

Utilization of Doubled Haploid Technology and Development of Maize Inbred Lines in South Korea

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Introduction

Line development and hybrid selection are the key procedures in maize breeding. Inbred line development is an essential prerequisite to make good hybrids and this line development in Korea is totally dependent on conventional methods. For development of inbred lines, we have to do self-pollination for at least seven cycles. This conventional line development system is tedious, labor-intensive, and time-consuming procedure. Doubled haploid technology in maize is a rapid line development system and many maize research institutes in foreign countries have been actively using this technology. Key requisite for doubled haploid breeding is possession of inducer lines which can produce haploid when source population is crossed with them.

Objectives

In this study, we want to settle this technology in Korea, to identify haploid inducing factors, and to develop temperate inbred lines for hybrid breeding.

Advantages of DH breeding

- Reduction of inbred line development cycles (7 cycle → 3 cycle)
- Decrease of costs for breeding works in field
- Less progenies needed in selection ($4^n \rightarrow 2^n$)
- Simple establishment of mapping population

Materials and Methods

- Haploid induction : 8 populations crossed with inducer(Tails)
- Chromosome doubling : Colchicine(0.04%), 12h
- Doubled haploid line selection : 11 inbred lines

Results and Discussion

Maize Research Institute in Republic Korea secures the right of using inducer lines and is trying to set up the new system and to develop inbred lines by the doubled haploid breeding in Korea. The possessed inducer, Tails, is originated in tropical area, CIMMYT, but it is well adapted in the temperate area, South Korea. The silking days was 72 when it was planted at April 23rd and plant height was 196cm. When three maize populations were crossed with the inducer, the average haploid induction rate was 4.1%. Using this doubled haploid technology, we can greatly reduce the period of line development and strengthen maize research ability in Korea. There are lots of pending issues such as increase induction rate, viability improvement of doubled plants, and color marker inhibitor control. But, we expect our breeding capacity will be progressed by introduction of Doubled Haploid technology.



Fig.1. Process of line development by Doubled Haploid technology.

Table 1. Agronomic characteristics of tropical inducer, **Tails** in Korea.

Planting date (mm/dd)	Silking date (mm/dd)	Days to Silking (days)	Pollen Shed period	Plant height (cm)	Ear Height (cm)
04/23	07/04	72	07/01~07/11	196	83

Table 2. Haploid induction rate on waxy and field corn population.

Population	Diploid (2n)	Indistinct (?)	Haploid (n)	Haploid induction rate(%)
Mibaek2(F1)	11,977	64	289	2.9
W1429(F2)	7,280	46	361	5.3
32P75(F2)	6,520	9	262	4.0

Table 3. Transplanting and haploid rate of chromosome doubled plants on field and waxy corn population.

Populations	Doubling (Plants)	Transplanting (Plants)	Transplanting rate (%)	Normal Growth (Plants)	Diploid (Plants)	Haploid (Plants)	Haploid rate (%)
P1543/KPO	797	627	78	567	195	372	66
JK131	774	650	84	614	27	587	96
GW31/SO335	419	288	69	278	38	240	86
W Pop. A	1033	880	85	845	442	403	48
W Pop. B	777	680	88	567	258	309	54



Fig.1. The first DH lines of field and waxy corn developed in Korea.

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Literature Cited

- Chaikam V, Martinez L, Melchinger AE, Schipprack W, Prasanna MB. 2016. Development and validation of red root marker-based haploid inducers in maize. *Crop Sci.* 56: p. 1678 – 1688.
- Lee JY, SH Ryu, KJ Park, JY Park, YH Seo, JK Choi, KH Kim, 2014, Doubled Haploid Technology in Maize Breeding: Theory and Practice (Korean translated version). Gangwon ARES, Chuncheon: p. 13 -33.
- Prigge V, XW Xu, L Li, R Babu, SJ Chen, GN Atlin, AE Melchinger. 2012. New insight into the genetics of *in vivo* induction of maternal haploids, the backbone of doubled haploid technology in maize. *Genetics* 111: p. 781-793.