Distribution and Some Morphological Characters of *Vigna* sp. in the Republic of Nauru

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Introduction

From November 27 to December 10 in 1975, the writer was dispatched to the Republic of Nauru for ecological studies in agriculture. In this island, several strains of some pulses are in growth in the whole ground spreading along the road and near the

Table 1. Distribution and habitat of *Vigna marina* MERR. in the Republic of Nauru

Strain No.	Collection No.	Date	District	Habitat
1	12-3-3	Dec. 3	Aiwo	Near harbour. Seashore.
2	12-3-4	Dec. 3	Aiwo	At the beach. A few matured grains.
3	12-3-5	Dec. 3	Boe	Seashore. Near fowl droppings.
4	12-7-1	Dec. 7	Boe	Seashore.
5	12-7-2	Dec. 7	Yaren	Seashore.
6	12-2-1	Dec. 2	Yaren	Inland.
7	12-2-2	Dec. 2	Meneng	Inland. Many *Lepidoptera.*
8	12-2-3	Dec. 2	Meneng	Inland.
9	12-3-1	Dec. 3	Meneng	Beach. Many spider.
10	12-6-1	Dec. 6	Meneng	Inland. Shaded by coco palms.
11	12-3-2	Dec. 3	Anibare	Seashore.
12	12-4-1	Dec. 4	Anibare	Inland. Growing sporadically. Shaded by several trees.
13	12-4-2	Dec. 4	Anibare	Seashore. Growing together with *Pittosporum* sp.
14	12-4-3	Dec. 4	Ijuw	Seashore.
15	11-30-1	Nov. 30	Anabar	Inland. Near lake. Growing thickly.
16	12-4-4	Dec. 4	Anabar	Seashore.
17	12-4-5	Dec. 4	Anetan	Inland.
18	12-4-6	Dec. 4	Anetan	Seashore. Growing sporadically.
19	12-4-7	Dec. 4	Ewa	Seashore.
20	12-4-8	Dec. 4	Ewa	Seashore.
21	12-4-9	Dec. 4	Baiti	Seashore.
22	12-4-10	Dec. 4	Uaboe	Seashore.
23	12-4-11	Dec. 4	Nibok	Seashore.
24	12-4-12	Dec. 4	Denigomodu	Seashore. Growing sporadically.
2	12-4-13	Dec. 4	Denigomodu	Seashore.
26	12-5-1	Dec. 5	Buada	Lagoon Lake. Shaded by kapok trees.

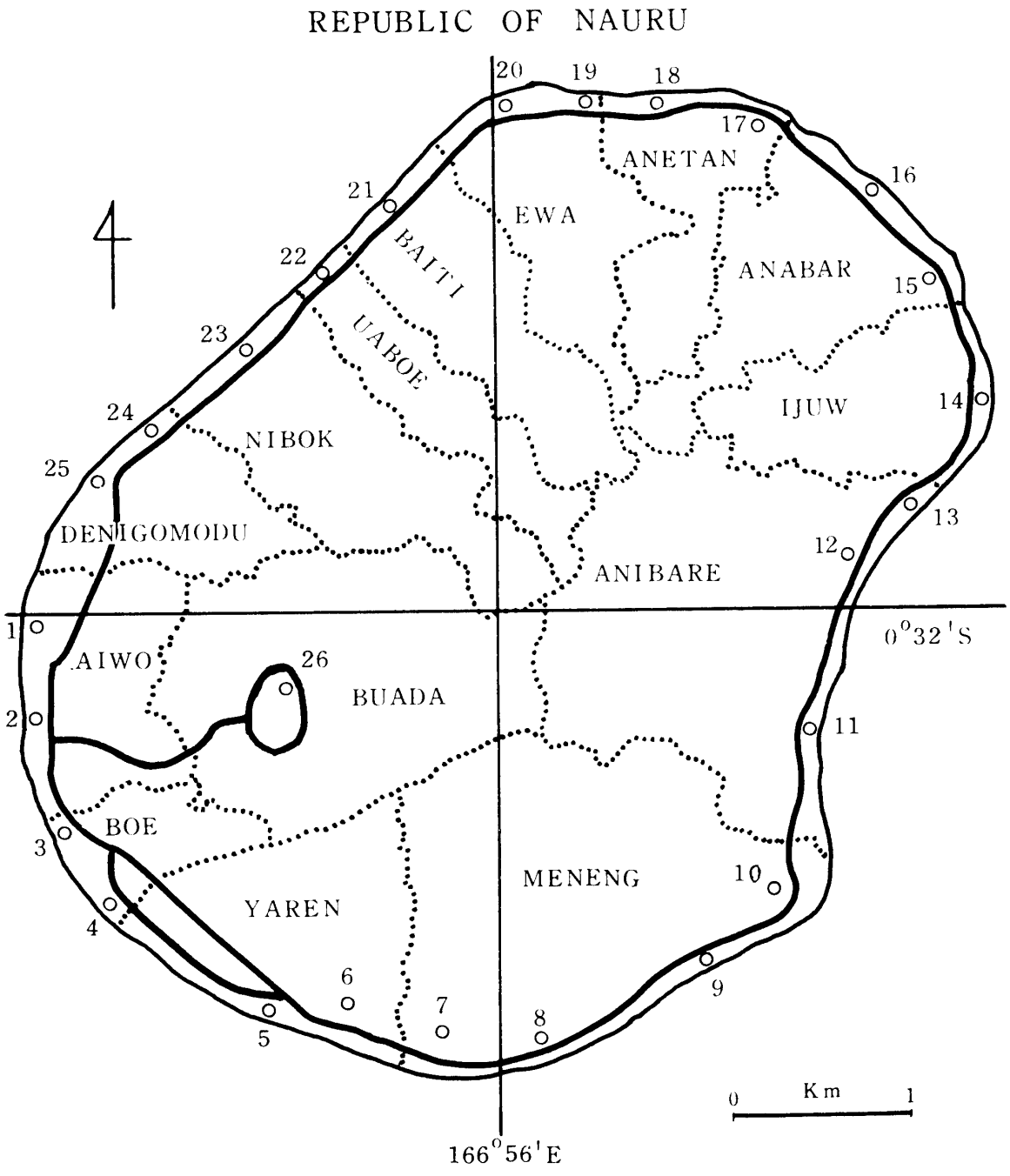

Fig. 1. Map showing localities where *Vigna marina* was collected in the Republic of Nauru. Solid line: main road; dotted line: district boundary; open circle: collection-area. Code numbers used in the figure are corresponding to the strain number which was used in Table 1.

beach. Grains of these pulses are not used at all for food by the people.

In this report, some records on morphological characters of grains collected and some considerations of ecotypic differentiations have been mainly described.

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Materials and Methods

Twenty six strains were collected at about a kilometer intervals in this trip (Fig. 1 and Table 1), and these were used for morphological investigations of grains. Measurements were done in length, width and thickness of grains, and done at the largest position of the respective character. Fifty grains were used for the measurement of each strain, excepting No.2 (34 grains), No.12 (32), No.18 (45) and No.24 (19). The whole data referring to the six characters were illustrated by the average values in the whole grains in the respective strain. Calculations, moreover, were done for the ratios of length to width,

Table 2. Morphological characters of grains

Strain No.	Length (*mm*)	Width (*mm*)	Thickness (*mm*)	L/W	L/T	W/T
1	6.08±0.29	4.36±0.19	4.11±0.20	1.40±0.08	1.49±0.10	1.06±0.03
2	6.09±0.40	4.28±0.23	3.80±0.21	1.43±0.11	1.61±0.13	1.13±0.06
3	5.65±0.27	4.28±0.18	3.90±0.18	1.32±0.08	1.45±0.09	1.10±0.04
4	5.74±0.27	4.43±0.25	4.07±0.26	1.30±0.11	1.42±0.12	1.09±0.05
5	5.70±0.31	4.27±0.24	3.98±0.22	1.34±0.09	1.44±0.13	1.07±0.05
6	5.77±0.35	4.48±0.21	4.14±0.16	1.38±0.11	1.40±0.10	1.08±0.04
7	5.38±0.24	4.27±0.17	3.96±0.13	1.26±0.08	1.36±0.08	1.08±0.05
8	6.15±0.24	4.57±0.17	4.17±0.18	1.35±0.06	1.48±0.08	1.10±0.04
9	6.20±0.27	4.37±0.18	3.97±0.14	1.42±0.06	1.57±0.08	1.10±0.05
10	6.06±0.32	4.59±0.19	4.25±0.15	1.32±0.09	1.43±0.09	1.08±0.05
11	6.02±0.30	4.46±0.21	4.02±0.16	1.33±0.09	1.50±0.08	1.13±0.06
12	5.85±0.25	4.11±0.14	3.86±0.12	1.42±0.07	1.52±0.08	1.07±0.04
13	6.13±0.26	4.42±0.21	4.02±0.27	1.39±0.08	1.53±0.12	1.10±0.06
14	5.84±0.25	4.21±0.18	3.91±0.13	1.39±0.07	1.50±0.08	1.08±0.04
15	5.89±0.23	4.37±0.16	4.01±0.17	1.35±0.06	1.47±0.08	1.09±0.04
16	6.06±0.38	4.33±0.21	3.93±0.23	1.40±0.09	1.55±0.11	1.10±0.06
17	6.47±0.20	4.52±0.17	4.12±0.15	1.44±0.06	1.57±0.07	1.10±0.04
18	5.66±0.40	4.04±0.24	3.79±0.23	1.40±0.10	1.50±0.11	1.07±0.05
19	5.71±0.43	4.18±0.20	3.89±0.15	1.37±0.10	1.47±0.10	1.07±0.05
20	6.16±0.37	4.12±0.18	4.09±0.24	1.49±0.09	1.51±0.10	1.01±0.05
21	6.04±0.41	4.32±0.28	3.91±0.24	1.40±0.09	1.55±0.12	1.11±0.06
22	6.16±0.34	4.34±0.23	4.02±0.28	1.43±0.11	1.54±0.18	1.08±0.07
23	5.84±0.27	4.17±0.23	4.23±0.18	1.41±0.08	1.38±0.08	0.99±0.04
24	6.04±0.28	4.08±0.17	3.92±0.15	1.49±0.10	1.54±0.10	1.04±0.03
25	5.85±0.26	4.27±0.19	4.15±0.19	1.37±0.08	1.41±0.08	1.03±0.03
26	6.33±0.26	4.34±0.19	3.67±0.19	1.46±0.06	1.73±0.09	1.19±0.07

of length to thickness and of width to thickness. To make clear the relationships between these two characters, correlation coefficient and linear regression of them were calculated.

Results

PART I. Respective character

1. Length

The results are given in Table 2. Length for individual grain level ranged from 7.20 *mm* to 4.55 *mm*. In the strain level, the longest (6.47 *mm*) was obtained in No.17, followed by No.26 (6.33 *mm*) and No.9 (6.20 *mm*). The shortest (5.38 *mm*) was noted in No.7, followed by No.3 (5.65 *mm*) and No.18 (5.66 *mm*). It may be noted that the values were peculiarly large and small in No.17 and No.7, respectively. Modes were found within 5.81 to 5.85 *mm* and 6.06 to 6.10 *mm*. The differences in length were confirmed to be very large in accordance with each strain. Average and its standard deviations in the whole strains were found to be 5.96 ± 0.24.

2. Width

Width for individual grain level ranged from 5.10 *mm* to 3.25 *mm*. In the strain level, the widest (4.59 *mm*) was obtained in No.10, followed by No.8 (4.57 *mm*) and No. 17 (4.52 *mm*). The narrowest (4.04 *mm*) was noted in No.18, followed by No.24 (4.08 *mm*) and No.12 (4.11 *mm*). Modes were found within 4.25 to 4.27 *mm* and 4.34 to 4.36 *mm*. The differences in width were confirmed to be large in respective to each strain. Average and its standard deviations in the whole strains were found to be 4.31 ± 0.14.

3. Thickness

Thickness for individual grain level ranged from 4.70 *mm* to 3.00 *mm*. In the strain level, the thickest (4.25 *mm*) was obtained in No.10, which was the same as the width, followed by No.23 (4.23 *mm*) and No.8 (4.17 *mm*). The thinnest (3.67 *mm*) was noted in No.26, followed by No.18 (3.79 *mm*) and No.2 (3.80 *mm*). It may be noted that the value was peculiarly small in No.26. Mode was found within 3.90 to 3.92 *mm*. The differences in thickness were confirmed to be large in accordance with each strain. The average and its standard deviations in the whole strains were found to be 4.00 ± 0.14.

4. Ratio of length to width

Ratio of length to width for individual grain level ranged from 1.70 to 1.06. In the strain level, the largests (1.49) were obtained in Nos.20 and 24, followed by No.26 (1.46). The smallest (1.26) was noted in No.7, followed by No.4 (1.30) and Nos.3 and 10 (1.32). It may be noted that the value was peculiarly small in No.7. Mode was found in 1.40. The differences in the ratio of length to width were confirmed to be very large in accordance with each strain. Average and its standard deviations in the whole strains were found to be 1.39 ± 0.06.

5. Ratio of length to thickness

Ratio of length to thickness for individual grain level ranged from 2.06 to 1.16. In

the strain level, the largest (1.73) was obtained in No.26, followed by No.2 (1.61) and Nos. 9 and 17 (1.57). The smallest (1.36) was noted in No.7, which was the same as the ratio of length to width, followed by No.23 (1.38) and No.6 (1.40). It may be noted that the value was peculiarly large in No.26. Modes were found within 1.50 to 1.51 and 1.54 to 1.55. The differences in the ratio of length to thickness were confirmed to be very large in accordance with each strain. Average and its standard deviations in the whole strains were found to be 1.50 ± 0.08.

6. Ratio of width to thickness

Ratio of width to thickness for individual grain level ranged from 1.36 to 0.84. In the strain level, the largest (1.19) was obtained in No.26, which was the same as the ratio of length to thickness, followed by Nos.2 and 11 (1.13). The smallest (0.99) was noted in No.23, followed by No.20 (1.01) and No.25 (1.03). It may be noted that the value was peculiarly large in No.26, which was the same as the ratio of length to thickness. Mode was found in 1.10. The differences in the ratio of width to thickness were confirmed to be very large in accordance with each strain. Average and its standard deviations in the whole strains were found to be 1.08 ± 0.04.

PART II. Relations between the respective two characters

1. Length and width

Whole strains: Correlation coefficient of width on length in the whole strains was $+0.3563$, showing no significance even at 5% level.

Strain level: Correlation coefficient and linear regression of width on length in the same strain were calculated, and are shown in Table 3. Two, 3, 2 and 19 strains showed significances at 0.1%, 1%, 5% levels and no significance even at 5% level, respectively.

2. Length and thickness

Whole strains: Correlation coefficient of thickness on length in the whole strains was $+0.1563$, showing no significance even at 5% level.

Strain level: Correlation coefficient and linear regression of thickness on length in the same strain were calculated, and are shown in Table 3. One, 1, 5 and 19 strains showed significances at 0.1%, 1%, 5% levels and no significance even at 5% level, respectively.

3. Width and thickness

Whole strains: Correlation coefficient of thickness on width in the whole strains was $+0.4589$ to the degree of freedom of 24, which was significant at 5% level. This finding was clearly different from the former 2 findings on relations. Generally speaking, the thicker is the thickness, the wider is the width. Linear regression of width on thickness was calculated as follows; $Y = 0.474X - 0.662$, where Y and X indicate width and thickness, respectively. This formula indicates that the width becomes 0.474 *mm* wider, by becoming 1 degree thicker the thickness (O points, 4.31 *mm* in width and 3.94 *mm* in thickness, respectively).

Strain level: Correlation coefficient and linear regression of thickness on width

Table 3. Correlation coefficient and linear regression of the three components; width on length, thickness on length and thickness on width

Strain No.	Length and Width		Length and Thickness		Width and Thickness		O points		
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Length	Width	Thick-ness
1	0.2426	–	0.1598	–	0.7912***	Y=0.738X−0.131	–	4.40	4.15
2	0.1936	–	0.1161	–	0.5645***	Y=0.616X+2.523	–	4.15	3.80
3	0.1608	–	0.1676	–	0.6879***	Y=0.700X+0.632	–	4.25	3.90
4	−0.2325	–	−0.1922	–	0.6518***	Y=0.632X+2.025	–	4.35	4.10
5	0.2138	–	−0.2653	–	0.6690***	Y=0.742X−0.737	–	4.25	3.90
6	0.1002	–	−0.0541	–	0.5850***	Y=0.741X−0.238	–	4.50	4.15
7	−0.0365	–	−0.0186	–	0.1576	–	–	–	–
8	0.1780	–	0.1656	–	0.6074***	Y=0.584X+1.253	–	4.50	4.15
9	0.4582***	Y=0.690X+0.346	0.2352	–	0.3538*	Y=0.442X−0.693	6.20	4.40	3.95
10	−0.1243	–	0.0257	–	0.4019**	Y=0.526X−1.161	–	4.65	4.25
11	−0.1058	–	0.2683	–	0.2767	–	–	–	–
12	0.1089	–	−0.1044	–	0.4809**	Y=0.537X+1.612	–	4.00	3.80
13	0.0745	–	−0.1196	–	0.6322***	Y=0.489X+0.653	–	4.40	4.05
14	0.2115	–	−0.0184	–	0.5728***	Y=0.752X+0.303	–	4.15	3.85
15	0.2692	–	0.1761	–	0.6072***	Y=0.560X+0.833	–	4.30	3.95
16	0.3136*	Y=0.284X−0.820	0.2550	–	0.5408***	Y=0.990X−2.549	6.18	4.40	3.83
17	0.1146	–	0.1393	–	0.4774***	Y=0.534X+1.064	–	4.45	4.10
18	0.4474**	Y=0.739X+2.508	0.3295*	Y=0.573X+2.463	0.7649***	Y=0.805X−0.110	5.33	3.93	3.63
19	−0.1514	–	−0.3126*	Y=−0.278X+0.485	0.4543***	Y=0.622X+2.033	5.68	4.05	3.85
20	0 3117*	Y=0.320X+1.293	0.3825**	Y=0.588X+1.372	0.5380***	Y=0.807X+0.927	5.98	4.05	4.03
21	0.5602***	Y=0.422X−0.554	0.3224*	Y=0.282X−1.544	0.5937***	Y=0.689X−2.434	6.08	4.30	3.70
22	−0.2467	–	−0.4556***	Y=−0.277X+0.704	0.5945***	Y=0.476X−1.364	6.23	4.30	3.80
23	0.3654**	Y=0.218X+0.279	0.2429	–	0.5601***	Y=0.722X+1.669	5.78	4.10	4.25
24	−0.0977	–	0.0621	–	0.7178***	Y=0.786X−0.508	–	4.05	3.85
25	0.2205	–	0.3121*	Y=0.415X−1.085	0.8369***	Y=0.820X+0.431	5.90	4.25	4.15
26	0.4258**	Y=0.304X+0.195	0.3455*	Y=0.245X+0.332	0.2076	–	6.28	4.30	3.65

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=48, excepting No. 2 (32), No. 12 (30), No. 18 (43) and No. 24 (17).

in the same strain were calculated, and are shown in Table 3. Twenty, 2, 1 and 3 strains showed significances at 0.1%, 1%, 5% levels and no significance even at 5% level, respectively. This finding was clearly different from the former 2 relations mentioned above.

4. Ratio of length to width and ratio of length to thickness

Whole strains: Correlation coefficient of ratio of length to thickness on ratio of length to width in the whole strains was +0.6712 to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the ratio of length to width, the larger is the ratio of length to thickness. Linear regression of ratio of length to width on ratio of length to thickness was calculated as follows; $Y=0.971X+3.331$, where Y and X indicate ratio of length to width and ratio of length to thickness, respectively. This formula indicates that the ratio of length to width becomes 0.971 larger, by becoming 1 degree larger the ratio of length to thickness (O points, 1.37 in the ratio of length to width and 1.55 in the ratio of length to thickness, respectively).

Strain level: Correlation coefficient and linear regression of ratio of length to thickness on ratio of length to width in the same strain were calculated, and are shown in Table 4. Twenty five and 1 strain showed significances at 0.1% level and no significance even at 5% level, respectively.

5. Ratio of length to width and ratio of width to thickness

Whole strains: Correlation coefficient of ratio of width to thickness on ratio of length to width in the whole strains was −0.1315, showing no significance even at 5% level.

Strain level: Correlation coefficient and linear regression of ratio of width to thickness on ratio of length to width in the same strain were calculated, and are shown in Table 4. Five, 2, 3 and 16 strains showed significances at 0.1%, 1%, 5% levels and no significance even at 5% level, respectively.

6. Ratio of length to thickness and ratio of width to thickness

Whole strains: Correlation coefficient of ratio of width to thickness on ratio of length to thickness in the whole strains was +0.6247 to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the ratio of length to thickness, the larger is the ratio of width to thickness. Linear regression of ratio of length to thickness on ratio of width to thickness was calculated as follows; $Y=0.616X-1.973$, where Y and X indicate ratio of length to thickness and ratio of width to thickness, respectively. This formula indicates that the ratio of length to thickness becomes 0.616 larger, by becoming 1 degree larger the ratio of width to thickness (O points, 1.55 in the ratio of length to thickness and 1.09 in the ratio of width to thickness, respectively).

Strain level: Correlation coefficient and linear regression of ratio of width to thickness on ratio of length to thickness in the same strain were calculated, and are shown in Table 4. Nine, 7, 5 and 5 strains showed significances at 0.1%, 1%, 5% levels and no significance even at 5% level, respectively.

Table 4. Correlation coefficient and linear regression of three components; ratio of length to thickness on ratio of length to width, ratio of width to thickness on ratio of length to width, and ratio of width to thickness on ratio of length to thickness

Strain No.	L/W and L/T		L/W and W/T		L/T and W/T		O points		
	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	Correlation coefficient	Linear regression	L/W	L/T	W/T
1	0.8405***	Y=0.698X+0.147	0.0073	-	0.4447**	Y=0.640X−1.039	1.42	1.52	1.07
2	0.7792***	Y=0.974X+0.087	−0.0857	-	0.4373**	Y=0.329X+0.865	1.41	1.57	1.12
3	0.7955***	Y=0.696X−0.279	−0.2334	-	0.3592*	Y=0.416X−0.706	1.35	1.48	1.11
4	0.8197***	Y=0.727X−0.980	−0.2079	-	0.3766**	Y=0.426X+0.386	1.33	1.43	1.11
5	0.8303***	Y=0.919X+1.883	0.0807	-	0.6098***	Y=0.512X−0.150	1.33	1.48	1.10
6	0.8601***	Y=0.805X−0.306	−0.2584	-	0.2915*	Y=0.344X+2.591	1.27	1.36	1.10
7	0.6751***	Y=0.669X+0.345	−0.4847***	Y=−0.355X+0.435	0.3087*	Y=0.228X−1.010	1.25	1.35	1.09
8	0.7521***	Y=0.618X+0.386	−0.2430	-	0.4478**	Y=0.453X−1.186	1.36	1.51	1.10
9	0.5813***	Y=0.448X+0.837	−0.3322*	Y=−0.203X+0.522	0.5846***	Y=0.464X−0.171	1.41	1.58	1.11
10	0.8528***	Y=0.906X+1.516	−0.4777***	Y=−0.482X−1.627	−0.1071	-	1.32	1.46	1.12
11	0.6804***	Y=0.776X−1.276	−0.6305***	Y=−0.980X−1.477	0.1267	-	1.34	1.48	1.16
12	0.8034***	Y=0.691X−1.009	−0.1872	-	0.4155*	Y=0.473X−0.265	1.47	1.55	1.09
13	0.7330***	Y=0.723X+0.078	0.0240	-	0.6762***	Y=0.968X+2.816	1.39	1.52	1.16
14	0.7692***	Y=0.671X+0.791	0.0413	-	0.3894**	Y=0.423X−0.865	1.39	1.52	1.08
15	0.7265***	Y=0.583X−0.345	−0.1666	-	0.5912***	Y=0.576X+1.868	1.35	1.46	1.11
16	0.7081***	Y=0.567X+1.886	−0.2286	-	0.4395**	Y=0.418X+0.746	1.37	1.55	1.12
17	0.6181***	Y=0.567X+1.756	−0.4351**	Y=−0.335X+0.058	0.4133**	Y=0.347X−1.701	1.43	1.62	1.11
18	0.8378***	Y=1.044X+0.264	−0.0623	-	0.4821***	Y=0.407X+1.880	1.39	1.48	1.10
19	0.7782***	Y=0.766X−0.467	−0.4061**	Y=−0.408X−2.481	0.2655	-	1.39	1.48	1.12
20	0.6458***	Y=0.587X−0.384	−0.3066*	Y=−0.260X−1.070	0.5059***	Y=0.473X+0.627	1.51	1.52	1.03
21	0.6958***	Y=0.770X+0.810	−0.1814	-	0.5722***	Y=0.732X−1.694	1.43	1.63	1.14
22	0.8304***	Y=0.724X+1.927	0.2031	-	0.7133***	Y=0.923X+1.843	1.42	1.65	1.18
23	0.6797***	Y=0.714X+1.180	−0.4807***	Y=−0.848X+1.989	0.3080*	Y=0.517X+0.110	1.38	1.38	0.98
24	0.8468***	Y=0.868X+0.851	−0.4012	-	0.0741	-	1.50	1.58	-
25	0.8703***	Y=0.884X−0.721	−0.3194*	Y=−0.442X−1.376	0.2034	-	1.41	1.44	1.02
26	02594	-	−0.4989***	Y=−0.463X+0.345	0.6992***	Y=0.912X+0.017	1.45	1.75	1.21

***, **, *; significant at 0.1%, 1% and 5% levels, respectively. d.f.=48, excepting No. 2 (32), No. 12 (30), No. 18 (43) and No. 24 (17).

PART III. Standard deviations

1. Practical values

In Table 2, the standard deviations, *i.e.*, intra-strain's variations, are given. Standard deviations (abbreviated as s. d.) of length ranged from 0.43 to 0.20. Mode was found as 0.27. The average and its standard deviations in the whole strains were found to be 0.30 ± 0.06. S. d. of width ranged from 0.28 to 0.14. Modes were found as 0.21, 0.19, 0.18 and 0.17. The average and its standard deviations in the whole strains were found to be 0.20 ± 0.03. S. d. of thickness ranged from 0.28 to 0.12. Mode was found as 0.15. The average and its standard deviations in the whole strains were found to be 0.19 ± 0.05.

S. d. of ratio of length to width ranged from 0.11 to 0.06. Modes were found as 0.09 and 0.08. The average and its standard deviations in the whole strains were found to be 0.08 ± 0.01. S. d. of ratio of length to thickness ranged from 0.18 to 0.07. It may be noted that the value was peculiarly large in No.22. Mode was found as 0.08. The average and its standard deviations in the whole strains were found to be 0.10 ± 0.02. S. d. of ratio of width to thickness ranged from 0.07 to 0.03. Modes were found as 0.05 and 0.04. The average and its standard deviations in the whole strains were found to be 0.04 ± 0.01.

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

Correlation coefficient of s. d. of length on width in the whole strains was $+0.5938$ to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the s. d. of length, the larger is the s. d. of width. Linear regression of length on width was calculated as follows; $Y = 1.169X + 0.361$, where Y and X indicate length and width, respectively. This formula indicates that the s. d. of length becomes 1.169 larger, by becoming 1 degree larger the s. d. of width (O points, 0.31 in length and 0.21 in width, respectively).

Correlation coefficient of s. d. of length on thickness in the whole strains was $+0.3886$ to the degree of freedom of 24, which was significant at 5% level. Generally speaking, the larger is the s. d. of length, the larger is the s. d. of thickness. Linear regression of length on thickness was calculated as follows; $Y = 0.539X - 0.207$, where Y and X indicate length and thickness, respectively. This formula indicates that the s. d. of length becomes 0.539 larger, by becoming 1 degree larger the s. d. of thickness (O points, 0.31 in length and 0.20 in thickness, respectively).

Correlation coefficient of s. d. of width on thickness in the whole strains was $+0.6796$ to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the s. d. of width, the larger is the s. d. of thickness. Linear regression of width on thickness was calculated as follows; $Y = 0.478X - 0.467$, where Y and X indicate width and thickness, respectively. This formula indicates that the s. d. of width becomes 0.478 larger, by becoming 1 degree larger the s. d. of thickness (O points, 0.21 in width and 0.20 in thickness, respectively).

Correlation coefficient of s. d. of ratio of length to width on ratio of length to thickness in the whole strains was $+0.6846$ to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the s. d. of ratio of length to width, the larger is the s. d. of ratio of length to thickness. Linear regression of ratio of length to width on ratio of length to thickness was calculated as follows; $Y = 0.479X + 1.157$, where Y and X indicate the s. d. of ratio of length to width and the s. d. of ratio of length to

thickness, respectively. This formula indicates that the s. d. of ratio of length to width becomes 0.479 larger, by becoming 1 degree larger the s. d. of ratio of length to thickness (O points, 0.08 in ratio of length to width and 0.12 in ratio of length to thickness, respectively).

Correlation coefficient of s. d. of ratio of length to width on ratio of width to thickness in the whole strains was +0.2380 to the degree of freedom of 24, showing no significance even at 5% level.

Correlation coefficient of s. d. of ratio of length to thickness on ratio of width to thickness in the whole strains was +0.5394 to the degree of freedom of 24, which was significant at 1% level. Generally speaking, the larger is the s. d. of ratio of length to thickness, the larger is the s. d. of ratio of width to thickness. Linear regression of ratio of length to thickness on ratio of width to thickness was calculated as follows; $Y=1.143X-1.857$, where Y and X indicate the s. d. of ratio of length to thickness and the s. d. of ratio of width to thickness, respectively. This formula indicates that the s. d. of ratio of length to thickness becomes 1.143 larger, by becoming 1 degree larger the s. d. of ratio of width to thickness (O points, 0.12 in ratio of length to thickness and 0.05 in ratio of width to thickness, respectively).

3. Relations between the practical values and its standard deviations

Correlation coefficient of practical value on its s. d. among lengths in the whole strains was −0.0702 to the degree of freedom of 24, showing no significance even at 5% level. Correlation coefficient of practical value on its s. d. among widths in the whole strains was −0.0025 to the degree of freedom of 24, showing no significance even at 5% level. Correlation coefficient of practical value on its s. d. among thicknesses in the whole strains was −0.0061 to the degree of freedom of 24, showing no significance even at 5% level. Correlation coefficient of practical value on its s. d. among ratios of length to width in the whole strains was −0.1336 to the degree of freedom of 24, showing no significance even at 5% level. Correlation coefficient of practical value on its s. d. among ratios of length to thickness in the whole strains was +0.1821 to the degree of freedom of 24, showing no significance even at 5% level.

Correlation coefficient of practical value on its s. d. among ratios of width to thickness in the whole strains was +0.5898 to the degree of freedom of 24, which was obviously significant at 0.1% level. Generally speaking, the larger is the practical value of ratio of width to thickness, the larger is the s. d. of ratio of width to thickness. Linear regression of practical value on the s. d. was calculated as follows; $Y=2.040X-0.339$, where Y and X indicate practical value and the s. d., respectively. This formula indicates that the practical value becomes 2.040 larger, by becoming 1 degree larger the s. d. (O points, 1.09 in the practical value and 0.05 in the s. d., respectively).

Discussion

Though, of course, the discussions and conclusive hypotheses on the inter- and intra-strain's variations of grain morphology are to be drawn, basing on the extensive analyses, which may be obtained after several experiments made with the use of the progenies, the following facts may appreciably be drawn from the data mentioned above.

The materials used may be detected as *Vigna marina* MERR. Morphological and

ecological characters shown by this plants were coincident with the keys mentioned by Parham[2].

This species is in growth in a form of a wild plant. But several species belonging to this genus, *i.e.*, cowpea (= *V. sinensis*), longyard bean (= *V. sesquipedalis*), are usually being cultivated as the most important grain legumes but as the secondary species in tropical and subtropical regions. The total benefits from growing grain legumes are frequently ignored in commercial cropping systems, but the positive aspects of growing tropical legumes have been emphasized for some problems such as collecting germplasm (= drought or insect resistances)[3]. So, this species will also be subjected to consideration of agricultural improvement.

It will be expected that if the practical values and ranging variations found in the respective character, and their native localities were ascertained, it might naturally throw light on the evolutional prospect of this plant[1]. The whole strains might be divided into several groups in view of grain size, *i.e.*, length-width-thickness. For example, No.17 was seen as long (length) – wide (width) – thick (thickness), No.26 as long-middle-thin, (in the same order), No.8 as middle-wide-thick, Nos.1 and 9 as middle-middle-thick, No.15 as middle-middle-middle, No.7 as short-middle-middle, No.18 as short-narrow-thin, and so on. Basing on the analyses mentioned above, the following items may be noted in view of geographical specificities. No.26, which was collected near Lagoon Lake, showed peculiarly thin grains, in spite of long length. So, it showed peculiarly large ratios of length to width, of length to thickness and of width to thickness. On the contrary, No.7, which was collected at the inside of road in Meneng District, showed peculiarly short grains. So, it showed peculiarly small ratios of length to width and of length to thickness.

In comparison of strains distributed both inside and outside of the road, *i.e.*, near sea and far from sea, however, clear tendency was not to be found in view of practical values obtained in length, width and thickness, and ratios of length to width and of length to thickness. On the contrary, it was noticeable that ratios of width to thickness found in strains distributed inside of the road were noted to show middle portions of ranges, only lying within 1.10 to 1.07.

In view of the standard deviations, *i.e.*, intra-strain's variations, the following facts were ascertained. Strains distributed in north and northwest sides of the island showed relatively large standard deviations in length, width and thickness. On the contrary, distributed in inside of road showed relatively small standard deviations in three components. This meant that the latter strains were genetically in stable state, especially in Nos.7, 12, 15 and 17. The differences found in stability seemed to have been mainly due to the ecological conditions. The former were always subjected to the relatively severe environmental conditions, while the latter were more or less protected by a tree's or herb's shelter, as may be easily deduced from the ecological status. These findings propose a quite interesting problem concerning the strain or variety differentiations.

Furthermore, intra-strain's variations of grains in the whole strains in view of the morphological characters have been looked upon as relatively small. So, it may be concluded that they has a long history from introduced or migrated times here, and fit well to the natural conditions in the respective areas. Moreover, it has been stated that the ecological niches in tropics, in which the few species of *Gramineae* adapted, are the

following conditions; coastal sands and muds, salt licks, etc.[4] Though the species used here belong to *Leguminosae*, this hypothesis may be applicable to this plant.

Correlation coefficients among the respective two characters in the whole strains were unexpectedly decided as significant in only one case, *i.e.*, correlation between width and thickness. This fact was also found in strain level. It may be concluded that three components, *i.e.*, length, width and thickness, are fundamentally exhibited independently of the other components. On the other hand, correlation coefficients among the respective two ratios in the whole strains were shown as significant excepting one case. It means that the whole ratios are relatively of stable characters.

Correlation coefficients of intra-strain's variation of the respective two characters were expectedly decided as significant excepting one case. Generally speaking, the larger is the variation in one character, the larger is the variation in another character. It may be said that strains considered to be stable or unstable showed negligible or considerable variations through almost all the characters, respectively.

Relations among the practical values of 6 characters measured and these respective intra-strain's variations were also calculated, but significance was shown only in one case, *i.e.*, ratio of width to thickness. As a conclusion, it was ascertained that the ratio of width to thickness was the most stable characteristic through the whole characters measured. In other words, this character could not be affected by any environmental condition.

Summary

During the trip made from November to December in 1975 in the Republic of Nauru, 26 strains of *Vigna* sp. were collected. The morphological studies of grains collected and considerations on distribution and ecotypic differentiations of this species were reported here. The results obtained here were summarized as follows:

The materials could be detected to be a sort of beach bean, *Vigna marina* MERR., in view of morphological and ecological characters.

Length, width and thickness of grains were found to be 5.96 *mm*, 4.31 *mm* and 4.00 *mm* in average values, respectively. Correlation coefficients among length and width, length and thickness, and width and thickness, were +0.3563, +0.1563 and +0.4589, respectively. The last one showed significance at 5% level. Ratios of length to width, of length to thickness, and of width to thickness were found to be 1.39, 1.50 and 1.08 in average values, respectively. Correlation coefficients of ratio of length to width on ratio of length to thickness, ratio of length to width on ratio of width to thickness, ratio of length to thickness on ratio of width to thickness, were +0.6712, −0.1315 and +0.6247, respectively. The first and the third ones showed significances at 0.1% level.

Correlation coefficients among intra-strain's variations in the respective character were +0.5938, +0.3886, +0.6796, +0.6846, +0.2380 and +0.5394 in the same order mentioned above, respectively. Excepting the fifth one, these values showed significances among them at 0.1%, 1% or 5% levels. Correlation coefficients among the practical values and its intra-strain's variations were −0.0702, −0.0025, −0.0061, −0.1336, +0.1821 and +0.5898 in the same order, respectively. Among these only the last one showed significance among them at 0.1% level.

Ecotypic differentiations were extensively discussed in view of values found in 6

characters and ecological conditions. It may be noticeable that strains distributed in north and northwest sides of the island showed relatively large intra-strain's variations in several characters, but strains distributed in inside of road showed relatively small ones. It means that the latter are genetically in a stable state.

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