Clonal variability in black pepper hybrid Panniyur 1

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Abstract

Forty two clones of twenty year old Panniyur 1 plants, grown as a monocrop of black pepper, were analyzed for variations in yield contributing factors as well as quality parameters over a period of three years. The analysis of the data has revealed that the plants exhibited considerable amount of variability for characters under study and the standard deviation was more for berries spike[-1] and yield. Among the quality characteristics, oleoresin exhibited more variability than piperine. From the non hierarchical Euclidean cluster analysis it is observed that the plants can be clustered ideally in to five clusters based on their mean performance. The intra and inter cluster distance was more for cluster number 4, which later culminated in maximum number of plants (13) having high yield and oleoresin.

Key words: clonal variation, cluster analysis, phenotypic variation, *Piper nigrum*

The first ever hybrid of black pepper, Panniyur 1 (*Uthirankotta* X *Cheriyakaniyakadan*), has been holding the status of one of the widely cultivated varieties of black pepper in Kerala since its release in 1971 and Wayanad is no exception. Among all the known varieties of black pepper in India, Panniyur 1 recorded the highest potential yield of 8800 kg dry pepper ha^{-1} (NRCS 1991). Considerable variation in black pepper, among the clones within a cultivar, for quantitative characters including yield has been reported. Cultivar Karimunda provides a classic example (Ratnambal *et al.* 1985). It is learnt that some of the true to type vegetatively propagated vines of Panniyur 1 found to exhibit variation in yield potential under the identical environment of soil and other physical factors. In an analysis of yield spanning over 20 years, plants with high mean yield and low S.D. have been identified among the vines of Panniyur 1 (Pradeepkumar *et al.* 1999). If this variability in yield potential is due to the genotypic factors a breakthrough could be achieved in raising the yield potential of Panniyur 1 by selection of superior clones. Hence a study was undertaken to analyze the variability in yield contributing factors and quality parameters in a population of Panniyur 1 involving 42 vines through cluster analysis.

The plants were selected from a base population of twenty year old monocrop garden of Panniyur 1, over an area of 4 ha planted at a spacing of 3.6 m x 3.6 m, which is grown as a

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rainfed crop in deep forest loam soil of Regional Agricultural Research Station, Ambalavayal, Wayanad. All the cultural and manurial practices as per the package of practices recommendations of Kerala Agricultural University were followed. From this base population 42 plants were selected at random based on green spike yield over a period of 10 years and the plants were observed for length of spike, berries spike^{-1}, green spike yield for 1998-99, 1999-2000 and 2000-01 seasons. The estimation of oleoresin was done by exhaustive extraction with acetone and gravimetry and piperine using the solvent ethylene dichloride (AOAC 1997) for 2000-01 season. The data was subjected to cluster analysis as per non hierarchical Eucledian cluster analysis (Spark 1973).

The summary statistics of yield and quality parameters are given in Table 1. The vines exhibited considerable variation of characters under study and highest standard deviation was observed for berries spike^{-1} (SD 17.710) and yield (SD 12.901), while lowest for piperine (SD 0.238). In black pepper greater amount of variability exists for yield when compared to components of yield such as spike and berry characters, but the heritability is the lowest (Ibrahim *et al.* 1985a). Analysis of the data has revealed that plant number 10 (P_{10}) was showing superiority in almost all characters under study. It produced the longest spike (14.28 cm) over a mean length of 12.099 cm and maximum number of berries spike^{-1} (65.323). However, the yield per vine was though more than the average it was not the highest as expected. The piperine content was comparatively high (7.359%) and out of the 42 clones highest amount of oleoresin (13.150%) was recorded for this clone. Another clone that was showing very good prospect was P_{32} with a green spike yield of 51.767 kg vine^{-1}, with comparatively high percentage of piperine (7.067%) and oleoresin (10.980%).

In black pepper combining yield and quality parameters has been a perennial goal for improvement programs. More emphasis is given lately on the export of value added products like pepper oleoresin and oil in place of traditional bulk pepper. Certain wild types of black

pepper and local land races were reported to contain more piperine and oleoresin (Mathai *et al.* 1981). The general tendency of high quality

Table 1. Summary statistics of yield and quality characters of selected plants in Panniyur 1 (Mean data for 3 years)

Plant No.	Spike length (cm)	Berries spike^{-1}	Yield vine^{-1} (kg)	Piperine (%)	Oleoresin (%)
1	11.817	52.967	16.433	7.427	10.980
2	12.113	55.067	19.633	7.521	11.790
3	12.100	34.933	18.400	6.747	10.310
4	11.767	62.733	14.330	7.055	10.650
5	12.350	46.967	15.933	7.023	12.330
6	10.890	39.967	21.400	6.865	9.990
7	12.633	48.733	19.067	7.180	11.990
8	10.717	46.800	19.633	7.241	12.190
9	12.873	60.210	14.700	6.749	12.430
10	14.280	65.323	24.833	7.359	13.150
11	11.887	56.787	26.600	7.215	11.860
12	11.073	36.700	12.600	6.668	8.730
13	13.080	54.767	21.233	7.084	11.520
14	12.850	60.867	21.367	7.124	10.970
15	14.067	61.567	24.433	7.127	12.230
16	13.433	59.533	28.900	7.108	10.580
17	10.777	61.633	15.267	6.888	9.00
18	11.960	48.333	18.767	6.776	8.750
19	12.873	59.700	25.400	6.707	9.280
20	11.240	45.167	18.433	7.067	8.730
21	11.873	49.233	13.833	6.895	8.590
22	11.793	57.307	19.533	6.728	10.330
23	11.603	60.590	11.700	6.625	8.760
24	11.607	47.017	16.567	6.873	11.250
25	11.110	43.220	22.767	6.976	10.980
26	11.147	48.070	21.467	7.141	10.950
27	13.020	55.427	29.050	7.065	12.870
28	11.443	55.207	16.733	6.537	9.050
29	11.870	49.400	20.200	6.907	9.030
30	11.517	49.067	15.100	6.750	8.460
31	13.200	41.000	19.500	7.067	10.910
32	13.253	63.567	51.767	7.067	10.980
33	11.517	52.550	19.267	7.236	11.240
34	11.057	51.333	16.433	7.063	8.760
35	12.437	48.977	31.733	7.029	9.590
36	11.713	54.433	26.800	7.459	10.570
37	12.333	46.333	9.667	6.892	10.400
38	12.647	52.527	11.833	7.039	8.760
39	12.003	54.900	16.233	6.901	8.300
40	13.500	50.800	25.000	7.264	10.360
41	12.683	60.500	21.533	6.815	10.500
42	10.480	50.503	26.567	7.438	10.250
Mean	12.099	52.448	20.492	7.017	10.437
SD	1.400	17.710	12.901	0.238	1.352

Table 2. Correlation matrix between yield and quality characters in clones of Panniyur 1

Variable	Spike length	Yield	Berries spike[-1]	Piperine	Oleoresin
Spike length	1.000				
Yield	0.440*	1.000			
Berries spike[-1]	0.627*	0.341	1.000		
Piperine	-0.0248	0.358	0.0252	1.000	
Oleoresine	0.396	0.458	0.386	0.487	1.000

* Significant at 5 % level

parameters in low yielding cultivars and vise versa was not observed in the present analysis as P_{37} recorded par below levels of oleoresin and piperine and lowest yield among the observed clones. The trend in the case of highest yielding clone (P_{32}) has already been discussed elsewhere. Correlation analysis of the data was carried out to find out the extent of inter relationships of the individual factors.

The correlation analysis of the data has revealed that all the yield contributing factors have positive influence on the final yield of the crop and the correlation matrix is given in Table 2. Length of spike found to have pronounced influence on yield (r = 0.440) and the correlation was less for berries spike[-1] (r = 0.341). The highest significant correlation was observed between berries spike[-1] and spike length (0.627). Ibrahim *et al.*(1985b) observed high correlation of yield with spike length and berries spike[-1] (0.31 and 0.44, respectively). Interestingly the green spike yield was found to be positively correlated with the quality parameters like piperine (0.358) and oleoresin (0.458). The only negative correlation was observed between spike length and piperine (-0.0248) and it was also observed that with increase in piperine content, the content of oleoresin also increases.

The genotypic coefficient of variability (GCV) and phenotypic coeffecient of variability (PCV) for the characters indicate higher variation for yield and lower variation for piperine and oleoresine (Table 3). From the non hierarchical Euclidean cluster analysis it is observed that the clones can be clustered ideally to five clusters base on their mean performance. The intra and inter clusteral distance are given in Table 4 and the number of plants falling in each clus-

Table 3. GCV and PCV values for yield and quality characters in clones of Panniyur 1

Variable	GCV	PCV
Spike length	4.90	10.82
Berries spike[-1]	4.69	23.24
Yield	24.38	49.52
Piperine	3.40	3.47
Oleoresine	3.50	3.62

Table 4. Intra and inter cluster distances between cluster centroides in Panniyur 1 plants

Cluster No.	1	2	3	4	5
1	1.050				
2	2.289	1.379			
3	2.411	2.466	1.218		
4	3.845	2.228	2.972	1.576	
5	1.695	1.791	3.008	3.058	1.265

Table 5. Cluster details and means of variables in each cluster

Cluster No.	No. of plants in each cluster	Means of variables				
		Spike length (cm)	Yield (kg)	Berries spike[-1]	Piperine (%)	Oleoresin (%)
1	7 (6, 2, 17, 21, 30, 34, 38)	11.04	17.43	51.00	6.88	8.90
2	5 (9, 24, 31, 37, 41)	12.72	21.00	60.28	6.88	11.10
3	9 (1, 2, 3, 4, 8, 25, 26, 33, 42)	10.58	26.78	52.82	7.28	11.04
4	13 (5, 7, 10, 11, 13, 14, 15, 16, 27, 32, 35, 36, 40)	13.40	43.00	68.17	7.16	11.46
5	8 (18, 19, 20, 22, 23, 28, 29, 39)	11.85	22.62	65.22	6.78	9.03

ter and the corresponding means are given in Table 5.

The intra and inter cluster distance was more for clusters involving cluster number 4, which later culminated in maximum number of plants in that cluster (13). The mean of variables was the highest for all the characters under observation for this cluster except for piperine content which was more for cluster number 3. The plants of cluster number 4 offer new opportunity to raise the yield and quality plateau of Panniyur 1 through selective vegetative propagation. In black pepper, cluster analysis is useful in establishing the relative resemblance of the cultivars (Ravindran *et al.* 1997). The present study points towards the existence of phenotypic variability in Panniyur 1. The cause of this variability needs to be elucidated through genetic and molecular studies for the perpetuation and improvement of desirable traits.

References

AOAC 1997 Official Methods for Analysis of Association of Official Agricultural Chemists. 9th edn. Washington D.C.

Ibrahim K K, Pillay V S & Sasikumaran S 1985a Path coefficient analysis of some yield components in black pepper (*Piper nigrum* L). Ind. Spices. 22 : 21-25.

Ibrahim K K, Pillay V S & Sasikumaran S 1985b Genotypic and phenotypic correlations among yield and its components in black pepper (*Piper nigrum* L). Agric. Res. J. Kerala 23 : 150-53.

Mathai C K, Kumaran P M & Chandy K C 1981 Evaluation of commercially important chemical constituents in wild black pepper types. Qual Plant. Food Hum. Nutr. 30 : 199-202.

NRCS 1991 Spice Varieties. National Research Centre for Spices, Indian Council of Agricultural Research, Calicut, Kerala.

Pradeepkumar T, Vasanthakumar K, Aipe K C, Kumaran K, Susamma P George, Manomohandas T P & Anith K N 1999 Studies on yielding behaviour of black pepper. Ind. J. Arecanut Spices and Medicinal Plants 1 (3) : 88-90.

Ratnambal M J, Ravindran P N & Nair M K 1985 Variability in black pepper cultivar 'Karimunda'. J. Plantation Crops 13 : 154-57

Ravindran P N, Balakrishnan R & NirmalBabu K 1997 Morphometrical studies on black pepper (*Piper nigrum* L). 1. Cluster analysis of black pepper cultivars. J. Spices and Aromatic Crops 6 (1) : 9-20

Spark 1973 Non hierarchical Eucledian cluster analysis. Applied Statistics 22 (1) : 58.