

# Effects of sowing dates on the growth and productivity of different corn cultivars

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## 파종시기에 따른 옥수수 품종별 생육 및 생산성에 미치는 영향

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### Abstract

As the environment changes with different sowing periods, corn growth and productivity can be affected. Therefore, optimal seeding dates are necessary to maximize yield and land utilization. The delay in planting maize resulted in a shorter reproductive period and fewer growing days. Thus, the present field study examined the impact of delayed seeding dates on the growth and productivity of corn varieties Gwangpyeongok, Dacheongok and Shinhwangok. We sowed on 2nd, 9th 16th, and 23rd of May, 2023 in Grassland Forage, Cheonan region. Based on the results, the Dacheongok cultivar had significant positive variation at all seeding dates. In spite of this, delayed planting of corn decreased overall growth and DM yield across all cultivars. Accordingly, this study suggests that planting at the beginning month of May could get potential yield for all cultivars. However, delaying planting dates reduced corn growth and yield sharply.

## 1. Introduction

Corn is used extensively in Korea for silage production, fresh consumption, and rotation with winter cash crops and summer upland crops. Korea's native corn varieties were not improved until 1960. Corn variety development began in the 1960s. The 'Hwangok-2' corn variety was distributed to farmers in 1962 to begin systematic corn breeding. Hybrid varieties replaced synthetic varieties in the 1970s, with single-cross hybrids among corn hybrids. Suwon 19" is the first single-cross hybrid to reach advanced country yield levels. During the 1980s, silage replaced grain corn in breeding programs. A single-cross hybrid corn seed supply system was established after the government's livestock promotion policy. Globalization and agricultural imports increased consumer living standards in the 1990s. Corn varieties have been developed to meet people's needs. 29 varieties of corn with excellent cultivation stability were developed in the 20th century. During the 2010s, private seed companies developed corn varieties instead of governments or universities. Korea Seed & Variety Service (KSVS) has registered 110 corn varieties. In 2016 and 2015, National Institute of Crop Science, RDA developed Dacheongok and Shinhwangok a new cultivar maize F1 (Son et al., 2018; Son et al., 2017). Dacheongok was bred from inbred lines KS197 and KS202. The Shinhwangok was bred by crossing KS178 and KS145. Maximizing yield and land utilization requires

optimal seeding dates. The delayed planting of maize reduced reproductive period and its growing degree days (Imholte et al., 2012). In this aspect, this study examined the impacts of different seeding periods (May 2, 9, 16, & 23rd 2023) on the growth and productivity of different corn cultivars in the Grassland and Forage division, National Institute of Animal Science, Cheonan, in 2023.

## 2. Method and Materials

### 2.1. Field Conditions and Experiment

Experiment fields are at latitude 36.931739/ longitude 127.106166 was used in the Cheonan. Different maize cultivars were sown on May 2, 9, 16 and 23, in 2023, with a plot size of 12 m<sup>2</sup>. Two seeds were sown per row at a rigid density with an inter-row distance of 75 cm X 20 cm. Across a plot of 12 m<sup>2</sup>, six rows of 4 m length were sown at intervals of 20 cm, 75 cm apart. Nitrogen (100kg/ha), phosphorus (150kg/ha), and potassium (150kg/ha) were applied as basal fertilizer. Additional fertilizer nitrogen (100kg/ha) was applied to crop growth during the four to six leaf stage.

### 2.2. Data analysis

At the yellow-ripening stage, stem height, stem diameter, and

dry matter yield of stover and grain were measured based on research analysis criteria for agriculture and science technology (RDA, 2012). The dry matter (DM) content of each sample was determined, and powdered samples were stored. A Kjeldahl method (AOAC, 1990) was used to determine crude protein (CP) content. Based on Van Soest et al., 1991, Acid detergent fiber (ADF), and neutral detergent fiber (NDF) content were determined. SPSS16 software was used to analyze significant differences (one-way ANOVA, multivariate analysis, post hoc, Duncan and descriptive analysis parameters) followed by the least significant difference test. Significant P values were less than 0.05.

### 3. Results and Discussion

Table 1 & Table 2 illustrates the growth characteristics, dry matter, and nutrient contents of various corn cultivars at the sowing date of 2nd May 2023. Dacheongok and Gwangpyeongok were both taller than Shinhwangok ( $p < 0.05$ ). As for other parameters such as diameter, corn stover, grain quantity, and total dry matter content, there was no statistically significant difference between cultivars. Corn stover and total DM content of Dacheongok cultivars were the highest, followed by Gwangpyeongok and Shinhwangok. There is no significant difference in nutrient contents between corn plants and grains of all cultivars, such as NDF, ADF, and CP levels.

Table 1. Growth and dry matter yield of different corn cultivars for ruminant animals feed (Planting date, 9 May, 2023)

Cultivars	Height (cm)	Diameter (cm)	Dry matter yield (kg/ha)		
			Stover	Grain	Total yield
GPO*	289±17 <sup>a</sup>	21.84±2.0 <sup>a</sup>	9,714 ±1923 <sup>a</sup>	9,933 ±1000 <sup>a</sup>	19,647 ±2,579 <sup>a</sup>
DCO	292±08 <sup>a</sup>	21.62±2.0 <sup>a</sup>	11,104 ±1710 <sup>a</sup>	9,647 ±769 <sup>a</sup>	20,751 ±2,013 <sup>a</sup>
SHO	268±14 <sup>b</sup>	20.44±1.0 <sup>a</sup>	9,346 ±600 <sup>a</sup>	9,290 ±596 <sup>a</sup>	18,636 ± 624 <sup>a</sup>

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. Different letters within a column indicate a significant difference between corn cultivars ( $p < 0.05$ ).

Table 2. Nutrient contents of different corn cultivars (Planting period 2 May, 2023)

Cultivars	Plant nutrient (%)			Grain nutrient (%)		
	NDF	ADF	CP	NDF	ADF	CP
GPO*	68.54 ±7.29	42.16 ±5.02	5.51 ±1.58	22.89 ±1.10	8.11 ±0.93	8.34 ±0.62
DCO	58.93 ±7.42	34.83 ±4.37	4.19 ±0.64	29.34 ±2.70	11.70 ±1.98	7.91 ±0.71
SHO	65.92 ±4.64	38.67 ±3.36	4.88 ±1.59	20.36 ±1.26	6.34 ±0.71	9.87 ±0.24

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. NDF: neutral detergent fiber; ADF: Acid detergent fiber; CP: crude protein

Table 3 & Table 4 shows the growth characteristics and dry matter content of corn cultivars at seeding 9th May 2023. Dacheongok and Gwangpyeongok grew taller than Shinhwangok ( $p < 0.05$ ). Dacheongok had the largest diameter, followed by Gwangpyeongok and Shinhwangok. Dacheongok exhibited a higher stover content than the other two cultivars. There is no significant difference between cultivars in grain quantity. The total dry matter (DM) of the cultivars varied significantly. Dacheongok had a higher DM than Gwangpyeongok and Shinhwangok ( $p < 0.05$ ). Nutrient contents of corn plants and grains such as NDF, ADF, and CP levels for all cultivars do not differ significantly.

Table 3. Growth and dry matter yield of different corn cultivars for ruminant animals feed (Planting date, 9 May, 2023)

Cultivars	Plant height (cm)	Diameter (cm)	Dry matter yield (kg/ha)		
			Stover	Grain	Total yield
GPO*	273 ±20 <sup>a</sup>	20.5 ±2.7 <sup>b</sup>	9,355 ±778 <sup>b</sup>	8,575 ±614 <sup>a</sup>	17,931 ±1156 <sup>ab</sup>
DCO	259 ±10 <sup>a</sup>	23.5 ±1.8 <sup>a</sup>	12,094 ±849 <sup>a</sup>	8,378 ±811 <sup>a</sup>	20,472 ±1641 <sup>a</sup>
SHO	244 ±8.0 <sup>b</sup>	18.8 ±1.5 <sup>b</sup>	8,593 ±1262 <sup>b</sup>	8,092 ±621 <sup>a</sup>	16,686 ±650 <sup>b</sup>

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. Different letters within a column indicate a significant difference between corn cultivars ( $p < 0.05$ ).

Table 4. Nutrient contents of different corn cultivars (Planting period 9 May, 2023)

Cultivars	Plant nutrient (%)			Grain nutrient (%)		
	NDF	ADF	CP	NDF	ADF	CP
GPO*	62.44 ±3.91	37.46 ±2.23	3.41 ±0.37	26.14 ±1.58	9.63 ±1.05	7.89 ±0.89
DCO	62.28 ±2.80	35.43 ±0.95	4.48 ±0.89	22.38 ±3.71	7.54 ±1.92	7.76 ±0.32
SHO	55.03 ±3.97	31.71 ±3.38	5.28 ±1.27	18.63 ±1.04	5.87 ±0.91	10.23 ±0.87

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. NDF: neutral detergent fiber; ADF: Acid detergent fiber; CP: crude protein

Table 5 & Table 6 shows the growth characteristics and dry matter content of different corn cultivars at the time of sowing on 16th May 2023. Shinhwangok, Dacheongok, and Gwangpyeongok cultivars have similar heights and diameters. The quantity of corn grain and total DM were not significantly different between cultivars. Dacheongok had the highest stover content, followed by Gwangpyeongok, and Shinhwangok. Cultivars and their grains did not differ significantly in their nutrient contents such as NDF, ADF, and CP levels.

Table 5. Growth and dry matter yield of different corn cultivars for ruminant animals feed (Planting date 16 May, 2023)

Cultivars	Plant height (cm)	Diameter (cm)	Dry matter yield (kg/ha)		
			Stover	Grain	Total yield
GPO*	273±19 <sup>a</sup>	20.27±3.0 <sup>a</sup>	8,535±893 <sup>ab</sup>	8,056±208 <sup>a</sup>	16,591±005 <sup>a</sup>
DCO	270±11 <sup>a</sup>	20.91±2.3 <sup>a</sup>	8,913±198 <sup>a</sup>	8,742±1559 <sup>a</sup>	17,655±1466 <sup>a</sup>
SHO	236±10 <sup>a</sup>	19.42±1.8 <sup>a</sup>	7,194±430 <sup>b</sup>	8,549±1533 <sup>a</sup>	15,743±1908 <sup>a</sup>

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. Different letters within a column indicate a significant difference between corn cultivars ( $p<0.05$ ).

Table 6 Nutrient contents of different corn cultivars (Planting period 16 May, 2023)

Cultivars	Plant nutrient (%)			Grain nutrient (%)		
	NDF	ADF	CP	NDF	ADF	CP
GPO*	64.64±2.95	37.61±2.66	3.75±1.13	22.34±2.33	6.85±1.31	8.12±0.75
DCO	52.77±3.05	30.44±1.40	3.87±0.76	25.42±1.63	9.88±1.08	6.95±0.59
SHO	63.07±2.24	36.56±1.45	3.85±0.31	20.64±2.91	7.48±1.53	9.13±0.35

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. NDF: neutral detergent fiber; ADF: Acid detergent fiber; CP: crude protein

Table 7 & Table 8 shows growth characteristics of different corn cultivars sown in 2023 at 23rd May. Gwangpyeongok and Dacheongok had higher corn heights than Shinhwangok. The diameters of all cultivars remain unchanged. The stover content of all cultivars differed significantly ( $p<0.05$ ). Dacheongok had a higher stover content than Gwangpyeongok and Shinhwangok. There was no significant difference in grain quantity. Gwangpyeongok and Dacheongok had higher total DM. There was no significant difference between cultivars and their grains in terms of their nutrient contents, such as NDF, ADF, and CP levels.

Table 7. Growth and dry matter yield of different corn cultivars for ruminant animals feed (Planting date 23rd May, 2023)

Cultivars	Plant height (cm)	Diameter (cm)	Dry matter yield (kg/ha)		
			Stover	Grain	Total yield
GPO*	264±14 <sup>a</sup>	20.71±1.6 <sup>a</sup>	7,276±420 <sup>b</sup>	6,399±743 <sup>a</sup>	13,676±411 <sup>a</sup>
DCO	250±11 <sup>a</sup>	20.42±1.0 <sup>a</sup>	8,842±1753 <sup>a</sup>	6,146±1087 <sup>a</sup>	14,989±675 <sup>a</sup>
SHO	224±11 <sup>b</sup>	20.76±1.6 <sup>a</sup>	4,246±530 <sup>c</sup>	6,828±888 <sup>a</sup>	11,074±1414 <sup>a</sup>

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. Different letters within a column indicate a significant difference between corn cultivars ( $p<0.05$ ).

Table 8. Nutrient contents of different corn cultivars (Planting period 23 May, 2023)

Cultivars	Plant nutrient (%)			Grain nutrient (%)		
	NDF	ADF	CP	NDF	ADF	CP
GPO*	60.24±8.36	35.56±6.44	3.09±0.31	23.83±2.13	8.95±0.88	7.11±0.27
DCO	55.57±3.21	30.15±2.30	4.77±0.56	29.59±1.20	11.87±1.06	7.06±1.17
SHO	62.79±7.02	36.71±7.78	3.81±0.81	22.09±2.59	8.22±1.35	7.77±0.34

\*GPO: Gwangpyeongok, DCO: Dacheongok, SHO: Shinhwangok. NDF: neutral detergent fiber; ADF: Acid detergent fiber; CP: crude protein

#### 4. Conclusions

Seeding at the right time maximizes land use. Too early or too late planting could reduce nutrient content. Reduced vegetative and reproductive stages reduce yield when planting is delayed. According to the present study, Dacheongok cultivar showed significant positive variation among all cultivars. In contrast, delayed planting of corn reduced growth and DM yield. Accordingly, this study suggests that seeding in early May month gets potential yields for all cultivars, and delaying planting dates reduces corn growth and its yield.

#### 5. References

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