Occurrence of Two Races of Black Pepper in Southern Region of India

KC Velayudhan, C Rajalaksmi, M Latha, VS Sujatha and S Mani
National Bureau of Plant Genetic Resources, Regional Station, Vellanikkara, Thrissur-680 654 (Kerala)

Out of a 192 accessions of black pepper, 103 including 48 named clones, 12 wild clones and 43 unnamed clones from Western Ghats region were observed for 12 quantitative and 7 qualitative passport and spike and berry characters. The collection based on two very important qualitative characters such as berry shape and pace of ripening colour change, which are closely associated with each other along with distribution pattern could be divided into two races (race 1 with 7 accessions and race 2 with 96 accessions). These races are named as race 'Kariyilanchi' and 'Karimunda' respectively after the local varietal names of two prominent accessions each representing a race. Numerical taxonomic study based on the above characters could substantiate the racial classification with 6 accessions of the first race falling under a single group in the dendrogram. One chemical parameter, oleoresin content is lesser (30.03%) in race 1 as compared to 41.36% in race 2.

Key words: Black pepper, Races, Karivilanchi, Karimunda

Formal taxonomy has failed most conspicuously at the infra-specific level in cultivated plants (Harlan, 1975). Infra-specific classification of cultivated plants involves fitting a set of man-made categories to the man-influenced products of earlier domestication and the resultants of later evolutionary processes, which apparently produces a hierarchic series of discontinuities. Thus, according to Barbara Pickersgill there is a need for full and systematic classification of cultivated plants, which will have either a general or commercial value as a system of identification. Cultivated plants fall under two major groups such as sexually (through seeds) and asexually (through vegetative means) propagated ones. A race might have originated in some geographic region at some point of time in the history of the crop evolution. As a biological unit, it is not clearly separable as a species but has distinct cohesion of morphology, geographical distribution, ecological adaptation and frequently breeding behaviour. The race is a group of useful cultivars in a crop. In the present study, an attempt has been made to identify two races of black pepper of commerce having vegetative mode of propagation coupled with sexual in the wild and run wild forms in its centre of origin on the basis of spike and berry characters.

Black pepper (*Piper nigrum* L.) having a monocentric origin in a limited geographic area in tropical region with high rainfall on the western slopes and plateau region of Western Ghats has a short history as a crop but has longer commercial history as a forest produce. It has spread to very far off areas in South East Asia and South America without any appreciable secondary centres of diversity. Its spread to the other tropical areas in Brazil, Malaysia, Thailand and Vietnam is comparatively a recent development. This crop has originated from the wild ones through domestication and selection (Ravindran et al., 2000). Cultivar diversity is richest in Kerala followed by Karnatatka. The cultivars are mostly bisexual as against the dioecious wild ones. Intermediate populations of various species and their segregating progenies probably arising through natural hybridization and segregation have been noticed to occur in pockets of Western Ghats. Escape of cultivated ones through birds and establishment of bisexual types in forest areas has also been observed. Nearly hundred cultivars have been reported from Southern region of India. There is an overlapping of local names in relation to regions, places, situations, dialects and spike and berry characters. Though *Piper* species of Western Ghats has been subjected to numerical taxonomic analysis and isoenzyme analysis with a view to group them. However, no report on the existence of different races in the crop has been made so far. Morphometric analysis of 44 black pepper cultivars and 7 wild accessions using 22 characters to classify them into 11 groups has been furnished by Ravindran (1991) and Ravindran et al. (1997a, b). Ravindran et al. (2000) has also attempted to furnish spike and berry characters of 14 species of the genus from Western Ghats. A comprehensive report on all the cultivars with distinguishing key characters is still needed in this crop. Thus as a part of characterization and documentation of collections made from southern region, observation of the first author on various pepper cultivars and wild population during his survey and collection trips in southern region indicated that the most prominent character of the cultivated pepper

is the shape and size of its berries and changing colour on ripening. These appear to be two important characters probably have an evolutionary significance in the crop.

Materials and Methods

Out of a total of 192 accessions of black pepper maintained in the National Bureau of Plant Genetic Resources (NBPGR), Regional station's farm at Vellanikkara, 103 accessions belonging to 48 named clones (Tables 1 and 2) were observed for 12 quantitative and 7 qualitative spike and berry characters at the time of harvesting during January to March, in 2002 and 2003. The collections were divided subjectively into two races (race 1 and race 2) based on two associated characters such as berry shape

Table 1. Race wise list of collections of black pepper

S.No.	Terno	Collno	Icno	Local Names	Locality	District	State
Oval berried types							
1	300	V90/P-90	266416	Kariyilanchi	Payyakode	Kollam	Kerala
2	301	V90/P-92	266417	Kariyilanchi	Ithikkara	Kollam	Kerala
3	331	V91/P-207	266404	Kariyilanchi	Kunnakkad	Palakkad	Kerala
4	421	VB/2001-69	373830	Karivilanchi	Mavila	Kollam	Kerala
5	425	VB/2001-75	373836	Elamaravan	Ummannur	Kollam	Kerala
6	427	VB/2001-68	373829	Nadan	Mavila	Kollam	Kerala
7	438	VU/2001-8	373754	Ayimpiriyan	Vengola	Thiruvananthapuram	Kerala
Round berried types							
1	1	V3613	85313	–	Edamalayar	Idukki	Kerala
2	6	V3643	85318	Nadan	Kuttampuzha	Idukki	Kerala
3	8	V3646	85320	Karimunda	Puyamkutti	Idukki	Kerala
4	12	V3654	85324	Karimunda	Adimali	Idukki	Kerala
5	19	V3671	85331	–	Kallar	Idukki	Kerala
6	21	V3675	85333	–	–	Idukki	Kerala
7	23	V3677	85335	–	Ayiram Acre	Idukki	Kerala
8	26	V3686	85338	Nedumundi	Ayiram Acre	Idukki	Kerala
9	27	V3688	85339	Narayakkodi	Ayiram Acre	Idukki	Kerala
10	29	V3690	85341	Kuthiravali	Ayiram Acre	Idukki	Kerala
11	41	V3712	85353	Karimundi	Nedunkandam	Idukki	Kerala
12	42	V3713	85354	Vattamundi	Nedunkandam	Idukki	Kerala
13	45	V3717	85357	Neelamundi	Nedunkandam	Idukki	Kerala
14	49	V3722	85361	Vellamundi	Nedunkandam	Idukki	Kerala
15	50	V3724	85362	Wild	Nedunkandam	Idukki	Kerala
16	51	V3725	85363	Vellamundi	Perumpazham	Idukki	Kerala
17	54	V3728	85366	Vellamunda	Thekkady	Idukki	Kerala
18	58	V3735	85370	Ottamundi	Kumili	Idukki	Kerala
19	59	V3726	85371	Thevanmundi	Kumili	Idukki	Kerala
20	63	V3740	85375	Narayakkodi	Peermed	Idukki	Kerala
21	64	V-3741	85376	Vellamundi	Peermed	Idukki	Kerala
22	65	V3742	85377	Thevanmundi	Peermed	Idukki	Kerala
23	69	V3749	85381	Vattamundi	Chinnar	Idukki	Kerala
24	74	V3756	85386	Malamundi	Thadiyanpad	Idukki	Kerala
25	75	V3757	85387	Karimunda	Thadiyanpad	Idukki	Kerala
26	80	V3774	85392	Narayakkodi	Ranni	Pathanamthitta	Kerala
27	84	V3805	85396	Chomala	Mekkazhoor	Pathanamthitta	Kerala
28	85	V3807	85397	Karimunda	Perinadu	Pathanamthitta	Kerala
29	86	V3808	85398	Valiyaramunda	Perinadu	Pathanamthitta	Kerala
30	89	V3811	85401	Valiyamunda	Kochandi	Pathanamthitta	Kerala
31	90	V3812	85402	Palikkodi	Kochandi	Pathanamthitta	Kerala
32	91	V3819	85403	Wild	Muahiar	Pathanamthitta	Kerala
33	94	V3841	85406	Valiyaramunda	Vadasserikkara	Pathanamthitta	Kerala
34	99	V3852	85411	–	Chittar	Pathanamthitta	Kerala
35	100	V3854	85412	Neelamunda	Chittar	Pathanamthitta	Kerala
36	103	V3858	85415	–	Konni	Pathanamthitta	Kerala
37	105	V3861	85410	Narayakkodi	Konni	Pathanamthitta	Kerala
38	106	V3865	85418	Karivally	Konni	Pathanamthitta	Kerala

S.No.	Tcrno	Collno	Icno	Local Names	Locality	District	State
39	108	V3867	85420	Karinthakara	Konni	Pathanamthitta	Kerala
40	110	V3873	85422	Arimani	Adoor	Pathanamthitta	Kerala
41	112	V3879	85424	Konnamankara	Pandalam	Pathanamthitta	Kerala
42	114	V3885	85426	Kotta	Moduveli	Pathanamthitta	Kerala
43	115	V3888	85427	–	Aranmula	Kottayam	Kerala
44	116	V3891	85428	–	Kuttoor	Pathanamthitta	Kerala
45	117	V3892	85429	–	Kuttoor	Pathanamthitta	Kerala
46	121	V3899	85433	Cholakkodi	Chambakkara	Kottayam	Kerala
47	122	V4031	85434	Ottanadan	Kallara	Kottayam	Kerala
48	127	V4060	85437-a	Wild	Kudajadiri	Udupi	Karnataka
49	175	V4168	85487	–	Mukkali rd.	Palakkad	Kerala
50	176	V4174	85488	–	Mukkali Rd	Palakkad	Kerala
51	216	V4288	85528	Arivally	Panniyur	Kannur	Kerala
52	217	V4289	285529	Karimundi	Panniyur	Kannur	Kerala
53	218	V4290	85530	Arakalamundi	Panniyur	Kannur	Kerala
54	219	V4291	85531	Vattamundi	Panniyur	Kannur	Kerala
55	221	V4293	85533	Kanjiramundi	Panniyur	Kannur	Kerala
56	224	V4296	85536	Kuttianikkodi	Panniyur	Kannur	Kerala
57	225	V4297	85537	Kottanadan	Panniyur	Kannur	Kerala
58	226	V4298	85538	Kutching	Panniyur	Kannur	Kerala
59	228	V4300	85540	Kalluvalli	Panniyur	Kannur	Kerala
60	232	V4304	85544	Vokkale	Panniyur	Kannur	Kerala
61	233	V4305	85545	Cul.331	Panniyur	Kannur	Kerala
62	275	V4108	266411	Wild	Charmadighat	S.Kanara	Karnataka
63	276	V90/P-1	266410	Karimunda	Mandiram	Pathanamthitta	Kerala
64	288	V90/P-76	266414	Wild	Kallar estate	Kollam	Kerala
65	290	V90/P-79	266415	–	–	Kollam	Kerala
66	303	V90/P-94	266418	Kariyilanchi	Ithikkara	Kollam	Kerala
67	305	V/90—96	266419	–	Ochira	Kollam	Kerala
68	306	V91/P-99	266379	Wild	Makkootta	Kudagu	Karnataka
69	309	V91/P-137	266382	–	Sullya	S.Kanara	Karnataka
70	310	V91/P-138	266383	–	Sullya	S.Kanara	Karnataka
71	321	V91/P-188	266394	–	Malampuzha	Palakkad	Kerala
72	322	V91/P-189	266395	Wild	Malampuzha	Palakkad	Kerala
73	324	V91/P-191	266397	Wild	Malampuzha	Palakkad	Kerala
74	327	V91/201P-202	266400	–	Kappunakam	Malapppuram	Kerala
75	329	V91/P-205	266402	–	Thachanatukara	Palakkad	Kerala
76	330	V91/P-206	266403	–	Kunnakkad	Palakkad	Kerala
77	332	V91/P-180	266405	–	Moozhiar	Pathanathitta	Kerala
78	334	V91/P-179	266407	Wild	Palaruvi	Kollam	Kerala
79	343	V92/P-256	266438	–	Appangala	Kudagu	Karnataka
80	356	Kuthiravlly II	266441	–	PRS, Panniyur	Kannur	Kerala
81	363	Cul-406	266445	Cul-406	IISR, Calicut	Kozhikkode	Kerala
82	364	Vally	266446	Vally	PRS, Panniyur	Kannur	Kerala
83	367	Kottanadan II	266447	Kottanadan-II	PRS, Panniyur	Kannur	Kerala
84	371	Kaniakadan	266451	–	PRS, Panniyur	Kannur	Kerala
85	380	Arakalamunda	266455	Arakalamunda	PRS, Panniyur	Kannur	Kerala
86	383	Karimunda IV	266456	Karimunda-I	PRS, Panniyur	Kannur	Kerala
87	385	Perumkkodi	266457	Perumkodi	PRS, Panniyur	Kannur	Kerala
88	390	TMB-XII	266459	TMB-XII	PRS, Panniyur	Kannur	Kerala
89	426	VB/2001-67	373828	Ottamaniyan	Ariyankavu	Kollam	Kerala
90	431	VU/2001-19	373770	–	Onthupacha	Kollam	Kerala
91	432	VU/2001-9	373575	Vadakkan	Kulathupuzha	Kollam	Kerala
92	435	Panniyur-1	–	Panniyur-1	PRS, Panniyur	Kannur	Kerala
93	441	Panniyur2	–	Panniyur-2	PRS, Panniyur	Kannur	Kerala
94	442	Panniyur4	–	Panniyur-4	PRS, Panniyur	Kannur	Kerala
95	444	Panniyur5	–	Panniyur-5	PRS, Panniyur	Kannur	Kerala
96	445	V3656	85331A	–	Kallar	Idukki	Kerala

and colour change in ripening. The subjective classification resulted in inclusion of seven collections in race 1 and 96 collections in race 2. The quantitative data was computed for range, mean, SD and phenotypic CV% separately for each race and furnished separately for races 1 and 2 in Table 3. Frequency class distribution of 7 qualitative data was made. Finally data on 12 quantitative and 8 qualitative characters (including the codes for races) were used for sequential, agglomerative, hierarchical and tested clustering (SAHN) based on computed similarity or dissimilarity indices (SIMINT) using linearly transformed rectangular data matrix in NTSYS 2.2 package. A tree dendrogram showing the clustering pattern in the collection is furnished in Figure 3. Three samples representing round berried type and four of oval berried type (replicated thrice) were subjected to estimation of essential oil content and oleoresin content and mean values were given in Table 4 for race 1 and 2 respectively. Diagrammatic representation of the two berry shapes is furnished in Figure 2 and a photograph of the two types in Plate 1. Geographic distribution of the two races has also been furnished in Figure 3. The present information has been interpreted in view of the available information of berry shape in related species of the genus distributed naturally in forests of the Western Ghats and based on the evidences available in literature.

List of descriptors and their states

S.No.	Character	Codes for descriptor states		
1	Race	1-Race 1	2- Race 2	
2	Status	1-Cultivated	2-Wild	
3	Berry shape	1-Round	2-Oval	
4	Berry size	1-Small	2-Medium	3-Large
5	Fruit pungency	1-Low	2-Medium	3-High
6	Seed shape	1-Round	2-Oval/conical	
7	Seed size	1-Small	2-Medium	3-Large
8	Berry colour change	1-Fast	2-Slow	
9	Berry length (mm)			
10	Berry width (mm)			
11	Single spike wt. (g)			
12	Fresh berry wt./ spike (g)			
13	100 berry volume (ml)			
14	100 berry fresh wt.(g)			
15	100 berry dry wt. (g)			
16	100 seed fresh wt. (g)			
17	100 seed dry wt. (g)			
18	Seed length (mm)			
19	Seed width (mm)			
20	Berry dry wt.%			

Results and Discussion

On the basis of berry shape and the time taken for berry colour change in ripening berries, two distinct cultivar groups such as oval and spherical berry bearing types were identified. The passport information is listed in Table 1. The oval berried cultivars were mostly confined to southern most districts of Kerala (Fig. 2). The one such sample was collected from an estate in Palkkad district. This might be as a result of spread of this type from Southern Kerala through the newly settled farming communities. Only three cultivars such as Karivilanchi, Nadan and Elamaravan belong to the first group. Oval berry shape is closely associated with the slow pace of colour change in ripening berries. However, few collections falling under the race 2 with round berry shape such as IC 85402 ('Palikkodi') from Pathanthitta, IC 266418 (wild) from Kallar estate in Kollam, IC 266400 from Malappuram, IC 466407 (wild) Palaruvi in Kollam, IC 266456 ('Karimunda-II', a variant of typical 'Karimunda') kept by a Research Station also exhibited the slow pace of colour change. Thus, the evolutionary significance of both berry shape and the colour change in ripening berry appear to have close association that can be possibly traced back to the species/ crop origin and domestication. Such types are rarely noticed in the forest and in farmers' fields.

The first group hailing from southern Kerala contained seven accessions with oval berries, more pronounced and uniform yellow colour of mature berries and uniformly larger berries. The large berry size is commercially a

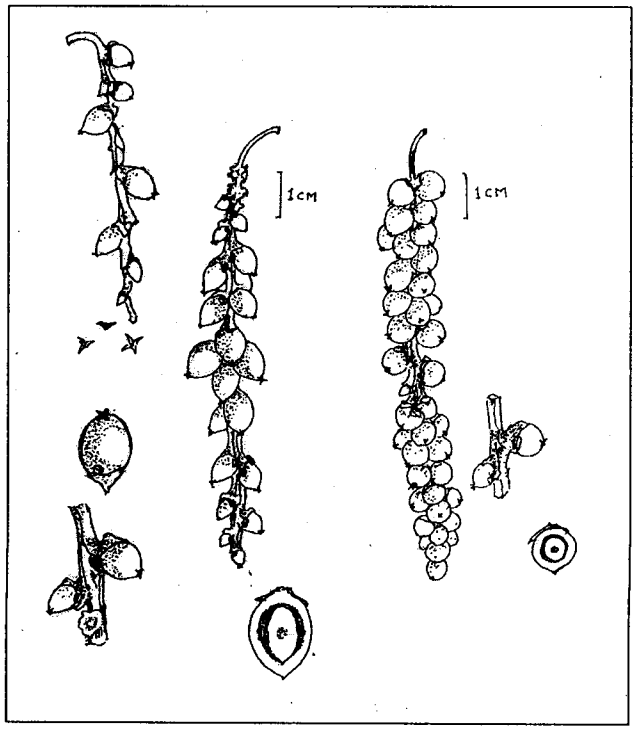


Fig. 1: Diagrammatic representation of oval and round fruits

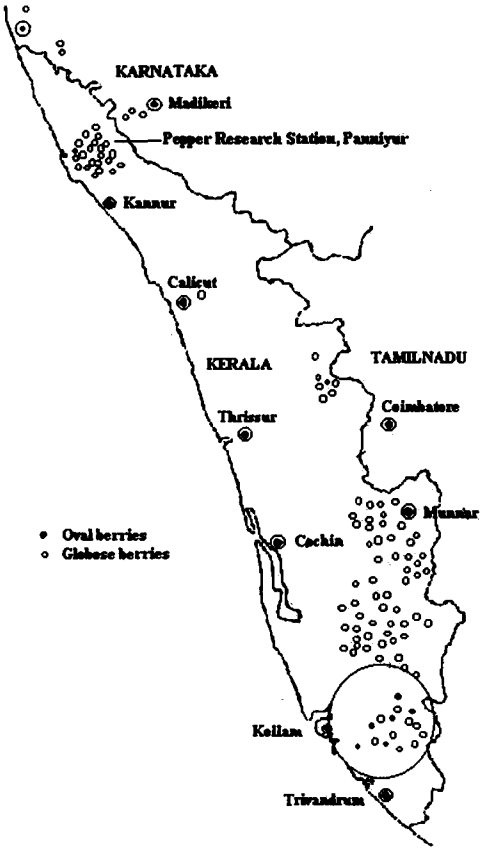


Fig. 2: Distribution of black pepper races in southern region

useful character. The second group included ninety six accessions with round berry, less uniform yellow colour in mature berries and with highly varying berry size from small to large. This group is uniformly distributed all over in the pepper growing areas in Kerala and Karnataka and as wild in forest areas. Diagrammatic representation of the berry of each group is given in Figure 1 and photographs in Plate 1. The variation noticed in race 2 is very high as compared to race 1 as evident from range, mean, SD and CV% for 12 quantitative characters in Table 2. In race 1, higher amount of phenotypic CV% values *viz.* 68.21%, 120.81% and 66.64% were noticed in the case of single spike weight, fresh berry weight/ single spike and 100-berry volume respectively. The range of CV% varied from 23.08% in berry dry weight% to 120.81% in the case of fresh berry weight per spike. With respect to race 2 greater CV% values *viz.* 62.06, 50.61% 59.97% and 50.61% were obtained in berry length, berry width, seed length and seed width respectively.

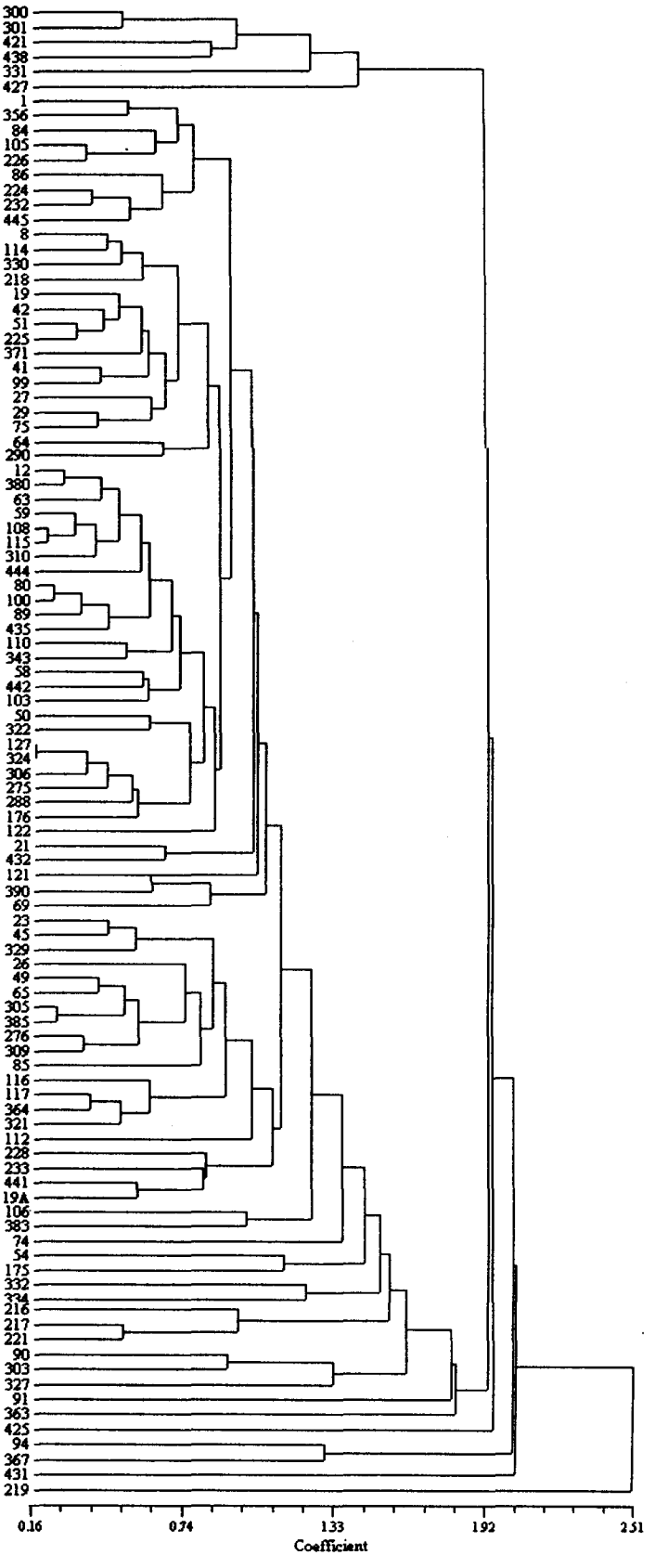
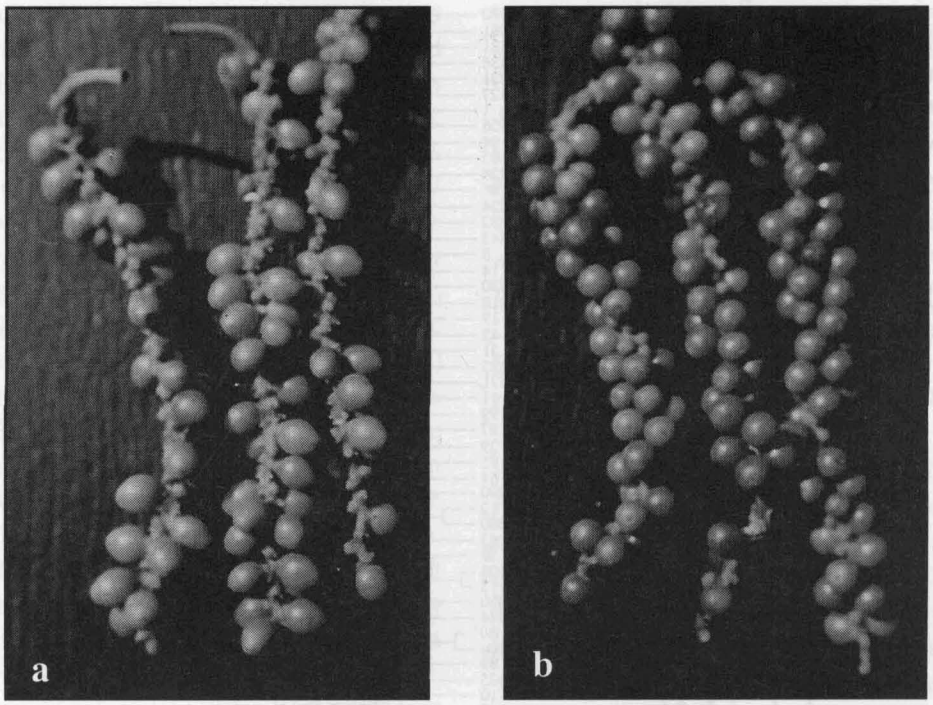


Fig. 3: Dendrogram of black pepper cultivars



IC 266217 (Race 1- 'Kariyilanchi') *IC 85320 (Race 2- 'Karimunda')*

Plate 1. Black pepper with oval/oblong fruit and that with round fruit

Table 2. Showing range, mean, SD and CV% in round berry bearing type

Race-1 (Oval berried types)						
	Berry length (cm)	Berry width (cm)	Single spike wt. (g)	Berry wt./ spike (g)	Hundred berry wt. (g)	Hundred dry berry wt. (g)
Min	0.53	0.47	1.70	1.44	2.62	2.44
Max	7.40	7.30	36.90	72.00	27.04	12.00
Mean	5.23	5.00	5.93	5.76	12.70	5.14
S.D	1.940	1.851	4.05	6.95	3.84	1.55
CV%	37.10	37.03	68.21	120.81	30.26	30.29
	Hundred berry volume (ml)	Hundred fresh seed wt. (g)	Hundred dry seed wt. (g)	Deed length (cm)	Seed width (cm)	Berry dry wt. %
Min	3	3.60	2.08	0.43	0.40	21.62
Max	143	20.40	5.80	6.67	5.45	56.08
Mean	14.57	6.51	4.00	4.08	3.84	39.70
S.D	15.45	2.80	0.83	1.49	1.37	9.16
CV%	106.04	42.95	20.77	36.37	35.93	23.08
Race-2 (Round berried types)						
	Berry length (cm)	Berry width (cm)	Single spike wt. (g)	Berry wt./ spike (g)	Hundred berry wt. (g)	Hundred dry berry wt. (g)
Min	0.62	0.54	3.23	2.88	6.4	4.72
Max	7.80	6.11	7.50	6.72	15.92	7.76
Mean	4.43	3.88	5.29	4.77	11.51	6.22
S.D	2.75	2.34	1.49	1.33	3.01	1.10
CV%	62.06	60.28	28.19	27.92	26.12	17.63
	Hundred fresh volume (ml)	Hundred dry seed wt. (g)	Deed length seed wt. (g)	Seed width (cm)	Berry dry (cm)	Hundred berry wt. %
Min	6	4	2	0.46	0.41	28.35
Max	16.40	16.40	8.10	5.20	4.51	48.70
Mean	12.44	9.64	4.95	3.41	3.07	39.83
S.D	3.67	4.88	1.71	2.04	1.82	6.21
CV%	29.53	50.61	34.61	59.97	59.20	15.59

Table 3. Frequency distribution of various qualitative characters

Parameter	Classes	Class description	Number	Total
Status	1	Cultivars	87	103
	2	Wild	12	
	3	Improved	4	
Fruit shape	1	Globose	93	103
	2	Oval	10	
Fruit size	1	Small	10	103
	2	Medium	60	
	3	Large	33	
Pungency	1	Low	20	103
	2	Medium	61	
	3	High	22	
Seed shape	1	Globose	91	102
	2	Oval/conical	11	
Seed size	1	Small	29	100
	2	Medium	48	
	3	Large	23	
Fruit colour	1	Green to yellow to red fast	92	103
	2	Green to yellow to red slow	11	

Table 4. Chemical characters of black pepper races

Berry shape		Essential oil content	Oleoresin content
Round berry (race 2)	Mean	3.83	41.36
	SD	0.47	1.80
Oval berry (race 1)	Mean	4.33	30.06
	SD	0.35	3.03

Table 5. Berry shape in related species as per the taxonomic reports

Species	Berry shape	Colour change	
Piper schmidtii	Oblong/oval	Ripening black	Small
Piper wightii	Conical/shperical	Ripening orange yellow to red	Large
Piper tricho stachyon	Oblong/spherical	Ripening orange yellow to red	Large
Piper galeatum	Oblong/spherical	Ripening orange yellow to red	Large
Piper bababudanii	Oblong/oval	Ripening orange yellow to red	Large
Piper sugandhi	Oblong/oval	Ripening orange yellow to red	Large
Piper pseudonigrum	Spherical	Ripening orange yellow to red	Large

The range of CV% varied from 15.59% in berry dry weight to 62.06 in berry length. The berry dry weight% showed a CV% range of 28.35 to 48.7. Thus in both the groups berry dry weight % had good range of variation.

All the above given 20 characters (8 qualitative including the race code based on subjective observation and 12 quantitative were used for clustering and the dendrogram (Fig. 3) indicated that all the 6 collections of race 1 clustered together at 1.5 CEC. However, a cultivar from Kollam was far away separated along with collections falling under race 2. Thus 6 collections were categorised in race 1.

The two chemical parameters such as essential oil content and oleoresin content in representative samples of both the races also exhibited some difference. The oleoresin content which is more (41.36) in the second type than that in the first (30.06%). The actual difference will have to be studied in detail.

Black pepper as a wild species and as crop has a monocentric origin in and around forests of Western Ghats. Its gene pool based on breeding behaviour is yet to be worked out. Diversity of closely related species and varieties to black pepper are maximum noticed in Western Ghats. Ravindran (1991) proposed two probable bases for the origin of black pepper through natural hybridization and suggested that *P. wightii* x *P. galeatum* gave rise to *P. nigrum* with 2n =52 and *P. wightii* x *P. nigrum* var. *hirtullosum* with 2n=52 chromosomes. The picture of natural hybridization of these species as drawn by him may not be very true as the existing ecological niches of the above species are much-differentiated altitudinally in the mountain. Further, the grouping and clustering of species on the basis of morphology has given different pictures in the past as reported by Rahiman (1981) and Ravindran *et al.* (1991). Rahiman's study indicated that *P. nigrum* and *P. bababudanii* were closer where as that of Ravindran et al. (1991) indicated that *P. nigrum* and *P. sugandhi* were closer. *P. psuedonigrum* and *P. sugandhi* are morphologically very close and greater distribution all over Western Ghats in Kerala, Karnataka and Tamilnadu along with intermediate types. *P. galeatum, P. trichostachyon, Piper nigrum, P. nigrum* var. *hirtullosum, P. sugandhi / P. pseudonigrum* and *P. bababudanii* could be noticed in forests of Coorg district. Glabrous forms of *P. pseudonigrum* and *P. sugandhi* are almost similar. Hairy forms of *P. pseudonigrum* are almost similar to *P. nigrum* var. *hirtullosum*. Thus there is very dynamic and turbulent situation of closely occurring species in evergreen forests at middle elevations of Western Ghats especially at 1000 m. elevation. Such situations occur in Coorg, Nilgiris, Coimbatore, Idukki, Pathanamthitta, Kollam, Thiruvananthapuram and Tirunelveli districts. Some of the intermediate types were doubted for *P. nigrum* earlier. *P. wightii* usually occur in rare pockets

in above 2000 m elevation in Nilgiris, Anamalays and Munnar. It is gradually becoming eroded too due to habitat distruction. Further, *P. nigrum* var. *hirtullosum* is also very much related to *P. pseudonigrum* which have greater distribution in areas where natural population of *P. nigrum* is less. True natural population of *P. nigrum* is usually noticed up to 900 m elevation; above, which either cultivated *P. nigrum* or its run wild populations occur along with *P. sugandhi, P. pseudonigrum, P. galeatum, P. trichostachyon* etc. Pepper as a crop probably was domesticated from the wild clones and this process is still going on in Uttar Kannada forests in Karnataka. There is a possibility of domestication of intermediate natural hybrid progenies by vegetative means in the past and these clones might remain without much change in farming areas around the vicinity of the original home. Thus the occurrence of oval berried types in eastern parts of Kollam district of Kerala can be attributed to original domestication of similar types involving natural hybrid population arising from chance interspecific hybridization in forest areas between round berried wild *P. nigrum* and those species with oval berries. *P. schmidtii, P. wightii, P. trichostachyon, P. galeatum, p. bababudanii* and *p. sugandhi* have been reported to have the oval, hemi-spherical, oblong berries. Variation within the species with respect to berry shape may be also present.

Since *P. nigrum* is a polymorphic species having good amount of morphological variation and chromosome numbers reportedly varying from 2n = 52 to 128, existence of interspecific hybrids in wild and cultivated populations having different genomes cannot be ruled out. This obviously is a point for detailed study including interspecif hybridization, morphological and molecular characterization of the wild species, interspecific hybrids and their back crosses involving wild and cultivated *P. nigrum* and others in order to clearly define the gene pool of black pepper and its relatives in Western Ghats. It is probable that the oval berry shape noticed in both in cultivated and wild *P. nigrum* has an evolutionary significance while studying the origin of the crop through natural hybridization. According to Harlan (1975), in dynamics of crop domestication the effects of selection pressure in vegetatively propagated crops are absolute and immediate as against those in seed crops. As black pepper is a good example of pure form of 'vegeculture' Harlan's point is quite acceptable in order to assume instant domestication of such cultivated types from the wild clones in rare pockets. The two races identified in the present study have been named as 'Kariyilanchi' for race 1 and 'Karimunda' for the race 2 as these were representative common cultivars of black pepper in the region.

Race 1. 'Kariyilanchi'

Standard representative specimen: Live specimen Collectors No. V90/P-92; IC 266417

Distribution : Ithikkara, Kollam, Kerala, India

Race 2. 'Karimunda'

Standard representative specimen: Live specimen: Collector's No. V-3646; IC 85320

Distribution: Puyamkutti, Idukki, Kerala, India

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References

Harlan, JR (1975). Crops and Man. American Society of Agronomy and Crop Science Society of America Madison, Wisconsin, p. 107-121.

Harlan JR and de Wet (1972) A simplified classification of cultivated *Sorghum Crop Sci.* **12:** 172-176.

Rahiman BA (1981) Biosystematic Studies in Varieties and Species of Piper Occurring in Karnataka Region. PhD. Thesis, Department of Bio-Sciences, Mangalore University, Mangalore. pp. 1-204.

Rahiman BA and Raghavan S (1985) Analysis of Divergence in eight species of Piper using D^2 statistics. *Bot. Bull. A cademica Sinica* **26:** 39-45.

Ravindran PN (1991) Studies on Black Pepper and Some of its Wild Relatives. Ph.D. Thesis, Univ. Calicut, Kerala.

Ravindran PN, Balakrishnan R and Nirmal Babu K (1997a) Morphometric studies on black Pepper. I Cluster analysis of black pepper varieties. *J. Spices and Aromatic Crops* **6:** 9-20.

Ravindran PN, Balakrishnan R and Nirmal Babu K (1997b) Morphometric Studies on black pepper II. Principal Component analysis of black pepper cultivars. *J. Spices and Aromatic Crops* **6:** 21-29.

Ravindran PN, Nirmal Babu B Sasikumar and KR Krishnamurthy (2000). Botany and crop Improvement of Black Pepper In Black Pepper (ed) PN Ravindran. Hard Wood Academic Publishers. p. 23-142.