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Effect of different levels of nitrogen and detasseling on the quality and nutrient uptake of Baby corn

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Abstract
In an experiment which was conducted during the *rabi* season of 2020–21 at Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, to assess the effect of different nitrogen levels and tassel removal on protein content and nutrient uptake in baby corn (*Zea mays* L.). The experiment was laid out in a split-plot design with three replications, comprising six nitrogen levels (0, 40, 80, 120, 160, and 200 kg N ha^{-1}) in the main plots and two tasseling practices (tasselled and detasseled) in the subplots. Results revealed that increasing nitrogen levels significantly enhanced protein content in baby corn and green fodder. Application of 200 kg N ha^{-1} recorded the highest protein content in baby corn (11.99%) and fodder (10.26%), which was statistically at par with 160 kg N ha^{-1} and superior to lower nitrogen levels. Nitrogen uptake by both baby corn and fodder increased progressively with higher nitrogen application, with maximum uptake observed at 200 kg N ha^{-1}. Phosphorus and potassium uptake were not significantly influenced by nitrogen levels. Tassel removal had no significant effect on protein content or nutrient uptake in either baby corn or fodder. No significant interaction was observed between nitrogen levels and tasseling practices for protein content or nutrient uptake. The study concludes that application of 160 to 200 kg N ha^{-1} optimizes protein content and nitrogen uptake in baby corn without any notable advantage from detasseling.

Keywords: Baby corn, nitrogen levels, protein content, nutrient uptake, detasseling, tassel removal

1. Introduction
Baby corn (*Zea mays* L.) is a specialized maize crop harvested as immature, unfertilized cobs 1-2 days after or immediately upon silk emergence (Neupane *et al*., 2017) [8]. Due to its short growth cycle, it serves as a highly profitable vegetable for both fresh consumption and the canning industry. Beyond its primary yield, the succulent green biomass provides high-quality fodder for livestock, making it an ideal candidate for integrated crop-livestock farming systems (Vamshi and Sahoo, 2022) [12]. Unlike grain maize, baby corn is cultivated at significantly higher plant densities often to maximize cob production per unit area. This intensive plant population necessitates a robust nutrient management strategy, as baby corn is a heavy feeder (Kumar and Bohra, 2014) [6]. Among the essential nutrients, Nitrogen (N) is the primary limiting factor for growth and development. As a fundamental constituent of chlorophyll, amino acids, and enzymes, nitrogen directly dictates the plant's photosynthetic capacity. Strategic nitrogen application not only enhances the physical yield but also improves the biochemical quality of the cobs, specifically by increasing protein content and carbohydrate accumulation (Nithinkumar *et al*., 2024) [9]. Furthermore, optimal N availability stimulates root proliferation, which synergistically enhances the uptake of other vital macronutrients such as Phosphorus (P) and Potassium (K). In addition to nutrient management, detasseling the removal of the male inflorescence before pollen shed is a critical agronomic practice in baby corn production. Since baby corn is harvested before fertilization, the tassel represents an unnecessary physiological sink. Removing the tassel eliminates apical dominance and redirects photosynthates and nutrients toward the developing cobs (Smith *et al*., 2018) [11]. This diversion of resources is hypothesized to improve cob size, weight, and overall nutritional profile. Despite the established importance of nitrogen and detasseling individually, there remains a knowledge gap regarding their interactive effects on nutrient uptake and cob quality under varying agro-climatic conditions. Optimizing nitrogen levels is vital for maximizing economic returns while minimizing

environmental hazards like leaching. Consequently, evaluating the synergy between nitrogen fertilization and detasseling is essential to develop a comprehensive management package that ensures high-quality produce and sustainable soil health.

2. Materials and Methods

A field experiment was carried out in a sandyloam texture soil at OUAT Bhubaneshwar during 2020-2021 rabi with pH of 5.6, slightly acidic and low in organic carbon (0.48%) and available nitrogen (250.3 kg ha^{-1}), medium available phosphorus (17.4 kg ha^{-1}) and potassium (143.6 kg ha^{-1}). The experiment was conducted in a split plot design with 6 nitrogen levels as main plot treatments (N_1-0, N_2- 40, N_3- 80, N_4-120, N_5-160, N_6- 200 kg N ha^{-1}) and two sub plot treatments with tassel (T_1) and without tassel (T_2). For the estimation nutrient content The samples of plants were taken from the experimental field at the time of harvest and those were oven dried. The dried samples were taken for analysis for calculating uptake of plant nutrients *viz*., nitrogen, phosphorus and potash. Then the oven dried samples were processed for final grinding. Those were passed through a sieve with 2 mm diameter. Analysis of nitrogen was done by Modified Micro-Kjeldahl's method (Jackson, 1967) [5], phosphorus was through Di-acid digestion method and colourimetric determination (Piper, 1950) [10] and potassium is through flame photometer method (Jackson, 1967) [5]. Nutreint uptake was calculated using the below formula.

$$Nutrient\ uptake\ (kg\ ha^{-1}) = \frac{Nutrient\ content\ (Baby\ corn, fodder) \times Dry\ matter(Baby\ corn, fodder)}{100}$$

Protein content in the dehusked baby corn was estimated by multiplication of the factor 6.25 with the nitrogen content of dehusked baby corn (Humphries, 1956) [4].

Protein content = Nitrogen content (%) × 6.25

Statistical Analysis

The analysis was carried out using the standard procedure of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The standard error of mean (SEm±) and critical difference (CD) were computed at the 5 per cent level of significance.

3. Results and discussion

3.1 Protein content

Increasing levels of nitrogen application significantly enhanced the protein content of baby corn. The highest protein content (11.99%) was recorded with the application of 200 kg N ha^{-1} (N_6), which was significantly superior to all other nitrogen treatments. Application of 160 kg N ha^{-1} resulted in a protein content of 11.24%, which was statistically higher than that recorded under N_4, N_3, N_2, and N_1 treatments. Application of 40 kg N ha^{-1} (N_2) increased the protein content by 4.2% compared to the non-nitrogen control, clearly indicating the positive influence of nitrogen fertilization on protein accumulation in baby corn.

Protein content in fodder was also markedly influenced by varying nitrogen levels. The maximum protein percentage in green fodder (10.26%) was obtained with the application of 200 kg N ha^{-1}, which was statistically at par with 160 kg N ha^{-1}. These two treatments recorded significantly higher protein content than the remaining nitrogen levels. The treatment receiving 160 kg N ha^{-1} recorded a protein content of 9.47%, which was statistically comparable with treatments receiving 120, 80, and 40 kg N ha^{-1}. The lowest protein content (7.7%) in fodder was observed under the control treatment with no nitrogen application (Table 1)

Quality parameters of baby corn play a crucial role in determining market acceptability and price, thereby influencing net returns. Protein is an important quality attribute contributing to the nutritional value of baby corn. The experimental results revealed a progressive increase in protein content with increasing nitrogen levels up to 200 kg N ha^{-1}. The enhanced protein content with higher nitrogen application may be attributed to the role of nitrogen in amino acid synthesis, which forms the basic structural unit of proteins. Similar findings were reported by Bindhani *et al*. (2008) [1] and Nithinkumar *et al*., 2024 [9] who observed an increase in protein content with increasing nitrogen levels.

Tassel removal had no significant effect on protein content in either baby corn or fodder. Protein content in baby corn was almost identical in both tasselled and detasselled plants. Likewise, no significant difference was observed in fodder protein content between tasselled and detasselled treatments (Table 1).

3.2 Uptake of nutrients (kg ha^{-1})

3.2.1 Nitrogen uptake (kg ha^{-1})

Nitrogen uptake by baby corn increased significantly with increasing levels of nitrogen application. Among the treatments, application of 200 kg N ha^{-1} recorded the highest nitrogen uptake by baby corn (6.06 kg ha^{-1}), which was statistically at par with 160 kg N ha^{-1} (5.89 kg ha^{-1}). These two treatments were significantly superior to all other nitrogen levels. Application of 120 kg N ha^{-1} resulted in a higher nitrogen uptake (5.26 kg ha^{-1}) compared to 80, 40, and 0 kg N ha^{-1}. Nitrogen uptake at 80 kg N ha^{-1} (4.44 kg ha^{-1}) was 33.7% and 58.0% higher than that observed with 40 kg N ha^{-1} and the control, respectively. Application of 40 kg N ha^{-1} increased nitrogen uptake by 18.1% over the no-nitrogen treatment.

Nitrogen uptake by fodder also increased significantly with increasing nitrogen levels. The highest nitrogen uptake in fodder (167.0 kg ha^{-1}) was recorded with application of 200 kg N ha^{-1}, which was significantly superior to all other nitrogen treatments. Application of 160 kg N ha^{-1} resulted in nitrogen uptake of 137.67 kg ha^{-1}, which was statistically higher than uptake observed under 120, 80, and 40 kg N ha^{-1}. The lowest nitrogen uptake in fodder (23.34 kg ha^{-1}) was recorded under the control treatment receiving no nitrogen (Table 1).

Total nitrogen uptake by baby corn and fodder differed significantly with varying nitrogen levels. The maximum total nitrogen uptake (173.06 kg ha^{-1}) was recorded with application of 200 kg N ha^{-1}, which was significantly higher than all other treatments. Total nitrogen uptake under 160 kg N ha^{-1} (143.55 kg ha^{-1}) was statistically superior to treatments receiving 120, 80, 40, and 0 kg N ha^{-1}. Enhanced nitrogen uptake at higher nitrogen levels may be attributed to increased availability of nitrogen in the soil solution, favourable soil conditions, and improved root absorption capacity of the crop. The results further indicated that nitrogen uptake by dehusked baby corn at 200 kg N ha^{-1} was statistically comparable with 160 kg N ha^{-1}. Similar trends were reported by Golada *et al*. (2017) [3], who observed increased nitrogen uptake in fodder with higher nitrogen application, and by Dar *et al*. (2014) [2], who recorded maximum nitrogen uptake in baby corn with increasing nitrogen

levels up to 120 kg ha^{-1}.

Detasseling had no significant effect on nitrogen uptake in either baby corn or fodder (Table 1). Although slightly higher nitrogen uptake by baby corn (4.68 kg ha^{-1}) was observed in detasseled plants, the difference was not statistically significant. Moreover, the interaction between nitrogen levels and detasseling was non-significant for nitrogen uptake in both baby corn and fodder

3.2.2 Phosphorus uptake (kg ha^{-1})

Application of different nitrogen levels did not result in significant variation in phosphorus uptake by baby corn or fodder. However, numerically higher phosphorus uptake was recorded in baby corn (0.91 kg ha^{-1}) and fodder (14.28 kg ha^{-1}) with the application of 200 kg N ha^{-1}. Detasseling also had no significant influence on phosphorus uptake in either baby corn or fodder (Table 1). Furthermore, the interaction effect between nitrogen levels and detasseling on phosphorus uptake by baby corn and fodder was found to be non-significant.

3.2.3 Potassium uptake (kg ha^{-1})

Different levels of nitrogen application did not result in significant variation in potassium uptake by baby corn or fodder. However, numerically higher potassium uptake was observed in baby corn (3.45 kg ha^{-1}) and fodder (142.92 kg ha^{-1}) with the application of 200 kg N ha^{-1}. Detasseling had no significant influence on potassium uptake in either baby corn or fodder (Table 1). Furthermore, the interaction effect between nitrogen levels and detasseling on potassium uptake by baby corn and fodder was found to be non-significant.

Table 1: Protein content (%) and Nutrient uptake of babycorn (kg ha^{-1}) as effected by levels of nitrogen and detasseling

Treatments	Protein content (%) in dehusked baby corn	Protein content (%) in fodder	Nutrient uptake of Baby corn (kg ha^{-1})		Nutrient uptake of Fodder (kg ha^{-1})				Nutrient uptake of Baby + fodder (kg ha^{-1})		
			N	P	K	N	P	K	N	P	K
Main plot											
N_1	8.19	7.7	2.81	0.75	3.02	23.34	11.59	137.33	26.15	12.34	140.35
N_2	8.53	8.27	3.32	0.73	3.02	33.5	13.07	136.03	36.82	13.8	139.06
N_3	9.2	8.81	4.44	0.77	3.25	60.15	12.87	139.72	64.59	13.64	142.96
N_4	10.02	8.79	5.26	0.85	3.18	90.42	13.47	138.13	95.67	14.32	141.31
N_5	11.24	9.47	5.89	0.91	3.3	137.67	13.6	141.95	143.55	14.51	145.25
N_6	11.99	10.26	6.06	0.91	3.45	167	14.28	142.92	173.06	15.2	146.37
SE(m) +	0.208	0.419	0.082	0.067	0.211	0.851	1.044	2.3	0.796	1.066	2.241
CD (0.05)	0.656	1.321	0.257	NS	NS	2.68	NS	NS	2.507	NS	NS
Sub plot											
T_1	9.72	8.83	4.58	0.8	3.18	86.28	13.4	139.5	88.99	13.69	142.68
T_2	9.99	8.94	4.68	0.84	3.23	84.41	12.89	139.19	90.96	14.24	142.42
SE(m) +	0.106	0.16	0.05	0.027	0.17	0.812	0.229	0.851	0.806	0.232	0.866
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

4. Conclusion

Application of nitrogen significantly improved protein content and nitrogen uptake in baby corn and fodder, with superior performance at higher nitrogen levels. The treatments receiving 160 and 200 kg N ha^{-1} recorded maximum protein content and nitrogen uptake, with no significant advantage of 200 kg N ha^{-1} over 160 kg N ha^{-1}. Phosphorus and potassium uptake were not significantly affected by varying nitrogen levels. Tassel removal and its interaction with nitrogen levels had no significant influence on protein content or nutrient uptake, indicating that detasseling is unnecessary for improving nutritional quality in baby corn.

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