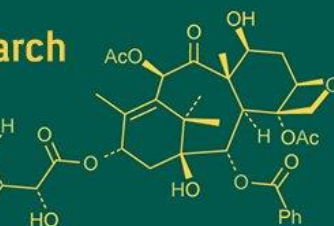
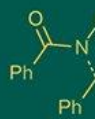


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Effect of date of sowing and varieties on growth parameters in spring maize (*Zea mays* L.)

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Abstract

The present investigation entitled "Effect of date of sowing and varieties on growth and parameters in spring maize (*Zea mays* L.)" was carried out during *Spring* season of 2022 at Nawabganj Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The field experiment included two factors, viz, dates of sowing (11th March & 1st April) and varieties (DKC-9248, DKC-9108, Pioneer-3355, DKC-9208 and Pioneer-1899) was laid out in split plot design and replicated four times.

The date sowing on 11th March recorded better growth, yield attributes and grain yield (53.79 q/ha) and harvesting index (31.45%) of maize crop. Among maize varieties tested Vis DKC-9248 exhibited maximum grain yield (63.77q/ha) and harvest index (30.84%) compared to other tested varieties. As regard physiological parameters sowing date on 11th March recorded maximum RGR at 60 to 90 days (40.37 mg/g/day). Among varieties respectively Pioneer-1899 recorded maximum RGR (40.63 mg/g/day).

Keywords: Maize, date of sowing, tasseling & silking, leaf area, fresh weight

Introduction

The most frequently grown crop in the world is maize (*Zea mays* L.), a domesticated cereal grain that originated in Central America. One of the most adaptable developing crops, it has a wide range of uses. Globally, maize is the due to its maximum genetic production potential; it is referred to as queen of cereals.

Only maize can be cultivated in a wide range of climates, ecosystems, and environments. In addition to this, there are numerous varieties of maize, including regular yellow-white grain, sweet corn, baby corn, popcorn, waxy corn, high-amylase corn, high-oil corn, and quality protein maize, among others. In addition, maize is a crucial industrial raw material that offers significant potential for value addition.

It is grown in 166 nations with greater variation in soil, temperature, biodiversity, and management techniques, covering more than 160 million ha worldwide. Among the food cereal crops, maize contributes the most, at 40% annually. (More than 800 metric tonnes) of food are produced worldwide. The largest producer of maize globally is the United States, which accounts for about 35% of global production. China comes in second with over 20% of global production and an equivalent acreage. The crop with the highest productivity in the US is maize (> 10 t ha⁻¹), which is twice as productive as the world average of 5.3 t ha⁻¹.

In India maize is the third most important food crops after rice and wheat. According to 4th advance estimate its production is likely to be 31.51 M Tones (2020-21) mainly during Kharif season which covers 80% area. According to latest final data (2019-20) it is being cultivated on 9.57 m ha area, 28.77 MT production with average 30.06 q/ha productivity in India and 0.73 mha area, 1.69MT production with average 23.31 q/ha productivity in Uttar Pradesh (Agri. Stat. at a glance 2021). Despite maize being predominantly rainfed crop its productivity is more than rice which is mainly grown under assured irrigated/rainfed conditions. Maize grain contains about 10% protein, 4%oil, 70% carbohydrate 2.3 crude fibres, 10.4% albuminoids, 1.4% ash. Maize is primarily used for feed (60%) followed by human food (24%), industrial (starch) products (14%) beverages and seed (1% each). Thus,

maize has attained an important position as industrial crop because 75% of its produced is used in starch and feed industries.

Maize can be grown successfully in different of soils ranging from loamy sand to clay loam. However, soils with good organic matter content having high water holding capacity with neutral pH are considered good for higher productivity. Being a sensitive crop to moisture stress particularly excess soil moisture and salinity stresses; it is desirable to avoid low lying fields having poor drainage and also the field having higher salinity. Therefore, the fields having provision of proper drainage should be selected for cultivation of maize.

Growth and development are different concepts although they have related stages. Plant growth refers to irreversible increase in organ or whole plant size (length, area, volume and weight), while plant development refers to processes related to cell differentiation, organ initiation, member appearance, and extends to plant senescence. Selection of adapted genotypes and field plant management practices such as fertilization, pest's control and irrigation arrangement was reported by Streck *et al.* (2003). Temperature is a major environmental agent that determines the rate of plant growth and development.

Materials and methods

A field experiment was carried out during *Spring* season of 2022 at Nawabganj Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The experiment was comprised of five genotype namely- DKC-9248, DKC-9108, DKC-9208, Pioneer-1899 and Pioneer-3355 and two different date of sowing viz. 11th March and 1st April. The experiment was laid out in split plot design with three replications. The DKC-9248, DKC-9108, DKC-9208, Pioneer-1899 and Pioneer-3355 were used as a test crop sown in line mark at 60 cm row to row and 25 cm of plant to plant distance. A common dose of 120 kg N, 60 kg P₂O₅ and 40 kg K₂O per ha was applied in the form of urea, DAP and MOP respectively. All agronomic practices were applied equally to each experimental plot.

Germination (%)

To record the germination percentage, note the total number of seeds planted during sowing, count the number of successfully emerged seedlings roughly 7 to 14 days later, and then divide the emerged seedlings by the total seeds planted before multiplying by 100 to get the final percentage.

$$\text{Emergence (\%)} = \frac{\text{Total number of emerge seedling}}{\text{Total number of seed sown}} \times 100$$

Plant height

Plant height (cm) was quantified on five randomly selected plants within the inner rows of each treatment plot to estimate edge effect. Measurements were recorded as the liner distance along the vertical axis from the soil surface to the terminal anatomical apex of the plant utilizing a graduated metric ruler.

Total number of leaves plant⁻¹

To determine the total number of leaves per plant, count all fully emerged and functional green leaves on an individual plant at a specific growth stage.

Leaf area (cm²)

Leaf area (cm²) was evaluated non-destructively for all functional green leaves across five representative, randomly selected plants per replication. Individual leaf area was calculated using the linear dimensions of maximum length (L) and maximum width (W) according to the standard mathematical model:

$$\text{Leaf Area} = L \times W \times K$$

Where K represent the crop specific shape correction factor (K= 00.75 for maize)

Fresh weight plant⁻¹

Select representative plants from the net plot area of each treatment, avoiding border rows to eliminate the edge effect. Carefully uproot the designated plants, wash the root system gently with running water to remove adhering soil particles, and blot them dry with filter paper. Separate the plants into components if required, or keep them intact, and immediately weigh them on a calibrated digital electronic balance to prevent moisture loss through transpiration. Select representative plants from the net plot area of each treatment, avoiding border rows to eliminate the edge effect. Carefully uproot the designated plants, wash the root system gently with running water to remove adhering soil particles, and blot them dry with filter paper. Separate the plants into components if required, or keep them intact, and immediately weigh them on a calibrated digital electronic balance to prevent moisture loss through transpiration.

Dry weight plant⁻¹

To determine the Dry Weight (g plant⁻¹) at harvest, take the exact plants used for fresh weight measurement and place them into labelled perforated paper bags. Dry the samples in a forced-air hot-air oven at 60-65 °C until they reach a constant weight, which typically requires 48 to 72 hours. Immediately transfer the dried samples to a desiccator to cool to room temperature without absorbing atmospheric moisture, and then weigh them on a precision digital electronic balance to record the final dry matter accumulation per plant.

Days to 50% silking

To find the days to 50% silking, continue daily observations immediately following the tasseling stage and record the total number of days from the sowing date until half of the plants in the plot display visible silk threads emerging from their ear husks.

$$\text{Days to 50\% silking} = \text{Date of 50\% silking} - \text{Date of Sowing}$$

Days to 50% tasseling

To determine the days to 50% tasseling, monitor the crop field daily as it approaches its reproductive stage and record the exact number of days from the initial sowing date until 50% of the total plant population shows the tip of the male tassel emerging just above the flag leaf sheath.

$$\text{Days to 50\% tasseling} = \text{Date of 50\% tasseling} - \text{Date of sowing}$$

1. Results and Discussion

The field study revealed that while germination percentage remained statistically unaffected by the treatments

(averaging a uniform 97.0% across the experiment), the variations in sowing dates (D_1 and D_2) and maize hybrids (V_1 to V_5) exerted a highly significant influence on vegetative growth, physiological efficiency, and reproductive phenology. Early sowing (D_1) significantly enhanced leaf development at maturity (16.75 leaves plant⁻¹), fresh weight (291.02 g/plant) and dry matter accumulation (147.06 g/plant) at 60 DAS (36.26%) by offering a prolonged, ambient environmental window for optimal photosynthesis and resource assimilation.

Conversely, delayed sowing (D_2) triggered a "forced maturity" response, significantly accelerating reproduction by reducing the days to 50% tasseling (from 51.35 to 50.19 days) and 50% silking (from 55.55 to 54.10 days) due to

rapid thermal unit accumulation, which ultimately restricted vegetative growth and biomass yield. Among the tested genotypes, cultivar DKC-9248 (V_2) consistently emerged as a superior, long-duration hybrid, recording the maximum number of leaves (17.50), the highest peak dry weight at maturity (148.68 g) despite requiring the longest duration to reach 50% tasseling (53.85 days) and silking (58.15 days). In contrast, varieties like Pioneer-1899 (V_5) and DKC-9108 (V_3) exhibited early-maturing, short-duration characteristics with compressed flowering windows and lower total biomass accumulation, confirming that choice of variety combined with optimized sowing timelines is crucial for maximizing maize morpho-physiological growth and structural crop development.

Table 1: Effect of date of sowing and varieties on germination (%), leaves per plant and plant fresh weight in *Spring* Maize

Treatments	Germination (%)	Leaves per plant			Plant fresh weight		
		30 DAS	60 DAS	At maturity	30 DAS	60 DAS	At maturity
V_1D_1	97.3	5.00	10.50	17.0	10.98	149.50	316.48
V_1D_2	97.0	4.75	9.50	16.75	11.41	146.59	300.75
V_2D_1	97.5	5.25	10.25	17.50	12.03	150.09	321.00
V_2D_2	97.5	5.25	10.25	17.50	11.64	150.00	321.00
V_3D_1	96.8	5.00	10.00	15.50	10.90	144.83	291.30
V_3D_2	96.5	4.75	9.25	15.50	10.39	145.75	291.30
V_4D_1	97.0	4.75	9.75	17.75	10.10	146.11	298.03
V_4D_2	97.0	4.75	9.50	16.75	9.96	146.21	298.03
V_5D_1	96.8	4.75	9.50	17.00	10.93	147.33	228.30
V_5D_2	97.0	4.75	9.25	17.00	10.94	146.72	228.30
SEm±	0.30	0.214	0.33	0.31	0.17	0.70	2.59
CD (P=0.05)	NS	NS	NS	0.78	0.385	1.76	5.31
Interaction (V×T)							
SEm±	0.52	0.370	0.57	0.54	0.30	1.21	4.48
CD at 5%	NS	NS	NS	NS	NS	NS	9.19

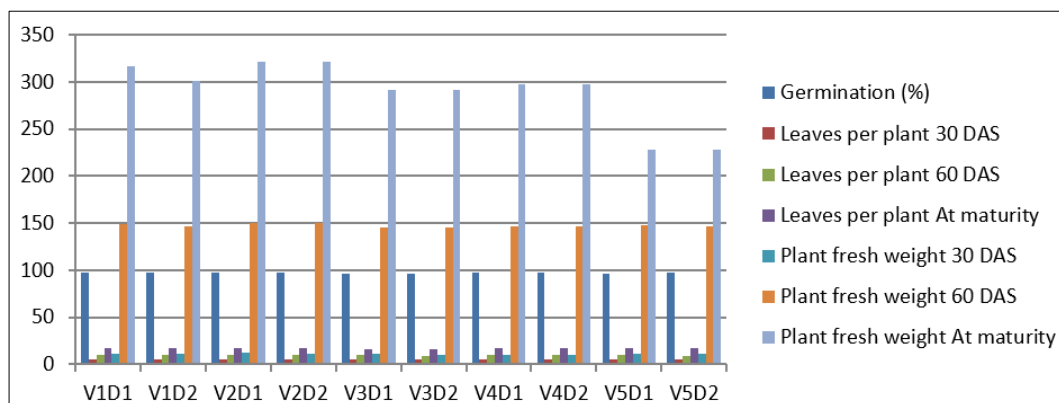


Fig 1: Effect of date of sowing and varieties on germination (%), leaves per plant and plant fresh weight in *Spring* Maize

Table 2: Effect of date of sowing and varieties on total dry weight, days to 50% tasseling and days to 50% silking in *Spring* maize

Treatments	Total dry weight			Days to 50% Tasseling	Days to 50% Silking
	30 DAS	60 DAS	At maturity		
V_1D_1	3.00	44.00	147.00	53.00	55.25
V_1D_2	2.95	43.69	146.60	52.00	56.00
V_2D_1	3.98	44.98	148.89	55.50	60.00
V_2D_2	3.28	44.64	148.46	52.20	56.30
V_3D_1	2.25	42.98	146.09	51.25	54.00
V_3D_2	1.98	43.53	145.48	48.00	52.20
V_4D_1	2.78	43.01	147.11	49.00	54.52
V_4D_2	2.00	42.89	146.39	49.75	52.75
V_5D_1	2.00	43.11	146.23	48.00	54.00
V_5D_2	2.58	43.00	145.19	49.00	53.25
SEm±	0.023	0.45	0.86	0.32	0.39
CD (P=0.05)	0.057	1.12	2.16	0.65	0.79
Interaction (V×T)					
SEm±	0.040	0.77	1.49	0.55	0.67
CD at 5%	0.082	NS	NS	1.12	1.37

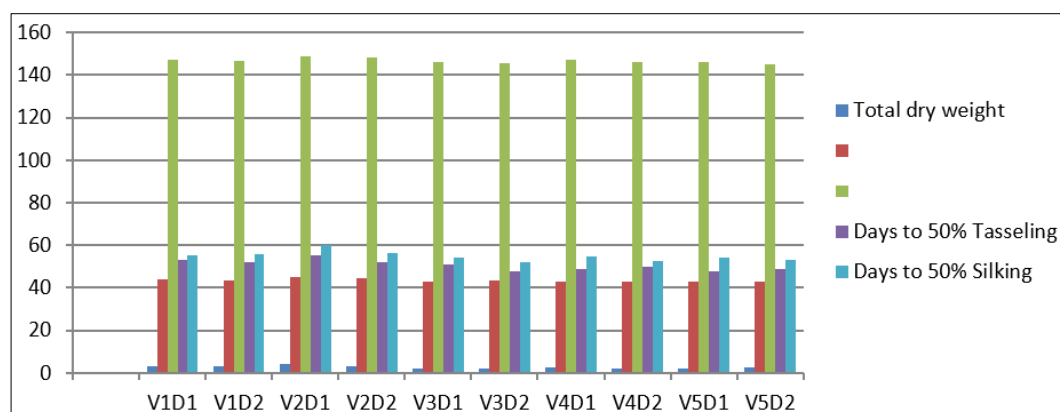


Fig 2: Effect of date of sowing and varieties on total dry weight, days to 50% tasseling and days to 50% silking in *Spring* maize

2. Conclusion

Early sowing (D₁) provides an ideal thermal and environmental window that significantly enhances structural growth parameters, resulting in a higher number of leaves per plant and superior fresh and dry matter accumulation across all growth stages compared to delay planting (D₂). Among the evaluated cultivars, DKC-9248 (V₂) exhibits the most robust growth profile, consistently outperforming other hybrids in leaf production, fresh weight, and dry matter yield at maturity. These findings indicate that selecting long-duration, high-biomass genotypes like DKC-9248 (V₂), combined with an early sowing schedule, provides the optimal agronomic strategy to maximize canopy development and vegetative productivity in maize.

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