Improved Farming Practices for the Cultivation of Spice, Clove (*Syzygium aromaticum*) in India

M. Shamina

10.18805/BKAP387

ABSTRACT

Clove is a very valuable spice used throughout the world with various medicinal and culinary properties. It cannot be cultivated in all climates and soils. In tropical countries it prefers to grow in red soil in higher altitudes with colder climate. In India, Western Ghats provides a suitable niche for the growth of clove in terms of climate and soil. The clove of commerce is the air-dried unopened flower bud obtained from evergreen medium sized tree. The tree grows to a height of 10-12 metres and start flowering in about four years. Eugenol is the main essential oil extracted from clove buds, stalks and leaves. It continues to produce flower buds for hundred or more years.

Key words: Clove, Spices, *Syzygium aromaticum,* Unopened flower bud.

Cloves (*Syzygium aromaticum*, *Eugenia aromaticum* or *Eugenia caryophyllata*) is one of the most valuable spice with immense medicinal properties. It is an unopened dried flower bud, which are commonly used in Indian dishes and it imparts a hot taste for various cuisines. It is a very common spice in various dishes in Asia, Africa and other Mediterranian countries. It is a medium sized tree belonging to the family Myrtaceae. Their fragrance is very intense and also has a pungent burning taste. It is also used as food preservative for centuries. It can also be used to give aroma and flavour for hot beverages such as tea and coffee. This evergreen tree, which grows to a height ranging from 7-18 m, posses small leaves producing flowers in terminal clusters as small bunches. Each peduncle consist of 3 or 4 stalked flowers at the end and each flower has thick ovary enclosed by four fleshy sepals. Above the sepals there are four petals which are dome shaped. The lower part of the flower, along with the calyx, develops in to a fleshy, dark one-seeded drupe. Flower buds are a good source of phenolic compounds such as gallic acid, eugenol acetate and eugenol. Clove oil contains active constituents which possess antioxidant, anti-fungal, anti-viral, anti-microbial, anti-inflammatory, anti-thrombotic, anaesthetic, pain reliving and insect repellent properties. The antioxidant and the antimicrobial activity of clove is much higher than that of fruits and vegetables (Cortés-Rojas *et al*. 2014). Eugenol comprises 90% of the essential oil is the main constituent responsible for the medicinal properties and aroma of the clove (Bisset, 1994; Dorman *et al*. 2000; Parle and Deepa, 2010). Other constituents of clove oil includes crategolic acids, vanillin and tannins such as bicornin, gallotannic acid, methyl salicylate, the flavanoids such as eugenin, kaempferol, euginitin and various triterpinoides and sesquiterpenes (Bao *et al*. 2012). It is highly valued in medicine as carminative, aromatic and stimulant. The antiseptic and antibiotic properties of clove oil are used in medicine especially in dentistry, oral and pharyngeal treatments. It has wider applications in preparations of toothpaste, mouthwashes, soaps and perfumes. It is used as remedy for tooth ache and it improves digestion, reduce inflammation and also get relief from upper respiratory infections. It is also reported to help diabetics in sugar assimilations. They prefer to grow in black loamy soil of forest but in tropical country like India, it prefers to grow in red laterite soil in hilly and sloppy terrain of Western Ghats at an elevation of about 1500 to 2000 feet. The plant cannot withstand waterlogged conditions and thus it needs a good drainage of water. The islands of Zanzibzar, Pemba and Indonesia are the major producers of clove in the world. Out of the world's total production, about 66% comes from Indonesia alone. The clove was introduced to India around 1800 AD by East India Company and is the native of Moluccas Islands in Indonesia, the spice island in East Indian Archipelago (Michael, 2007). Many species of *Syzygium* occur in the Indian subcontinent and the important ones are *S. aromaticum, S. cumini, S. fruiticosum, S. jambos* and *S. zeylanicum*. However none of these species is closely related to the cultivable clove (Sasikumar *et al*. 1999). The plant can grow well in the areas which receives an annual rainfall of 100 cm or above with little cold misty climate and

Department of Botany, University of Calicut, Malappuram-673 635, Kerala, India.

Corresponding Author: M. Shamina, Department of Botany, University of Calicut, Malappuram-673 635, Kerala, India.
Email: drshaminam@gmail.com

How to cite this article: Shamina, M. (2022). Improved Farming Practices for the Cultivation of Spice, Clove (*Syzygium aromaticum*) in India. Bhartiya Krishi Anusandhan Patrika. 37(1): 97-101. DOI: 10.18805/BKAP387.

Submitted: 25-10-2021 **Accepted:** 15-04-2022 **Online:** 13-05-2022

also at a temperature of 25 to 35°C with heavy sun light and high humidity (above 70%) is preferred.

Study area

The area of study was a private plantation in Karingad village of Kozhikode District, Kerala state. It is located 11.6959°N latitude 75.7815°E longitude of Western Ghats of India. The study was conducted during the period 2015-2020.

Data collection on soil fertility of clove plantation land

The physico- chemical characteristics of soil such as pH, exchangeable bases such as calcium, magnesium and zinc were analysed by turbidity method from the laboratory of Core Valley Herbal technologies Pvt. Ltd. Kozhikode District. The soil samples were collected from twenty different sites of the field area. The samples were air dried and sieved through 2 mm sieve.

Data analysis of manuaring and watering

The year wise data collection on manuaring, watering and growth pattern was also recorded.

Planting of seedlings

The planting material is unopened flower bud of two months to one year old. The ripened fruit which has fallen from the mother plant were collected and soaked in water overnight. It is then sown directly in the nursery bed. The seed beds should be protected from sunlight. The seeds are planted at a spacing of 5 cm and a depth of 3 cm. The germination starts within two weeks. After one month it was transplanted into a small polybags. The seedling of one year old is preferably good for planting. Planting of clove is generally done during the monsoon. The first step is digging a pit of dimension of one meter. After digging, the pit has to keep empty for two weeks and only after that seedlings can be planted. Moreover no manuring is needed at the time of planting. The distance between the two plants should be 18-20 feet otherwise when the plant grows the branches touches and it affects the growth and yield of the plant. The different agricultural practices on Clove cultivation is given in the (Fig 1).

Since the plant cannot withstand strong winds, so that tall strong trees are planted around the plantation to mitigate the affect of heavy gusts. Teak trees (*Tectona grandis*) were planted along the boundary of clove plants. It is highly effective than any other plants as a windbreaker. There are also reports that shade is essential to protect the crop from adverse weather conditions. Banana, *Acacia* sp., *Albizia* sp. and Subhabool (Krishnamoorthy, 1998), are the common shade plants to be established 6-12 months prior to clove planting. Artificial shade with plaited coconut leaves (Pillai, 1972), Jack fruit, Casuarinas and Japanese bamboo may be planted at the border of the plots (Singh and Singh, 2008). During the initial growth phase the plant require protection from direct sunlight. Clove prefers partial shade and it is mainly achieved by intercropping with Arecanuts, Pepper and Cocoa. The climatic conditions also influence the growth pattern and yield of clove. If there is any fluctuation in climate including heavy winds, that adversely affects the production and yield of clove. So proper attention is to be needed for the better production. Care should also be given that other weeds were not allowed to grow near the roots of the plants since it affects the growth pattern of the plant. Laterite red soil of the tropical rain forest is the best suited soil for the cultivation of clove. Soil analysis test has to be conducted to determine the deficiency of micronutrients or trace elements in the soil where it is growing and it should be supplimented along with annual manuring programme. The soil pH should range from 4.0 to 5.6 (Pruthi, 2001). But in this experimental plot, the pH is almost alkaline shows that the soil was not much deficient in nutrients. The macronutrients calcium, magnesium and zinc were 100.65 kg/acre, 40.18 kg/acre and 16.42 kg/acre respectively. This shows that the soil is not deficient in any macronutrients since this plantation was in Western Ghats forest region and the top soil is highly nutrient rich with litter.

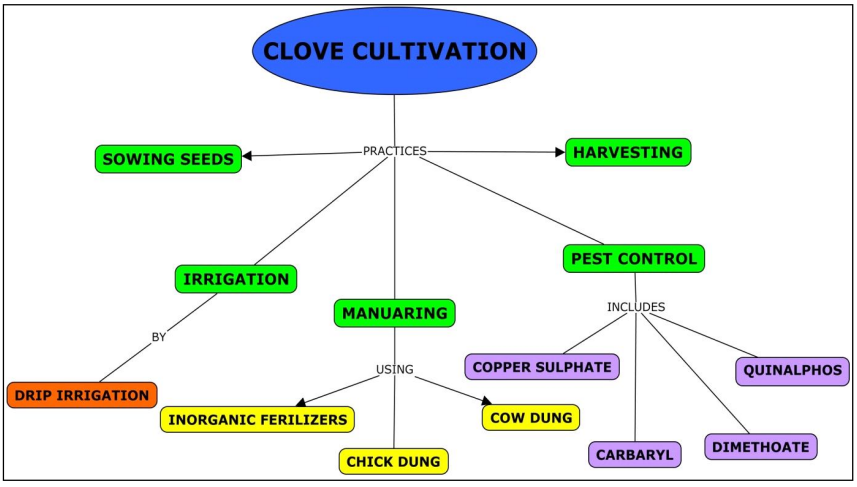

Fig 1: An outline of agricultural practices in clove cultivation.

Manuring and irrigation

The crop usually grows well with the organic manuring mainly chicken dung. It should be supplemented to the soil during monsoon season only. It should not be applied during summer season because it adversely affects the growth pattern of the plant. In the first year, 5 kg chicken dung was added to each plant while in second and third years it was 25 kg and 50 kg per plant respectively. From third year onwards 50 kg dung was applied during annual manuaring programme. The quantity should be increased gradually by 40-50 kg of organic manure. By this manuring we can observe a rapid growth of the plant rather than by the use of inorganic fertilizers. Clove also responds to application of inorganic fertilizers such as nitrogen, phosphorus and potassium but in this field the author didnot applied any inorganic fertilizers. The Clove plant after three years of growth is given in (Fig 2).

The plant requires regular irrigation upto four years of planting and after that it survives with normal rain water. Although the trees can survive without irrigation, it is advantageous to irrigate grown up trees also on all non rainy days for proper growth and yield. Extreme care should be given in the early years of growth and keep the soil moisture at minimum level by proper watering. The recommended type of irrigation is mainly by drip method. In the first year, 5 litres of water poured to each plant per day while in second year it was increased to 15 litres of water. In third year the amount of water given to each plant was further increased by 30 litres per day. Even though irrigation is not essential from fourth year onwards, it is still continuing except in rainy seasons.

Plant protection

In order to protect the plant from pest, it should be applied with pesticides. The stem is protected from insects such as stem borer, *Sahyadrassus malabaricus* by using certain chemicals such as 0.15% carbaryl or 0.1% Quinalphos. It usually infects at the basal region of the main shoot by girdling the stem and bores interior into the stem resulting in the wilting of plant. Pruning off the affected stem is also a good practice for the eradication of pest. Other diseases includes leaf rot caused by *Cylindrocladium quinqueseptatum*. It infests the leaf tips and margins and finally the entire leaves get rotten. Leaves are protected by spraying with copper

Fig 2: Clove plant after three years of growth cultivated above 2000 ft. in Western Ghats of Kerala, India.

Table 1: Different growth parameters of the clove plant.

Treatments	First year	Second year	Third year	Fourth year	Fifth year
Height of the plants in (meters)	0.3	1.0	1.4	2.2	2.7
Yield of the plant in (grams)	5	12	20	28	35

Fig 3: Dried Cloves harvested on fourth year.

sulphate and lime mixture.It can also applied on the shoot also. This practice should be done at least twice in a year. Many scale insects such as wax scale (*Ceroplastes floridensis*), shield scale (*Pulvinaria psidii*), masked scale (*Mycetaspis personata*) and soft scale (*Kilifia accuminata*) also infects the clove seedlings aswellas young plants. The scales are generally seen clustered together on tender stems and lower surface of leaves. Scale insects feed on plant sap thus causing a yellow spot on leaves and finally results in the wilting of shoots. Spraying with insecticide dimethoate (0.05%) is effective for the management of scale insects.

Harvesting

The plant started flowering from fourth year onwards under sound conditions. Full bearing is achieved by about ten years and the plant continues its production up to hundred years. But the yield in the initial stages is very low. All the plants in the plantation does not start flowering in the fourth year. However many of the plants will definitely produce flower under ambient conditions. The yield will slowly increase year after year and from tenth year onwards the plant achieves its full bearing. The flower buds are initially green coloured but at the maturity turns pinkish red. During harvesting those buds which are brownish pink coloured are handpicked. Cloves are harvested when 2 cm long. It consists of a long four fused calyx and four unopened petals. The collected buds are dried under sunlight for 4-7 days. Its leaves and stalks also yield essential oil which is also commercially and medicinally important. On an average plant, the yield will be 3-10 kg per year. The harvesting should be done without affecting the branches of the tree. The harvested flower buds are separated from the clusters by hand and spread in the drying yard for drying. The correct stage of drying is reached when the stem of the bud is dark brown and rest of the bud is light brown in colour. Well dried cloves weigh about one third of the fresh weight of cloves. About 12000 to 15000 dried cloves weigh 1 kg. In higher altitudes the flowering season is usually December-January while in plains it will be September-October. The growth and yield parameters were given in the Table 1. The dried Cloves harvested on fourth year is given in the (Fig 3).

The processing of clove includes the production of clove bud oil, clove stem oil and clove leaf oil. This essential oil is obtained by steam distillation of buds, stem or leaves. On distillation of buds 20% oil will obtain which contains about 90% eugenol which has got a high marketing value.

Conclusion

Since clove is a very valuable spice used in various cuisines and also has many medicinal properties, its marketing is easy but during the initial stages of growth extreme care should be given in terms of irrigation, pest control and manuring.

Acknowledgement

This research did not receive any specific grant from funding agencies in the public, commercial or not for profit sectors. I gratefully acknowledge the Assistant Principal Agricultural Officer, Department of Agriculture, Kerala for the whole hearted help in the cultivation of clove plants.

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