

## AICRP on Spices, Pottangi

# Black Pepper Cultivation

**Black pepper (*Piper nigrum*)**, called the King of Spice, is a flowering vine in the family Piperaceae, cultivated for its berries. It is native to Western Ghat High Land Zone of South India. Popularly, it is known as 'Black gold' because of its unique position in the international trade. The fruit, known as a peppercorn when dried, is approximately 5 mm (0.20 in) in diameter, dark red when fully matured, and, like all drupes, it contains a single seed. Peppercorns, and the ground pepper derived from them, may be described simply as pepper, or more precisely as black pepper (cooked and dried unripe fruit), green pepper (dried unripe fruit) and white pepper (ripe fruit seeds). Dried ground pepper has been used since antiquity for both of its flavour and as a medicine. The spiciness of black pepper is due to the chemical piperine, not to be confused with the capsaicin. Pepper is mainly used as a spice and flavoring agent in food industry. It also has industrial uses in perfumery and pharmaceutical industries. The volatile oil of pepper has a moderate initial impact and a fresh irritating, warm flavour, terpinaceous, sweet odour with a musty and slightly wood note upon drying out.

**Botanical characteristics :** Black pepper (*Piper nigrum*) is a climbing perennial plant with vining or bushy and wooden stems. The plant has simple, alternating leaves which are oval in shape and produces clusters, or spikes, of 50 to 150 flowers. The fruits develop on the flower spike and are small spherical fruits which are green and ripen to red. Each stem can produce 20-30 spikes. Black pepper can grow to be 10 m (33 ft) in height but under cultivation it is usually restricted to 3-4 m (10-13 ft). The origin of black pepper is believed to be Malabar Coast of India. Black pepper vines develop three types of aerial shoots, namely (a) primary stem with long internodes and 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.

**Climate :** Pepper is a tropical plant, requiring adequate rain fall and humidity and cannot tolerate frost. It will not grow where the temperature drops below 10°C. Temperature for growth is ranged from 10°C to 40°C, the optimum being 20° to 30°C. Very high or low temperatures are not conducive for growth. A moderate winter climate is essential. The hot and humid climate of sub-mountainous tracts (altitude up to 1000 m) is ideal for its growth. 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 with proper distribution pattern. High humidity helps for luxuriant crop growth and better yield. It can be cultivated up to 1500 m above sea level. The crop is pollinated through raindrops and hence frequent showers during flowering are beneficial for getting higher yield.

**Soil:** Pepper can be grown in a wide range of soils. The loamy or humus rich virgin soil with good water-holding capacity is ideal. As the crop is susceptible to water logging, it must be planted by preparing heap of soil on field and drainage must be given to prevent root rot. Sloppy lands should be preferred for pepper cultivation than plain lands where drainage facilities may be inadequate. However, sloppy land with the slopes forming southwards should be avoided in order to prevent the scorching effect of the sun. The soil pH should be ranged from 5.5 to 7.0.

**Varieties :** Karimunda is the most popular of all the established cultivars. The other important cultivars are Kottanadan, Narayakodi, Aimpriyan, Neelamundi, Kuthuvally, Balancotta and Kalluvally etc. in Kerala. Varieties Billimalligesara, Karimalligesara, Doddiga, Mottakare and Uddagare are popular in Karnataka. The hybrid variety 'Panniyur-1' is a high yielding one capable of giving 3 to 4 times the yield of other local varieties. In terms of quality, Kottanadan has the highest oleoresin (17.8%) followed by Aimpriyan (15.7%). Panniyur-1, Panniyur-6, Sreekara, Subhakara, Thevam and Malabar excel will be recommended for Odisha.

**Nursery raising rooted cuttings :** The secondary runner shoots of vines are cut into pieces of 2 -3 nodes in each in September or February-March. After trimming the leaves, cutting of 2 -3 nodes are planted with at least one node below the soil level on suitable nursery beds or in polythene bags (6'x 4') or bamboo baskets filled with potting mixture of 2: 1: 1 ratio of top soil, river sand and farm yard manure. 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. Sufficient number of holes may be provided at the base of the polythene bags to ensure good drainage.

Name	Pedigree	Released from	Av. yield kg/ha (dry)	Oleoresin (%)	Piperine (%)	E.Oil (%)	Remark
Panniyur-1	F <sub>1</sub> of Uthirankotta X Cheryakaniyakadan	Pepper Research Station, Panniyur in 1966	1242.0	11.8	5.3	3.5	Vigorous, do not tolerate heavy shade, non-pigmented growing tip, long spikes and bold berries, average yield = 2.2 kg green berries per vine, 35% dry recovery, early bearing
Panniyur-6	Clonal selection from Karimunda	Pepper Research Station, KAU, Panniyur	2127	8.3	4.9	1.3	Suitable for open cultivation as well as partial shade, 33.0% dry recovery
Subhakara	Clonal selection of Karimunda	IISR, Kozikode	2352.0	12.4	3.4	5.0	Suited to all pepper growing tracts, average yield = 4.94 kg green berries/vine, 35.5% dry recovery, high quality
Sreekara	Clonal selection of Karimunda	IISR, Kozikode	2677.0	13.0	5.1	7.0	Adopted to various climatic conditions in all the pepper growing tracts, 35.0% dry recovery
IISR Thevam	Clonal selection of Thevamundi	IISR, Kozikode	2148	8.2	1.6	3.1	Tolerant to Phytophthora foot rot disease, suited to high altitudes and plains
IISR Malabar Excel	F <sub>1</sub> of Cholamundi X Panniyur-1	IISR, Kozikode	1440	13.5	3.0	3.2	Suited to high altitudes and rich in oleoresin

After planting the bags, it should be placed under shade and watered regularly. Ensure sufficient moisture in the soil and cool atmosphere inside the coverage. Sprouting occurs after 20 to 25 days. The cuttings will be ready for planting in the field after 9 months especially in June-July.

Cuttings may be treated with some chemicals in order to achieve the early root formation and development. Dip the lower cut (up to 2 cm) in 1000 ppm solution of 3-Indole butyric acid (IBA) for 45 seconds will substantially increase the root formation and development. The solution can be prepared by dissolving one gram of IBA in one litre of water containing 3 to 5 gram of sodium carbonate (washing soda). The dipping period of 45 seconds should be strictly followed as any deviation from this may be injurious.

**Planting Methods :** Three systems of planting in black pepper are followed as:

- Either grown as mono crop by trailing on support or standards. Spacing between the rows is 3 m and between the plants 3 m. which gives 1100 plants/ha.
- Grown as mixed crop with coconut and areca nut.
- Pepper vines are trailed on trees like mango, cashew, jackfruit, silver oak, etc

After the receipt of first monsoon, plant two or three rooted cuttings in the pit at a distance of about 30-45 cm from the base of the standard. Press the soil around the cuttings well by hands and keep mound for water flow off. Tie the growing tender shoots to the support for easy trailing. When pepper is planted with coconut or areca nut as standard, a different method has to be adopted. Plant the vines 1.5 metre away from the base of the coconut tree and a metre away in the case of areca nut. Train the pepper vines on a temporary stake for one to two years. When they attain sufficient length to reach the tree trunk, remove the stakes without causing damage to the vines and tie the pepper plants on to the tree trunk and train them on it. At a spacing of 2.5m x 2.5 m, there will be about 1600 standards or support per hectare. For planting one hectare 3200 rooted cuttings at the rate of two cuttings per pit are required. Pit size of 50 x 50 x 50 cm is prepared little before the onset of monsoon. After receiving good showers, mix 1 part of fully decomposed FYM or vermi-compost with 1 part of top soil and mix 10g of chloropyriphous dust and put into the hole. Carefully remove the plant from its container and set it in the hole. Fill the extra spaces with FYM or vermin-compost and top soil mixture. Transplant the black pepper seedlings at the start of the rainy season.

**After Care :** Two hoeing and weeding are given once in June- July and again in September. Weeding is done for better growth and to improve soil aeration. Hand weeding is done when the weeds are too close to the plant.

- Apply one basket of compost mixed with 500g of neem cake, 200g VAM, 50g Azotobacter, 50g PSB, 50g Potashbacteria, 50g Trichoderma viridae and 50g Pseudomonas fluorescent per plant per annum just at the onset of south-west monsoon and cover lightly with soil.
- The fertilizer recommendation adopted at present for a pepper crop of three years and above is: nitrogen -140g, phosphorus -50g and potash -270 g per plant. It is better to apply the fertilizers in two split doses, one in May-June and the other in September- October.
- Only one-third of this dosage should be applied during the first year.
- It is increased to two-third in the second year.
- The full dose is given from the third year.

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

- get stronger plants
- reduce wild growth of the runners
- keep the plants at a certain height
- stimulate the growth of lateral fruit-bearing branches.

When the plants are not pruned, the secondary runners will show dense growth and suppress the tertiary runners, with a resultant loss in yield. Young plants are only allowed to retain 3 main runners. To strengthen these runners, they must be pruned back to 7 internodes. The long secondary runners hanging from the top must be pruned every year.

**Intercropping :** Short-lived catch crops can be used as intercrop to control weed, improve soil fertility levels, and to add profit. Plants like beans, cabbage, cauliflower, radish, ginger, turmeric, and hot and sweet pepper etc. approximately 1 meter away from the black pepper rows may be used as inter crops.

**Mulching :** Black pepper plants have a shallow root system. The use of an organic soil cover with dried leaves, paddy straw etc. is therefore very beneficial for root development and growth. This will help in restricting weed growth, maintaining relatively low temperature, and in keeping the soil moist even during the dry season. Place 4 to 6 inch mulching using rice hull or dried grass or dried leaves at a distance of 6 inches from the trunk spreading towards the edge of the crown.

**Irrigation :** Irrigation is essential for early two years of plantation of black pepper for better root development. For mature seedlings, water frequently especially when flowering or fruiting. Irrigation can be complemented with mulching, good vegetation, or by shallow cultivation. 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. Overhead irrigation is preferred to flood irrigation. The most effective irrigation system consists of permanent plastic microjets. The rainfall must be supplemented by irrigation to about 2 000 mm/year.

#### **Phytophthora Disease Management:-**

- Grayish sunken spots and mycelial threads appear on the leaves and the infected leaves are attached to one another with the mycelial threads.
- On stems, the infection occurs as dark brown lesions which spread both upwards and downwards. The new flushes subtending the points of infection gradually droop and dry up.
- One or more black spots appear on the leaves which have a characteristic fine fibre like projections at the advancing margins which rapidly enlarge and cause defoliation.
- The tender leaves and succulent shoot tips of freshly emerging runner shoots trailing on the soil turn black when infected. The disease spreads to the entire vine, from these infected runner shoots and leaves, during intermittent showers due to rain splash.
- If the main stem at the ground level or the collar is damaged, the entire vine wilts followed by shedding of leaves and spikes with or without black spots. The branches break up at nodes and the entire vine collapses within a month.
- If the damage is confined to the feeder roots, the expression of symptoms is delayed till the cessation of rain and the vine starts showing declining symptoms such as yellowing, wilting, defoliation and drying up of a part of the vine. This may occur during October-November onwards. These vines may recover after the rain and survive for more than two seasons till the root infection culminates in collar rot and death of the vine.

**Management :** The disease can be controlled by adopting integrated disease management strategies.

Removal and destruction of dead vines along with root system from the garden is essential as this reduces the build up of inoculum (fungal population). Planting material must be collected from disease free gardens and the nursery raised preferably in fumigated or solarized soil.

- Adequate drainage should be provided to reduce water stagnation.
- Injury to the root system due to cultural practices such as digging should be avoided.
- The freshly emerging runner shoots should not be allowed to trail on the ground. They must either be tied back to the standard or pruned off.
- The branches of support trees must be pruned at the onset of monsoon to avoid build up of humidity and for better penetration of sunlight. Reduced humidity and presence of sunlight reduces the intensity of leaf infection.
- Any of the following chemical control measures can be adopted.
- After the receipt of a few monsoon showers (May -June), all the vines are to be drenched at a radius of 45-50 cm with copper oxychloride 0.2% 5-10 litres/vine. A foliar spray with Bordeaux mixture 1% is also to be given. Drenching and spraying are to be repeated once again during August-September. A third round of drenching may be given during October if the monsoon is prolonged.
- After the receipt of a few monsoon showers, all the vines are to be drenched with potassium phosphonate 0.3% 5-10 litres/vine. A foliar spray with potassium phosphonate 0.3% is also to be given. A second drenching and spraying with potassium phosphonate 0.3% is to be repeated during August-September. If the monsoon is prolonged, a third round of drenching may be given during October.
- After the receipt of a few monsoon showers, all the vines are to be drenched with 0.125% metalaxyl mancozeb 5-10 litres/vine. A foliar spray with 0.125% metalaxyl mancozeb may also be given.
- At the onset of monsoon (May-June), apply Trichoderma around the base of the vine 50g/vine (This quantity is recommended for a substrate containing Trichoderma 10 10 cfu). A foliar spray with potassium phosphonate

0.3% or Bordeaux mixture 1% is also to be given. A second application of Trichoderma and foliar spray of Bordeaux mixture 1% or potassium phosphonate 0.3% are to be given during August - September.

#### Phyllody disease :

This disease which is caused by phytoplasma is noticed in parts of Wynad and Kozhikode districts of Kerala.

- The affected vines exhibit varying stages of malformation of spikes.
- Some of the floral buds are transformed into narrow leaf like structures.
- Such malformed spikes show leafy structures instead of floral buds, exhibiting phyllody symptoms.
- In advanced stages, the leaves become small and chlorotic, and the internodes are also shortened.
- The affected fruiting laterals give a witches broom appearance.
- Severely affected vines become unproductive. In severely affected vines the entire spike is converted into small branches which appear chlorotic and the vines decline rapidly. The infected vine becomes unproductive within 2 to 3 years.

**Management :** The infected vines are to be destroyed to prevent the further spread of the disease.

#### Slow decline (slow wilt)

- Foliar yellowing, defoliation and die-back are the aerial symptoms of this disease.
- The affected vines exhibit varying degrees of root degeneration due to infestation by plant parasitic nematodes.
- The diseased vines exhibit foliar yellowing from October onwards coinciding with depletion of soil moisture.
- With the onset of south west monsoon during May/June, some of the affected vines recover and put forth fresh foliage.
- However, the symptoms reappear in subsequent seasons after the cessation of the monsoon and the diseased vines gradually lose their vigour and productivity.
- The affected vines show varying degrees of feeder root loss and the expression of symptoms on the aerial parts occur after a considerable portion of the feeder roots are lost.
- The root system of diseased vines show varying degrees of necrosis and presence of root galls due to infestation by plant parasitic nematodes such as *Radopholus similis* and *Meloidogyne incognita* leading to rotting of feeder roots.
- The damage to feeder roots is caused by these nematodes and *P. capsici* either independently or together in combination. There is no spatial segregation of plant parasitic nematodes and *P. capsici* in the soil under field conditions.

#### Management :

It is necessary to adopt a combination of fungicide and nematicide application for the management of the disease.

- Severely affected vines which are beyond recovery should be removed from the plantation and destroyed.
- The pits for planting should be treated with phorate 10 G@15g or carbofuran 3 G@50 g at the time of planting.
- Nematode free rooted cuttings raised in fumigated or solarized nursery mixture should be used for planting in the field.
- Phorate 10 G@ 30 g or carbofuran 3 G@100 g/vine should be applied during May/June (with the onset of south west monsoon) and September/October. Along with phorate the basins should be drenched with either copper oxychloride 0.2% or potassium phosphonate 0.3% or metalaxyl mancozeb 0.125%.

The soil should be raked in the basin of the vine lightly without causing damage to the root system, and the nematicide should be spread uniformly in the basin and covered with soil immediately. Sufficient soil moisture should be ensured at the time of nematicide application. It is better to take up control measures during early stages of the disease.

**Yield :** After flowering, it takes about 9 months before the ripe berries can be picked. They ripen over a period of 2 to 3 months. The berries are green at first, turning yellow and then red when fully ripe. The berries are harvested every 7 to 14 days. The first commercial yield from cuttings is harvested from the third year and the maximum yield from the seventh year.

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