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Techniques in Quality Planting Material Production in Major Spices Crops

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ABSTRACT

Spices like black pepper, cardamom, tree spices such nutmeg, cinnamon, clove are perennials and ginger and turmeric are grown annually. Most of them are propagated by vegetative methods. Non-availability of quality planting material is one of the important production constraints that affect the area expansion or gap filling programmes. Each crop requires specific techniques and handling to produces for planting material production from proven mother plants. The black pepper cuttings collected from mother plant are further multiplied by employing suitable rapid multiplication techniques. The simple and fast techniques are 'soil mound' with multiplication ratio of 1:40 in a year for production of normal cuttings. The micro propagated ginger can be raised using soil less medium in 18 or 20 well protrays, which is easy for transport and ensure pathogen free. In cardamom, vegetative techniques with average production of 32-42 suckers after 12 months of planting from one planting unite. Cardamom and turmeric are propagated through rhizome, around 1500 kg/ha seed is required and this can be reduced by adopting novel single bud transplanting is popular with several advantages. In tree spices nutmeg and kokum propagated through softwood grafting and cinnamon by layering. Bush pepper and dwarf grafts are suitable urban horticulture and vertical farming. Use of growth regulators, ideal potting mixture and fortification with PGPR's or bio-control agents enhance seedlings vigour. By adopting these efficient multiplication techniques we can meet the quality planting material requirements of spices.

Keywords

Quality, Material,
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Introduction

India is the land of Spices. It is the largest producer, consumer and exporter of the spices in the World. According to the Spice Board of India, sixty three spices are grown in the country. Spices is growing up every year, But per capita land resources are decreasing day by day due to huge population pressure and industrialization. On the other hand casual

natural hazards, pest and diseases outbreak etc. are also serious threats for getting that targeted outputs at a point of time. Sometimes problems like non-availability of quality and high yielding varieties. Low productivity mainly due to infestation of several diseases and pests, poor post-harvest handling practices, result in more production cost. Price insecurity and inadequate extension works are also major constraints against these

rapid multiplication techniques. Hence, rapid multiplication of planting materials through modern propagation techniques is urgently needed. India is the world's largest producer, consumer and exporter of spices; the country produces about 75 of the 109 varieties listed by the International Organization for Standardization (ISO) and accounts for half of the global trading in spices.

The export of spices and spices products is growing up every year. But it is alarming that per capital and resources are decreasing day by day due to huge population pressure and industrialization. It is almost impossible to have a horizontal expansion of spice growing area. On the other hand casual natural hazards, pest and diseases outbreak, market fluctuation, etc. areal so serious threats for getting that targeted out puts at a point of time. But sometimes, they concerned with some problems like non-availability of quality and high yielding varieties, low productivity mainly due to infestation of several diseases and pests, poor post-harvest handling practices, result in more production cost. Even, price in security and inadequate extension works real so major constraints against these rapid multiplication techniques. Hence, rapid multiplication of planting materials through modern propagation techniques is urgently needed.

Techniques in quality planting material production

Propagation techniques

Conventional propagation needs a large quantity of planting material which results less sprouting ratio, more incidences of disease and pests and poor root development as well as field establishment. Modern propagation techniques are more advantageous over convention alone. Through modern propagation techniques production of

virus free, disease and insect pest resistant planting material with large quantities within a shorter space of time can be possible. These plants grow faster and more vigorously. Also gives higher yield as compare to conventional methods.

Turmeric

Single bud rhizomes method

Planting of turmeric by traditional way required more amount of quality planting material but less availability and highest cost are the main constraint. Even though, it takes nearly five to six months for rhizome development along with better crop establishment. Hence, to overcome these constraints rapid multiplication of turmeric through single bud method is one of the best methods. For this, a disease free, one to one and half month old seed rhizomes, treated with car bendazim@2g/litre and monocrotophos are used.

These rhizomes are cut into small pieces having single bud, cured on palmmat, covered with 0.5% humic acid treated coco peat and sprinkled the water upto 4 days. These sprouted single bud rhizomes sown in portray contains coco peat (100g) and *Pseudomonas fluorescens* (5g) and covered with polythene sheet. Finally after emergence of leaf, spray the crop with 0.5% humic acid and plant lets are ready for transplanting within 25-30 days.

Malhotra *et al.*, (2016) reported that single bud techniques of turmeric for seedlings production in portray was more beneficial as compared to direct planting method as showed on Table 1.

Phan Van Tan (2016) Stepwise optimization of different plant is to change the growth regulator, reduce the level of macro-nutrition and add humate. The M2 medium (MS's

macronutrition $\frac{1}{4}$, MS's micronutrition + Morel's vitamin + coconut milk 10% + sucrose 25 g/l + humate 1.0 ml/l + agar 7.5 g/l + 2,4D 0.5 mg/l + BAP 1.0 mg/l + TDZ 1.0 mg/l) is the highest ratio of callus induction. The TA3 medium (MS's macronutrition $\frac{1}{4}$ + MS's micronutrition + Morel's vitamin + coconut milk 10% + sucrose 25g/l + humate 2.0 ml/l + 2,4 D 0.5 mg/l + Kinetin 2.0 mg/l + TDZ 1.0 mg/l + BAP 1.0 mg/l + NAA 2.0 mg/l + activated carbon 2.0 g/l) is able to create buds and regeneration multiple bud for *Curcuma* sp. TA3 medium adding IAA 2 mg/l and IBA 0.5 mg/l has resulted in the highest indices of quantity, healthy shoot and large diameter of roots. A large number of healthy plantlets are induced by the medium of MS's macronutrients $\frac{1}{2}$, MS's micronutrients full, Morel's vitamin, humate 3 g/l, coconut milk 150 ml/l, activated carbon 3 g/l, composition phytohormone: IAA 2 mg/l + BAP 2 mg/l + TDZ 0.5 mg/l.

Ginger

A transplanting technique in ginger by using single bud sprouts (about 5g) has been standardized to produce good quality planting material with reduced cost. The yield of ginger is *at par* with conventional planting system. The technique involves raising transplants from single sprout seed rhizomes in the potray and planting in the field after 30-40 days. The advantages of this technology are production of healthy planting materials and reduction in seed rhizome quantity and eventually reduced cost on seeds.

Sathyagowri *et al.*, (2011) the conventional ginger propagation method is by rhizomes which have many limitations. Field grown ginger rhizomes with buds were rinsed thoroughly in running water then dipped in 70% ethanol for 1 min. They were surface sterilized using Captan 0.3% followed by Doxycycline 0.2% for 10 min and finally with

commercial bleach 20% of Cloro x TM. The sterilized rhizome buds of various sizes *viz.*, 0.5 cm, 1.0 cm and 2.0 cm length were excised and cultured on MS medium with 3.0 mg L-1 BAP and 0.5 mg L-1 NAA to select the suitable size of explants for the establishment of culture. Results revealed that explants of 0.5 cm length exhibited high rate of survival (66.67%) and morphogenic response (44.44%) among the explant sizes tested. Consequently the selected explants (0.5 cm long) cultured were transferred to MS medium with 5.0 mg L-1 BAP and 0.5 mg L-1 NAA for shoot multiplication after 6 weeks of cultures. Thus micro-shoots were placed on the medium containing 3.0 mg L-1 BAP and 0.5 mg L-1 NAA to regenerate *in vitro* plantlets. The regenerated plantlets were successfully acclimatized. This might be helpful to obtain large number of *in vitro* planting material of ginger rapidly for cultivation.

Abbas *et al.*, (2011) also developed the promising protocol for *in vitro* propagation of *Zingiber officinale* Rosco using sprouting buds was established. Sprouting buds were sterilized and cultured onto MS medium supplemented with different growth regulators. Augmentation of MS-medium with 4.5mg/litre BAP recorded the highest percentage of shoot lets multiplication. Shoot lets were highly rooted on half strength of B5 medium supplemented with 1.0mg/litre NAA. The maximum percentage of acclimatization, hardening and rhizomes production of *in vitro* derived plants in green house was 80–100%.

Rapid multiplication techniques of small cardamom

Ankegowda *et al.*, (2012) Small cardamom is propagated by rapid clonal propagation method. One grownup sucker and a young growing shoot are planted at 1.8x0.6m spacing, which is protected with erecting

pandal. From one planting unit about 32-42 suckers produced after 12 months. Hence in one hectare of clone nursery about 1, 48, 144-1, 94, 439 plants were produced in 12 months through rapid clonal multiplication techniques

Micro propagation of cardamom

Poudel *et al.*, (2018) cultured in Murashige and Skoog (MS) medium enriched with 9 different concentrations of BAP (6-benzylaminopurine) and IBA (indole-3-butyric acid) namely 0.5 mg/L (BAP), 1.0 mg/L (BAP), 1.5 mg/L (BAP), 2.0 mg/L (BAP), 1 mg/L (IBA), 0.5 mg/L (BAP)+ 1 mg/L (IBA), 1.0 mg/L (BAP)+ 1 mg/L (IBA), 1.5 mg/L (BAP)+ 1 mg/L (IBA) and 2.0 mg/L (BAP)+ 1 mg/L (IBA).

This study showed that the explants grown in MS medium supplemented with 1.0 mg / L BAP + 1.0 mg / L IBA showed the maximum root induction rate. Buds produced roots in the same medium. The roots planted in the screen house were transplanted for the hardening process. Then these hardened plants were transferred to the netted nursery for further multiplication process. This protocol developed could be used for developing the superior quality plants of large cardamom.

Cinnamon

Waman *et al.*, (2018) Air layering: Done on semi hardwood shoots (25-30 cm). Ring on bark shoot and a rooting hormone (IBA 2000 ppm or IAA 2000 ppm) is applied on the portion. Moist coir dust or coir husk is placed around and wrapping with a polythene sheet of 20 cm length. Rooting takes place in 40-60 days. Well rooted air layers are separated from the mother plant. Bagged in polythene bags filled with potting mixture. Rooted cuttings and layers can be planted in the main field with the onset of rains (Table 2).

Black pepper

Black pepper can be propagated by seeds, cuttings, layering, and grafting. Seed propagation of ten results in genetic variation while other methods of propagation are slow and time consuming.

So, there is a need to introduce efficient methods for rapid propagation of black pepper. In different countries of worlds like India, Sri Lanka black pepper is plants are multiplied rapidly in order to get more seedling in short duration and for quality planting material.

Split bamboo methods

A trench is made of 45 cm depth, 30 cm width and convenient length, filled with rooting medium comprising of forest soil, sand and farm yard manure in 1:1:1 ratio. Split halves of bamboo is fixed at 45 degree angle on a strong support. Rooted cuttings are planted in the trench at the rate of one cutting for each bamboo split. The lower portions of the bamboo splits are filled with rooting medium (preferably weathered coir dust-farm yard manure mixture in 1:1 ratio) and the growing vine is tied to the bamboo split in such a way so as to keep the nodes pressed to the rooting medium. As the cuttings grow, the bamboo splits are filled with rooting medium and each node is pressed down to the rooting medium and tied. When the vine reaches the top (3-4 months after planting of the cutting) the terminal bud is nipped off and the vine is crushed at about three nodes above the base, in order to activate the axillary buds.

After about 10 days, the vine is cut at the crushed point and removed from the rooting medium and cut between each node. Each cutting with the bunch of roots intact is planted in polythene bags filled with fumigated potting mixture.

Table.1 Comparison of direct planting and transplanting (single bud rhizome) method of turmeric on sprouting and vegetative phases of the plant

Growing Phase	Direct Planting method (whole seed)	Transplanting Method (single bud rhizome)
Sprouting phase.	20DAP	Plants have 34 leaves (1 month old).
Vegetative phase.		
One month after planting.	2-3 leaves/plants	6-7 leaves per plants.
Tillering stage.	3 MAP	1½ – 2 MAP
Rhizome development phase.	Starts from 5 MAP	Starts from 3 MAP
Rhizome maturation phase.	7-9 MAP	6-7 MAP

Malhotra *et al.*, 2016

Table.2 Air layering in cinnamon (*Cinnamomum verum* L.) under wet humid tropical conditions

Treatment	Rooting Percentage	Number of primary roots layer ⁻¹	Mean length of primary root (cm)	Mean thickness of primary root (mm)
July 3	87.5	5.8 a	5.52 b	2.74 a
July 23	57.5	4.2 a	7.37 a	2.33 a
August 12	47.5	4.2 a	5.18bc	2.04 a
September 1	50.0	3.7 a	8.53 a	2.17 a
September 21	35.0	5.3 a	3.60 c	2.15 a
October 11	43.2	3.8 a	4.00bc	2.20 a

Waman *et al.*, 2018

Table.3 Effects of age of scion stick on sprouting, survival and growth in soft wood grafting of Kokum

Treatment (Age of scions in months)	Sprouting (%)	Survival after Three months (%)	Mean No. of leaves at the time of survival/graft	Length of sprout at survival/ graft (cm)
6	97 (80.02)	84 (66.42)	9.75	1.425
5	96 (78.46)	86 (68.03)	9.25	1.450
4	89 (70.63)	82 (64.90)	9.50	1.450
3	93 (74.66)	85 (67.21)	6.60	1.450
2	91 (72.54)	83 (65.65)	6.60	1.450
1	61 (51.35)	45 (42.71)	3.60	0.500
'F test	Sig.	Sig.	Sig.	Sig.
S. Em. +	2.89	2.25	0.70	0.29
C.D. at 5%	8.74	6.76	2.10	0.88

Haldankar *et al.*, 1992

Table.4 Effect of time of softwood grafting on sprouting, survival and growth of nutmeg grafts

Month	Sprouting (%)		Survival (%)	
	2002-03	2003-04	2002-03	2003-04
July	100.00	100.00	99.77	98.70
August	100.00	100.00	99.12	98.00
September	98.25	95.35	95.55	93.45
October	96.00	95.35	90.00	88.70
November	90.70	89.45	82.70	76.00
December	78.27	82.75	72.65	71.00
January	73.35	72.35	71.35	68.40
February	93.30	92.25	80.70	80.00
March	89.35	88.70	82.70	85.35
April	91.35	90.70	84.00	84.70
May	90.20	94.70	84.70	90.70
Jun	100.00	99.78	99.55	96.45
Mean	76.31	76.14	70.97	69.48
SE	1.5	1.31	1.73	1.64
CD at 5 %	4.42	3.85	5.09	4.80

Khandekar *et al.*, (2006)

The advantages of this method of propagation are rapid multiplication (1:40), well developed root system, higher field establishment and vigorous growth as a result of better root system.

Serpentine method

It is one of the cheapest propagation techniques for production of rooted cuttings of black pepper is serpentine layering. In a nursery shed with roofing sheet or shade net, rooted black pepper cuttings are planted in polythene bags containing about 500g potting mixture, which will serve as mother plants. As the plant grows and produces few nodes small polythene bags (20x10cm) filled with potting mixture maybe kept under each node. The node maybe kept gently pressed into the mixture assuring contact with the potting mixture. Roots start growing from the nodes and the cuttings keep on growing further. Each node with the polythene bag is cut just below the rooted node. The rooted nodes will

produce new sprouts in a week time and will be ready for field planting in two-three months' time. On an average, 60 cuttings can be harvested per mother plant in a year by this method.

Soil mound method

A soil mound of 2.5mx0.60m (45°angle) of 2m length (height) was prepared using locally available soil. In the upper layer of 5cm of soil mound, well decomposed cow dung was mixed@1kg/m². Rooted cuttings were planted at the base of soil mound in previously made tranche at 20 cm spacing.

Khandekar *et al.*, (2004) concluded that soil mound method of black pepper multiplication showed superior result over conventional method of multiplication and followed by split bamboo method and serpentine method of propagation respectively. The longest vine length, more number of node and branches per vine and number of roots per node also

highest in soil mound method. Similarly, the number of cuttings available per harvest, number of cuttings per year and maximum success percentage of cutting was greatest in soil mound method followed by split bamboo and serpentine method.

Kokum

Haldankar *et al.*, (1992) Vegetatively propagated by softwood grafting. Use more than 22 weeks old seedling and 5-6 months old scion sticks are suitable. Sprouting in kokum softwood grafts was 82% and 76.5% in October and Feb – May months respectively (Table 3).

Nutmeg

Khandekar *et al.*, (2006) the grafting method developed at Regional Coconut Research Station, Bhatye, Maharashtra provides scope for grafting nutmeg for prolonged period. May was the best month for soft wood grafting with maximum success of 80 per cent. There tension of leaves on rootstock did not influence the success of softwood grafting (Haldankar *et al.*, 1999) (Table 4).

It is concluded that the literature reviewed here highlighted the Conventional propagation methods being slow, a rapid method of multiplication is needed especially for newly developed high yielding varieties, which are available in small quantities. Production of pathogen free healthy crop. Strengthened concept for quality production.

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