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CYTOLOGICAL DATA ON SOME WILD TROPICAL VIGNA SPECIES AND CULTIVARS FROM COWPEA AND ASPARAGUS BEAN

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ABSTRACT

A number of wild species of the genus *Vigna* were examined as to their chromosome numbers and mitotic metaphase plate configurations.

Both the reported diploid numbers 20 and 22, were found or confirmed in a number of wild African species and one originating from East Asia. In species with the chromosome number 20 no deviations from this chromosome number were found. The identification of individual chromosomes is generally limited by their extremely small size. Moreover, the results did not tally with those of other authors. Therefore we abandoned the subject.

Thirty-six cultivars of *V. unguiculata* and *V. sesquipedalis* of various tropical and subtropical sources were investigated, together with wild or subspontaneous types of *V. unguiculata* and some closely allied forms. The diploid chromosome numbers 22 and 24 have been mentioned in literature.

The following results have been obtained:

1° A deviation of the chromosome number 22 ranging from 20 to 24 is noted in almost 10% of the cases analysed. Twenty-four chromosomes were found in the majority of these cases.

2° When comparing the wild and subspontaneous types and their close allies with the cultivars, deviations in the cultivars decreased by half which points to a stabilising influence of domestication and selection.
In this respect no difference was observed between e.g. the African and American cultivars studied.

3° In some of the *Vigna* species, whether having 20 or 22 chromosomes, there is a considerable difference in shape and size of the entire set, which is independent of the degree of spiralization: in this manner, the Central- and South American types generally are characterized by smaller chromosomes as compared to those in the African and Indian cultivars.

4° The difference is emphasized by the results of grafting combinations between cultivars with large and small chromosome sets.

5° The above-mentioned facts may indicate that the polyphyletic origin of the subtribe *Phaseoleae* may even be traced in a genus such as *Vigna*.

1. INTRODUCTION

In various respects the genus *Vigna* offers a number of problems.
Even the delimitation of the genus against the two other large genera considered to

be its immediate neighbours, viz. *Dolichos* and *Phaseolus*, meets with uncertainties and with the taxonomists a trend exists at least to merge *Vigna* and *Dolichos*.

Within the genus *Vigna* there is a considerable confusion as to subdivision and speciation.

E. G. BAKER in 1926 dealt with the African material available at that time, but his classification is often lacking in a satisfactory morphological basis, and in many cases rests on a vague regional bordering of a type or has been made on scanty herbarium material.

This study deals with chromosome numbers and configurations of *Vigna* sensu stricto exclusively. The material consisted of a collection of wild types from Africa and of cultivars of cowpea and asparagus bean from all parts of the world.

A more elaborate study of wild *Vigna unguiculata* (L.) WALP., its immediate allies and the cowpea cultivars was stimulated by a request of Dr. ROBERT STANTON who during his stay at the Regional Research Station, Samaru, N. Nigeria, for several years collected the wild and cultivated strains in those regions. On account of difficulties in the classification and the contradictory data on chromosome numbers in literature he asked the author to undertake a cytological investigation.

2. SOURCES OF VIGNA MATERIAL

Part of the wild species were collected by the author during three trips in Africa in the years 1954, 1957 and 1962. I gratefully acknowledge the assistance of Mr. J. B. GILLETT, Kew Herbarium with respect to the nomenclature of a number of these types.

The other ones and the cultivars of *Vigna unguiculata, Vigna sesquipedalis* were collected or sent on request by various Experiment Stations, These are:

L numbers	Regional Research Station, Samaru, North Nigeria.
K numbers	Grassland Experiment Station, Kitale, Kenya.
PI	USDA Plant Introduction Section, Beltsville, Maryland.
L numbers Mlingano	Mlingano Sisal Research Institute, Ngomeni, Tanganyika.
IC numbers	Indian Agricultural Research Institute, New Delhi.
27 —— numbers	Estación Agricola Experimental "Tulio Ospina", Medellin, Colombia.

The cultivar Going CPMi was imported from Mahalapye Experimental Station, Bechuanaland, Early Red 531 from Instituto Agronômico do Estado de São Paulo, Campinas, Brasil, whereas Whippoorwill, Forage Crop 31705 and Capucijner S 403/A/46/1 were sent by Landbouwproefstation, Paramaribo, Surinam.

Several of these cultivars were handed over to me by Dr. WIENK who, in this laboratory, studied the photoperiodicity in cowpeas.

3. METHOD

All counts were made on seedling root tips, fixed in Navashin fluid and stained with crystal violet. When necessary, as with the wild species, herbarium material has been stored under our own collection number. Designs of metaphase plates were made at a magnification of 20 × 100.

4. Results

In Tables 1 and 2 the numerical results of our investigations have been compiled.

Figures 1–74 illustrate the characteristics of the mitotic metaphase plate in each of the types mentioned: the numbering of the figures is identical to that in the tables.

It appears that the majority of the species studied and all the cultivars of cowpea and asparagus bean have 2n = 22 chromosomes. The occurrence of deviations from this number will be discussed later on.

Three of the wild African species and *V. oligosperma* Backer (syn. *V. Hosei* Backer) from Borneo have 2n = 20 chromosomes. The question whether this chromosome number might be of some taxonomical value will be a further point of consideration.

Another feature, being the considerable variation in chromosome dimensions found in the various types which have been studied will also be included in the discussion.

5. Discussion

a) *Nomenclature*

In the introduction to this study we mentioned the difficulties with respect to the status of the genus *Vigna*. At present we shall limit our considerations to *Vigna* s.s. and here we are immediately confronted with the nomenclature of the cowpea proper.

The Kew specialists who in 1958 edited the second edition of Vol. I of the Flora of West Tropical Africa on p. 569 solved the problem by naming the wild african cowpeas *V. unguiculata* (L.) Walp. and reserving the name *V. sinensis* (L.) Savi ex Hassk. for the cultivated ones. While working on the photoperiodic effect in cowpeas, Wienk (1963), however, scrutinized the literature and found, that Sellschop (1962) had reverted to the recombined name of Linnaeus' description in spite of the absence of a type specimen and that this name had been accepted by the authorities of the Royal Botanic Gardens, Kew. In accordance with this recent view, we rejected the name *Vigna sinensis* and adopted *V. unguiculata* for all the relevant material in our study.

It should also be mentioned that from Dr. Stanton's collections made in the Northern Nigerian region it becomes clear that the boundary between *V. unguiculata* and *V. racemosa* may be rather vague and more conditioned by ecological circumstances than previously supposed. When a more intensive collection is made in an extensive region, as is done in Dr. Stanton's case, all kinds of transitions may be found and the clear differentiations between the species descriptions may become rather vague.

As far as I can see, this may be the case in quite a number of *Vigna* species e.g. *V. Dekindtiana*, from East Africa, more or less closely related to *V. unguiculata* and the swarm of types which are present throughout Northern Tropical Africa whereever there is brookland and which all come under the broad outlines of the description of *Vigna gracilis* Hook.f. or very closely related species.

b) *Chromosome numbers and deviations*

In summing up the chromosome countings in *Vigna* which may be found in the literature we come to the results in table 3.

TABLE 1. WILD SPECIES OF VIGNA INVESTIGATED

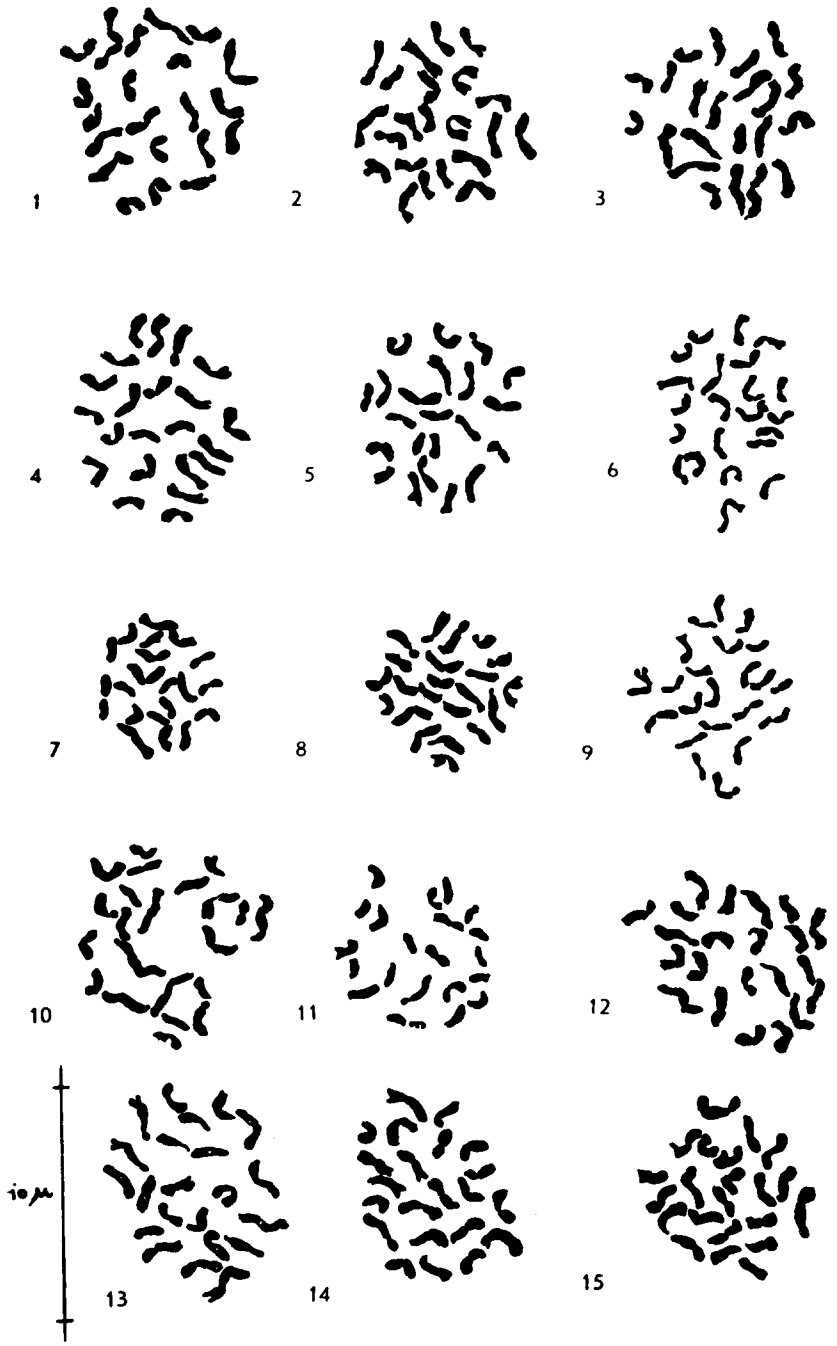
	Name of species	Origin	Collection no.	Diploid chromosome no.
1. Vigna	coerulea Bak.	Shika, N. Nigeria	57030	22
2. „	Dekindtiana Harms	Arusha, Tanganyika	62128	–
3. „	Dekindtiana Harms L 40	Mlingano, Tanganyika	63038	–
4. „	fragrans Bak. f. K 5220	Malindi, Kenya	62219	–
5. „	gracilis Hook. f.	Brafouédi, Ivory Coast	54067	–
6. „	gracilis Hook. f.	Oroumbo Boka, Ivory Coast	54071	–
7. „	maranguenis (Taub.) Harms	Molo, Kenya	62211	–
8. „	maranguenis (Taub.) Harms forma vel sp. aff.	Gimma, Ethiopia	62369	–
9. „	multinervis Hutch. & Dalz.	Dabou, Ivory Coast	57160	–
10. „	oblongifolia A. Rich. K 53507	Kitale, Kenya	62234	–
11. „	parviflora Welw. ex Bak. K 5195	Kitale, Kenya	62221	–
12. „	parviflora Welw. ex Baker	Wonji, Ethiopia	62342	–
13. „	parviflora Welw. ex Baker	Gimma, Ethiopia	62358	–
14. „	racemosa Hutch. & Dalz. WC – 20 L 1774	Samaru, N. Nigeria	61058	–
15. „	racemosa Hutch. & Dalz.? ex Jakara L 1759	Samaru, N. Nigeria	61066	–
16. „	Schimperi Bak. K 52336	Oljoro Orok, Kenya	62233	–
17. „	Schliebenii Harms L 35	Mlingano, Tanganyika	63039	–
18. „	triloba Chiov.	Shika, N. Nigeria	57044	–
19. „	triloba Chiov. L 21	Mlingano, Tanganyika	63033	–
20. „	unguiculata (L.) Walp. WC-2 L 1751	Samaru, N. Nigeria	61054	–
21. „	unguiculata (L.) Walp. WC-8 L 1754	Samaru, N. Nigeria	61056	–
22. „	unguiculata (L.) Walp. WC-8-1 L 1760	Samaru, N. Nigeria	61057	–

23.	„	unguiculata (L.) Walp.? WC-3 L 1768	Samaru, N. Nigeria	61055	–
24.	„	unguiculata (L.) Walp.? Waken gizo (ex Gussau) L 1745	Samaru, N. Nigeria	61059	–
25.	„	unguiculata (L.) Walp.? Dalaram Kanuri L 1761	Samaru, N. Nigeria	61060	–
26.	„	unguiculata (L.) Walp.? Gayan gayan (ex Hunkui) L 1746	Samaru, N. Nigeria	61063	–
27.	„	unguiculata (L.) Walp.? Larwa Kanuri L 1762	Samaru, N. Nigeria	61064	–
28.	„	unguiculata (L.) Walp.? Waken gizo (ex Mokwa) L 1757	Samaru, N. Nigeria	61065	–
29.	„	unguiculata (L.) Walp.	Boukoko, Equat. Africa	57104	-
30.	„	vexillata Benth. L 95	Ruiru, Kenya	62192	–
31.	„	vexillata Benth. L 95	Mlingano, Tanganyika	63034	–
32.	„	vexillata Benth. L 70	Mlingano, Tanganyika	63036	–
33.	„	spec. Gayan gayan (ex. Hunkui) L 1748	Samaru, N. Nigeria	61062	–
34.	„	spec. Yaryadin gona (ex Gussau) L 1749	Samaru, N. Nigeria	61061	–
35.	„	ambacensis Welw.	Cové, Dahomey	57151	20
36.	„	heterophylla A. Rich. K 51326	Kitale, Kenya	62220	20
37.	„	pubigera Bak.	Dabou, Ivory Coast	57160	20
38.	„	oligosperma Backer	Bogor, Indonesia	62007	20

TABLE 2. COWPEA VARIETIES AND CULTIVARS INVESTIGATED (V. UNGUICULATA (L.) WALP.)

Name		Origin	Our Collection no.	Diploid chromosome no.
a) Nigeria				
39. Banta-B	L 742	Samaru, N. Nigeria	61044	22
40. Waken Kaka	L 1033	Samaru, N. Nigeria	57017	–
41. Kirsi (Kirmoki)	L 1034	Samaru, N. Nigeria	57019	–
42. Wake Mai Rodi ex Kaciya	L 1030	Samaru, N. Nigeria	57024	–
43. Jan Wake ex Angwah Tagwai	L 1040	Samaru, N. Nigeria	57022	–
44. Wake Danferi ex Kaciya	L 603a	Samaru, N. Nigeria	57023	–
45. Wake Danferi ex Kaciya	L 6036	Samaru, N. Nigeria	57021	–
46. Ex-Lafia A	L 1645	Samaru, N. Nigeria	61045	–
47. Ayabilo ex Zongo		Samaru, N. Nigeria	57020	–
48. Ayabilo ex Tagama	L 6020	Samaru, N. Nigeria	57018	–
49. Ayabilo ex Tagama		Samaru, N. Nigeria	57025	–
50. Ex-Bukuru A	L 1643	Samaru, N. Nigeria	62010	–
b) Southern Africa				
51. Cowpea	37C-6	South Africa	60029	–
52.	PI 221731	South Africa via U.S.A.	61051	–
53. Going	CPM 1	Mahalapye, Bechuanaland	62011	–
c) India				
54. Sirsa no. 35	IC 2925	New Delhi	61048	–
55. Kor	PI 163142	India via U.S.A.	61049	–
56. Delhi Local	IC 669	New Delhi	61050	–

d) U.S.A.				
57. Whippoorwill		U.S.A. via Surinam	61042	–
58. Forage crop	31705	U.S.A. via Surinam	61043	–
59. Early Red	531	U.S.A. via Brasil	61053	–
e) South and Central America				
1) Surinam				
60. Capucijner	S 403/A/46/1	Surinam	61052	–
2) Costa Rica				
61. Hibo Caneio	PI-Inst. = 0.128	Costa Rica	63042	–
62. Garbancito	PI-Inst. = 0.151	Costa Rica	63043	–
3) Colombia				
63. Magdalena 8	27132	Medellin	62004	–
64. Magdalena 9	27133	Medellin	61046	–
65. Tolima 4	27010	Medellin	61047	–
66. Bolivar 15A	27188	Medellin	62002	–
67. Córdoba 3 Roja	27015	Medellin	62003	–
68. Cabecita negra	27115	Medellin	62005	–
69. Cabecita # 2	27155	Medellin	62006	–
70.	PI 147561	Colombia via U.S.A.	63044	–
4) Paraguay				
71.	PI 152199	Paraguay via U.S.A.	63041	–
72.	PI 152194	Paraguay via U.S.A.	63045	–
73. Vigna sesquipedalis A. J. Pieters	L 1935	Samaru, N. Nigeria	61067	–
74. Vigna sesquipedalis A. J. Pieters		Bogor, Indonesia	——	–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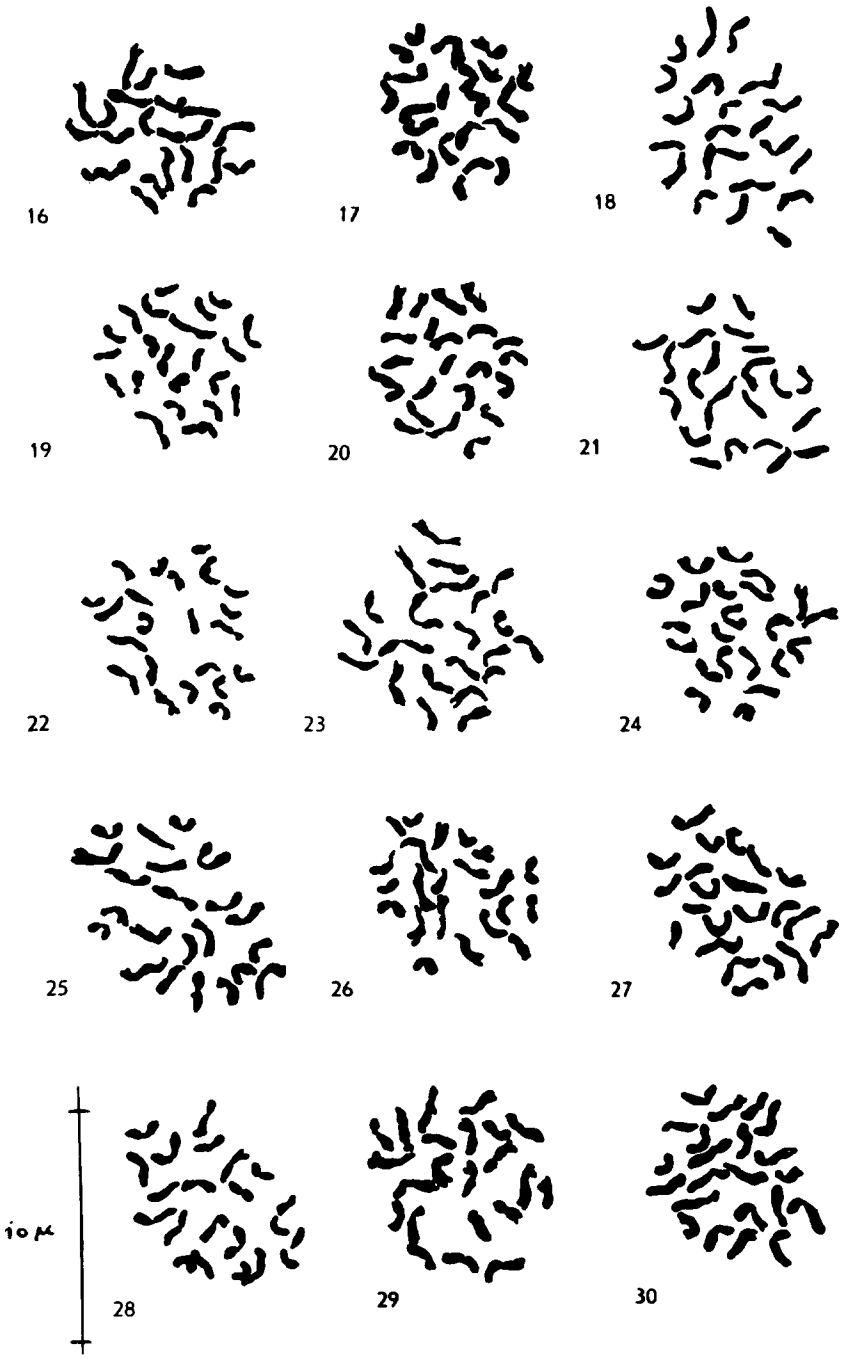
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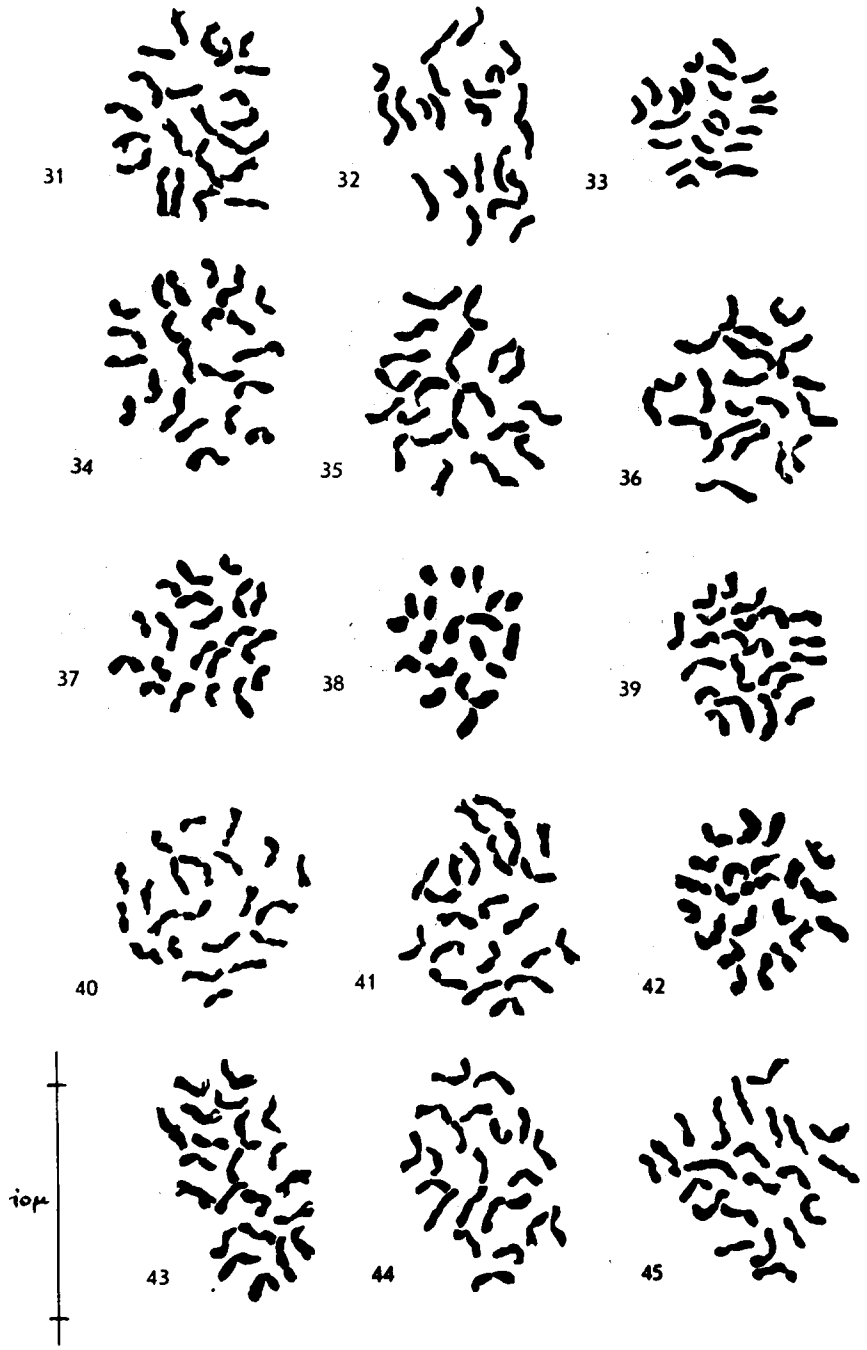
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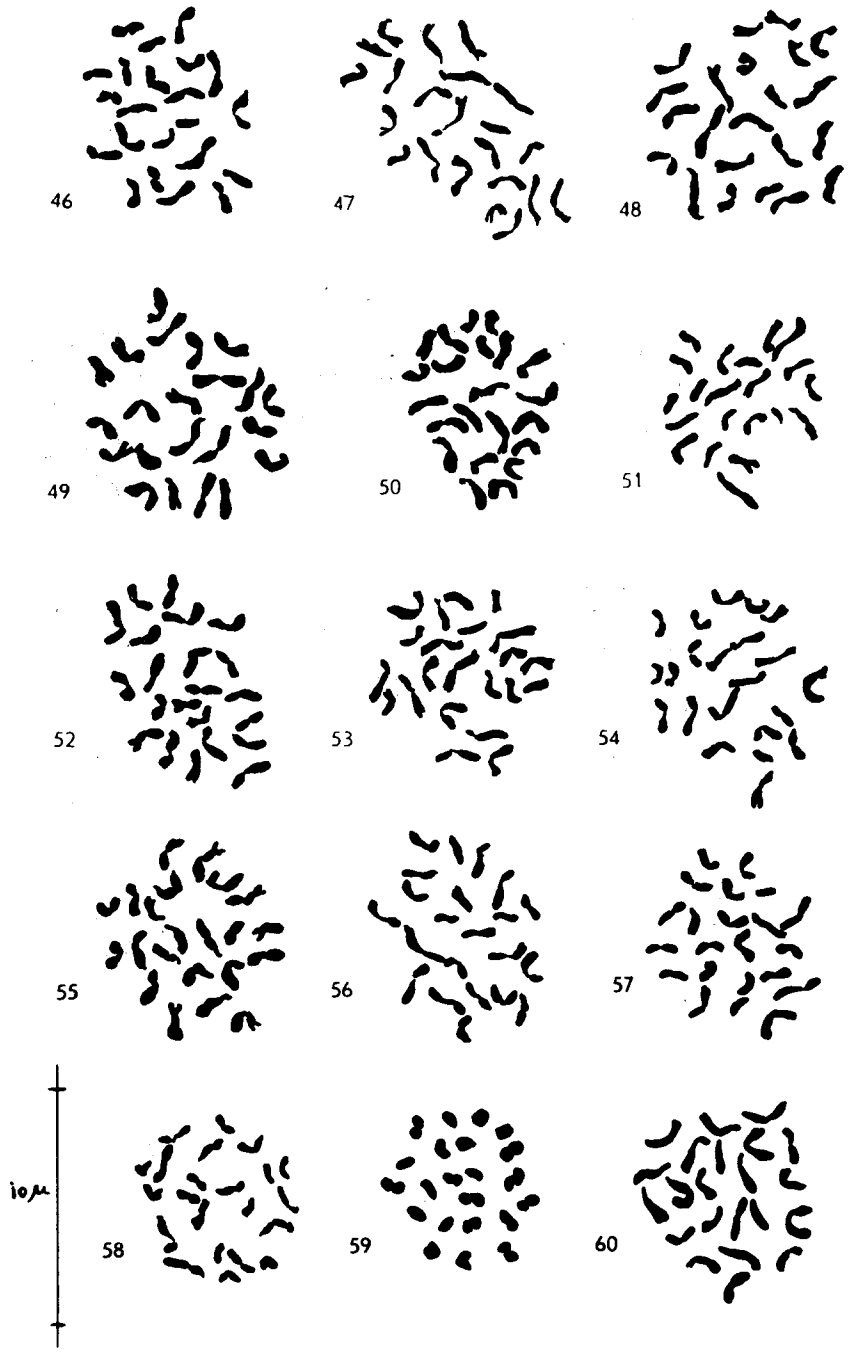
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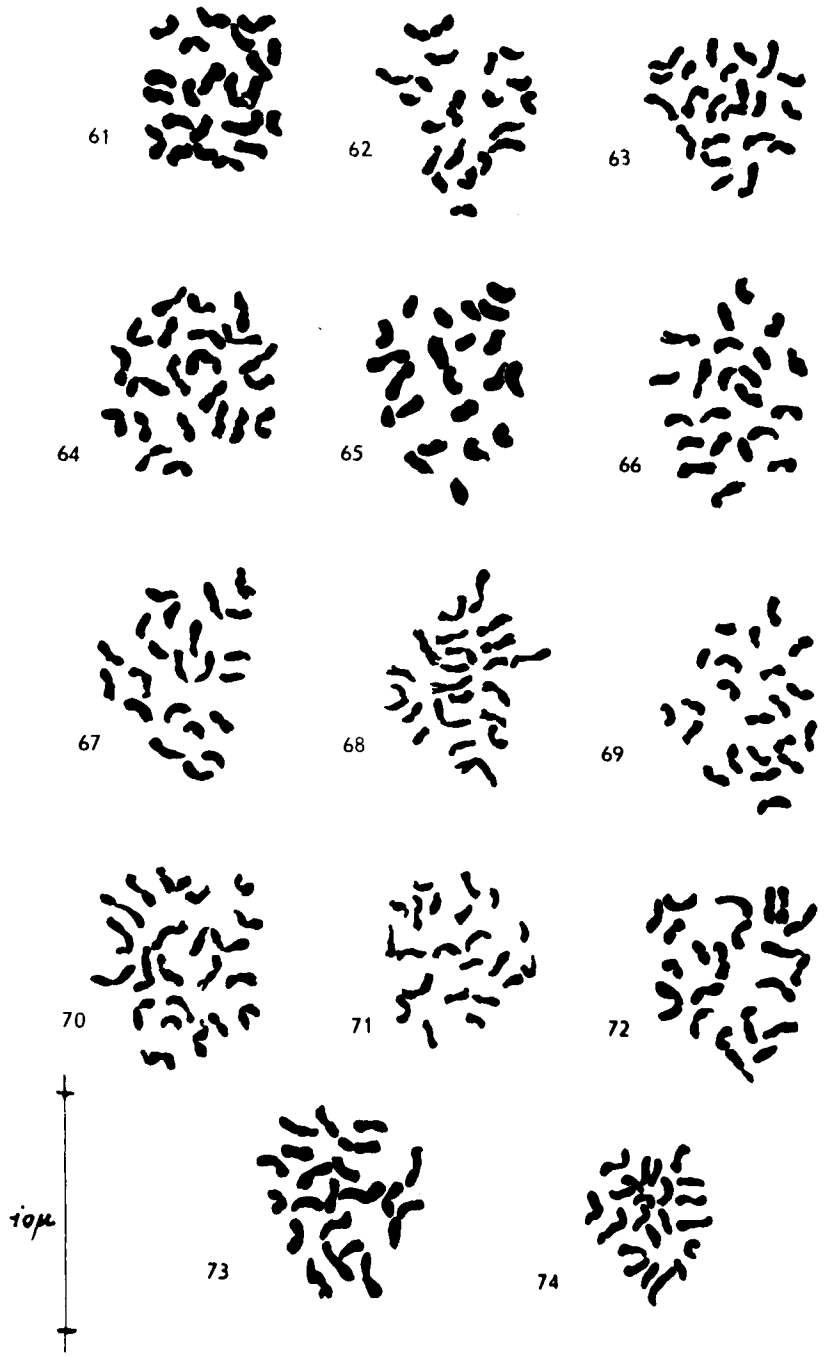
61
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72
10μ
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74

TABLE 3. CHROMOSOME COUNTS IN LITERATURE

V. ambacensis Welw.	20	Dusseau & Magnant, 1941
capensis (= vexillata?)	22	Tschechow & Kartashowa, 1932
catjang (Burm.) Walp. var. Barabazar	22	Sen & Bhowal, 1960
catjang (Burm.) Walp. var. Poona	22	Sen & Bhowal, 1960
glabra (= nilotica?)	22	Tschechow & Kartashowa, 1932
davyi Bolus.	22	Sen & Bhowal, 1960
gracilis Hook.f.	22	Sen & Bhowal, 1960
heterophylla A.Rich.	20	Sen & Bhowal, 1960
lanceolata	22	Karpetchenko, 1925
luteola (= glabra?)	22	Schnack & Covas, 1947; Sen & Bhowal, 1960
marina (Burm.) Merr. (= lutea?)	22	Sen & Bhowal, 1960
membranacea A.Rich.	20	Sen & Bhowal, 1960
oblongifolia A.Rich.	22	Sen & Bhowal, 1960
owahuensis	22	Tschechow & Kartashowa, 1932
parviflora Welw.	22	Sen & Bhowal, 1960
pubigera Bak.	20	Miège, 1962
Schimperi Bak.	22	Sen & Bhowal, 1960
sesquipedalis A. J. Pieters	24	Kawakami, 1930
sesquipedalis A. J. Pieters	24	Floresca, Capinpin & Pancho, 1960
sesquipedalis A. J. Pieters var. Globe	22	Sen & Bhowal, 1960
sesquipedalis A. J. Pieters var. Kharagpur	22	Sen & Bhowal, 1960
sinensis (L.) Savi ex Hassk.	24	Karpetchenko, 1925; Floresca, Capinpin & Pancho, 1960; Miège, 1962
sinensis (L.) Savi ex Hassk. var. Giant	22	Sen & Bhowal, 1960
sinensis (L.) Savi ex Hassk. var. Tabara	22	Sen & Bhowal, 1960
unguiculata (L.) Walp.	22	Karpetchenko, 1925
vexillata (C.) Benth.	22	Sen & Bhowal, 1960
wilmsii Burtt Davy	22	Sen & Bhowal, 1960

It is evident that there are two base numbers at least, viz. n = 10 and n = 11. But several reports, of which some are quite recent, mention 2n = 24 (n = 12) in the species *V. sesquipedalis* and *V. unguiculata*, the latter being mostly referred to as *V. sinensis*.

It was this discrepancy that lead to the making of a more elaborate investigation into wild species from Africa and a considerable number of cultivars. Whenever sufficient metaphase plates were available, the number of cases analyzed ranged from 10 to sometimes over 30 cases. Tables 4 and 5 show the distribution of chromosome number in such plates, for the wild species and cultivars respectively.

From these tables it may be seen, that in the 20 chromosome species no deviations from this number occur. Both in the wild 22 species and in the cultivars from cowpea and asparagus bean, however, the numbers may vary from 20 to 24, the majority always being 22, so that this number may be looked upon as normal. One plate with 44 chromosomes out of a total of over 1,100 cases counted may be considered as a chance reduplication which has no bearing upon the general problem.

The considerable variation per type in the number of plates counted, in a number of cases from 3 to 10 owing to scarcity of material, leaves no room for mathematical treatment of the individual results, but an attempt has been made to make an analysis of some of the results.

TABLE 4. DISTRIBUTION OF CHROMOSOME NUMBERS IN THE PLATES COUNTED IN WILD SPECIES OF VIGNA

	Name of species	20	21	22	23	24	44
1.	Vigna coerulea Bak.	–	–	10	–	–	–
2.	„ Dekindtiana Harms	–	–	8	–	–	–
3.	„ Dekindtiana Harms L 40	–	–	3	1	–	–
4.	„ fragrans Bak.f. K 5220	–	–	11	–	–	–
5.	„ gracilis Hook.f.	1	–	3	1	–	–
6.	„ gracilis Hook.f.	–	–	9	–	3	–
7.	„ maranguensis (Taub.) Harms	–	–	6	1	–	–
8.	„ maranguensis (Taub.) Harms forma vel sp. aff.	–	–	4	–	–	–
9.	„ multinervis Hutch. & Dalz.	–	–	13	1	–	–
10.	„ oblongifolia A.Rich. K 53507	–	–	4	1	–	–
11.	„ parviflora Welw. ex Baker K 5195	–	–	5	–	–	–
12.	„ parviflora Welw. ex Baker	–	–	10	–	–	–
13.	„ parviflora Welw. ex Baker	–	–	10	–	–	–
14.	„ racemosa Hutch. & Dalz. WC - 20 L 1774	–	–	23	–	2	–
15.	„ racemosa Hutch.? ex Jakara L 1759	–	–	22	1	2	–
16.	„ Schimperi Bak. K 52336	–	–	3	–	–	–
17.	„ Schliebenii Harms L 35	–	1	7	1	–	–
18.	„ triloba Chiov.	1	–	5	–	1	–
19.	„ triloba Chiov. L 21	–	–	9	–	–	–
20.	„ unguiculata (L.) Walp. WC - 2 L 1751	–	–	21	–	4	–
21.	„ unguiculata (L.) Walp. WC - 8 L 1754	–	–	29	–	1	–
22.	„ unguiculata (L.) Walp. WC - 8 - 1 L 1760	–	–	20	–	–	–
23.	„ unguiculata (L.) Walp.? WC - 3 L 1768	–	–	12	–	–	1
24.	„ unguiculata (L.) Walp.? Waken Gizo L 1745	–	–	13	1	1	–
25.	„ unguiculata (L.) Walp.? Dalaram Kanuri L 1761	2	–	27	–	1	–
26.	„ unguiculata (L.) Walp.? Gayan gayan L 1746	–	–	9	–	1	–
27.	„ unguiculata (L.) Walp.? Larwa Kanuri L 1762	–	–	21	–	–	–
28.	„ unguiculata (L.) Walp.? Waken Gizo L 1757	–	–	20	1	1	–
30.	„ vexillata Benth.	–	–	7	–	–	–
31.	„ vexillata Benth. L 95	–	–	10	–	–	–
32.	„ vexillata Benth. L 70	–	–	3	–	–	–
33.	„ spec. Gayan gayan (ex Hunkui) L 1748	1	–	24	1	1	–
34.	„ spec. Yaryadingona (ex Gussau) L 1749	3	2	36	1	6	–
35.	„ ambacensis Welw.	30	–	–	–	–	–
36.	„ heterophylla A.Rich. K 51326	5	–	–	–	–	–
37.	„ pubigera Bak.	10	–	–	–	–	–
38.	„ oligosperma Backer	10	–	–	–	–	–

1. We have already mentioned that the 4 wild species with 2n = 20 showed no numerical deviations in a total of 55 plates counted.

2. The 34 wild species from Africa with 22 chromosomes give the following results:

Total number of plates counted		473	
from these : 22 chromosomes		427	
deviations : 20	8		
21	3		
23	11		
24	24		
Total	46	9.73%	

TABLE 5. DISTRIBUTION OF CHROMOSOME NUMBERS IN THE PLATES COUNTED IN CULTIVARS OF COWPEA AND ASPARAGUS BEAN

Name of cultivar			20	21	22	23	24
39. Vigna unguiculata (L.) Walp.	Banta-B	L 742	–	–	13	–	–
40. „ „ „	Waken Kaka	L 1033	–	–	23	1	–
41. „ „ „	Kirsi (Kirmoki)	L1034	–	–	30	–	–
42. „ „ „	Wake Mai Rodi	L 1035	1	1	25	–	4
43. „ „ „	Jan Wake	L 1040	–	–	20	–	–
44. „ „ „	Wake Danferi	L 603a	1	–	16	1	1
45. „ „ „	Wake Danferi	L 6036	–	–	30	–	–
46. „ „ „	Ex-Lafia A	L 1645	–	–	9	–	–
47. „ „ „	Ayabilo ex Zongo		–	–	30	–	–
48. „ „ „	Ayabilo ex Tagama	L 6020	–	–	25	–	–
49. „ „ „	Ayabilo ex Tagama		–	–	28	2	2
50. „ „ „	Ex-Bukuru A	L 1643	–	1	5	–	–
51. „ „ „	Cowpea 37 C-6		–	1	5	–	–
52. „ „ „		PI 221731	–	–	6	–	–
53. „ „ „	Going CPM 1		–	–	7	–	–
54. „ „ „	Sirsa No. 35	IC 2925	–	–	13	–	–
55. „ „ „	Kor	PI 163142	–	–	15	1	–
56. „ „ „	Delhi Local	IC 669	1	2	25	1	–
57. „ „ „	Whippoorwill		–	–	14	–	1
58. „ „ „	Forage crop	31705	–	–	30	–	–
59. „ „ „	Early Red	531	–	–	30	–	–
60. „ „ „	Capucijner	S403/A/46/1	–	–	20	–	–
61. „ „ „	Hibo Caneio	PI-Inst. = 0.128	–	–	7	–	–
62. „ „ „	Garbancito	PI-Inst. = 0.151	–	–	3	–	–
63. „ „ „	Magdalena 8	27132	–	–	10	–	–
64. „ „ „	Magdalena 9	27133	–	–	14	–	–
65. „ „ „	Tolima 4	27010	–	–	20	–	–
66. „ „ „	Bolivar 15A	27118	–	–	19	–	–
67. „ „ „	Córdoba 3 Roja	27015	–	–	12	2	–
68. „ „ „	Cabecita negra	27115	–	–	28	–	2
69. „ „ „	Cabecita ≠ 2	27155	–	–	9	–	1
70. „ „ „		PI 147561	–	–	4	–	–
71. „ „ „		PI 152199	–	1	9	–	–
72. „ „ „		PI 152194	–	–	2	–	–
73. Vigna sesquipedalis A. J. Pieters		L 1935	–	–	12	–	–
74. „ „ „		Bogor	–	–	9	1	–

3. Considering together the wild types from *V. unguiculata* (L.) WALP. and those that are regarded to be very close allies, viz. *V. Dekindtiana* HARMS, *V. racemosa* HUTCH. & DALZ. and the two *Vigna* types no.'s 30 and 31 from Samaru, also closely related to *V. unguiculata*, this is the result:

16 types under consideration

Total number of plates counted		332	
from these : 22 chromosomes		298	
deviations : 20	6		
21	2		
23	6		
24	20		
Total	34	10.24%	

4. Wild types excluding the above-mentioned:
18 types under consideration

Total number of plates counted			141
from these : 22 chromosomes			129
deviations : 20		2	
21		1	
23		4	
24		5	
	Total	12	8.51%

5. In a total number of 36 cultivars (34 cowpeas and 2 asparagus beans) we find the following results:

Total number of plates counted			606
from these : 22 chromosomes			577
deviations : 20		3	
21		6	
23		9	
24		11	
	Total	29	4.79%

6. 12 cultivars of cowpeas from Northern Nigeria (no's 39–50):

Total number of plates counted			269
from these : 22 chromosomes			254
deviations : 20		2	
21		2	
23		4	
24		7	
	Total	15	5.58%

7. 12 cultivars of cowpeas from South and Central America (no's 61–72):

Total number of plates counted			143
from these : 22 chromosomes			137
deviations : 20		0	
21		1	
23		2	
24		3	
	Total	6	4.20%

8. Before discussing the results obtained from these analyses, it may be noticed that practically in all cases the amount of 24 chromosome deviations is about half the total number of deviations.

9. A comparison between the wild 22-chromosome species and the cultivars shows that chromosome variations are about twice as many in the wild material. (9.73% for wild against 4.79% for cultivars).

10. In order to obtain even better comparable data we separated the wild material into two groups, viz. an *V. unguiculata* with allies portion and the other wild types. The percentage of deviations for the *V. unguiculata* group appears to be 10.24% whereas for the other wild types 8.51% was found.

11. Another question is whether the group of cultivars may be considered as homogeneous with respect to the frequency of deviations.

    Therefore the two groups of 12 Northern Nigerian cultivars and of the 12 South- and Central American cultivars were separately investigated as to the number of deviations in each of them, resulting in 5.58% and 4.20% respectively.

So the results from the above-mentioned analyses point all in a similar direction: within the 22 chromosomic taxa of the genus *Vigna* investigated so far, the chromosome number tends to deviate, about 50 per cent of the deviations resulting in 24 chromosomes.

The frequency of the total range of deviations between 20 and 24 is twice as great in wild *unguiculata* and its allies as in the cultivars: this points to domestication and designed selection by breeders as stabilizing factors concerning the chromosome pattern.

It is even quite possible that such a selection may result in some cultivars with $2n = 24$ as a regularly occurring number: obviously we did not come across them in the available material. As we did not study the meiosis in any of the types, it seems not feasible to enter into the problem whether the variation in chromosome number is caused by either breaking or fusion of chromosome parts.

c) *Chromosome types and dimensions*

SEN and BHOWAL (1960) tried to study the individual chromosome types in *Vigna*, but owing to the small dimensions their efforts were in vain. In their table 3, however, they listed the chromosome pairs according to long, medium and short ones and determined the number of satellited pairs in each of the types studied. We tried to do the same but we shall not give the results, as neither the distribution of dimensions nor the number of the satellited pairs tally with the data of SEN and BHOWAL; there appeared to be a variation in the number of satellited pairs from 0 to 2 in the cultivars studied.

The aspect of chromosome dimensions, however, asks for a closer observation.

Comparison of e.g. two *V. unguiculata* cultivars no. 51 and no. 59, (both $2n = 22$) and two 20 chromosome species *V. ambacensis* and *V. oligosperma*, (no. 35 and no. 38) show that there exists a considerable difference in the shape and size of the chromosomes.

This difference might be ascribed to fluctuations in the extent of spiralization, if the examples in our plates would not be representative of all the cases examined in the type under consideration. Furthermore, when examining the entire range of figures illustrating the cultivars of *V. unguiculata* we may find that on the whole the

Central- and South American types are characterized by smaller-sized chromosomes as compared to those in the African and Indian cultivars.

Another indication that the genus *Vigna* is not a uniform group and more especially, that *Vigna unguiculata* is not entirely homogeneous is also noteworthy.

When working on photoperiodic effects concerning the influence of induced scions upon non-induced stocks, Dr. WIENK in trying out a successfull grafting method, made also preliminary combinations between Early Red, Tolima 4 and Kor in both directions. He obtained results which at first seemed unexplainable. In the meantime, however, the difference in chromosome type and size was found. Since then the same experiment has been repeated a few times with Early Red and Kor, always with the same result, which is as follows:

Between the cultivars Kor and Early Red the following four grafting combinations can be made: 1) Kor upon Kor, 2) Early Red upon Early Red, 3) Early Red upon Kor, 4) Kor upon Early Red. Owing to lack of space in our hothouses each combination could be made only with a small number of plants, but we repeated this experiment four times, the last time with 25 plants in each group. Each time, however, the results pointed in the same direction, viz.: a large-chromosomic scion on a small-chromosomic stock always yielded less than 100 per cent success, in the main between 50 and 80 per cent. We look forward to repeat this experiment with other combinations and hope to let them grow for a longer period in order to observe the entire life cycle of the graftings.

We have not yet attempted hybridizations between the large – and small chromosomic types, but we feel that in this respect also interesting results might be expected.

d) *Taxonomy and cytological data in the genus Vigna*

There does not seem to exist any monographical work on the genus *Vigua*. TAUBER in ENGLER & PRANTL (1899) subdivides the genus of about 40 species known at that moment into two subsections. E. G. BAKER in the Leguminous Plants of Africa makes a classification based on a few morphological characteristics and discriminates 6 sections as far as the African species are concerned.

In general, this classification has been maintained in the flora of West Africa.

In table 6 we put down the species investigated cytologically according to the classification made by BAKER.

Chromosome numbers in italics are the results of our own counts; those followed by the sign = are a corroboration of former reports by other authors.

In the course of this investigation another feature arose which seemed worthwhile pursuing. Both species *V. pubigera* and *V. ambacensis* with 2n = 20 also are characterized by an oblique hilum on the seed. We examined this feature in all the species investigated by us and arrived at the results put down in table 6.

In the present state of investigation, as laid down in this table, the only conclusion is that so far no correlation may be found between the species characteristics, the chromosome numbers and the areas of distribution, such as presented in the various current floras. From these viewpoints there are not yet better directions for a more rational classification in the genus *Vigna*. Moreover, not until the systematic status of the material which has been described and is therefore known under the genus names of *Vigna*, *Phaseolus* and *Dolichos* is sorted out and adequately described (GILLETT

TABLE 6. VIGNA
Classification by E. G. Baker

Seed type (hilum)[1]	Species	Chrom. no. dipl.[2]
	I. Microdontae	
*	multinervis	*22*
*	parviflora	*22*=
*	ambacensis	*20*=
*	pubigera	*20*=
**	luteola (glabra?)	22
*	gracilis	*22*=
** or *	maranguensis	*22*
**	Schimperi	*22*=
**	marina (lutea?)	22
**	fragrans	*22*
	II. Appendiculatae	
**	coerulea	*22*
**	racemosa	*22*
**	unguiculata	*22*=
**	Dekindtiana	*22*
** or *	triloba (mensensis var. hastata)	*22*
*	Schliebenii	*22*
	III. Macrodontea	
	membranacea	20
*	heterophylla	*20*=
*	oblongifolia	*22*=
	IV. Vexillatae	
**	vexillata (capensis?)	*22*=
	V. Liebrechtsia	
	VI. Procerae	
**	oligosperma (Hosei)	*20*

[1] * hilum oblique
** hilum central

[2] chromosome numbers in italics have been counted by the present author; = means that the counting results tally with those previously reported by other authors.

1964) and not before a great deal more of cytological investigation in conjunction has been done, will it become possible to obtain a rational classification in these genera.

There may even be a polyphyletic trend all through the subtribe of the *Phaseoleae* which, incidentally, can be traced as far as within a genus such as *Vigna*.

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