Growth and Productivity of Different Corn Cultivars: Optimizing Aowing Dates

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사일리지용 옥수수의 품종별 생육 및 생산성: 최종파종시기

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Abstract

The study evaluated the growth characteristics and dry matter yield of corn cultivars such as Gwangpyeongok, Dacheongok, and Shinhwangok over four sowing dates: April 29, May 7, May 13, and May 20, 2024.There were significant differences in plant height among cultivars at all sowing periods ($p < 0.05$), with the earliest sowing dates (April 29 and May 7) resulting in greater plant height. Despite significant differences in stem diameter between cultivars within sowing periods, no notable differences were found between sowing dates. Cultivars also differed significantly in their stover and grain yield within each sowing period.The highest stover content was observed on May 13, while the highest grain yield was observed on April 29. Both cultivar and sowing date significantly influenced total dry matter yield. Dacheongok consistently produced the highest total dry matter yield. The May 13 sowing date produced the highest dry matter production. Corn forage yields are highly dependent on both cultivar selection and optimal sowing date.

1. Introduction

Korea requires around 5.6 million tons of forage annually to feed domestic ruminants, with over 80% being self-sufficient (MAFRA, 2016), primarily through rice straw. The government has worked to increase self-sufficiency, but funding for forage-related policies has decreased since 2014. Corn, a versatile crop, is essential for human food, livestock feed, and biofuel, with global production reaching 1.1 billion tons in 2019. Corn's adaptability to varying climates makes it ideal for use in both warm and cold regions. In Korea, corn breeding began in the 1960s with the development of synthetic varieties, later shifting to hybrids. The country's corn is used for silage, fresh consumption, and crop rotation. Optimizing planting dates is critical for maximizing yield and silage quality, as delayed planting can reduce plant growth and nutrient content. This study focuses on optimizing planting dates for Korean corn varieties and evaluating their growth characteristics and silage quality.

2. Methods and Materials

2.1 Corn cultivation

The experimental fields are located at latitude 36. 931739/ longitude 127.106166 was used in the Cheonan. Sowing of different maize cultivars was conducted on May 2, 9, 16 and 23, in 2023, with a plot size of 12 m2 (3X4). The corn plants were sown at a rigid density of two seeds per row with an inter-row distance of 75 cm X 20 cm. In a plot of 12 m2, six rows of 4 m length were sown at intervals of 20 cm, 75 cm apart from each other. As basal fertilizer, nitrogen (100kg/ha), phosphorus (150kg/ha), and potassium (150kg/ha) were applied per hectare. Additional fertilizer nitrogen (100kg/ha) was applied at the time of crop growth during the four to six leaf stage (Ilavenil et al.,2024).

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 represents the growth characteristics and dry matter yield of differrent corn cultivars such as Gwangpyeongok, Dacheongok and Shinhwangok from different sown peroids such as April 29, May 7, May 13, and May 20, 2024. There are significant differences in height between various corn cultivars at all sown peorids ($p<0.05$). An average of three cultivars exhibited significantly increased height for sown peroids April 29, May 7, 2024 than the other sown peroids ($p<0.05$). The diameter of corn showed significant variations between cultivars within sown peroids ($p<0.05$) (Data not shown). The stover content and grain quantity exhibited significant differences between cultivars within sown peroids ($p<0.05$). A total of three cultivars showed a higher stover content in the peroid sown on May 13 than in other sown peroids. Where as higher grain quantity was noted for sown date April 29, 2024. Total dry matter yield for different cultivars showed significant variations based on the planting period (Table 1).

[Table 1] Growth and dry matter yield of corn cultivars at different sown periods.

Cultivars	Dry Matter Yield (kg/ha)		
	Stover	Grain	Total
	Sown Date (4/29)		
Gwangpyeongok	9,865 ± 1891^{ab}	9,108 ± 82^{4b}	18,973 ± 2,560^{a}
Dacheongok	13,024± 702^{a}	7,731 ± 803^{ab}	20,755 ± 1,385^{a}
Shinhwangok	6,760 ± 2,023^{b}	6,659 ± 1459^{ab}	13,419 ± 996^{b}
Mean	**9,883 ± 3,132^{AB}**	**7,833 ± 1,227^{A}**	**17,716 ± 3,826^{AB}**
	Sown Date (5/7)		
Gwangpyeongok	9,167 ± 267^{b}	8,212 ± 299^{a}	17,379 ± 434^{ab}
Dacheongok	14,822 ± 1268^{a}	4,604 ± 138^{b}	19,426 ± 1,181^{a}
Shinhwangok	7,310 ± 533^{c}	8,393 ± 2257^{a}	15,703 ± 2,788^{b}
Mean	**10,433 ±3,912^{AB}**	**7,070 ±2,136^{AB}**	**17,503 ± 1,864^{AB}**
	Sown Date (5/13)		
Gwangpyeongok	11,000 ± 2,466^{b}	7,261 ± 848^{a}	18,261 ± 2,603^{b}
Dacheongok	17,227 ± 137^{a}	5,010 ± 987^{b}	22,236 ± 1,053^{a}
Shinhwangok	10,205 ± 1,089^{b}	8,953 ± 1,204^{a}	19,158 ± 604^{ab}
Mean	**12,811 ± ,844^{A}**	**7,075 ± 1978^{AB}**	**19,885 ± 2,084^{A}**
	Sown Date (5/20)		
Gwangpyeongok	10,296 ± 1,676^{a}	6,168 ± 385^{a}	16,463 ± 1,656^{a}
Dacheongok	11,240 ± 1,,701^{a}	5,462 ±1,689^{a}	16,702 ± 3,369^{a}
Shinhwangok	6,654 ± 360^{b}	6,069 ± 583^{a}	12,722 ± 818^{a}
Mean	**9,396 ±2,421^{B}**	**5,900 ± 381^{B}**	**15,296 ± 2,232^{B}**

Table 2 and 3 show the nutrient content of different corn cultivars from different sowing periods. Sowing dates significantly affected the nutrient profiles of the three maize cultivars. Shinhwangok consistently exhibited high crude protein (CP) content in the stover and grain at most sowing dates and also had high levels of neutral detergent fiber (NDF) and acid detergent fiber (ADF). Across all dates, Dacheongok showed a tendency toward higher grain fiber content, especially ADF. However, Gwangpyeongok had lower CP levels in both stover and grain, particularly later in the season. Additionally, delayed sowing (5/20) resulted in higher stover fiber concentrations.

[Table 2] Variations in stover nutrient content of different corn cultivars.

Cultivars	Stover nutrients (%)		
	CP	NDF	ADF
	Sown Date (4/29)		
Gwangpyeongok	5.24 ± 1.2^{a}	56.4 ± 1.6^{a}	30.5 ± 3.1^{b}
Dacheongok	5.38 ± 1.2^{a}	56.3 ± 1.1^{a}	29.9 ± 0.2^{b}
Shinhwangok	5.78 ± 0.1^{a}	59.2 ± 1.6^{a}	30.7 ± 1.6^{a}
Mean	**5.47 ± 0.3^{A}**	**57.3 ± 1.6^{B}**	**31.7 ± 2.6^{B}**
	Sown Date (5/7)		
Gwangpyeongok	5.07 ± 1.4^{a}	63.6 ± 2.5^{a}	38.8 ± 3.5^{a}
Dacheongok	5.27 ± 1.3^{a}	58.0 ± 5.5^{a}	30.9 ± 2.1^{b}
Shinhwangok	5.23 ± 0.1^{a}	58.1 ± 0.4^{b}	36.45± 3.0^{ab}
Mean	**5.20 ± 0.1^{A}**	**59.9± 3.2^{AB}**	**34.4± 4.0^{AB}**
	Sown Date (5/13)		
Gwangpyeongok	4.40 ± 1.4^{a}	55.8 ± 2.1^{a}	37.4 ± 1.9^{a}
Dacheongok	5.60 ± 0.6^{a}	50.6 ± 3.9^{b}	29.2 ± 2.9^{b}
Shinhwangok	5.88 ± 1.3^{a}	64.2 ± 1.7^{a}	36.7 ± 1.8^{a}
Mean	**5.30 ± 1.1^{A}**	**56.9 ± 2.6^{B}**	**34.4± 2.2^{AB}**
	Sown Date (5/20)		
Gwangpyeongok	4.17 ± 1.0^{a}	63.2 ± 1.8^{b}	37.9 ± 2.9^{a}
Dacheongok	5.50 ± 1.0^{a}	59.2 ± 1.4^{c}	32.4 ± 3.7^{a}
Shinhwangok	3.58 ± 0.4^{b}	69.9 ± 0.4^{a}	38.9 ± 5.3^{a}
Mean	**4.40 ± 0.8^{A}**	**64.1 ± 1.2^{A}**	**36.4 ± 3.9^{A}**

[Table 3] Variations in graon nutrient content of different corn cultivars.

Cultivars	Grain nutrients (%)		
	CP	NDF	ADF
	Sown Date (4/29)		
Gwangpyeongok	8.1 ± 0.4^{b}	21.1 ± 2.1^{a}	7.94 ± 0.9^{a}
Dacheongok	8.0 ± 0.3^{b}	21.9 ± 3.2^{a}	7.77 ± 1.7^{a}
Shinhwangok	9.6 ± 0.9^{a}	17.5 ± 0.7^{a}	5.38 ± 0.5^{b}
Mean	**8.6 ± 0.9^{A}**	**20.0± 2.3^{A}**	**7.03 ± 1.4^{A}**
	Sown Date (5/7)		
Gwangpyeongok	7.66 ± 0.8^{a}	17.2 ± 1.2^{b}	5.75 ± 0.7^{b}
Dacheongok	7.20 ± 0.4^{a}	21.4 ± 0.8^{a}	9.30 ± 2.2^{a}
Shinhwangok	7.48 ± 0.4^{a}	18.0 ± 1.8^{b}	5.57 ± 1.2^{b}
Mean	**6.92 ± 0.6^{B}**	**20.6± 1.3^{A}**	**7.34 ± 1.4^{A}**
	Sown Date (5/13)		
Gwangpyeongok	7.05 ± 0.3^{a}	19.1 ± 3.2^{b}	6.86 ± 1.6^{b}
Dacheongok	6.36 ± 0.1^{a}	24.7 ± 1.3^{a}	9.61 ± 0.3^{a}
Shinhwangok	7.35 ± 0.1^{a}	18.1 ± 0.6^{b}	5.56 ± 0.3^{b}
Mean	**6.90 ± 0.4^{B}**	**26.6± 1.7^{A}**	**7.30 ± 0.7^{A}**
	Sown Date (5/20)		
Gwangpyeongok	7.60 ± 1.0^{a}	21.5 ± 3.0^{b}	7.14 ± 0.5^{b}
Dacheongok	6.89 ± 0.5^{a}	25.6 ± 1.5^{a}	10.1 ± 0.8^{a}
Shinhwangok	7.04 ± 0.4^{a}	17.5 ± 0.6^{b}	5.72 ± 0.1^{b}
Mean	**7.10 ± 0.6^{B}**	**21.5± 1.7^{A}**	**7.6 ± 0.5^{A}**

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