



Effect of Nitrogen and Foliar Application of Naphthalene Acetic Acid (NAA) on Growth and Yield of Baby corn (*Zea mays* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment entitled effect of nitrogen and foliar application of naphthaleneacetic acid on growth and yield of Baby corn (*Zea mays* L.) was conducted during the Rabi season of 2020 at the Fodder Production Farm of Livestock Research Station, Sri Venkateswara Veterinary University, Lam Farm, Guntur, Andhra Pradesh. The experiment was laid out in Randomized Block Design with 10 treatments and each replicated thrice. Treatments consisted of a combination of three levels of nitrogen (60.0, 90.0, 120.0kg/ha) and three levels of naphthalene acetic acid (20,40,60 ppm). It was found that an application of 120 kg Nitrogen/ha as basal along with foliar spray of 40 ppm naphthalene acetic acid at 25 and 35 days after sowing, was the most suitable treatment for obtaining growth and yield attributes such as plant height (177.60 cm), number of leaves (11.33), plant dry weight (113.58g/plant), chlorophyll content (68.43), Leaf Area Index (8.65) and green fodder yield (20333 kg/ha) with net return (83,701.88 Rs/ha) and B:C ratio (1.68). On the basis of one-year experimentation it is

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concluded that the application of 120 kg Nitrogen/ha + 40 ppm naphthalene acetic acid, on baby corn improved cob yield by 25 % and was found more productive than the recommended dose of fertilizer.

Keywords: Baby corn; nitrogen; NAA; growth; yield.

1. INTRODUCTION

Maize (*Zea mays* L.) is the world's 3rd largest cereal crop, followed by wheat and rice, with highest production potential among the cereals [1]. In India, maize is grown in 9.22 Million hectare area with a production and productivity of 28.72 million tonnes and 3.115 kg/ha, respectively, contributing 2.53 % of the world production [2,3].

Baby corn is a de-husked maize "ear", harvested young especially when the silk has not emerged or just emerged and no fertilization has taken place or the shank with un-pollinated silk, which is grown as a vegetable crop which can potentially improve the economic status of farmers [4].

Baby corn is popular among consumers worldwide because of its high nutritional value i.e., 8.2 g Carbohydrate, 2 g Protein, 0.2 g Fat, 0.28 mg Iron, 0.05 mg Thiamine, 0.08 mg Riboflavin, 11 mg Ascorbic acid per 10 gm of fresh weight [4] and because of its taste, tenderness and sweetness. Additionally, baby corn it is also used as a raw ingredient in various preparations such as chapsuey, pickles, and corn pakoras, as well as a decorative and crispy vegetable and salad. By products of baby corn such as tassels, young husk silk and green stalk are used as livestock food. Recently, baby corn has gained popularity as valuable vegetable in Delhi, Uttar Pradesh, Haryana, Maharashtra, Karnataka, Andhra Pradesh, Rajasthan and Meghalaya States in India, and is grown on 8.5million hectares area with the production and productivity of 21.3 Metric tonnes. and 2507 kg/ha, respectively. It is a profitable crop that allows a diversification of production, aggregation of value, and income generation [5].

It is highly remunerative and farmers can get a high return in a period of 45-60 days. As baby corn provides more income within a short period than maize and other vegetable crops, it becomes a demand by crop and farmers are cultivating those on large scale.

Plant growth regulators known as bio-stimulants or bio inhibitors can modify physiological processes in plants. Plant growth regulators improve the effective partitioning and translocation of accumulates from source to sink in the field crops. Naphthalene acetic acid (NAA), being an auxin, promote vegetative growth by active cell division, cell enlargement and cell elongation and thus, help in improving growth characteristics and in stimulating reproductive growth (Reference needed). Growth regulator spray had a positive effect on green cob yield of baby corn [1].

Nitrogen is considered as one of the most important plant nutrients for growth and development of crops due to its key role in synthesis of chlorophyll and amino acids which contribute to the building unit of protein and thus, growth of plants. Indian soils have a deficiency of nitrogen and vary from state to state . Most of the Indian soils are deficient in Nitrogen and it varies from state to state. Chouhan *et al.* [6] reported that nitrogen promotes leaf and stem growth which consequently increase the yield and plant quality.

Baby corn is considered as a high nutrient demanding crop which requires balanced application of nutrients, either nitrogen or NAA as both of these are integrated components that are associated with growth, development and high productivity of baby corn when applied under appropriate dosage. Based on this, the present experiment was conducted to establish the effect of nitrogen and NAA on growth and yield of Baby corn (*Zea mays* L).

2. MATERIALS AND METHODS

The field experiment was conducted during Rabi season of 2020-2021 at Fodder Production Farm of Livestock Research Station, Sri Venkateswara Veterinary University, Lam Farm, Guntur Andhra Pradesh, India, which has a tropical climate with maximum and minimum temperatures of 31.37 and 15.82 °C, respectively. The soil of the experimental field was black clay with pH 8.5 and EC 0.45/dms, organic carbon (0.42 %), N

(288 kg/ha), P₂O₅ (174 kg/ha) and K₂O (418 kg/ha).

A combination of ten treatments were replicated thrice and laid out in a randomized block design. The treatments were: T₁-60 kg N/ha + 20 ppm NAA, T₂-90 kg N/ha + 20 ppm NAA, T₃-120 kg N/ha + 20 ppm NAA, T₄-60 kg N/ha + 40 ppm NAA, T₅-90 kg N/ha + 40 ppm NAA, T₆-120 kg N/ha + 40 ppm NAA, T₇-60 kg N/ha + 60 ppm NAA, T₈-90 kg N/ha + 60 ppm NAA, T₉-120 kg N/ha + 60 ppm NAA, T₁₀- N:P:K 60:60:60. All treatments commonly received 20 kg P₂O₅, 40 kg K₂O/ha and nitrogen as per the treatment description as basal dose.

The ridges and furrows were opened at 45 cm distance. Healthy seeds of Baby corn variety G-5414 of Syngenta Pty. Ltd., were sown on 23rd November 2020 by dibbling two seeds manually per hill on one side of the ridge by keeping 15 cm intra row spacing at a depth of 3-4 cm. Foliar application of NAA was given (500 L/ha) at 25 and 35 days after sowing with a hand sprayer during morning hours between 07-10 IST as per treatment. Relative Chlorophyll content was determined (4th or 5th leaves from apex) using a Portable dual-wave length Chlorophyll meter (Minolta SPAD-502 of KONICA MINOCTA SENSING INC, JAPAN) at 30 and 60 DAS. To calculate the leaf area index (L.A.I.), five leaves were selected at random from the sample plants. The leaf area of these sample leaves was measured with a Leaf Area Meter (LI-COR-3100C of LI-COR®, USA). The area covered by the leaf was determined and the total area of leaves per plant was calculated by counting the leaves per plant and multiplying it by average leaf area. Then the leaf area index (LAI) was calculated by following formula LAI = Leaf area/Ground area.

The first harvesting of baby corns cobs was carried out 58 days after sowing (20.01.2021) and subsequently harvested in 2 pickings. The cobs were harvested from an area of one metre squared, treatment wise and weighed with and without husk where after the obtained values were converted to per hectare and recorded as kg/ha.

The experiment data was analyzed as per the methods of "Analysis of Variance technique [7]. The significance and nonsignificance of the

treatment effect was judged with the help of "F (variance ratio) table.

3. RESULTS AND DISCUSSION

Basal application of nitrogen in combination with NAA at 25 and 35 days aftersowing, showed considerable an effect on different growth and yield attributes of baby corn. The results presented in Table1 show that the plants which received 120 kg N/ha as basal along with 40 ppm NAA at 25 and 35 days aftersowing recorded highest plant height, 17.60% higher plant height *i.e.* 177.60 cm over the plants received recommended dose of fertilizer, which is recorded 151.02 cm. Enhanced plant height with NAA application may be due to cell wall extensibility and cell wall loosening and increased cell division and elongation in the presence of endogenous gibberellin [8] and synergetic effect of enhanced nitrogen availability which is required for vegetative growth throughout crop development/growth? [1]. These results are in conformity with Muthukumar *et al.* [1].

The highest number of leaves (11.33) , chlorophyll content (68.43) , and leaf area index(8.65) was also recorded with the same treatment *i.e.*120 kg N/ha as basal along with 40 ppm NAA at 25 and 35 days after sowing (Table.1.) It was found that there were no significant differences among treatments with regard to number of leaves. Significant response in leaf area index and chlorophyll content might be due to combined effect of nitrogen and NAA which might be promoted promoting rapid vegetative growth, resulting in increased chlorophyll production [9] and NAA, being an auxin, promoted vegetative growth. In fact, increase in leaf area index with nitrogen fertilization could be attributed to a more fact that more protein synthesis at higher nitrogen rates induced vegetative growth, which resulted in increase of photosynthetic surface that stimulated more leaf length, width and leaf blade size. Thakur *et al.* [10], Bhindhani *et al.* [11], and Jeet *et al.* [12] reported similar findings. The increase in LAI might be due to significant increase in leaf expansion, higher rate of cell division and cell enlargement and there by improved quality of vegetative growth with application of NAA. These results are comparable with results reported by Muthukumar *et al.*[1].

Table 1. Effect of nitrogen levels and NAA on growth attributes of Baby corn

Tr. No.	Treatments	Plant height (cm)	Number of leaves	Chlorophyll content	Leaf area index	Plant dry weight (g)	Crop growth rate(g/m ² /day)	Relative growth rate (g/g/day)
T ₁	60 kg N/ha + 20ppm NAA	115.67	10.13	51.30	5.33	76.95	1.75	0.0121
T ₂	90 kg N/ha + 20ppm NAA	165.20	10.20	57.66	6.77	80.21	1.68	0.0109
T ₃	120 kg N/ha + 20ppmNAA	173.45	11.00	68.22	8.50	113.58	2.78	0.0146
T ₄	60 kg N/ha + 40 ppm NAA	161.54	10.20	56.35	6.39	78.01	1.59	0.0106
T ₅	90 kg N/ha + 40 ppm NAA	169.81	10.33	60.50	6.86	82.81	1.78	0.0113
T ₆	120 kg N/ha + 40 ppm NAA	177.60	11.33	68.43	8.65	113.83	3.33	0.0168
T ₇	60 kg N/ha + 60 ppm NAA	155.00	10.07	52.73	5.08	73.56	1.64	0.0118
T ₈	90 kg N/ha + 60 ppm NAA	162.54	10.27	55.33	6.51	78.07	1.53	0.0101
T ₉	120 kg N/ha + 60 ppm NAA	170.68	10.47	66.80	7.90	92.42	2.01	0.0114
T ₁₀	N:P: K 60:60:60	151.02	10.00	49.27	5.04	68.65	1.60	0.0125
	<i>F test</i>	S	NS	S	S	S	S	S
	<i>S. Em (±)</i>	1.43	0.28	0.16	0.20	0.16	0.08	0.0005
	<i>CD (p=0.05)</i>	4.25	-	0.49	0.58	0.47	0.24	0.0015

S = Significant ; NS =Non Significant

Table 2. Effect of nitrogen levels and NAA on yield and yield attributes of Baby corn

Tr. No	Treatments	No. of cob/plant	Length of cob (cm)	Length of corn (cm)	Girth of Cob (cm)	Girth of corn (cm)	Cob weight (g)	Corn weight (g)	Cob yield (kg/ha)	Corn yield (kg/ha)
T ₁	60 kg N/ha + 20ppm NAA	4.00	19.78	8.57	6.01	3.42	44.49	10.76	13840.74	2309.63
T ₂	90 kg N/ha + 20ppm NAA	3.87	20.06	8.27	10.42	3.58	50.29	13.47	14670.37	2396.11
T ₃	120 kg N/ha + 20ppm NAA	4.00	22.64	10.51	11.06	3.56	54.24	16.67	15773.13	2681.83
T ₄	60 kg N/ha + 40 ppm NAA	4.00	19.88	8.36	6.38	3.40	47.20	12.00	14000.00	2290.67
T ₅	90 kg N/ha + 40 ppm NAA	4.07	20.95	8.82	10.51	3.46	51.24	14.53	14685.19	2474.07
T ₆	120 kg N/ha + 40 ppm NAA	4.00	22.71	10.57	11.11	3.57	57.87	16.73	16144.44	2712.59
T ₇	60 kg N/ha + 60 ppm NAA	3.93	19.77	8.43	6.59	3.38	43.51	9.60	14685.19	2273.26
T ₈	90 kg N/ha + 60 ppm NAA	3.67	20.03	8.92	10.42	3.43	49.09	13.07	1390.00	2367.19
T ₉	120 kg N/ha + 60 ppm NAA	4.00	22.03	8.94	11.28	3.57	52.36	15.87	14814.81	2570.37

Tr. No	Treatments	No. of cob/plant	Length of cob (cm)	Length of corn (cm)	Girth of Cob (cm)	Girth of corn (cm)	Cob weight (g)	Corn weight (g)	Cob yield (kg/ha)	Corn yield (kg/ha)
T ₁₀	N:P: K 60:60:60	3.80	19.67	8.04	6.59	3.28	39.73	8.80	12881.48	2242.74
	<i>F test</i>	NS	S	S	S	NS	S	S	S	S
	<i>S. Em (±)</i>	0.09	0.04	0.06	0.07	0.07	0.46	0.12	163.23	22.61
	<i>CD (p=0.05)</i>	-	0.13	0.17	0.20	-	1.37	0.35	484.98	67.19

S = Significant; NS =Non Significant

The highest plant dry weight (113.83g), crop growth rate (3.33 g/m²/day), and relative growth rate (0.0168 g/g /day) was observed with the application of 120 kg N/ha as basal along with 40 ppm NAA at 25 and 35 days after sowing, which was significantly higher than rest of the treatments (Table 2). Dry matter production related to productivity contributes an important factor in source-sink relationship. Total dry matter production is related to plant height and leaf area application of growth regulator had an effect on LAI and an indirect effect on dry matter production (DMP). Similar findings were reported by Muthukumar *et al.*[1].

The analyzed data (Table.2) regarding reproductive parameters show that yield and yield attributes of baby corn was significantly affected by the combination of basal application of 120 kg/ha with foliar application of 40 ppm NAA at 25 and 35 days after sowing which is significantly higher than the rest of the treatments.

A faster growth under influence of higher level of nitrogen fertilization might have played a significant role in reducing competition for photosynthates and nutrients with other plants, resulting in healthy plants. The increased availability of photosynthates might have enhanced the number of flowers and their fertilization, resulting in high number of yield attributes. In most cereals, greater assimilating surface at reproductive developments results in improved green cob formation because of adequate production of metabolites and their translocation towards cob [13]. The findings of the present investigation are in line with Bindhani *et al.*, [11].

Cob yield increased due to increased mobilization of reserve food materials in developing sink through increase in hydrolysing and oxidizing enzyme activities (Reference needed). NAA, being an auxin, promote vegetative growth by cell division, cell enlargement and cell elongation and thus helped improving growth characteristics and also in stimulating reproductive growth [1]. The results of the present study indicate a positive response of baby corn to plant growth regulators and the findings corroborate with other researchers.

4. CONCLUSION

The results of the present experiment entitled "Effect Of Nitrogen Fertilization and Naphthalene

Acetic Acid on Growth And Yield of Baby Corn (*Zea mays* L.)" indicate that basal application of 120 kg/ha nitrogen along with 40ppm of naphthalene acetic acid at 25 and 35 Days after sowing as foliar spray will be beneficial to obtain high yield of Baby corn.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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