



# **Effect of Sowing Dates and Fertility Levels on Growth of Baby Corn (*Zea mays* L.) under Temperate Conditions**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors TAA, ZR, RAB, SN and ZAD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors TAA, ZR, RAB and SF managed the analyses of the study. Authors TAA, RUN, SN, SM and SB managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

There are several factors affecting the growth of maize; however, the optimum date of sowing is important for maize so that the crop grown can complete its life cycle under optimum environmental conditions and managing the fertilizer is one of the most important factors affecting maize growth. A field experiment was conducted to study the “effect of sowing dates and fertility levels on growth of Baby corn (*Zea mays* L.) under temperate condition” during *Kharif* 2018. The experiment comprised of two factors with four sowing dates viz., 18<sup>th</sup> Standard Meteorological Week ((SMW) (30<sup>th</sup> April - 6<sup>th</sup> May)), 21<sup>st</sup> SMW (21<sup>st</sup> May – 27<sup>th</sup> May), 24<sup>th</sup> SMW (11<sup>th</sup> June – 17<sup>th</sup> June) and 27<sup>th</sup> SMW (2<sup>nd</sup> July – 8<sup>th</sup> July) as main plot treatments and four fertility levels viz., unfertilized control (F<sub>0</sub>), 100:50:25 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>1</sub>), 120:60:30 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>2</sub>) and 140:70:35 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>3</sub>) as sub-plot treatments laid out in split plot design with three replications. The results of the experiment revealed that growth baby corn was significantly influenced by sowing dates and fertility levels, among different sowing dates, 18<sup>th</sup> SMW (Standard Meteorological Week) recorded significantly higher growth and among different fertility levels F<sub>3</sub> fertility level (140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>) recorded significantly higher growth than other fertility levels.

**Keywords:** *Baby corn; sowing dates; growth and fertility levels.*

## 1. INTRODUCTION

Maize (*Zea mays* L.) is the third-largest cereal crop in the world, after rice and wheat. It is referred to as the "Queen of Cereals" because of its great production, simplicity in processing, and affordability compared to other cereals [1]. In addition to being used as human food and animal feed, it has several industrial uses. Over 190 million hectares of land are under maize cultivation globally, producing 1438 million tonnes annually [2]. Maize is grown on an area of 9.50 million hectares, with an annual yield of 27.23 million tonnes and a productivity of 2.87 tonnes hectare<sup>-1</sup> in India [3]. It is the second most important cereal crop after rice in the union territory of Jammu and Kashmir, and is cultivated over an area of 0.31 million hectares, with a production of 0.51 million tonnes and an average productivity of 1650 kg ha<sup>-1</sup> [3].

Baby corn, sweet corn, popcorn, and other types of special purpose corn have enormous commercial potential both domestically and abroad. Growing maize for vegetables, often known as baby corn, is being considered for the purpose of diversifying and adding value to maize as well as the expansion of the food processing sector. Baby corn is dehusked maize ear harvested young especially when the silk has either not emerged or just emerged and no fertilization has taken place or we can say the shank with unpollinated silk is baby corn. Baby corn is light yellow in colour with regular row arrangement, 10 to 12 cm long and diameter 1 to 1.5 cm arrangement are preferred in the market [4].

People are looking for high-quality meals rather than bulky things due to the rapid change in standard of life and growing concern for health. As a healthy and reliable vegetable, baby corn holds a prominent place. However, the crop does not yet have any location-specific technologies. Agro-techniques to increase productivity are thus necessary today. Because it is crucial for improved utilisation of the crop's available moisture and nutrients, sowing time has a significant impact on how well the crop performs. The best environmental conditions for growth and a better crop utilisation of the available moisture and nutrients are provided by the sowing period, which has a significant impact on the performance of the crop. According to Lee et al. [5], the timing of the sowing had a significant impact on maize growth. It has long been known that the addition of certain growth inputs could enhance the growth and productivity of maize. Inputs for growth include fertilisation, which is essential. NPK fertilisation has been shown to increase maize productivity, according to Rajanna et al. [6]. There hasn't been much research done in this area on how fertility levels and sowing dates affect the growth of baby maize. In view of these facts the study entitled “Effect of sowing dates and fertility levels on growth of Baby corn (*Zea mays* L.) under temperate conditions”.

## 2. MATERIALS AND METHODS

The experiment was conducted at Crop Research Farm of Division of Agronomy, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir,

Wadura, Sopore during *Kharif*, 2018. The experiment comprised of two factors with four sowing dates viz., 18<sup>th</sup> Standard Meteorological Week ((SMW) (30<sup>th</sup> April - 6<sup>th</sup> May)), 21<sup>st</sup> SMW (21<sup>st</sup> May – 27<sup>th</sup> May), 24<sup>th</sup> SMW (11<sup>th</sup> June – 17<sup>th</sup> June) and 27<sup>th</sup> SMW (2<sup>nd</sup> July – 8<sup>th</sup> July) as main plot treatments and four fertility levels viz., unfertilized control (F<sub>0</sub>), 100:50:25 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>1</sub>), 120:60:30 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>2</sub>) and 140:70:35 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> (F<sub>3</sub>) as sub-plot treatments laid out in split plot design with three replications.

Plant height of randomly tagged or marked plants in each plot was taken at 15 days interval from base of plant to the apex of flag leaf. The height was averaged and recorded as plant height in centimetres. Plant samples in each plot were collected from the net plots at 15 days interval from sowing date up to harvesting stage. After drying for 5-6 days, the samples were oven dried at 60-65°C to a constant weight. Dry weight of plant sample was recorded as gram per plant and then converted to q ha<sup>-1</sup>. Total number of leaves of 10 randomly marked plants in each plot were counted at 15 days interval and averaged as number of leaves per plant. Leaf area index was worked out by using the following formula:

$$\text{Leaf area index (LAI)} = \frac{\text{Total leaf area}}{\text{Ground area}}$$

Crop growth rate (gm<sup>-2</sup>day<sup>-1</sup>) represents dry weight gained per unit area per unit time (gm<sup>-2</sup> day<sup>-1</sup>). It was calculated with the help of following formula:

$$\text{Crop Growth Rate (CGR)} = \frac{W - W_1}{T_2 - T_1} \times 1/A$$

W<sub>1</sub> = dry matter production (g) at time T<sub>1</sub>

W<sub>2</sub> = dry matter production (g) at time T<sub>2</sub>

T<sub>1</sub> = days to first reading

T<sub>2</sub> = days to second reading

A = Plant area (m<sup>2</sup>)

### 3. RESULTS AND DISCUSSION

#### 3.1 Plant Height

In order to monitor the overall architecture of the plant's canopy and to control the orientation of the leaves, which further controls how effectively a plant uses the sun's energy for photosynthetic processes, plant height is a key growth indicator. As presented in Table 1, the 18<sup>th</sup> SMW sowing (S<sub>1</sub>) had significantly higher plant height than

other sowing dates, while the 27<sup>th</sup> SMW sowing (S<sub>4</sub>) had the lowest plant height. The temperature was high during the delayed sowing period, which might have led to growth rate. Because early-sown crops had more time to make use of the available growth resources, they grew taller than delayed-sown crops. The findings are also consistent with the observation made by Moosavi et al. [7] that there is a significant decline in plant height with the delay in maize sowing time. This significant decline in plant height following the delay in sowing may be related to higher temperatures that the delayed sowing date plants experienced, which constrained their growing period and prevented them from assimilate building because of the early maturity of the plants. However, up to 30 days after sowing, the late-sown crop (27<sup>th</sup> SMW) was taller than the early-sown crop (18<sup>th</sup> SMW), followed by the crop sown in the 24<sup>th</sup> SMW. This is because the late-sown crop was exposed to comparatively higher temperatures than the early-sown maize. Early crop development in late-sown crops was accelerated by the rapid accumulation of heat units, which might have caused an initial faster increase in plant height.

In comparison to the other fertility levels, the F<sub>3</sub> fertility level (140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>) recorded significantly higher plant height, whereas the F<sub>0</sub> fertility level recorded the lowest plant height (Table 1). The higher plant height observed at higher fertiliser levels might have result from a balanced supply of enough nutrients delivered in the right proportions and in appropriate amounts during crop growth and development. Both Sobhana et al. [8] and Ashok Kumar [9] observed that increased fertilisation had similar impacts on baby corn.

#### 3.2 Leaf Area Index

Because optimal leaf area is necessary for maximum light absorption, which leads to higher photosynthesis, leaf area index is extremely important for all crop plants. From 45 to 60 days after sowing, the 18<sup>th</sup> SMW sowing (S<sub>1</sub>) had the maximum leaf area index, which thereafter steadily decreased until harvest (Table 2). The leaf area index of baby corn (*Zea mays* L.) significantly decreased as a result of the delayed seeding. The shorter growing season may have played a role in the LAI reduction with delayed sowing. Moosavi et al. [7] and Williams and Lindquist in [10] also reported that there was a decline in the leaf area index of maize crop with delay in the sowing time and With F<sub>3</sub> fertility level

(140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>), a significantly higher leaf area index was observed. As fertility levels were reduced, the leaf area index decreased until it reached its lowest value with F<sub>0</sub> fertility level (Table 2). At 60 days after sowing, the maximum leaf area index was noted. From then, it gradually decreased till maturity. This could be attributed to the reason that the crop received enough nitrogen and phosphorus from the soil at the F<sub>3</sub> fertility level.

Higher levels of both nitrogen and phosphorus might have encouraged more vegetative buds, which in turn led to more green leaves and an improved leaf area index (LAI). Senescence of the leaves brought on by the maturation of lower leaves might be the cause of the falling trend in the leaf area index from 60 days after sowing until harvest. These findings are consistent with those of Choudhary et al. [11] and Maurya et al. [12].

**Table 1. Effect of dates of sowing and fertility levels on plant height (cm) of baby corn at 15 days interval**

Treatments	15 DAS	30 DAS	45 DAS	60 DAS	Harvest
<b>Main Plot</b>					
<b>Dates of sowing</b>					
18 <sup>th</sup> SMW (S <sub>1</sub> )	6.01	31.76	102.73	159.81	186.63
21 <sup>st</sup> SMW (S <sub>2</sub> )	6.10	34.41	97.60	151.90	177.72
24 <sup>th</sup> SMW (S <sub>3</sub> )	6.20	37.67	90.53	142.31	160.27
27 <sup>th</sup> SMW (S <sub>4</sub> )	6.26	40.61	83.92	135.54	144.59
SEm±	0.02	1.13	1.41	2.01	2.28
CD (p≤0.05)	0.08	3.92	4.89	6.96	7.87
<b>Sub Plot</b>					
<b>Fertility levels (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>)</b>					
Unfertilized control (F <sub>0</sub> )	6.13	27.75	77.10	129.96	145.22
100:50:25 (F <sub>1</sub> )	6.14	35.80	90.77	143.84	164.50
120:60:30 (F <sub>2</sub> )	6.15	38.72	100.32	154.43	176.64
140:70:35 (F <sub>3</sub> )	6.15	42.19	106.59	161.33	182.85
SEm±	0.01	1.13	1.51	2.41	1.98
CD (p≤0.05)	N.S.	3.30	4.42	3.89	5.78

SMW= Standard Meteorological Week, DAS = Days after sowing

**Table 2. Effect of dates of sowing and fertility levels on leaf area index of baby corn at 15 days interval**

Treatments	15 DAS	30 DAS	45 DAS	60 DAS	Harvest
<b>Main Plot</b>					
<b>Dates of sowing</b>					
18 <sup>th</sup> SMW (S <sub>1</sub> )	0.23	0.83	3.51	5.37	5.02
21 <sup>st</sup> SMW (S <sub>2</sub> )	0.24	1.00	3.35	5.08	4.86
24 <sup>th</sup> SMW (S <sub>3</sub> )	0.28	1.18	3.13	4.66	4.42
27 <sup>th</sup> SMW (S <sub>4</sub> )	0.30	1.21	2.98	4.28	4.00
SEm±	0.01	0.01	0.04	0.07	0.04
CD (p≤0.05)	0.03	0.05	0.14	0.25	0.15
<b>Sub Plot</b>					
<b>Fertility levels (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>)</b>					
Unfertilized control (F <sub>0</sub> )	0.25	0.91	2.46	3.72	3.57
100:50:25 (F <sub>1</sub> )	0.26	1.03	3.17	4.65	4.27
120:60:30 (F <sub>2</sub> )	0.26	1.10	3.58	5.38	5.10
140:70:35 (F <sub>3</sub> )	0.28	1.19	3.76	5.64	5.36
SEm±	0.01	0.02	0.06	0.08	0.07
CD (p≤0.05)	N.S.	0.08	0.20	0.24	0.22

SMW= Standard Meteorological Week, DAS = Days after sowing

### 3.3 Dry Matter Accumulation and Mean Crop Growth Rate

Another crucial characteristic to express plant growth and metabolism, which ultimately affect yield, is the build-up of dry matter. When baby corn was delayed in being sown, the dry matter production and crop growth rate (CGR) (Tables 3 and 4) were both significantly lower. Rapid phenological development with delayed sowing

might have been caused by a rise in temperature, which also increased respiration rates and lowered net gains, which led to the production of less dry matter. Additionally, the temperature might be favourable for baby corn on the 18th SMW sowing ( $S_1$ ), which led to a larger production of dry matter because of a higher net gain of photosynthates. These results are in confirmation with the findings of Oktem et al. [13].

**Table 3. Effect of dates of sowing and fertility levels on dry matter accumulation ( $q\ ha^{-1}$ ) of baby corn at 15 days interval**

Treatments	15 DAS	30 DAS	45 DAS	60 DAS	Harvest
<b>Main Plot</b>					
<b>Dates of sowing</b>					
18 <sup>th</sup> SMW ( $S_1$ )	4.06	15.92	55.09	91.14	116.68
21 <sup>st</sup> SMW ( $S_2$ )	4.16	17.54	52.32	86.06	109.98
24 <sup>th</sup> SMW ( $S_3$ )	4.36	19.62	48.85	78.87	96.27
27 <sup>th</sup> SMW ( $S_4$ )	4.54	22.60	46.37	73.35	89.84
SEm±	0.05	0.49	0.69	1.25	1.16
CD ( $p<0.05$ )	0.17	1.69	2.38	4.32	4.01
<b>Sub Plot</b>					
<b>Fertility levels (<math>N:P_2O_5:K_2O\ kg\ ha^{-1}</math>)</b>					
Unfertilized control ( $F_0$ )	4.26	16.48	44.93	66.53	79.08
100:50:25 ( $F_1$ )	4.28	18.48	48.88	81.49	102.83
120:60:30 ( $F_2$ )	4.28	19.79	53.08	87.86	111.70
140:70:35 ( $F_3$ )	4.30	20.93	55.75	93.54	119.15
SEm±	0.04	0.37	0.56	1.35	2.36
CD ( $p<0.05$ )	N.S.	1.10	1.65	3.96	6.91

**Table 4. Mean crop growth rate ( $g\ m^{-2}\ day^{-1}$ ) of baby corn as influenced by dates of sowing and different fertility levels**

Treatments	15-30DAS	30-45DAS	45-60DAS	60DAS-harvesting
<b>Main plot</b>				
<b>Dates of sowing</b>				
18 <sup>th</sup> SMW ( $S_1$ )	8.74	22.29	27.03	17.03
21 <sup>st</sup> SMW ( $S_2$ )	9.08	20.18	25.32	15.94
24 <sup>th</sup> SMW ( $S_3$ )	10.00	16.78	22.84	11.53
27 <sup>th</sup> SMW ( $S_4$ )	10.55	14.65	20.67	10.99
SEm±	<b>0.30</b>	<b>0.38</b>	<b>0.58</b>	<b>0.43</b>
CD ( $p<0.05$ )	<b>1.04</b>	<b>1.31</b>	<b>2.00</b>	<b>1.51</b>
<b>Sub Plot</b>				
<b>Fertility levels (<math>N:P_2O_5:K_2O\ kg\ ha^{-1}</math>)</b>				
Unfertilized control ( $F_0$ )	7.98	16.63	16.90	8.36
100:50:25 ( $F_1$ )	9.13	17.90	24.40	14.17
120:60:30 ( $F_2$ )	10.17	19.03	26.52	15.89
140:70:35 ( $F_3$ )	11.09	20.35	28.04	7.07
SEm±	<b>0.26</b>	<b>0.37</b>	<b>0.56</b>	<b>0.81</b>
CD ( $p<0.05$ )	<b>0.76</b>	<b>1.08</b>	<b>1.64</b>	<b>2.38</b>

In comparison to other fertility levels, the F<sub>3</sub> fertility level (140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>), significantly increased dry matter production, and it dropped as fertility levels decreased (Table 3). The higher plant height and leaf area index that resulted in improved light absorption by the crop, which in turn produced more photosynthates and dry matter, may be the cause of the F<sub>3</sub> fertility level's increased dry matter accumulation. These results are well supported by the findings of Sutaliya and Singh [14] and Arunkumar et al. [15]. The results of the current study also indicated that F<sub>3</sub> fertility level (140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>) recorded higher crop growth rate at 15 days interval from 15 DAS up to harvest. The crop growth rate (CGR) indicates the increase in dry matter per unit area per unit time. The higher crop growth rate attained during the investigation under the above treatment is the reflection of accumulation of dry matter at the respective periods (Table 4). These results are in agreement with those of Mahmood et al. [16].

#### 4. CONCLUSION

From results of the present study, it has been found that sowing dates as well as fertility levels had a significant effect on growth of baby corn and among different sowing dates, early sowing date recorded higher growth and among different fertility levels, fertility level 140:70:35 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup> recorded higher growth as compared other fertility levels and control treatment. Therefore, it can be concluded that in order to obtain higher growth of baby corn under temperate conditions, we should go for early sowing and it should be fertilized with 140:70:35 dose of N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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