proved to treat lower respiratory tract diseases in young children and infants. Clinical trial of intranasal curcumin in blood plasma and lung tissue of mice showed potency against asthma by bronchoconstriction inhibition and recruitment of inflammatory cells in lungs. This study evidenced the possibility of curcumin to be used in nasal drops. Other studies have described that curcumin can improve the elimination of nitric oxide and decrease the nitric oxide synthase activity. This might be a mechanism of curcumin which could prevent the bronchial inflammation in asthmatic patients. Curcumin also serves to retain breathing after asthma attack.

12. **Neuroprotective Property:** Neurological disorders are the disorders of central and peripheral nervous system. It produces epilepsy, Alzheimer's disease, Parkinson's disease, depression, and traumatic disorders of the nervous system. Several studies conducted on neuroprotective properties of turmeric and the ability of turmeric to prevent the development of neurodegenerative diseases such as Alzheimer's and Parkinson's are specifically due to its anti-inflammatory and antioxidant properties.

The development of Alzheimer's is mainly attributed to environmental factors, in particular: diet, smoking, cardiovascular diseases, type 2 diabetes, and serious cranio-cerebral injuries. Clinical studies have shown that curcumin can bind Aβ and enhance Aβ cellular uptake, avoiding plaques deposition thus influencing the peptide aggregation and inhibiting fibrils formation and elongation, which resulted in reduction of cellular damage. By this mechanism, curcumin helps to prevent Alzheimer's. While, Parkinson's disease is characterized by the abnormal accumulation and aggregation of the presynaptic

protein α-synuclein in the dopaminergic neurons as Lewy bodies (LBs). Curcumin was found to directly modulate the aggregation of α-synuclein in *in vitro* as well as in *in vivo* pharmacological studies. Oral and intravenous administration of curcumin was able to modulate dopaminergic damage suppressing apoptosis, inducing microglial activation and improved locomotion.

Depression is another neurological disorder mostly faced by people in this fast moving and competitive world. Clinical studies showed that treatment with curcumin altered the biomarkers of depression and improved the mood of the patients. Several studies were conducted in this regard and have shown that turmeric is safe and effective for the treatment of patients with depressive disorder.

13.**Gastrointestinal Disorders:** Turmeric is used for treating upset stomach, abdominal cramps, and flatulence. In clinical study, it was found that extracts of turmeric reduced secretion of acid from the stomach and protected against injuries such as inflammation along the stomach or intestinal walls, and ulcers caused from certain medications, stress, or alcohol. In another study to assess the effects of turmeric extract on irritable bowel syndrome (IBS) in healthy adults, it was found that the IBS prevalence decreased remarkably.

14. Protection from Eye Disorders: Age-related cataractogenesis is a significant health problem worldwide. Oxidative stress has been suggested to be the common underlying mechanism of cataractogenesis. The superoxidase dismutase and catalase enzyme activities of curcumin seems to prevent oxidative damage and found to delay the development of cataract. These studies suggest that curcumin may be an effective protective agent against cataractogenesis induced by Light Perception Only (LPO).

15. **Wound Healing Property:** Tissue repair and wound healing are complex processes that involve inflammation, granulation, and remodelling of the tissue. Clinical trials exhibit that curcumin significantly accelerated healing of wounds. Biopsies of the wound showed re-epithelialization of the epidermis and increased migration of various cells including myofibroblasts, fibroblasts, and macrophages in the wound bed. Multiple areas within the dermis showed extensive neovascularization and Masson's trichrome staining showed greater collagen deposition in curcumin-treated wounds.

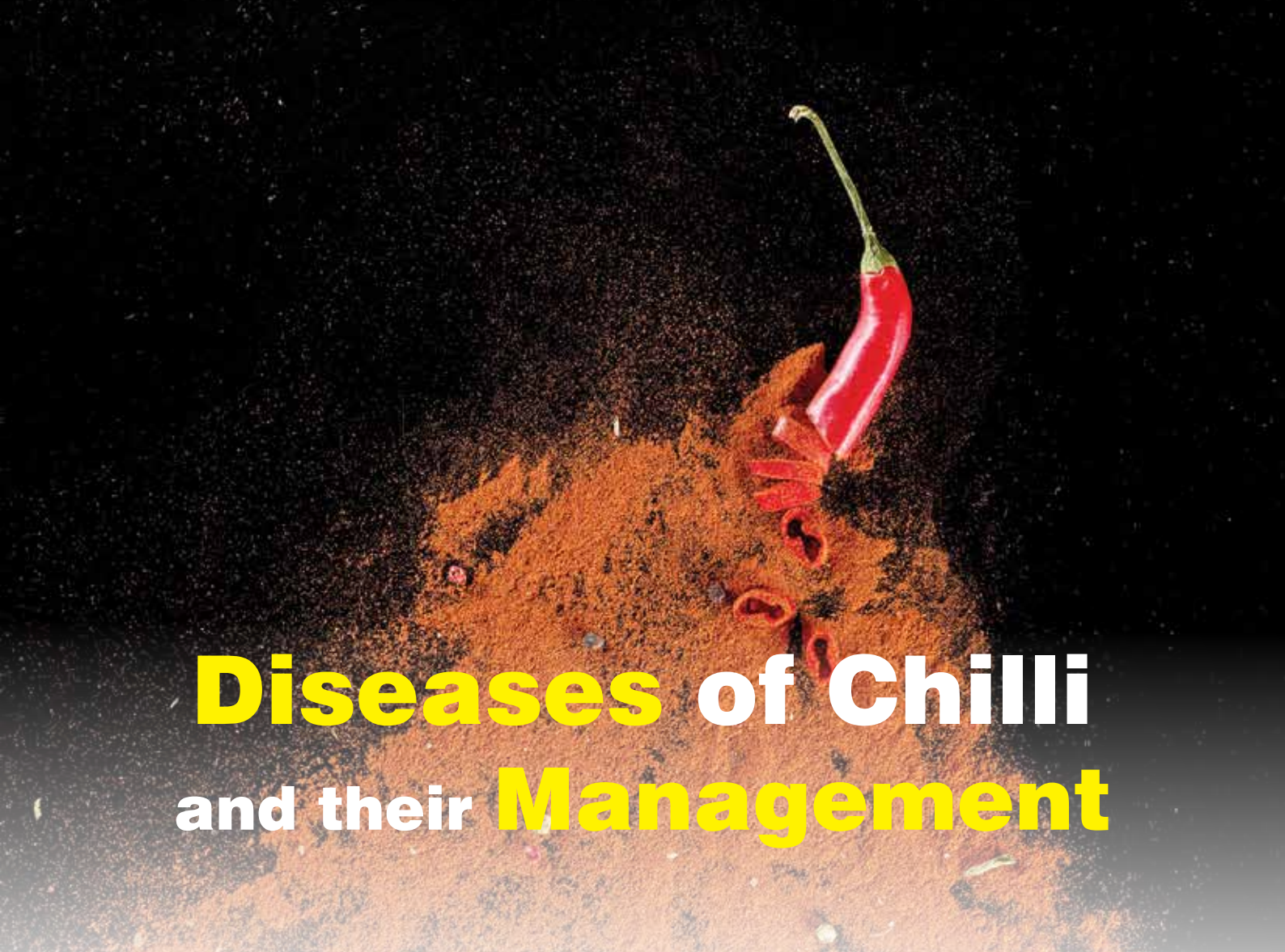
In the light of the above facts, it can be concluded that turmeric has immense potential in medicinal usages. Since ancient times, turmeric has been used in ayurvedic medicine with various biological applications. In the United States of America, turmeric has been granted 'Generally Recognized as Safe' (GRAS) status by the FDA. Nowadays, researchers find enthusiasm in treating various diseases and disorders with natural products. Although, some work has been done on the possible medicinal application of turmeric, not much study was done for drug development yet. Curcumin is a nontoxic, highly promising natural antioxidant compound having a wide spectrum of biological functions. Curcumin is now available in pure form, which shows a wide spectrum of biological activities, and it would be easier to develop new drugs from this compound after extensive studies on its mechanism of action and pharmacological effects. Studies have indicated that curcumin is nontoxic to humans even at a dose of 8000 mg/day taken continuously. No significant toxicity has been reported following short or long-term administration of turmeric extracts at standard doses. It is expected that curcumin may find application as a novel drug in near future to control various diseases, disorders, and oxidative stress.

Sources:

Krup V, Prakash LH, Harini A (2013) Pharmacological Activities of Turmeric (*Curcuma longa linn*): A review. J Homeop Ayurv Med 2: 133.doi:10.4172/2167-1206.1000133

Louay Labban (2014). Medicinal and pharmacological properties of Turmeric (*Curcuma longa*): A review. *Int J Pharm Biomed Sci*. 5(1):17-23.

Sarker S. D. and Nahar L.(2007) Bioactivity of Turmeric. Turmeric: the genus Curcuma edited by P.N. Ravindran, K. Nirmal Babu, and K. Sivaraman pp.257-296.



Diseases of Chilli and their Management

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India is the largest producer and exporter of chilli (*Capsicum annum* L.) in the world. Chilli suffers due to diseases caused by fungi, bacteria, viruses, and nematodes which makes the plant weak resulting in losses both in terms of quantity and quality. It is necessary to have an integrated pesticide management to get chilli acceptable to international market. For healthy and higher production of chilli, diagnosis of diseases are important. Major diseases of chilli, their symptoms and current management practices are described here.

1. Damping-off

Damping-off is of common occurrence in nursery beds and young seedlings, resulting in reduced seed germination and poor stand of seedlings. A number of fungi like species of *Pythium, Phytophthora, Fusarium* and *Rhizoctoria*, are associated with the disease.

Symptoms: Damping-off of chilli occurs in two stages viz; pre and post emergence, based on the time of infection. If the infection takes place before the hypocotyl breaks the seed coat or as soon as the radicle and the plumule emerge out of seeds, the seedlings disintegrate before they come out of soil surface. This is referred to as pre-emergence damping-off which results in poor field emergence/ poor seed germination. The second phase i.e., post emergence damping-off is characterized by development of disease after the seedlings emerged out of soil surface but before the stems are lignified. The infection results in lesion formation on the collar region giving a pinched appearance. The infected areas appear brown and water soaked. As a result of

Chilli nursery

softening of the tissue, the plants shrivel and collapse. When conditions are favourable, this disease causes 90 per cent killing of seedlings.

Management:

1. There should be thin sowing to avoid overcrowding.
2. Growing chilli nursery in light soil, light irrigation, proper drainage, and application of well decomposed farm yard manure do not favour pathogen development and thus reduces the chances of damping-off.
3. Rotation of 2-3 years with non-host crops and raised nursery beds reduce the disease.
4. The nursery beds should be at a raised level to maintain good drainage.
5. In chemical control, fungicide (Captan) is recommended for dry seed treatment at 2.5-3 g/kg seed.
6. Biological agents like *Rhizobacteria - Azospirillum* sp., *Azotobacter* sp. and *Pseudomonas fluorescens* are useful in improving emergence of seedling and reducing the damping - off caused by *Rhizoctonia solani*. Good control of damping -off caused by *Pythium* sp; has been observed by using *Trichoderma viride*, *T. harzianum* and *Laetisaria arvalis*. These antagonists are as effective as recommended fungicides.
7. Integrated schedule of managing the damping-off by tarping the field with clear plastic for two months during the hot summer followed by two sprays of metalaxyl in the crop. This treatment is effective and economical.

2. Anthracnose (die back)

Anthracnose is caused by fungus (*Colletotrichum capsici*). On leaves, small, irregular, brownish black scattered spots appear. Severely infected leaves fall off leading to defoliation. The infection on growing tips leads to necrosis of branches which progresses backwards. The entire branch or top becomes dark brown to black in color but with time such necrotic tissues appear grayish white and wither away. The die back symptoms starts from the top and in severe cases may kill the plant. Only few fruits of poor quality are produced on the disease affected plants. On green as well as ripe fruits, small, circular, yellowish to pinkish sunken spots appear. These become brownish to black with time. Severely infected fruits are discoloured.

Management:

1. Since the fungus is seed borne, disease free seeds harvested from healthy fruits should be used.
2. Removal of *Solanaceous* weed hosts and infected crop debris is useful in reducing the primary inoculums.
3. Seed borne infection can be controlled by seed treatment with Carbendazim at 2 g /kg seed and Captan at 3 g /kg seed.
4. Judicious use of fertilizer and irrigation also take care of the disease.
5. Weeds and other alternate host such as black gram and cowpea should not be allowed to grow in the vicinity of chilli fields.
6. Grow resistant varieties viz. B 61, Lorai, K. Surekkh, G. 4, Chemthor.
7. Varieties such as Arka Lohit, Jayant, Phule-C-5 and X-235 are resistant to dieback.
8. Crop should be protected by fungicidal sprays viz. Dithane M-45(0.2%), Copper oxychloride (0.3%), Carbendazim 50 WP (0.1%), Score 25 EC (0.05%).
9. Vermi wash alone or in combination with cow urine (0.5 litre + 0.5 litre in 15 litre water) can manage this fungal disease.

3. Powdery mildew

Powdery mildew is caused by fungus (*Leveillula taurica).* The first symptoms are tiny, white superficial spots on leaves which become powdery as they enlarge. The superficial white powdery mass may ultimately cover the entire leaf surface. The effect of severe infection may be a premature defoliation of the plant. The fruits remain undersized.

Management:

1. Field sanitation is important.
2. Diseased plant refuge should be collected and burnt in the field.

Field drying of chilli

Grading of chilli in the field

3. Foliar spraying of Karathane (0.1%) or Calixin (0.1%) or Systhane (0.05%), or Mycobutanil 10 WP (0.05%) is recommended to control this disease.

4. Powdery mildew disease can be organically managed through foliar spray of two kilogram (2 kg) Haldi powder and eight kilogram (8 kg) Raakh per ha.

5. Bioagent - *Ampelomyces quisqualis* fungus is a natural parasite of powdery mildew. This parasitism reduces growth and kills the mildew colony in chilli.

4. Bacterial leaf spot

Bacterial leaf spot is caused by *Xanthomonas vesicatoria*. This disease is mainly seed-borne but sometimes it is also soil borne. This pathogen is reported to have several alternate hosts. Small, dark and greasy yellowish green spots develop on the leaves, followed by chlorosis and severe leaf drop. Discolouration and vertical lesions can also be seen on stem. On green fruits small, water soaked spots develop, whereas ripe fruits remain unaffected.

Management:

1. To manage this disease, suitable crop rotation and burning of disease debris is recommended.

2. In nursery and field, plants may be sprayed with copper fungicide such as Blitox 50 WP (0.3%) or antibiotics such as streptocycline and agrimycin-100 (0.01 to 0.02%).

3. Varieties Pant C-1, Sabour Angar, J-218, G-2, G-5 and KCS-1 are reported moderately resistant to this disease.

5. Leaf curl

Leaf curl disease is important and causes heavy losses in the yield and quality of fruits. This disease is caused by tobacco leaf curl, a Gemini virus. The virus has a very wide host range. It is transmitted by an insect, white fly named *Bemisia tabaci*. It is not transmitted by sap, plant contact or seed.

Symptoms: Initially the leaves become pale yellow in colour, followed by slight curling. The interveinal

areas are puckered, there is shortening of the internodes and reduction of size of the leaves giving the plants witches' broom appearance. Fruit formation is rudimentary and distorted.

Management:

1. A combination of use of resistant varieties, barrier/ trap crops, and insecticides against the vectors has been found successful in reducing disease intensity.
2. Destroy the affected plants by burning.
3. Use healthy plants from healthy nursery for transplanting.
4. For vector control, spray Dimethoate 30 EC or Methyl demeton 25 EC at 1 ml/ litre of water. After flowering, use malathione 50 EC at 1 ml/litre of water for vector controls. Foliar spray of Neem seed kernel extract at 0.5 % also can be used.
5. For integrated pest management module in chilli sprays- Azadirachtin 0.03%, Verticillium fungus, spinosad 45sc at 200 ml/ha can be used.
6. For organic management of leaf curling, follow intercropping chilli with bajra, til (sesame), wheat or barley as non host barrier crop for vector.
7. The variety AVRDC-105 is less affected by leaf curl.

6. Mosaic

Mosaic is caused by the cucumber mosaic virus or cumus virus-1. Symptoms of chilli mosaic are appearance of yellow and dark green areas on the leaf surface followed by puckering. In severe cases the leaves are greatly reduced in size and become filamentous and reduction in lamina. Disease affected plants are stunted, compact, bushy and produce less flowers and pods. The pods are usually deformed and rough. Mosaic disease is both sap and aphid transmissible.

Management:

1. Planting of maize as barrier crop is helpful in reducing the incidence of mosaic by 50 per cent besides increasing the yield.
2. Growing marigold with capsicum has been reported to cause significant reduction in the incidence of viruses infecting chilli pepper in Mexico.
3. To manage this disease, control measures referred in leaf curl could be followed.
4. Punjab Lal (S-118-2), Bengal Green-1, perennial and Gauhati Black are resistant to mosaic virus.

7. Root - Knot nematode

The nematode is known as *Meloidogyne.* Affected plants develop light yellowish cast in contrast to the normal green of healthy plants. The most distinctive symptom of root-knot is galls on the roots. The general appearance of the crop in the field is of patchy growth.

Management:

1. Follow cultural practices as suggested for damping-off.
2. The field should be deep ploughed and left free during hot summers i.e., May and June.
3. The field where high population of nematodes are observed, crop rotation should be practised. In this sesame, wheat, maize, onion, garlic, mustard, etc., should be taken.
4. The spread of nematodes to non infested areas normally takes place through nursery plants, hence seedlings should be raised at nematode free sites or in fumigated beds.
5. During field preparation, application of Neem, Mahuva Cake at 1-2 t/ha can be done.
6. Solarization of chilli nurseries can be done for reducing nematode population in order to get nematode free seedlings.
7. Intercropping of marigold with chilli reduce nematode population and root galling.
8. Losses can be minimized by using improved, disease resistant varieties like Pusa Jwala.
9. Use bioagent *Pacelomyces lilacinus* for management of this disease. This may be used in nursery, seedling, drip and soil applications.

Yellow trap

8. Mycoflora on capsicum fruits

Mycoflora like *Colletotrichum, Aspergillus flavus, A. niger, Alternaria, Cladosporium, and Rhizopus* are predominately associated with the harvested chilli fruits and seeds obtained from threshing floor, during transport and storage.

Management:

Proper harvesting, drying, packing and storage with prescribed cleanliness specifications can help to avoid mycoflora on chilli.

9. Aflatoxin

The fungi growing on seeds and other edible plant parts produce toxic compounds which are known as mycotoxins. They cause mycotoxicosis in humans and animals. *Aspergillus flavus, A. parasiticus* and *A. oryzae* are species that produce aflatoxins. They possess carcinogenic effects in animals and human beings. Aflatoxin beyond acceptable levels in chilli and its products is not acceptable for export. In the past, aflatoxins including b1 were noticed at a high level. But thanks to the extension work carried out by various government agencies including Spices Board, this threat is well under control. European limits on spices are very low for aflatoxin B1.

Management:

Aflatoxin contamination can be avoided by harvesting the crop at proper maturity, drying the produce properly and quickly, removal of damaged fruits and keeping moisture level to safe during storage (below 9 %). Good warehousing facilities are essential. There is a need to use clean sheets for spreading the pods during sun drying. Also the drying should be, as far as possible, continuous without interruption. Storage godown should not permit entry of water by seepage from ground. Provide adequate storage aeration.

Note: Chemical management measures suggested include application of pesticides notified as per the draft order SO 1512(E) 14-5-20. Those chemicals shall not be used once the order comes into force on the date of its final publication in the official Gazette. It is advised to always undertake judicious use of plant protection chemicals, adhering to the relevant standards of food safety and quality.

Online Spice Clinics

Spices Board has been attending to the farmers' concerns on effective crop management and management of various pests and diseases in spices through its spice clinics. Spice clinics are regularly organized by Indian Cardamom Research Institute (ICRI), Spices Board at the farmers' field where information on good cultivation practices are shared with the farmers and later their concerns on specific issues at field are attended and curative measures suggested.

Due to COVID -19, spice clinics became online. ICRI Myladumpara conducted an online Spice Clinic on 'Viral Diseases of Small Cardamom and their Management' on 24th November 2020 for the farmers from the states of Kerala, Karnataka and Tamil Nadu. Dr Saju K A, Scientist-C interacted with the farmers and provided information on Viral Diseases of Small Cardamom and their Management. Around 29 farmers benefited from this programme.

Another spice clinic on 'Harvesting and Processing of Black pepper' was organized on 26th November 2020. Dr John Jo Varghese, Scientist -C and Dr Manoj Oommen, Scientist-C, ICRI Myladumpara led the session and answered to the queries of the pepper farmers. The programme was attended by around 62 pepper farmers.

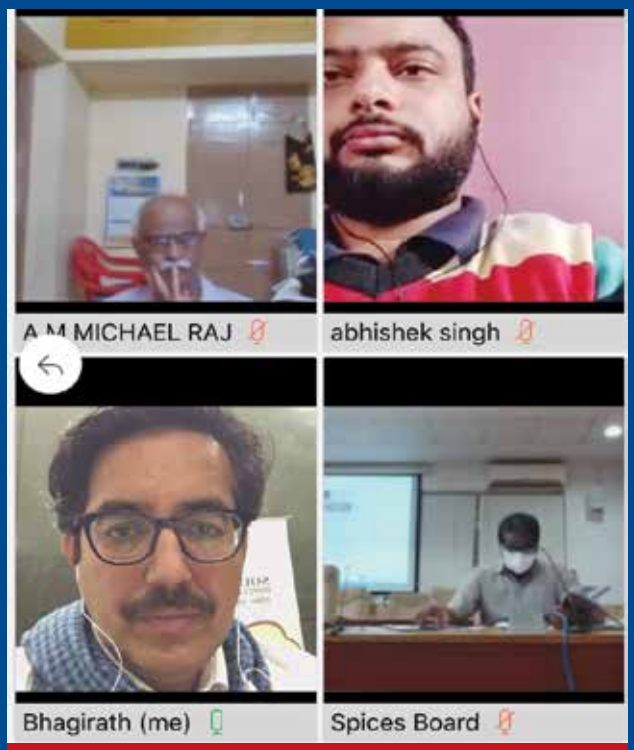
An online spice clinic on 'Impact of Climate Change on Small Cardamom' was conducted on 3rd December 2020 for the farmers from the states of Kerala, Karnataka and Tamil Nadu. Dr M. Murugan, Professor and Head, Cardamom Research Station (KAU), Pampadumpara interacted with the farmers and provided information on Impact of Climate Change on Small Cardamom. Around 65 farmers attended the programme.

Spice clinic on 'Farmers' Experience in Cardamom Cultivation´ was organized on 17th December 2020. Mr Staney Pothen, Vice Chairman, Spices Board and progressive cardamom farmer delivered the lecture. The Scientists of ICRI also interacted with farmers and clarified their doubts. The programme was applauded by around 65 farmers who attended the programme.

Harnessing Entrepreneurship Opportunity in Spices in India: National Webinar on Spices

India has achieved a remarkable breakthrough in export of spices during Covid - 19 pandemic. The nation recorded highest export in terms of quantity at 5.7 lakh tonnes during April - August 2020 compared to 4.9 lakh tonnes achieved during the same period in 2019. Notably, the export of spices from India rose by 15% registering Rs.10,001.61 crores in value during April to August 2020 compared to Rs. 8,858.06 crores achieved during the previous year. Chilli, cumin, small cardamon, ginger, turmeric, fenugreek, nutmeg, mace, coriander and other seed spices such as aniseed, and dill seed, among others, grew substantially contributing to the spices export basket from India. Concurrently, the domestic consumption of spices is also on the rise. All these factors have positively influenced the entrepreneurship sector and has opened the door for tremendous opportunities in the international and domestic market.

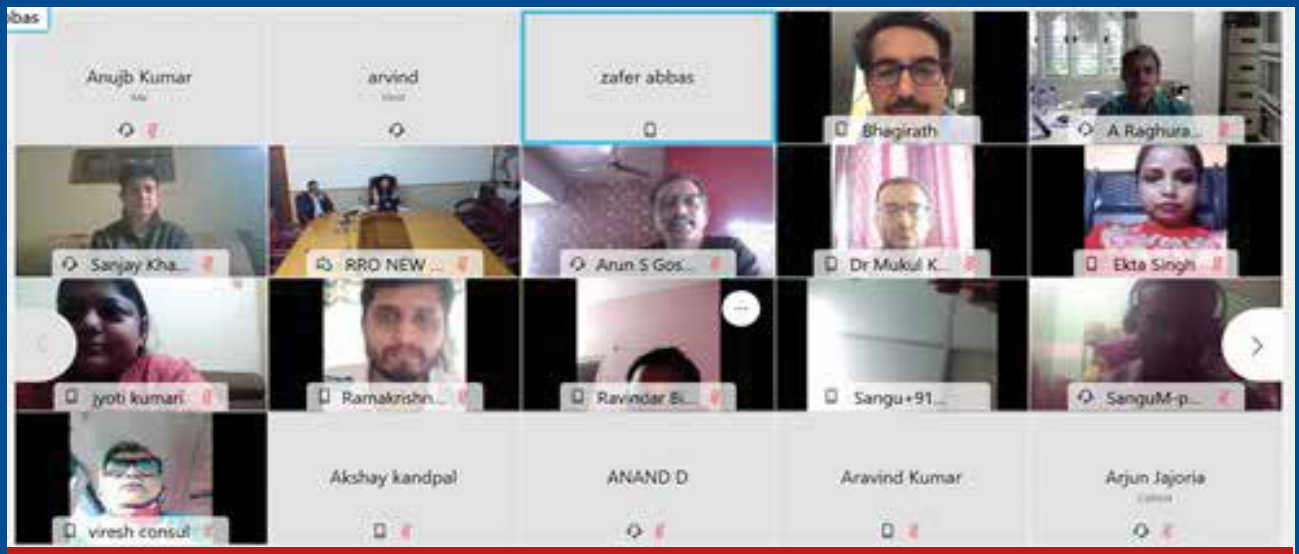
The national level spices webinar on 'Harnessing entrepreneurship opportunity in spices in India' was jointly organized by the Spices Board India, the Khadi & Village Industries Commission (KVIC), the Department of Biotechnology and the DBT-SABC Biotech Kisan Hub for Western Dry Region on 27th November 2020. The webinar was meant to engage the rural gramodyog of KVIC, share insights and expertise on the potential of business opportunities in spices sector in India. The national level spices webinar was a platform for hundreds of entrepreneurs, startups and progressive farmers from rural areas and professionals of DBT-SABC Biotech Kisan Hub, KVIC, ICAR-National Research Centre on Seed Spices (NRCCS), ICAR-Indian Institute of Spices Research (IISR), Food Safety and Standards Authority of India(FSSAI) and the Federation of Indian Spices Stakeholders (FISS) to gather and provide up-to-date information about the emerging opportunities for entrepreneurs, programmes and schemes, and investment and financing, registration processes to spur the growth of spices sector in India.



Participants of national webinar on spices

In his introductory remarks, the KVIC Chairman Shri Vinai Kumar Saxena called on to the entrepreneurs of the nation to seize the unexplored potential of immunity boosting spices and make India '*atmanirbhar'*. Shri P M Suresh Kumar, Director (Marketing & Administration), Spices Board and Dr Shrishail K Kulloli, Field Officer, Spices Board enumerated schemes and programmes on spices for entrepreneurs while Dr Gopal Lal, Director of ICAR-NRCSS and Dr E Jayashree of ICAR-IISR listed technologies and value-added products of spices developed indigenously by ICAR institutions, which can be commercialized by the entrepreneurs.

Dr Bhagirath Choudhary, Director, DBT-South Asia Biotechnology Centre Biotech Kisan Hub for Western Dry Region and Dr C D Mayee, President of the Board of Directors, SABC, offered to help entrepreneurs and businesses alike to strengthen the quality production of spices, improve IPM based production and establish linkages between producers, processors and consumers as part of DBT's Biotech Kisan Hub for Western Dry Region. The webinar was coordinated by Ms Sarita, Principal of Multi-Disciplinary Training Centre (MDTC) of KVIC



Participants attending the national webinar on spices 'Harnessing Entrepreneurship Opportunity in Spices in India'.

on behalf of the DBT-SABC Biotech Kisan Hub. She emphasized on the need for creating self-reliance amongst the poor, the necessity to build a strong rural community spirit and generation of employment, especially self - employment.

Dr Vijay Pal Singh, Joint Director, Food Safety and Standards Authority of India (FSSAI) made a comprehensive presentation on registration and certification process of spices products and familiarized participants about the improved registration system of FSSAI-FoSCoS.

Dr Govind Gujar, Research Scientist, South Asia Biotechnology Centre offered the concluding remarks and proposed the vote of thanks expressing gratitude to all delegates for their active participation.

Virtual Buyer Seller Meet

on Spices for Meghalaya and NE Region 2020

The North East region of India is renowned for the production of organic spices. With the objective to promote spice trade in the North East region, Spices Board Regional Office, Guwahati along with Field Office, Shillong, Meghalaya conducted a virtual Buyer Seller Meet on Spices for Meghalaya and NE Region on 17th December 2020. Shri K N Kumar IAS, Chairman, Meghalaya Farmers Commission, inaugurated the Buyer Seller Meet. Shri D Sathiyan, IFS, Chairman and Secretary, Spices Board delivered the keynote address. The online BSM was conducted successfully with participation of more than 200 stakeholders including spices farmers from NER, spices traders and registered spices exporters, etc. The majority of spices farmers' participation was from the state of Meghalaya.

The programme commenced with an introduction on the spices sector of the North Eastern region and Meghalaya by Shri Vishwa Bhushan Joshi, Field Officer, Spices Board Shillong. Shri P M Suresh Kumar, Director (Marketing and Administration), Spices Board delivered the welcome address. The Director, during the welcome address, briefed about the various marketing activities of the Board and India's spice export to the foreign countries which touched new heights than the previous years even under the current pandemic situation. He also added that the Board is focused on the post harvest management of spices for maintaining the desired quality for export.

Shri K N Kumar IAS, in his inaugural address, called for more programmes aimed at the development of farmers that can bring down the involvement of middlemen in the spices supply chain. He also stated that these programmes would enable farmers to sell their produce at reasonable prices to the exporters and traders directly. He further opined that there are many issues related to spices sector in Meghalaya which are to be solved through discussion and planned action. He also informed about the 'Lakadong Mission', which was launched by the Government of Meghalaya, for promoting the production of organic and high curcumin lakadong turmeric.

Shri D Sathiyan, IFS, during the keynote address, observed that it was the 4th online BSM conducted by Spices Board in the region and the response received from stakeholders from the region has been very inspiring. He drew attention to the huge potential Meghalaya possesses for cultivation of different spices and added that the region has the best turmeric (which has a curcumin content of more than seven per cent) in the world. He informed about the existing opportunities for spices processing and

value addition in the area, since spice manufacturers and exporters registered with the Board from the region are very less compared to other parts of the nation. He stressed the need for organizing more entrepreneurship development training programmes in Meghalaya for turmeric and ginger processing and also recommended the extensive execution of organic certification programmes in the state.

Shri GHP Raju IPS, Principal Secretary, Co-operation, Government of Meghalaya, during his special address, informed the role of cooperative societies and the procedure for formation of co-operative societies for spices. He also stated that there is a great demand for spices in pharmaceutical and cosmetic industries and the formation of more spices cooperatives will benefit the spices farmers of the state in future. Speaking at the occasion, Dr Kadirvel G, Principal Scientist & Head of Agri Business Incubation Centre, ICAR Research Complex for North Eastern Hill Region, Meghalaya, cited that the demand for turmeric used for curcumin extraction surged during the pandemic period. He informed that India earned more foreign exchange this year by exporting turmeric, which helps in boosting immunity and is a vital ingredient in beauty products, health drinks, etc. Pointing at the shortage of adequate facilities for quality checking, collection and propagation of right varieties, etc., in Meghalaya, he opined that Farmer Producer Organizations (FPOs) play an effective role in solving issues like aggregation, supply chain management, entrepreneurship ecosystem (agri business), production of quality planting material, etc. Smt Sainara Nongbet, Director of Horticulture, Government of Meghalaya briefed about spices sector in Meghalaya and the important activities implemented by the department along with data on area and production.

The BSM later progressed to an interactive session. The buyers (mainly the spices exporters and traders) and progressives spices farmers from Meghalaya and NER introduced themselves. All queries brought up during the session were answered by the Spices Board officials.

Shri Anan Debbarma, Assistant Director, Spices Board Regional Office, Guwahati rendered the vote of thanks.

Soil Conservation Practices in Plantations -3

Biological Measures of Erosion Control

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The different kinds of soil erosions, discussed in the previous sections, influence agricultural production by way of their effect on quantity as well as quality of the produce besides damaging soil health. Soil erosion not only removes the fertile topsoil, but also hastens land degradation and terrain deformation. Soil compaction is another important consequence of soil erosion which results in increased bulk density and poor drainage. All these changes have influence on our water bodies by reducing water availability, sedimentation of water bodies and water pollution. A number of locally adaptable soil and water conservation measures are available, which can be divided into biological and engineering measures. Biological measures involve the use of vegetation such as forestry, agroforestry and various agronomic practices. The agronomic measures of erosion control are applicable in areas where the soil slope is below two per cent. The main aim of these control measures is to reduce the impact of raindrops through the covering of soil surface and increasing infiltration rate and water absorption capacity of the soil which results in reduced runoff and soil loss through erosion. These measures are cheaper, sustainable, and in certain situations more effective than engineering measures.

1. Contour Cultivation

This method is also known as contour ploughing, contour farming or contour bunding. Contour line is an imaginary line on the land surface, all points of which are at the same elevation above a datum plane, usually mean sea level. Contour cultivation is farming with row patterns that run nearly level around the hill and not up and down the hill. Contour farming is one

Contour farming for soil and water conservation.

of the most commonly used agronomic measures for soil and water conservation in hilly agro-ecosystems and sloping lands. All the agricultural operations viz. ploughing, sowing and inter-cultivation have to be practised along the contour line. The ridges and furrows formed across the slope build a continual series of small barriers to the flowing water which reduces the velocity of runoff and thereby reducing soil erosion and nutrient loss. It conserves soil moisture in low rainfall areas due to increased infiltration rate and time of concentration, while in high rainfall areas, it reduces the soil loss. In both situations, it reduces soil erosion, conserves soil fertility and moisture, and thus improves overall crop productivity. However, the effectiveness of this practice depends upon rainfall intensity, soil type, and topography of a particular locality. In contour farming, the width of each strip needs to be decided based on slope, management, and farm equipment used in plantations.

2. Crop Rotation

Crop rotation is the practice of growing a planned sequence of various crops in succession on the same piece of land to get maximum profit from the least investment without impairing the soil fertility. Monocropping is the agricultural practice of growing a single crop season after season and year after year on the same piece of land. This results in exhaustion of soil nutrients and depletes soil fertility. In areas where soil erosion is a serious concern, we must consider including legume crops in crop rotation which reduces soil erosion, restores soil fertility, and conserves soil and water. Further, the incorporation of crop residue improves organic matter content and soil health besides reducing water pollution. A suitable rotation with high canopy cover crops helps in sustaining soil fertility, suppresses weed growth, decreases pests and disease infestation, increases input use efficiency and system productivity while reducing the soil erosion.

3. Cover Crops

In agriculture, cover crops refer to plants that are planted to cover the soil rather than for the purpose of being harvested. For effective erosion control, we must plant close-growing crops with high canopy density. Usually, it is better if we choose legume crops with good biomass to protect soil from erosion and it should not be planted in rows. The effectiveness of cover crops depends on crop geometry and development of canopy for interception of raindrops which helps in reducing the exposure of soil surface for erosion. The most effective cover crops are cowpea, green gram, black gram, groundnut, etc. By reducing soil erosion, cover crops also reduce both the rate and quantity of water that drains off from the field. This would in turn reduce environmental risks to waterways and ecosystems downstream. The biomass of the cover crop will act as physical barrier between rainfall and soil surface and allows

raindrops to steadily trickle down from surface to subsurface soil layers. The root growth of the cover crops helps in formation of good soil structure that will help water to filter through the soil profile instead of draining off from the surface. This will improve the soil water storage and recharging of aquifers.

4. Intercropping

Cultivation of two or more crops simultaneously in the same field with definite or alternate row pattern is known as intercropping. It may be classified as row, strip, and relay intercropping based on the crops, soil type, topography, and climatic conditions. While selecting suitable crops in an intercropping system, care should be taken so that erosion permitting and resisting crops should be intercropped with each other. It is also important to choose crops with different rooting patterns such as shallow and deep rooting crops. Intercropping provides better coverage on the soil surface, reduces the direct impact of raindrops, and protects soil from erosion. One of the most important advantages of an intercropping system is that it will very efficiently utilize both soil and water resources and is a drought mitigation strategy too. In plantations, growing alternate strips of erosion permitting and erosion resistant crops with a deep root system and high canopy density can be recommended.

5. Mulching

Mulch is simply a protective layer of material, organic or non-organic, spread on top of soil. It protects the soil from erosion, reduces compaction from the impact of heavy rains, conserves moisture thereby reducing the need for frequent irrigation, maintains a more even soil temperature and prevents weed growth. When the organic mulches slowly decompose, they provide organic matter which keeps the soil loose. This improves root growth, increases water infiltration and water holding capacity of the soil. Inorganic mulches such as the weed control ground cover available in the market conserves soil moisture and prevents weed growth.

6. Conservation Tillage

Conservation tillage is a common practice that creates a mulch on the soil surface. Unlike the common practice of ploughing all the crop residues into the soil, here the crop residues are left on the top of the soil. These crop residues help to protect the soil against wind and water erosion. In this practice, at least 30 per cent of soil surface should remain covered with crop residue before and after planting the next crop to reduce soil erosion and runoff, and for other benefits such as carbon sequestration. Conservation tillage includes reduced tillage, minimum tillage, no-till, direct drill, mulch tillage, stubble-mulch farming, trash farming, strip tillage, etc. The concept of conservation tillage is widely accepted in large scale mechanized crop production systems to reduce the erosive impact of raindrops and to conserve the soil moisture with the maintenance of soil organic carbon.

7. Land Configuration Techniques

Different land configuration techniques such as ridge and furrow, raised bed and furrow, broad bed

Intercropping as a soil conservation measure

Inorganic mulches, like the weed control ground cover, conserve soil moisture and prevent weed growth

Conservation of tillage for protection against wind and water erosion

Mulching helps in moisture conservation and prevention of weed growth

and furrow, and ridging the land between the rows can be adopted for erosion control. The method chosen depends on crops, cropping systems, soil type, topography and rainfall. It will help in better crop establishment, intercultural operations, reduced runoff, soil and nutrient loss, conserve water and efficient utilization of resources. In ridge and furrow system**,** raising rainy season crops on ridges and *rabi* season crops in furrows reduces the soil crusting and ensures good crop stand over sowing on flat beds. Moreover, inter-row rainwater can be drained out properly during the monsoon period and collected in farm ponds, for life-saving irrigations and profile recharging for the establishment of *rabi* crops. It leads to the increased moisture content in soil profile which reduces moisture stress on plants during the drought period. Broad bed and furrow system is primarily advocated in vertisols with high rainfall (>750 mm). Beds of 90–120 cm width are formed, separated by sunken furrows of about 50–60 cm wide and 15 cm depth. The preferred slope along the furrow is between 0.4 and 0.8%. Two to four rows of the crop can be grown on the bed, and the width and crop geometry can be adjusted to suit the cultivation and planting equipment. This is an *in situ* soil moisture conservation method developed by ICARISAT wherein we can safely dispose of excess runoff without causing erosion.

(To be continued)

Calendar of Operations
February 2021

Timely planning and execution of farm operations based on agroclimatic conditions of the area is important for successful farming for higher productivity and sustainability. To facilitate this, a calendar of operations in respect of important spice crops for February is given below.

Cardamom

I Agronomic measures

NURSERY

- Regular watering may be given to bed/polybag/ sucker nursery based on necessity.
- To control damping off/seedling rot diseases in nursery, soil drenching with 0.2% Copper oxychloride or *Pseudomonas* 2% may be taken up.
- As bio-control measure, *Trichoderma* or *Pseudomonas* or *Bacillus* species may be applied in the soil.
- For controlling leaf rot disease, after removal of affected leaves, spray 1 % Bordeaux mixture or 0.2% Copper oxychloride

MAIN FIELD

- Irrigation to be started based on necessity wherever irrigation facility is available.
- In rain fed areas, if mulching is not done previously, mulch the base of the plants immediately with dried leaf/weed materials.
- In areas where the roots are exposed due to soil erosion, earth up the base with topsoil only up to the half of the bulbous portion of the tillers and then mulch the base.

II. Pest management

- For Integrated Pest Management, prune dry leaves without removing green leaf sheath.
- Quinalphos @120 ml/100l of water. (Spray may coincide shoot borer moth emergence).

III. Disease Management

- Remove and destroy the viral diseases (*Katte*, *Niligiri necrosis* and *Kokke kandu*) affected plants.
- If symptoms of stem lodging are noticed, spray 1 % Bordeaux mixture or *Pseudomonas* (1%) after removal of affected leaf and tillers
- Root rot and leaf yellowing can be controlled by foliar spraying and soil drenching of *Pseudomonas* (1%).
- Cover the exposed roots with topsoil, proper irrigation and mulching should be provided.
- Provide shade wherever direct sunlight is noticed.

IV. Harvest and Post-harvest operations

- Harvesting can be continued with a gap of 25 to 30 days depending upon the weather conditions and maturity of capsules. Ensure always, right maturity for better out-turn.
- Wash harvested capsules thoroughly before drying in curing chamber.
- Timely removal of water vapour from curing chamber and maintaining proper temperature during curing will result in better green colour of the produce.
- Clean and store the cured cardamom at 10% moisture level in 300 gauge black polythene lined gunny bags and inside wooden boxes.

Large Cardamom

NURSERY

- Regular watering may be continued in sucker nursery depending on the necessity.
- Overhead pandals may be erected in sucker nurseries wherever required if it is not done so far.
- If any symptoms of disease/pest infestation are noticed, it may be controlled immediately.
- Need based weeding and mulching may be done in sucker nursery.
- Every large cardamom farmer should have his own nursery for replanting /gap filling operations.

PLANTATION

- After harvest of the crop, the dried leaves and shoots may be dumped in a pit instead of using as mulch to prevent the further spread of pest and diseases.
- The base of the plants may be mulched after harvest of the crop with forest leaves, etc.
- *Chirke* and *Foorkey* infected plants may be destroyed by uprooting/burial at regular intervals.

- Regular inspections may be carried out to observe caterpillar/shoot borer incidence. If any, may be hand picked and destroyed mechanically.
- In plantation, irrigation may be provided depending upon necessity.
- For replantation of old and disease affected gardens, all old cardamom plants should be uprooted, cut into pieces and buried in the pits to avoid the spread of disease and to keep the plantation ready for planting. Necessary pre-planting operations like opening of pits, shade regulation, land clearing may be done.
- Application of cattle manure/compost/ organic manures will help in getting sustained production, improving productivity and quality of the crop, which can be done in February month.

Pepper

I Agronomic measures

NURSERY

- Runner shoots already marked and coiled on wooden pegs removed. Then cut them into bits with two-three nodes by rejecting the over matured and immature portion of the vines.
- Plant these cuttings in polythene bags of size 6" x 4" filled with topsoil, sand and farm yard manure in 3:1:1 proportion.
- Provide adequate holes in the polybags in the lower half of the bags.
- Arrange the planted polybags inside a pandal and irrigate regularly.
- Wherever irrigation facilities are available, start irrigating the plants once in a week by hose irrigation or daily by drip irrigation.

MAIN FIELD

- Always ensure that the base of the vines and roots are not damaged, while doing intercultural operations.

II Post harvest operations

- Continue harvesting by observing the right maturity indicated by the colour change in one

or two berries in a spike from green to orange or red.

- Do not apply any pesticides during the month on plants.
- Always ensure threshing of pepper by hygienic means either manually or using mechanical pepper thresher.
- For drying use only clean floor made of concrete, clean bamboo mats or polythene sheets to get quality final produce.

Vanilla

- Irrigation to be continued based on weather condition and necessity.
- Always ensure adequate mulch material with organic debris.
- Tying of vines with the standard to be continued based on necessity.
- Pollinate the flowers manually with the help of skilled labourers between 6.00 a.m. to 1.00 p.m. on the day of flowering.

- Look out for any vanilla vines exhibiting viral symptoms and remove such vines immediately and destroy.
- Continue harvesting by seeing light yellowing observed at the distal end of the bean to ensure better quality of cured beans.
- Adopt Bourbon method of curing or sell green beans immediately after harvest with advance arrangement with the buyer.

Ginger/Turmeric

- Seed rhizomes stored in pits need inspection once in 20 days. Shriveled and disease affected rhizomes are to be removed.

Chilli

- Irrigate once in 20-25 days in black soils and 10-15 days in red loamy soils.
- Apply N.P.V. @ 200 litre per acre to control pod borers.
- Change the lure of pheromone traps for monitoring pod borers (*Spodoptera litura, Heliothis armigera*)
- Spray Mancozeb 2.5 g or Copper oxychloride 3g / litre of water to control die back and fruit rot diseases.
- After second picking of chilli, the produce is exposed to sun for 10-15 days. Spreading on open yards leads to contamination, and discolouration. To avoid this, use mechanical chilli drier/solar chilli drier wherever possible.
- Always dry in polythene sheets / poly house dryers or clean drying yards.
- The moisture content of dried pods is to be kept 8-10 per cent.

Fennel (Kharif transplanted)

- Crop should be irrigated at an interval of 15-20 days if optimum moisture is not available in the soil.
- Spray any systemic insecticide to control seed midge and aphid.
- Harvest the physiologically matured umbels and dry under shade.

Fennel (Rabi transplanted)

- Irrigation should be done as per need. Spray any systemic insecticide to control seed midge and aphid.
- Harvest the physiologically matured umbels and dry under shade.

Fennel (Rabi drilled)

- Irrigation should be done as per need. Spray any systemic insecticide to control seed midge and aphid.

Cumin

- Apply irrigation as per requirement of crop. Spray any systemic insecticide to control aphid, if observed.
- Harvesting, threshing, drying, processing and packing should be done under hygienic conditions.
- Cleaning and grading of the produce is beneficial to fetch good price.

Fenugreek

- Crop should be irrigated at an interval of 20-25 days. To control the aphid, thrips & jassids, spray Methyl-o-demeton(0.025%).Repeat the spray after 10-15 days based on necessity.
- To control Powdery mildew, spray 0.1% calyxin in 500ml water. Based on necessity the application may be repeated after15-20 days.
- If termite infestation is observed, drenching with Chlorpyriphos @ 25-30 ml per 10 litre of water should be done.

Coriander

- Fifth and sixth irrigation should be given 105-110 days and 115-125 days after sowing.
- To control the powdery mildew and aphids spraying of recommended pesticides/fungicides may be done.

Celery

- Intercultural operations and hand weeding should be done and 40 kg. nitrogen should be applied as topdressing(during first fortnight).
- Irrigation should be given at 15-20 days interval.

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