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## 1. Characteristics of maize races growing in the middle part of Japan.

Japanese races are composed of two types of flint corn. One type is the so-called "Tripsacoid" maize. It was introduced into Japan recently, probably after the establishment of the Agricultural Experiment Station in 1877, from the northwestern United States and Europe. At present, its races are distributed mainly over open fields in the northern part of Japan. On account of their lateness and susceptibility to frost damage, none of the old Japanese races are grown in such fields. The other type of flint corn is a group of old Japanese races belonging to the so-called "Caribbean" tropical flint (Sutô, 1956). It is said that a Portuguese introduced seeds of this type from Europe to Kyûshû in 1573. This maize has rapidly spread over the temperate uplands ranging from about 300 to 100 m in altitude. In accordance with adaptation to specific environments in such regions, a number of local races had been differentiated, without any contamination with other types, before 1877. As compared with the North American or European flints, they are characterized by the following characters: Plant mediate or tall in height, medium or late in maturity, highly resistant to humidity, lodging and leaf blight, well-adapted to barren soil; tillers and prop roots absent or few in number; leaves many in number and large in size, the longest leaf arising from a high position on the stalk; stalk thick in diameter, having many short internodes; tassel very long and pendent, having fewer long branches; paired spikelets very lax, shedding a small amount of pollen at anthesis; ear high in position, large in size, conical or occasionally cylindrical in shape, usually having an enlarged butt and about 12 to 16 kernel-rows; shank having enlarged nodes and a ribbed surface; husks short in length, but very abundant in number, having no flag-leaves; cob very large in diameter and soft in texture; kernels large, somewhat spherical in shape, orange in color and hard in texture, giving a good quality.

There are three centers of their distribution in the temperate regions of Japan; (1) the highland fields around Mt. Aso in Kyûshû, (2) the terraced fields at the mountain sides in Shikoku and (3) the upland fields at the foot of Mt. Fuji in Honshû. The 57 samples used in this work were collected from about 100 farmer's fields in 10 upland localities around Mt. Fuji and neighboring mountains at the central part of Japan. According to agronomical, genecological and cytogenetical viewpoints, the findings obtained are summarized as follows:

a) The 57 samples were identified as belonging to 19 races, of which the maturity was early in 2 races, medium in 4, late in 8 and extra-late in the remaining 5. Six of these, comprising 2 early, 2 medium, and 2 late races, were proved to be favorable as breeding material.

b. The 10 native localities examined were classified into 5 areas.

1) The eastern area consists of three localities, Tsukui (T), Dôshi (S) and Akiyama (A). The majority of corn fields were terraces of the mountain solitudes of Mt. Tanzawa situated at the eastern part of Mt. Fuji. The 6 races were distributed. They had a typically conical and short ear with large and spherical kernels and about 12 kernel-rows. Yields of both grain and stalks were usually low, and their quality was inferior to that in any area of this region. Characteristics of the races were not so particular, but of a primitive nature. All of them but one, largeness in kernel size, are considered unworthy for agronomical purposes. But, it is cytologically interesting that these races possessed many knobs, 9 to 10 on the average, and had no B chromosomes with the exception of one race in Dôshi.

2) The Kamigane area occupies the southern side of the mountain-range of Chichibu situated at the northern part of Mt. Fuji. Soils were fertile. Farmers were very careful in their management of corn fields and in their selection of the seed corn. There was a useful late race, besides an early one and a medium one. The cob was very large and soft, sometimes hollow in its center, making it easily possible to push kernels into the cob with the fingers. Kernels were spherical in shape and more yellowish in color. Races frequently had a B chromosome. The frequency of chromosome knobs was as high as that in the former area.

3) The northern area is composed of several localities, i.e. Funatsu (F), Narusawa (N), Yamanaka, Iwama and others. They are all situated at the northern foot of Mt. Fuji, which is the best place for corn production in this region. From old times, farmers have carefully grown corn as a staple food. The two races were distributed, one, which was found to be early, in Narusawa and Yamanaka, and the other, which was medium, in Funatsu and Iwama. Both are considered to be of some agronomic value. The ear was long-cylindrical, having a hard rod-like cob and about 8 to 12 kernel rows. Kernels were large in size, very good in quality, and their color was brilliant orange. The frequency of B chromosomes was high, as in the Kamigane area. The knob number was less, about 7 on the average.

4) The southern area occupies the southern foot of Mt. Fuji, containing such localities as Jûrigi (J), Suyama (S) and Itazuma (I), and represents another of the most productive corn growing areas. Five races were grown in these localities; an 8-rowed extra-early one was the most interesting. No B chromosomes were observed in any of these races. The number of chromosome knobs was about 8. In the extra-early race of the Jûrigi locality, the number of knobs was 5, this being the smallest number in this region.

Table 1. Frequency of occurrence of chromosome knobs in 51 maize races growing in Mt. Fuji and its neighboring districts.

| Native place | No. of races | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | Subt. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | S | L | S | L | S | L | S | L | S | L | S | L | S | L | S | L | S | L | S | L | Total |
| T | 5 | - | 1 | - | 2 | 3 | - | 5 | - | 3 | - | 6 | - | 10 | - | 5 | - | 9 | 1 | 1 | 4 | 41 | 45 |
| | av. | - | 0.2 | - | 0.4 | 0.6 | - | 1.0 | - | 0.6 | - | 1.0 | - | 2.0 | - | 1.0 | - | 1.8 | 0.2 | 0.2 | 0.8 | 8.2 | 9.0 |
| A | 6 | - | 3 | 3 | - | 4 | 1 | 6 | - | 2 | - | 5 | - | 12 | - | 6 | - | 11 | 1 | 4 | 5 | 53 | 58 |
| | av. | - | 0.5 | 0.5 | - | 0.7 | 0.2 | 1.0 | - | 0.3 | - | 0.8 | - | 2.0 | - | 1.0 | - | 1.8 | 0.2 | 0.7 | 0.8 | 8.8 | 9.7 |
| D | 4 | 1 | - | 1 | 1 | 3 | 1 | 3 | - | 3 | - | 4 | - | 8 | - | 4 | - | 7 | 1 | 1 | 4 | 33 | 37 |
| | av. | 0.3 | - | 0.3 | 0.3 | 0.8 | 0.3 | 0.8 | - | 0.8 | - | 1.0 | - | 2.0 | - | 1.0 | - | 1.9 | 0.3 | 0.3 | 1.0 | 8.3 | 9.3 |
| K | 9 | 7 | - | 1 | - | 6 | 2 | 9 | - | 2 | - | 9 | - | 16 | - | 8 | - | 16 | 4 | 6 | 6 | 74 | 80 |
| | av. | 0.8 | - | 0.1 | - | 0.8 | 0.2 | 1.0 | - | 0.2 | - | 1.0 | - | 1.8 | - | 0.9 | - | 1.8 | 0.4 | 0.7 | 0.7 | 8.2 | 8.9 |
| F | 6 | 6 | - | 5 | 3 | 1 | - | 4 | - | 2 | - | 6 | - | 10 | - | 5 | - | 5 | 3 | - | 6 | 37 | 43 |
| | av. | 1.0 | - | 0.8 | 0.5 | 0.2 | - | 0.7 | - | 0.3 | - | 1.0 | - | 1.5 | - | 0.8 | - | 0.8 | 0.7 | - | 1.0 | 6.2 | 7.2 |
| N | 6 | 5 | - | - | - | 4 | 1 | 5 | - | - | - | 6 | - | 9 | - | 6 | - | 9 | 2 | - | 3 | 39 | 42 |
| | av. | 0.8 | - | - | - | 0.7 | 0.2 | 0.8 | - | - | - | 1.0 | - | 1.5 | - | 1.0 | - | 1.5 | 0.3 | - | 0.5 | 6.5 | 7.0 |
| J | 3 | - | - | - | 1 | 1 | 1 | 1 | - | - | - | 1 | - | 5 | - | 2 | - | 2 | 1 | - | 3 | 12 | 15 |
| | av. | - | - | - | 0.3 | 0.3 | 0.3 | 0.3 | - | - | - | 0.3 | - | 1.7 | - | 0.7 | - | 0.7 | 0.3 | - | 1.0 | 4.0 | 5.0 |
| S | 6 | - | - | 1 | - | 3 | 2 | 5 | - | 1 | - | 5 | - | 12 | - | 6 | - | 11 | 2 | 2 | 3 | 47 | 50 |
| | av. | - | - | 0.2 | - | 0.5 | 0.3 | 0.8 | - | 0.2 | - | 0.8 | - | 2.0 | - | 1.0 | - | 1.8 | 0.3 | 0.3 | 0.5 | 7.8 | 8.3 |
| I | 6 | - | - | 2 | - | 1 | 1 | 6 | - | 2 | - | 6 | - | 11 | - | 5 | - | 10 | - | 4 | 1 | 48 | 49 |
| | av. | - | - | 0.3 | - | 0.3 | 0.2 | 1.0 | - | 0.3 | - | 1.0 | - | 1.8 | - | 0.8 | - | 1.7 | - | 0.7 | 0.2 | 8.0 | 8.2 |
| Total | 51 | 19 | 4 | 13 | 7 | 28 | 9 | 44 | - | 15 | - | 47 | - | 92 | - | 47 | - | 80 | 15 | 18 | 35 | 384 | 419 |
| | av. | 0.4 | 0.1 | 0.3 | 0.1 | 0.5 | 0.2 | 0.9 | - | 0.3 | - | 0.9 | - | 1.8 | - | 0.9 | - | 1.5 | 0.3 | 0.4 | 0.7 | 7.5 | 8.2 |

The abbreviations under the 1st column, T, A, D, K, F, N, J, S and I, are the 1st letter of the local name, Tsukui, Akiyama, Dôshi, Kamigane, Funatsu, Narusawa, Jûrigi, Suyama and Itazuma, respectively. The letters in the 1st row, B, 1, 2, 3....9, S and L, correspond to B chromosomes, chromosomes 1, 2, 3....9, and the short and long arms of the chromosomes, respectively. One of the ten chromosome (no. 10) is not included in the table because of having no knobs.

5) The western area occupies the western foot of Mt. Fuji. Corn introduction to this area is comparatively recent. The growing area is not so wide. Corn growers are careless in corn management. There were three races. Plants and leaves were remarkably small. The ear was also small and conical, and had many kernel-rows containing small kernels, generally arising in a high position on the stalk. The variability of characters within a race was very conspicuous. It is assumed that repeated contaminations of the Caribbean corn with a primitive race of pop corn have occurred. Such a race has from old times been native to this region, essentially similar to the race "Lady Finger" grown in Latin America. No cytological examination was made on any races in this area.

2. A recessive mutant producing male sterility.

Two male sterile plants appeared in certain populations heterozygous for $ra_1$-$gl_1$-ii, a chromosome 7 linkage tester which has been preserved by sib-crosses in the breeding fields of our institute. One male sterile was called "A28" and the other "A29". These two mutants behaved similarly so far as the results of crossing experiments were concerned. In the present work, two stocks of different sources, a chromosome 7 linkage tester marked by $ra_1$-$gl_1$-ii and a multiple tester (Mangelsdorf's or Randolph's), were used as pollinators to be crossed with the male steriles. $F_1$ plants resulting from a cross with the multiple tester were all normal in a total of 1072, whereas two $F_1$ populations involving the chromosome 7 linkage tester were composed of a few male-sterile plants in addition to normal ones. One of these was an $F_1$ derived from the cross of a ms plant and consisted of 209 normal and 5 ms plants; the other $F_1$ was derived from a cross of a normal plant heterozygous for ms and gave 617 normal and 9 ms plants. The present sterile mutation, like that reported in 1950 by Prof. M. M. Rhoades in his paper on cytoplasmic male sterility, may also be induced by the genes, $ra_1$-$gl_1$-ii, especially ii.

From the data obtained on $F_2$ and backcross segregations, it seems highly probable that the present sterility is controlled by a single recessive allele. However, a significant discrepancy from the expected ratio of 3:1 or 1:1 was frequently encountered between (1) sterile stocks (A28 and A29), (2) different fields planted, (3) generations of sterility induced, and (4) different pollinators. At present the genetical cause is unknown. Out crosses were all made using the male sterile as the female parent. The cytoplasm in all crossing progenies should therefore have been transmitted from the sterile parent only. Whether the discrepancy is caused by such a cytoplasmic effect or not will be further studied.

At any rate, it may be assumed from the data in Table 2 and 3 that a gene governing the present case of male sterility is located on chromosome 4 with approximately 40% of recombination with $su_1$.