NUTMEG-'The Twin Spice': An Overview

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Abstract

The nutmeg tree produces two separate products; nutmeg and mace. Nutmeg is a handsome, evergreen tree with dense foliage. Varieties of Nutmeg are cultivated in India. Grafting, budding and so on are various vegetative propagation methods which are discussed in this paper. It also helps to gain an insight on various diseases affecting nutmeg. The paper explores the past studies to create a brief overview of Nutmeg-'The Twin Spice'.

Keywords: Nutmeg; Methods of Vegetative Propagation; Diseases**.**

Nutmeg - An Introduction

Nutmeg is the seed of *Myristica fragrans* Houtt, an evergreen tree. The nutmeg belongs to the family Myristicaceae. The nutmeg tree produces two separate products; nutmeg and mace. Nutmeg is the kernel of the seed and mace is the dried aril that surrounds the single seed within the fruit. It is considered native of the eastern island of the Moluccas. Indonesia and Grenada are major producers and suppliers of nutmeg followed by Sri Lanka.

1.1. General Description of *Myristica fragrans*

Nutmeg is a handsome, evergreen tree with dense foliage. Trees are 10-20 m tall: branches are spreading with dark gray bark: leaves are shiny and oblong to ovate in shape. (Purseglove et al., 1981; Shanmugavelu and Rao, 1977) described the Nutmeg tree as a spreading evergreen tree 4-10 m tall sometimes attaining 20 m height. It is usually dioecious, but sometimes male and female flowers are found on the same tree. Further, there are numerous spreading branches with the main branches arising low on the trunk. The bark is grayish black and slightly fissured brown. Nutmeg being a strictly cross-pollinated crop the plants differ in growth and vigor (Anonymous, 1989; Krishnamoorthy et al., 1996) observed the total canopy of Nutmeg tree to be 40.0 to 109.4 m3 among the genotypes they studied. The crown volume and surface area showed positive correlation with yield. The simultaneous consideration of height, spread, number of secondary, crown volume and crown surface area explained variability

in nutmeg fruit yield positively (Haldenkar et al., 2004). The girth at 140 cm ranged from 30 to 47 cm (Nazeem, 1989).

1.2. Morphological and Genetic Variations in Nutmeg

A high amount of variability has been reported in growth rate, productivity, size and shape of the leaf, flower size and shape and size of the fruit and seed (Haldankar et al. 1999; Haldenkar et al., 2004; Krishnamoorty 1996; Sasikumar, 2009; Shanmugavelu and Rao, 1977; Sriram, 1977).

1.3. Cultivated Varieties of Nutmeg

There are two basic types of nutmeg available in world trade – West Indian and East Indian types. The West Indian variety is grown in the islands of Grenada and Trinidad, while the East Indian type is cultivated in Sianev, Sangihe, Ternate, Amboyna, Banda and Java. East Indian nutmegs are highly aromatic and superior and mace has a pale yellow colour, possessing a characteristic flavour. Four cultivars were developed at Konkan Krishi Vidyapeeth (BSSKV). They are, Konkan Sugandha, Konkan Swad, Konkan Shrimathi. and Konkan Sanyukta

1.4. Grafting

Grafting is the most successful vegetative propagation method in nutmeg and epicotyl grafting is wieldy used for commercial multiplication.

1.4.1. Epicotyl grafting

Epicotyl grafting (Mathew and Joseph, 1982) is the most widely adopted propagation technique in nutmeg. Epicotyl grafting has been reported on the cultivated species of nutmeg, *M. fragrans* (Krishnamoorthy and Mathew, 1985) and also on wild spices, *M.beddomei* and M. Malabarica (Mathew and Joseph, 1982). However, *M. fragrans* was found to be the most ideal rootstock. Though grafting could be carried out during all the seasons, on M. fragrans, the result (80 per cent) was obtained when the seedlings were 20-30 days old (Krishnamoorthy and Mathew, 1985). Under Maharashtra conditions medium matured (4 months) and matured (6 months) scion sticks recorded higher success. Prior defoliation is not a prerequisite for this technique in nutmeg. It is essential to provide a cover of polybags on scion stick especially in non-rainy season, where as it is not essential when high humidity prevails (July). The location of scion stick did not1influence the success of epicotyl grafting. September was found to be the most favourable season for epicotyl grafting in nutmeg (Haldankar et al., 1999).

1.4.2. Soft wood grafting

Softwood grafting is possible in nutmeg (*Myritica Fragrans* Houtt.) it was revealed that may was the best season for softwood grafting with maximum success (80.00%) followed by June (54.00%) and July (50.00%). were preferred for softwood grafting. Retention of one terminal leaf on except the terminal leaf, for apical bud swelling was advantageous and recorded 70.00 per cent success. The retention of the leaves on rootstocks did not influence the success of softwood grafting (Haldanker et al., 1997).

The success in softwood grafting differs according to the scion variety. The variation among genotypes for sprouting, and survival of growth parameters was statistically significant. The magnitudes of GV, PV, habitability and genetic advance were low for sprouting and survival of nutmeg grafts. The graft survival has strong negative correlation with leaf width. Maximum graft sprouting was associated with the faster production of new leaves with less breadth and longer petiole. (Haldankar et al., 2003)very little studies have been conducted to understand the influence of rootstock on the performance of grafts. Moreover, due to the lack of an efficient clonal propagation technique through cutting or layering, the rootstocks used in the grafting studies are mostly seedlings. The performance of the grafts need not be identical in such cases. Clonal propagation of rootstocks through cutting or layering needs to be standardized for obtaining uniform

1.4.3.Approach grafting

The approach grafts on nutmeg can be prepared throughout the year. High percentage of graft take was recorded on both, edible nutmeg (*Myristica fragrans* Houtt.) rootstock (40to90%) and wild nutmeg (*Myristica malabarica*) rootstock(30to 100%. The mortality after separation of the grafts was as high as30 per cent on edible nutmeg stock and 50 per cent on wild nutmeg rootstock (Haldankar et al., 1999)

1.5. Budding

(Beena & Kurian, 1996) reported that budding in nutmeg on three year old rootstocks by forket method can be carried out in July with 30 per cent success. However the success reported in budding is too low for commercial application. The authors presumed that phenolic compounds present in the plant would have interfered with bud take. Anatomical studies of the budded region revealed that the failure in bud take was due to blockage of vessels with tylosis which caused deleterious effects on the newly inserted bud and hindered the union (Beena & Kurian, 1996). The authors also attributed low callus development, sparse differentiation of vascular tissues in the bud shield,

presence of necrotic tissues hindering the formation of callus and lack of bud union in budded trees. The physiological status of the mother plant also would have played a major role on bud take, but burst ad scion growth. Girdling the bud wood prior to bud collection was reported to enhance bud take. Girdling increases gibberellic acid (GA), indoleacetic acid (IAA) and starch concentrations in the bud wood and reduces cytokinins(Poll et al., 1993) , thus favouring bud take. Rootstocks Other than M. fragrans have also been used for budding nutmeg. *M. beddomei* King, *M. malabarica* Lam.. and *M. succedanea* were used as rootstocks for *M. fragrans* and a success of 26 per cent was obtained on *M. succedanea* (Postma , 1935). The influence of rootstock on bud take , growth, yield, fruit size and survival has been reported on may trees of horticultural importance (Glucina et al., 1992); however no such reports are available in nutmeg.

1.5.1 Top Working (Top Budding)

Nutmeg is commonly propagated through the seeds. This is not an ideal method for commercial multiplication because of its dioeciously nature. Identification of sex of nutmeg at the seedling stage is not feasible with the available techniques and if seeds are used for propagation the sex of the tree can be identified only after six-seven years when they begin to flower. The male and female trees are produced in the ratio 1:1 which means that about 50 per cent of the trees propagated by seedlings turn out to be male. Male trees are essential in a nutmeg population for pollination. One male tree is sufficient for every 10-15 female trees for pollination and the rest of the male trees available would be unproductive. These unproductive trees available in the plantation can be made productive by converting them to female trees by top working. Top working could also rejuvenate the low yielding female trees. A simple technique standardized at Indian Institute of Spices Research, Calicut, for converting unproductive male and low yielding female trees by top budding is described here.

1.5.1.1 Applications of Top working

(a) Converting unproductive male trees to female.

(b) Converting low productive female/bisexual trees to high yielders.

(c) For budding with trees with certain identified/specific characters.

(d) *In situ* budding for raising plantations.'

1.5.2. Green chip budding

An efficient green chip budding method has been standardized in nutmeg with 90-100 per cent success when done during July November, on 6-12 month old Myriatica Fragrans rootstock for production of orthotropic budded plants. Chip budding is a grafting/budding method used for asexual propagation of woody plants. Normally in chip budding leaf is not used. Here the chip budding technique has been modified to suit this crop by using green bud with a leaf to get hundred per cent success.

Green chip budding in nutmeg is an ideal method which could be followed in nutmeg for production of orthotropic plants. This method of budding is superior to other methods of budding because here the bud is removed with the cambial tissue and the union is faster resulting in higher success percentage. This method can be done throughout the year but the success percentage is high when done during July to November. This method can be adopted as a successful technique for vegetative propagation of nutmeg using orthotropic and plagiotropic buds from high yielding female trees though this technology is best suited for production of orthotropic budded plants due to the limited availability of orthotropic buds. More over a successful technology for vegetative propagation of nutmeg is available. Hence the advantage of this budding over grafting is that more orthotropic plants could be produced from the available orthotropic scions.

1.6. Soil Factors

The soil types on which nutmeg is cultivated are very different. They range from sands to Ioams. The trees also thrive well on the poor soil in New Guinea provided the correct cultural measures are taken, the most important feature of the soil appears to be a high content of organic matter (Hekestra & Schlette, 1960). Stagnant water not only causes poor growth, but in most cases even root rot. The soil needs to have a fair water holding capacity , especially in climates with dry periods . nutmeg grows in clay loam soils in Indonesia, lateritic clays in Malaysia and volcanic loams in Moluccas. Well-drained soils in humus are best (Shanmugavelu and Rao, 1977). Water logged or soils having inadequate moisture may be avoided (Purseglove et al., 1981). Area with shade, sheltered from wind and free from water stagnation should be selected for nutmeg plantation

1.7. Climatic Factors

The right climatic conditions for cultivation of nutmeg may be deduced for the fact that the tree belongs to a family of tropical rain forest trees. According to (Deinum , 1949) , nutmeg needs a warm and rainy tropical climate with an average temperature of 25-30 degree celcesius and without any real dryperiods. A humid tropical climate is the best for nutmeg and it grows up to an elevation of 1000 m above MSL (Shanmugavelu and Rao, 1977). A well distributed rainfall of 150-250 cm and an annual mean temperature of 20-30 degree celcesius are ideal for nutmeg (Bavappa and Ruettimann, 1981). according to (Ruinard, 1961)(the new plantions of nutmeg in Grenda are situated above an elevation of 300 meters(900 feet), because nutmeg thrives and produces better in these areas owing to the higher rainfall.

1.8. Irrigation

Seedlings may be irrigated periodically during summer (Shanmugavelu and Rao, 1977). For 4 year old plants, 20 litre of water per plant thrice a week are given; the quantity of water is to be increased at later stages of growth (Krishnamoorthy, 1987).

1.9 Important Diseases

1.9.1.Thread Blight

The thread blight is a major concern, especially in abandoned and less attended plantations and is considered as one among the most prevalent diseases of nutmeg. This infection becomes severe during post-monsoon period and under heavily shaded conditions. Two types of thread blights are reported in nutmeg. (Suseela Bhai & Biju, 2018)

1.9.1.1 White thread blight

The white thread blight caused by *Marasmius pulcherima* is characterized with the formation of fine white hyphal aggregates manifested as threads. These mycelial threads traverse along the stem underneath the leaves in an irregular or fan-shaped manner leading to blighting of affected portions. The affected Leaves remain attached to the stem. (Suseela Bhai & Biju, 2018)

1.9.1.2 Horse hair blight

The second type viz., horse hair blight caused by *Marasmius equicrinus* manifests as fine black silky threads which form an irregular, loose network on the stem and leaves subsequently leading to foliar and stem blight. In the later stages, the dried leaves detach from branches and remain suspended.

The disease can be managed by timely adoption of cultural practices and plant protection measures. Intensity of the disease can be reduced considerably by regulating shade in plantations. Adopting phytosanitation by collecting and destructing disease affected plant parts during May, before the onset of monsoon reduces population density of the pathogen. Prophylactic sprays with Bordeaux mixture (1%) during May - June before the onset of monsoon and repeated sprays during August - September considerably reduces the disease. (Suseela Bhai & Biju, 2018)

1.9.2 Nut/Fruit Rot

The disease is of common occurrence in several parts of Kerala which appears during the monsoon. The disease causes severe crop loss due to premature fruit fall. The disease initiates as water soaked, dull green to dark brown lesions on the rind near the stalk portion of the fruit.

The brownish lesions later rot, which further spread to the entire fruit, will eventually lead to fruit fall. The rotting may extend to the mace also, which reduces the quality of the spice. The affected fruits are covered with greenish black spots with brownish tissue beneath. (Suseela Bhai & Biju, 2018)

1.9.3 Leaf Spot and Shot Hole

The disease was first reported from Meghalaya and now is prevalent in all nutmeg cultivating tracts with a potential to cause Large-scale destruction of the crop. The disease is restricted to the foliage, and the pathogen infects leaves at different stages of maturity. However, young Leaves are more prone to infection. (Suseela Bhai & Biju, 2018)

1.9.4.Fruitdrop

The disease appears as water-soaked lesions at the base or any part of the fruit, which later turn brownish followed by premature splitting of the pericarp and rotting of mace and seed. The half-matured or unripe fruits are more vulnerable to the disease, which makes its appearance during the monsoon and is favoured by incessant rainfall. As the disease progresses, the internal tissues rot completely and infection on peduncle (fruit stalk) leads to shedding of fruits.(Suseela Bhai & Biju, 2018)

1.9.5 Root Rot

The aerial symptoms of root rot include foliar yellowing and subsequent defoliation As the disease advances, the tree declines due to eroding roots. The fruits becomedry and shrivel. The pathogen invades the root system forming a black layer over the root, which ultimately penetrates the wood, kills the tree resulting in die back. The disease is caused by Rosellinia pepo. Root rot caused by Fomes *noxius* and the brown root rot incited by *F.camoensis* are also reported from Indonesia (Suseela Bhai & Biju, 2018)

1.9.6. Pink Disease

The disease is fatal to foliage, branches and fruit. This manifests in the form of strings or threads composed of fine parallel, mycelial filaments growing more or less superficially along the tower surface of branches and twigs. Subsequently, the infection advances to the petiole and spreads over the leaf blade, which later withers and turns brownish. In the later stages, the infection extends to the branches and fruits. (Suseela Bhai & Biju, 2018)

1.9.7. Leaf and Fruit Fall

Leaf and fruit fall caused by Phytophthora meadii is reported from major nutmeg growing areas of Thrissur,Ernakulam and Kottayam districts ofKerala. The disease appears during monsoon and leads to severe defoliation and fruit fall. The symptoms manifest as dark brown water-soaked lesions formed on the midrib of the leaves which later enlarge and spread along lateral veins to Lamina resulting in blighting of the leaves. The petioles of infected leave turn black and blackish lesions appear on young shoots which enlarge in Size resulting in rotting and drying up of shoot.from the tip downwards. Prophylactic spray with Bordeaux mixture (1%) before the onset of monsoon (May - June) and during August. (Suseela Bhai, R., Biju, 2018)

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