

CHAPTER IV

RESULTS

4.1 Variability Profile

The oil palm germplasm from Senegal and Gambia exhibited low coefficient of variation to high coefficient of variation for the various plant attributes investigated (Table 1). A high variance for fresh fruit bunch (FFB), carotene, leaf number (LN), mesocarp-to-fruit ratio (M/F), shell-to-fruit ratio (S/F) and oil yield (OY) was observed, whereas for the rest of the other traits a low to medium variation was observed.

Table 1: Extent of Variation.

Characters	Coefficient of variation (%)
Yield traits	24.36 - 197.68
Bunch quality traits	0.69 - 85.06
Vegetative traits	0.50 – 107.20
Physiological traits	0.76 - 34.30
Fatty acid composition	0 – 59.09

4.2 Principal Components Analysis (PCA)

In order to determine with which combination type of the various agronomic traits the Senegal and Gambian oil palm germplasm would achieve high yield, PCA was performed. The result of the PCA therein explained the genetic diversity of the oil palm germplasm.

Table 2: Variability profile of Senegal and Gambian oil palm germplasm as analyzed by descriptive statistics

Parameter	N	Minimum	Maximum	Mean	Std. Deviation	Variance
FFB	44	24.36	197.68	84.59	33.40	1115.64
BNO	44	8.82	25.16	18.45	3.40	11.58
ABW	44	2.75	13.26	4.62	2.06	4.23
BWT	44	0.90	13.81	4.12	2.24	5.03
MFW	44	1.93	12.50	3.03	1.95	3.80
MNW	44	1.24	2.50	1.61	0.23	0.05
PB	44	0.00	5.10	0.46	0.81	0.66
MF	44	28.09	85.06	38.02	11.20	125.36
KF	44	6.06	19.15	15.00	2.75	7.56
SF	44	8.88	58.62	46.98	9.27	85.87
ODM	44	61.73	77.77	70.18	3.55	12.58
OWM	44	32.13	49.68	41.16	4.00	15.99
FB	44	47.63	65.63	57.74	3.35	11.23
OB	44	4.58	23.33	9.31	3.57	12.76
KB	44	3.49	11.53	8.65	1.70	2.90
OY	44	0.69	45.76	8.82	8.87	78.71
KY	44	0.94	10.45	6.83	2.13	4.52
TEP	44	1.25	50.05	12.92	9.20	84.62
FP	44	24.00	34.40	31.03	2.34	5.45
PCS	44	8.98	32.85	17.27	4.51	20.36
RL	44	3.20	5.33	3.93	0.38	0.15
LL	44	74.55	107.20	86.27	5.86	34.31
LW	44	3.46	5.16	4.05	0.39	0.15
LN	44	105.00	169.00	125.81	11.68	136.52
HT	44	2.14	3.50	2.81	0.35	0.12
LA	44	3.84	8.49	5.05	0.97	0.94
LAI	44	2.27	5.03	2.99	0.57	0.33
DIAM	44	0.50	0.86	0.68	0.06	0.00
F	44	0.60	0.89	0.70	0.06	0.00
LAR	44	10.09	18.56	13.01	1.65	2.73
BDM	44	0.67	15.81	6.59	2.76	7.63
VDM	44	7.27	19.52	12.26	2.35	5.51
TDM	44	12.26	34.30	18.85	4.17	17.40
BI	44	0.05	0.49	0.34	0.09	0.01
E	44	0.56	1.25	0.87	0.13	0.02
NAR	44	8.13	16.18	12.37	1.63	2.65
C14:0	42	0.21	1.13	0.50	0.15	0.02
C16:0	42	32.21	44.76	39.22	2.33	5.43
C16:1	42	0.07	0.58	0.15	0.10	0.01
C18:0	42	2.20	7.25	5.15	0.81	0.65
C18:1	42	38.63	53.93	44.77	3.05	9.28
C18:2	42	6.43	13.29	9.88	1.25	1.56
C18:3	42	0.10	0.60	0.19	0.09	0.01
C20:0	42	0.00	0.29	0.12	0.07	0.00
IV	42	53.27	59.09	56.26	1.50	2.26
Carotene	42	391.67	2405.88	1650.86	398.73	158987.16

4.2.1 Scores Plot

The score plot explained the percentage variance associated with each principal component obtained by drawing a graph between eigenvalues and principal component numbers. Nine principal components (PCs) exhibited eigenvalue of more than one and accounted for 88% of variability and as a result, these nine PCs were given due importance for further explanation (Figure 3). PC 1 showed 28% of variability with eigenvalue 11.20 in germplasm which then decreased gradually. Elbow line is obtained after which after 4th PC tended to straight. After that, little variance could be observed in each PC and it ended at 9th PC with variability of 3% and eigenvalue of 1.21.

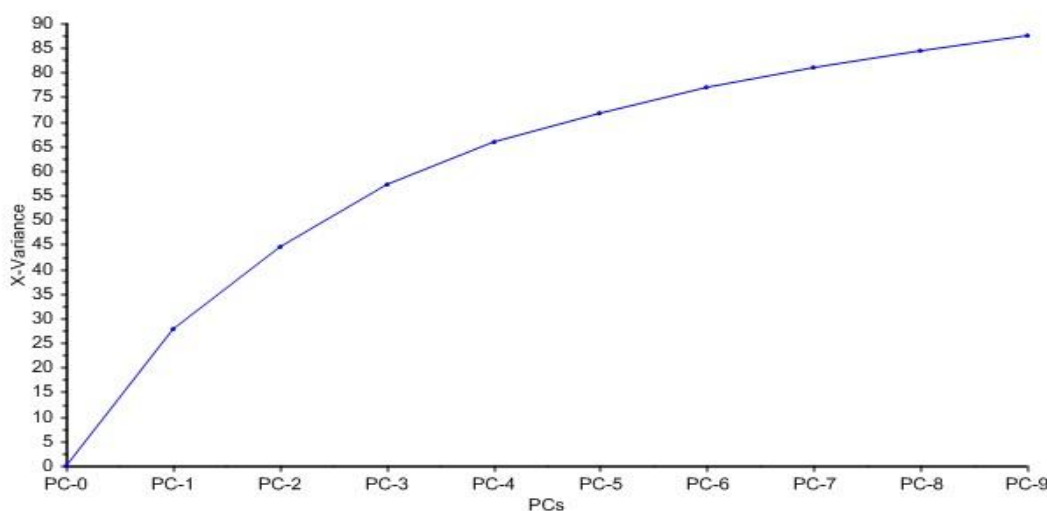


Figure 3: Score plot of principal component analysis between percentage variance and number of principal components

4.2.2 Loadings

The result of the PCA shown in Table 2 indicates the contribution of the various agronomic traits across the extracted PCs.

Table 3: Principal component analysis for Senegal and Gambia oil palm germplasm based on 46 agronomic traits

Traits	Principal Component Axes								
	1	2	3	4	5	6	7	8	9
FFB	-0.89	-0.29	-0.22	-0.09	-0.09	0.04	-0.13	0.13	-0.09
BNO	-0.22	-0.60	-0.65	-0.15	-0.08	-0.05	-0.10	0.14	-0.10
ABW	-0.96	-0.07	0.13	0.00	-0.05	0.10	-0.10	0.08	-0.01
BWT	-0.96	-0.10	0.14	-0.10	0.07	0.05	-0.02	0.03	-0.03
MFW	-0.88	0.03	0.35	0.06	-0.04	0.27	-0.04	-0.04	-0.06
MNW	-0.21	-0.14	-0.01	0.23	-0.26	0.74	-0.02	0.20	0.04
P/B	-0.83	0.06	0.24	-0.15	0.01	0.11	-0.18	-0.19	-0.15
M/F	-0.84	-0.04	0.47	0.03	0.07	0.13	-0.03	-0.15	-0.03
K/F	0.66	-0.06	-0.25	-0.22	-0.14	0.08	-0.32	-0.07	0.49
S/F	0.78	0.07	-0.48	0.03	-0.04	-0.18	0.15	0.20	-0.13
O/DM	-0.39	-0.18	0.51	-0.10	-0.01	-0.55	0.14	-0.09	0.09
O/WM	-0.39	-0.20	0.51	-0.09	0.05	-0.53	0.08	-0.21	0.11
F/B	0.24	-0.27	0.44	0.13	-0.34	0.49	0.01	-0.16	0.19
O/B	-0.75	-0.16	0.56	0.04	0.05	0.12	0.00	-0.20	0.07
K/B	0.65	-0.16	-0.07	-0.13	-0.25	0.26	-0.28	-0.12	0.52
OY	-0.94	-0.14	0.25	-0.05	0.01	0.11	-0.05	-0.04	-0.02
KY	-0.30	-0.61	-0.53	-0.31	-0.07	0.14	-0.17	0.06	0.25
TEP	-0.94	-0.24	0.15	-0.10	0.00	0.13	-0.07	-0.03	0.03
FP	-0.09	-0.64	-0.27	-0.15	0.00	-0.12	0.39	-0.21	0.22
PCS	-0.45	0.78	-0.26	-0.11	-0.11	-0.03	0.07	-0.06	0.12
RL	-0.49	0.74	-0.10	-0.20	0.07	-0.10	-0.11	-0.06	0.05
LL	-0.26	0.43	-0.50	0.17	0.36	-0.08	-0.14	-0.06	0.17
LW	-0.58	0.33	0.12	0.38	-0.38	0.08	-0.08	0.24	-0.13
LN	-0.47	0.51	0.03	-0.26	0.13	-0.06	0.14	-0.20	0.29
HT	0.08	-0.02	-0.26	0.06	-0.31	0.32	0.65	-0.14	-0.22
LA	-0.74	0.60	-0.15	0.17	0.04	0.03	-0.02	-0.01	0.12
LAI	-0.75	0.59	-0.15	0.17	0.04	0.03	-0.02	-0.01	0.12
DIAM	-0.04	0.72	0.07	0.02	-0.52	-0.11	-0.10	-0.08	0.06
F	-0.63	0.67	-0.16	0.15	-0.02	-0.06	-0.03	0.03	0.17
LAR	-0.39	-0.57	0.11	0.31	0.50	0.07	-0.15	0.07	0.19
BDM	-0.88	-0.32	-0.26	-0.16	0.00	0.02	-0.05	0.09	-0.06
VDM	-0.38	0.69	-0.35	-0.12	-0.31	-0.03	0.26	-0.17	0.16
TDM	-0.85	0.18	-0.39	-0.19	-0.18	0.00	0.12	-0.04	0.05
BI	-0.59	-0.68	-0.26	-0.16	0.19	0.03	-0.12	0.15	-0.03
E	-0.69	-0.17	-0.46	-0.40	-0.26	-0.03	0.19	-0.07	-0.04
NAR	-0.25	-0.50	-0.43	-0.55	-0.31	-0.09	0.20	-0.08	-0.11
C14:0	-0.29	-0.49	0.42	0.39	-0.01	-0.17	0.22	0.30	0.06
C16:0	-0.17	-0.30	-0.41	0.76	-0.10	-0.09	0.02	-0.28	0.03
C16:1	-0.09	0.17	-0.55	0.45	0.30	-0.09	-0.04	0.02	-0.12
C18:0	0.30	0.00	0.41	-0.29	-0.30	-0.03	-0.44	-0.25	-0.35
C18:1	0.16	0.43	0.11	-0.73	0.33	0.20	0.05	0.24	-0.04
C18:2	-0.22	-0.44	0.27	0.49	-0.41	-0.28	0.12	0.04	0.25
C18:3	-0.12	0.19	-0.63	0.31	-0.02	-0.06	-0.04	0.22	0.02
C20:0	-0.05	-0.34	-0.29	-0.24	-0.30	-0.33	-0.44	-0.10	-0.04
IV	-0.06	0.16	0.46	-0.50	0.00	-0.06	0.26	0.52	0.29
Carotene	0.06	-0.13	-0.09	-0.12	0.56	0.34	0.19	-0.51	0.01
Eigenvalue	11.20	6.67	5.01	3.47	2.36	2.13	1.65	1.38	1.21
Variance (%)	28	17	13	9	6	5	4	3	3
Cumulative (%)	28	45	58	67	73	78	82	85	88

The most contributing agronomic traits to PC 1 with their corresponding eigenvector in bracket were: FFB (-0.89), ABW (-0.96), BWT (-0.96), MFW (-0.88), P/B (-0.53), M/F (-0.84), S/F (0.78), K/F (0.66), O/B (-0.75), K/B (0.65), OY (0.66), TEP (-0.94), BDM (-0.89), TDM (-0.85), and e (-0.69). On PC 2, the most contributing traits with their corresponding eigenvector in bracket were BNO (-0.60), KY (-0.61), FP (-0.64), PCS (0.78), RL (0.74), LA (0.60), DIAM (0.72).

For PC 3 BNO (-0.65), O/DM (-0.51), O/WM (0.57), O/B (0.56), KY (-0.53), LL (-0.50), C16:1 (-0.55), and C18:3 (-0.63) were the most contributing traits. The most contributing traits to PC 4, are PC 5, PC 6, PC 7, PC 8 and PC 9 with their corresponding eigenvectors in bracket were: NAR (-0.55), C16:0 (0.76), C18:1 (-0.73), IV (-0.50): DIAM (-0.52), carotene (0.56): O/DM (-0.55), O/WM (-0.53): HT (0.65): IV (0.52), carotene (-0.51): and K/B (0.52) respectively.

Figure 4 is a PC loading plot and has two dimensional scatter plots showing the distribution of the various traits in space. It could be observed from the graph that each variable has a loading on the plot. Variables along the vertical axis are the ones with the highest contribution to the PC 1 while those along the horizontal axis are correlated to the PC 2. It is also visible on the graph that some of the variables are superimposed on one another while some of the variables on the other hand are further apart on two opposite ends.

The correlation loadings plot of the various traits in two dimensional axes is shown in Figure 5. The variables on the inner circle indicate 50% variance while those found on the outer circle indicate 100% variance and they exhibit high contribution to PC 1.

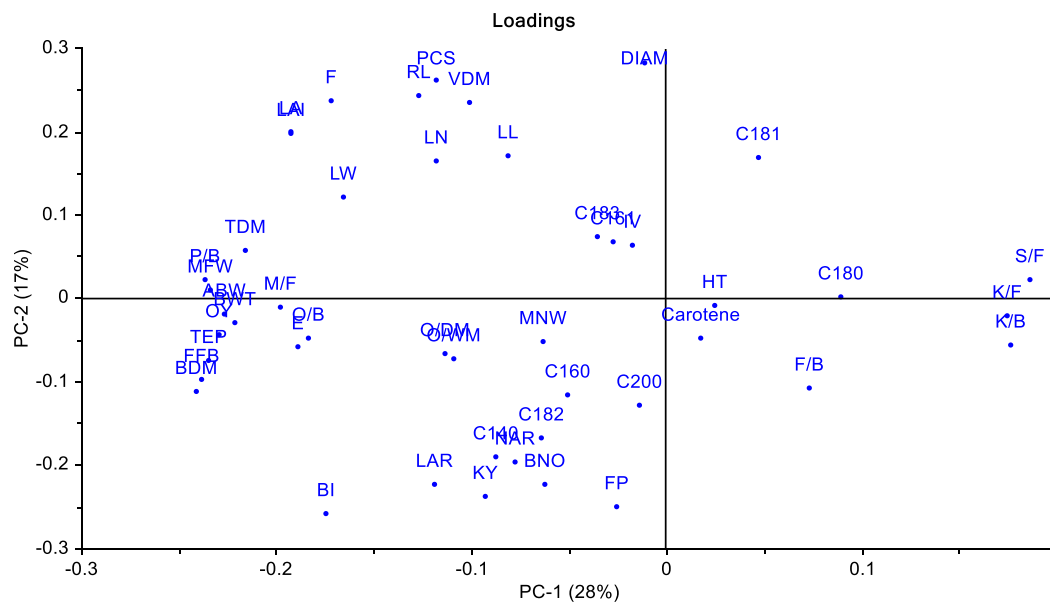


Figure 4: Scattered diagram of 46 oil palm germplasm traits for first two components contributing almost half of the total variability

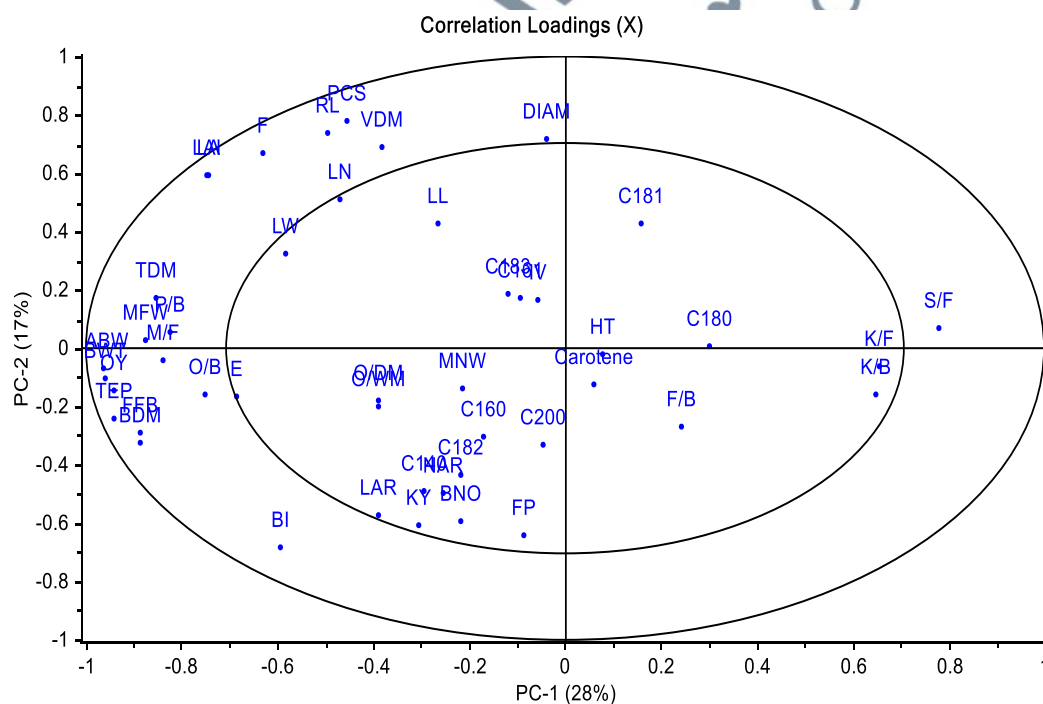


Figure 5: Scattered diagram of 46 oil palm germplasm traits showing correlation to the first two components

4.2.3 Scores

On the basis of the extracted PCs, the Senegal and Gambian oil palm germplasm were given scores (Table 3). Based on the first three PCs, the oil palm germplasm with the highest score on PC 1 was SSC 3 (-16.53). On the same PC, SEN 09.04, SEN 13.07, SEN 02.08 and SEN 01.02 had scores -7.87, 4.83, 4.25 and -3.11 respectively. Lowest score was recorded for SEN 07.03 (-0.03). As seen on PC 2, SEN 01.02 had the highest score (5.96). GAM 05.08, SEN 02.08 and SEN 13.04 had scores of -5.64, 5.04, and 4.57 respectively. PC 3 on the other hand, revealed that highest score was recorded by SEN 01.02 (-8.83) while the least was by SEN 10.05 (-0.02) and SEN 05.02 (-0.02).

The scatter plot as displayed in Figure 6 shows the distribution of the Senegal and Gambian oil palm germplasm on two dimensional plots. As observed from the plot, the oil palm germplasm can be seen in groups. Some of the oil palm accessions are closely packed while some are further apart. Accessions like SSC 3, SEN 09.04, SEN 01.02 and GAM 05.08 are singly without any other accessions close to them. It can also be observed that SSC 3 is the most dispersed accessions out of all the other accessions. Noticeable from the graph as well is the center point of both the vertical and horizontal axes where dense distribution of some of the accessions can be observed. The accessions found at the point are laid on top of one another.

4.2.4 Bi-plot

A PC bi-plot shows the simultaneous distribution of the traits as well as the accessions with the high scores for the traits (Figure 7). On the graph, it can be seen that the

Senegal and Gambian the oil palm accessions are positioned close to the traits that best portray them.

Table 4: Scores of the 42 Senegal-Gambian oil palm germplasm on the extracted PCs

Accessions	Principal Components								
	PC-1	PC-2	PC-3	PC-4	PC-5	PC-6	PC-7	PC-8	PC-9
GAM 05.02	1.29	-0.20	1.23	-1.77	1.03	-0.78	1.67	-2.32	0.97
GAM 05.08	1.79	-5.64	2.19	1.67	2.79	4.07	-1.39	-1.04	1.49
SEN 01.02	-3.11	5.96	-8.83	4.30	1.25	1.33	1.73	1.29	0.23
SEN 01.03	-0.57	0.09	0.49	-0.45	-1.02	0.60	1.53	0.25	-0.44
SEN 02.01	0.12	0.72	-0.75	-0.57	0.45	-0.58	-0.38	-0.29	0.67
SEN 02.04	0.17	0.02	-0.21	-1.44	-1.10	-0.57	0.63	1.56	0.29
SEN 02.05	-0.12	-3.47	-1.48	-1.93	0.10	-0.75	-0.52	-0.28	0.43
SEN 02.06	0.37	-0.63	-2.06	-1.37	-1.41	-0.31	0.22	0.70	0.25
SEN 02.08	4.25	5.04	3.20	-0.54	1.30	1.89	0.73	-0.05	-1.42
SEN 02.09	0.70	-0.73	-1.73	-0.47	0.54	0.40	-0.07	-0.43	-1.10
SEN 03.03	0.43	0.42	-1.36	0.94	0.33	-0.23	-0.60	-0.12	0.29
SEN 03.06	0.44	-0.49	-1.32	3.93	2.82	-1.35	-0.58	-1.80	-0.70
SEN 03.07	2.63	-1.70	0.20	0.93	2.04	1.45	-1.58	-0.51	-0.62
SEN 04.01	1.48	0.73	0.84	0.39	1.12	-1.74	-1.13	0.50	0.76
SEN 04.02	0.94	-1.58	-1.06	1.46	-1.38	-2.47	-0.79	-0.65	-1.03
SEN 04.03	-0.79	-1.66	-1.64	1.17	0.80	-1.44	-1.34	1.54	1.31
SEN 05.01	0.53	-1.27	1.25	0.60	-0.51	-1.27	-2.31	0.78	0.71
SEN 05.02	-0.06	-3.63	-0.02	0.96	-1.71	3.49	0.43	1.13	1.63
SEN 05.03	-0.83	-1.83	-1.79	-0.14	-0.49	-1.28	-0.68	0.65	0.48
SEN 05.04	0.74	-0.33	-0.37	-1.04	2.51	0.72	-0.94	0.37	-0.18
SEN 05.05	1.55	-0.94	-1.79	-0.99	-0.01	2.34	0.37	0.36	-0.38
SEN 05.08	0.61	-2.88	-0.57	-2.47	-0.37	-0.72	0.45	0.59	-2.26
SEN 06.01	0.41	-1.67	-0.71	-1.55	-1.68	-1.54	-0.52	0.23	1.33
SEN 06.08	-0.12	-0.69	0.47	-1.07	0.31	1.80	1.47	0.77	0.08
SEN 07.03	-0.03	-0.68	0.91	-1.62	-0.44	0.01	0.59	0.40	1.08
SEN 07.04	-0.49	-1.73	-1.59	-1.06	-1.38	-0.12	0.51	-1.37	-1.07
SEN 07.05	2.21	-1.77	1.80	3.19	0.00	-1.11	1.15	-1.94	-0.16
SEN 07.08	0.98	-2.15	-1.96	-1.56	-0.24	-0.02	1.59	0.13	-0.80
SEN 08.02	-0.45	-1.92	-2.83	1.13	-1.76	0.57	-1.87	0.19	-1.45
SEN 08.03	2.87	0.33	3.28	0.21	1.68	0.59	1.25	2.74	-1.17
SEN 08.04	2.81	-1.19	2.32	1.94	0.33	-0.82	3.11	0.27	-1.78
SEN 09.04	-7.87	-1.73	3.43	2.45	0.09	-1.23	1.83	2.33	1.08
SEN 10.03	1.21	-0.77	1.51	2.25	-0.69	-1.26	1.01	-0.50	1.26
SEN 10.05	1.13	-2.22	-0.02	-1.48	-1.16	-0.80	0.78	-0.53	-1.23
SEN 12.01	2.07	2.37	0.61	-0.19	-0.63	-0.91	0.03	-0.60	0.59
SEN 12.02	2.42	4.12	-0.27	-3.60	3.02	-1.15	-2.41	1.38	-1.04
SEN 12.03	0.92	3.50	0.38	0.44	1.31	-1.83	1.00	-2.07	1.28
SEN 12.05	2.77	3.90	1.24	-2.21	-0.40	0.30	-0.09	0.22	2.56
SEN 13.01	2.45	2.12	-2.19	-0.95	-3.10	2.52	-0.12	-2.35	0.44
SEN 13.04	1.30	4.57	0.52	-1.31	-0.79	0.21	0.87	-0.14	0.99
SEN 13.07	4.83	4.23	3.91	4.31	-4.40	0.65	-2.49	0.92	-1.09
SSC 3	-16.53	3.01	3.46	-1.12	-0.23	1.23	-1.32	-1.60	-1.22

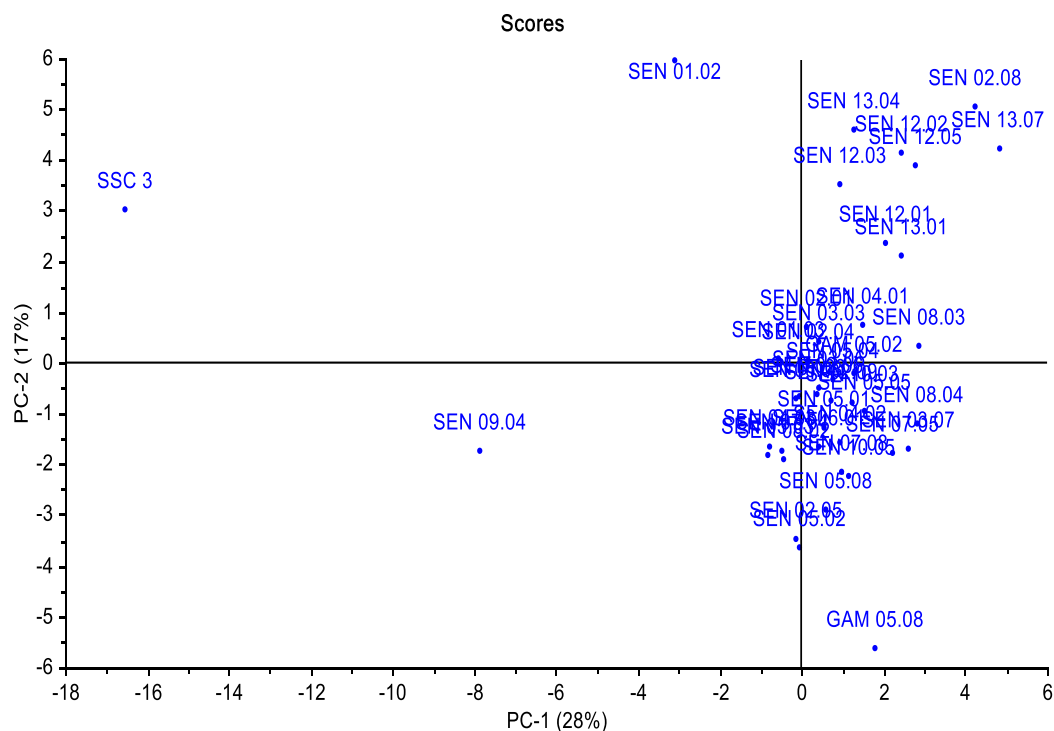


Figure 6: Two dimensional ordinations of 42 Senegal-Gambian oil palm accessions on principal axes 1 and 2

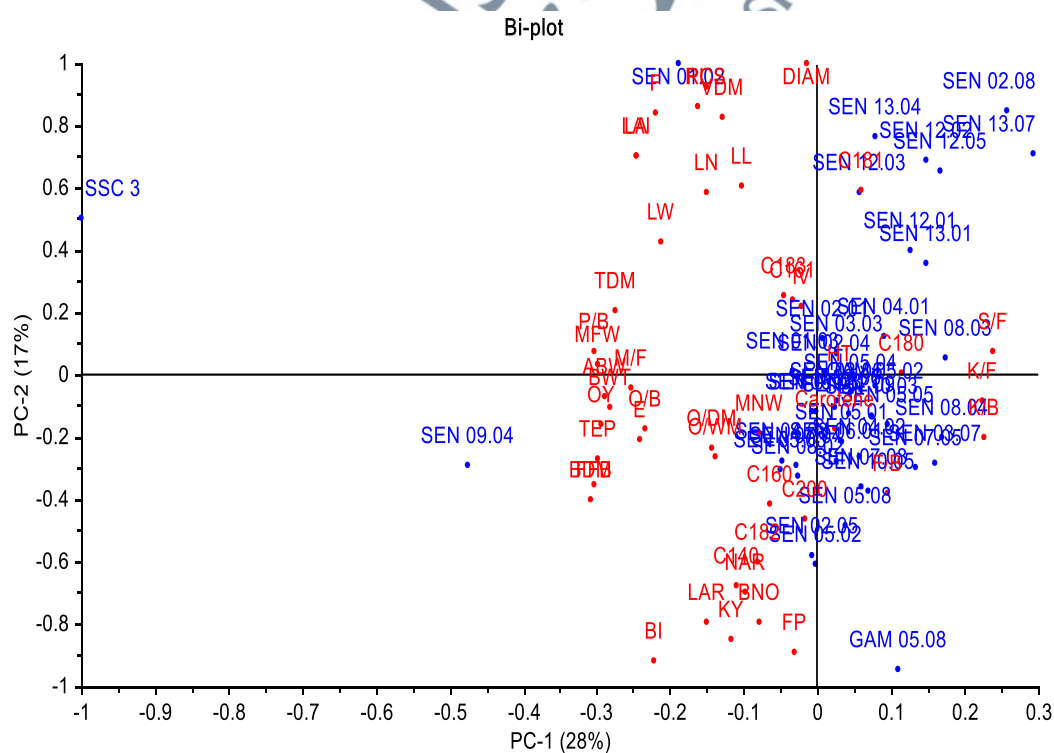


Figure 7: Bi-plot of 46 oil palm agronomic traits and 42 oil palm accessions on PC 1 and PC 2

4.3 Cluster Analysis

The dendrogram generated through Ward's hierarchical method divided the Senegal-Gambian accessions into six clusters (Figure 8). Cluster-I, cluster-II and cluster-III comprised of only one accession each which include SEN 01.02, SEN 09.04 and SSC 3 respectively. Cluster-IV had eight accessions which comprised of SEN 02.08, SEN 12.01, SEN 12.02, SEN 12.03, SEN 12.05, SEN 13.01, SEN 13.04, and SEN 13.07. Cluster-V had six accessions which consisted of GAM 05.08, SEN 05.02, SEN 07.05, SEN 08.03, SEN 08.04, and SEN 10.03. Cluster-VI was the largest group and consisted of GAM 05.02, SEN 01.03, SEN 02.01, SEN 02.04, SEN 02.05, SEN 02.06, SEN 02.09, SEN 03.03, SEN 03.06, SEN 03.07, SEN 04.01, SEN 04.02, SEN 04.03, SEN 05.01, SEN 05.03, SEN 05.04, SEN 05.05, SEN 05.08, SEN 06.01, SEN 06.08, SEN 07.03, SEN 07.04, SEN 07.08, SEN 08.02, and SEN 10.05.

Means of the agronomic traits that characterize individual clusters are presented in Table 4. The germplasm grouped in cluster-I was reflected by high fresh fruit bunch, highest mean values for bunch number, nut weight, shell to fruit ratio, petiole cross section, frond length, height, vegetative dry mass, palmitic acid, palmitoleic acid, and linoleic acid.

Cluster-II had the second highest mean value of fresh fruit bunch, bunch weight, mean fruit weight, mesocarp-to-fruit ratio, oil to dry mass, oil to wet mass, oil to bunch ratio, oil yield, total economic product, bunch dry mass and bunch index. This cluster also recorded highest mean value for frond production and leaf area ration while it had lowest height value and carotene content.

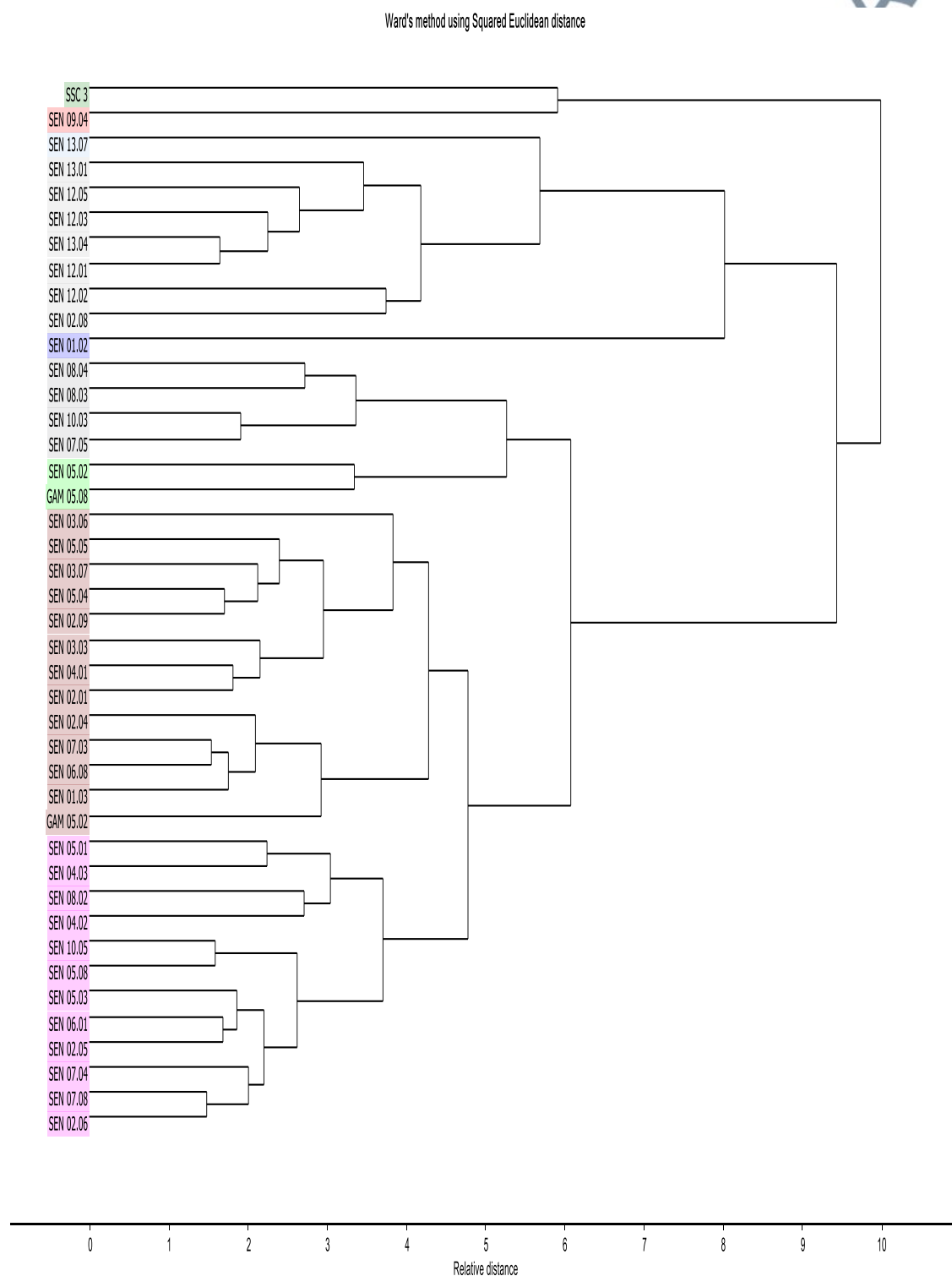


Figure 8: The relationship among the oil palm germplasm accessions reflected by cluster analysis

Cluster-III was noted for having the highest mean value for most of the yield traits as well as morpho-physiological traits. This cluster had highest mean value of FFB, BWT, MFW, P/B, M/F, O/DM, O/WM, O/B, OY, TEP, LW, LA, LAI, f , BDM, TDM, BI, e , NAR and moderate values for fatty acid traits.

Cluster-IV was characterized by lowest mean values for most of the yield traits and highest mean value of kernel to fruit ratio and trunk diameter. Also noted in this cluster was high shell to fruit ratio, petiole cross section, leaflet number and moderate leaflet length.

Cluster-V had moderate to high values of most traits under study. The accessions in therein also had highest mean value of fruit to bunch ratio and carotene content.

Cluster-VI had medium to high values for most traits under study. They however had, highest mean value for kernel yield and arichidic acid and high carotene content.

Table 5: Characteristics means of six clusters generated by Ward's cluster analysis based on 46 agronomic traits

	Cluster-I	Cluster--II	Cluster-III	Cluster-IV	Cluster-V	Cluster-VI
FFB	106.04	141.68	197.68	49.15	62.51	88.51
BNO	21.00	18.88	15.86	14.22	16.33	20.19
ABW	5.05	8.83	12.55	3.37	3.88	4.36
BWT	3.93	8.49	12.57	2.63	3.41	3.88
MFW	2.65	6.97	12.50	2.31	3.11	2.51
MNW	1.91	1.65	1.89	1.53	1.79	1.58
P/B	0.00	0.55	5.10	0.10	0.24	0.37
M/F	28.09	57.40	84.31	33.80	38.67	35.12
K/F	13.29	9.03	6.41	16.70	14.96	15.54
S/F	58.62	33.58	9.28	49.50	46.37	49.34
O/DM	61.73	75.15	77.37	68.49	70.43	70.33
O/WM	32.13	46.11	49.68	39.58	41.66	41.42
F/B	50.76	57.35	55.60	58.20	60.22	57.33
O/B	4.58	15.50	23.12	7.79	10.21	8.51
K/B	6.78	5.29	3.62	9.63	9.02	8.89
OY	4.86	27.17	45.76	3.36	7.12	7.57
KY	7.19	5.67	7.16	4.28	6.03	7.79
TEP	9.17	30.57	50.05	5.93	10.73	12.25
FP	30.00	33.50	28.14	28.80	31.76	31.74
PCS	29.52	17.88	27.53	20.13	12.87	16.01
RL	4.45	3.94	5.00	4.13	3.47	3.85
LL	107.20	88.54	88.86	86.60	80.08	86.44
LW	4.57	4.98	5.16	4.10	3.91	3.93
LN	136.00	125.50	158.07	130.73	121.34	122.35
HT	3.39	2.60	2.58	2.77	3.01	2.81
LA	7.59	6.40	8.28	5.24	4.36	4.74
LAI	4.49	3.79	4.90	3.10	2.58	2.81
DIAM	0.70	0.69	0.74	0.76	0.61	0.66
F	0.86	0.78	0.88	0.72	0.65	0.68
LAR	12.36	17.03	14.60	11.12	14.17	13.06
BDM	8.32	11.11	15.81	3.46	4.95	6.96
VDM	18.43	12.77	16.15	13.74	10.00	11.74
TDM	26.75	23.89	31.96	17.20	14.95	18.70
BI	0.31	0.45	0.49	0.19	0.32	0.37
E	1.00	0.96	1.18	0.77	0.74	0.89
NAR	11.46	11.76	12.88	10.81	11.25	13.15
C140	0.30	1.13	0.52	0.36	0.65	0.49
C160	44.76	39.74	38.69	37.18	40.27	39.40
C161	0.53	0.10	0.13	0.12	0.12	0.16
C180	2.20	4.03	5.32	5.70	4.89	5.20
C181	43.45	41.52	45.07	47.42	42.85	44.56
C182	8.16	13.29	9.94	8.93	10.91	9.86
C183	0.60	0.10	0.18	0.17	0.18	0.19
C200	0.00	0.07	0.12	0.10	0.08	0.14
IV	53.58	59.09	56.58	56.82	56.34	56.05
Carotene	1575.49	1421.42	1607.71	1624.35	1793.83	1638.94

Figures in bold are maximum values

4.3.1 Genetic Distance

The genetic distance of all the oil palm germplasm as analyzed by the proximity matrix of squared Euclidean distance (see Appendix 1), revealed that the largest genetic distance was between SEN 13.07 and SSC 3 (520.302) followed by SEN 02.08 and SSC 3 (454.034). The least distance was found between SEN 02.06 and SEN 07.08 (10.366). The inter cluster distance as shown in Table 5 also revealed that the largest genetic distance was between cluster-III and cluster-V (158.629) while the least was between cluster-V and cluster-VI.

Table 6: Inter cluster distance as analyzed by proximity matrix of squared Euclidean distance

Case	Squared Euclidean Distance					
	1: Cluster-I	2: Cluster-II	3: Cluster-III	4: Cluster-IV	5: Cluster-V	6: Cluster-VI
1: Cluster-I	0.000	118.586	149.386	99.442	107.001	86.122
2: Cluster-II	118.586	0.000	74.408	91.789	63.147	56.828
3: Cluster-III	149.386	74.408	0.000	151.442	158.627	126.870
4: Cluster-IV	99.442	91.789	151.442	0.000	38.770	36.825
5: Cluster-V	107.001	63.147	158.627	38.770	0.000	20.757
6: Cluster-VI	86.122	56.828	126.870	36.825	20.757	0.000