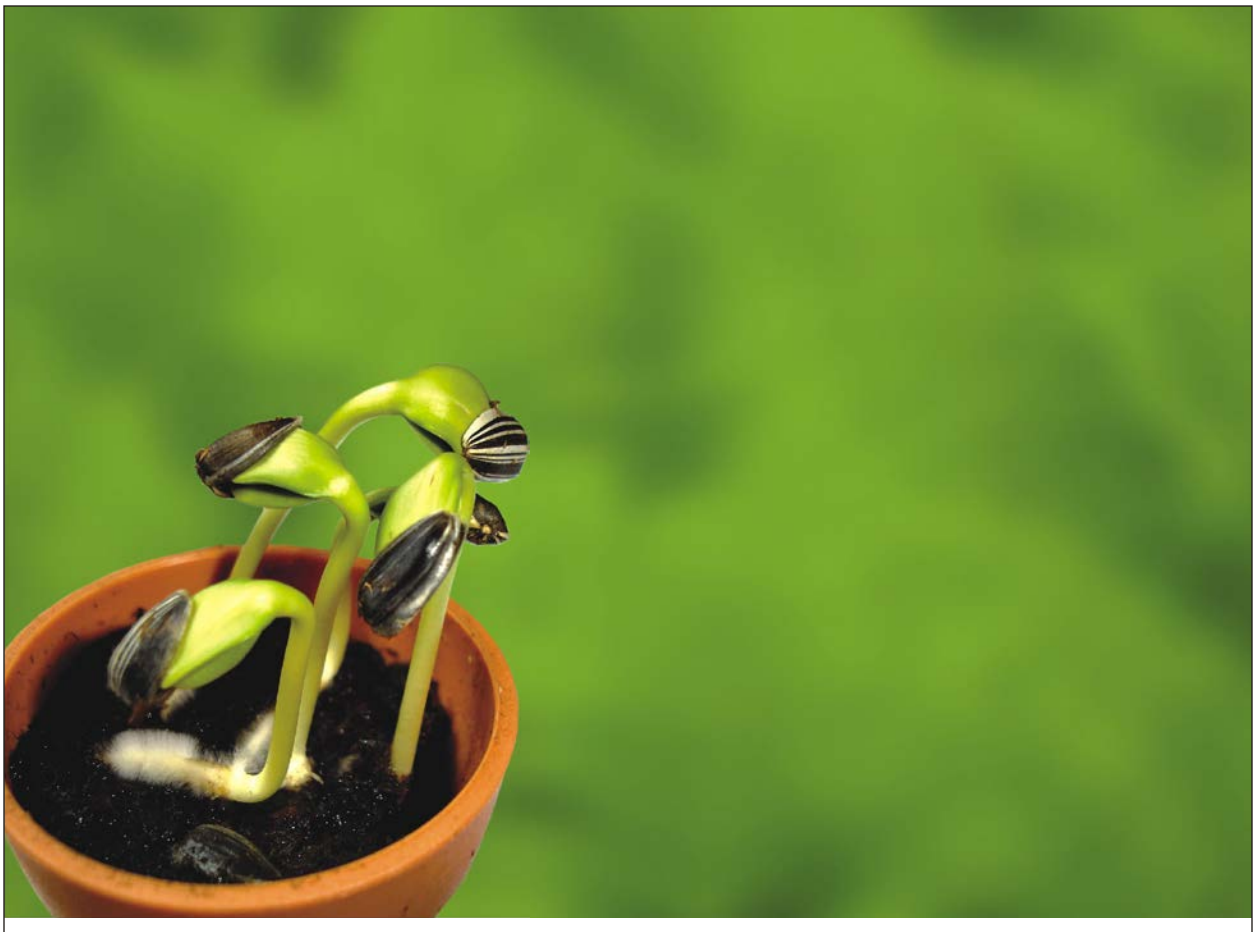

International Journal of Plant Breeding and Genetics

ISSN 1819-3595

Academic Journals Inc.

www.academicjournals.com

International Journal of Plant Breeding and Genetics 4 (4): 293-296, 2010
ISSN 1819-3595 / DOI: 10.3923/ijpbg.2008.47.50

Association of Agronomic Characters in Robusta Coffee (*Coffea canephora* Pierre ex Froehner)*

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Abstract: A study has been taken up in robusta coffee (*Coffea canephora* Pierre ex Froehner) to analyse the association of agronomic characters by factor analysis using 28 characters by principal component analysis. Five factors were obtained and the 28 characters under study could be grouped into five groups. Bush spread, length of primary branches and girth of primary branches were found to be the lead characters in the first group, out turn (fresh to clean coffee) the lead character in the second group, internode length the lead character in the third group, out turn (fresh to dry) the lead character in the fourth group and number of primary branches the lead character in the fifth group. These characters could be used as lead characters in selection and other plant breeding programmes in robusta coffee so that the bulk of variables for analysis could be reduced without compromising the outcome.

Key words: Character association, robusta coffee, *Coffea canephora*

INTRODUCTION

The coffee of commerce is yielded mainly by two species of coffee namely *Coffea arabica* L. (arabica coffee) and *Coffea canephora* Pierre ex Froehner (robusta coffee). Arabica coffee is mostly high grown and robusta grows well under medium elevations. As in the case of other crops, in coffee also most of the agronomic characters are polygenic (Anonymous, 2000). Polygenic characters show different levels of association with each other. The reason is mainly the influence of same sets of alleles on different characters. Grouping characters based on their association with each other is a very effective tool to group the variables, so as to find out the lead variables thus reducing the bulk of characters under study. Presently character association has been analyzed by factor analysis using 28 growth, yield and quality characters of robusta coffee by principal component analysis (Sneath and Sokal, 1973). The major objective of the study was to group the agronomic characters of robusta coffee into different groups and to identify lead variables of each group so that they can be focused upon in future studies on genetic variability and crop improvement of the species.

MATERIALS AND METHODS

The present experiment was carried out in the coffee germplasm maintained at Regional Coffee Research Station, Chundale, Wayanad, Kerala, India during 2002-2006. The experimental field is located at an altitude of 840 m above mean sea level with an annual rainfall of 2000-3000 mm spread over a period of nine months ranging from March to November. Average humidity of the area is 88.9% with average minimum and maximum temperatures between 17.6 and 27.3°C. Soil is generally lateritic

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Originally Published in International Journal of Plant Breeding and Genetics, 2008

Table 1: Accessions of robusta coffee studied for character association

S. No.	Accession No.	Source	S. No.	Accession No.	Source
1	DR.1	India	38	WC.12	India
2	DR.2	India	39	WC.13	India
3	DR.3	India	40	WC.14	India
4	DR.4	India	41	WC.15	India
5	DR.5	India	42	WC.16	India
6	DR.6	India	43	WC.17	India
7	DR.7	India	44	WC.18	India
8	DR.8	India	45	WC.19	India
9	DR.9	India	46	WC.20	India
10	DR.10	India	47	WC.21	India
11	DR.11	India	48	WC.22	India
12	DR.12	India	49	WC.23	India
13	DR.13	India	50	WC.24	India
14	DR.14	India	51	WC.25	India
15	DR.15	India	52	WC.26	India
16	DR.16	India	53	WC.27	India
17	DR.17	India	54	WC.28	India
18	DR.18	India	55	WC.29	India
19	DR.19	India	56	WC.30	India
20	DR.20	India	57	WC.31	India
21	Wt.1	India	58	WC.32	India
22	Wt.2	India	59	WC.33	India
23	Wt.3	India	60	WC.34	India
24	Wt.4	India	61	S.879	Java
25	Wt.5	India	62	S.1932	Madagascar
26	Wt.6	India	63	S.1902	Saigon
27	WC.1	India	64	S.880	Uganda
28	WC.2	India	65	S.1979	Uganda
29	WC.3	India	66	S.3399	Costa rica
30	WC.4	India	67	S.1509	Ivory coast
31	WC.5	India	68	S.1977	Uganda
32	WC.6	India	69	S.1481	Guatemala
33	WC.7	India	70	S.3400	Costa rica
34	WC.8	India	71	S.3655	Ivory coast
35	WC.9	India	72	S.3656	Ivory coast
36	WC.10	India	73	S.3657	Ivory coast
37	WC.11	India	74	S.274	India

to laterites. The soil structure varies from sandy to clayey loams with the soil pH varying from 5.2 to 6.3. Seventy four robusta coffee accessions/genotypes, which include 61 robusta accessions identified from India and 13 exotic robusta accessions introduced by Central Coffee Research Institute, India from different coffee growing countries, planted during 1979-1983 period have been utilized for the present study (Table 1). All the plants studied were stabilized and mature during the period of data collection. The experiment was laid out in randomized block design, with three replications and fifteen plants per plot. The seedlings were planted at a spacing of 3×3 m and maintained uniformly as per the package of practices recommended by Coffee Board, India under rain fed conditions. Observations on 28 characters including 10 growth characters and 18 yield characters were made in 2004-05 when the plants became mature and stable in yield. The data were analysed for character association using the statistical software STATISTICA.

RESULTS AND DISCUSSION

Five factors were obtained by factor analysis and the 28 characters under study could be grouped into five different groups as shown in Table 2 and 3. When analyzed based on relative factor loading, the characters showed that the first group consisted of 8 characters namely bush spread, length of primary branches, girth of primary branches, number of secondaries per primary, stem girth, leaf area,

Table 2: Factor analysis in the case of robusta coffee-factor loadings

Characters	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Stem girth	**0.639807**	0.010860	-0.489978	-0.102137	-0.017221
No. of primary branches	-0.258061	0.339424	-0.249582	0.071041	**0.584578**
No. of secondaries per primary	**0.693735**	0.179370	-0.370573	-0.020532	-0.242038
Girth of primary branches	**0.768921**	0.017594	-0.184672	-0.104438	-0.038807
Length of primary branches	**0.787217**	0.322455	-0.017096	0.095973	0.163332
Internodal length	0.135302	-0.092991	**0.666879**	0.455414	0.298342
Bush spread	**0.789702**	0.387527	-0.033421	0.094140	0.175637
Leaf length	**0.535227**	-0.436830	0.331351	-0.104391	-0.266479
Leaf breadth	0.504894	-0.346099	**0.525249**	0.053210	0.018369
Leaf area	**0.617314**	-0.445298	0.471808	-0.036310	-0.127094
Fruits per node	0.300932	0.102978	0.050531	-0.641511	**0.336301**
Fruit length	-0.272419	-0.525034	-0.119287	**0.247852**	-0.095637
Fruit breadth	-0.310406	-0.234442	-0.255921	-0.028621	**0.000968**
Fruit thickness	-0.329220	-0.320904	-0.324690	**0.095800**	-0.019566
Fruit volume	-0.320853	-0.403248	-0.252134	**0.165224**	-0.033170
Weight of 100 fresh fruits	-0.240434	**0.136114**	0.120254	-0.171444	0.071142
Weight of 100 dry fruits	-0.081938	**0.272386**	-0.025109	0.107783	-0.086876
Bean length	-0.050973	**0.230790**	0.024259	0.040114	-0.152445
Bean breadth	-0.041285	**0.398686**	0.276403	0.062357	-0.058822
Bean thickness	-0.128993	**0.293330**	0.204594	-0.068796	0.076314
Bean volume	-0.085331	**0.325072**	0.175105	0.011692	-0.060867
Bean density	-0.080459	-0.303469	-0.051589	-0.490819	-0.161270
Weight of 100 beans	-0.088490	**0.265992**	0.077842	-0.046643	-0.039405
Yield per plant	**0.181576**	-0.439722	-0.156994	-0.421445	0.137304
Out turn (fresh to dry)	0.322010	0.261043	-0.335086	**0.574606**	-0.345442
Out turn (dry to clean)	-0.302854	0.298986	**0.477259**	-0.332473	-0.199624
Out turn (fresh to clean)	-0.308482	**0.539188**	0.292250	-0.204953	-0.428329
Percentage of A grade beans	0.008672	-0.272944	**0.429739**	0.310582	0.165955
Expl. var	4.635690	2.901932	2.587603	1.828842	1.225318
Prp.Totl	0.165560	0.103640	0.092414	0.065316	0.043761

Table 3: Factor analysis in the case of robusta coffee-factors identified

Factors	Characters
1	Bush spread, length of primary branches, girth of primary branches, number of secondaries per primary, stem girth, leaf area, leaf length, yield per plant
2	Out turn (ripe to clean), bean breadth, bean volume, bean thickness, weight of 100 dry fruits, weight of 100 beans, bean length, weight of 100 fresh fruits
3	Internodal length, leaf breadth, out turn (dry to clean), percentage of A grade beans
4	Out turn (fresh to dry), fruit length, fruit volume, fruit thickness
5	Number of primary branches, fruits per node, fruit breadth

leaf length and yield per plant; the second group consisted of out turn (ripe to clean), bean breadth, bean volume, bean thickness, weight of 100 dry fruits, weight of 100 beans, bean length and weight of 100 fresh fruits; the third group consisted of internodal length, leaf breadth, out turn (dry to clean) and percentage of A grade beans; the fourth group consisted of out turn (fresh to dry), fruit length, fruit volume and fruit thickness and the fifth group consisted of number of primary branches, fruits per node and fruit breadth (Table 2, 3). Bush spread, length of primary branches and girth of primary branches were found to be the lead characters in the first group, out turn (ripe to clean) the lead character in the second group, internodal length the lead character in the third group, out turn (fresh to dry) the lead character in the fourth group and number of primary branches the lead character in the fifth group. Thus the study reveals the association of bush spread, length of primary branches and girth of primary branches with number of secondaries per primary, stem girth, leaf area, leaf length and yield per plant, the association of out turn (ripe to clean) with bean breadth, bean volume, bean thickness, weight of 100 dry fruits, weight of 100 beans, bean length and weight of 100 fresh fruits; the association of internodal length with leaf breadth, out turn (dry to clean) and percentage of A grade beans; the association of out turn (fresh to dry) with fruit length, fruit volume and fruit thickness and

the association of number of primary branches with fruits per node and fruit breadth. This analysis show that bush spread, length of primary branches, girth of primary branches, number of primary branches, internodal length, out turn (ripe to clean) and out turn (fresh to dry) are the lead characters to be considered while planning breeding programmes in robusta coffee so that the bulk of variables for analysis could be reduced.

Factor analysis can be used as an efficient tool to find out character association and to group the variables so as to effect data reduction by identifying the lead variables of each group. This method has been utilized already in crops like rubber (Abraham *et al*., 2002), cardamom (Radhakrishnan *et al*., 2004; Hrideek, 2007), tea (Ramasubramanian, 2005), rice (Mini, 2006) chillies (Hrideek *et al*., 2006) and coconut (Abdul Kadher *et al*., 2007).

The present study has shown that the polygenic agronomic characters of robusta coffee can be grouped in to five different groups based on factor analysis. This shows the association of characters in the species and provides important information on character groups that share common genetic factors. Moreover, the study has shown that bush spread, length of primary branches, girth of primary branches, number of primary branches, internodal length and out turn are the characters that are to be given premium importance while carrying out crop improvement programmes in robusta coffee.

REFERENCES

Abdul Kadher, N., A.V. Prasanth, K.P. Ganesan, R. Umamaheswari and K.V. Mohanan, 2007. A study of germination behaviour of coconut seedlings. Abs. Gregor Mendel Foundation Seminar 2007, 2-3 March, University of Calicut, Kerala, India, pp: 27-27.

Abraham, S.T., A.O.N. Panikkar, P.J. George, R.B. Nair, C.P. Raghu and A. Varghese, 2002. Factor analysis in certain wild genotypes of *Hevea brasiliensis*. Proceedings of the 15th Plantation Crops Symposium, 10-13 December, Mysore, India, pp: 14-19.

Anonymous, 2000. Coffee Guide. Central Coffee Research Institute, Chikmagalur, Karnataka- 577117, India, pp: 193.

Hrideek, T.K., P.P. Menon, K.M. Kuruvilla, K.J. Madhusoodanan and J. Thomas, 2006. Factor analysis in exotic chillies. Indian J. Agric. Res., 40: 277-281.

Hrideek, T.K., 2007. A study of variability, performance and adaptability of some elite land races and hybrids of small cardamom (*Elettaria cardamomum* Maton). Ph.D Thesis, University of Calicut, Kerala, India.

Mini, C.B., 2006. Studies on variability and conservation of some native rices of Kerala. Ph.D Thesis, University of Calicut, Kerala, India.

Radhakrishnan, V.V., Priya P. Menon, K.J. Madhusoodanan, K.M. Kuruvilla and J. Thomas, 2004. Factor analysis in cardamom (*Elettaria cardamomum* Maton). J. Spices Aromatic Crops, 13: 37-39.

Ramasubramanian, B., 2005. Studies on genetic variability, genetic divergence and crop improvement in tea (*Camellia assamica* (Masters) Wight). Ph.D Thesis, University of Calicut, Kerala, India.

Sneath, P.H.A. and R.R. Sokal, 1973. Numerical Taxonomy. 1st Edn. Freeman, San Francisco, USA., pp: 573.