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Genetic Analysis of the Thoroughbred Population in Japan

1. Genetic Contribution of Important Breeders
and Breeding Horses and of Groups of
Horses imported in Different Periods.

By

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Thoroughbred population in Japan was formed through the import begun at the end of the Meiji era. During World War II the import of breeding horses was stopped, but recently the number of imported horses has gradually been increasing with the prosperity of horse racing and brought a great influence.

The first List of the Horses Registered for Breeding was published in 1949 by the Japan Light-Breed Horse Registration Association. In the early of thoroughbred breed import, some private breeders, the Imperial Stock Farm and National Government took a great part. Nowadays most import of the thoroughbred has been done by many private breeders.

The authors studied on the features of genetic structure of the thoroughbred population in Japan by means of the calculation of genetic contribution of important breeders and breeding horses and of groups of horses imported in different periods.

Materials for analysis

The analysis was carried out by the method of WRIGHT and others: the samples derived from the List of the Horses Registered for Breeding. A sample List of every four year, 1949-'53, '57, '60, '63, '66, '69, was respectively taken until 100 at the fixed interval of pedigree numbers and traced back the pedigree. As the number of registry in 1957 was 78, all the horses were derived for samples (Table 1).

The pedigree of the horses was fully traced back for past five generations—the first generation is sire and dam. In case that imported horses didn't appear till the fifth generation it was traced back still more to its appearance.

Next three analysis were carried out on the basis of this pedigree.

TABLE 1. Sample year and sample horses.

Sample List year	Number of pedigree registered horses	Number of sample horses	Average birth year of sample horses
1949-1953	743	100	1940
1957	78	78	1950
1960	311	100	1953
1963	474	100	1957
1966	723	100	1961
1969	838	100	1964

1. Comparison of genetic contribution of important breeders.

a) Method

For this analysis the samples of only 1949-'53 and 1969 were used. The pedigree of each sample was traced back to those breeders of the sample horse's ancestors in full for five generations and genetic contribution of important breeders to groups of sample horses were calculated by means of WIENER method (Table 2).

Herein we regarded that genetic contribution of breeders was a proportion of a part expected from the horse bred by the breeders in question among all genes of sample horses.

i) It is recorded what times the breeder in question appeared as a breeder at each place in the pedigree in full for five generations (Table 3). However when the breeder in question is a breeder of someone and someone's ancestor too (there are many cases that one breeder produced parents and those ancestors successionaly) if each breeder was traced as different appearance, as WIENER pointed out, a part of genetic contribution of a descendant was calculated one more time at the ancestors. So in such a case a breeder in question was calculated at the latest descendant only and wasn't calculated at all ancestors. Moreover the appearance after the fifth generation was calculated as that of the fifth generation.

ii) Secondly in every generation the frequency of appearance was respectively totaled in stallions and mares. These total scores were regarded as f_s and f_m , and genetic contribution of the breeder in question through stallions and mares of his production was indicated in the following.

$$\sum (1/2)^n \cdot f_s / N \quad \text{and} \quad \sum (1/2)^n \cdot f_m / N$$

n is a number of generations traced back from the sample horse and N is a number of samples. $\sum$ is indicated the total genetic contribution of all five generations.

TABLE 2. An example of computation of per cent genetic contribution of a breeder to sample horses.
(The case of Koiwai Farm, 1949-'53 sample of size N=100)

No. of generation back from sample horses (n)	1	2	3	4	5
Frequency of appearance in each position of the pedigree	12	0	0	0	0
				0	0
			0	0	0
				0	0
				0	0
				0	0
		0	0	0	0
				0	0
			2	0	0
				0	0
				0	0
				0	0
	22	2	0	0	0
				0	0
			1	0	0
				0	0
				0	0
				0	0
		8	0	0	0
				0	0
			7	0	0
				0	0
				0	0
				0	0
Total frequency	f_s	12	0	0	0
	f_m	22	10	4	0
$(1/2)^n f_s/N$		6	0.50	0	0
$(1/2)^n f_m/N$		11	2.00	1.25	0

Genetic contribution

through stallions $\sum (1/2)^n f_s/N \times 100\% = 6.50$

through mares $\sum (1/2)^n f_m/N \times 100\% = 14.50$

Total = 21.00

b) Result and discussion

The result is showed in Table 3 and 4.

From Table 3 (1949-'53 sample horses)

Koiwai Farm, the private farm, contributed exceedingly and next to it Imperial Stock Farm (Shimofusa and Niikappu) and National Government (all

TABLE 3. Per cent genetic contribution of important breeders to 1949-'53 sample horses.

Breeder	Per cent genetic contribution (%)												
	Generation												
	1		2		3		4		5		Total		
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Total
Koiwai Farm	6.00	11.00	0.50	2.00	—	1.25	—	0.25	—	—	6.50	14.50	21.00
Imperial Stock-Farm	5.00	5.00	0.25	0.75	—	0.13	—	—	—	—	5.25	5.88	11.13
National Government	—	3.50	0.50	1.00	0.06	0.13	—	—	—	—	0.56	4.63	5.19
all the above three breeders combined	11.00	17.00	1.00	2.25	—	0.63	—	—	—	—	12.00	19.88	31.88
the other private farms (23)	4.00	17.00	—	0.50	—	—	—	—	—	—	4.00	17.50	21.50

TABLE 4. Per cent genetic contribution of important breeders to 1969 sample horses.

Breeder	Per cent genetic contribution (%)												
	Generation												
	1		2		3		4		5		Total		
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Total
Koiwai Farm	1.00	—	4.50	2.50	1.38	2.63	0.06	0.19	—	0.38	6.94	5.70	12.64
Imperial Stock-Farm	1.00	—	3.50	1.00	2.63	0.63	0.19	0.13	—	0.03	7.32	1.79	9.11
National Government	—	—	0.25	0.25	0.13	0.63	0.31	0.56	—	0.22	0.69	1.66	2.35
all the above three breeders combined	2.00	—	7.75	3.50	4.13	3.88	0.25	0.63	—	0.31	14.13	8.32	22.45
the other private farm (96)	10.00	37.50	—	—	—	—	—	—	—	—	10.00	37.50	47.50

stations together) followed. It is because of proviso stated previously that the total value of the contribution (31.88 per cent) in case of calculating the three farms together is smaller than the respective total values (37.32 per cent).

Considering that genetic contribution of the other private farms didn't reach 1 per cent on an average, the contribution of three can be said pretty large. Particularly Koiwai Farm is conspicuous and its value indicated 20 per cent level. This is not only because there were lots of horses but also because there were good breeding horses, specially mares. It may be said in this connection that 15 horses out of the 17 important breeding horses whose genetic contribution was over 3 per cent (Table 5) were kept in the three.

From Table 4 (1969 sample horses)

Total genetic contribution of the above three was 22.13 per cent. After World War II all the three stopped thoroughbred breeding early or late. So the decrease of contribution seemed natural, although, keeping still 20 per cent level showed that these three contributed remarkably for the improvement of the thoroughbred breeding. In 1949-'53 there were such farms as Koiwai which contributed excessively but it comes to '69 such farms cannot be found. From 1949-'53 to 1969 the number of other private farms increased from 23 to 96. Considering from these things, recently it seems that genetic contribution has been going to disperse to each private farm.

2. Genetic contribution of important breeding horse

a) Method

We regarded that genetic contribution of particular breeding horses was a proportion of a part expected from the breeding horses among all the genes of sample horses. Genetic contribution of each important stallion and mare which was born or imported since 1901 was calculated about all sample years. The method is as follows.

In the pedigree of all N heads sample horses about a certain sample year, the times of particular breeding horse's appearance in each generation were indicated f . However all the appearance since the fifth generation was treated as that of the fifth generation. The genetic contribution of breeding horse in question to sample horses was indicated next by WIENER's method.

$$\sum (1/2)^n \cdot f/N$$

n was a number of generations traced back from the sample horse and $\sum$ was indicated the total genetic contribution of all five generations.

b) Result and discussion

The horses whose genetic contribution was over 3 per cent in any sample years was put up in Table 5. These were 17 heads in all containing two

TABLE 5. Per cent genetic contribution of important horses to sample horses of different sample years.

Name of horse	Year imported or born	Breeder who imported or bred	Per cent genetic contribution					
			1949-'53	1957	1960	1963	1966	1969
(stallion)								
Primero	Engl. 1936	K.F. imp.	3.75	6.57	9.75	7.88	6.75	6.38
Shian More	Engl. 1927	K.F. imp.	9.25	5.61	5.19	6.31	3.56	3.60
Tournesol	Engl. 1927	S.F. imp.	6.50	4.81	7.44	4.94	4.44	2.69
Diolite	Engl. 1935	S.F. imp.	4.00	3.85	4.38	5.81	2.63	2.54
Theft	Engl. 1937	H.F. imp.	4.75	2.88	4.63	4.88	2.88	2.63
Chapel Brampton	Engl. 1919	S.F. & N.F. imp.	3.63	0.80	1.50	1.07	1.19	0.32
Intaglio	Engl. 1907	K.F. imp.	3.82	1.68	1.19	2.34	2.07	1.78
Gallon	Edgl. 1912	T.F. & O.F. imp.	3.00	1.40	1.63	2.00	1.10	1.20
Tsukitomo	(Carried) 1932	S.F. prod.	1.00	4.80	5.00	2.50	3.69	1.94
Tokinochikara	1936	S.F. prod.	1.00	3.20	2.50	0.63	1.50	1.13
Kumohata	1936	S.F. prod.	—	3.21	6.75	2.25	3.38	2.00
Minamihomare	1939	K.F. prod.	—	1.92	0.75	3.00	1.50	0.88
Shimatata	1944	K.F. prod.	—	0.64	1.50	3.75	0.88	1.00
Hindstan	Engl. 1955	U.L.B.H.S. imp.	—	—	—	3.00	2.75	1.50
Solonaway	Engl. 1958	H.L.B.H.A. imp.	—	—	—	—	3.00	1.25
(mare)								
Hoshihata	Amer. 1931	S.F. imp.	1.25	2.56	4.88	2.57	2.00	1.63
Hoshitomo	Amer. 1931	S.F. imp.	1.50	4.80	5.00	2.63	3.69	1.94

K.F.—Koiwai Farm

S.F.—Shimofusa Imperial Stock-Farm

H.F.—Hidaka Stallion Farm

N.F.—Niikappu Imperial Stock-Farm

T.F.—Tochigi Stallion Farm

O.F.—Oou Stallion Farm

H.L.B.H.A.—Hidaka Light-Breed Horse Association

U.L.B.H.S.—Urakawa Light-Breed Horse promotion Society

mares Hoshihata and Hoshitomo. The highest value is indicated by the contribution of Primero to sample in 1960 that is 9.75 per cent. As the value is not conspicuous it is thought that line breeding by particular breeding horse has not been practiced.

3. Genetic contribution in the groups of the imported horses in different periods.

a) Method

Imported horses since Meiji era were divided into three groups according

to its imported year (① Meiji, Taisho era 1901-'23. ② Before World War II 1924-'46. ③ After World War II 1947-'69) and genetic contribution of each group in each sample year was calculated. Genetic contribution in a certain group in a certain year is indicated by total score of genetic contribution to sample horses in the year, and of each imported horse belonging to the group. Contribution of each imported horse was calculated by method of independent's contribution explained previous. And a carried horse is regarded as a domestic breed and the dam is regarded to have contributed to the sample horses instead of the sire.

b) Result and discussion

Looking at figure 1 it is natural that both groups of ① and ② decreased gradually and on the contrary the group ③ increased. As to the three groups, thinking about the influence to sample horses since the early stage of imported horses it may be inferred that the figure shows the convex curve on an average. The influence of the group ③ to the sample in 1957 is pretty unnatural. This is because 25 horses were imported ones among 78 horses in all, that is, nearly 30 per cent of imported horses. In other samples except



Fig 1. Genetic contribution of groups of imported in different periods in each samples.

1949-'53 samples, the proportion of imported horses is nearly 10 per cent.

Summary

There are many studies of genetic contribution of livestock population by pedigree analysis about cows, but the horses' are very few. The authors studied about the process how thoroughbred population in Japan was formed and its genetic contribution. The authors hope to contribution to the improvement of thoroughbred breed in Japan. Material was the pedigree of respective 100 random sampling horses derived from the List of the Horses Registered for Breeding in 1949-'53, '57, '60, '66, '69, (in 1957 78 heads in all) and traced back in full for five generations. Its genetic structure was divided into important breeders, important breeding horses and the groups of horses imported in different periods and inferred by the method of WIENER. 1) In genetic contribution of important breeders to sample in 1949-'53 the highest value was that of Koiwai Farm (21.00 per cent) and followed Imperial Stock Farm and National Government in order, but recently the contribution dispersed to many private farms. The contribution of these three totaled 31.88 per cent in 1949-'53 and at present these farms stopped their thoroughbred breeding but they kept still 20 per cent level, so it was obvious how greatly they have contributed to the thoroughbred breed in Japan. 2) Most of important breeding horses were kept in the above three farms and among the contribution of them Primero was conspicuous (9.75 per cent) and it is thought that line breeding of particular breeding horse has not been practised. 3) The period imported breeding horses were divided into three groups, ① Meiji and Taisho era, ② before World War II, ③ after World War II and the contribution of each group to each sample was calculated. In 1949-'53 the order of contribution was ② ① ③ but in 1969 it changed into ③ ② ①. The number of imported horses indicated a tendency to increase year after year. However the attitude to the import of horses seemed to have a difference between before and after World War II. Before the war superior horses were imported for the purpose of improving breeding. But after the war it is progressing to the direction of so-called market breeding under the tendency of general worship to the horses produced in foreign countries which are to be sold in high price at the market. According to the change into free trade the influence of imported horses will increase more and more in future.

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References

- 1) ABE, T. and OFUKU, S., 1962. Jap. J. Zootech. Sci., 33: 3.
- 2) BARKER, J. S. F., 1957. Austral. J. Agric. Res. 8: 561.
- 3) BARKER, J. S. F., and G. P. DAVEY, 1960. *ibid.*, 11: 1072.
- 4) WIENER, G., 1953. J. Agric. Sci., 43: 123.
- 5) WRIGHT, S., 1923. J. Hered., 14: 339.
- 6) WRIGHT, S., 1923. *ibid.*, 14: 405.