

Grain Morphology of Wild Rice in African Countries (VIII)

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Received for Publication September 1, 1997

Introduction

On the distribution of wild rice in Africa, some few scientific reports have been published^{1,2,4,5,33-37}. Although Africa has been considered to be one of the most important distribution areas of the wild rice in the world, accumulation of complete data on these aspects is far from being perfect. Taking these facts into account, the present study-series were made to ascertain exactly the distribution, and the geographical, seasonal and ecotypic differentiations of wild rice in African areas.

Recently, wild *Oryza* species have frequently been studied from several agronomic viewpoints. For example, Yuan *et al.* (1992)³⁸ reported wild rice close to the *japonica* type of *O. sativa*. Farooq *et al.* (1992)³ reported about the variability in salt tolerance of accession of wild rice species, *Oryza punctata* and *O. officinalis*. Reimers *et al.* (1993)³² studied wild species of *Oryza* in the resistance to rice blast (B1). Plant regeneration efficiency from anther culture of F₁ cross Pankaj x *O. rufipogon* has been improved for the purpose of enhancing submergence tolerance³¹. These wild rices mentioned above may be used in the wider ranges of agronomy. These are the reasons why wild rice should be studied in the global viewpoints.

The writer made research trips in 8 countries of Africa. In the previous papers, the preliminary and advanced data have been published as the results of the first and the second survey trips made in 1984 and 1985⁸⁻¹⁴, respectively. In the following papers, the results obtained in the third survey trip made in 1988 were reported¹⁶⁻¹⁸. Further, in the previous papers, else than these, habitat and the records of the morphological characters of the unhusked grains¹⁹, the husked grains²², the comparative data (= husked/unhusked)²⁴, and the grain areas and volumes²⁵, and correlation coefficients between the practical values of the unhusked and husked grains and the linear regression between these^{26,28,29} of the wild rices collected in 1984, 1985 and 1988 were described, with the confirmation of the morphological characters of grains, which were to make the strain's specificities more obvious.

In the present paper, mutual relationships fixed in the view of the practical values, standard deviations and variation ranges were mainly described as the final report of the present experimental series, in order to confirm the morphological characters of grains as well as to make clear the geographical, species and ecotypic differentiations of the grains belonging the genus *Oryza*.

Materials and Methods

To make clear the relationships between practical values, standard deviations and variation ranges in the strain level, 6 relations were calculated, *i.e.*, practical value and other

practical value, standard deviations and other standard deviations, variation range and other variation range (left halves of Tables 1 to 32), practical value and its standard deviation, practical value and its variation range, standard deviation and its variation range (right halves of Tables 1 to 32). In these tables, correlation coefficients were shown, and linear regression were calculated but omitted. Finally, comparisons of the relation-groups were made, using mainly the data shown in Tables 1 to 32.

190 strains of *Oryza longistaminata* CHEV. et ROEHR., 49 strains of *Oryza breviligulata* CHEV. et ROEHR., 44 strains of *Oryza punctata* KOTSCHY and 1 strain of *Oryza brachyantha* CHEV. et ROEHR., were used to make the morphological investigations.

Thirty grains were used for the measurements of each strain. In the present paper, the following abbreviations were used, *i.e.*, L (length), W (width), T (thickness), L/W (ratio of length to width), L/T (ratio of length to thickness), W/T (ratio of width to thickness), s.d. (standard deviations), c.c. (correlation coefficient), l.r. (linear regression), d.f. (degree of freedom), UHG (unhusked grain), HG (husked grain), CV (comparative value), CM (comparison), AV (area and volume).

Results and Discussion

The results were given in Tables 1 to 32, *i.e.*, *O. longistaminata* in Tables 1 to 15 --- Table 1 (corresponded to the group 1 in the previous papers^{22,24,25,26,28,29}): strains in Madagascar (abbreviated as MD in the table) collected in 1985 (strain Nos.301-313, 13 strains); Table 2 (2): the same, collected in 1988 (Nos.2001-2047, 47 strains); Table 3 (3): the same, collected in the both years (60 strains); Table 4 (5): Tanzania (TA) collected in 1988 (Nos.2048-2083, 36 strains); Table 5 (6): the same, collected in 1984 (No.314, 1 strain) and 1988 (36 strains); Table 6 (7): Kenya (KE) collected in 1985 (Nos.315-324, 10 strains); Table 7 (8): Nigeria (NI) collected in 1984 (Nos.325-336, 5 strains); Table 8 (9): the same, collected in 1985 (Nos.337-382, 29 strains); Table 9 (10): the same, collected in the both years (34 strains); Table 10 (11): Ivory Coast (IV) collected in 1984 (Nos.384-390, 7 strains); Table 11 (12): Senegal (SE) collected in 1985 in Casamance region (Nos.391-441, 35 strains); Table 12 (13): the same, collected in 1985 in northern region (Nos.444-455, 7 strains); Table 13 (14): the same, in both the regions (42 strains); Table 14 (15): the summed-up data of strains (SUM) collected in 1984 and 1985 in the whole countries (107 strains); Table 15 (16): the summed-up data of strains collected in 1984, 1985 and 1988 in the whole countries (190 strains); *O. breviligulata* in Tables 16 to 22 --- Table 16 (17): Nigeria (NI) collected in 1984 (strain Nos.328-334, 7 strains); Table 17 (18): the same, collected in 1985 (Nos.344-380, 17 strains); Table 18 (19): the same, collected in the both years (24 strains); Table 19 (21): Senegal (SE) collected in 1985 in Casamance region (Nos.398-442, 17 strains); Table 20 (22): the same, collected in 1985 in northern region (Nos.443-456, 7 strains); Table 21 (23): the same, in both the regions (24 strains); Table 22 (24): the summed-up data of strains (SUM) collected in 1984 and 1985 in the three countries (49 strains); *O. punctata* in Tables 23 to 30 --- Table 23 (25): Tanzania (TA) collected in 1984 (strain Nos.457-459, 3 strains); Table 24 (26): the same, collected in 1988 (Nos.2084-2109, 26 strains); Table 25 (27): the same, collected in both the years (29 strains); Table 26 (28): Kenya (KE) collected in 1984 (Nos.460-464, 5 strains); Table 27 (29): the same, collected in 1985 (Nos.465-474, 10 strains); Table 28 (30): the same, collected in both the years (15 strains); Table 29 (31): the summed-up data of strains (SUM) collected in 1984 and 1985 in

Table 1. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Madagascar, *O. longistaminata*, 301-313 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.9010***	0.7441**	0.8440***	1	-0.3092	-0.4328	0.9358***
1·3	0.7124**	0.3297	0.7169**	2	-0.6433*	-0.7082**	0.9608***
2·3	0.7793**	0.3560	0.6565*	3	-0.1267	-0.1286	0.8717***
4·5	0.6232*	0.5054	0.7966**	4	-0.0984	0.2229	0.9803***
4·6	-0.0188	0.6664*	0.8486***	5	0.0689	-0.1570	0.9031***
5·6	0.7691**	0.7707**	0.9005***	6	-0.2099	-0.2528	0.8888***
11·12	0.8649***	0.8286***	0.9185***	11	-0.4188	-0.5336	0.9760***
11·13	0.6719*	0.7041**	0.8734***	12	-0.5269	-0.5239	0.9825***
12·13	0.8205***	0.5443	0.7533**	13	-0.1215	-0.1748	0.9518***
14·15	0.5766*	0.8357***	0.9264***	14	0.0740	0.0673	0.9039***
14·16	-0.0917	0.8971***	0.9105***	15	0.2443	0.1205	0.9621***
15·16	0.7600**	0.6166*	0.8346***	16	-0.1189	-0.0731	0.9562***
21·22	0.7501**	0.8792***	0.9523***	21	-0.3831	-0.3722	0.9780***
21·23	0.3577	0.7945**	0.8931***	22	-0.4819	-0.3685	0.9813***
22·23	0.6837**	0.8586***	0.9534***	23	-0.5843*	-0.6250*	0.9237***
24·25	0.6793*	0.8303***	0.9375***	24	0.4402	0.3018	0.9888***
24·26	0.0091	0.7182**	0.8793***	25	0.2142	0.4015	0.9052***
25·26	0.7006**	0.8449***	0.9543***	26	-0.0417	0.1718	0.9396***
1·11	0.9266***	0.9444***	0.9779***	31	-0.3738	-0.3870	0.8472***
2·12	0.8896***	0.8175***	0.8723***	32	-0.0949	-0.2972	0.9395***
3·13	0.9693***	0.4260	0.8146***	33	-0.2246	-0.3302	0.9805***
4·14	0.7972**	0.8931***	0.6891**	34	0.0446	-0.0377	0.9780***
5·15	0.8172***	0.8008**	0.9514***	35	-0.4685	-0.4209	0.9928***
6·16	0.8208***	0.7497**	0.8826***	36	-0.4416	-0.3853	0.9910***
31·33	0.9104***	0.7403**	0.8014***				
32·34	0.9257***	0.7867**	0.7775**				
35·36	0.9605***	0.9248***	0.9547***				

Character numbers; 1, 11, 21-length, 2, 12, 22-width, 3, 13, 23-thickness, 4, 14, 24-L/W, 5, 15, 25-L/T, 6, 16, 26-W/T, 1~6-unhusked grains, 11~16-husked grains, 21~26-comparative values (=husked/unhusked), 31-area (UHG), 32-volume (UHG), 33-area (HG), 34-volume (HG), 35-quotient of area (=33/31), 36-quotient of volume (=34/32)

d.f.; 11

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

the two countries (18 strains); Table 30 (32): the summed-up data of the strains collected in 1984, 1985 and 1988 in the two countries (44 strains). Groups 4 (TA, *O. longistaminata* collected in 1984), 20 (IV, *O. breviligulata* collected in 1984) and 33 (SE, *O. brachyantha* collected in 1985) were omitted in these tables owing to being the only 1 strain each, as shown in the footnotes of Tables 11 of the previous papers^{22,24,25,26,28,29}.

Some strains have conceived different meanings in view of physiological, meteorological and phylogenetical characters, and those should be separately considered in morphological

Table 2. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Madagascar, *O. longistaminata*, 2001–2047 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.6442***	0.3736**	0.1516	1	-0.1497	-0.1013	0.9131***
1·3	0.6045***	0.1520	0.0766	2	0.1613	0.3286*	0.3495*
2·3	0.7535***	0.0559	0.1159	3	0.3286*	0.2530	0.8699***
4·5	0.5503***	0.1663	0.2330	4	-0.0919	0.0953	0.8324***
4·6	-0.5386***	0.0833	0.1082	5	0.3845**	0.4001**	0.8578***
5·6	0.4021**	0.4093**	0.6527***	6	0.2112	0.4797***	0.6316***
11·12	0.7134***	0.0603	0.0599	11	0.1597	0.2505	0.9172***
11·13	0.8224***	0.1743	0.1537	12	0.1881	0.2416	0.8273***
12·13	0.8059***	0.1380	0.1952	13	0.4613**	0.3320*	0.8600***
14·15	0.5482***	0.0423	0.1945	14	0.2091	0.1716	0.8491***
14·16	-0.6998***	0.1864	0.0449	15	0.2911*	0.2482	0.9068***
15·16	0.2094	0.3191*	0.3235*	16	0.4728***	0.3477*	0.9142***
21·22	0.0892	0.0632	-0.0998	21	0.1773	0.2335	0.7917***
21·23	-0.1214	-0.0316	0.1466	22	0.0673	-0.1109	0.7366***
22·23	0.2024	-0.2211	-0.2983*	23	-0.3748**	-0.4230**	0.7762***
24·25	0.3588*	0.0343	0.2305	24	0.2627	0.2402	0.8050***
24·26	-0.4972***	0.4662***	0.1826	25	0.4107**	0.3479*	0.8715***
25·26	0.3532*	0.1288	0.1035	26	0.2405	-0.0139	0.7208***
1·11	0.8769***	0.1723	0.0634	31	0.0590	0.3813**	0.8171***
2·12	0.9355***	0.0634	0.3147*	32	0.6374***	0.5731***	0.9295***
3·13	0.9358***	0.5163***	0.3837**	33	0.5359***	0.4566**	0.6419***
4·14	0.7571***	0.1347	0.0982	34	0.7463***	0.6407***	0.9363***
5·15	0.6704***	0.2422	0.0879	35	-0.1247	-0.1719	0.8354***
6·16	0.8070***	0.2117	0.2116	36	-0.0801	-0.0755	0.7424***
31·33	0.9487***	0.2527	0.2937*				
32·34	0.9675***	0.6421***	0.5386***				
35·36	0.5837***	0.7674***	0.7246***				

Character numbers are the same as mentioned in Table 1.

d.f.; 45

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

studies as well. Accordingly, those were divided into the two groups, and thereafter were summed-up in the respective countries and groups, in view of the subsequent analyses. Table 31, group No.34 in the previous papers: East Africa of *O. longistaminata*; 107 strains in the total, i.e., Madagascar (1 [13 strains] and 2 [47 strains]), Tanzania (4 [1 strain] and 5 [36 strains]) and Kenya (7 [10 strains]); Table 32, group No.35 in the previous papers: West Africa of *O. longistaminata*, 83 strains in the total, i.e., Nigeria (8 [5 strains] and 9 [29 strains]), Ivory Coast (11 [7 strains]), Senegal (12 [35 strains] and 13 [7 strains]).

1. Relationships between the practical values of the two respective characters

(1) *O. longistaminata*

Table 3. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Madagascar, *O. longistaminata*, 301-313 in 1985 and 2001-2047 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.6943***	0.6083***	0.6709***	1	-0.3762**	-0.0022	0.9378***
1·3	0.6620***	0.4717***	0.5432***	2	-0.0585	-0.1005	0.6614***
2·3	0.7637***	0.3919**	0.5912***	3	0.0197	-0.0433	0.9184***
4·5	0.5692***	0.5182***	0.6445***	4	-0.0121	-0.1768	0.9372***
4·6	-0.4809***	0.4132**	0.6285***	5	0.1560	0.0954	0.9099***
5·6	0.4420***	0.5856***	0.8261***	6	0.1800	0.3007*	0.7338***
11·12	0.7347***	0.6014***	0.5867***	11	-0.2772*	-0.2567*	0.9560***
11·13	0.7897***	0.5835***	0.6284***	12	-0.1482	-0.0708	0.9371***
12·13	0.7975***	0.5770***	0.6626***	13	-0.0259	-0.1252	0.9391***
14·15	0.5290***	0.6008***	0.6226***	14	-0.0620	-0.1098	0.9384***
14·16	-0.6116***	0.6267***	0.6135***	15	0.1407	0.0800	0.9545***
15·16	0.3426**	0.6758***	0.7174***	16	0.4721***	0.3963**	0.9622***
21·22	0.2566*	0.7699***	0.7270***	21	0.0034	0.0272	0.9437***
21·23	-0.1052	0.6458***	0.7172***	22	-0.0398	-0.0303	0.8805***
22·23	0.3248*	0.6573***	0.6458***	23	-0.4984***	-0.5237***	0.8983***
24·25	0.3597**	0.6695***	0.7334***	24	0.1234	0.1093	0.9503***
24·26	-0.4437***	0.7800***	0.7667***	25	0.3680**	0.3886**	0.9219***
25·26	0.4483***	0.7163***	0.7179***	26	0.3406**	0.3085*	0.9285***
1·11	0.7243***	0.5971***	0.5985***	31	-0.0512	-0.0280	0.9061***
2·12	0.9181***	0.4977***	0.6590***	32	0.2075	0.0943	0.9518***
3·13	0.9346***	0.6897***	0.7221***	33	0.1244	-0.0611	0.7323***
4·14	0.7669***	0.6714***	0.6620***	34	0.2941*	0.1503	0.9527***
5·15	0.6989***	0.6120***	0.5915***	35	-0.1642	-0.1533	0.9586***
6·16	0.7847***	0.5002***	0.6776***	36	-0.1775	-0.1346	0.9402***
31·33	0.9391***	0.5658***	0.7096***				
32·34	0.9536***	0.7445***	0.7236***				
35·36	0.7003***	0.9284***	0.9267***				

Character numbers are the same as mentioned in Table 1.

d.f.; 58

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

Correlation coefficient (abbreviated as c.c.) and linear regression (l.r.) of the practical value on another practical value among 27 character-combinations were calculated, and c.c. were shown in the leftmost columns of the Tables 1 to 15, 31 and 32. In the strains collected in Madagascar (MD) in 1985 (group No.1), 11, 8, 4 and 4 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 1). For example, c.c. of length (UHG) on width (UHG) through the whole strains (=13) was +0.9010 to the degree of freedom of 11, which was obviously significant at 0.1% level. Generally speaking, the longer was the length (UHG), the wider was the width (UHG). In those collected in 1988 (2), 20, 1, 2 and 4 combinations showed significances at 0.1%, 1% and 5% levels and no

Table 4. Correlation coefficient of the former character (Y) on the latter character (X) for 47 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Tanzania, *O. longistaminata*, 2048-2083 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.4240**	0.4537**	0.4401**	1	0.4424**	0.3749*	0.9408***
1·3	0.4895**	0.1028	0.0253	2	0.5895***	0.5834***	0.9699***
2·3	0.7567***	0.4135*	0.3106	3	0.3677*	0.2236	0.9155***
4·5	0.6777***	0.0853	0.1768	4	0.0591	-0.0634	0.8957***
4·6	-0.7132***	0.2553	0.3098	5	0.1096	-0.0927	0.9115***
5·6	0.0278	0.5539***	0.5361***	6	0.4408**	0.4680**	0.9171***
11·12	0.1104	0.4020*	0.3746*	11	-0.0936	-0.0082	0.8630***
11·13	0.5695***	0.2480	0.0362	12	0.5064**	0.5370***	0.9544***
12·13	0.4830**	0.6082***	0.4938**	13	0.0499	0.0568	0.9128***
14·15	0.6546***	0.3637*	0.3407*	14	-0.0457	-0.1449	0.8138***
14·16	-0.7341***	0.3093	0.4836**	15	0.1999	0.1449	0.8786***
15·16	0.0235	0.1207	0.4586**	16	0.3741*	0.5013**	0.7627***
21·22	0.4644**	0.2438	0.1937	21	-0.3416*	-0.3711*	0.9175***
21·23	0.6012***	0.2587	0.3730*	22	-0.4597**	-0.5222**	0.8349***
22·23	0.5700***	0.0495	0.2473	23	-0.6482***	-0.6751***	0.8912***
24·25	0.7162***	0.4214*	0.5218**	24	0.0152	0.0790	0.9250***
24·26	-0.5557***	0.3195	0.1407	25	0.0001	-0.1027	0.9003***
25·26	0.1629	0.3977*	0.2671	26	0.1870	0.2447	0.8349***
1·11	0.6411***	0.6192***	0.6249***	31	0.6439***	0.3631*	0.9694***
2·12	0.8897***	0.7623***	0.6872***	32	0.7521***	0.7716***	0.9854***
3·13	0.8391***	0.5366***	0.6161***	33	0.3734*	0.4907**	0.9191***
4·14	0.8423***	0.5646***	0.4286**	34	0.5847***	0.6040***	0.9695***
5·15	0.6760***	0.3349*	0.3215	35	-0.1422	-0.2201	0.8087***
6·16	0.8650***	0.5941***	0.7319***	36	-0.2693	-0.1430	0.8159***
31·33	0.7779***	0.7958***	0.8109***				
32·34	0.8115***	0.8796***	0.8573***				
35·36	0.9731***	0.6993***	0.7460***				

Character numbers are the same as mentioned in Table 1.
d.f.; 34

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

significance even at 5% level, respectively (Table 2). The higher significant level was found in 2 than those in 1. In those collected both in 1985 and in 1988 (3), 22, 2, 2 and 1 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 3).

In TA, 19, 4 and 4; and 20, 3 and 4 combinations showed significances at 0.1% and 1% levels and no significance even at 5% level in 1988 (Table 4, 5), and 1984 and 1988 (Table 5, 6), respectively. In KE (7), 12, 4, 1 and 10 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 6). It was remarkable that the 37.0% (=10/27) combinations showed no significance, which was a very high level in

Table 5. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Tanzania, *O. longistaminata*, 314 in 1984 and 2048-2083 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.4407**	0.4607**	0.4366**	1	0.4217**	0.3657*	0.9399***
1·3	0.5033**	0.1168	0.0255	2	0.4735**	0.4820**	0.9718***
2·3	0.7713***	0.4365**	0.3001	3	0.2906	0.2091	0.9051***
4·5	0.6887***	0.1847	0.1921	4	0.1323	0.0179	0.9150***
4·6	-0.7076***	0.3651*	0.3418*	5	0.1520	-0.0791	0.9000***
5·6	0.0206	0.5876***	0.5400***	6	0.4045*	0.4571**	0.9057***
11·12	0.1532	0.4169*	0.4035*	11	-0.1154	-0.0396	0.8651***
11·13	0.5879***	0.2488	0.0465	12	0.3760*	0.3735*	0.9585***
12·13	0.5280***	0.5730***	0.4752**	13	0.0347	0.0208	0.9120***
14·15	0.6503***	0.4341**	0.3791*	14	-0.0109	-0.1012	0.8469***
14·16	-0.7142***	0.3711*	0.5053**	15	0.2547	0.1822	0.8801***
15·16	0.0583	0.1772	0.4753**	16	0.3918*	0.5136**	0.7709***
21·22	0.4566**	0.4466**	0.3879*	21	-0.3482*	-0.3767*	0.9330***
21·23	0.5973***	0.3816*	0.3680*	22	-0.3369*	-0.3601*	0.6856***
22·23	0.5205***	0.2589	0.2441	23	-0.6910***	-0.6594***	0.8533***
24·25	0.6830***	0.5500***	0.5797***	24	-0.0544	0.1530	0.9369***
24·26	-0.5607***	0.4768**	0.2677	25	0.0651	-0.0508	0.9050***
25·26	0.2039	0.5128**	0.3433*	26	0.3135	0.3363*	0.8551***
1·11	0.6499***	0.6534***	0.6241***	31	0.5971***	0.3443*	0.9692***
2·12	0.8959***	0.7872***	0.7151***	32	0.7050***	0.7257***	0.9854***
3·13	0.8568***	0.5334***	0.6150***	33	0.3161	0.4061*	0.9194***
4·14	0.8395***	0.6466***	0.5297***	34	0.5450***	0.5553***	0.9693***
5·15	0.6907***	0.3797*	0.3291*	35	-0.1268	-0.2108	0.8585***
6·16	0.8505***	0.6222***	0.7385***	36	-0.2958	-0.1728	0.8620***
31·33	0.7915***	0.7984***	0.8096***				
32·34	0.8261***	0.8768***	0.8564***				
35·36	0.9674***	0.7995***	0.8063***				

Character numbers are the same as mentioned in Table 1.

d.f.; 35

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

comparison with the previous strains.

In NI, 4, 5, 5 and 13; 14, 1, 4 and 8; and 16, 3, 3 and 5 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 7, 8), 1985 (Table 8, 9), and 1984 and 1985 (Table 9, 10), respectively. It was noticeable that the strains collected in 1985 (9) showed the higher significances than those in 1984 (8). In IV (11), 5, 6, 3 and 13 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 10). In SE, 17, 2, 3 and 5; 5, 2, 8 and 12; and 21, 2, 3 and 1 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 11, 12), northern (Table 12, 13), and both regions (Table 13, 14),

Table 6. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Kenya, *O. longistaminata*, 315-324 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.8193**	0.6404*	0.7482*	1	-0.5211	-0.7461*	0.9347***
1·3	0.9851***	0.7280*	0.7863**	2	-0.6926*	-0.7396*	0.9453***
2·3	0.8518**	0.7021*	0.6390*	3	-0.6944*	-0.7534*	0.9749***
4·5	0.6125	0.7641*	0.7717**	4	0.7357*	0.7662**	0.9887***
4·6	-0.9310***	0.8843***	0.8905***	5	0.6270	0.7259*	0.9837***
5·6	-0.2896	0.8150**	0.8515**	6	-0.2919	-0.4207	0.9812***
11·12	0.8922***	0.5168	0.7334*	11	-0.8560**	-0.8814***	0.9759***
11·13	0.9458***	0.7960**	0.8510**	12	-0.1817	-0.4382	0.8979***
12·13	0.8944***	0.7161*	0.8427**	13	0.0005	-0.8097**	0.9736***
14·15	0.3040	0.7793**	0.7210*	14	0.4404	0.2811	0.9489***
14·16	-0.7974**	0.8954***	0.8652**	15	0.3884	-0.0200	0.9763***
15·16	0.3289	0.8837***	0.9230***	16	0.0549	0.0386	0.9711***
21·22	-0.1416	0.7158*	0.8988***	21	-0.5840	-0.6637*	0.8390**
21·23	0.3994	0.5439	0.7547*	22	0.3575	0.2226	0.6581*
22·23	0.0897	0.5273	0.8792***	23	-0.3715	-0.3503	0.9789***
24·25	0.8102**	0.8954***	0.9165***	24	-0.7959**	-0.7477*	0.9886***
24·26	-0.4893	0.8943***	0.8716**	25	-0.4210	0.2256	0.9839***
25·26	0.0883	0.7471*	0.7058*	26	0.4043	0.4117	0.9587***
1·11	0.8924***	0.8563**	0.9482***	31	-0.5822	-0.8321**	0.8910***
2·12	0.9815***	0.6800*	0.7739**	32	-0.3574	-0.6189	0.9125***
3·13	0.9733***	0.9186***	0.9300***	33	-0.3052	0.2337	0.8838***
4·14	0.6989*	0.9300***	0.9036***	34	-0.2804	-0.5129	0.9382***
5·15	-0.3621	0.8705**	0.8433**	35	-0.4104	-0.3208	0.9909***
6·16	0.8916***	0.9040***	0.8840***	36	-0.4477	-0.3760	0.9653***
31·33	0.9714***	0.6482*	0.8113**				
32·34	0.9806***	0.7781**	0.8716**				
35·36	0.9345***	0.9591***	0.9943***				

Character numbers are the same as mentioned in Table 1.
d.f.; 8

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

respectively. It was remarkable that the results showed the higher significances in Casamance (12) than those in northern (13) regions.

In SUM, 25, 24, 23, 22; 0, 1, 2, 2; 0, 0, 1, 1; 2, 2, 1 and 2 combinations showed significances at 0.1% [1984 and 1985 in the whole countries (107 strains), abbreviated as 15 (Table 14), 1984, 1985 and 1988 in the whole countries (190 strains), 16 (Table 15), East Africa in the whole years (107 strains), 34 (Table 31), West Africa in the whole years (83 strains), 35 (Table 32)], at 1% (15, 16, 34, 35) and 5% (15, 16, 34, 35) levels and no significance even at 5% level (15, 16, 34, 35), respectively. 92.6, 92.6, 96.3 and 92.6% combinations of the whole showed significances in 15, 16, 34, 35, respectively. It was noticeable that the strains of East Africa

Table 7. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. longistaminata*, 325-336 in 1984

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.8654	0.5345	0.6058	1	0.4714	0.7363	0.9197*
1·3	0.9318*	0.2761	0.4207	2	-0.1242	-0.0641	0.9671**
2·3	0.9706**	0.7914	0.5976	3	0.5464	0.5799	0.9423*
4·5	0.0347	0.7916	0.3529	4	0.8667	0.9330*	0.9153*
4·6	-0.5570	0.2421	0.7135	5	0.4585	0.8087	0.8233
5·6	0.8098	0.4355	0.7121	6	0.4307	0.1855	0.9440*
11·12	0.9697**	0.4339	0.7172	11	0.7184	0.7098	0.9935***
11·13	0.9287*	0.8502	0.8804*	12	0.5748	0.7898	0.9258*
12·13	0.9774**	0.8236	0.9451*	13	0.6408	0.7397	0.9662**
14·15	0.6138	0.8035	0.8553	14	0.6838	-0.7960	0.9120*
14·16	-0.6466	0.8261	0.5802	15	0.8547	0.7753	0.9709**
15·16	0.2039	0.4877	0.4226	16	-0.2376	-0.3246	0.9658**
21·22	-0.1929	0.9297*	0.8897*	21	0.6966	0.6309	0.9480*
21·23	-0.3556	0.6277	0.4139	22	-0.3445	-0.0054	0.9187*
22·23	0.9071*	0.7806	0.5414	23	-0.2202	0.0612	0.9182*
24·25	0.9731**	0.9654**	0.9556*	24	0.7720	0.7576	0.9961***
24·26	0.5026	0.7868	0.5885	25	0.9516*	0.8111	0.9393*
25·26	0.6588	0.6755	0.7582	26	0.9166*	0.4757	0.6010
1·11	0.9923***	0.6515	0.8720	31	0.8548	0.9245*	0.9839**
2·12	0.8707	0.2441	0.6327	32	0.9116*	0.8993*	0.9689**
3·13	0.9951***	0.6885	0.5262	33	0.9283*	0.9685**	0.9882**
4·14	0.9438*	0.8738	0.6990	34	0.9420*	0.9633**	0.9808**
5·15	0.6360	0.5388	0.9075*	35	-0.1211	-0.1210	0.9092*
6·16	0.9804**	-0.2236	0.0507	36	-0.2190	0.5863	0.9589**
31·33	0.9981***	0.9140*	0.9176*				
32·34	0.9983***	0.9438*	0.9187*				
35·36	0.8818*	0.9133*	0.8368				

Character numbers are the same as mentioned in Table 1.

d.f.; 3

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

(34) showed higher significances than those of West Africa (35).

(2) *O. breviligulata*

In NI, 7, 2, 3 and 15; 13, 2, 3 and 9; and 13, 2, 1 and 11 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, 17), 1985 (Table 17, 18), and 1984 and 1985 (Table 18, 19), respectively. It was noticeable that the strains collected in 1985 (18) showed the higher significances than those in 1984 (17), which was the same as in case of *O. longistaminata*. In SE, 14, 0, 0 and 13; 7, 3, 3 and 14; and 14, 0, 0 and 13 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 19, 21), northern (Table 20, 22), and both regions (Table 21, 23),

Table 8. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. longistaminata*, 337-382 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.2577	0.3599	0.6529***	1	-0.1792	-0.2779	0.9420***
1·3	0.1641	0.4425*	0.7167***	2	-0.2718	-0.3175	0.9572***
2·3	0.5743**	0.5589**	0.7781***	3	-0.5671**	-0.6546***	0.9263***
4·5	0.7974***	0.7250***	0.5167**	4	0.1683	0.0805	0.9564***
4·6	-0.3400	0.6386***	0.8502***	5	0.1019	0.0829	0.9677***
5·6	0.2731	0.6169***	0.8058***	6	0.0481	0.0805	0.9492***
11·12	-0.0181	0.3291	0.4756**	11	-0.0762	-0.2681	0.9281***
11·13	0.2056	0.0805	0.3496	12	-0.0174	-0.0862	0.9597***
12·13	0.4539*	0.2817	0.4942**	13	-0.3049	-0.4557*	0.9083***
14·15	0.7781***	0.8214***	0.4114*	14	-0.0656	-0.2007	0.9300***
14·16	-0.4392*	0.5300**	0.6893***	15	-0.0024	-0.0382	0.9120***
15·16	0.1864	0.6386***	0.7100***	16	0.3407	0.4026*	0.9760***
21·22	-0.0385	0.6464***	0.7708***	21	-0.6095***	-0.6283***	0.9535***
21·23	0.4476*	0.7197***	0.7584***	22	0.2028	0.0043	0.9713***
22·23	0.6602***	0.7603***	0.8336***	23	-0.2499	-0.2920	0.9653***
24·25	0.8204***	0.8415***	0.8686***	24	-0.3779*	-0.4305*	0.9724***
24·26	-0.8281***	0.7895***	0.8435***	25	-0.0794	-0.2059	0.9588***
25·26	-0.3837*	0.7235***	0.7698***	26	0.6579***	0.6851***	0.9728***
1·11	0.9570***	0.6211***	0.7588***	31	-0.2727	-0.4061*	0.9435***
2·12	0.7414***	0.5592**	0.7300***	32	-0.2958	-0.3580	0.8713***
3·13	0.8831***	0.4730**	0.6973***	33	-0.0679	-0.3116	0.8633***
4·14	0.8813***	0.7212***	0.8454***	34	-0.1608	-0.3529	0.9239***
5·15	0.9501***	0.6279***	0.8164***	35	-0.0882	-0.0613	0.9483***
6·16	0.8724***	0.7593***	0.8321***	36	-0.2053	-0.1312	0.9705***
31·33	0.8712***	0.5330**	0.7459***				
32·34	0.8337***	0.5408**	0.5986***				
35·36	0.9621***	0.9097***	0.9218***				

Character numbers are the same as mentioned in Table 1.
d.f.; 27

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

respectively. It was remarkable that the slightly higher significance was found in Casamance (21) than those in northern (22) regions, which was the same as in case of *O. longistaminata*.

In SUM (1984 and 1985 in the three countries [49 strains], abbreviated as 24), 14, 2 and 11 combinations showed significances at 0.1% and 5% levels and no significance even at 5% level, respectively (Table 22). 59.3% combinations of the whole showed significances.

(3) *O. punctata*

In TA, 1, 1, 0 and 25; 13, 1, 1 and 12; and 12, 3, 3 and 9 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 23, 25), 1988 (Table 24, 26), and 1984 and 1988 (Table 25, 27), respectively. It was noticeable that the

Table 9. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. longistaminata*, 325-336 in 1984 and 337-382 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1-2	0.5268**	0.5271**	0.7365***	1	0.1227	0.1438	0.9575***
1-3	0.4530**	0.5894***	0.7653***	2	-0.0909	-0.0781	0.9592***
2-3	0.7146***	0.6664***	0.7664***	3	-0.0095	0.0538	0.9423***
4-5	0.7506***	0.7786***	0.5123**	4	0.0630	-0.0289	0.9534***
4-6	-0.4252*	0.6044***	0.8530***	5	0.0968	0.0882	0.9581***
5-6	0.1030	0.6164***	0.8184***	6	0.1417	0.2051	0.9412***
11-12	0.3493*	0.3990*	0.6281***	11	0.0682	-0.0466	0.9154***
11-13	0.4239*	0.2553	0.5725***	12	0.3554*	0.4361**	0.9509***
12-13	0.7346***	0.4880**	0.7064***	13	0.1141	0.0983	0.9401***
14-15	0.7759***	0.8263***	0.3755*	14	-0.0938	-0.2581	0.9251***
14-16	-0.5331**	0.5744***	0.7074***	15	-0.0114	-0.0790	0.9084***
15-16	0.0907	0.6502***	0.7474***	16	0.3594*	0.4634**	0.9485***
21-22	-0.1222	0.6971***	0.7970***	21	-0.5246**	-0.5764***	0.9544***
21-23	0.2630	0.7236***	0.7399***	22	0.1986	-0.0162	0.9536***
22-23	0.6937***	0.7688***	0.8153***	23	-0.1743	-0.0818	0.9253***
24-25	0.8414***	0.8647***	0.8900***	24	-0.2627	-0.3608*	0.9592***
24-26	-0.7668***	0.7541***	0.8037***	25	0.0104	-0.1685	0.9517***
25-26	-0.3206	0.6822***	0.7863***	26	0.6555***	0.6816***	0.8898***
1-11	0.9585***	0.6223***	0.8133***	31	0.4250*	0.3923*	0.9677***
2-12	0.7252***	0.6077***	0.7855***	32	0.5602***	0.6461***	0.9490***
3-13	0.9324***	0.6446***	0.7645***	33	0.4711**	0.3627*	0.9114***
4-14	0.8898***	0.7331***	0.8322***	34	0.6345***	0.6367***	0.9652***
5-15	0.9266***	0.5972***	0.8517***	35	-0.0575	-0.0092	0.9328***
6-16	0.8993***	0.7251***	0.8143***	36	-0.1306	0.0024	0.9430***
31-33	0.9541***	0.7301***	0.8435***				
32-34	0.9488***	0.8478***	0.8885***				
35-36	0.9523***	0.9133***	0.9167***				

Character numbers are the same as mentioned in Table 1.

d.f.; 32

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

remarkably higher significance was found in 26 than those in 25. In KE, 1, 2, 4 and 20; 5, 4, 2 and 16; and 7, 3, 2 and 15 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 26, 28), 1985 (Table 27, 29), and 1984 and 1985 (Table 28, 30), respectively. The higher significance was found in 29 than those in 28.

In SUM, 9, 15; 3, 3; 4, 2; 11 and 7 combinations showed significances at 0.1% (1984 and 1985 in the two countries [18 strains], abbreviated as 31 (Table 29); 1984, 1985 and 1988 in the two countries [44 strains], abbreviated as 32 (Table 30), at 1% (31, 32) and at 5% (31, 32) levels and no significance even at 5% level (31, 32), respectively. 59.3 and 74.1% combinations of the whole showed significances in 31 and 32, respectively.

Table 10. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Ivory Coast, *O. longistaminata*, 384-390 in 1984

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.1390	0.0296	-0.0773	1	-0.5758	-0.4714	0.9258**
1·3	0.3050	-0.4801	-0.1098	2	-0.0091	-0.2279	0.9165**
2·3	0.9213**	0.0272	-0.0156	3	-0.3373	0.1825	0.6974
4·5	0.9739***	0.2121	0.0669	4	0.0046	0.3237	0.8259*
4·6	-0.6551	-0.6410	0.5210	5	-0.7525	-0.5229	0.9383**
5·6	-0.4691	-0.3839	-0.2200	6	-0.8040*	-0.4511	0.3863
11·12	0.2295	0.5321	0.2770	11	0.4535	0.3636	0.9301**
11·13	0.6325	-0.6086	-0.4918	12	0.3449	0.3209	0.9125**
12·13	0.7911*	0.5835	-0.5238	13	-0.1440	-0.2536	0.8236*
14·15	0.9795***	-0.0876	-0.6728	14	0.7724*	-0.0689	0.9555***
14·16	-0.7702*	0.6907	0.1751	15	-0.2013	-0.2258	0.8396*
15·16	-0.6278	0.0221	-0.6728	16	-0.3519	-0.4043	0.7776*
21·22	0.1174	0.6285	0.5166	21	-0.1034	-0.2482	0.9483**
21·23	0.6512	0.5477	-0.1643	22	-0.3774	-0.4531	0.9343**
22·23	0.4434	0.7961*	0.7288	23	0.0979	-0.4178	0.5977
24·25	0.8802**	0.9055**	0.8496*	24	-0.0158	-0.1881	0.8267*
24·26	-0.7270	0.5578	0.7922*	25	0.0533	0.2305	0.9550***
25·26	-0.3451	0.4540	0.8052*	26	0.0323	0.2141	0.8183*
1·11	0.9633***	-0.6870	-0.4002	31	-0.3990	-0.4351	0.9668***
2·12	0.9120**	0.1297	0.3500	32	-0.1907	-0.2066	0.9783***
3·13	0.9167**	0.2740	-0.3847	33	0.2392	0.4139	0.9161**
4·14	0.9231**	0.6596	0.7334	34	0.1155	0.2371	0.9563***
5·15	0.9276**	0.5509	0.5497	35	0.2171	-0.3653	0.6674
6·16	0.7679*	-0.4099	-0.2344	36	0.1309	0.1312	0.4938
31·33	0.9656***	-0.5594	-0.6492				
32·34	0.9537***	-0.3638	-0.2837				
35·36	-0.0937	0.9148**	0.6252				

Character numbers are the same as mentioned in Table 1.

d.f.; 5

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

2. Relationships between the standard deviations of the two respective characters

(1) *O. longistaminata*

C.c. and l.r. of s.d. on another s.d. among the 27 character-combinations were calculated, and c.c. were shown in the second columns from the left of the Tables 1 to 15, 31 and 32. In MD, 11, 9, 2 and 5; 4, 2, 1 and 20; and 25, 2, 0 and 0 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1985 (Table 1, 1), 1988 (Table 2, 2), and 1985 and 1988 (Table 3, 3), respectively. It was noticed that the higher significances were remarkably found in 1 than those in 2. In TA, 10, 1, 6 and 10; 11, 6, 5 and 5 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1988 (Table

Table 11. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. longistaminata*, 391-441 in Casamance region in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.2477	0.1722	0.4127*	1	-0.2519	-0.1464	0.9331***
1·3	0.5095**	0.2270	0.3864*	2	-0.0977	0.0047	0.9539***
2·3	0.3039	0.3116	0.5288**	3	-0.2858	-0.1630	0.9216***
4·5	0.1839	0.3636*	0.5222**	4	0.0428	0.0014	0.9443***
4·6	-0.6452***	0.5175**	0.6065***	5	0.3423*	0.3055	0.9564***
5·6	0.6248***	0.7357***	0.7708***	6	0.5979***	0.5844***	0.9740***
11·12	0.4092*	0.3572*	0.5491***	11	-0.3956*	-0.3054	0.9434***
11·13	0.7054***	0.1749	0.3746*	12	-0.3948*	-0.1535	0.9221***
12·13	0.6762***	0.4804**	0.5509***	13	-0.3068	-0.1655	0.9241***
14·15	0.4328*	0.5081**	0.6942***	14	0.0546	-0.0712	0.9515***
14·16	-0.4692**	0.7135***	0.7668***	15	-0.0033	0.2350	0.6603***
15·16	0.5881***	0.4441**	0.4869**	16	0.5748***	0.5635***	0.9579***
21·22	0.3306	0.6313***	0.7337***	21	-0.6336***	-0.6140***	0.9394***
21·23	0.5869***	0.6085***	0.7872***	22	-0.4445**	-0.2664	0.9631***
22·23	0.7810***	0.8508***	0.8881***	23	-0.5727***	-0.4737**	0.9135***
24·25	0.7845***	0.9182***	0.9093***	24	0.0933	-0.1075	0.9635***
24·26	-0.3397*	0.7789***	0.8773***	25	0.2622	0.0706	0.9161***
25·26	0.3020	0.7744***	0.9178***	26	0.4711**	0.5315**	0.9452***
1·11	0.9012***	0.4258*	0.6239***	31	-0.0516	0.1569	0.9037***
2·12	0.7509***	0.6464***	0.7873***	32	0.2351	0.2133	0.8491***
3·13	0.9164***	0.5692***	0.7050***	33	-0.2210	-0.0634	0.9410***
4·14	0.5347***	0.7032***	0.7358***	34	-0.1694	0.0220	0.9021***
5·15	0.7765***	0.4773**	0.8138***	35	-0.5052**	-0.3910*	0.9347***
6·16	0.9306***	0.8454***	0.8701***	36	-0.3741*	-0.3936*	0.6386***
31·33	0.8905***	0.6847***	0.7976***				
32·34	0.9357***	0.5343***	0.7051***				
35·36	0.9471***	0.6853***	0.9496***				

Character numbers are the same as mentioned in Table 1.

d.f.; 33

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

4, 5), and 1984 and 1988 (Table 5, 6), respectively. In KE (7), 9, 6, 9 and 3 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 6).

In NI, 0, 1, 4 and 22; 16, 6, 1 and 4; and 23, 2, 1 and 1 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 7, 8), 1985 (Table 8, 9), and 1984 and 1985 (Table 9, 10), respectively. It was noticed that the value of 9 was remarkably larger than those of 8, which was the same as in case of 1st item. In IV (11), 2, 1 and 24 combinations showed significances at 1% and 5% levels and no significance even at 5% level, respectively (Table 10). In SE, 15, 5, 3 and 4; 0, 2, 5 and 20; and 16, 4, 2 and 5

Table 12. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. longistaminata*, 444-455 in northern region in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.8490*	0.3873	0.4149	1	-0.1958	0.0677	0.9625***
1·3	0.4831	-0.1411	0.1579	2	-0.3593	-0.1228	0.9597***
2·3	0.7874*	0.0711	0.2237	3	0.3720	-0.4944	0.9762***
4·5	0.6993	0.2329	0.3203	4	0.7816*	0.8724*	0.9611***
4·6	0.1387	0.3802	0.3527	5	0.7246	0.8361*	0.9552***
5·6	0.8043*	0.7871*	0.8968**	6	0.6812	0.7991*	0.9455**
11·12	0.9454**	-0.0816	0.0122	11	-0.2105	-0.0754	0.9865***
11·13	0.8373*	-0.1669	0.0380	12	0.0401	0.3883	0.9247**
12·13	0.9522***	0.3720	0.6738	13	0.4754	0.5517	0.9792***
14·15	0.6155	0.3720	0.8145*	14	0.1577	0.0887	0.9499**
14·16	-0.1094	-0.1678	0.0805	15	0.4657	0.5285	0.9418**
15·16	0.7145	0.5664	0.8145*	16	0.6192	0.7799*	0.9631***
21·22	0.4442	0.1189	0.1304	21	-0.8217*	-0.8028*	0.9898***
21·23	0.0917	0.5920	0.3447	22	0.1961	0.2246	0.9194**
22·23	0.7297	0.4610	0.6434	23	0.0664	0.1511	0.9108**
24·25	0.6423	-0.0433	-0.2229	24	0.1605	0.1833	0.9472**
24·26	-0.2007	0.6763	0.7440	25	0.0168	0.0426	0.8663*
25·26	0.6157	-0.1623	-0.1811	26	-0.5612	-0.6362	0.9864***
1·11	0.9884***	0.7384	0.7176	31	0.2972	0.6485	0.9054**
2·12	0.9596***	0.6944	0.6116	32	0.3550	0.5533	0.9435**
3·13	0.8270*	0.8332*	0.8624*	33	0.3730	0.5720	0.9703***
4·14	0.7624*	0.8179*	0.7867*	34	0.6854	0.7723*	0.9905***
5·15	0.8743*	0.9158**	0.9616***	35	-0.1003	0.0650	0.9595***
6·16	0.8278*	0.8592*	0.9546***	36	0.2354	0.4779	0.9471**
31·33	0.9914***	0.9074**	0.9159**				
32·34	0.9694***	0.7081	0.8602*				
35·36	0.9224**	0.8264*	0.8794**				

Character numbers are the same as mentioned in Table 1.

d.f.; 5

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 11, 12), northern (Table 12, 13), and both regions (Table 13, 14), respectively. It was remarkable that the results showed the higher significances in Casamance (12) than those in northern (13) regions, which was the same as in case of the 1st item.

In SUM, 27, 27, 27, 26; 0, 0, 0 and 1 combinations showed significances at 0.1% and 5% levels in 1984 and 1985 (Table 14, 15), 1984, 1985 and 1988 (Table 15, 16), in East Africa (Table 31, 34) and in West Africa (Table 32, 35), respectively. The whole of the groups (=100.0%) (15, 16, 34, 35) showed significances in the whole combinations. It was noticed that the strains of East Africa (34) showed slightly the higher significances than those of West Africa (35),

Table 13. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. longistaminata*, 391-441 in Casamance region and 444-455 in northern region 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.5542***	0.2093	0.3839*	1	-0.1083	0.0386	0.9449***
1·3	0.5546***	0.1046	0.2805	2	-0.1365	-0.0231	0.9526***
2·3	0.5085***	0.2723	0.4821**	3	-0.2196	-0.1082	0.9306***
4·5	0.2497	0.3342*	0.4851**	4	0.1357	0.0845	0.9385***
4·6	-0.5885***	0.4749**	0.5565***	5	0.4079**	0.4266**	0.9471***
5·6	0.6289***	0.7398***	0.7982***	6	0.5990***	0.5996***	0.9605***
11·12	0.6173***	0.2794	0.4690**	11	-0.3364*	-0.2474	0.9498***
11·13	0.7249***	0.0890	0.2870	12	-0.0908	-0.0853	0.9221***
12·13	0.7340***	0.4496**	0.5437***	13	-0.1665	-0.0096	0.9325***
14·15	0.4398**	0.3663*	0.6000***	14	0.0742	-0.0478	0.9518***
14·16	-0.4596**	0.6412***	0.6514***	15	0.0585	0.2565	0.7375***
15·16	0.5905***	0.4439**	0.5600***	16	0.5707***	0.5657***	0.9513***
21·22	0.3436*	0.6062***	0.7022***	21	-0.6519***	-0.6330***	0.9441***
21·23	0.5659***	0.6073***	0.7568***	22	-0.4137**	-0.2440	0.9614***
22·23	0.7769***	0.8281***	0.8735***	23	-0.5255***	-0.4300**	0.9132***
24·25	0.7703***	0.8938***	0.8872***	24	0.0948	-0.1298	0.9629***
24·26	-0.3260*	0.7743***	0.8742***	25	0.2405	0.0673	0.9167***
25·26	0.3370*	0.7358***	0.8933***	26	0.4240**	0.4472**	0.9450***
1·11	0.9405***	0.4793**	0.5372***	31	0.1299	0.3146*	0.9032***
2·12	0.8318***	0.6444***	0.7680***	32	0.2157	0.2477	0.8592***
3·13	0.9023***	0.5883***	0.7031***	33	-0.0214	0.1121	0.9453***
4·14	0.5550***	0.6773***	0.7161***	34	0.1889	0.3265*	0.9363***
5·15	0.8233***	0.5581***	0.8502***	35	-0.4777**	-0.3642*	0.9372***
6·16	0.9229***	0.8463***	0.8882***	36	-0.3338*	-0.3218*	0.6574***
31·33	0.9435***	0.7244***	0.8160***				
32·34	0.9519***	0.5508***	0.6846***				
35·36	0.9449***	0.6951***	0.9424***				

Character numbers are the same as mentioned in Table 1.

d.f.; 40

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

which was the same as in case of the 1st item.

(2) *O. breviligulata*

In NI, 3, 4, 0 and 20; 5, 1, 3 and 18; and 8, 2, 2 and 15 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, 17), 1985 (Table 17, 18), and 1984 and 1985 (Table 18, 19), respectively. The slightly larger value was found in 18 than those in 17. In SE, 13, 3, 3 and 8; 2, 2, 2 and 21; and 14, 2, 6 and 5 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 19, 21), northern (Table 20, 22), and both regions (Table 21, 23),

Table 14. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in 1984 and 1985 in the whole countries, *O. longistaminata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.5582***	0.5097***	0.7049***	1	-0.1284	-0.1628	0.9312***
1·3	0.4989***	0.4314***	0.6752***	2	-0.2303*	-0.2311*	0.9518***
2·3	0.6049***	0.5140***	0.6647***	3	-0.1400	-0.0505	0.9225***
4·5	0.5429***	0.5755***	0.7290***	4	0.1811	0.0554	0.9574***
4·6	-0.4532***	0.5922***	0.7645***	5	0.1659	0.0573	0.9224***
5·6	0.4942***	0.7294***	0.8229***	6	0.2738**	0.1874	0.9190***
11·12	0.4867***	0.4843***	0.6957***	11	-0.2425*	-0.3332***	0.9348***
11·13	0.5548***	0.3494***	0.6243***	12	-0.1473	0.0340	0.9458***
12·13	0.7373***	0.5062***	0.3776***	13	-0.0954	-0.0172	0.9300***
14·15	0.6592***	0.6706***	0.7826***	14	-0.0235	-0.1770	0.9293***
14·16	-0.4144***	0.6109***	0.7502***	15	-0.0243	-0.0091	0.8690***
15·16	0.4022***	0.6131***	0.7406***	16	0.3865***	0.3729***	0.9406***
21·22	0.0314	0.7486***	0.8536***	21	-0.5717***	-0.5919***	0.9379***
21·23	0.4021***	0.6714***	0.7777***	22	-0.0185	0.0070	0.9291***
22·23	0.6440***	0.7976***	0.8810***	23	0.0963	-0.2888**	0.9211***
24·25	0.7769***	0.8840***	0.9059***	24	-0.2276*	-0.0077	0.9629***
24·26	-0.6042***	0.7957***	0.8625***	25	-0.0108	-0.1005	0.9430***
25·26	0.0126	0.7820***	0.8677***	26	0.5431***	0.5988***	0.9348***
1·11	0.9367***	0.6401***	0.8068***	31	0.0666	-0.1019	0.9350***
2·12	0.7707***	0.7015***	0.8224***	32	0.2918**	0.3138***	0.9320***
3·13	0.9260***	0.6647***	0.7892***	33	0.0792	0.0441	0.9320***
4·14	0.7391***	0.7664***	0.8278***	34	0.3133**	0.3147***	0.9579***
5·15	0.8698***	0.6762***	0.8670***	35	-0.3714***	-0.3093**	0.9561***
6·16	0.8835***	0.8147***	0.8687***	36	-0.2888**	-0.1957*	0.8300***
31·33	0.9423***	0.7079***	0.8181***				
32·34	0.9445***	0.7669***	0.8361***				
35·36	0.8656***	0.8421***	0.9506***				

Character numbers are the same as mentioned in Table 1.
d.f.; 105

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

respectively. The higher significance was clearly found in 21 than those in 22, which was the same as in case of the 1st item.

In SUM, 18, 3 and 6 combinations showed significances at 0.1% and 1% levels and no significance even at 5% level, respectively (Table 22, 24). 77.8% combinations of the whole showed significances.

(3) *O. punctata*

In TA, 1, 2, 1 and 23; 1, 5, 8 and 13; and 4, 3, 7 and 13 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 23, 25), 1988 (Table 24, 26), and 1984 and 1988 (Table 25, 27), respectively. It was noticed that the

Table 15. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in 1984, 1985 and 1988 in the whole countries, *O. longistaminata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.5868***	0.6156***	0.7391***	1	-0.1533	-0.1841*	0.9485***
1·3	0.6272***	0.5400***	0.6745***	2	-0.1174	-0.1367	0.8881***
2·3	0.6768***	0.5800***	0.6958***	3	-0.1263	-0.1233	0.9421***
4·5	0.5592***	0.6185***	0.7395***	4	0.0924	0.1486	0.9587***
4·6	-0.5393***	0.5494***	0.7575***	5	0.0796	0.0920	0.9189***
5·6	0.3886***	0.6986***	0.8312***	6	0.1905*	0.1621	0.8603***
11·12	0.5110***	0.6227***	0.7325***	11	-0.2451**	-0.2848**	0.9306***
11·13	0.6690***	0.5248***	0.6579***	12	-0.1307	0.0687	0.9528***
12·13	0.7312***	0.6504***	0.4463***	13	-0.2473**	-0.1030	0.9415***
14·15	0.6455***	0.6784***	0.7761***	14	0.0905	-0.1763	0.8217***
14·16	-0.5384***	0.6805***	0.7572***	15	-0.0067	-0.0101	0.8349***
15·16	0.2845**	0.6620***	0.7774***	16	0.4362***	0.4357***	0.9336***
21·22	0.0391	0.7832***	0.8443***	21	-0.4280***	-0.0523	0.9488***
21·23	0.3636***	0.7257***	0.8053***	22	0.2135*	0.0253	0.9488***
22·23	0.4774***	0.7931***	0.8335***	23	-0.0043	-0.3411***	0.9415***
24·25	0.6409***	0.8452***	0.8660***	24	-0.3455***	0.0836	0.9653***
24·26	-0.6532***	0.8363***	0.8432***	25	0.0220	-0.0366	0.9534***
25·26	0.0824	0.8137***	0.8327***	26	0.6290***	0.6330***	0.9553***
1·11	0.9112***	0.7073***	0.7891***	31	0.0456	-0.0986	0.9509***
2·12	0.8236***	0.7285***	0.8392***	32	0.2596**	0.2229*	0.9567***
3·13	0.9245***	0.7364***	0.8158***	33	0.0415	-0.0165	0.9156***
4·14	0.7244***	0.7930***	0.8350***	34	0.1412	0.1923*	0.9642***
5·15	0.8059***	0.6852***	0.7703***	35	-0.1408	-0.1110	0.9591***
6·16	0.8267***	0.7142***	0.8412***	36	-0.1686	-0.0972	0.8950***
31·33	0.9334***	0.7618***	0.8493***				
32·34	0.9391***	0.8400***	0.8621***				
35·36	0.8436***	0.8968***	0.9369***				

Character numbers are the same as mentioned in Table 1.

d.f.; 188

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

remarkably higher significance was found in 26 than those of 25, which was quite the same as in case of the 1st item. In KE, 0, 2 and 25; 0, 3 and 24; and 1, 2 and 24 combinations showed significances at 0.1% and 5% levels and no significance even at 5% level in 1984 (Table 26, 28), 1985 (Table 27, 29), and 1984 and 1985 (Table 28, 30), respectively.

In SUM, 1, 7; 0, 3; 6, 5; 20 and 12 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 29, 31), and 1984, 1985 and 1988 (Table 30, 32), respectively. 25.9 and 55.6% combinations of the whole showed significances in 31 and 32, respectively.

3. Relationships between the variation ranges of the two respective characters

Table 16. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. breviligulata*, 328-334 in 1984

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.4163	0.4474	0.4915	1	-0.7475	-0.7410	0.8265*
1·3	-0.7465	-0.0328	0.1635	2	0.3174	0.2104	0.8935**
2·3	0.7070	0.5398	0.4934	3	0.4452	-0.1522	0.9700***
4·5	-0.3322	0.3174	0.3450	4	0.6868	0.5448	0.7216
4·6	0.3878	0.2555	-0.0714	5	0.1768	0.4526	0.8046*
5·6	0.6421	0.3761	0.2454	6	0.1742	0.2424	0.9454**
11·12	-0.5511	0.4598	0.2376	11	-0.6626	-0.7966*	0.8751**
11·13	-0.6541	-0.0668	-0.0312	12	0.4135	0.5518	0.9511***
12·13	0.8333*	0.6640	0.7343	13	0.2808	0.1914	0.9853***
14·15	0.9530***	0.7408	0.5932	14	0.1144	-0.1284	0.8685*
14·16	-0.0137	0.3067	0.3084	15	0.1732	0.2071	0.8381*
15·16	0.2896	0.5707	0.4295	16	0.2025	0.2624	0.9489**
21·22	0.3940	-0.1937	-0.2183	21	0.8677*	0.8169*	0.9630***
21·23	-0.2140	0.2582	0.3749	22	-0.6009	-0.5983	0.9064**
22·23	-0.0597	0.4167	0.5757	23	0.2831	-0.6487	0.4523
24·25	0.2066	0.3311	0.2223	24	0.4814	0.0582	0.7890*
24·26	-0.7924*	0.5130	0.3855	25	0.2700	0.6070	-0.0468
25·26	0.4118	-0.2582	-0.0747	26	-0.5906	-0.5228	0.7411
1·11	0.9941***	0.9700***	0.7375	31	-0.5249	-0.4329	0.9371**
2·12	0.9553***	0.9768***	0.4975	32	0.1410	0.2491	0.9402**
3·13	0.9873***	0.9451**	0.9368**	33	-0.2474	-0.2944	0.9107**
4·14	0.9954***	0.4556	0.0542	34	0.1319	0.2963	0.8915**
5·15	0.9934***	0.9423**	0.8482*	35	-0.3889	-0.2509	0.9012**
6·16	0.8605*	0.9330**	0.6857	36	-0.2652	-0.5577	0.8959**
31·33	0.9426**	0.9783***	0.9196**				
32·34	0.9635***	0.9346**	0.8051*				
35·36	0.9250**	0.7500	0.9388**				

Character numbers are the same as mentioned in Table 1.
d.f.; 5

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

(1) *O. longistaminata*

C.c. and l.r. of variation range on another variation range among the 27 character-combinations were calculated, and c.c. were shown in the third columns from the left of Tables 1 to 15, 31 and 32. In MD, 21, 5, 1 and 0; 3, 1, 4 and 19; and 27, 0, 0 and 0 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1985 (Table 1, 1), 1988 (Table 2, 2), and 1985 and 1988 (Table 3, 3), respectively. The level of 1 was remarkably higher than those of 2, which was the same as in cases of the 1st and the 2nd items. In TA, 8, 6, 3 and 10; and 10, 4, 7 and 6 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1988 (Table 4, 5), and 1984 and 1988 (Table 5,

Table 17. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. breviligulata*, 344-380 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.1116	0.2116	0.3718	1	0.2569	0.3400	0.0632
1·3	0.3892	-0.4583	-0.3521	2	0.1283	0.1766	0.8704***
2·3	0.8939***	0.0650	0.2557	3	0.1474	0.2498	0.8595***
4·5	0.9249***	0.1425	-0.1764	4	0.5220*	0.5338*	0.9499***
4·6	-0.5467*	-0.3950	-0.4024	5	0.3999	0.4321	0.8948***
5·6	-0.1916	0.1061	-0.0765	6	0.4914*	0.5522*	0.8424***
11·12	-0.2677	0.2703	0.0525	11	0.2988	0.3641	0.8947***
11·13	-0.0787	-0.1373	-0.3248	12	0.1509	0.3864	0.7865***
12·13	0.8140***	0.3236	0.1406	13	0.1776	0.2674	0.8429***
14·15	0.9055***	-0.0886	-0.2163	14	0.5944*	0.4741	0.9149***
14·16	-0.6811**	-0.2726	-0.2932	15	0.2186	0.0866	0.8594***
15·16	-0.3123	0.5192*	0.3806	16	0.4594	0.3915	0.8760***
21·22	-0.6279**	-0.1195	-0.0219	21	-0.1823	-0.1575	0.7399***
21·23	0.3505	0.1560	-0.2689	22	-0.1617	-0.2262	0.9453***
22·23	0.0639	-0.0539	0.2950	23	-0.2940	-0.4773	0.7963***
24·25	0.5602*	0.1943	0.3163	24	0.2056	0.0770	0.9395***
24·26	-0.5951*	0.5410*	0.6360**	25	0.5555*	0.5864*	0.7911***
25·26	0.2948	0.1156	0.1168	26	0.4896*	-0.3343	0.8490***
1·11	0.9698***	0.8968***	0.9108***	31	-0.1523	-0.1252	0.8875***
2·12	0.9908***	0.4565	-0.0622	32	0.1333	0.3870	0.8025***
3·13	0.9666***	0.9395***	0.5005*	33	-0.2327	0.0803	0.7578***
4·14	0.9882***	0.8772***	0.5592*	34	0.3601	0.6087**	0.8985***
5·15	0.9774***	0.3663	0.4169	35	-0.4496	-0.4496	0.8389***
6·16	0.9437***	0.8182***	0.6684**	36	-0.5360*	-0.5569*	0.8974***
31·33	0.9843***	0.8597***	0.4085				
32·34	0.7563***	0.5864*	0.5696*				
35·36	0.8909***	0.6268**	0.8691***				

Character numbers are the same as mentioned in Table 1.

d.f.; 15

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

6), respectively. In **KE** (7), 10, 11 and 6 combinations showed significances at 0.1%, 1% and 5% levels, respectively (Table 6).

In **NI**, 0, 0, 7 and 20; 22, 3, 1 and 1; and 25, 1, 1 and 0 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 7, 8), 1985 (Table 8, 9), and 1984 and 1985 (Table 9, 10), respectively. It was noticed that the value of 9 was remarkably larger than those of 8, which was the same as in the cases of the former 2 items. In **IV** (11), 3 and 24 combinations showed significances at 5% level and no significance even at 5% level, respectively (Table 10). In **SE**, 21, 3, 3 and 0; 2, 3, 5 and 17; and 21, 3, 1 and 2 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at

Table 18. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Nigeria, *O. breviligulata*, 328-334 in 1984 and 344-380 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.1556	0.2878	0.3657	1	-0.0123	0.0241	0.0781
1·3	0.2473	-0.2427	-0.0791	2	0.1581	0.1778	0.8767***
2·3	0.7307***	0.2361	0.3439	3	0.2544	0.2883	0.8986***
4·5	0.8861***	0.1496	0.0282	4	0.4910*	0.5360**	0.8857***
4·6	-0.3607	-0.2662	-0.3394	5	0.2915	0.4061*	0.8633***
5·6	0.1091	0.1223	-0.0555	6	0.4338*	0.4922*	0.8703***
11·12	-0.3344	0.3035	-0.0639	11	-0.0534	-0.0307	0.8955***
11·13	-0.0380	-0.1193	-0.1723	12	0.2162	0.4020	0.8004***
12·13	0.6584***	0.4684*	0.2966	13	-0.2021	0.2011	0.8923***
14·15	0.8663***	0.0749	-0.0893	14	0.4527*	0.2984	0.9060***
14·16	-0.5277**	-0.0844	-0.0944	15	0.1856	0.1123	0.8541***
15·16	-0.0387	0.4733*	0.3566	16	0.4525*	0.4455*	0.9142***
21·22	-0.2694	-0.1448	-0.0425	21	0.0181	0.0042	0.8045***
21·23	0.2455	0.1588	-0.2083	22	-0.2206	-0.2261	0.9484***
22·23	0.0042	0.1457	0.3652	23	-0.2615	-0.5301**	0.7646***
24·25	0.4745*	0.2797	0.3919	24	0.2536	0.0844	0.9240***
24·26	-0.5956**	0.5935**	0.6503***	25	0.5506**	0.6264**	0.7188***
25·26	0.3895	0.1700	0.1938	26	0.3504	-0.2835	0.8584***
1·11	0.9751***	0.9249***	0.8413***	31	-0.1373	-0.0512	0.9044***
2·12	0.9833***	0.6563***	0.1886	32	0.2357	0.4205*	0.8975***
3·13	0.9744***	0.9264***	0.6920***	33	-0.0900	0.0291	0.8183***
4·14	0.9891***	0.8295***	0.4466*	34	0.3156	0.4914*	0.8887***
5·15	0.9802***	0.5619**	0.5696**	35	-0.3412	-0.2848	0.8339***
6·16	0.9500***	0.8404***	0.6772***	36	-0.4551*	-0.5429**	0.8992***
31·33	0.9764***	0.9218***	0.6001**				
32·34	0.8175***	0.7864***	0.6674***				
35·36	0.8553***	0.6922***	0.8830***				

Character numbers are the same as mentioned in Table 1.

d.f.; 22

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

5% level in Casamance (Table 11, 12), northern (Table 12, 13), and both regions (Table 13, 14), respectively. It was noticeable that the higher significance was found in Casamance (12) than those of northern (13) regions, which was the same as in the cases of the former 2 items.

In SUM, the whole combinations (=100.0%) showed significances at 0.1% level (Table 14, 15, Table 15, 16, Table 31, 34, and Table 32, 35).

(2) *O. breviligulata*

In NI, 0, 3, 2 and 22; 2, 2, 3 and 20; and 6, 2, 1 and 18 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, 17), 1985 (Table 17, 18), and 1984 and 1985 (Table 18, 19), respectively. The slightly higher value was

Table 19. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. breviligulata*, 398-442 in Casamance region in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.2538	-0.0314	0.4044	1	-0.3258	-0.6857**	0.9006***
1·3	-0.2311	0.2950	0.4636	2	-0.3323	-0.1493	0.9150***
2·3	0.8191***	0.7170**	0.7961***	3	-0.4776	-0.3316	0.8995***
4·5	0.9094***	0.7738***	0.6655**	4	0.5426*	0.4712	0.8358***
4·6	-0.0640	0.8181***	0.7573***	5	0.5595*	0.4034	0.7202**
5·6	0.3552	0.8667***	0.9062***	6	0.5249*	0.5405*	0.9215***
11·12	-0.2112	0.5530*	0.2831	11	-0.5412*	-0.4920*	0.9185***
11·13	-0.0929	0.4904*	0.5228*	12	-0.2667	0.0119	0.7298***
12·13	0.0789	0.4156	0.7615***	13	-0.3732	-0.0976	0.8531***
14·15	0.9313***	-0.0691	0.8375***	14	0.6225**	0.3680	0.8825***
14·16	-0.0237	0.7158**	0.7427***	15	-0.1383	0.7139**	0.1175
15·16	0.3374	0.4261	0.5315*	16	0.4263	0.3641	0.9075***
21·22	0.0726	0.4953*	0.6163**	21	-0.1022	-0.2643	0.8177***
21·23	0.0284	0.3328	0.5711*	22	-0.7449***	-0.4834*	0.8966***
22·23	0.9056***	0.8582***	0.2020	23	-0.8465***	-0.7555***	0.9057***
24·25	0.9442***	0.9243***	0.8707***	24	0.7513***	0.5343*	0.9362***
24·26	0.1072	0.9178***	0.8101***	25	0.9298***	0.7746***	0.9350***
25·26	0.4244	0.9283***	0.7851***	26	0.4372	0.3035	0.9369***
1·11	0.9910***	0.4174	0.6892**	31	-0.2523	-0.1286	0.8981***
2·12	0.9671***	0.7739***	0.8839***	32	0.0725	0.0295	0.8997***
3·13	0.9708***	0.8602***	0.8370***	33	-0.1351	-0.1786	0.9347***
4·14	0.9515***	0.9586***	0.8652***	34	-0.0031	0.2220	0.9166***
5·15	0.9304***	0.3344	0.7492***	35	-0.7768***	-0.5730*	0.8774***
6·16	0.9122***	0.8660***	0.8307***	36	-0.7706***	-0.4588	0.8528***
31·33	0.9522***	0.7790***	0.8177***				
32·34	0.9753***	0.6181**	0.8421***				
35·36	0.9556***	0.9354***	0.9488***				

Character numbers are the same as mentioned in Table 1.

d.f.; 15

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

found in 18 than those in 17, which was the same as in the cases of the former 2 items. In SE, 17, 3, 3 and 4; 2, 3, 3 and 19; and 17, 3, 2 and 5 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 19, 21), northern (Table 20, 22), and both regions (Table 21, 23), respectively. The higher significance was found in 21 than those in 22, which was the same as in the cases of the former 2 items.

In SUM, 17, 2, 2 and 6 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 22, 24). 77.8% combinations of the whole showed significances, which was quite the same as in the cases of the former 2 items.

(3) *O. punctata*

Table 20. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. breviligulata*, 443-456 in northern region in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.3554	0.5458	0.5892	1	0.5197	-0.2408	0.2634
1·3	-0.4498	0.4387	0.8349*	2	-0.1365	-0.0953	0.7128
2·3	0.6429	0.3489	0.6663	3	-0.0428	0.0978	0.9784***
4·5	0.9735***	0.2373	-0.4388	4	0.8245*	0.4326	0.7646*
4·6	-0.0773	0.6416	-0.1833	5	0.1317	-0.0499	0.9406**
5·6	0.1515	0.7202	0.9425**	6	-0.1961	-0.2056	0.8344*
11·12	-0.6616	0.3423	0.0189	11	0.3694	-0.3198	0.5597
11·13	-0.2837	-0.0144	0.0334	12	-0.5617	0.0315	0.6812
12·13	0.5206	0.5026	0.6942	13	0.1806	-0.7111	0.9605***
14·15	0.9670***	0.1377	0.2143	14	0.9143**	0.5431	0.7078
14·16	-0.6015	0.6619	0.4898	15	-0.0917	-0.2469	0.9745***
15·16	-0.3795	0.5463	0.8156*	16	-0.2503	-0.2149	0.7439
21·22	-0.5208	0.1132	0.6763	21	-0.0797	-0.4360	0.6835
21·23	0.5104	0.5401	0.4906	22	-0.5547	0.2391	0.5801
22·23	0.0981	0.7338	0.9459**	23	0.0000	-0.0605	0.6345
24·25	0.8342*	0.5401	0.5612	24	-0.6515	-0.6800	0.7991*
24·26	-0.8398*	0.0000	0.1210	25	-0.7077	-0.6648	0.8800**
25·26	-0.4591	-0.4167	0.0928	26	-0.1904	-0.3686	0.7077
1·11	0.9882***	0.7275	0.2131	31	0.6567	-0.0181	0.6443
2·12	0.9290**	0.8622*	0.4308	32	0.1316	-0.3975	0.7130
3·13	0.9376**	0.9139**	0.9599***	33	0.6208	-0.0867	0.6171
4·14	0.9976***	0.9634***	0.5654	34	-0.4310	-0.6419	0.9521***
5·15	0.9949***	0.9560***	0.9635***	35	0.3000	-0.2082	0.7958*
6·16	0.8193*	0.9033**	0.9179**	36	-0.3142	-0.1812	0.9554***
31·33	0.9662***	0.8739*	0.7005				
32·34	0.9397**	0.5858	0.6901				
35·36	0.9515***	0.7303	0.8022*				

Character numbers are the same as mentioned in Table 1.

d.f.; 5

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

In **TA**, 1, 3, 0 and 23; 1, 3, 2 and 21; and 1, 2, 10 and 14 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 23, **25**), 1988 (Table 24, **26**), and 1984 and 1988 (Table 25, **27**), respectively. The slightly higher significance was found in **26** than those of **25**. In **KE**, 0, 0, 1 and 26; 0, 2, 1 and 24; and 1, 2, 4 and 20 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 26, **28**), 1985 (Table 27, **29**), and 1984 and 1985 (Table 28, **30**), respectively.

In **SUM**, 2, 6; 1, 6; 5, 1; 19 and 14 combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 29, **31**), and 1984, 1985 and 1988 (Table 30, **32**), respectively. 29.6 and 48.2% combinations showed significances in **31** and

Table 21. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Senegal, *O. breviligulata*, 398-442 in Casamance and 443-456 in northern regions in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.3264	-0.0479	0.3718	1	-0.1810	-0.2948	0.8511***
1·3	-0.3126	0.2842	0.4848*	2	-0.0049	0.1054	0.9149***
2·3	0.8482***	0.5881**	0.7527***	3	-0.3257	-0.0970	0.9049***
4·5	0.9329***	0.6750***	0.4968*	4	0.4749*	0.3554	0.8315***
4·6	-0.0265	0.7952***	0.6583***	5	0.1538	0.3227	0.7681***
5·6	0.3332	0.8368***	0.8957***	6	0.4700*	0.4485*	0.9030***
11·12	-0.3423	0.4529*	0.2696	11	-0.3165	-0.4413*	0.8577***
11·13	-0.1988	0.3714	0.4039	12	-0.1289	0.1745	0.7544***
12·13	0.0107	0.4378*	0.7392***	13	-0.2133	0.0722	0.7492***
14·15	0.9412***	-0.0232	0.7470***	14	0.5849**	0.2779	0.8621***
14·16	-0.0984	0.6517***	0.3977	15	-0.1436	0.5752**	0.1191
15·16	0.2402	0.4623*	0.5492**	16	0.2970	0.2640	0.8760***
21·22	-0.1177	0.4140*	0.6044**	21	-0.0895	-0.2643	0.7790***
21·23	-0.0025	0.3275	0.5469**	22	-0.6987***	-0.3591	0.8475***
22·23	0.8823***	0.8355***	0.1307	23	-0.8275***	-0.6871***	0.8654***
24·25	0.9312***	0.9168***	0.8524***	24	0.6689***	0.4347*	0.9276***
24·26	-0.0512	0.8966***	0.7843***	25	0.8968***	0.7134***	0.9255***
25·26	0.3073	0.9055***	0.6558***	26	0.3489	0.2286	0.9263***
1·11	0.9891***	0.4420*	0.6410***	31	-0.0306	-0.0773	0.8611***
2·12	0.9692***	0.7981***	0.8696***	32	0.1880	0.1021	0.8788***
3·13	0.9715***	0.8740***	0.8875***	33	-0.0171	-0.1091	0.8990***
4·14	0.9650***	0.9556***	0.8479***	34	-0.0090	0.1618	0.9235***
5·15	0.9429***	0.4233*	0.7853***	35	-0.6836***	-0.4844*	0.8018***
6·16	0.8953***	0.8344***	0.8395***	36	-0.7354***	-0.3241	0.7814***
31·33	0.9478***	0.7936***	0.8105***				
32·34	0.9692***	0.6219**	0.8068***				
35·36	0.9510***	0.9049***	0.9395***				

Character numbers are the same as mentioned in Table 1.

d.f.; 22

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

32, respectively, which were nearly the same values found in the former 2 items.

4. Relationships between the practical values and their standard deviations

(1) *O. longistaminata*

C.c. and l.r. of practical value on its s.d. among the 24 characters were calculated, and c.c. were shown in the third columns from the right of Tables 1 to 15, 31 and 32. In MD, 0, 0, 2 and 22; 4, 4, 2 and 14; and 2, 3, 2 and 17 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1985 (Table 1, 1), 1988 (Table 2, 2), and 1985 and 1988 (Table 3, 3), respectively. It was noticed that the higher significance was found in 2 than those

Table 22. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in 1984 and 1985 in the whole countries, *O. breviligulata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1-2	-0.1264	0.2041	0.4471**	1	0.0308	0.0753	0.8907***
1-3	-0.0552	0.0430	0.2560	2	0.2085	0.2575	0.9163***
2-3	0.8091***	0.4788***	0.6105***	3	0.0336	0.1755	0.9052***
4-5	0.9154***	0.5200***	0.3401*	4	0.4766***	0.4379**	0.8509***
4-6	-0.2020	0.4794***	0.3120*	5	0.1206	0.3572*	0.7965***
5-6	0.2059	0.6943***	0.6870***	6	0.3998**	0.4055**	0.8897***
11-12	-0.2452	0.4022**	0.2493	11	-0.0666	-0.0916	0.8521***
11-13	-0.0659	0.1455	0.2231	12	0.1669	0.3680**	0.7916***
12-13	-0.0369	0.4593***	0.6086***	13	-0.0162	0.2204	0.8040***
14-15	0.9141***	0.0377	0.4737***	14	0.5112***	0.2387	0.8429***
14-16	-0.2859*	0.4120**	0.7127***	15	-0.0699	0.4541**	0.8886***
15-16	0.1162	0.4916***	0.4604***	16	0.3550*	0.3306*	0.8921***
21-22	-0.1800	0.1690	0.2298	21	0.0669	-0.1315	0.7779***
21-23	0.2893*	0.2653	0.2295	22	-0.5507***	-0.2724	0.8850***
22-23	0.7653***	0.6476***	0.0738	23	-0.6746***	-0.6500***	0.7138***
24-25	0.8742***	0.8035***	0.6877***	24	0.5729***	0.3022	0.9070***
24-26	-0.2149	0.8315***	0.7157***	25	0.8606***	0.7034***	0.9064***
25-26	0.2709	0.8185***	0.4540**	26	0.3097*	0.2186	0.7859***
1-11	0.9793***	0.7875***	0.7915***	31	0.1535	0.2105	0.9087***
2-12	0.8401***	0.7752***	0.6787***	32	0.4429**	0.5248***	0.9248***
3-13	0.9642***	0.8955***	0.8954***	33	0.1524	-0.5232***	0.8784***
4-14	0.9636***	0.9023***	0.6702***	34	0.3515*	0.4911***	0.9264***
5-15	0.9393***	0.4403**	0.7326***	35	-0.5903***	-0.3998**	0.7220***
6-16	0.9267***	0.7878***	0.7529***	36	-0.6815***	-0.3607*	0.7971***
31-33	0.6824***	0.8914***	0.7872***				
32-34	0.9709***	0.7889***	0.7828***				
35-36	0.9297***	0.8435***	0.9147***				

Character numbers are the same as mentioned in Table 1.
d.f.; 47

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

of 1, which was clearly a reversed result of the 2nd and 3rd items. In **TA**, 5, 4, 4 and 11; and 4, 2, 5 and 13 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1988 (Table 4, 5), and 1984 and 1988 (Table 5, 6), respectively. In **KE** (7), 2, 3 and 19 characters showed significances at 1% and 5% levels and no significance even at 5% level, respectively (Table 6).

In **NI**, 0, 0, 5 and 19; 2, 1, 1 and 20; and 3, 2, 3 and 16 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 7, 8), 1985 (Table 8, 9), and 1984 and 1985 (Table 9, 10), respectively. As somewhat reversed results of the former 3 items, the slightly higher level was found in 8 than those of 9. In **IV** (11), 2 and 22 characters

Table 23. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Tanzania, *O. punctata*, 457-459 in 1984

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	-0.9622	-0.1429	0.0000	1	0.9912*	0.9963*	0.9989*
1·3	-0.8934	-0.8885	-0.8910	2	0.0000	0.6432	0.9820
2·3	0.9820	-0.3273	-0.4539	3	0.9897	0.9959*	0.9986*
4·5	0.9999**	0.9966*	0.5714	4	0.2624	0.0498	0.9768
4·6	-0.9401	-0.9747	-0.7250	5	0.3366	0.8457	0.7872
5·6	-0.9417	-0.9897	-0.9795	6	0.1429	0.4456	0.9497
11·12	-0.3789	0.8660	0.9999**	11	0.3195	0.9999**	0.9999**
11·13	0.1073	-0.8171	0.0000	12	0.9820	0.8660	0.9449
12·13	-0.9608	-0.4193	-0.8660	13	0.9567	0.7206	0.9608
14·15	0.8058	-0.8692	-0.6871	14	0.2116	0.1834	0.9996**
14·16	-0.5000	0.9522	-0.3183	15	-0.9939*	-0.9982*	0.9988*
15·16	0.1099	-0.8660	0.9075	16	0.5000	0.3747	-0.6156
21·22	0.8660	0.9999**	0.5000	21	-1.0000***	-0.7206	0.7206
21·23	-0.7559	0.5000	-0.5000	22	0.9999**	0.6934	0.9999**
22·23	-0.3273	0.9999**	-1.0000***	23	-0.1890	-0.4539	0.9608
24·25	1.0000***	-0.8660	-0.9449	24	-0.8660	-0.5000	0.8660
24·26	0.9608	-1.0000***	-0.5695	25	0.5000	0.1890	0.9449
25·26	0.9608	0.8660	-0.1452	26	0.6934	-0.6611	0.0822
1·11	0.9768	0.0468	0.9999**	31	0.9872	0.9854	0.9999**
2·12	0.5000	0.9449	0.9820	32	0.9646	0.9966*	0.9830
3·13	-0.0524	0.9078	0.7206	33	-0.6357	-0.4812	0.9826
4·14	0.9846	0.9741	0.9992**	34	0.4799	0.7538	0.9382
5·15	0.6866	-0.8660	-0.9819	35	-0.9449	-0.3394	0.6286
6·16	0.8660	-0.9897	0.9022	36	-0.5000	0.0000	0.8660
31·33	0.7360	0.2136	0.4013				
32·34	0.9277	0.9128	0.9684				
35·36	0.3273	0.8660	0.6286				

Character numbers are the same as mentioned in Table 1.

d.f.; 1

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

showed significances at 5% level and no significance even at 5% level, respectively (Table 10). In SE, 4, 3, 4 and 13; 0, 0, 2 and 22; and 4, 4, 2 and 14 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 11, 12), northern (Table 12, 13), and both regions (Table 13, 14), respectively. The higher significance was remarkably found in 12 than those of 13, which was the same as in the cases of the former 3 items.

In SUM, 4, 4, 5, 4; 4, 3, 1, 4; 3, 2, 2, 3; and 13, 15, 16 and 13 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 14, 15), 1984, 1985 and 1988 (Table 15, 16), in East Africa (Table 31, 34), and in West Africa

Table 24. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Tanzania, *O. punctata*, 2084-2109 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.2206	0.6013**	0.4680*	1	0.3742	0.3898*	0.8721***
1·3	0.1722	0.2327	0.3326	2	-0.3287	0.0120	0.8685***
2·3	0.3959*	-0.0607	-0.1206	3	-0.2354	-0.3806	0.8612***
4·5	0.2277	0.4655*	0.3732	4	0.6693***	0.3421	0.9348***
4·6	-0.5534**	0.4950*	0.1134	5	0.5527**	0.4179*	0.8904***
5·6	0.3472	0.4049*	0.0268	6	0.0928	0.2759	0.7638***
11·12	0.1718	0.2708	-0.0689	11	0.2766	0.3039	0.8540***
11·13	0.1204	0.4545*	0.5744**	12	-0.3126	-0.1600	0.7439***
12·13	0.7180***	-0.1472	0.0000	13	0.0307	-0.2453	0.8028***
14·15	0.7403***	0.6201***	0.3820	14	0.6225***	0.4875*	0.8127***
14·16	-0.3810	0.6033**	0.3422	15	0.6509***	0.5913**	0.9144***
15·16	0.2785	0.3449	0.2699	16	0.0276	0.0409	0.8619***
21·22	0.0377	0.2497	0.0411	21	0.0699	0.0412	0.9450***
21·23	0.1854	-0.2079	0.5107**	22	-0.4603*	-0.4650*	0.8702***
22·23	0.3777	0.2372	0.1794	23	-0.5990**	-0.7555***	0.7639***
24·25	0.6821***	0.5482**	0.3159	24	0.3579	0.3430	0.8520***
24·26	-0.6547***	0.5100**	0.3228	25	0.2893	0.3340	0.9438***
25·26	0.0750	0.3977*	0.3440	26	0.1719	0.3088	0.5502**
1·11	0.7634***	0.4259*	0.4018*	31	0.2265	0.4825*	0.8455***
2·12	0.8066***	-0.1577	-0.1576	32	0.1261	0.0407	0.9316***
3·13	0.9059***	0.2130	0.3484	33	0.1402	-0.0186	0.8951***
4·14	0.7245***	0.4832*	0.1276	34	0.4280*	0.2132	0.8685***
5·15	0.8190***	0.5849**	0.5532**	35	0.3011	-0.0850	0.3412
6·16	0.7892***	0.4226*	0.2669	36	-0.2223	-0.1234	0.8330***
31·33	0.8163***	-0.0057	0.0423				
32·34	0.8519***	0.3325	0.2681				
35·36	0.7591***	0.3486	0.7695***				

Character numbers are the same as mentioned in Table 1.
d.f.; 24

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

(Table 32, 35), respectively. 45.8, 37.5, 33.3 and 45.8% characters of the whole showed significances in 15, 16, 34 and 35, respectively. The higher significance was found in 35 than those of 34, which was a reversed result of the 1st item.

(2) *O. breviligulata*

In NI, 0, 1 and 23; 0, 6 and 18; and 1, 5 and 18 characters showed significances at 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, 17), 1985 (Table 17, 18), and 1984 and 1985 (Table 18, 19), respectively. The higher significances were found in 18 than those of 17, which was the same as in the cases of the former 3 items. In SE, 6, 1, 4 and 13; 0, 1, 1 and 22; and 6, 1, 2 and 15 characters showed significances at 0.1%, 1% and 5% levels and no

Table 25. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Tanzania, *O. punctata*, 457-459 in 1984 and 2084-2109 in 1988

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.3909*	0.4508*	0.4344*	1	0.3419	0.2980	0.9007***
1·3	0.2621	-0.0939	0.0318	2	-0.4522*	-0.2322	0.9010***
2·3	0.4782**	-0.2664	-0.2718	3	-0.0162	-0.2052	0.8857***
4·5	0.2378	0.3794*	0.3474	4	0.6497***	0.3086	0.9387***
4·6	-0.5451**	0.3440	0.1124	5	0.5674**	0.4324*	0.8652***
5·6	0.3819*	0.3739*	0.2450	6	-0.0045	0.1047	0.8213***
11·12	0.2582	0.5973***	0.4213*	11	-0.0947	-0.1054	0.9056***
11·13	0.3372	0.2634	0.1823	12	-0.5111**	-0.4165*	0.8789***
12·13	0.7747***	-0.1607	-0.1002	13	0.0708	-0.1242	0.8213***
14·15	0.7440***	0.6360***	0.4620*	14	0.5314**	0.4239*	0.9015***
14·16	-0.3827*	0.7851***	0.4614*	15	0.5906***	0.5391**	0.9263***
15·16	0.2721	0.4358*	0.3993*	16	0.0394	0.0582	0.7328***
21·22	0.0540	0.4580*	0.3451	21	0.0641	0.0377	0.9508***
21·23	0.0846	-0.3453	0.2354	22	-0.2620	-0.2441	0.9206***
22·23	0.2149	-0.2281	-0.1942	23	-0.0313	-0.2451	0.8099***
24·25	0.6178***	0.5257**	0.3793*	24	0.3033	0.2824	0.9001***
24·26	-0.5411**	0.6142***	0.4939**	25	0.3314	0.3931*	0.9422***
25·26	0.3013	0.4289*	0.4100*	26	0.3500	0.4364*	0.6099***
1·11	0.8256***	0.3484	0.3980*	31	0.0515	0.1629	0.8939***
2·12	0.8486***	0.2384	0.2672	32	0.1386	0.0597	0.9101***
3·13	0.8840***	0.3132	0.4042*	33	0.0794	-0.3867*	0.9421***
4·14	0.7393***	0.5413**	0.3503	34	0.0717	-0.1054	0.8929***
5·15	0.7673***	0.4156*	0.4682*	35	0.2565	-0.0524	0.5722**
6·16	0.7336***	0.3067	0.4850**	36	-0.3034	-0.2276	0.8637***
31·33	0.8772***	0.1814	0.2617				
32·34	0.9060***	0.2630	0.3055				
35·36	0.7253***	0.4971**	0.8340***				

Character numbers are the same as mentioned in Table 1.

d.f.; 27

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

significance even at 5% level in Casamance (Table 19, 21), northern (Table 20, 22), and both regions (Table 21, 23), respectively. The remarkably higher significance was found in 21 than those of 22, which was the same as in the cases of the former 3 items.

In SUM, 8, 2, 3 and 11 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 22, 24). 54.2% characters of the whole showed significances, which was clearly the lower value than those of the former 3 items.

(3) *O. punctata*

In TA, 1, 1, 2 and 20; 3, 2, 2 and 17; and 2, 3, 1 and 18 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 23, 25), 1988

Table 26. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Kenya, *O. punctata*, 460-464 in 1984

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.2129	0.1712	-0.5435	1	0.9663**	0.9433**	0.9939***
1·3	0.8097	-0.6969	-0.5932	2	-0.3098	-0.5551	0.8716
2·3	-0.2885	-0.6839	-0.0802	3	-0.4239	-0.3618	0.9342*
4·5	0.8141	-0.2007	0.1692	4	0.5235	0.0906	0.8278
4·6	-0.7350	-0.4491	-0.0734	5	-0.3706	0.9043*	0.9043*
5·6	-0.2052	0.6053	0.5265	6	0.7884	0.7868	0.9888**
11·12	0.4642	0.2818	0.5744	11	0.7825	0.4916	0.8872*
11·13	0.9472*	0.2959	0.8137	12	-0.6649	-0.8593	0.9432*
12·13	0.3781	0.8709	0.7917	13	0.0109	-0.6239	0.9131*
14·15	-0.4116	0.7332	0.6730	14	0.4706	0.2291	0.9665**
14·16	-0.9514*	0.4936	0.4966	15	0.4231	0.3833	0.9772**
15·16	0.6713	0.1693	0.2682	16	0.3464	0.6537	0.9106*
21·22	-0.7845	0.1572	0.3484	21	0.1912	-0.2274	0.8475
21·23	0.7298	0.2402	0.1309	22	0.6814	0.8321	0.8504
22·23	-0.2789	0.6547	0.6384	23	-0.6875	-0.7450	0.9814**
24·25	-0.3880	0.3844	-0.0120	24	0.0581	-0.7428	0.4564
24·26	-0.5950	0.1681	-0.0521	25	0.7168	0.7249	0.9916***
25·26	0.9703**	0.8848*	0.8098	26	0.8374	0.8458	0.9933***
1·11	0.9876**	0.8956*	0.7368	31	0.3011	0.1456	0.9682**
2·12	0.8644	0.8662	0.8251	32	-0.1993	-0.2302	0.9029*
3·13	0.5374	-0.4293	-0.0741	33	0.8306	0.6474	0.9034*
4·14	0.9484*	-0.3777	-0.8682	34	0.5255	0.4941	0.8787*
5·15	-0.3761	-0.2186	-0.0921	35	0.2942	0.4083	0.9875**
6·16	0.4222	0.3863	0.5750	36	-0.4063	-0.4889	0.9322*
31·33	0.9972***	0.4385	0.2481				
32·34	0.9466*	-0.3438	0.0642				
35·36	0.5976	0.7810	0.8778*				

Character numbers are the same as mentioned in Table 1.

d.f.; 3

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

(Table 24, 26), and 1984 and 1988 (Table 25, 27), respectively. The higher significance was found in 26 than those of 25, which was the same as in the cases of the former 3 items. In KE, 1, 0 and 23; 1, 4 and 19; and 2, 4 and 18 characters showed significances at 1% and 5% levels and no significance even at 5% level in 1984 (Table 26, 28), 1985 (Table 27, 29), and 1984 and 1985 (Table 28, 30), respectively. The higher significance was found in 29 than those of 28, which was the same as in the cases of the former 3 items.

In SUM, 1, 5; 2, 3; 4, 4; 17 and 12 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 29, 31), and 1984, 1985 and 1988 (Table 30, 32), respectively. 29.2 and 50.0% characters of the whole showed significances

Table 27. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Kenya, *O. punctata*, 465-474 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.1229	-0.4023	-0.2323	1	0.4467	0.2310	0.9208***
1·3	0.4779	-0.3629	-0.1755	2	0.1467	0.1349	0.9420***
2·3	0.5090	0.0465	0.0952	3	-0.6540*	-0.7255*	0.9647***
4·5	0.9417***	0.5742	0.5062	4	0.5504	0.3636	0.9133***
4·6	-0.4806	0.4142	0.6296	5	0.7684**	0.9076***	0.9076***
5·6	-0.1601	0.5394	0.6181	6	0.2167	0.1892	0.9732***
11·12	-0.1367	-0.4512	-0.1058	11	-0.2251	-0.1695	0.9583***
11·13	-0.0431	0.3791	0.4528	12	0.0112	-0.2240	0.8945***
12·13	0.5170	0.0143	0.2603	13	-0.4073	-0.2905	0.8740***
14·15	0.8178**	0.5445	0.8533**	14	-0.0691	-0.0836	0.9109***
14·16	-0.0650	0.3547	0.5940	15	0.2936	0.1500	0.9493***
15·16	0.5188	0.5263	0.7574*	16	0.7459*	0.7068*	0.9302***
21·22	0.5462	-0.6391*	-0.5789	21	0.0477	0.2878	0.8792***
21·23	0.1481	-0.5416	-0.2943	22	-0.4252	-0.3870	0.9004***
22·23	0.0093	-0.0208	0.3529	23	-0.0402	0.4383	0.9361***
24·25	-0.0222	-0.4496	0.0158	24	0.2898	0.6171	0.7578*
24·26	-0.6323*	-0.0069	0.3318	25	0.6491*	0.6421*	0.8892***
25·26	0.8264**	0.6800*	0.8102**	26	0.7160*	0.6758*	0.9502***
1·11	0.9860***	0.2505	0.4631	31	0.3300	0.1113	0.7955**
2·12	0.4713	0.4478	0.6311	32	-0.5060	-0.5910	0.8920***
3·13	0.8233**	0.7499*	0.5155	33	-0.4213	-0.4226	0.7333*
4·14	0.9409***	0.0874	0.4382	34	-0.3912	-0.5186	0.8807***
5·15	0.9211***	0.1262	0.2381	35	-0.5121	-0.6562*	0.7630*
6·16	0.4345	0.4479	0.5543	36	0.2226	0.1747	0.9318***
31·33	0.9000***	-0.2578	0.3818				
32·34	0.8671**	0.4505	0.5417				
35·36	0.7037*	0.0668	0.3666				

Character numbers are the same as mentioned in Table 1.

d.f.; 8

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

in 31 and 32, respectively. The higher significance was found in 32 than those of 31, which was the same as in the cases of the former 3 items.

5. Relationships between the practical values and their variation ranges

(1) *O. longistaminata*

C.c. and l.r. of practical value on its variation range among 24 characters were calculated, and c.c. were shown in the second columns from the right of Tables 1 to 15, 31 and 32. In MD, 0, 1, 1 and 22; 3, 4, 4 and 13; and 1, 2, 3 and 18 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1985 (Table 1, 1), 1988 (Table 2, 2), and 1985 and 1988 (Table 3, 3), respectively. It was noticed that the higher significances were found in

Table 28. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in Kenya, *O. punctata*, 460-464 in 1984 and 465-474 in 1985

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.1813	-0.2387	-0.0950	1	0.5582*	0.3842	0.9409***
1·3	0.5118	-0.4871	-0.3191	2	0.2145	0.1804	0.9412***
2·3	0.2924	-0.1728	0.0220	3	-0.4991	-0.7255**	0.9381***
4·5	0.9099***	0.3344	0.4122	4	0.5410*	0.3205	0.8863***
4·6	-0.4905	0.0620	0.4446	5	0.5251*	0.9038***	0.9038***
5·6	-0.0868	0.5659*	0.6078*	6	0.3579	0.2670	0.9606***
11·12	0.0271	-0.4209	-0.0731	11	-0.0869	-0.0645	0.9517***
11·13	0.2844	0.3611	0.4882	12	-0.0903	-0.2940	0.8987***
12·13	0.4789	0.0435	0.2529	13	-0.2286	-0.1663	0.8824***
14·15	0.7093**	0.5806*	0.7318**	14	0.0286	-0.0090	0.9209***
14·16	-0.2932	0.3975	0.5469*	15	0.2808	0.1430	0.9293***
15·16	0.4635	0.4581	0.7017**	16	0.6057*	0.6752**	0.9198***
21·22	0.3581	-0.4613	-0.4064	21	0.0995	0.2172	0.8657***
21·23	0.3246	-0.2731	-0.1783	22	-0.3742	-0.3324	0.9014***
22·23	-0.0872	0.1260	0.4077	23	-0.3156	0.2795	0.9486***
24·25	-0.1733	-0.2905	-0.0326	24	0.3094	0.5374*	0.7446**
24·26	-0.6546**	0.0113	0.1945	25	0.6906**	0.6903**	0.9318***
25·26	0.8827***	0.7658***	0.8133***	26	0.7540**	0.8053***	0.9585***
1·11	0.9797***	0.3160	0.4884	31	0.3331	0.1478	0.8676***
2·12	0.5644*	0.3117	0.4614	32	-0.1956	-0.3046	0.9227***
3·13	0.6956**	0.2705	0.3133	33	-0.1821	-0.2610	0.7805***
4·14	0.9341***	-0.0497	0.1245	34	0.0331	-0.0294	0.8906***
5·15	0.8327***	0.1102	0.2230	35	-0.3813	-0.4675	0.8592***
6·16	0.3677	0.4443	0.5776*	36	0.0099	-0.0040	0.9217***
31·33	0.9217***	-0.2091	0.2651				
32·34	0.8550***	0.4258	0.4957				
35·36	0.5773*	0.4057	0.5765*				

Character numbers are the same as mentioned in Table 1.
d.f.; 13

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

2 than those of 1, which was the same as in the case of the 4th item. In TA, 5, 4, 3 and 12; and 3, 3, 7 and 11 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1988 (Table 4, 5), and 1984 and 1988 (Table 5, 6), respectively. In KE (7), 1, 3, 6 and 14 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 6).

In NI, 0, 2, 3 and 19; 3, 0, 4 and 17; and 4, 2, 3 and 15 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 7, 8), 1985 (Table 8, 9), and 1984 and 1985 (Table 9, 10), respectively. The slightly higher significance was found in 9 than those of 8, which was the same as in the cases of the 1st, 2nd and 3rd items, and

Table 29. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in 1984 and 1985 in the whole countries, *O. punctata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.1768	-0.2124	-0.0677	1	0.5428*	0.4020	0.9488***
1·3	0.4863*	-0.4699*	-0.3511	2	0.1677	-0.2295	0.9411***
2·3	0.3824	-0.1720	0.0110	3	-0.4807*	-0.6926**	0.9425***
4·5	0.9136***	0.3353	0.4116	4	0.5211*	0.2975	0.8983***
4·6	-0.4872*	-0.0219	0.3338	5	0.5131*	0.4257	0.8986***
5·6	-0.0923	0.5493*	0.5529*	6	0.3328	0.2459	0.9619***
11·12	0.0978	-0.3198	-0.0447	11	-0.1225	-0.0992	0.9452***
11·13	0.3137	0.3458	0.4072	12	-0.1309	-0.2744	0.9006***
12·13	0.6023**	0.0433	0.1668	13	-0.2799	-0.1079	0.8635***
14·15	0.7098***	0.5682*	-0.2494	14	0.0861	0.0329	0.9215***
14·16	-0.0535	0.5671*	0.4714*	15	0.3398	0.1773	0.9135***
15·16	0.4952*	0.5450*	0.7179***	16	0.6280**	0.6587**	0.7576***
21·22	0.4079	-0.4548	-0.3391	21	0.0590	0.1391	0.8380***
21·23	0.3377	-0.2490	-0.1934	22	-0.4253	-0.3218	0.8633***
22·23	0.0385	0.0038	0.3605	23	-0.2884	0.2058	0.9478***
24·25	-0.0589	-0.2195	-0.0133	24	0.3052	0.5352*	0.7731***
24·26	-0.5522*	0.0743	0.2354	25	0.6912**	0.6639**	0.9312***
25·26	0.8883***	0.7748***	0.8134***	26	0.7681***	0.6581**	0.9565***
1·11	0.9768***	0.3251	0.4464	31	0.2592	0.1173	0.9079***
2·12	0.6429**	0.3453	0.4918*	32	-0.2066	-0.3113	0.9285***
3·13	0.7218***	0.3381	0.3407	33	-0.3396	-0.3792	0.8330***
4·14	0.9346***	0.1225	0.2368	34	-0.0755	-0.0962	0.8972***
5·15	0.8010***	0.1729	0.2035	35	-0.4496	-0.4830*	0.8308***
6·16	0.3464	0.4153	0.6132**	36	-0.0615	-0.0640	0.9200***
31·33	0.9107***	-0.1158	0.3568				
32·34	0.8432***	0.4865*	0.5471*				
35·36	0.6115**	0.4402	0.5680*				

Character numbers are the same as mentioned in Table 1.

d.f.; 16

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

which was a result quite different from those of the 4th item. In IV (11), the whole characters (=24) showed no significance even at 5% level (Table 10). In SE, 3, 2, 2 and 17; 0, 0, 6 and 18; 3, 3, 4 and 14 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 11, 12), northern (Table 12, 13), and both regions (Table 13, 14), respectively. The significant levels of 12 and 13 were fixed to be nearly the same, which was a result quite different from those of the former 4 items, in which the levels of 12 were clearly larger than those of 13.

In SUM, 6, 3, 5, 4; 2, 1, 1, 2; 2, 3, 2, 5; and 14, 17, 16 and 13 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 14,

Table 30. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in 1984, 1985 and 1988 in the whole countries, *O. punctata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.9970***	0.0563	0.7207***	1	0.4994***	0.2893	0.8789***
1·3	0.3581*	-0.1972	-0.2068	2	-0.3812*	0.0963	0.9296***
2·3	0.4273**	-0.3815*	-0.2584	3	-0.1487	-0.3410*	0.9396***
4·5	0.7098***	0.1294	0.2230	4	0.5672***	0.2505	0.9236***
4·6	-0.4735**	0.0905	0.1213	5	0.5816***	0.4419**	0.8539***
5·6	0.2793	0.4902***	0.4308**	6	0.2329	0.2222	0.9278***
11·12	0.2594	0.3721*	0.4367**	11	-0.1581	-0.1682	0.9306***
11·13	0.2562	0.1301	0.2019	12	-0.4117**	-0.3947**	0.9341***
12·13	0.5802***	-0.3171*	-0.0623	13	-0.1197	-0.1555	0.8137***
14·15	0.6871***	0.4802***	-0.2419	14	0.2731	0.2180	0.9277***
14·16	-0.1116	0.5279***	0.5084***	15	0.4340**	0.2587	0.8924***
15·16	0.4752**	0.4303**	0.5167***	16	0.3332*	0.2928	0.7984***
21·22	0.2141	0.4885***	0.4841***	21	0.2002	0.2023	0.9509***
21·23	0.2103	-0.2675	-0.1734	22	-0.0026	0.0351	0.9372***
22·23	-0.1330	-0.2370	-0.0979	23	-0.3115*	-0.4004**	0.9218***
24·25	0.3064*	0.2113	0.2863	24	0.1822	0.1818	0.9155***
24·26	-0.5207***	0.3441*	0.2069	25	0.5164***	0.5048***	0.9168***
25·26	0.6548***	0.5977***	0.6355***	26	0.6059***	0.5279***	0.9441***
1·11	0.9308***	0.2481	0.4464**	31	0.2501	0.1533	0.8695***
2·12	0.7881***	0.4540**	0.4758**	32	0.2259	-0.0183	0.9065***
3·13	0.7551***	0.4146**	0.3446*	33	-0.4120**	-0.4186**	0.9371***
4·14	0.8441***	0.5098***	0.4646**	34	0.0275	-0.1119	0.8962***
5·15	0.8245***	0.2305	0.2919	35	0.3242*	0.1358	0.7521***
6·16	0.5993***	0.3713*	0.4679**	36	0.0104	0.1029	0.8888***
31·33	0.8873***	-0.0947	0.2234				
32·34	0.8511***	0.1601	0.2434				
35·36	0.6887***	0.5167***	0.7956***				

Character numbers are the same as mentioned in Table 1.
d.f.; 42

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

15), 1984, 1985 and 1988 (Table 15, 16), in East Africa (Table 31, 34), and in West Africa (Table 32, 35), respectively. 41.7, 29.2, 33.3 and 45.8% characters of the whole showed significances in 15, 16, 34, 35, respectively. The higher significance was found in 35 than those of 34, which was quite the same and the reversed results of those of the 4th item, and of the former 3 items, respectively.

(2) *O. breviligulata*

In NI, 0, 2 and 22; 1, 4 and 19; and 4, 5 and 15 characters showed significances at 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, 17), 1985 (Table 17, 18), and 1984 and 1985 (Table 18, 19), respectively. The higher significance was found in 18 than those

Table 31. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in East Africa (Madagascar, Tanzania and Kenya), 107 strains of *O. longistaminata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.5958***	0.6165***	0.6518***	1	0.0019	-0.0404	0.9466***
1·3	0.7178***	0.4996***	0.5337***	2	0.0399	0.0214	0.8244***
2·3	0.7461***	0.5006***	0.5665***	3	-0.0813	0.0305	0.9343***
4·5	0.6027***	0.5097***	0.5764***	4	0.3390***	0.2646**	0.9567***
4·6	-0.6619***	0.4183***	0.5924***	5	0.2202*	0.1497	0.9284***
5·6	0.1936*	0.6058***	0.7747***	6	0.0918	0.1244	0.7819***
11·12	0.5999***	0.6024***	0.6208***	11	-0.0183	-0.0061	0.9385***
11·13	0.7860***	0.5840***	0.5734***	12	0.0459	0.0277	0.9599***
12·13	0.7442***	0.6324***	0.6801***	13	0.1142	-0.0699	0.9471***
14·15	0.6073***	0.5931***	0.6435***	14	0.1811	0.1391	0.9279***
14·16	-0.6901***	0.5887***	0.6022***	15	0.1217	0.1940*	0.9366***
15·16	0.1477	0.5547***	0.6974***	16	0.3053**	0.3217***	0.9032***
21·22	0.2922**	0.6763***	0.7271***	21	-0.1815	-0.1737	0.9131***
21·23	0.3068**	0.5448***	0.6672***	22	-0.0028	0.0279	0.8709***
22·23	0.3794***	0.6042***	0.6686***	23	-0.4474***	-0.4599***	0.9183***
24·25	0.4971***	0.7088***	0.7543***	24	-0.0724	-0.0618	0.9578***
24·26	-0.4993***	0.7510***	0.6997***	25	0.2058*	0.2063*	0.9348***
25·26	0.3499***	0.7047***	0.6757***	26	0.3983***	0.3867***	0.9298***
1·11	0.7779***	0.7100***	0.7096***	31	0.0006	0.1744	0.9474***
2·12	0.9187***	0.6740***	0.7727***	32	0.4018***	0.3347***	0.9732***
3·13	0.9083***	0.7292***	0.7660***	33	0.1608	0.1402	0.8520***
4·14	0.8241***	0.7739***	0.7310***	34	0.4013***	0.3336***	0.9681***
5·15	0.6790***	0.6124***	0.6052***	35	-0.0947	-0.0946	0.9486***
6·16	0.8109***	0.5675***	0.7430***	36	-0.1497	0.0804	0.9368***
31·33	0.9171***	0.7206***	0.8098***				
32·34	0.9321***	0.8647***	0.8530***				
35·36	0.8193***	0.9147***	0.9216***				

Character numbers are the same as mentioned in Table 1.

d.f.; 105

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

of 17, which was the same as in the cases of the former 4 items. In SE, 2, 2, 5 and 15; 0, 0, 0 and 24; and 2, 1, 4 and 17 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 19, 21), northern (Table 20, 22), and both regions (Table 21, 23), respectively. The remarkably higher significance was found in 21 than those of 22, which was the same as in the cases of the former 4 items.

In SUM, 5, 5, 3 and 11 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 22, 24). 54.2% characters of the whole showed significances.

Table 32. Correlation coefficient of the former character (Y) on the latter character (X) for 27 combinations (left column), practical value, s.d. and range; for 24 characters (right column), practical value on its s.d., practical value on its range and s.d. on its range; collected in West Africa (Nigeria, Ivory Coast and Senegal), 83 strains of *O. longistaminata*

Combination	Practical value	S.d.	Range	Character	Practical value on its s.d.	Practical value on its range	S.d. on range
1·2	0.5337***	0.4719***	0.6917***	1	-0.1015	-0.0554	0.9370***
1·3	0.4078***	0.4012***	0.6483***	2	-0.1748	-0.1475	0.9564***
2·3	0.4978***	0.5176***	0.6835***	3	-0.1152	-0.0498	0.9259***
4·5	0.5321***	0.5646***	0.6978***	4	0.1024	-0.1275	0.9538***
4·6	-0.2877**	0.5544***	0.7549***	5	0.2330*	0.0900	0.6720***
5·6	0.5360***	0.7143***	0.8056***	6	0.3774***	0.2857**	0.9267***
11·12	0.4269***	0.4497***	0.6610***	11	-0.2032	-0.2617*	0.9314***
11·13	0.9975***	0.2530*	0.5334***	12	0.0039	0.1678	0.9423***
12·13	0.7077***	0.5240***	0.6946***	13	-0.0805	0.1841	0.9220***
14·15	0.6680***	0.6047***	0.7855***	14	-0.0594	-0.2440*	0.9318***
14·16	-0.3885***	0.6456***	0.7424***	15	-0.0892	-0.0246	0.7903***
15·16	0.2453*	0.5800***	0.6993***	16	0.3230**	0.3250**	0.9434***
21·22	-0.0339	0.7237***	0.8258***	21	-0.6346***	-0.6444***	0.9557***
21·23	0.4384***	0.7261***	0.7947***	22	0.0622	0.2574*	0.9545***
22·23	0.6459***	0.8416***	0.8870***	23	-0.3829***	-0.2739*	0.9209***
24·25	0.7780***	0.9012***	0.9097***	24	-0.2792*	-0.0346	0.9575***
24·26	-0.3113**	0.8062***	0.8647***	25	0.0005	-0.1517	0.9482***
25·26	-0.0543	0.7709***	0.8765***	26	0.6344***	0.6907***	0.9334***
1·11	0.9448***	0.5877***	0.7688***	31	0.1300	0.1597	0.9496***
2·12	0.7358***	0.6930***	0.8225***	32	0.3490**	0.4099***	0.9304***
3·13	0.9140***	0.6546***	0.7568***	33	0.1432	0.1312	0.8811***
4·14	0.8044***	0.7417***	0.8312***	34	0.3539**	0.3800***	0.9555***
5·15	0.8958***	0.6374***	0.8596***	35	-0.3406**	-0.2788*	0.9399***
6·16	0.8845***	0.8103***	0.8676***	36	-0.2430*	0.0080	0.7818***
31·33	0.9424***	0.7160***	0.8203***				
32·34	0.9451***	0.7640***	0.8331***				
35·36	0.8442***	0.8103***	0.9416***				

Character numbers are the same as mentioned in Table 1.
d.f.; 81

***, **, *; significant at 0.1%, 1% and 5% levels, respectively

(3) *O. punctata*

In **TA**, 0, 1, 4 and 19; 1, 1, 5 and 17; and 0, 1, 6 and 17 characters showed significances at 0.1%, 1% and 5% levels and no significance in 1984 (Table 23, **25**), 1988 (Table 24, **26**), and 1984 and 1988 (Table 25, **27**), respectively. The slightly higher significance was found in **26** than those of **25**, which was the same as in the cases of the former 4 items. In **KE**, 0, 0, 2 and 22; 1, 0, 5 and 18; 2, 3, 1 and 18 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 26, **28**), 1985 (Table 27, **29**), and 1984 and 1985 (Table 28, **30**), respectively. The higher significance was found in **29** than those of **28**, which

was the same as in the cases of the former 4 items.

In **SUM**, 0, 2; 4, 4; 2, 1; 18 and 17 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 and 1985 (Table 29, **31**), and 1984, 1985 and 1988 (Table 30, **32**), respectively. 25.0 and 29.2% characters of the whole showed significances in **31** and **32**, respectively. The slightly higher significance was found in **32** than those of **31**, which was the same as in the cases of the former 4 items.

6. Relationships between the standard deviations and their variation ranges

(1) *O. longistaminata*

C.c. and l.r. of s.d. on its variation range among the 24 characters were calculated, and c.c. were shown in the rightmost columns of Tables 1 to 15, **31** and **32**. In **MD**, 24 and 0; 23 and 1; and 24 and 0 characters showed significances at 0.1% and 5% levels in 1985 (Table 1, **1**), 1988 (Table 2, **2**), and 1985 and 1988 (Table 3, **3**), respectively. The quite the same significances were found in **1** and **2**, and which was a quite different result from those in the former 5 items, in which the higher values were constantly found in **2**. In **TA**, the whole characters (=24) showed significances at 0.1% level in the respective cases (Table 4, **5**, and Table 5, **6**). In **KE** (**7**), 22, 1 and 1 characters showed significances at 0.1%, 1% and 5% levels, respectively (Table 6).

In **NI**, 2, 9, 11 and 2 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984, respectively (Table 7, **8**). On the other hand, the whole characters (=24) showed significances at 0.1% level in 1985 (Table 8, **9**), and 1984 and 1985 (Table 9, **10**). So, the higher significance was found in **9** than those of **8**, which was the same as in the cases of the 1st, 2nd, 3rd and 5th items. In **IV** (**11**), 5, 3, 6 and 5 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively (Table 10). The 19 characters showed significances, which was the highest level through the whole items (=6) in this area. In **SE**, 13, 10 and 1 characters showed significances at 0.1%, 1% and 5% levels in northern region, respectively (Table 12, **13**). On the other hand, the whole characters showed significances at 0.1% level in Casamance (Table 11, **12**) and in both regions (Table 13, **14**). The same level was ascertained both in **12** and in **13**.

In **SUM**, the whole characters (=100.0%) showed significances at 0.1% level in 1984 and 1985 (Table 14, **15**), 1984, 1985 and 1988 (Table 15, **16**), in East Africa (Table 31, **34**), and in West Africa (Table 32, **35**).

(2) *O. breviligulata*

In **NI**, 4, 11, 5 and 4; 23, 0, 0 and 1; and 23, 0, 0 and 1 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 16, **17**), 1985 (Table 17, **18**), and 1984 and 1985 (Table 18, **19**), respectively. The higher significance was found in **18** than those of **17**, which was the same as in the cases of the former 5 items. In **SE**, 22, 1, 0 and 1; 5, 2, 4 and 13; and 23, 0, 0 and 1 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in Casamance (Table 19, **21**), northern (Table 20, **22**), and both regions (Table 21, **23**), respectively. The clearly higher significance was found in **21** than those of **22**, which was the same as in the cases of the former 5 items.

In **SUM**, the whole characters (=100.0%) showed significances at 0.1% level (Table 22, **24**).

(3) *O. punctata*

In **TA**, 0, 4, 3 and 17; 22, 1, 0 and 1; and 23, 1, 0 and 0 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 23, **25**), 1988 (Table 24, **26**), and 1984 and 1988 (Table 25, **27**), respectively. The remarkably higher

significance was found in **26** than those of **25**, which was the same as in the cases of the former 5 items. In **KE**, 3, 6, 10 and 5; 20, 1, 3 and 0; 23, 1, 0 and 0 characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level in 1984 (Table 26, **28**), 1985 (Table 27, **29**), and 1984 and 1985 (Table 28, **30**), respectively. The higher significance was found in **29** than those of **28**, which was the same as in the cases of the former 5 items.

In **SUM**, the whole characters (=100.0%) showed significances at 0.1% level in 1984 and 1985 (Table 29, **31**), and 1984, 1985 and 1988 (Table 30, **32**).

7. The four relation-groups under comparison

From the data obtained in Tables 1 to 32, relationships between the two respective characters were compared, and the following facts were ascertained. In this chapter, the three relation-groups, *i.e.*, A (relation between the two respective practical values, corresponding to chapter 1), B (relation between the respective s.d.s., corresponding to chapter 2), and C (relation between the two respective variation ranges, corresponding to chapter 3), were analysed. In addition to these, summed-up data in the columns A, B and C were regulated, and were shown in D column, under the condition that the calculation was to be made by means of the significances in disregard of the significant levels.

(1) *O. longistaminata*

Significant correlations were counted as follows in the order of Tables 1 to 15, 31 and 32; column A (23, 23, 26, 23, 23; 17, 14, 19, 22, 14; 22, 15, 26, 25, 25; 26, 25), B (22, 7, 27, 17, 22; 24, 5, 23, 26, 3; 23, 7, 22, 27, 27; 27, 27), C (27, 8, 27, 17, 21; 27, 7, 26, 27, 3; 27, 10, 25, 27, 27; 27, 27), and D (72, 38, 80, 57, 66; 68, 26, 68, 75, 20; 72, 32, 73, 79, 79; 80, 79), respectively. Totals, averages and their s.d.s. through the whole cases were found to be 368/459 (=27 character-combinations \times 17 tables) = 80.2%, 21.65 ± 4.12 in A, 336/459 = 73.2%, 19.77 ± 8.36 in B, 360/459 = 78.4%, 21.18 ± 8.37 in C, and 1,064/1,377 (=27 combinations \times 17 tables \times 3 items) = 77.3%, 62.59 ± 19.78 in D, respectively. 280, 48, 40, 91 (A), 247, 48, 41, 123 (B), 278, 40, 42, 99 (C), and 805, 136, 123, 313 (D) character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant combinations, averages and their s.d.s. were counted as 215/306 (=3 items \times 17 tables \times 6 character-combinations) = 70.3%, 35.83 ± 2.67 , 224/306 = 73.2%, 37.33 ± 3.64 , 216/306 = 70.6%, 36.00 ± 4.87 , 265/306 = 86.6%, 44.17 ± 1.21 , 144/153 (=3 \times 17 \times 3) = 94.1%, 48.00 ± 0.00 , and 1,064/1,377 (=3 \times 17 \times 27) = 77.3%, 39.41 ± 5.45 in UHG, HG, CV, CM, AV and Total items, respectively.

(2) *O. breviligulata*

Significant correlations were counted as follows in the order of Tables 16 to 22; column A (12, 18, 16, 14, 13, 14, 16), B (7, 9, 12, 19, 6, 22, 21), C (5, 7, 9, 23, 8, 22, 21), and D (24, 34, 37, 56, 27, 58, 58), respectively. Totals, averages and their s.d.s. through the whole cases were found to be 103/189 (=27 combinations \times 7 tables) = 54.5%, 14.71 ± 1.91 in A, 96/189 = 50.8%, 13.71 ± 6.32 in B, 95/189 = 50.3%, 13.57 ± 7.40 in C, and 294/567 (=27 combinations \times 7 tables \times 3 items) = 51.9%, 42.00 ± 13.87 in D, respectively. 82, 9, 12, 86 (A), 63, 17, 16, 93 (B), 61, 18, 16, 94 (C), and 206, 44, 44, 273 (D) character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant combinations, averages and their s.d.s. were counted as 40/126 (=3 items \times 7 tables \times 6 character-combinations) = 31.8%, 6.67 ± 4.11 , 40/126 = 31.8%, 6.67 ± 3.04 , 47/126 = 37.3%, 7.83 ± 3.89 , 110/126 = 87.3%, 18.33 ± 1.70 , 57/63 (=3 \times 7 \times 3) = 90.5%, 19.00 ± 0.00 , and 294/567 (=3 \times 7 \times 27) = 51.9%, 10.89 ± 6.28 in UHG, HG, CV,

CM, AV and Total items, respectively. The values in the whole items were remarkably lower than those of *O. longistaminata*.

(3) *O. punctata*

Significant correlations were counted as follows in the order of Tables 23 to 30; column A (2, 15, 18, 7, 11, 12, 16, 20), B (4, 14, 14, 2, 3, 3, 7, 15), C (4, 6, 13, 1, 3, 7, 8, 13), and D (10, 35, 45, 10, 17, 22, 31, 48), respectively. Totals, averages and their s.ds. through the whole cases were found to be 101/216 (=27 combinations×8 tables) =46.8%, 12.63 ± 5.57 in A, 62/216=28.7%, 7.75 ± 5.29 in B, 55/216=25.5%, 6.88 ± 4.11 in C, and 218/648 (=27 combinations×8 tables×3 items) =33.6%, 27.25 ± 13.91 in D, respectively. 63, 20, 18, 115 (A), 15, 13, 34, 154 (B), 12, 19, 24, 161 (C), and 90, 52, 76, 430 (D) character-combinations showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant combinations, averages and their s.ds. were counted as 36/144 (=3 items×8 tables×6 character-combinations)=25.0%, 6.00 ± 2.16 , 47/144=32.6%, 7.83 ± 3.80 , 43/144=30.0%, 7.17 ± 5.49 , 62/144=43.1%, 10.33 ± 1.70 , 30/72 (=3×8×3)=41.7%, 10.00 ± 2.94 , and 218/648 (=3×8×27)=33.6%, 8.07 ± 3.91 in UHG, HG, CV, CM, AV and Total items, respectively. The values in the whole items were remarkably lower than those of *O. longistaminata* and *O. breviligulata*, which was looked upon as one of the species specificities.

(4) Comparison with other materials

Average values of significant correlations with the other areas were counted as follows in the order of wild rice collected in northeastern India (17 strains)⁶⁾, cultivated rices collected in India (21 strains)⁷⁾, Burma (64 strains)¹⁵⁾, Chinsurah (100 strains)²⁰⁾, Madura (29 strains)²¹⁾ and Fiji (20 strains)²³⁾; column A-55.6%, B-44.4%, C-37.0%, D-45.7%; A-65.4%, B-56.8%, C-42.0%, D-54.7%; A-88.9%, B-77.8%, C-77.8%, D-81.5%; A-75.3%, B-66.7%, C-60.5%, D-67.5%; A-74.1%, B-63.0%, C-55.6%, D-64.2%; A-63.0%, B-77.8%, C-33.3%, D-58.0%, respectively.

In comparison with those and the present data, *O. longistaminata* of the present experiment showed the value nearly the same as those of the cultivated rice of Burma, being relatively high. On the other hand, *O. breviligulata* and *O. punctata* of the present experiment clearly showed lower values than those of the other materials. The phenomena were seen as one of the species specificities.

8. The other four relation-groups under comparison

From the data obtained in Tables 1 to 32, the other relationships between the two respective characters were compared, and the following facts were ascertained. In this chapter, the three relation-groups, *i.e.*, E (relation between practical values and their s.ds., corresponding to chapter 4), F (relation between practical values and their variation ranges, corresponding to chapter 5), and G (relation between s.ds. and their variation ranges, corresponding to chapter 6), were analysed. In addition to these, summed-up data from the columns E, F and G were regulated, and were shown in H column, under the condition that the calculation was to be made by means of the significances in disregard of the significant levels.

(1) *O. longistaminata*

Significant correlations were counted as follows in the order of Tables 1 to 15, 31 and 32; column E (2, 10, 7, 13, 11; 5, 5, 4, 8, 2; 11, 2, 10, 11, 9; 8, 11), F (2, 11, 6, 12, 13; 10, 5, 7, 9, 0; 7, 6, 10, 10, 7; 8, 11), G (24, 24, 24, 24, 24; 24, 22, 24, 24, 19; 24, 24, 24, 24, 24; 24, 24), and H (28, 45, 37, 49, 48; 39, 32, 35, 41, 21; 42, 32, 44, 45, 40; 40, 46), respectively. Totals, averages and their

s.ds. through the whole cases were found to be 129/408 (=24 characters×17 tables) =31.6%, 7.59 ± 3.52 in E, 134/408=32.8%, 7.88 ± 3.36 in F, 401/408=98.3%, 23.59 ± 1.24 in G, and 664/1,224 (=24 characters×17 tables×3 items) =54.3%, 39.06 ± 7.30 in H, respectively. 45, 37, 47, 279 (E), 44, 32, 58, 274 (F), 353, 28, 20, 7 (G), and 442, 97, 125, 560 (H) characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant characters, averages and their s.ds. were counted as 155/306 (=3 items×17 tables×6 characters) =50.7%, 25.38 ± 3.29 , 153/306=50.0%, 25.50 ± 7.59 , 183/306=59.8%, 30.50 ± 5.85 , 173/306=56.5%, 28.83 ± 5.34 , and 664/1,224 (=3×17×24) =54.3%, 27.67 ± 6.09 in UHG, HG, CV, AV and Total items, respectively.

(2) *O. breviligulata*

Significant correlations were counted as follows in the order of Tables 16 to 22; column E (1, 6, 6, 11, 2, 9, 13), F (2, 5, 9, 9, 0, 7, 13), G (20, 23, 23, 23, 11, 23, 24), and H (23, 34, 38, 43, 13, 39, 50), respectively. Totals, averages and their s.ds. through the whole cases were found to be 48/168 (=24 characters×7 tables) =28.6%, 6.86 ± 4.12 in E, 45/168=26.8%, 6.43 ± 4.14 in F, 147/168=87.5%, 21.00 ± 4.24 in G, and 240/504 (=24 characters×7 tables×3 items)=47.6%, 34.29 ± 11.59 in H, respectively. 20, 6, 22, 120 (E), 9, 13, 23, 123 (F), 124, 14, 9, 21 (G), and 153, 33, 54, 264 (H) characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant characters, averages and their s.ds. were counted as 60/126 (3 items×7 tables×6 characters) =47.6%, 10.00 ± 4.55 , 54/126=42.9%, 9.00 ± 1.83 , 65/126=51.6%, 10.83 ± 2.97 , 61/126=48.4%, 10.17 ± 3.18 , and 240/504 (=3×7×24)=47.6%, 10.00 ± 3.34 in UHG, HG, CV, AV and Total items, respectively. The values were slightly smaller than those of *O. longistaminata*.

(3) *O. punctata*

Significant correlations were counted as follows in the order of Tables 23 to 30; column E (4, 7, 6, 1, 5, 6, 7, 12), F (5, 7, 7, 2, 6, 6, 6, 7), G (7, 23, 24, 19, 24, 24, 24, 24), and H (16, 37, 37, 22, 35, 36, 37, 43), respectively. Totals, averages and their s.ds. through the whole cases were found to be 48/192 (=24 characters×8 tables)=25.0%, 6.00 ± 2.92 in E, 46/192=24.0%, 5.75 ± 1.56 in F, 169/192 =88.0%, 21.13 ± 5.58 in G, and 263/576 (=24 characters×8 tables×3 items)=45.7%, 32.88 ± 8.45 in H, respectively. 12, 15, 21, 144 (E), 6, 14, 26, 146 (F), 139, 14, 16, 23 (G), and 157, 43, 63, 313 (H) characters showed significances at 0.1%, 1% and 5% levels and no significance even at 5% level, respectively.

Through the whole columns, significant characters, averages and their s.ds. were counted as 76/144 (=3 items×8 tables×6 characters)=52.8%, 12.67 ± 4.35 , 68/144=47.2%, 11.33 ± 2.75 , 68/144=47.2%, 11.33 ± 3.54 , 51/144=35.4%, 8.50 ± 0.96 , and 263/576 (=3×8×24)=45.7%, 10.96 ± 3.51 in UHG, HG, CV, AV and Total items, respectively. The values were fixed to be larger in the order of *O. longistaminata* (54.3%), *O. breviligulata* (47.6%) and *O. punctata* (45.7%), which was seen as one of the species specificities.

(4) Comparison with other materials

Average values of significant correlations with the other areas were counted as follows in the same order of the 7th chapter; column E-16.7%, F-25.0%, G-95.8%, H-45.8%; E-36.1%, F-29.2%, G-95.8%, H-53.7%; E-37.5%, F-33.3%, G-100.0%, H-56.9%; E-63.9%, F-63.9%, G-100.0%, H-75.9%; E-50.0%, F-45.8%, G-100.0%, H-65.3%; E-54.2%, F-33.3%, G-79.2%, H-55.6%, respectively.

In comparison with the previous and the present data, the present materials including 3

species showed relatively lower significant levels than those of the other materials.

9. Further discussion

Basing on the results obtained in the previous and the present experiments, the following problematic items are to be discussed here.

(1) Character specificities

In *O. longistaminata*, the significant correlations were counted as follows in the order of character-combination Nos.1·2 to 35·36 (D); 37, 32, 37, 33, 36, 40 (UHG); 36, 32, 42, 41, 39, 34 (HG); 32, 33, 36, 46, 37, 32 (CV); 43, 43, 46, 45, 43, 45 (CM); 48, 48, 48 (AV), respectively. The largest (48/51 [=3 items×17 tables]=94.1%) was found in the combination Nos.31·33, 32·34 and 35·36, followed by Nos.24·25 and 3·13 (46/51=90.2%). The smallest (32/51=62.8%) was noted in Nos.1·3, 11·13, 21·22 and 25·26, followed by Nos.4·5 and 21·23 (33/51=64.7%). In the other items, those were counted as follows in the order of character Nos.1 to 36 (H); 24, 28, 22, 24, 25, 32 (UHG); 28, 24, 22, 19, 19, 41 (HG); 37, 25, 36, 25, 24, 36 (CV); 28, 35, 26, 37, 24, 23 (AV), respectively. The largest (41/51=80.4%) was found in character No.16, followed by Nos.21 and 34 (37/51=72.6%). The smallest (19/51=37.3%) was noted in Nos.14 and 15, followed by Nos.3 and 13 (22/51=43.1%).

In *O. breviligulata*, those correlations were counted as follows in the order of Nos.1·2 to 35·36 (D); 1, 2, 11, 12, 7, 7 (UHG); 3, 2, 9, 10, 8, 8 (HG); 5, 3, 7, 12, 14, 6 (CV); 17, 16, 21, 18, 18, 20 (CM); 19, 19, 19 (AV), respectively. The largest (21/21 [=3 items×7 tables]=100.0%) was found in Nos.3·13, followed by Nos.6·16 (20/21=95.2%). The smallest (1/21=4.8%) was noted in Nos.1·2, followed by Nos.1·3 and 11·13 (2/21=9.5%). In the other items, those were counted as follows in the order of character Nos.1 to 36 (H); 5, 6, 7, 15, 10, 17 (UHG); 10, 7, 7, 12, 8, 10 (HG); 8, 10, 12, 12, 16, 7 (CV); 6, 9, 7, 11, 13, 15 (AV), respectively. The largest (17/21=81.0%) was found in No.6, followed by No.25 (16/21=76.2%). The smallest (5/21=23.8%) was noted in No.1, followed by Nos.2 and 31 (6/21=28.6%).

In *O. punctata*, those correlations were counted as follows in the order of Nos.1·2 to 35·36 (D); 7, 3, 4, 8, 5, 7 (UHG); 5, 3, 5, 14, 10, 10 (HG); 5, 1, 2, 7, 11, 17 (CV); 13, 8, 10, 12, 10, 9 (CM); 7, 9, 14 (AV), respectively. The largest (17/24 [=3 items×8 tables]=70.8%) was found in Nos.25·26, followed by Nos.14·15 and 35·36 (14/24=58.3%). The smallest (1/24=4.2%) was noted in Nos.21·23, followed by Nos.22·23 (2/24=8.3%). In the other items, those were counted as follows in the order of character Nos.1 to 36 (H); 16, 8, 15, 11, 19, 7 (UHG); 9, 11, 7, 12, 15, 14 (HG); 7, 10, 11, 8, 16, 16 (CV); 9, 8, 10, 8, 9, 7 (AV), respectively. The largest (19/24=79.2%) was found in No.5, followed by Nos.1, 25 and 26 (16/24=66.7%). The smallest (7/24=29.2%) was noted in Nos.6, 13, 21 and 36.

Through the whole species, 3 character-combinations, *i.e.*, Nos.31·33, 32·34 and 35·36, and the other 3 combinations, *i.e.*, Nos.1·3, 11·13 and 21·23, showed the higher and the lower significant levels, respectively, in which the former and the latter belonged to AV item and L·T item, respectively (D). In the other item (H), two characters, *i.e.*, Nos.12 and 13, showed the lower significant levels, which belonged to HG item. No remarkable highly significant character was found.

In category comparisons, significant correlations were fixed to get larger in the order of AV > CM > Total > HG > CV > UHG (D), and in that of CV > AV > Total > UHG > HG (H) through the whole species in the category averages.

(2) Species specificities

In the D categories, the average values found in character-combinations were fixed to be

70.3% (*O. longistaminata*), 31.8% (*O. breviligulata*), 25.0% (*O. punctata*) (UHG); 73.2%, 31.8%, 32.6% (HG); 70.6%, 37.3%, 29.9% (CV); 86.6%, 87.3%, 43.1% (CM); 94.1%, 90.5%, 41.7% (AV); 77.3%, 51.9%, 33.6% (Total), respectively. It was clearly ascertained that the values were fixed to get larger in the order of *O. longistaminata* > *O. breviligulata* > *O. punctata*.

In the H categories, those were fixed to be 50.7%, 47.6%, 52.8% (UHG); 50.0%, 42.9%, 47.2% (HG); 59.8%, 51.6%, 47.2% (CV); 56.5%, 48.4%, 35.4% (AV); 54.3%, 47.6%, 45.7% (Total), in the same species- and item-orders, respectively. *O. longistaminata* showed the largest values through the whole categories. *O. breviligulata* showed the larger and the smaller values than those of *O. punctata* in CV, AV and Total, and in UHG and HG, respectively.

(3) Locality specificities

In *O. longistaminata*, significant correlations were ascertained as follows in the order of **MD** to **SE**; **MD** (88.9% in Table 1, 46.9% in Table 2, 98.8% in Table 3, 78.2% in average), **TA** (70.4% in Table 4, 81.5% in Table 5, 75.9% in average), **KE** (84.0% in Table 6), **NI** (32.1% in Table 7, 84.0% in Table 8, 92.6% in Table 9, 69.6% in average), **IV** (24.7% in Table 10), **SE** (88.9% in Table 11, 39.5% in Table 12, 90.1% in Table 13, 72.8% in average), respectively (D). Locality averages showed the larger values in the order of **KE** > **MD** > **TA** > **SE** > **NI** > **IV**. The values of East Africa were clearly larger than those of West Africa. In the H categories, those were ascertained as follows in the same order; **MD** (38.9%, 62.5%, 51.4%, 50.9%), **TA** (68.1%, 66.7%, 67.4%), **KE** (54.2%), **NI** (44.4%, 48.6%, 56.9%, 50.0%), **IV** (29.2%), **SE** (58.3%, 44.4%, 61.1%, 54.6%), respectively. Locality averages showed the larger values in the order of **TA** > **SE** > **KE** > **MD** > **NI** > **IV**, respectively. It was noticed that the values of **IV** were the lowest through both of the D and the H categories.

In *O. breviligulata*, those were ascertained as follows in the order of **NI** (29.6% in Table 16, 42.0% in Table 17, 45.7% in Table 18, 58.6% in average) to **SE** (69.1% in Table 19, 33.3% in Table 20, 71.6% in Table 21, 87.0% in average) (D). In the H categories, those were ascertained as follows in the same order; **NI** (31.9%, 47.2%, 52.8%, 66.0%) and **SE** (59.7%, 18.1%, 54.2%, 66.7%), respectively. Locality averages of **NI** were fixed to be smaller than those of **SE** through both of the D and the H categories.

In *O. punctata*, those were ascertained as follows in the order of **TA** (12.4% in Table 23, 43.2% in Table 24, 55.6% in Table 25, 37.0% in average) to **KE** (12.4% in Table 26, 21.0% in Table 27, 27.2% in Table 28, 20.2% in average) (D). In the H categories, those were ascertained as follows in the same order; **TA** (22.2%, 51.4%, 51.4%, 41.7%) and **KE** (30.6%, 48.6%, 50.0%, 43.1%). The values of **TA** were larger and smaller than those of **KE** in the D and the H categories, respectively.

Through the 3 species, further 2 comparisons were available. The values of **TA** were smaller and larger than those of **KE** in the D of *O. longistaminata* and the H of *O. punctata*, and the H of *O. longistaminata* and the D of *O. punctata*, respectively. The values of **NI** were always smaller than those of **SE** through the whole of the D and the H in *O. longistaminata* and *O. punctata*.

In view of the intra-locality (=country) variations, some constancies were ascertained, in disregard of the species status. Strains collected in **NI** in 1984 (8 in *O. longistaminata*, 17 in *O. breviligulata*) showed the significances lower than those of 1985 (9 in *O. longistaminata* and 18 in *O. breviligulata*). On the other hand, strains collected in Casamance region of **MD**

(12 in *O. longistaminata* and 21 in *O. breviligulata*) showed the significances higher than those of northern region (13 in *O. longistaminata* and 22 in *O. breviligulata*). In *O. punctata*, strains collected in 1984 in TA (25) and KE (28) showed always the significances lower than those of 26 (TA in 1988) and 29 (KE in 1985), respectively.

(4) Negative relationships

In *O. longistaminata*, negative correlations at the significant levels were counted as follows in the order of Tables 1 to 15, 31 and 32, under the condition that the calculation was to be made by means of the significances in disregard of significant levels; column A (0, 3, 3, 3, 3; 2, 0, 3, 3, 1; 3, 0, 3, 3, 3; 3, 3) B (0 in the whole Tables), C (1 in Table 2, 0 in the other Tables), D (0, 4, 3, 3, 3; 2, 0, 3, 3, 1; 3, 0, 3, 3, 3; 3, 3), E (2, 1, 3, 3, 3; 4, 0, 3, 1, 1; 7, 1, 6, 6, 4; 1, 5), F (2, 1, 2, 3, 3; 8, 0, 5, 2, 0; 4, 1, 4, 6, 3; 1, 5), G (0 in the whole Tables), H (4, 2, 5, 6, 6; 12, 0, 8, 3, 1; 11, 2, 10, 12, 7; 2, 10), respectively. Totals, averages and their s.d.s. through the whole cases were found to be 39/368 (=the whole numbers of significant correlations)=10.6%, 2.29 ± 1.18 (A), 0/336=0.0% (B), 1/360=0.3%, 0.06 ± 0.24 (C), 40/1,064=3.8%, 2.35 ± 1.23 (D), 51/129=39.5%, 3.00 ± 2.03 (E), 50/134=37.3%, 2.94 ± 2.13 (F), 0/401=0.0% (G), 101/664=15.2%, 5.94 ± 3.89 (H), and 141/1,728=8.2%, 8.29 ± 4.56 in the whole cases, respectively.

In character-combinations, Nos.4·6, 14·16, 22·23, 24·26 and 25·26 showed 12, 14, 1, 12 and 1 negative correlations at significant levels, respectively. It was noticeable that L/W (4, 14, 24) and W/T (6, 16, 26) characters were fairly concerned with negative values, which was looked upon as one of the character-specific-specificities. The remaining 22 character-combinations showed no significant level. In characters, Nos.1, 2, 3, 6; 11, 12, 13, 14; 21, 22, 23, 24; 31, 35 and 36 showed negative correlations at significant levels as 3, 6, 4, 1; 11, 1, 3, 1; 20, 6, 20, 8; 2, 8 and 7, respectively. The remaining 9 character-combinations showed no significant level.

In *O. breviligulata*, negative correlations at the significant levels were counted as follows in the order of Tables 16 to 22; A (1, 4, 2, 0, 1, 0, 1), B and C (0 in the whole Tables), D (1, 4, 2, 0, 1, 0, 1), E (0, 1, 1, 5, 0, 4, 4), F (1, 1, 2, 5, 0, 3, 4), G (0 in the whole Tables), H (1, 2, 3, 10, 0, 7, 8), respectively, in which the phenomena in B and G columns were the same as in cases of *O. longistaminata*. Totals, averages and their s.d.s. through the whole cases were fixed to be 9/103=8.7%, 1.29 ± 1.28 (A), 0/96=0.0% (B), 0/95=0.0% (C), 9/294=3.1%, 1.29 ± 1.28 (D), 15/48=31.3%, 2.14 ± 1.96 (E), 16/45=35.6%, 2.29 ± 1.67 (F), 0/147=0.0% (G), 31/240=12.9%, 4.43 ± 3.58 (H), and 40/534=7.5%, 5.71 ± 3.10 in the whole cases, respectively.

In character-combinations, Nos.4·6, 14·16, 21·22 and 24·26 showed 1, 3, 1 and 4 negative correlations at significant levels, respectively, in which 1st, 2nd and 4th combinations were the same as in the cases of *O. longistaminata*. It was also noticed that L/W (4, 14, 24) and W/T (6, 16, 26) characters were constantly concerned with negative values. The remaining 23 character-combinations showed no significant level. In characters, Nos.1, 11, 22, 23, 33, 35 and 36 showed negative correlations at significant levels as 1, 4, 4, 7, 1, 6 and 8, respectively. The remaining 17 characters showed no significant level.

In *O. punctata*, negative correlations at the significant levels were counted as follows in the order of Tables 23 to 30; A (0, 2, 3, 1, 1, 1, 2, 2), B (1, 0, 0, 0, 1, 0, 1, 2), C (1 in Table 23, 0 in other Tables), D (2, 2, 3, 1, 2, 1, 3, 4), E (2, 2, 2, 0, 1, 0, 1, 4), F (1, 2, 2, 0, 2, 1, 2, 4), G (0 in the whole Tables), H (3, 4, 4, 0, 3, 1, 3, 8), respectively, in which C and G columns were the same as in the cases of *O. longistaminata*, and *O. longistaminata* and *O. breviligulata*, respectively. Totals, averages and their s.d.s. through the whole cases were found to be 12/

101=11.9%, 1.50 ± 0.87 (A), $5/62=8.1\%$, 0.63 ± 0.70 (B), $1/51=1.8\%$, 0.13 ± 0.33 (C), $18/218=8.3\%$, 2.25 ± 0.97 (D), $12/48=25.0\%$, 1.50 ± 1.23 (E), $14/46=30.4\%$, 1.75 ± 1.09 (F), $0/169=0.0\%$ (G), $26/263=9.9\%$, 3.25 ± 2.22 (H), and $44/481=9.2\%$, 5.50 ± 3.12 in the whole cases, respectively.

In character-combinations, Nos.1·3, 2·3, 4·6, 12·13, 14·16, 21·22, 22·23 and 24·26 showed 1, 1, 4, 1, 2, 1, 1 and 7 negative correlations at significant levels, respectively, in which 3rd, 5th, 8th; 7th; and 6th combinations were the same as in the cases of *O. longistaminata* and *O. breviligulata*; *O. longistaminata*; and *O. breviligulata*, respectively. The remaining 19 combinations showed no significant level. In characters, Nos.2, 3, 12, 15, 21, 22, 23, 33 and 35 showed negative correlations at significant levels as 2, 6, 4, 2, 1, 2, 4, 3 and 2, respectively. The remaining 15 characters showed no significant level.

In the whole species, negative correlations at significant levels were ascertained as $60/572$ (=negative correlations at significant levels/total correlations at significant levels) = 10.5% (A), $5/494=1.0\%$ (B), $2/510=0.4\%$ (C), $67/1,576=4.3\%$ (D), $78/225=34.7\%$ (E), $80/225=35.6\%$ (F), $0/717=0.0\%$ (G), $158/1,167=13.5\%$ (H), and $225/2,743=8.2\%$ in the whole cases, respectively. It was remarkable that columns E and F, A and H, and B, C, D and G belonged to the high, intermediate and low negative correlation items, respectively. It was noticeable that range characters (C and G columns) showed quite low values in view of negative status. In character-combinations, 3 columns, i.e., Nos.4·6, 14·16 and 24·26 (L/W·W/T), showed 17, 19 and 23 negative correlations at significant levels, respectively, which might be named as a higher negative group. Six combinations, i.e., Nos.1·3, 2·3, 12·13, 21·22, 22·23 and 25·26, showed 1, 1, 1, 2, 2 and 1 negative correlations at significant levels, respectively, which might be named as the lower negative group. The remaining 18 combinations showed no negative correlation at significant level. It was noticed that CM and AV items showed no negative ones at all. Average and its s.d. through the whole cases were found to be 2.48 ± 6.16 .

In character items, Nos.1, 2, 3, 6; 11, 12, 13, 14, 15; 21, 22, 23, 24; 31, 33, 35 and 36 showed negative correlations at significant levels as 4, 8, 10, 1; 15, 5, 3, 1, 2; 21, 12, 31, 8; 2, 4, 16 and 15, respectively. It was noticed that character No.23 (T of CV) showed 31 cases. The remaining 7 characters showed no negative correlation at significant level. Average and its s.d. through the whole cases were found to be 6.58 ± 7.95 .

In the previous and the present experimental data, significant correlations in the respective group averages were ascertained as follows in the order of wild rice collected in north-eastern India⁶¹, cultivated rices collected in India⁷¹, Burma¹⁵¹, Chinsurah²⁰¹, Madura²¹¹, Fiji²³¹, *O. longistaminata* in the present data (Table 15 in the present paper), *O. breviligulata* in the present data (Table 22) and *O. punctata* in the present data (Table 30); 1 (character-combination Nos.24·26), 3 (4·6, 14·16, 24·26), 9 (1·2, 1·3, 4·6, 5·6, 11·12, 11·13, 14·16, 15·16, 24·26), 6 (4·5, 5·6, 11·12, 14·16, 15·16, 24·26), 4 (1·2, 4·6, 14·16, 24·26), 2 (4·6, 14·16), 3 (4·6, 14·16, 24·26), 1 (14·16), 2 (4·6, 24·26) in the A columns; 0, 0, 0, 0, 0, 0, 0, 0, 2 (2·3, 12·13) in the B; 0 in the whole materials (=9) in the C; 0, 3 (character Nos.22, 23, 35), 2 (23, 26), 1 (21), 4 (13, 21, 23, 36), 2 (23, 36), 4 (11, 13, 21, 24), 4 (22, 23, 35, 36), 4 (2, 12, 23, 33) in the E columns; 0, 0, 1 (22), 1 (21), 0, 0, 3 (1, 11, 23), 4 (23, 33, 35, 36), 4 (3, 12, 23, 33) in the F; 0 in the whole materials (=9) in the G, respectively. It was noticeable that character-combination Nos.4·6, 14·16, 24·26 (L/W·W/T) in the A columns and character No.23 (T in HG/UHG) showed particularly a lot of negative correlations, which was looked upon as typical character-specificities. Data obtained in the present materials showed large numbers of negative

significant correlations in comparison with those of the other materials.

Basing on the data obtained in the previous and the present experiments in the columns A to H, it was concluded that those phenomena meant the character-, species- and locality-specificities in these characters. In other words, those characters might genetically be fixed as those which were in possession of a flexibility and an affectability to any effects coming from the environmental conditions.

10. Concluding remarks

Wild rice species have frequently been studied from several agronomical viewpoints in the wider ranges. Variations in morphological characters, such as grain shape (L/W), were tested for strains collected from Republic of Korea³⁴⁾. A search was made for *Acremonium* spp. endophytes in the seeds of *Oryza* and the related genera³⁰⁾. L, W and T of UHG were determined for 2 cultivated species (*O. sativa* and *O. glaberrima*) and 5 wild species (*O. breviligulata*, *O. longistaminata*, *O. punctata*, *O. perennis* and *O. sativa* var. *spontanea*)²⁷⁾. However, only a few reports on the fundamental data concerning morphological characters have been published up to now. Although these analyses have been looked upon as very important contributions, but there has been no basic analysing method. Taking these facts into account, the present study-series were made to ascertain exactly the distribution, and the geographical, seasonal and ecotypic differentiation of the wild rice in African areas. In the previous papers, the following items were reported, preliminary and advanced data of the first and the second survey trips⁸⁻¹⁴⁾, those of the third trip¹⁶⁻¹⁸⁾, morphological characters of the unhusked grains¹⁹⁾, and the husked grains²²⁾, the comparative data (HG/UHG)²⁴⁾, grain areas and volumes²⁵⁾, correlation coefficients between the practical values of the unhusked and the husked grains and the linear regression between these two^{26,28,29)}, and the present paper was carried out as described above, with the confirmation of the morphological characters of grains, which was to make the strain's specificities more obvious. The methodologies conducted in the present study-series may be fixed as one of the fundamental analyses executed for species- and strain-differentiations of not only of the genus *Oryza* but also of related and other genera, on account of the fact that several unique specificities concerning strain-, species- and/or locality-specificities were ascertained in the respective papers.

Summary

During the periods from October to November in 1984, from August to November in 1985 and from May to August in 1988, the writer was dispatched to the 8 countries of Africa, *i.e.*, Madagascar, Tanzania, Kenya, Nigeria, Ivory Coast, Liberia, Senegal and Gambia, for collecting the wild and cultivated rices. During the trips, 284 strains of the wild rice, *i.e.*, 190 strains of *Oryza longistaminata* CHEV. et ROEHR., 49 of *O. breviligulata* CHEV. et ROEHR., 44 of *O. punctata* KOTSCHY and 1 of *O. brachyantha* CHEV. et ROEHR., were collected and a lot of populations of those were observed. In this paper to confirm the varietal variations, relationships between practical values, standard deviations and variation ranges among the 24 characters and the 27 character-combinations, investigations were carried out as the final report of this study-series, following the contents of the previous papers. The main results obtained were summarized as follows.

1. In the summed-up data obtained from the 3 relation groups, *i.e.*, practical value on the other practical values (A), s.d. on the other s.d.s. (B), variation range on other variation

ranges (C), and through the 3 columns (D), 368/459 character-combinations (=80.2%), 336/459 (=73.2%), 360/459 (=78.4%), and 1,064/1,377 (=77.3%) in *O. longistaminata*, 103/189 (=54.5%), 96/189 (=50.8%), 95/189 (=50.3%), and 294/567 (=51.9%) in *O. breviligulata*, 101/216 (=46.8%), 62/216 (=28.7%), 55/216 (=25.5%), and 218/648 (=33.6%) in *O. punctata* showed significances, respectively. Significant values were fixed to be larger in the order of *O. longistaminata* > *O. breviligulata* > *O. punctata*. Through 3 species, character-combination Nos.31·33, 32·34, 35·36 (AV), and Nos.1·3, 11·13, 21·23 (L·T) showed the higher and the lower significant levels, respectively. Locality averages were shown, in general, the larger values were fixed in the order of **KE** > **MD** > **TA** > **SE** > **NI** > **IV**, and East Africa > West Africa.

2. Concerning correlations among the 3 components in the same characters, *i.e.*, between practical value and its s.d. (E), between practical value and its variation range (F), between s.d. and its variation range (G), and through the 3 items (H), 129/408 (=31.6%), 134/408 (=32.8%), 401/408 (=98.3%), and 664/1,224 (=54.3%) in *O. longistaminata*, 48/168 (=28.6%), 45/168 (=26.8%), 147/168 (=87.5%), and 240/504 (=47.6%) in *O. breviligulata*, 48/192 (=25.0%), 46/192 (=24.0%), 169/192 (=88.0%), and 263/576 (=45.7%) characters in *O. punctata* showed significances, respectively. *O. longistaminata* showed the largest values through the whole categories in the 3 species. *O. breviligulata* showed the values larger and the smaller than those of *O. punctata* in CV, AV, Total, and UHG, HG, respectively. Through the 3 categories, character Nos.12 and 13 showed remarkably the lower significant levels. Locality averages showed, in general, the larger values in the order of **TA** > **SE** > **KE** > **MD** > **NI** > **IV**.

3. In comparison of categories (=groups of the respective characters), significant correlations were, in general, fixed to be larger in the order of AV > CM > Total > HG > CV > UHG (D), and in that of CV > AV > Total > UHG > HG (H) through the whole species.

4. Significant correlations in the negative statuses were counted as follows in the order of A to H and the whole, illustrated by ratio (%) of negative to the total significant cases; 10.6, 0.0, 0.3, 3.8, 39.5, 37.3, 0.0, 15.2, 8.2 in *O. longistaminata*; 8.7, 0.0, 0.0, 3.1, 31.3, 35.6, 0.0, 12.9, 7.5 in *O. breviligulata*; 11.9, 8.1, 1.8, 8.3, 25.0, 30.4, 0.0, 9.9, 9.2 in *O. punctata*; 10.5, 1.0, 0.4, 4.3, 34.7, 35.6, 0.0, 13.5, 8.2 in the whole species, respectively. Through the whole species, character-combination L/W·W/T and the character T in HG/UHG showed particularly large values of negative correlations in significant levels.

5. Varietal and ecotypic differentiations were extensively discussed, basing on the data from the previous and the present experiments. Characters, character-combinations and the other items confirmed in the present study-series were certainly to be looked upon as being in possession of something useful and fundamental in methodology, having some universal validities and indices in the examinations of variety- and strain-differentiations. Moreover, comparisons of data obtained here and in some other neighbouring Continent and regions were carried out to some extents, and a few interesting informations were shown in view of locality-specificities. Present materials of *O. longistaminata* showed the significant levels getting the higher and the lower in A ~ D and E ~ H categories, respectively, in comparison with those of the other distributing areas of the species.

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