

## 6. BLACK PEPPER BREEDING IN KERALA

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Black pepper of commerce, the dried fruits of *Piper nigrum* L., is also known as "King of Spices" and is one of the important and earliest known spices produced and exported from India. *P. nigrum* is indigenous to the tropical forests of the Malabar coast of peninsular India from where it has spread throughout the tropics. Today, black pepper is cultivated in 11 countries viz. India, Brazil, Indonesia, Malaysia, Madagascar, Micronesia, Sri Lanka, Thailand, Vietnam, China and Mexico [1].

Even though India accounts for 45% of the total world area (155780 ha), her share in the world production is only 24.35% (55000 t.), whereas Indonesia with lesser area (118000ha.) accounts for 27% of the production (61,000 t.) Brazil with 8.6% area (30,000 ha.) accounts for 21% of the world production (47,500 t.) and Malaysia with just 3.2% of the area (11,200 ha.) accounting for 12.18% of the world production (29,000 T.). Productivity of the crop is the highest in Malaysia at present (2589 kg/ha), followed by Thailand (1985 kg/ha) and Brazil (1583 kg/ha). In Kerala black pepper is grown in an estimated area of 1,51,000 ha with an annual production of about 37740 MT. Productivity of black pepper in India is reported to be only 353 kg/ha., which is abysmally low. In order to increase the productivity of black pepper, attention has been paid to develop high yielding varieties. Due to the concerted and systematic research efforts of the last 3 decades, 9 high yielding black pepper varieties are released for general cultivation in addition to building up of a large collection of black pepper germplasm.

### Genetic Resources of Black Pepper

Over 1000 species are reported in the genus *Piper* [2]. Of these about 100 species occur in India. *P. nigrum* ( $2n = 52$ ) has probably origi-

nated as an interspecific hybrid between *P. wightii* and *P. galeatum* [3]. In the hot and humid tropical evergreen forests of Western ghats of South India, *Piper nigrum*, still occurs as wild plants. It is believed that domestication of black pepper started about 6,000 years ago in the uplands and the coastal areas of Kerala and Karnataka states and now about 100 and odd cultivars are prevalent in India.

Systematic collection of cultivated and wild germplasm of *P. nigrum* has been one of the thrust areas of research undertaken by IISR, Calicut and the Institute, maintains over 2,612 accessions of germplasm.

### Land races in black pepper

Over a hundred traditional black pepper cultivars are prevalent in Kerala and Karnataka [2]. Many of these cultivars are very popular in their respective tracts. Most important cultivars and their salient features are given in Table 1.

### Exotic varieties

'Kuching', 'Jamby', Ldk etc. are some of the popular high yielding varieties of Malaysia and Indonesia, maintained at IISR, Calicut. However, these varieties are not significantly superior in yield or quality as compared to the common indigenous cultivars.

### Breeding behaviour and breeding strategies

Blessed with the twin advantages of vegetative propagation and viable sexual reproduction, black pepper offers immense scope for exploiting hybrid vigour as well as selection breeding. Clonal selection, hybridisation and open pollinated progeny selection have been used for evolving new varieties of black pepper [4,5].

Black pepper is a predominantly self pollinated (geitonogamy) perennial vine propagated by cuttings [6].

Pepper Research Station (KAU), Panniyur, Kannur, (District) as well as the Indian Institute of Spices Research (formerly National Research Centre for Spices, Calicut) are the pioneers in black pepper breeding in the state as well as in the country.

### Selection

Wide variability for yield and quality characters even within a particular cultivar is a frequent phenomenon in black pepper. Clonal selec-

tion in 'Karimunda' and 'Kottanadan' have resulted in identifying superior varieties of these highly popular cultivars.

### Hybridisation

The wide variability encountered in different black pepper cultivars for yield, quality and other yield attributes coupled with advantages of sexual reproduction and vegetative multiplication have helped in releasing two superior black pepper hybrids [F1]-Panniyur 1 and Panniyur 3.

Hybridisation procedure in black pepper is as follows. The anther lobes of the female spike (female parent) are removed before the emergence of the stigma with a fine needle. Usually only the upper 2/3 part of the spike is retained and the rest removed. Emasculated spikes are covered with a butter paper bag or finely perforated polythene cover. Undehisced anthers from the spikes of male parent are collected on the previous day evening prior to pollination and kept in a vial in a desiccator. Next day morning the vials are taken out, the anther lobes are gently crushed, and the dehisced pollen grains are mixed with a drop of water and the pollen suspension is applied on the stigmas of the emasculated spike with a small camel hair brush, after removing the bag from the spike. The spikes are again covered after pollination. Pollination is repeated for 3-4 days. The cover is retained till the development of the berries. In some varieties, where the female phase matures much earlier to the male phase (protogyny), emasculation may not be necessary and direct repeated pollinations will be sufficient to produce hybrids.

### Open pollinated progeny selection

Because of the sexual reproduction and vegetative propagation some amount of heterozygosity is inherent in black pepper and this heterozygosity yields considerable variation in the progenies. Two black pepper varieties, Panniyur 2 and Panniyur 5 are released, so far, through open pollinated progeny selection.

### Polyploidy breeding

An induced tetraploid of the black pepper variety Panniyur-1 is produced for the first time at IISR, Calicut by treating fresh seeds with 0.05% colchicine. A natural triploid ( $2n=78$ ) cultivar of black pepper was also identified at IISR, Calicut [7.8]

The varieties developed/released through the above strategies with their salient features are given in Table 2.

### Breeding for nematode, disease and pest resistance

Developing disease and pest resistant black pepper cultivars through screening and selection have been a major programme at IISR, Calicut.

Root knot nematode (*Meloidogyne incognita*) is a serious problem in some black pepper tracts. IISR, Calicut has developed a nematode tolerant cultivar viz. "Pournami" through selection.

*Phytophthora* foot rot (quick wilt) is another very serious disease of black pepper. A *Phytophthora* tolerant line 'P24' with a mean yield of 3.6 kg (fresh) per vine is at the pre release trial at IISR, Calicut. Other promising *Phytophthora* tolerant lines are P-339, P-1178, P-1534, HP-23, C-1095 and C-1047.

Four accessions of cultivated black pepper viz. Acc. No. 816, 841, 1084 and 1114 are found to be relatively resistant to 'pollu' beetle.

### Breeding for drought tolerance

Developing drought tolerant /resistant black pepper cultivars has been another priority research programme at IISR, Calicut. Screening of germplasm against moisture stress has resulted in identifying few promising Karimunda lines viz. KS 69, and KS 51, KS 114. These drought tolerant lines are undergoing yield evaluation.

### Breeding for high altitude

Most of the black pepper varieties are not specifically bred for high altitudes, where it can be grown either as a monocrop or as an intercrop on the shade trees of tea or coffee or cardomom estates. In order to meet this long standing demand from planters, IISR Calicut has taken up a breeding programme for high altitude areas [above 3,000 ft. MSL.]. The evaluation of 100 hybrids at Valparai [Tata Tea Ltd.] is in progress.

### Breeding for high quality

Black pepper cultivars rich in piperine, oleoresin and essential oil are in great demand. Screening of the germplasm collections has resulted in identifying some high piperine and oleoresin types as well as high oil types. Kottanadan, Kumbakodi, Kuthiravally, and Nilgiri are rich in piperine, and oleoresin whereas Balankotta, Kaniyakadan and Kumbakody

are high in essential oil. These lines will be used in hybridization programme to evolve high quality, high yielding cultivars.

#### Bio technological approaches in black pepper improvement

Genetic variability in cultivated black pepper varieties for one of the most important and serious problem being faced by the growers i.e. foot rot disease [quick wilt] caused by *Phytophthora capsicii* is rather low at present. The advent of r-DNA techniques will allow the introduction of foreign gene(s) conferring resistance against this disease to established cultivars. Resistant genes from other disease resistant spices or from other sources, if can be incorporated into cultivated black pepper by genetic engineering techniques, it will be one of the cheapest and effective ways of producing disease resistant varieties. Suitable *in vitro* selection system is a pre-requisite in such studies.

Kanamycin sensitivity assay, being a prelude to *Agrobacterium* mediated genetic transformation, was conducted using cotyledons of 'Karimunda' cultivar. Callus formation of the cotyledons was completely inhibited at 50 µg ml<sup>-1</sup> and above concentration of Kanamycin [9]. Micropropagation as well as callus regeneration protocols are also standardised for black pepper [10,11]

Crop improvement works in black pepper involving both traditional as well as bio technological methods are in progress at IISR, Calicut; Pepper Research Station, Panniyur as well as at Kerala Agril. University, Trissur. These works will be leading to novel varieties possessing the desired characteristics.

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Table 1. Popular land races of black pepper

1 Name	2 Yield/Acre (kg/fresh)	3 Dry recovery %	4 Oleoresin %	5 Piperine %	6 Essential oil (%)
<b>Aimpiriyam</b> Originally from Trivandrum Dist., Now popular in Wynnad. Performs well in plains and hilly regions : not suitable for shaded areas, late to mature.	4 - 5	34 - 35	12-13	4 - 5*	2.5 - 3.0
<b>Arakulam Munda.</b> From Thodupuzha area, early variety.	1.5 - 2.0	33	9.8	4.4	4.7
<b>Balankotta.</b> A Malabar cultivar, tolerant to shade. Performs well as mixed crop in arecanut gardens.	1 - 3	33	9.3	4.0	5.0
<b>Kalluvally.</b> A Malabar cultivar, hardy in nature	1 - 2	35 - 38	8.4 - 11.8	2.5-5.4	3.0
<b>Karimkotta.</b> A common cultivar of Malabar, hardy and tolerant to drought and to some extent tolerant to disease.	2.0	35	12	4.4	3.1
<b>Karimunda.</b> Originally from South Kerala. Now very popular through out Kerala. Tolerant to shade, performs well as a mixed crop.	3-5	32-38	7-13.1	4.4-6.2	3.5
<b>Kottanadan.</b> From Nedum-angad taluk of Trivandrum district: Perform well in plains and hilly regions upto 700-800 n MSL. Widely adapted and high yielding	5	34-35	17.8	6.6	2.5

Table 1. (Contd.)

1	2	3	4	5	6
<b>Kurimalai.</b> Popular in Sagar district, Karnataka. Performs well as inter crop in coconut and arecanut gardens. Not suitable for Kerala.	2-3	33-35	12.6	3.37	3.6
<b>Kuthiravally.</b> A cultivar from Central Kerala, now popular in Wynnad, Idukki and Cannanore districts. A stable yielder.	3	35	15.0	6.0	4.5
<b>Malligesara.</b> A cultivar of Uttara Kannada. Suitable for mixed cropping in arecanut gardens	2 - 3	-	-	-	-
<b>Narayakodi.</b> A cultivar of Kottayam district, now common in all pepper growing tracts. Somewhat field tolerant to disease.	1.5-2.0	36.0	11.0	5.4	4.0
<b>Neelamundi.</b> Reported to be somewhat field tolerant to foot rot. Suitable for high elevation areas.	2.0	33-34	13.9	4.6	3.3
<b>Perambrammunda.</b> A cultivar of Malabar resembling Neelamudi. Berries are bold.	2.0	35	10.2	2.9	4.4
<b>Poonjaran munda.</b> A variety originally from Poonjar in Kottayam district. Moderate yielder.	2.0	35	11.6	4.76	4.7
<b>Valiakaniayakkadan.</b> Originally from Central Kerala side Now almost out of cultivation, Poor yielder.	2-3	33	9.9	3.5	5.3
<b>Vellananban.</b> Originally from Central Kerala. Reported to be tolerant to drought.	2-3	34	9.0	3.4	3.4

Table 2. Improved varieties of black pepper and their salient features

Name	Pedigree	Released from	Average yield (kg/ha)	Oleoresin (%)	Piperine (%)	Essential oil (%)
<b>Panniyur 1.</b> Suited to all pepper growing regions. Not suited to heavily shaded areas.	F1 of Uthirankotta x Cheryakaniya-kadan	Pepper Research Station, Panniyur KAU	1242.0	11.8	5.3	3.5
<b>Panniyur 2.</b> Reported to be shade tolerant.	Open pollinated progeny of Balankotta	Pepper Research Station, Panniyur KAU	2570.0	10.9	6.6	3.4
<b>Panniyur 3.</b> Late maturing, suited to all pepper growing regions.	F1 of Uthirankotta x Cheryakaniya-kadan	Pepper Research Station, Panniyur KAU	1953.0	12.7	5.2	3.1
<b>Panniyur 4.</b> Reported to perform well under a variety of conditions. Stable yielder.	Clonal selection from Kuthiravally	Pepper Research Station, Panniyur KAU	1277.0	9.2	4.4	2.1
<b>Panniyur 5.</b> Tolerant to nursery diseases and shade	Open pollinated progeny of Perumkodi	Pepper Research Station, Panniyur KAU	1098.0	12.33	5.5	3.8

Table 2. (Contd.)

1	2	3	4	5	6	7
<b>Subhakar</b> Suited to all pepper growing regions	Clonal selection from Karimunda	IISR, Calicut	2352.0	12.40	3.4	6.0
<b>Sreekara</b> Suited to all pepper growing regions	Clonal selection of Karimunda	IISR, Calicut	2677.0	13.0	5.1	7.0
<b>Panchami</b> Late maturing type suited type suited to all pepper growing regions.	Clonal selection of Aimpriyan	IISR, Calicut	2828.0	12.5	4.7	3.4
<b>Pournami</b> Tolerant to root knot nematode.	Clonal selection of Ottaplackal	IISR, Calicut	2333.0	13.8	4.1	3.4
<b>PLD-2*</b> Suited to Trivandrum and Quilon districts of Kerala.	Clonal selection from Kottanadan	CPCRI, Palode	-	-	-	-

\* Recommended for release