



## Nitrogen and detasseling influences growth, yield and economics of male sterile baby corn (*Zea mays*)

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### ABSTRACT

A field experiment was carried-out in the winter season of 2021–22 at the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India, to assess the effect of detasseling times and nitrogen levels on productivity and profitability of winter baby corn (*Zea mays* L.). The experiment comprised three detasseling times (No detasseling [Control], immediately after tassel emergence, and 7 days after tassel emergence) and four nitrogen levels (50, 100, 150 and 200 kg N/ha). A total 12 treatment combinations were evaluated in a factorial randomized-block design, replicated thrice. The results showed that detasseling immediately after tassel emergence enhanced the dry matter accumulation, yield attributes, and husked and dehusked baby corn yield by 11.4 and 15.2%, respectively and fodder yield (23.84 t/ha), over no detasseling; however, it stood at par with detasseling 7 days after tassel emergence. Further, an application of 200 kg N/ha resulted in the highest dry matter accumulation and yield attributes, finally leading to 36.9, 38.1 and 33.1%, improvement in husked, dehusked baby corn yield and fodder yield, respectively, compared to 50 kg N/ha. Using 150 kg N/ha was at par with 200 kg N/ha both for growth and yield. The net returns and benefit-cost ratio showed the similar trend as of baby corn yields. Overall, this study suggested that detasseling immediately after tassel emergence and application of 200 kg N/ha is advantageous to augment the productivity and profitability of winter baby corn under irrigated ecosystem of eastern Uttar Pradesh.

**Key words:** Detasseling time, Net return, Nitrogen, Winter baby corn

Baby corn was introduced as a vegetable crop around the world for crop diversification and value addition in maize (Hrudaya *et al.*, 2024). Baby corn is immature, dehusked maize ear, harvested within 1–2 days after silking at a 2–3 cm long silk stage before fertilization (Neupane *et al.*, 2017). It is a short-duration, early-maturing, and eco-friendly crop and has wider adaptability and the highest production potential (Sharma and Dass, 2012; Singh *et al.*, 2010). Recently, baby corn is gaining more popularity in peri-urban areas, where it earns foreign ex-

change and also creates a huge employment (Singh *et al.*, 2010). Besides, it is a rich source of nutrients including phosphorous, folic acids, vitamins, protein, etc. and provides nutritious, palatable and valuable green fodder as a livestock feed (Hooda and Kawtra, 2013). It is used for making various dishes like pickles, soups, pakora, curries, salads, etc., and became a great value addition in the food industry (Singh *et al.*, 2010).

The agro-techniques of baby corn include high plant density, high rates of nitrogen (N) application, and early harvesting (Kumar *et al.*, 2022). Baby corn requires a high amount of applied N to meet the demand of the crop because of the high plant population and also to maintain its quality and productivity (Bamboriya *et al.*, 2023). However, baby corn requires optimum N, and the timing of application coincides with critical stages (basal, knee-high stage, tassel emergence stage) could help in achieving high yields. Winter baby corn duration is longer due to low temperatures and gives higher productivity than the rainy season crop, thus requiring high N application (Neupane *et al.*, 2017). At the same time N application rates in excess of crop demand have many environmental implications and

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also affects yield and quality of baby corn. Thus, optimization of N in bay corn production is essential. Detasseling is important in baby corn production, it has a positive effect on the productivity and quality of baby corn (Moreira *et al.*, 2010). Tassel and silk compete for nutrients and solar radiation during the reproductive phase. Removing tassel from the plant improves translocation of the nutrients to the silk and also helps in efficient utilization of the solar radiation by flag-leaf and thus, improves yield and quality of baby corn (Cheng and Paredy, 1994). Detasseling operation significantly increases the number and weight of ears (Moreira *et al.*, 2010).

Based on above facts, it was hypothesized that combined effect of timing for detasseling and nitrogen levels may improve the productivity and profitability of winter baby corn. The objective of this study was to analyse the effect of nitrogen levels and detasseling time on growth, yield and economics of winter baby corn under irrigated conditions of eastern Uttar Pradesh, India.

The present investigation was undertaken during the year 2021-22 in the winter season (*rabi*) at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India (25°18'N latitude, 83°31'E longitude and altitude 75.7 m). The experimental site falls under the category of semi-arid to sub-humid climate with scanty rainfall, low humidity, and high temperature. A meagre amount of rainfall received during the entire experimental period amounted to 9.7 mm; the highest (7 mm) occurring during the 4<sup>th</sup> standard meteorological week. The mean maximum and minimum temperature during the experimental period was 27.4°C and 12.2°C respectively. Relative humidity ranged from 54 – 91%. The mean annual potential evapo-transpiration (PET) was 1525 mm and daily length of bright sunshine was 6.5 hrs with a mean evaporation of 2.6 mm during the cropping period. The experimental site had a sandy clay loam soil texture (sand 49.72%, silt 28.92%, clay 19.52%) neutral in soil pH (7.56), electrical conductivity 0.4/dS/m, organic carbon 0.33%, available nitrogen 198.1 kg/ha, phosphorous 19.56 kg/ha and potassium 147.3 kg/ha, respectively. Rice crop was grown prior to the experimental crop.

The experimental treatments included, four nitrogen levels (N<sub>1</sub>:50 kg N/ha, N<sub>2</sub>:100 kg N/ha, N<sub>3</sub>:150 kg N/ha and N<sub>4</sub>: 200 kg N/ha) and three detasseling timing (D<sub>1</sub>: No detasseling (control), D<sub>2</sub>: Immediately after tassel emergence and D<sub>3</sub>: 7 days after tassel emergence). The factorial experiment was set up in a randomized complete block design with 12 treatments and three replications using a plot size of 4.8 m × 3.3 m. The baby corn crop was sown during the winter season on 27 November 2021 with the recommended seed rate of 25 kg/ha (male sterile hybrid; G-

5414) and spacing of 40×20 cm. The seedlings were thinned 2 weeks after the sowing to maintain the uniform plant population. Nitrogen was applied in three splits of 50%, 25%, and 25% as basal, at the knee-height stage and at tassel emergence respectively, as per treatments, and the entire dose of phosphorous 75 kg/ha, potassium 60 kg/ha, sulfur 40 kg/ha and zinc 10 kg/ha was uniformly applied as the basal application to all treatments. Standard operations recommended for baby corn like earthing up (70 days after sowing; DAS) and detasseling (108-115 DAS) were done as per the treatments. The cobs were harvested after 2-3 cm silk emergence. The test crop was harvested (fodder) on 10 April 2022 (i.e., 135 DAS).

In each experimental plot, five random plants were selected and tagged. These five plants were observed throughout the experimentation to record the growth and yield attributes. The growth attribute *viz.*, dry matter accumulation/plant, was recorded at 30, 60, 90 DAS, and at harvest. Five representative plants per plot were randomly selected to measure dry matter accumulation per plant at 30 days interval and shade-dried followed by oven drying (65 ± 2 pC), weighed on achieving the constant weight and recorded in g/plant for respective plant part (Neupane *et al.*, 2017). Days to initiation of baby cobs/plant, number of baby cob/plant, days to 50% silk emergence, period of harvest (days), dehusked baby corn length and girth, husked baby corn and dehusked baby corn weight, husked and dehusked baby corn ratio and husked baby corn yield (t/ha), dehusked baby corn yield (t/ha) and fodder yield (t/ha) were recorded. Data of yield attributes taken from the tagged five plants were averaged. Five cobs per plot from tagged plants were used to record the data. Selected baby cobs were dehusked and the length and girth of baby corn were done by Digital Vernier Calipers. Hand-picking of young cobs harvested from each plot separately at the silk emergence stage (2-3cm) to determine the husked baby corn and dehusked baby corn yield and remaining stalk harvested for fodder yield from marked net-plot 8.74m<sup>2</sup> and values were converted into t/ha. A total of 4 pickings of baby corn were done at regular intervals.

Gross returns, net returns, and cost of cultivation were worked out for individual treatments by taking into account all the expenses; the cost of cultivation and gross returns were calculated based on the market price of inputs (i.e., land preparation, seed, fertilizer, irrigation, weeding, plant protection, and harvesting) and output market price (baby corn and fodder yield). Gross returns are considered as the total income received from the baby corn and fodder. The prices of baby corn and fodder were 50 ₹/kg and 5 ₹/kg, respectively. Net returns and the benefit-cost ratio were calculated by following equations.

Net returns (₹/ha) = Gross returns (₹/ha) – Cost of cultivation (₹/ha)

$$\text{Benefit cost ratio} = \frac{\text{Gross return (₹/ha)}}{\text{Cost of cultivation (₹/ha)}}$$

All data were statistically analyzed using ‘Analysis of Variance’ technique applicable to factorial randomized complete block design (Gomez and Gomez, 1984); the significance of differences between the treatments was determined by the ‘F test’. To evaluate the significant difference between the treatments, the least significant difference (LSD) at the  $p \leq 0.05$  level was calculated. Statistical analysis and graph preparation, was done by using R software.

The dry matter accumulation (g/plant) was not affected significantly by detasseling times during any of the stages (30, 60, 90 DAS, and at harvest, but nitrogen levels did affect significantly the dry matter accumulation except at 30 DAS. An increase in the nitrogen levels from 50 kg N/ha to 200 kg N/ha recorded significant improvement in dry matter accumulation at 60, 90 DAS, and at harvest (Fig. 1). This might be attributed to greater green foliage development, more photosynthetic activity and higher shoot growth resulting from higher nitrogen availability. These results are supported by the results from earlier experiments conducted by Dar *et al.* (2014). Interaction between the nitrogen levels and detasseling time on dry matter was non-significant.

There was a reduction in the number of days for initiation of baby corn harvest and days to 50% silk emergence with the application of treatment detasseling immediately

after tassel emergence followed by 7 days after tassel emergence (Table 1). This could be due to a rapid translocation of nutrients accelerating the cob development and silk emergence. Similarly, the harvest period of baby corn was longer with detasseling immediately after tassel emergence because of ample supply of nutrients and energy during harvest time, thus continuous initiation of baby cobs. Similarly, Sammauria *et al.* (2019) reported that tassel removal at 3 days after emergence (DAE) and 7 DAE showed at par results concerning yield attributes, grain yield, stover yield, and biological yield compared to the removal just after emergence in maize. Moreover, the number of baby corns plant<sup>-1</sup>, dehusked baby corn length and girth, and baby corn (husked) and Corn (dehusked) weight showed significant variation due to detasseling immediately after tassel emergence over the no detasseling but at par observed with 7 DAE. These attributes registered maximum values due to the detasseling immediately after tassel emergence because of less competition between the tassel and ear for nutrients and also flag leaf received high solar radiation thus increasing these attributes (Moreira *et al.*, 2010).

Increasing nitrogen levels up to 200 kg N/ha registered less number of days to initiation of husked baby corns and days to 50% silk emergence (Table 1). This might be due to the high availability of nitrogen causing rapid crop growth and the crop took less number of days to reach 50% silk emergence and days to initiation of baby corn harvest. Sobhana *et al.* (2012) also noted that increasing NPK 187.5+ 32.7+ 62.5 recorded less number of days taken for

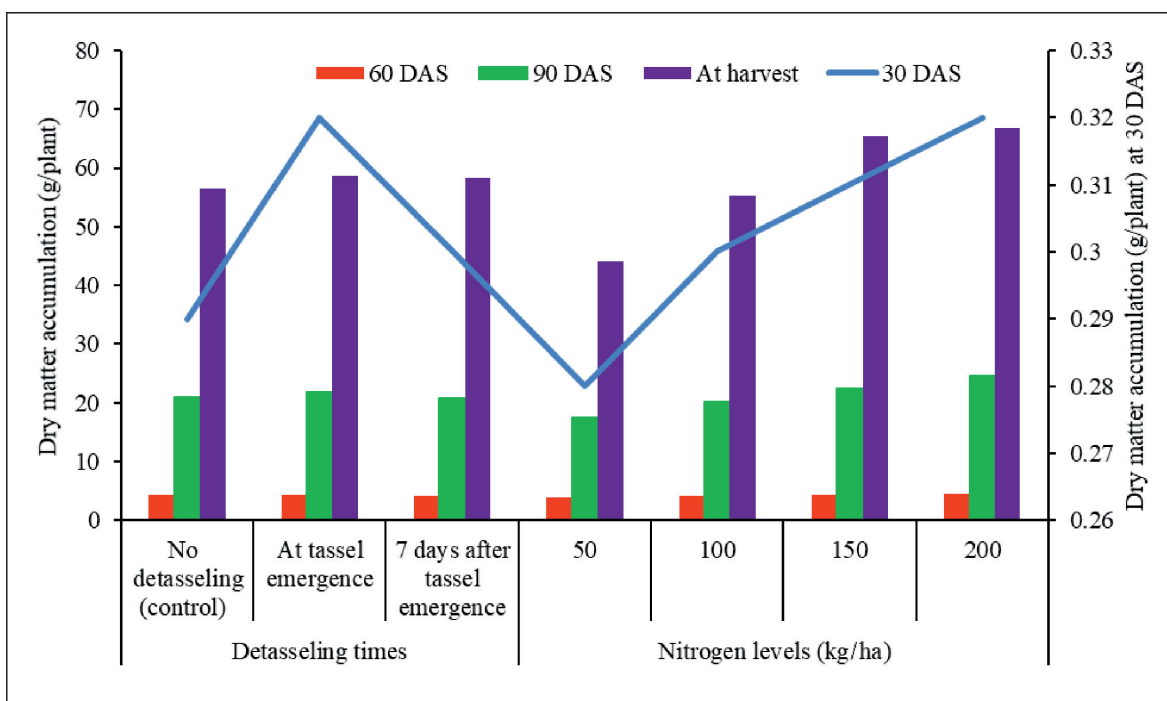


Fig. 1. Effect of nitrogen levels and detasseling time on dry matter accumulation (g/plant) of winter baby corn

baby cob initiational in New Delhi. Similarly, the harvest period and baby corns/plant recorded significantly higher with 200 kg N/ha over the 50 kg N/ha; however the former stood alike 150 kg N/ha. The harvesting period and baby corns/plant got prolonged under the application of 200 kg N/ha due to the high availability and uptake of nitrogen which enhances vegetative growth and delays maturity. Singh *et al.* (2010) also noticed that an increase in nitrogen levels thus increasing the fertility of soils could be better utilized for baby corn and then increase yield attributes ultimately affecting the yields.

The detasseling immediately after tassel emergence was found to increase husked baby corn yields by 11.4 and 5.9% over no detasseling and detasseling 7 days after the tassel emergence, respectively (Table 2) Similarly, the detasseling immediately after tassel emergence increased dehusked baby corn yield by 15.2 and 8.8% over treatment no detasseling and 7 days after the tassel emergence, respectively. The increased husked and dehusked corn yields may be due to a favorable increase of yield attributes by the adaption of detasselling immediately after tassel emergence. The results are strongly supported by the findings of Moreira *et al.* (2010), where detasselling in baby corn increases the number and the total weight of ears and marketable unhusked ears. The fodder yield of baby corn was also the highest in detasseling immediately after tassel emergence followed by 7 days after the tassel emergence and no detasseling due to a higher dry matter accumulation.

Husked and dehusked baby corn, and fodder yields were increased with an increase in nitrogen levels (Table 2). The application of 200 kg N/ha recorded a significant increase in husked and dehusked baby corn, and fodder yields increased by 36.9, 38.1, and 33.1%, respectively, over the 50 kg N/ha, however, it remained at par with 150 kg N/ha. This might be due to an increase in the nitrogen levels increasing the growth attributes, and yield attributes of baby corn, consequently increasing the husked and dehusked baby corn, and fodder yields. These results are supported by the findings of Singh *et al.* (2010), that NPK fertility levels 180+38.7+74.7 significantly increased the baby corn, cob, and fodder yields in Varanasi, India.

Detasseling immediately after tassel emergence resulted in the highest net returns and benefit-cost ratio over no detasseling, however, it was found at par with detasseling 7 days after tassel emergence. This might be due to the production of the highest baby corn and green fodder yields with their respective treatments. Sammauria *et al.* (2019) also reported that detasseling in maize was more profitable and improved productivity along with returns compared to the no detasseling at Bhilwara, India. Among the nitrogen levels, net returns, and benefit-cost ratio of baby corn were found significantly higher with 200 kg N/ha over 50 kg

Table 1. Effect of nitrogen levels and detasseling time on yield attributes of winter baby corn

Treatment	Days to baby corn harvest	Days to 50% silk emergence	Period of harvest (days)	Baby corns/plant	Baby corn (dehusked) length (cm)	Baby corn (dehusked) girth (cm)	Baby corn (husked) weight (g)	Baby corn (dehusked) weight (g)	Husked to dehusked baby corn ratio
No detasseling (control)	116.8	118.7	16.8	3.50	9.34	1.29	36.87	7.97	4.64
Immediate after tassel emergence	116.0	117.	17.5	3.68	10.44	1.35	39.43	8.89	4.45
7 days after tassel emergence	116.6	118.3	17.2	3.57	9.65	1.32	37.86	8.32	4.56
SEm±	0.24	0.25	0.16	0.04	0.27	0.01	0.44	0.12	0.08
CD (P=0.05)	NS	NS	0.46	0.11	0.78	0.03	1.29	0.34	NS
N <sub>50</sub>	118.0	120.2	13.6	3.03	9.19	1.25	34.85	7.60	4.59
N <sub>100</sub>	117.2	119.3	16.5	3.49	9.33	1.28	36.70	8.04	4.57
N <sub>150</sub>	115.5	117.0	18.7	3.83	10.23	1.34	39.28	8.71	4.53
N <sub>200</sub>	115.1	116.6	19.9	3.97	10.48	1.41	41.39	9.20	4.51
SEm±	0.27	0.29	0.18	0.04	0.31	0.01	0.51	0.13	0.09
CD (P=0.05)	0.81	0.85	0.54	0.13	0.90	0.03	1.49	0.39	NS

**Table 2.** Effect of nitrogen levels and detassling time on yield and economics of winter baby corn

Treatment	Husked baby corn yield (t/ha)	Dehusked baby corn yield (t/ha)	Fodder yield (t/ha)	Cost of cultivation (× 0000 ₹/ha)	Net returns (× 0000 ₹/ha)	Benefit-cost ratio
<i>Detassling time</i>						
No detassling (control)	8.01	1.74	23.17	75.74	135.60	2.79
Immediate after tassel emergence	9.04	2.05	23.84	77.66	154.05	2.98
7 days after tassel emergence	8.51	1.87	23.26	77.66	141.39	2.82
SEm±	0.11	0.04	0.72	-	4.182	0.05
CD (P=0.05)	0.33	0.12	NS	-	12.266	0.16
<i>Nitrogen levels (kg/ha)</i>						
N <sub>50</sub>	6.48	1.42	18.56	75.92	94.782	2.25
N <sub>100</sub>	7.97	1.75	20.85	76.81	123.73	2.61
N <sub>150</sub>	9.37	2.08	26.57	77.39	169.83	3.19
N <sub>200</sub>	10.27	2.29	27.71	77.97	186.39	3.39
SEm±	0.13	0.05	0.83	-	4.829	0.06
CD (P=0.05)	0.38	0.14	2.44	-	14.164	0.18

N/ha, but it was found at par with 150 kg N/ha. The reason is that an increase in nitrogen levels increased the baby corn and green fodder yields with their respective treatments.

It could be concluded that male sterile baby corn should be grown with a combination of detassling immediately after tassel emergence and application of 200 kg N/ha to achieve higher productivity and profitability in the winter season in Eastern Indo-Gangetic Plains.

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