

Morphological Studies on Ear Characteristics of Korean Indigenous Corn Lines Collected in Pusan and Kyungnam

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ABSTRACT

In order to get abundant germplasm for developing new corn varieties, major morphological characteristics of ear were evaluated with a total of 210 Korean indigenous maize lines collected from various parts of Pusan City and Kyungnam Province, Korea. The ear shape of Korean indigenous maize was mainly cone type or similar to cone type. Cylinder type or similar to cylinder type of corn was collected from the north-west mountainous region of Kyungnam Province, whereas cone type or similar to cone type was collected from the plain region. In the kernel colors of each ear, ears with mono colored kernels were 55.7% of the total, and ears with two to four mixed colors were 44.3%. Among the mono colored ears, brown was the most abundant at 16.8%. There was an average of 12~14 rows per ear.

Kernal rows per ear varied from 8~20. Waxy corn was predominant at 67.2%, mixed corn with waxy kernel and common kernel at 11.0%, and common corn at 21.8%.

Keywords : germplasm, indigenous maize, kernel, waxy.

One important problem in corn breeding is the limited genetic diversity of germplasms to be used as a breeding source. So it must be very important to collect and to evaluate corn germplasms to be used as breeding material such as wild corn or indigenous corn not yet used in corn breeding. In the United States where more than half of the world corn is produced, the development of new corn varieties seems to have culminated at the summit and has become more difficult simply because of insufficient gene pools to have used in corn breeding.

The narrowness of the gene source being used in the United States was reported by Zuber (1975). Through the survey in the Corn Belt, he found that the major inbreds used in the leading hybrid production originated from the same or very closely related populations. In other words, genes that con-

tributed to high yields in the United States were almost exhausted and overcoming the homogeneous in genetic constitution is the most important subject in corn breeding. In order to provide new gene sources for corn breeding, many corn breeders have tried to introduce gene pools from all over the world including Central and South America, South-East Asia, Europe, Russia, and China. As one way of broadening germ sources, the use of exotic germplasm has been highly suggested (Efron & Everet, 1969; Vera & Crane, 1970; Zuber, 1975).

In Korea, although the study scale was rather small, study of indigenous corn varieties by Park et al (1971) was the first attempt to find some useful gene sources from the Korean indigenous corn lines. Seven years later, Choe et al (1978) collected Korean indigenous corn lines from all over the nation and evaluated the growth characteristics of the collected corn lines. After the report, a series of reports were completed on the botanical characteristics of Korean indigenous corn lines (Choe et al., 1981; Han et al., 1984; Lee & Choe, 1982; Lee et al., 1933). Their reports showed that some Korean indigenous corn lines had characteristics of multi-ears, multi-tillers, high protein, super thin pericarp, and qualified waxy corn.

In Korea, since corn was a less important crop and the scale of production was small, transportation of corn from one area to other was not well practiced. Therefore a corn line in one area was traditionally confined to that area for a long time and had very few chances to mingle with corn in other areas. Corn lines have been subjected to natural selection in each local environment for a long period. Therefore, Korean indigenous corn is believed to have particular genetic characteristics.

The purpose of this study was to investigate the morphological characteristics of Korean indigenous corn lines collected in Pusan City and Kyungnam Province, Korea to provide good sources of breeding materials for new corn varieties.

MATERIALS AND METHODS

Collection of indigenous corn lines

Twenty-three cities and counties in Pusan City and Kyungnam Province were selected, and a total

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of 210 ears of indigenous corn were collected since October, 1998. Three 'Myun' and 'Dong' were selected from each city or county, and three or more ears were collected at each Myun or Dong. Regions where corn was collected were divided into five based on latitude and topography (Table 1).

Investigation on the morphological characteristics of ears

Collected indigenous corn was investigated on (1) ear shape (2) kernel color (3) kernel rows per ear (4) waxy corn.

Ear shape

Collected corn was classified into the following four ear shapes.

Each ear shape was as follows:

Kernel color

Kernel colors of collected ears were classified as brown, cho-colate, dark, purple, white, and yellow color. Many ears were variegated with two or more colors.

Kernel rows per ear

Numbers of kernel rows per ear were counted.

Waxy corn

Waxy corn was distinguished by iodine treatments.

Table 1. Regions of collection and number of Korean indigenous maize ears collected in Pusan and Kyungnam in 1998.

Region [†]	County	Number collected
A	Hamyang, Hapchon, Sanchong Keochang	50
B	Chinju, Hadong, Euiryung Changryung, Haman, Kimhae,	28
C	Changwon Yongsan, Ulsan, Ulju	36
D	Miryang Sachon, Koje, Namhae,	33
E	Kosong, Tongyoung, Masan, Chinhae, Kijang	63
Total	23	210

[†] A : North-west mountainous region

B : West plain region

C : Central plain region

D : East highland region

E : South coastal region

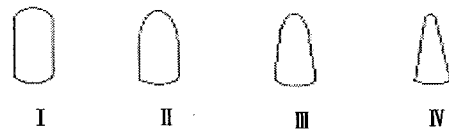


Fig. 1. Ear shapes of corn.

I. Cylindrical, II. Conic cylindrical

III. Conical, IV. Pointed conical

RESULTS AND DISCUSSION

Ear shapes

The ears collected were classified into four ear shapes. The majority of the ears belong to conical (Table 2). The ear shapes of collected corn lines were abundantly found in the following order ; conical, conic cylindrical, pointed conical, and cylindrical.

Ear shapes of corn varieties cultivated in the United Corn Belt States are generally cylindrical or conic cylindrical, and indigenous corn lines cultivated for long time by farmers in South America and Europe are generally conical (Anderson & Cutler, 1942; Anderson & Brown, 1948; Brandolini, 1969). The majority of the ear shape was conical and showed the same ear shape tendency as indigenous corn in South America and Europe.

The ear shape seemed to be closely related to the region where the corn was produced. From the mountainous region, cylindrical shaped ears were chiefly collected, and from the plain region, where corn is grown on a small scale, conical shaped ears were mostly collected.

Kernel color

Distribution of kernel colors of Korean indigenous corn lines are shown in Table 3. There were 6 kernel colors of indigenous corn, brown, chocolate, dark, purple, white, and yellow. An ear was composed of single colored kernels or two to four kinds of kernels with different colors. Ears with mono color was 55.7%, and ears with two mixed colors, three mixed colors and four mixed colors mixed were 23.9 %, 17.3% and 3.1%, respectively.

Among the ears with mono colored kernels, brown colored ears were the most abundant kernel color at 16.8%. Dark was the second most abundant kernel color at 14.7%. Yellow color was the most abundant kernel color of Korean indigenous corn collected in 1977 (Choe et al., 1978) but it was the least abundant kernel color of Korean indigenous corn collected in Pusan City and Kyungnam Province, Korea. in 1988. The above results seem to show that

Table 2. Classification of ear type of Korean indigenous maize lines in percent.

Ear type [†]	Region [†]					Total
	A	B	C	D	E	
I	2.0	-	2.8	3.0	4.8	2.5
II	46.0	32.1	25.0	30.3	54.0	37.5
III	38.0	42.9	58.3	48.5	33.3	44.2
IV	14.0	25.0	13.9	18.2	7.9	15.8

[†] I: Cylindrical type, II: Conic cylindrical type, III: Conical type, IV: Pointed conical type

[†] A: North-west mountainous region B: West plain region, C: Central plain region D: East highland region
E: South coastal region

Table 3. Distribution of kernel colors of Korean indigenous maize lines in percent.

Kernel color [†]	Region [†]					Total	Colors in an ear	
	A	B	C	D	E			
B	16.0		27.8	21.2	19.0	16.8	One 55.7	
C		10.7			1.6	2.5		
D	10.0		19.4	9.1	34.8	14.7		
P		21.3			4.8	5.2		
W	22.0	10.7	27.8	9.1	3.2	14.6		
Y				6.1	3.2	1.9		
BC	2.0		13.9			0.4	Two 23.9	
BD	6.0					4.0		
BP	4.0	3.6			1.6	1.8		
BW		3.6	2.8		3.2	1.9		
BY	2.0				1.6	0.7		
CP					1.6	0.3		
DP					1.6	0.3		
DW					3.2	0.6		
PW	12.0	14.3	8.3	15.2	4.8	10.9		
PY		3.6			4.8	1.7		
WY		3.6		3.0		1.3		
BDY	2.0	7.1		3.0	1.6	0.4		Three 17.3
BPW						4.3		
BPY	10.0					0.4		
DPW	2.0			9.1	3.2	2.5		
PWY	12.0	17.9		12.1	6.2	9.7		
BDWY				9.1		1.8	Four 3.1	
DPWY		3.6		3.0		1.3		

[†] B, C, D, P, W, and Y stand for brown, chocolate, vague, purple, white, and yellow, respectively.

[†] A: North-west mountainous region B: West plain region
C: Central plain region D: East highland region
E: South coastal region

Korean indigenous corn kernel colors varied according to the regions cultivated, and farmers were indifferent to kernel color.

Kernel rows per ear

Kernel rows per ear of corn collected were shown in Table 4.

Korean indigenous maize lines having twelve

kernel rows per ear was 36.5% among the ears collected, and that of 14 kernel rows per ear was 30.5%. Kernel rows per ear generally varied by environment during the cultivation period. There was not much difference in kernel rows per ear among the regions. Most of the ears had an average of 10 to 14 kernel rows per ear. Kernel rows per ear may effect kernel yield per ear, and possibly kernel size. Ears with irregular rows were mainly obser-

Table 4. Classification of row number of Korean indigenous maize lines in percent.

Row number	Region [†]					Total
	A	B	C	D	E	
8	2.0	14.3	—	3.0	—	3.9
10	16.0	21.4	8.3	21.2	14.3	16.2
12	30.0	46.4	50.0	21.2	34.9	36.5
14	42.0	17.9	27.8	33.3	31.7	30.5
16	6.0	—	11.1	3.0	12.7	6.6
18	—	—	2.8	—	4.8	1.5
20	2.0	—	—	—	—	0.4
Irregular	2.0	—	—	18.3	1.6	4.4

[†]A : North-west mountainous region, B : West plain region, C : Central plain region,
D : East highland region, E : South coastal region.

Table 5. Waxy, mixed waxy maize, and others of Korean indigenous maize lines in percent.

Group	Region [†]					Total
	A	B	C	D	E	
Waxy	54.0	46.4	94.4	69.6	71.4	67.2
Mixed waxy	20.0	10.7	2.8	15.2	6.4	11.0
Others	26.0	42.9	2.8	15.2	22.2	21.8

[†]A : North-west mountainous region, B : West plain region, C : Central plain region,
D : East highland region, E : South coastal region.

ved in the east highland region of Kyungnam Province. Kernels on ears with irregular rows were generally small.

Waxy corn

The percentage of waxy corn among the collected corn was shown in Table 5.

Waxy corn was 67.2% of collections, and it was the most popular corn in all the regions. Mixed corn with waxy kernel and non-waxy kernel was 11.0%. Waxy corn was collected more in the plains than in the mountainous region. Korean people prefer the taste of waxy corn to that of non-waxy corn, so it is thought that farmers in these regions have paid particular attention to the maintenance of waxy corn. Because the appearance of waxy corn is controlled by recessive genes, the maintenance of waxy corn in the regions where corns are cultivated on a large scale will be more difficult than in other regions where corns are cultivated on a small scale. Nevertheless, the result of this investigation showed that waxy corn was cultivated over 50% in all the regions except the west plain region of Kyungnam Province.

These days Korean people prefer waxy corn much more than 20 years ago. The result of the investigation in 197 showed that waxy corn was only 6.0% of collections (Choe et al., 1978).

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