BLACK PEPPER

PACKAGE OF PRACTICES

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Introduction :

Climate and Soil :

Pepper is a plant of humid tropics requiring adequate rainfall and humidity. The hot and humid climate of submountainous tracts of Western Ghats is ideal for its growth. It grows successfully between 20° north and south latitude, and from sea level up to 1500 metres above mean sea level. The crop tolerates temperatures between 10° and 40° C. A well distributed annual rainfall of 125 - 200 cm is considered ideal for pepper.

Pepper can be grown in a wide range of soils with a pH of 4.5 to 6.0 though in its natural habitat it thrives well in red laterite soils.

The pepper growing areas on the West Coast of India can be classified as 1) coastal area where pepper is grown in almost every homestead or plot of land; 2) slopes and valleys where pepper is extensively cultivated on a plantation scale; 3) hills at an elevation of 800 - 1500 m, where the crop is grown on shade trees in coffee plantations; 4) valleys as a mixed crop in arecanut gardens in northern part of Cannanore, Kasaragod, Dakshina Kannada and Uttara Kannada Districts.

Varieties :

Majority of the cultivated types of pepper are monoecious (male and female flowers found in the same spike) though variation in sex expression ranging from complete

male to complete female is found. Over 75 cultivars of pepper are being cultivated in India. *Karimunda* is the most popular of all the established cultivars of pepper among the growers in all districts of Kerala. The other important cultivars are *Kottanadan* (in South Kerala), *Narayakkodi* (in Central Kerala), *Aimpiriyan* (in Wynad areas), *Neelamundi* (in Idukki areas), *Kuthiravally* (in Calicut and also in Kumili regions), *Balancotta* and *Kalluvally* (in Northern Kerala) and *Malligesara* and *Uddagare* (in Karnataka areas). *Kuthiravally* and *Balancotta* show alternate bearing habit. Panniyur-1, the only hybrid pepper, was evolved at the Pepper Research Station, Panniyur (Kerala) and has *Uthirankotta* and *Cheriyakaniakadan* as its female and male parents respectively. The hybrid is outstanding in its yield potential, with an average of 2.2 kg of black pepper (6.3 kg of green pepper) obtained from an experimental plot at Panniyur. However, under extensive shade and higher dosage of nitrogen, the hybrid shows a tendency for increased vegetative growth and corresponding decrease in yield. In terms of quality, *Kottanadan* has the highest oleoresin (17.8%) followed by *Aimpiriyan* (15.7%).

Propagation:

Pepper develops three types of aerial shoots, viz., (a) primary stem with long internodes, with adventitious roots which cling to standard, (b) runner shoots which originate from the base of the vines also have long internodes which strike roots at each node; and (c) fruit bearing lateral branches with limited growth.

Cuttings are raised mainly from the runner shoots, though terminal shoots can also be used. Cuttings from the lateral branches are seldom used since in addition to reduction in the number of fruiting shoots, the vines raised from them are generally short lived and bushy in habit. However, rooted lateral branches are useful in raising pepper in pots.

Production of rooted cuttings:

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 in February - March, and after trimming the leaves, cuttings of 2 - 3 nodes each are planted either in nursery beds or polythene bags filled with fertile soil. Adequate shade is to be provided and irrigated frequently. The cuttings will strike roots and become ready for planting in May - June.

Rapid multiplication:

Recently very efficient propagation technique has been developed from Sri Lanka and it is becoming increasingly popular in India. In this method, a trench of 0.75 m deep and 0.3 m wide having convenient length is made. The trench is filled with rooting medium (preferably forest soil, sand, farmyard manure mixture 1 : 1 : 1). Split halves of bamboo with septa or split halves of PVC pipes having 1.25 - 1.5 m length and 8 - 10 cm diameter provided with plastic septa at 30 cm intervals are fixed at 45° angle on a strong support. The bamboos/ PVC pipes can be arranged touching one another. Rooted cuttings are planted in the trench at the rate of one cutting each for one bamboo or PVC pipe split. The lower portions of the bamboo or PVC pipe splits are filled with a rooting medium (preferably weathered coir dust - farmyard manure mixture 1 : 1) and the growing vine is tied to the bamboo or PVC pipe split in such a way as to keep the nodes pressed to the rooting medium. The tying could be done with dried banana sheath fibres. The vines are irrigated regularly. As the vines grow up, filling up the bamboo or PVC pipe splits with rooting medium and tying each node pressing it down to the rooting medium are to be continued regularly. For rapid growth the following nutrient solution may be applied.

Urea (1 kg), Super phosphate (0.75 Kg), Muriate of potash (0.5 Kg), Magnesium sulphate (0.25 Kg) in 250 litre water. The solution is applied at the rate of 0.25 litre per vine.

When the vine reaches the top (the initially planted vine takes 3-4 months for this) 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, each vine is cut at the crushed point and removed from the rooting medium and each node is separated. The nodal cutting with the bunch of roots intact is planted in polybags filled with pot mixture. Care should be taken to keep the axil above the soil. The polybags should be kept in a cool humid place, or should be covered with thin polythene (200 gauge) sheeting to retain high humidity. The buds start developing in about 3 weeks when the polybags can be removed and kept in shade.

The advantages of this method are:

1) Multiplication is rapid (1:40), 2) the root system is well developed and 3) better field establishment and more vigorous growth as a result of better root system.

Nursery diseases:

Leaf rot and blight of rooted cuttings: *(Rhizoctonia solani)*

The disease is often serious in nurseries during April-May period when warm humid conditions prevail. It is caused by *Rhizoctonia solani*. The fungus infects both leaves and stems. Infection starts as small brownish lesions on the leaves which spread irregularly. The mature lesions appear brittle and whitish to dark grey in colour. The adjacent infected leaves get adpressed to each other because of the fast spreading fungal threads (hyphae) which bind them together. On stems of rooted cuttings the infection occurs as dark brown lesions which spread both upwards and downwards. The new flushes subtending to the points of infection gradually droop and dry up.

Basal wilt : *(Sclerotium rolfsii)*

The disease is noticed mainly in nurseries during June-September period. The disease is caused by the fungus *Sclerotium rolfsii*. Water soaked spots are seen on the stem. Occasionally the round lesions show concentric zonations. On the stem the infected portion shows gradually advancing felt-like whitish threads causing soft rotting of the tissues. Whitish fungal threads girdle the stem resulting in drooping of leaves beyond the point of infection and in advanced cases the rooted cuttings dry up. On the mature lesions appear small whitish to cream coloured grain like sclerotial bodies.

Both these diseases in the nursery can be controlled if noticed early, by observing strict phytosanitary measures. The affected cuttings along with defoliated leaves should be removed from the nursery and destroyed. Later all the cuttings should be given a spray with 0.2% Bavistin or 0.2% copper oxychloride to check the disease incidence.

Plant parasitic nematode problems :

Root knots caused by *Meloidogyne incognita* and root necrosis and rot caused by the burrowing nematode *Radopholus similis* are the two important nematode diseases causing root damage. The nematode infested cuttings show stunted growth and foliar yellowing. To check nematode damage in the nursery it is desirable to fumigate the nursery soil mixture with methylbromide @ 500 g/100 cft of soil under polythene cover for 24-48 hours. Fumigation of soil mixture has to be carried out 15 days prior to planting the cuttings.

Establishing plantation :

Selection of site :

When grown on a slopy land, the slopes facing south should be avoided and the lower half of north and north-

eastern slopes preferred for planting, so that the vines are not subjected to the scorching effect of the southern sun during summer.

Preparation of land and planting shade trees :

With the receipt of first rain in May-June the primary stem cuttings of *Erythrina indica* (Murikku) or *Garuga pinnata* (Karayam) or *Grevilea robusta* (Silver oak) are planted. However, whenever *Erythrina indica* is used as standard, application of carbofuran 3G @ 30g may be done once in a year to control nematode and root grubs. When *Erythrina indica* and *Garuga pinnata* are used the primary stems/stem cuttings are cut in March-April and stacked in shade in groups. The stacked stems start sprouting in May. The stems are planted in the edge of the pits dug for pepper vines.

Planting :

With the onset of monsoon, 2-3 rooted cuttings of pepper are planted individually in the pits on the northern side of each standard. (In the case of unrooted cuttings, about 4-5 cuttings per pit are to be planted and the number of nodes in this case may be 4-5). At least, one node of the cutting should go below the soil for proper rooting). At a spacing of 2.5 × 2.5m, there will be about 1600 standards per ha.

Cultural practices :

As the cuttings grow, the shoots are tied to the standards as often as required. The young vines should be protected from hot sun during summer months by providing them with artificial shade. Regulation of shade by lopping the branches of standards is necessary not only for providing optimum light to the vines but also for enabling the standards to grow straight. Adequate mulch with green leaf or organic matter should be given towards the end of north-east monsoon. The base of the vines should not be disturbed to avoid root damage.

During the second year, practically the same cultural practices are repeated. However, lopping of the standards should be done carefully from the fourth year onwards, not only to regulate the height of the standards, but also to shade the pepper vines optimally. Excessive shading during flowering and fruiting encourages pest infestation.

From the fourth year, usually two diggings are given, one during May-June and the other towards the end of south-west monsoon in October-November. Growing cover crops like *Calapogonium mucunoides*, *Mimosa invisa* are also recommended under west-coast conditions to provide an effective soil cover to prevent soil erosion during rainy season. Further they dry during summer, leaving a thick organic mulch.

Manuring :

For laterite soils which are low to medium in major nutrients, the fertilizer recommendation adopted at present for a pure pepper crop is 140g N, 55g $P_2 O_5$ and 270g $K_2 O$ per vine per year. Only one-third of this dosage should be applied during the first year. It is increased to two-thirds in the second year. The full dose is given from the third year onwards. It is better to apply the fertilizers in two split doses, one in May-June and the other in August-September. The fertilizers are applied at a distance of about 30 cm all around the vine and covered with a thick layer of soil. Care should be taken to avoid direct contact of fertilisers with the roots of pepper. Besides, organic manure in the form of cattle manure or compost is given at the rate of 10 kg per vine during May. Application of lime at the rate of 600g per vine during April-May in alternate years is also recommended.

Plant Protection :

Diseases :

Phytophthora foot root (quick wilt disease) caused by the fungus *Phytophthora capsici* ("Phytophthora palmivora" MF_4) is the most destructive of all the diseases in black

pepper. This occurs mainly during the south-west monsoon season. All parts of the vine are vulnerable to attack and the symptom expression depends upon the site or plant part infected and the extent of damage.

Symptoms :

The damage caused to the aerial parts of the vine are clearly discernable.

a) On the leaves one or more black spots appear which have a characteristic fine fibre like projections from the advancing margins which rapidly enlarge and cause defoliation.

b) The tender leaves and succulent shoot tips of the freshly emerging runner shoots trailing on the soil turn black when infected.

c) From these infected runner shoots and leaves the disease spreads to the entire vine, during intermittant showers due to rain splash.

d) 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.

e) If the damage is confined to the feeder roots the symptom expression 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 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 vine.

Disease Management

Being soil borne, it is essential to tackle this problem in the following manner.

Phytosanitation :

a) Removal and distruction of dead vines along with root system from the garden is essential as this reduces the build up of inoculum (fungus population).

b) Planting material must be collected from disease free gardens and nursery raised preferably in fumigated soil.

Cultural practices :

1) Adequate drainage should be provided to reduce water stagnation.
2) Injury to the root system to be avoided due to cultural practices such as digging.
3) A green cover should be maintained either with grass or legumes.
4) 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.

Chemical control :

1) Spray the foliage with 1% bordeaux mixture during May-June as a prophylactic measure and repeat after 1½ months during July-August to cover the newly produced leaves.
2) The basin must be drenched with 0.2% copper oxychloride @ 5 l/vine during May-June & July-August.
3) Swab the stem upto about 1m. with bordeaux paste during first round of spraying.
4) The first round of spray may be done with Ridomil mancozeb 1.25g/litre @ 5 litres/vines followed by bordeaux mixture spray after 1½ months for better results.

Pollu disease :

This disease is caused by the fungus *Colletotrichum gloeosporioides*. It can be distinguished from the 'pollu'

(hollow berry) caused by the beetle by the presence of characteristic cracks on the infected berries. The disease appears towards the end of the monsoon. The affected berries show brown sunken patches during the early stages. Further development of berries is affected when infection occurs on young immature berries. In later stages, the discolouration gradually increases and the berries show the characteristic cross splitting. Finally, the berries turn to black in colour and dry. The fungus also causes angular to irregular brownish lesions with a chlorotic halo on the leaves.

This disease can be controlled effectively by spraying 1% Bordeaux mixture.

Little leaf disease:

This disease is noticed in Wynad and Idukki Districts of Kerala. The vines show shortening of internodes to varying degrees. The leaves become small and narrow with varying degrees of deformation. They appear leathery, puckered and crinkled. Chlorotic spots and streaks on the leaves that appear give an appearance of mosaic symptoms occasionally. The yield of the affected vines decrease gradually.

Although MLOs are suspected to be associated with disease no causal agent has been identified for this. The disease is gradually spreading. To arrest the further spread of the disease it is necessary to eradicate the infected plants once located.

Phyllody disease:

This is another new disease noticed in Wynad District of Kerala. The affected vines show varying malformation of spikes and flowers. Some of the floral buds are transformed into narrow leaf like structures. Such malformed spikes show these leafy structures instead of floral buds thus exhibiting 'Phyllody' symptoms. In advanced stages the leaves turn small chlorotic, and the

internodes become small. The affected fruiting laterals give a 'witches broom appearance' from a distance. Severely affected vines become unproductive. The disease is associated with Mycoplasma like organisms and the insect vectors are yet to be identified, to plan effective control measures.

In view of the gradual disease spread, eradication of affected vines from the garden once located is an immediate step that has to be adopted.

Slow decline: (Slow wilt)

Slow decline of black pepper is a debilitating disease affecting pepper vines. This disease is noticed both in pure pepper plantations as well as in mixed cropping systems involving areca-pepper and coconut-pepper.

Foliar yellowing, defoliation and dieback are the aerial symptoms of this disease. The affected vines exhibit varying degrees of root degeneration due to the infestation by plant parasitic nematodes. The diseased vines exhibit foliar yellowing from October onwards which become pronounced from December onwards coinciding with the 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 season after the cessation of the monsoon. Thus the diseased vines gradually loose their vigour and productivity exhibiting typical declining symptom.

The root system of diseased vines show varying degrees of necrosis, and root galls due to the infestation by plant parasitic nematodes viz., *Radopholus similis* and *Meloidogyne incognita* respectively leading to the rotting of feeder roots which is further aggravated by soil borne fungi like *Fusarium* sp., *Rhizoctonia* sp. and *Pythium* sp.

There is no spatial seggregation of plant parasitic nematedes and *Phytophthora* in the soils under field conditions. Hence it is necessary to go for combination of fungicide-nematicide application depending on location specific problems.

These nematodes can be effectively checked by adopting the following measures:

a) Nematode free rooted cuttings raised in fumigated nursery mixture should be used for fresh planting,

b) Remove the severely affected vines which are beyond recovery,

c) Treat the planting pit with phorate @ 15g or carbofuran @ 50g at the time of planting,

d) Apply phorate @ 30g or carbofuran @ 100/vine twice in a year. First application during May/June with the onset of South West monsoon and second application during September/October.

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

Nematode infestation in nursery:

Root-knot nematode, *M. incognita* and the burrowing nematode, *R. similis* are the two important nematode species infesting rooted cuttings in the nursery. The damage caused to the roots by nematode infestation results in the poor growth, foliar yellowing and some times interveinal chlorosis of leaves and establishment of such cuttings will be poor when planted in the fields. Rooted cuttings even

with a mild infestation by the nematodes when planted in the field will gradually lead to 'slow decline, at a later date.

Use fumigated nursery mixture for raising nematode free rooted cuttings. Nursery mixture can be fumigated either with methyl bromide (MBr) @ 500g/100 cft soil or drenching the soil with 2% formalin under polythene cover for 48 hours. After 48 hours, remove the polythene sheet, rake the soil mixture to liberate excess poisonous gas of the chemical. The soil mixture can be used for planting 2-3 weeks after chemical treatment.

A prophylactic application of nematicide is also necessary to check the nematode infestation. For this make three equidistant holes of 2-3 cm deep in the bag around the cutting and place phorate @ lg/bag or carbofuran @ 3g/bag in these holes and cover. A light irrigation may also be given to ensure adequate soil moisture.

Insect pests:

Pollu beetle:

The pollu bettle is the most destructive pest and is more serious in black pepper plantations in the plains and at lower altitudes. The adult is a small black beetle with an yellowish brown head and thorax. The adults feed on the growing points, tender shoots, tender and mature leaves, tender spikes and berries.

The adult females lay eggs on shoot tips, tender vines, leaf petiole, tender spikes and berries with the initiation of new flushes during monsoon. The grubs are creamy white when fully grown. The grubs on emergence bore into them and feed on the internal tissues. The most important type of damage caused by the grub is by boring into the berries, feeding on the internal contents and making them hollow. The infested berries turn yellow initially and then black and crumble when pressed. During

the period from January to April the adults do not breed but remain in the field feeding on older leaves.

Control: Spraying endosulfan or quinalphos (0.05%) twice a year during June - July and September - October is effective in controlling the pest.

Top shoot borer: *(Cydia hemidoxa)*

The top shoot borer is a serious pest in younger plantations. The caterpillars of this moth bore into tender shoots which turn black and dry up. When successive new shoots are attacked the growth of the vine is affected. The adult is a tiny moth with crimson and yellow forewing and grey hind wings. Fully grown caterpillars are greyish green. The pest infestation is higher during July - November when more new shoots are available on the vines.

Control: Spraying of endosulfan 0.05% is effective in controlling the pest infestation; the spraying has to be repeated to protect the emerging new shoots.

Leaf gall thrips: *(Liothrips karnyi)*

Infestation by leaf gall thrips is more serious at higher altitudes especially in younger vines and also in the nurseries.

The thrips live in colonies within the tubular marginal galls on leaves induced by them. The infested leaves become thick malformed and crinkled. The adults are minute and black, the larvae and pupae are creamy white and also live within galls.

Control: Spraying monocrotophos 0.05% is effective in controlling the pest infestation.

Scale insects:

Scale insects are sometimes serious pests in certain high altitude areas and also in left over cuttings in the

nurseries. Scale insects appear as encrustations on the stems, leaves and berries. They feed on plant sap which results in drying up of the infested portions of the vines. Among the various species of scale insects recorded on the crop *Lepidosaphes piperis* and *Aspidiotus destructor* are important. The females are sedentary and remain fixed to the plants. The former is dark brown and mussel shaped and the latter yellowish brown and oval.

Control: Spraying of dimethoate 0.05% is effective in controlling the pest infestation; a second spray after an interval of 15 days may be necessary to control the infestation completely. It is very important to undertake the control measures in the initial stages of pest infestation.

7. Harvesting and primary processing:

In Kerala, pepper flowers in May-June. The crop takes about 6-8 months from flowering to harvest. The harvest season extends from November to January in the plains and January to March in hills. During harvesting the whole spike is hand picked when one or two berries in the spike turn bright orange or purple. The berries are separated from the spikes and dried in the sun for 7-10 days. When dried, the berries retain the characteristic wrinkled appearance of black pepper of commerce. The C. F. T. R. I., Mysore has developed a method in which the fresh berries are dipped in hot water for a minute before drying in the sun. This gives a better appearance to the dried product.

The white pepper of commerce is prepared from either freshly harvested berries or dried black pepper using special techniques such as water steeping, steaming and decortication. The recovery of white pepper from green is about 25%.