

# PACKAGE OF PRACTICES - BLACK PEPPER



## KERALA AGRICULTURAL UNIVERSITY- PACKAGES OF PRACTICE

### **PEPPER (*Piper nigrum*)**

Pepper requires a warm and humid climate. Though an annual rainfall of 250 cm is ideal for the proper growth of the crop, it can also come up well in low rainfall areas, if the pattern and distribution of rainfall are conducive. About 70 mm of rainfall within a period of 20 days may be sufficient for triggering of flushing and flowering process in the plant, but once the process is set on, there should be continuous, rainfall until fruit development starts. Any dry spell, even for a few days, within this critical period will result in substantial reduction of yield. Very long spells of dry weather are unfavourable for the crop growth.

The plant tolerates a minimum temperature of 10°C and maximum of 40°C, the optimum being 20 - 30°C. It can be grown from sea level upto an altitude of 1200 m.

Pepper prefers a light porous and well-drained soil rich in organic matter. Water stagnation in the soil, even for a very short period, is injurious for the plant. So, heavy textured soils in locations where drainage facilities are inadequate should be avoided.

#### **Varieties**

*Improved varieties:* Panniyur-1, Panniyur-2, Panniyur-3, Panniyur-4, Panniyur-5, Panniyur-6, Panniyur-7, Subhakara, Sreekara, Panchami, Pournami. IISR Sakthi and IISR Thevam are tolerant to Phytophthora foot rot.

*Local varieties:* Kottanadan, Kuthiravally, Arakulam Munda, Balankotta, Kalluvally and Karimunda.

#### **Selection of site**

Sites with slight to moderate slope are ideal for pepper cultivation, as they promote drainage. Slopes facing south are to be avoided as far as possible. When such slopes are to be used for cultivation, the young plants may be sufficiently protected from the scorching sun during summer.

## **Selection of mother plants**

Cultivate varieties, which are proven to be highly productive. Select mother plants, which give regularly high yields and possess other desirable attributes such as vigorous growth, maximum number of spikes per unit area, long spikes, close setting of berries, disease tolerance etc. Selected mother plants should be in the age group of 5-12 years. Mark and label selected mother plants in October-November.

## **Raising of rooted cuttings**

Pepper is propagated vegetatively from cuttings. Select runner shoots produced at the base of mother plants and keep them coiled and raised to prevent from striking roots in the soil. Separate them from the vines in February-March. The middle one-third portion of runner shoot is preferred for planting. Very tender and too hard portions of the shoots are to be avoided. The shoots are cut into pieces with 2-3 nodes in each. Two node semi-hard wood cuttings are to be planted for rooting of pepper cuttings. Leaves, if any, are to be clipped off leaving a small portion of the petioles on the stem. Satisfactory rooting and survival of cuttings (over 70 per cent) could be achieved even without any hormone treatment. Plant the cuttings in polythene bags filled with potting mixture. The potting mixture is prepared by mixing two parts of fertile topsoil, one part of river sand and one part of well rotten cattle manure. Substituting granite powder (a waste material from stone quarries) for sand in conventional potting mixture (2:1:1) is good for growth of pepper cuttings and is economical. Recommended for black pepper nurseries for large scale multiplication. Solarized potting mixture supplemented with nutrient solution (urea, superphosphate, MOP and magnesium sulphate in 4:3:2:1 ratio) and fortified with biocontrol consortia promotes growth and helps in production of disease free rooted cuttings. When polythene bags are used, sufficient number of holes (16-20) may be provided at the base to ensure good drainage. The cuttings should be planted at least one node deep in the soil. The cutting after planting should be kept under good shade. In large nurseries, pandals are to be constructed for this purpose. The cuttings are to be well protected from direct sunlight and frequent watering is recommended in the nursery to maintain a humid and cool atmosphere around the cuttings. Watering 2-3 times a day is sufficient. Heavy watering, which makes the soil slushy and causes water logging is to be avoided.

## **Serpentine method of propagation**

Three node cuttings planted in polythene bags are kept in a corner of the nursery. When the plant develops two leaves they are trailed horizontally in polythene bags containing potting mixture kept below each tender node. Each node will be pressed into the mixture with polythene bags with 'V' shaped midribs of coconut leaves. As new shoots arise these will be trailed horizontally in polythene bags containing potting mixture. Upward growth of cutting is not arrested. Once twenty nodes get rooted first 10 bags in the rooted nodes will be separated by cutting at the inter nodes. The inter nodal stub will be pushed back into the potting mixture. These stubs also produce a second root system. Daily irrigation is to be given using a rose can. After three months it will be ready for planting in the main field. On an average 60 cuttings will be obtained in a year by this method from each mother cutting. Recommended in black pepper nurseries for large scale multiplication.

## **Field planting**

Planting of standards is to be taken up in April-May with the onset of pre-monsoon showers. Murukku (*Erythrina indica*) Karayam or Killingil (*Garuga pinnata*), *Ailanthus* sp., subabul (*Leucaena leucocephala*) etc. are suitable standards for growing pepper. Because of prevalence of *Erythrina* gall wasp avoid using *Erythrina* as standard. Only species tolerant to *Erythrina* gall wasp is *Erythrina variegata* (heavily thorny). In high altitude areas, dadap(*E.*

*lithosperma*) and Silver oak (*Grevillea robusta*) can be successfully used as standard for pepper. Seedlings of subabul and silver oak are to be planted 2-3 years before planting pepper. The cuttings of standards are to be planted in narrow holes of 40 to 50 cm depth. The spacing recommended is 3 m x 3 m on plain lands and 2 m between plants in rows across the slope and 4 m between rows on sloppy lands. The soil should be pressed well around the standards to avoid air pockets and keep the standards firm in the soil.

For planting pepper, prepare pits on the northern side of standards, 15 cm away from it. The pit size should be 50 cm x 50 cm x 50 cm. Fill the pits with a mixture of topsoil and compost or well rotten cattle manure @ 5 kg per pit. With the onset of southwest monsoon in June-July, plant 2 rooted cuttings in the pits at a distance of about 30 cm away from the standards. Press the soil around the cuttings and form a small mound slopping outward and away from the cuttings to prevent water stagnation around the plants. The growing portions of the cuttings are to be trailed and tied to the standards. Provide shade to the plants if the land is exposed and if there is a break in the rainfall. When pepper is trailed on arecanut, plant the cuttings 1.0 m away from palm and 1.5 m when coconut is used as the support. Trail the pepper vines on a temporary stake for 1-2 years. When they attain sufficient length to reach the tree trunk, remove the stake without causing damage to the vines and tie the pepper plants on to the tree trunk and trail them on it.

### **Management after planting**

If the terrain of the land is sloppy or uneven, carry out contour bunding or terracing to prevent soil erosion. Carry out digging around the standards and vines at a radius of about 1 m from the base or in the entire plantation, twice during the year, the first at the onset of southwest monsoon and the second towards the end of northeast monsoon. Weeding around the plants is to be done according to necessity. However, in foot rot affected gardens, digging should be avoided and weeds removed by slashing. In the early stages, tie the vines to the standards, if found necessary.

Where pepper is grown in large areas, growing of cover crops like *Calapagonium muconoides* is recommended. When such cover crops are grown, they are to be cut back regularly from the base of the plants to prevent them from twining along with the pepper vines. Lowering of vines after one year's growth will promote lateral branch production.

Intercropping of pepper gardens with ginger, turmeric, colocasia and elephant foot yam is advantageous. Banana as an intercrop in yielding gardens reduces pepper yield. Therefore, this is not recommended beyond three to four years after planting of pepper vines. However, in the early years, banana provides shade to the young plants and protects them from drying up during summer months.

When pepper is grown in open places, shading and watering of the young seedlings may be done during summer months for the first 1 to 3 years according to necessity. The young plants may be completely covered with dry arecanut leaves, coconut leaves or twigs of trees until summer months are over. Mulching the basins of pepper vines during summer months is highly advantageous. Saw dust, arecanut husk and dry leaves are suitable mulching materials. Removal of unwanted terminal shoot growths and hanging shoots should be done as and when necessary.

Prune and train the standards in March-April every year to remove excessive overgrowth and to give them a proper shape. The effective height of the standard is to be limited to about 6 m. A

second pruning of the standards may be done in July-August, if there is excessive shade in the garden.

### **Underplanting**

After regular bearing for about 20 years, the vines of most varieties start declining in yield. The age of decline in yield varies with variety and agroclimatic and management factors. So underplanting should be attempted at about 20 years after planting or when a regular declining trend in yield appears. The old and senile vines can be removed 3-5 years after underplanting depending upon the growth of the young vines.

### **Manuring**

Manuring for pepper vines is to be done in basins taken around the plant, 10-15 cm deep and 50-75 cm radius, depending up on the growth of the plants. Apply cattle manure / compost / green leaves @ 10 kg / plant / annum just at the onset of southwest monsoon and cover lightly with soil. It is desirable to apply lime at the rate of 500 g/vine in April-May, with the receipt of pre-monsoon showers, in alternate years.

Recommended nutrient dosage for pepper (3 years and above) is:

*N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O g/vine/year*

50:50:150 (general recommendation)

50:50:200 (for Panniyur and similar areas)

140:55:275 (for Kozhikode and similar areas)

*Note:* Apply 1/3 dose for one year old plants and 1/2 dose for two year old plants.

The fertilizers may be applied in two split doses, the first in May-June with the receipt of a few soaking rains and the second in August-September. Apply fertilizers in a circle of radius 30 cm around the vine in the case of plants trailed on erythrina (*Nadan murukku*) or teak pole (dead standard) soil application of Zinc @ 6 kg ha<sup>-1</sup> as zinc sulphate or foliar spray of Zn @ 0.5 per cent

during flowering and pin head stage of black pepper is recommended in Zinc deficient areas of black pepper cultivation for increasing the yield and quality. Application of Molybdenum @ 1 kg ha<sup>-1</sup> is recommended for areas deficient in soil molybdenum availability.

### **Irrigation**

Irrigating pepper plants of Panniyur-1 variety at IW/CPE ratio of 0.25 from November / December till the end of March and withholding irrigation thereafter till monsoon break, increases pepper yield by about 50 per cent. The depth of irrigation recommended is 10 mm (100 litres of water per irrigation at an interval of about 8-10 days under Panniyur conditions). The water is to be applied in basins taken around the plants at a radius of 75 cm. The basins may be mulched with dry leaves or other suitable materials.

### **Bush pepper**

For production of bush pepper, two to four node semi hard wood lateral branches are to be collected with a segment of orthotropic shoot intact and planted in the nursery for rooting during May-June. Well rooted plants are used for field planting. The rooted cuttings are to be planted at 3 pits or pots. Fertilizers can be applied @ 1.0, 0.5 and 2.0 g/pot of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O respectively at bimonthly interval. Alternatively, application of 15 g groundnut cake or 33 g of neem cake can also meet the N requirement of the crop. The bushy nature of the plant will have to be ensured by proper pruning of the viny growth. The potted plants are to be kept preferably under partial shade. It is necessary that re-potting is carried out after every two years.

Irrigating black pepper vines with 8 litres of water through drip per day during Oct - May enhances yield and quality in bush pepper with high BC ratio. Recommended for bush pepper grown as intercrop in coconut gardens.

## **Plant protection**

### **Pests**

For the control of pollu caused by the flea beetle *Longitarsus nigripennis*, spray any one of the following insecticides namely, dimethoate or quinalphos at 0.05 per cent concentration. The spraying is to be given at the time of spike emergence (June-July), at berry formation (September-October) and once again at berry maturing stage, if needed. It can also be controlled by spraying cypermethrin 0.01 per cent twice, first at the berry formation stage and the second one-month after the first spray (Sept-Oct.).

For controlling pepper leaf gall thrips, dimethoate 0.05 per cent may be used.

Three different types of scale insects are found infesting black pepper in high ranges of Idukki district. They are black pepper mussel scale (*Lepidosaphes piperis* Gr.) infesting all parts of vines, coconut scale (*Aspidiotus destructor* Sign) feeding from undersurface of leaf and soft scale *Marsipococcus marsupiale* Gr. confining to upper leaf surface. Infestation by mussel scale causes significant loss of yield as it affects all parts of plant including berries.

Two sprayings of dimethoate 0.05 per cent at fortnightly intervals after the harvest of berries effectively control black pepper mussel scale.

Soft scale (*Lecanium* sp.) is occasionally found to infest the foliage and vines at higher elevations. This scale insect can be controlled by spraying quinalphos 0.05 per cent. This treatment will be adequate to control the mealy bugs also. Root mealy bugs can be controlled by drenching the basins of vines with chlorpyrifos 0.075 per cent. Adequate precaution has to be taken to

ensure that the insecticide solution reaches the root zone of the vines. Many of the vines infested by root mealy bugs are also likely to be infected with *Phytophthora* and nematodes. For controlling hard scale, spot application of dimethoate 0.1 per cent is recommended.

Top shoot borer can be controlled by spraying dimethoate (0.05 per cent) on the tender shoots and flushes. The spraying has to be repeated to protect newly emerging shoots and flushes.

For control of the burrowing nematode *Radopholus similis* and the root knot nematode *Meloidogyne incognita*, adopt the following measures:

- (a) Use nematode free rooted cuttings for raising new plantations.
- (b) Apply talc based formulation of *Bacillus macerans* @ 10g/vine in basins ( $10^6$  cfu/g) at the time of planting of vines or just before the monsoon period in established plantations.

### **Diseases**

*Phytophthora* (foot rot)

For controlling the disease, adopt the following management practices:

#### **Phytosanitation**

All infected or dead vines along the root system are to be removed and burnt. Wherever water stagnation is a problem, effective drainage of both surface and sub-soil is to be ensured. To avoid soil splash and consequent disease initiation and spread, a legume cover in the plantation

should be ensured. Runner shoots are to be pruned or tied back to vines before the onset of monsoon. At the onset of monsoon, the branches of support trees may be lopped off to allow penetration of sunlight and avoid build up of humidity.

Apply 1 kg lime and 2 kg neem cake per standard per year as pre-monsoon dose. The application of neem cake should be four weeks after lime application.

### **Chemical control**

For the control of *Phytophthora* foot rot, any of the following control measures can be adopted.

1. After the receipt of monsoon showers (May-June), all the vines are to be drenched over a radius 45-50 cm with 0.2 per cent copper oxychloride @ 5-10 litres per vine. This varies according to the age of the plant. A foliar spray with 1 per cent Bordeaux mixture is also to be given. Drenching and spraying are to be repeated just before the northeast monsoon. A third round of drenching may be given during October if the monsoon is prolonged.

2. After the receipt of a few monsoon showers (May-June), all the vines are to be drenched over a radius of 45-50 cm with 0.3 per cent potassium phosphonate @ 5-10 litres per vine. This varies according to the age of the plant. A foliar spray with 0.12 per cent potassium phosphonate is also to be given. A second drenching and spraying with 0.3 per cent potassium phosphonate is to be repeated just before the northeast monsoon. If the monsoon is prolonged, a third round of drenching may be given during October.

### **Biocontrol**

Inoculate pepper vines with native arbuscular mycorrhizal fungi, *Trichoderma* and *Pseudomonas fluorescens* at the time of planting in the nursery and field and apply during the pre-monsoon period in the established plantations to control foot rot. In the field, apply the biocontrol agents around the base of the vine (see the chapter on biocontrol agents against plant pathogens).

*Note:* (1) All chemical control measures are prophylactic in nature and application of chemicals in advanced stages of disease will not be effective in combating the disease.

(2) In *Phytophthora* sick fields, use only chemical control measures.

### **Replanting / rejuvenation**

Total replanting has to be undertaken in gardens where the mortality is 50-60 per cent or above. Where the mortality is below 50 per cent, timely plant protection measures as described above should be given to all the existing vines as prophylactic measure and gaps filled up. Gap filling or replanting should be taken up only after a period of one year. At the time of replanting, soil drenching with Bordeaux mixture or copper oxychloride should be given. While replanting, farmers should be encouraged to use recommended varieties.

#### *Fungal pollu (Anthracnose)*

For the control of fungal pollu or anthracnose caused by *Colletotrichum gloeosporioides*, spray 1 per cent Bordeaux mixture, once before flowering starts (late June and early July) and then at berry formation stage (late August). Minimize shade in the garden.

Foliar spray of carbendazim @ 1g l<sup>-1</sup> or a formulation containing combination of carbendazim + mancozeb @ 1g l<sup>-1</sup> during the month of June can effectively control the disease.

Wherever *Phytophthora* foot rot management is undertaken properly, separate control measures for pollu disease may not be necessary.

*Note:* Since Bordeaux mixture application for pepper is to be given mostly at a time when the monsoon is very active, it is to be ensured that a sticker is added to the fungicide. The cheapest and most effective sticker is rosin washing soda mixture.

### **Rotting disease**

For control of rotting disease of cuttings in the nursery, VAM and *Trichoderma* can be applied in the potting mixture. VAM inoculum consisting of infected root bits and soils can be applied @100 cc per kg of potting mixture and *Trichoderma* @ 1g kg<sup>-1</sup> of potting mixture. For the control of foliar infection apply potassium phosphonate @ 3 ml litre<sup>-1</sup> at fortnightly interval. In case, biocontrol agents are not incorporated in the potting mixture, 1 per cent Bordeaux mixture spray at weekly interval may be resorted to. When the cuttings start germination, ensure good aeration in the nursery. Heavy watering, which causes water stagnation is to be avoided. Instead, light and frequent watering should be resorted to. Remove shade as soon as continuous rain sets in.

### **Phyllody**

In certain pockets, instead of normal spike with berries, leaf-like structures are produced. This is caused by Phytoplasma. Such vines, if noticed, must be uprooted and destroyed. Planting material should not be collected from such vines.

### **Stunted disease**

The symptoms due to this disease include shortening of internode and narrowing of leaves with mottling. Such leaves also become leathery and deformed. This is caused by a virus. Since the disease is systemic and transmitted through planting materials, avoid collecting planting materials from such vines. Once it is noticed, uproot the vines to avoid further spread.

### **Waiting period of insecticide / fungicide**

Dimethoate	20 days
Quinalphos	20 days
Mancozeb	30 days

### **Harvesting and processing**

#### **Black pepper**

Black pepper of commerce is produced from whole, unripe but fully developed berries. The harvested berries are piled up in a heap to initiate browning. Then berries are detached from the stalk by threshing. Then they are spread on suitable drying floor. During sun-drying, berries are raked to ensure uniform drying and to avoid mould development. Drying the berries for 3-5 days reduces the moisture content to 10-12 per cent. The dried berries are cleaned, graded and packed in double lined gunny bags.

Blanching the berries in boiling water for one minute prior to sun drying accelerates browning process as well as the rate of drying. It also gives a uniform lustrous black colour to the finished product and prevents mouldiness of berries. Prolonged blanching should be avoided since it can deactivate the enzymes responsible for browning process.

#### **White pepper**

White pepper is prepared from ripe berries or by decorticating black pepper. Bright red berries, after harvest are detached from the stalk and packed in gunny bags. The bags are allowed to

soak in slow running water for about one week during which bacterial rotting occurs and pericarp gets loosened. Then the berries are trampled under feet to remove any adhering pericarp, washed in water and then sun dried to reduce the moisture content to 10-12 per cent and to achieve a cream or white colour. White pepper is garbled, sorted and packed in gunny bags. Approximately 25 kg white pepper is obtained from 100 kg ripe berries.

### **Improved CFTRI method**

Fully mature but unripe berries are harvested and boiled in water for 10-15 minutes to soften the pericarp. After cooling, the skin is rubbed off either mechanically or manually, washed and sun dried to obtain white pepper. Since no retting operation is involved, the product will be free from any unpleasant odour. However, white pepper produced by this method gives pepper powder of light brown colour due to gelatinisation of starch in contrast to pure white powder obtained by traditional method.

### **Decorticated black pepper**

This is a form of white pepper produced by mechanical decortication of the outer skin of black pepper. This is generally done when white pepper is in short supply. The appearance of decorticated kernel is inferior to traditionally prepared white pepper, but is satisfactory when ground. Also the milling operation requires considerable skill to avoid excessive volatile oil loss.

### **Dehydrated green pepper**

In this method, under-mature berries are harvested and subjected to heat treatment for inactivating the enzymes responsible for browning reaction. Then the berries are dehydrated under controlled conditions wherein maximum retention of green colour is obtained. Dehydrated green pepper after reconstitution in water resembles freshly harvested green pepper. The advantage is that the season of availability can be extended and the berries could be stored for a year or more. Dry recovery comes to 20 per cent.

### **Canned green pepper**

Green pepper after harvest is preserved in two per cent brine solution and the product is heat sterilized. This product has the additional advantage over dehydrated green pepper in that it retains the natural colour, texture and flavour.

### **Bottled green pepper**

Green pepper is preserved without spoilage in 20 per cent brine solution containing 100 ppm  $\text{SO}_2$  and 0.2 per cent citric acid. Addition of citric acid prevents blackening of berries.

### **Cured green pepper**

To overcome the disadvantages of poor texture and weak flavour of dehydrated green pepper and the high unit weight and packing cost of canned and bottled green pepper, cured green pepper has been developed. Berries are thoroughly cleaned in water, steeped in saturated brine solution for 2-3 months, drained and packed in suitable flexible polyethylene pouches.

### **Freeze-dried green pepper**

Most of the moisture from fresh tender green pepper is removed by freezing the berries at  $-30^\circ\text{C}$  to  $-40^\circ\text{C}$  under high vacuum. The colour, aroma and texture of freeze-dried green pepper are superior to sun dried or mechanically dehydrated green pepper. Freeze-dried green pepper has 2-4 per cent moisture and is very light.

### **Pepper oil**

Black pepper is crushed to coarse powder and steam distilled to obtain 2.5 to 3.5 per cent colourless to pale green essential oil which becomes viscous on ageing. It is used in perfumery



and in flavouring. Oil can also be distilled from white pepper but high price of white pepper and low oil yield do not favour its commercial production.

### **Pepper oleoresin**

Extraction of black pepper with organic solvents like acetone, ethanol or dichloro-ethane provides 10-13 per cent oleoresin possessing the odour, flavour and pungent principles of the spice. The content of the pungent alkaloid piperine ranges from 4 to 6 per cent in dry pepper and 35 to 50 per cent in oleoresin. When freshly made, pepper oleoresin is a dark green, viscous, heavy liquid with a strong aroma. One kg of oleoresin when dispersed on an inert base can replace 15 to 20 kg of spice for flavouring purpose.

**Table 23. Drying percentage and oil content of Panniyur varieties of pepper**

Properties	Variety						
	P 1	P 2	P 3	P 4	P 5	P 6	P 7
Drying %	35.3	35.7	27.8	34.7	35.7	32.9	33.6
Piperine %	5.30	6.50	4.80	4.40	5.30	4.94	5.57
Oleoresin %	11.78	12.20	10.40	11.30	12.33	8.27	10.61
Essential oil %	3.31	3.40	3.12	3.12	3.80	1.33	1.50

Reference Link : <http://www.kau.edu/prspanniyur.htm>

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## **Varieties**

Panniyur 1, 2, 3, 4, 5, 6 and 7, Karimunda, Sreekara, Subhakara, Panchami, Pournami, IISR Thevam, IISR Malabar Excel, IISR Girimunda, IISR Sakthi, PLD-2.

- Lower elevation and less shady areas- Panniyur 1.
- Higher elevation and more shady areas - Karimunda.
- Inter cropping in Arecanut – Panniyur 5.



# Bush pepper

## Soil and climate

Pepper is grown mainly as a rainfed crop. Pepper requires heavy rainfall (150 - 250 cm) high humidity and warm climate. Thrives best on virgin soils rich in humus content and the crop can be grown at elevations up to 1500 m.

## Season

June – December

## Propagation

Black pepper vines develop three types of aerial shoots, namely (a) primary stem with long internodes, with adventitious roots which cling to the standards (b) runner shoots which originate from the base of the vine and have long internodes which strike roots at each node and (c) fruit bearing lateral branches. Cuttings are raised mainly from runner shoots, though terminal shoots can also be used. Cuttings from lateral branches are seldom used since they develop a bushy habit. However, rooted lateral branches are useful for raising bush pepper.

## Production of rooted cuttings

### Traditional method

Runner shoots from high yielding and healthy vines are kept coiled on wooden pegs fixed at the base of the vine to prevent the shoots from coming in contact with soil and striking roots. The runner shoots are separated from the vine during February-March and after trimming the leaves, cuttings of 2-3 nodes each are planted either in nursery beds or in polythene bags filled with fertile soil. Adequate shade has to be provided and the polythene bags are to be irrigated frequently. The cuttings become ready for planting during May - June.

### Rapid multiplication method

An efficient propagation technique developed at Sri Lanka has been modified for adoption in India for quick and easy multiplication of black pepper vines. In this method, a trench of 45 cm depth, 30 cm width and convenient length is made. The trench is filled with rooting medium comprising of forest soil, sand and farm yard manure in 1:1:1 ratio. Split halves of bamboo with septa or split halves of PVC pipes of 1.25-1.50 meter length and 8-10 cm diameter provided with plastic septa at 30 cm intervals are fixed at 45° 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. The tying can be done with dried banana leaf sheath fibers or coir rope. The cuttings are irrigated regularly. As the cuttings grow, the bamboo splits are filled with rooting medium and each node is pressed down to the rooting medium and tied. For rapid growth, a nutrient solution of urea (1 kg), super phosphate (0.75 kg), muriate of potash (0.5 kg) and magnesium sulphate (0.25 kg) in 250 litres of water is to be applied @ 0.25 litre per vine at monthly intervals.

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. Trichoderma @ one gram and VAM @ 100 cc/kg of soil can be added to the potting mixture. Care should be taken to keep the leaf axil above the soil. The polythenebags should be kept in a cool and humid place, or should be covered with thin polythene (200 gauge) sheet to retain humidity. The buds start developing in about 3 weeks and the polybags can then be removed and kept in shade.

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.

### Trench method

A simple, cheap and efficient technique for propagating black pepper from single nodes of runner shoots taken from field grown vines has been developed at the institute. A pit of 2.0 meter x 1.0 meter x 0.5 meter size is dug under a cool and shaded area. Single nodes of 8-10 cm length and with their leaf intact, taken from runner shoots of field grown vines are planted in polythene bags (25 cm x 15 cm, 200 gauge) filled at the lower half with a mixture of sand, soil, coir dust and cow dung in equal proportion. The single nodes are to be planted in the bags in such a way that their leaf axil is above the potting mixture. The polythene bags with the

planted single nodes are arranged in the pit. After keeping the bags in the pit, the pit should be covered with a polythene sheet. This sheet may be secured in position by placing weights on the corners. The cuttings should be watered at least five times a day with a rose can and the pit should be covered with the polythene sheet immediately after watering. It is advisable to drench the cuttings two-three times with copper oxychloride (2g/litre).

After two-three weeks of planting, the cuttings will start producing roots which are visible through the polythene bags. After the initiation of roots the frequency of watering may be reduced to three-four times a day. After about one month, new shoots start emerging from the leaf axil. At this stage it is advisable to keep the pit open for about one hour per day so that the cuttings would harden and will not dry when they are taken out of the pit. The cuttings can be taken out of the pit after two months of planting and kept in a shaded place and watered twice a day. These cuttings will be ready for field planting after about 2 months. By this method 80-85 per cent success can be obtained. Foliar application of nutrient solution will also enhance the growth of the cuttings.

### **Serpentine method**

Cheaper propagation technique 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 holding about 500 g potting mixture, which will serve as mother plants. As the plant grows and produces few nodes small polythene bags (20 x 10 cm) filled with potting mixture may be kept under each node. The node may be kept gently pressed in to the mixture assuring contact with the potting mixture with the help of a flexible twig such as mid rib of a coconut leaflet to enable rooting at that junction. Roots start growing from the nodes and the cuttings keep on growing further. The process of keeping potting mixture filled polythene bags at every node to induce rooting at each node is repeated. In three months the first 10 to 12 nodes (from the mother plants) would have rooted profusely and will be ready for harvest. Each node with the polythene bag is cut just below the rooted node and the cut end is also buried into the mixture to induce more roots. Polythene bags filled with solarized potting mixture or soil, granite powder and farmyard manure in 2:1:1 proportion is recommended for producing disease free rooted cuttings. The rooted nodes will produce new sprouts in a week time and will be ready for field planting in two-three months time. Daily irrigation can be given with a rose can. On an average, 60 cuttings can be harvested per mother plant in a year by this method.

### **Planting**

Slopes facing West and South should be avoided. Pits of 50 cm x 50 cm x 50 cm size are dug at a spacing of 2 to 3 m in either direction (Panniyur 1 - 3 x 3 m). 5 to 10 kg of FYM/Compost is mixed with top soil and the pits are filled. Rooted cuttings are planted in June - July @ two per standard like Silver oak, Dadap and Jack. In multitier cropping system, standards should be planted at a spacing of 7 - 8 m.

### **Manuring**

Apply cattle manure or Compost @ 10 kg/vine just before the onset of South West monsoon. In addition 100 g of N, 40 g of P and 140 g of K per vine are applied in two split doses in the months of May - June and in September - October. Slaked lime at 500 g per vine is applied in alternate years during May - June. Apply Azospirillum @ 100 g/vine one month after the application of chemical fertilizers. Integrated nutrient management - Inorganic N 50 % of the recommended dose + FYM 10 kg + 50 g Azospirillum + 50 g Phosphobacteria + 200 g VAM per plant. The manures and fertilizers are applied around the vine at a distance of 30 cm from the base and incorporated into the soil.

### **Irrigation**

Protective irrigation in basins during December - May at 10 days interval.

### **Aftercultivation**

Two weedings are given during the months of June - July and at October - November. The vines are to be trained to the standards. Prune excessive foliage of the standards and limit the height of the standards to about 6 m. Spray NAA @ 40 ppm to increase the berry size.

### **Fruit drop**

The spike shedding can be reduced by foliar spray of Diammonium Phosphate 1.0 % four times viz., before flower initiation (May), during new leaves and flower emergence (June) before spike initiation (July) and pinhead stage of berries (August).

### **Plant protection**

#### **Pests**

#### **Pollu Beetle and Leaf Caterpillars**

Spray Quinalphos 25 EC 2 ml/lit once in July and again in October.

### Leaf gall and thrips

Spraying Monocrotophos 36 WSC 1.5 ml/lit or Dimethoate 30 EC @ 2 ml/lit or Chlorpyriphos 2 ml/lit or Dichlorvos 76 WSC 1 ml/lit or Phosphomidan 40 SL @ 2 ml/lit three rounds at monthly intervals starting from new flush formation.

### Top shoot borer

Top shoot borer can be controlled by spraying Monocrotophos or Quinalphos (0.05%) on terminal shoots at monthly intervals (during July – October) to protect emerging new shoots.

### Diseases

#### Foot rot

#### Nursery

Apply *Trichoderma viride* @ 1 g/kg of pot mixture. Mulch the pot mixture with 150 gauge polythene sheet for 30 days and inoculate with *Pseudomonas*.

#### Main field

Any of the following formulation can be drenched in the soil twice (May – June and October - November).

- Neem cake 1/2 kg per vine + Swabbing of Bordeaux paste upto 1 m from the ground level.
- *Trichoderma viride* @ 20 g/vine + FYM or Bordeaux mixture 1 % or Metalaxyl-Mancozeb @ 2 g/lit.
- Neem cake 2 kg per vine + 0.1% Metalaxyl (pre monsoon foliar spray and soil application).
- *Pseudomonas fluorescens* (50 g) (pre and post monsoon) + neem cake (2 kg) (post monsoon) + metalaxyl 0.1 %.

**Slow wilt:** Apply Phorate 10 G @ 30 g or Carbofuran 3 G @ 100g per vine (May – June and September - October) + Copper oxy Chloride @ 0.2 % (Soil drenching) or Potassium phosphonate @ 0.3% or Metalaxyl @ 0.1 %.

**Anthracoese:** Foliar spray with Bordeaux mixture @ 1 % or Mancozeb @ 0.2 %.

**Nematode :** Soil application *Bacillus subtilis* (BbV 57) or *Pseudomonas fluorescens* @ 10 g/vine is recommended for the management of root knot and reniform nematode population in Black pepper.



**Black Pepper Immature Spikes**



**Black Pepper Mature Spikes**

**Harvest:**

Harvesting commences from third year onwards. The harvesting season is from November to March. Harvest is done by hand picking the whole spikes when few berries in the spike start turning red. The berries are separated and dipped in hot water (80°C) for one minute and sun dried for 7 to 10 days.

**Commercial Black Pepper****White Pepper****Yield**

About 2 to 3 kg/vine/year.

**Market information**

Growing districts	Kanyakumari, Nilgiris, Kolli Hills, Lower pulneys
Major markets in Tamil Nadu	Kanyakumari, Nagarkovil
Preferred varieties	Tellichery, Alleppey and Malabar Garbled (MGI)
Grade specification	Pungency and aroma

**Bush Pepper**

**Planting material:** One year old lateral branches with 2-3 nodes with the bit of orthotropic portion intact.

**Planting:** 3-5 well rooted cuttings per pit or pot

**Manures and Manuring:**

- 1:0.5:2 g of NPK per pot at bi monthly intervals
- 15 and 33 g of groundnut cake and neem cake per pit or pot.

**Pruning:** Pruning of hanging shoots to maintain the bushy nature, repeating at every two years interval.

**Source:** *Spices Board, Kerala*

**Updated on: 30.08.2013**

Reference Links : [http://agritech.tnau.ac.in/horticulture/horti\\_spices%20%282%29.html](http://agritech.tnau.ac.in/horticulture/horti_spices%20%282%29.html)



## Package of Practices for Cultivation of Black Pepper

**Botanical Name:** *Piper nigrum*

**Family:** Piperaceae

**Origin:** Western Ghats of India

Black pepper is considered to be the King of Spices. It is the most important foreign exchange earning commodity among the Indian spices. Pepper alone contributes about 70% of total export earnings from all spices. Popularly it is known as "Black gold" because of its unique position in the international trade. About 90% of the total production of the world is in India of which about 98 % in Kerala alone. In Maharashtra, black pepper is grown in the Konkan region

### **Soil:**

1. Pepper thrives well in humus rich virgin soils.
2. Fertile, well-drained, loamy soil, rich in humus are ideal.
3. Soil pH should be between 5.5 to 7.0
4. The crop is susceptible to water logging and hence is planted by preparing heap of soil on field.

### **Climate:**

1. Native of humid tropics.
2. Require warm and humid climate.
3. High humidity helps for luxuriant crop growth and better yield.
4. Very high or low temperatures are not conducive for growth,
5. Temperature range: 10 - 40°C.
6. Rainfall: Up to 200 cm.
7. Can be cultivated up to 1500 m above sea level,
8. Crop is pollinated through raindrops and hence frequent showers during flowering are beneficial

### **Propagation:**

1. Propagated vegetatively or by seeds.

2. Commercially propagated by vegetative method (short cuttings).
3. Cuttings with 2-3 nodes are made from vines or runners and raised in plastic bags during February-March.
4. Single node rooted cutting using bamboo method is the best method with an advantage of higher multiplication rate (1:40) and good anchorage due to the presence of two root system.

### **Planting Methods:**

Three systems of planting are followed,

1. Either grown as mono crop by training on support or standards. (Planting distance 3x3 m).
2. Grown as mixed crop with coconut and arecanut.
3. Pepper vines are trained on trees like mango, cashew, jackfruit, etc.

### **Planting:**

#### **a) Mono Crop:**

1. Proper site is selected.
2. Pits of 60 cm<sup>3</sup> are dug at distance of 3 x 3 m.
3. Pits are filled with mixture of 10 to 20 kg of well-decomposed FYM, 1 kg SSP and good soil and 50 g Lindane powder..
4. Pangara rootstocks 1.5 to 2 m long are planted in these pits a year before actual planting of pepper in August-September.
5. Pit of 45 cm<sup>3</sup> are dug at 30 cm distance on the east and north sides of Pangara rootstock.
6. Rooted cuttings are then planted in these pits in the month of June-July.
7. Banana varieties like Lai velchi can be planted as intercrop for first three years. This helps to give shade till proper growth of pangara and also obtain additional income.

#### **b) Intercrop:**

1. Two pits of 45 cm<sup>3</sup> at 30 cm distance on east and north sides of the main crop.
2. Pits are filled as above.
3. Planting of rooted cuttings is done in the months of June-July.

### **Training and Pruning:**

1. Being a perennial climbing shrub, black pepper requires staking, training and tying as and when required during growth.
2. A single stem is maintained up to a height of 1 m by removing lateral branches.
3. In order to facilitate easy harvesting and spraying operations, the growth of vine is regulated up to a height of 7- 8 m.
4. Regulation of shade is done by lopping the branches of standards in order to allow optimum light for the pepper vines.

### **After Care:**



Two diggings are given once in May-June and again in October-November. Weeding and earthing is done for better growth and to improve soil aeration.

### **Manures and Fertilizers:**

#### **Dose:**

a) CPCRI (Central Plantation Crop Research Institute) Kasargod, Kerala : 10 kg FYM, 100 g N, 40 g P<sub>2</sub>O<sub>5</sub> and 150 g K<sub>2</sub>O / vine / year.

b) KKY, Dapoli: 20 kg FYM, 4 kg Neem cake, 150 g N, 75 g P<sub>2</sub>O<sub>5</sub> and 140g K<sub>2</sub>O/ vine / year.

2) Application: The recommended dose is applied from 3rd year onwards. 1st year : 1/3rd of recommended dose. 2nd year : 2/3rd of recommended dose.

3. Dose is applied in two splits : 1st split (1st week of September) - Full dose of FYM, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and 1/2 N. 2nd split (February) - Remaining 1/2 dose of N (1/2 N).

4. The above dose should be applied in a shallow ring around the vines at a distance of 30 cm.

### **Irrigation:**

Irrigation is given at an interval of 7 - 8 days in winter and 2 - 4 days during summer. Mulching with grasses or dried leaves helps in reducing loss of soil moisture during summer months.

### **Harvesting:**

Stage of harvesting depends upon the kind of pepper to be made.

1. For black pepper, fully matured berries are harvested when any one berry in cluster shows scarlet red colour.

2. For white pepper, ripened fruits are harvested.

### **Pepper Oil and Oleoresin:**

Pepper oil is obtained by steam distillation of coarsely powdered berries yielding 2 to 3.5 % oil. Pepper oleoresin is obtained by solvent extraction method by using ground pepper. Ethyl acetate is a useful solvent for extraction. Oleoresin gives true flavor of spice and is used in meat production, vegetables, salads, ketchups and soups.

**Average Yield:** 2 - 3 kg berries/vine/year.

**Reference Link :** <https://www.google.co.in/#q=my+agriculture+information+bank>