The Recent Botanical Taxonomic System of Peanut Cultivars

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Increased peanut production and the importance of conducting studies on peannt cultivars in the world

According to world statistics on peanut production published 1971 by FAO, peanut yield in the world augmented twice as much as that produced about 20 years ago (from 1948 to 1952).

On the same comparison, in all the Asian countries where 50 to 60 per cent of the world peanut output have been produced yearly, including India and China which have ranked first and second in the world respectively, the yield in this period increased as much as 1.8 times.

In the same way, the production in South America increased five fold and in Africa about twice respectively.

But recently peanut production has not shown anymore significant increase and the acreage for peanut cultivation has not been enlarged in the world.

Importance of peanut which is one of the vital oilseed crops has been evaluated moreover by the recent technical development to make edible fibers from oilseed proteins, "meat free meat". And increasing attention has been paid to peanut production during the recent 20 years, especially in the countries having a large population.

The studies on the characteristics of peanut cultivars and their variation, the international exchange system for the introduction of new gene source and the basic researches of genetics and breeding of yield and quality (chemical composition and nutritional values) of peanut are necessary to be promoted more actively as well as the studies of cultivation technics.

Though some of the scientists had conducted studies on peanut in Asian countries—John et al. 1954[5], Kumazawa et al. 1954, Shakudo et al. 1962 and Katayama et al. 1963—the study of peanut is not so intensified in this area.

On the other hand, many studies on classification of cultivars of peanut have been accomplished in Africa in recent years (Boufill 1947, Catherinet 1955, Bunting 1955[1], 1958, Smartt 1961, Gibbons et al. 1972[2]) because, being the secondary center of peanut variation, this continent is favored with the conditions for the studies on the variation and classification of peanut cultivars.

The increasing interest in African nations to peanut seems to be manifested in this trend.

Development of classification studies on peanut cultivars

About 50 years ago, Waldron[10] proposed to classify the cultivated species of peanut (*Arachis hypogaea* L.) into two subspecies according to the plant type or growth habit; namely, (1) erect: ssp. *fastigiate* and (2) prostrate: ssp. *procumbens*.

Some people supported this proposal and it is newly evaluated recently by the most advanced taxonomic system of cultivars.

Gregory et al. (1951)[3] indicated that peanut can be classified into two big botanical cultivar groups on the basis of branching pattern which is due to the vegetative characters found by Richter in 1899; that is, the presence or absence of reproductive node on the main axis or the arrangement of reproductive node and vegetative node on the branch. From the viewpoint of the cultivar type, one group corresponds to the Virginia type and the other to the Spanish and Valencia types.

Bunting (1955)[1] studied the classification of cultivated peanut in Sudan and arrived at the same conclusion, and he named the two groups of branching pattern described above, "alternate branching" (Virginia type) and "sequential branching" (Spanish and Valencia types).

The applicability of his concepts on the classification of peanut cultivars was highly estimated by other scientists not only as a botanical or a natural classification but also as an agronomic classification.

An Argentine scientist, Krapovickas et al. (1957, 1969)[6,7] studied many land races of peanut at the gene centers of the genus *Arachis* and cultivated peanut plant, and reported many interesting results. He classified the peanut by the branching pattern described above and moreover by its correlating factors; that is, the form and size of fruits, growth habit, duration of vegetative period and the presence or absence of seed dormancy.

This classification could be the most fundamental and advanced botanical taxonomic system of peanut cultivars for the future studies of genetics and breeding of peanut. (Table 1)

Table 1. Botanical taxonomic system by Krapovickas et al. 1957 (Krapovickas 1969)[7]

Arachis hypogaea L.
- subspecies *hypogaea*
  - var. *hypogaea* (= *A. africana* Lour.), the Brazilian type of Dubard, Virginia type of Gregory et al.
  - var. *hirsuta* Kohler (= *A. asiatica* Lour.), the Peruvian type of Dubard in part.
- subspecies *fastigiata* Waldron
  - var. *fastigata*, Peruvian type of Dubard in part, Valencia type of Gregory et al.
  - var. *vulgaris* Harz, the Spanish type of Gregory et al.

Investigation on the statistical significance of the primary botanical taxonomic system of peanut cultivars based on the plant type

The variability of the characteristics of peanut caused many different opinions on the classification of varieties and the fundamental characteristics for classification.

Tardieu 1957, Jacqat 1962 and the author 1964[9] attached importance to floral characters, but Gibbons et al. 1972[2] thought much of vegetative characters such as the branching pattern.

The author investigated many peanut cultivars of the world and found the variation (0-2) in the number of sterile filaments (stamens) formed on the androecium of peanut. This variation was different between the two varietal groups (infraspecific taxons) mentioned above. (Maeda 1961, 1964)[8,9].

The statistical significance of the primary taxonomic system of peanut cultivars based on the plant type was investigated by the discriminant functions with four indices of this variation; namely, frequency of appearance (%) of "9-anthers-flower+10-anthers-flower" (%) calyx tube length, pod volume and terminal leaflet width.

Tables 2 and 3 show the range of variation and means of the four characters in cultivar groups, coefficients of correlation between each characters and the number of cultivars examined.

Discriminant equations were calculated to discriminate (1) Virginia Runner type (Pr) *vs.* Virginia Bunch type (Sp), (2) Spanish type (E_s) *vs.* Valencia type (E_v) and

Table 2. Ranges of variation and means of 4 characters in cultivar groups of peanut used for evalution of discriminant equations (Maeda 1964)[9]

Cultivar group	Character				
	Appearance of "9-" and "10 anthers-flower" (x_1) %	Width of terminal leaflet (x_2) cm	Pod volume[1] (x_3) cm³	Length of calyx-tube (x_4) cm	No. of cultivars (N)
① Prostrate	1.97 (0–9.0)	2.87 (2.5–3.6)	6.19 (3.1–9.9)	4.37 (2.5–6.9)	34
② Semi-prostrate	1.21 (0–7.9)	2.94 (2.5–3.6)	6.04 (2.5–9.2)	4.31 (3.3–5.9)	23
③ P	1.67 (0–9.0)	2.90 (2.5–9.9)	6.13 (2.5–9.9)	4.35 (2.5–6.9)	57
④ Spanish type	13.55 (3.0–35.0)	3.72 (3.1–4.3)	3.27 (2.0–4.9)	3.65 (2.7–4.7)	36
⑤ Valencia type	12.10 (2.0–52.0)	3.67 (2.8–4.7)	5.01 (3.3–7.9)	3.34 (2.0–5.8)	19
⑥ E	13.05 (2.0–52.0)	3.70 (2.8–4.7)	3.87 (2.0–7.9)	3.54 (2.0–5.8)	55
Difference between means ①–②	0.76	−0.07	0.15	0.06	Total No. of cultivars
④–⑤	1.45	0.05	−1.74	0.31	112
③–⑥	−11.38	−0.80	2.26	0.81	

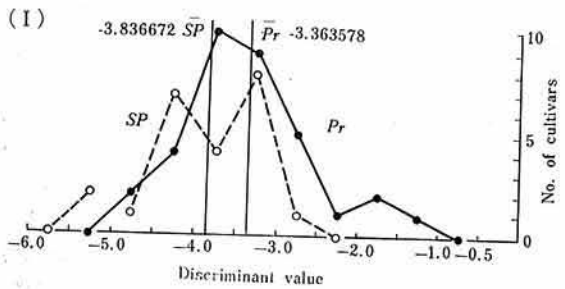
1) Evaluted by (length × width × thickness)

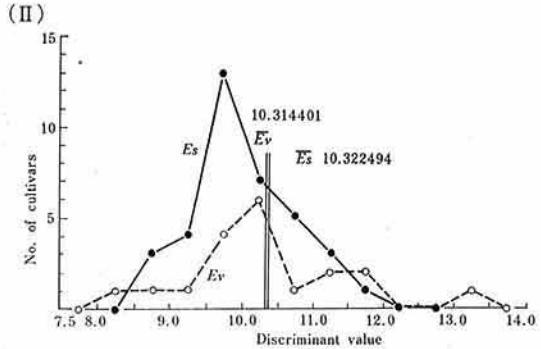
Table 3. Coefficients of correlation between 4 characters used for the evalution of discriminant equations (Maeda 1964)[9]

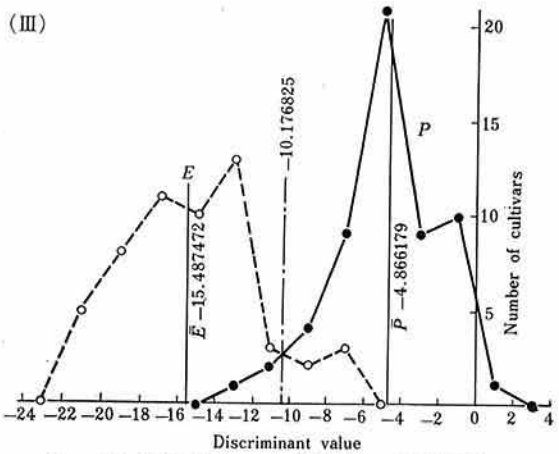
Character	x_1	x_2	x_3	x_4
x_1	•	0.677***	−0.370***	−0.184
x_2	•	•	−0.385***	−0.414***
x_3	•	•	•	0.273**

As whole cultivars (N=112)

(3) P(Pr+Sp) *vs.* E(Es+Ev). Fig. 1. I-III show the distribution of discriminant values obtained by substituting the values of the four characters of each cultivar into the discriminant equations.







$^{*}P_r - SP = 0.389456x_1 - 2.114145x_2 + 0.167173x_3 + 0.209054x_4$

$^{*}E_s - E_v = -0.048778x_1 + 1.964042x_2 + 0.275210x_3 + 0.695356x_4$

$^{*}P - E = -0.231234x_1 - 5.831568x_2 + 0.628915x_3 + 1.975205x_4$

$\bar{P} - \bar{E} = 10.621293 \quad F^{4}_{107} = 71.51 \quad P < 0.001$

Fig. 1, I~III. Discriminant equations and distribution of the discriminant values in each of the cultivar group classified by plant type and "cultivar-type" (Maeda 1964, modified)

Significant difference at 0.1 per cent level was detected by means of the F-test of mean discriminant values of each group only in the case of P *vs.* E which divided whole groups into two. But no significant difference was found among the cultivar types.

The probable error in the discrimination of any cultivar by the discriminant equation $X_{P\text{-}E}$ was not more than five per cent. Therefore, high confidence can be proved on this equation.

The cultivar, 1954 I.N. 797 which showed unique discriminant value (+0.497255) had peculiar long calyx-tube, big air-dried weight of fruit and kernel, and red and white variegated testa.

This cultivar was very similar to the "Nambiquarae rajado" which was collected in

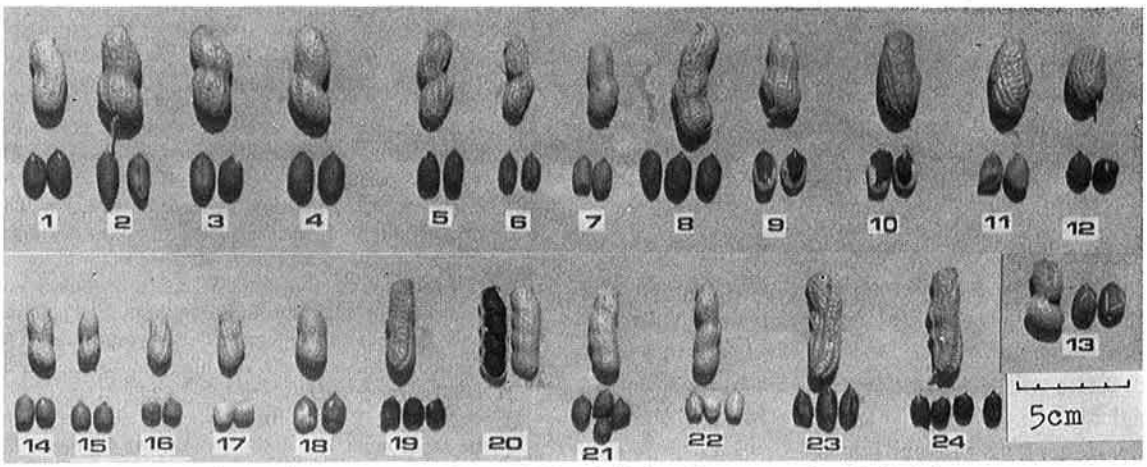


Fig. 2. Fruits of major cultivars of Kōchi University's collection divided into 2 primary botanical taxonomic groups, with 1 "Intermediate"

No.	Cultivar name	Origin	Plant type
Arachis hypogaea L.			
I.	Subspecies *hypogaea* (Virginia type)		
1.	Chiba handachi	Japan	*SP*
2.	Tachi rakuda	〃	*SP*
3.	Florida 392-12 B-28	U. S.	*Pr*
4.	Krapovicka's str. No. 2		*Pr*
5.	43-G-909	South Africa	*SP*
6.	Yuan Yang Tou	Taiwan	*Pr*
7.	T. M. V. 3	India	*Pr*
8.	Krapovicka's str. No. 12		*Pr*
9.	Nambiquare-Rajado	Brazil, 1971 (MAEDA)	*Pr*
10.	1954 IN 797		*Pr*
11.	Nambiquare-Amalero	Brazil, 1971 (MAEDA)	*Pr*
12.	Improved ground-nut	Sierra Leone	*SP*
II.	Subspecies *Fastigiata* Waldron (Spanish-Valencia type)		
14.	Chiba shōryū	Japan	*Es*
15.	Natal Common	Nigeria	*Es*
16.	Barberton	South Africa	*Es*
17.	Tanganyika-A, White	Tanganyika	*Es*
18.	South Africa No. 1		*Es*
19.	Kono	Sierra Leone	*Ev*
20.	Porto Alegre	Brazil, 1971 (MAEDA)	*Ev*
21.	COTIA-Tatu 53	Brazil, 1971 (MAEDA)	*Ev*
22.	Spanish White	U. S.	*Es*
23.	Krapovicka's str. No. 3		*Es*
24.	Krapovicka's str. No. 4		*Ev*
III.	"Intermediate"		
13.	Shantung Province str.	China 1967 (Imported)	*SP*

Pr: prostrate *SP:* semi-prostrate *Es:* erect, Spanish type *Ev:* erect, Valencia type

Brazil by the author in 1971, and was identified as *Arachis hypogaea* L. var. *nambyquarea* John et al. or as the Brazilian type of A. *hypogaea* L. ssp. *hypogaea* var. *hypogaea* Krapovickas et al. (Fig. 2, No. 9).

From these results, it seems reasonable to classify the peanut cultivars into two groups; that is, (1) prostrate (including semi-prostrate): Virginia type and (2) erect: Spanish and Valencia types by means of plant type as the primary character for classification.

Consequently, statistical significance could be obtained:

And the botanical taxonomic system of Gregory et al. 1951[3], Bunting 1955[1] and Krapovickas et al. 1957, 1969[6),7)] is recognized in terms of this classification.

Therefore, the former classification of the cultivar type is merely the secondary taxon in the botanical classification or agronomic significance.

After all, the plant type seems to be practical and fundamental character for the classification of peanut cultivars.

"Intermediate", infraspecific cross-origin cultivars

Formerly the pure line breeding method had been used for peanut breeding, but the hybridization method is widely employed recently so some new cultivars of cross-origin between two subspecies are already bred and released[4].

Krapovickas 1969[7] reported that "infraspecific intermediate" is caused more rarely than the "intermediate between botanical varieties" owing to the lethal characters of albino or malformation.

But the taxonomic treatment for the cultivars bred from artificial or natural hybridization between two subspecies poses a serious problem in future.

Fig. 2 shows the fruits of the major cultivars in Kōchi University's collection which has been introduced, preserved and classified by the author according to the above described classification system.

No. 13 in this figure belongs to the strain imported from Shantung Province, China, and its top shows the character of semi-prostrate and denser leafy canopy as well as the character of flowering on leaf axils of main axis and non-dormancy of seed.

And from the viewpoint of the specificity of its fruit character, it seems that this cultivar should be classified as the "intermediate of two subspecies".

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