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Effect of row spacing and nitrogen application on growth and yield of baby corn (*Zea mays* L.)

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Abstract
The present investigation entitled " Effect of row spacing and nitrogen application on growth and yield of baby corn (*Zea mays L.*). "Was conducted at crop research form of National Post Graduate college, Barhalganj, Gorakhpur, U. P. during rabi season of 2020 - 21 and 2021 - 22 with an object to study the effect of row spacing and nitrogen application on growth and yield of baby corn (*Zea mays L.*). The soil of the experimental filled was silty loom in texture with low, medium and high in N. P. and K., respectively. The experiment site is situated in sub-tropical zone in Indo - gangetic plains. The experiment was laid out in Randomize Black Design (Factorial) and sown on 5 February 2021 and 7 February 2022 with two factors *viz* - A - Row spacing i.e. R_1 - 40 cm X 20 cm, R_2 -50 cm X 20 cm and R_3 - 60 cm X 20 cm and B - Nitrogen application i.e. N_1- 50% RDN as basal + 50% RDN at knee high stage + 5 tonne FYM, N_2- 50% RDN as basal + 50% RDN at tassel emergence (TE) + 5 tonne FYM N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 tonne FYM and N_4 - 25% RDN as basal + 50% at knee high stage + 25% RDN at tassel emergence + 5 tonne FYM with three replication. The baby corn was harvested 4 times just after silk emergence. The result indicated that the row spacing 50 cm X 20 cm proved significantly superior over other row spacing in terms of leaf area index, chlorophyll content and dry weight and yield parameters *viz* - numbers of baby cob's plant^{-1}, weight of baby corn, length of baby corn, yield of baby corn and yield of fodder, harvest index, gross return (Rs ha^{-1}), net return ((Rs.ha^{-1}) and B: C ratio. respectively, while nitrogen application N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 tonne FYM gave significantly highest value in terms of plant height, leaf area index, chlorophyll content and dry weight and yield parameters *viz* - numbers of baby cob's plant^{-1}, weight of baby corn, length of baby corn, yield of baby corn and yield of fodder, harvest index, gross return (Rs ha), net return ((Rs ha) and B: C ratio. respectively over rest of the treatment. Row spacing 50 cm X 20 cm and nitrogen application 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 tonne FYM increased significantly the growth parameters and yield of baby corn.

Keywords: Baby corn, row spacing, nitrogen application, fertilizer, growth attributing parameters, yield attributing parameters, baby corn yield, fodder yield

Introduction
Maize (*Zea mays* L.) is a major agronomic crop, traditionally cultivated worldwide is a cross pollinated, long day and C_4 plant and used as food, feed, fodder and in industrial application belongs to the family Poaceae. Zea is an ancient Greek word which mean " sustaining life " and mays is the word from Tiano language meaning "life giver". The word Maize is from the Spanish connotation "Maize" which is the best way of describing the plant. Various other synonym like Zea, silk maize, Makka, Barajovar etc. are used to recognize the plant (*Kumar and Jhariya, 2013*) [6]. In the true sense of the term baby corn, the tender dehusked young ear of the female inflorescence of maize plant harvested 3 to 4 days after silking and before fertilization is sweet and crispy in taste called baby corn. It is a profitable crop that allows a diversification of production, aggregation of value and increased income (*Datta, et al., 2015*). Recent addition of baby corn in our country and its performance has been quiet encouraging due to higher profit per unit area. Therefore, cultivation of baby corn has been attracting the attention of farmers due to its extensive adaptability, high yielding capacity and quick developing traits builds.

Spacing has a pivotal role in the growth, development and yield of any crop. Therefore it is essential to establish the optimum plant population for the reason concerned, because of non tillering habit, baby corn can not compensate the loss of space unlike other tillering cereals like rice and wheat *(Dar, et al. 2017)* [2]. Baby corn is an exhaustive crop and its need for nutrients mainly to nitrogen is prominent. Consequently, heavy dose of nitrogen is required for exploiting the yield potential. Nitrogen is a constituent of all living cells and imparts dark green colour due to presence of chlorophyll. The photosynthetic efficiency of the plant is much increased due to chlorophyll, which is a primary absorber of solar energy.

Among the various ingredients of crop production, row spacing and nitrogen application are of immense importance and therefore need special attention to exploit full yield potential of baby corn. However, scientific data on these aspects are very meagre. Keeping these facts in view, the present field trial was conducted.

Materials and Methods

The field experiment was carried out at the Crop Research Farm of National Post Graduate college, Barhalganj, Gorakhpur, U.P. during rabii season of 2020 - 21 and 2021 - 22. The experimental site is situated in subtropical zone in indo - gangetic plains and lies between 260 471 North latitude, 820101 East langitude and 1130 m above sea level. The soil of the experimental field was silty loom in texture and slightly alkaline in reaction with PH 7.6, EC 0.2 0 desi Simon per metre, organic carbon 0.40% and available Nitrogen 196 kg ha^{-1}, Phosphorus 18.9 kg ha^{-1} and Potassium 260 kg ha^{-1} at 0 - 15 cm soil depth.

The experiment was laid out in Randomized Block Design (Factorial) and sown on 5th February 2021 and 7th February 2022, respectively with two factors *viz* - A - Row spacing i.e. R_1 - 40 cm X 20 cm, R_2 - 50 cm X 20 cm and R_3 - 60 cm X 20 cm and B - Nitrogen application i.e. N_1 - 50% RDN as basal + 50% RDN at knee high stage + 5 t FYM, N_2 - 50% RDN as basal + 50% RDN at tassel emergence (TE) + 5 t FYM, N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 t FYM and N_4 - 25% RDN as basal + 50% at knee high stage + 25% RDN at tassel emergence + 5 t FYM with three replication. The crop was sown by using seed rate of 40 kg ha^{-1}, while row spacing and nitrogen application were applied to the baby corn as per treatment of the experimental crop. The other agronomical cultural practices such as phosphorus, potassium, irrigation, weeding and plant protection measures have been performed as per requisite and recommendation of the crop. The baby corn was harvested manually just after silking.

Results and Discussion

Effect of row spacing

An experiment was conducted to observe the influence of row spacing on growth and yield of baby corn. The data pertaining to growth, yield and economics along with statistical interpretations are presented and discussed. The data (Table 1) revealed that row spacing had a sign6ificant effect on baby corn growth parameters *viz* - plant height, leaf area index, chlorophyll content and dry weight and yield parameters (Table- 2) *viz* - numbers of baby cob's $plant^{-1}$, weight of baby corn, length of baby corn, yield of baby corn and yield of fodder. Results clearly indicates that maximum crop growth parameter *viz* - leaf area index (2.91 and 2.94), chlorophyll content (40.30 and 40.51%) and dry weight (97.45 and 98.15 g) and yield parameters *viz* - numbers of baby cob's $plant^{-1}$ (3.55 and 3.88), weight of baby corn (9.59 and 9.64), length of baby corn (6.30 and 6.50 cm), yield of baby corn (20.07 and 20.31 q ha^{-1}) and yield of fodder (310.60 and 312.31 q ha^{-1}) were recorded with the row spacing 50 cm X 20 cm, which were significantly superior over 40 cm X 20 cm, during both the years, respectively, except baby corn height. It is due to harvest maximum solar radiation and uses soil resources effectively and finally resulted into higher photosyntate formation Kunjir, *et al*. (2007) [5]. Increase in population size also influence in increased inter specific competition for solar radiation, nutrients and water resulting in minimizing availability of photo assimilates for maintaining vegetative growth and finally yield *Sangoi, et al. (2002)* [7]. Highest plant height was observed with row spacing of 40 cm X 20 cm, which was significantly superior over 60 cm X 20 cm. Plant height increases with increase in plant population due to competition for light. The result of increase in plant height due to close row spacing are in close conformity with the findings of *Golada, et al.* (2017) [4] and *Sharma, et al.* (2023) [8].

Effect of nitrogen application

An experiment was conducted to observe the influence of split application of nitrogen on growth and yield of baby corn. The data pertaining to growth parameter and yield and yield attributing parameters along with statistical interpretation are presented and discussed. Crop growth parameters (Take - 1) *viz* - plant height, leaf area index, chlorophyll content and dry weight and yield parameters (Table - 2) *viz* - numbers of baby cob's $plant^{-1}$, weight of baby corn, length of baby corn, yield of baby corn and yield of fodder clearly indicates that plant height (162.83 and 164.67 cm), leaf area index (2.88 and 2.91), chlorophyll content (39.37 and 39.79%) and dry weight (95.41 and 96.28 g) and yield parameters (Table - 2) *viz* - numbers of baby cob's $plant^{-1}$ (3.37 and 3.60), weight of baby corn (9.70 and 9.75 g), length of baby corn (6.40 and 6.70 cm), yield of baby corn (20.48 and 20.68 qha^{-1}) and yield of fodder (313.80 and 315.53 q ha^{-1}) were recorded significantly highest with the nitrogen application N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 t FYM. Dry matter production is the sum of metabolic process occurring in the plants and their by affecting the yield. Due to split application of nitrogen, higher availability of nitrogen is responsible for more nucleic acid, amide and amino acids formation, which causes rapid cell multiplication. The nitrogen containing compounds, especially proteins, help in formation of more carbohydrates at the later stage of the growth. This may possible reason for increase in growth and yield parameters at higher availability of nitrogen as well as split application of nitrogen allows for a more synchronized supply of nitrogen with the crop's demand at different growth stages. Studies have shown that split application of nitrogen leads to a significant increase in growth and yield yield parameters in baby corn Charge, *et al*. (2020) [1] and Sharma, *et al*. (2023) [8].

Table 1: Plant height, leaf area index, chlorophyll content and dry weight as affected by row spacing and nitrogen application

Treatment	Plant height (cm)		Leaf area index		Chlorophyll content		Dry weight (g)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Row spacing								
S_1 - (40 X 20) cm.	159.25	161.03	2.46	2.47	30.51	30.82	85.26	85.92
S_2 - (50 X 20) cm.	153.48	155.15	2.91	2.94	40.30	40.51	110.74	111.53
S_3 - (60 X 20) cm.	140.05	141.68	2.66	2.68	33.70	33.81	94.53	95.87
S.Em±	2.27	2.67	0.03	0.04	0.47	0.55	1.47	1.61
CD	6.68	7.83	0.11	0.127	1.40	1.61	4.31	4.72
Nitrogen level								
N_1-50% basal+50% KHS+5 t. FYM	135.97	137.50	2.41	2.44	29.89	30.12	84.42	85.08
N_2-50% basal + 50% TE+5 t. FYM	147.00	148.63	2.61	2.62	32.26	32.36	93.89	95.03
N_3-50% basal+25% KHS+25%TE+5 t. FYM	162.83	164.67	2.88	2.91	39.37	39.79	108.42	109.41
N_4-25% basal+50% KHS+25%TE+5 t. FYM	157.90	159.67	2.80	2.81	37.82	37.93	100.63	101.58
S.Em±	2.63	3.08	0.04	0.05	0.55	0.63	1.69	1.86
CD	7.71	9.04	0.12	0.14	1.62	1.86	4.98	5.46

Table 2: No. of baby cob plant^{-1}, weight baby corn, length of baby corn, yield of baby corn and yield of fodder as affected by row spacing and

Treatment	No.of baby cob's plant^{-1}		Weight of baby corn (g)		Length of baby corn(cm)		yield of baby corn q ha^{-1}		yield of fodder q ha^{-1}	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Row spacing										
S_1 - (40 X 20) cm.	2.18	2.30	8.05	8.08	5.70	5.90	18.06	18.17	260.10	261.53
S_2 - (50 X 20) cm.	3.55	3.88	9.59	9.64	6.30	6.50	20.07	20.31	310.60	312.31
S_3 - (60 X 20) cm.	3.00	3.20	9.33	9.37	6.00	6.20	18.76	19.01	301.70	303.36
S.Em±	0.05	0.06	0.18	0.13	0.13	0.08	0.43	0.25	4.37	6.91
CD	0.15	0.17	0.55	0.40	0.38	0.26	1.26	0.75	12.81	20.26
Nitrogen level										
N_1-50% basal+50% KHS+5 t. FYM	2.27	2.40	8.20	8.24	5.60	5.80	17.42	17.60	265.20	266.66
N_2-50% basal + 50% TE+5 t. FYM	2.80	3.00	8.51	8.56	5.80	6.00	18.50	18.57	275.60	277.11
N_3-50% basal+25% KHS+25%TE+5 t. FYM	3.37	3.60	9.70	9.75	6.40	6.70	20.48	20.68	313.80	315.53
N_4-25% basal+50% KHS+25%TE+5 t. FYM	3.20	3.40	9.54	9.58	6.20	6.30	18.89	19.03	297.08	291.90
S.Em±	0.06	0.06	0.21	0.16	0.15	0.10	0.50	0.29	5.04	7.97
CD	0.17	0.20	0.64	0.47	0.44	0.30	1.46	0.87	14.80	23.40

Economics feasibility

To examine the economic feasibility and viability of different treatments under investigation. Economics of baby corn production in terms of gross return (Rs. ha^{-1}), net return (Rs.ha^{-1}) and B: C ratio were calculated for different treatment combination and the outcome is presented in Table - 3.

It is obvious from the above table that the treatment S_2 N_3 i. e. Row spacing - 50 cm X 20 cm + Nitrogen application N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 t FYM registered highest gross return (Rs 4,40,000.00 and 4,46,200.00 ha^{-1}), net return (Rs 3,50,923.34 and 3,57,123.34 ha^{-1}), and B: C ratio (3.93 and 4.00). This might be due to higher yield with the treatment compared to other treatments.

Table 3: Grass return, net return, Benefites cost ratio as affected of baby corn as affected by row spacing and nitrogen application:

Treatment combination	Gross return (Rs. ha^{-1})		Net return (Rs. ha^{-1})		Benefit: cost ratio (Rs.Re^{-1}) invested	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
S_1N_1	330,800.00	333,800.00	241,723.34	244,723.34	2.71	2.74
S_1N_2	351,200.00	352,200.00	262,123.34	263,123.34	2.94	2.95
S_1N_3	396,800.00	400,200.00	307,423.34	310,823.34	3.43	3.47
S_1N_4	374,200.00	375,600.00	284,823.34	286,223.34	3.18	3.20
S_2N_1	367,400.00	373,000.00	277,723.34	283,323.34	3.09	3.15
S_2N_2	390,200.00	393,600.00	300,523.34	303,923.34	3.35	3.38
S_2N_3	440,000.00	446,200.00	350,923.34	357,123.34	3.93	4.00
S_2N_4	415,600.00	419,600.00	326,523.34	330,523.34	3.66	3.71
S_3N_1	347,200.00	349,200.00	257,823.34	259,823.34	2.88	2.90
S_3N_2	368,800.00	368,400.00	279,423.34	279,023.34	3.12	3.12
S_3N_3	416,200.00	418,200.00	326,523.34	328,523.34	3.64	3.66
S_3N_4	392,800.00	392,800.00	303,123.34	303,123.34	3.38	3.38

Conclusion

Based on the experimental findings, it is described that row spacing 50 cm X 20 cm and nitrogen application N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 t FYM has been proved significantly best treatment among the different treatments of experiment to exploit the maximum yield.

Hence, it is calculated that sowing with row spacing 50 cm X 20

cm + nitrogen application N_3 - 50% RDN as basal + 25% RDN at knee high stage + 25% RDN at tassel emergence (TE) + 5 t FYM can be used as remunerative strategy and can be adapted in a eastern Uttar Pradesh.

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