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Impact of spatio-nitrogen interactions and foliar iron nutrition on nutrient uptake and green fodder yield of baby corn

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Abstract

A field experiment was conducted in sandy loam soils of Tamil Nadu Agricultural University, Coimbatore, during *Rabi* and summer seasons of 2016-17 and 2017-18 to evaluate the influence of crop geometry and N and Fe nutrition on quality of baby corn. Experiment was conducted with five crop geometry levels viz., 60 × 20cm (S₁), 60 × 15cm (S₂), 45 × 20cm (S₃), 45 × 15cm (S₄), 30 × 30cm (S₅) in main-plot and four nutrient levels such as 100% recommended dose of nitrogen (RDN) (N₁), 100% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₂), 125% RDN (N₃), 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₄) in sub-plot in split-plot design. Results revealed that interaction of crop geometry and nutrient levels showed a significant influence on the nutrient uptake and green fodder yield of baby corn at a spacing of 45 × 15cm and at the nutrient level of 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (S₄N₄) and was on par with S₄N₃ while the lowest values were recorded with S₁N₁.

Keywords: Baby corn, crop geometry, nitrogen, phosphorous, potassium, nutrient uptake, cob yield, green fodder yield

Introduction

Baby corn (*Zea mays* L.) has emerged as a high-value, short-duration crop that addresses the dual needs of the agricultural sector such as the high-quality succulent ears for human consumption and nutritious green fodder for the animal husbandry. The global baby corn market was valued at USD 1,014.4 million in 2024 and is projected to reach USD 1,500 million by 2035, driven by rising health consciousness and the vegetable's culinary versatility (Wise Guy Reports, 2024). Despite its economic potential, the crop's rapid 60-day maturation cycle necessitates precise nutrient management to sustain productivity. Research indicates that optimized nitrogen (N) delivery is fundamental to maximizing biomass, but its efficacy is increasingly linked to spatio-nitrogen interactions, where the spatial arrangement and timing of N application are synchronized with the crop's peak nutrient demand (Taylor & Francis, 2024).

While nitrogen facilitates vegetative expansion, the physiological quality of baby corn is often hindered by micronutrient deficiencies, particularly iron (Fe), which is vital for chlorophyll synthesis and electron transport. Recent studies have demonstrated that foliar iron nutrition (e.g., 0.5% FeSO₄) can bypass soil-fixation hurdles, significantly improving photosynthetic rates and nitrogen metabolism enzymes like nitrate reductase (Nasar *et al.*, 2024) [14]. Furthermore, integrated nutrient strategies combining optimized spacing with foliar micronutrients have been shown to increase cob and green fodder yields by over 20% compared to standard practices (Kiran *et al.*, 2025) [11]. This investigation explores the synergistic effect of spatial nitrogen placement and foliar iron application to enhance nutrient uptake efficiency, thereby improving both the harvest index of cobs and the nutritional value of the green fodder.

Materials and Methods

The field experiment was conducted during *rabi* and summer seasons of 2016-17 and 2017-18 at Eastern block farm, Tamil Nadu Agricultural University, Coimbatore to study the effect of crop geometry and nitrogen levels and iron foliar nutrition on the quality of baby corn.

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The experiment was laid out in split plot design with three replications. Main-plots consisted of five levels of crop geometry viz., 60 × 20cm (S₁), 60 × 15cm (S₂), 45 × 20cm (S₃), 45 × 15cm (S₄), 30 × 30cm (S₅) and four levels of nitrogen and Fe nutrition such as 100% recommended dose of nitrogen (RDN) (N₁), 100% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₂), 125% RDN (N₃), 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₄) were allocated to the sub-plots. The soil of the experimental field was sandy clay loam in texture belonging to *Typic Ustropept* having 7.6 pH, EC of 0.45 dS m⁻¹, organic carbon of 0.35%, low in available nitrogen (233 kg ha⁻¹), medium in available phosphorus (14.20 kg ha⁻¹) and high in potassium (406 kg ha⁻¹). Babycorn hybrid G-5414 was used in the experimentation. It is a high yielding hybrid and yields tender, soft and juicy babycorn.

The experimental field was prepared by ploughing, removing weeds, roots, stubbles, etc. and 2-3 cross harrowing. Farm yard manure (FYM) @ 12.5 t/ha was incorporated in the soil at the time of last harrowing. The sowing of babycorn into the soil @ one seed per hill at a depth of 2 to 3 cm was done as per the treatments. The recommended dose of nitrogen (RDN: 150 kg ha⁻¹), phosphorus (60 kg ha⁻¹) and potassium (40 kg ha⁻¹) in the form of urea, single super phosphate and muriate of potash, respectively were applied uniformly as per the treatments. N and K were applied in two equal splits *i.e.*, one at the time of sowing and the other at 25 days after sowing. Full dose of P was applied as basal. FeSO₄ foliar spray @ 1% was given at 30 and 45 DAS. All the package of practices were carried out as per the crop schedule, mentioned in the book “Crop Production Techniques of Horticultural Crops”, 2013, by Horticultural College and Research Institute, TNAU, Coimbatore.

Plant analysis at harvest

The plant samples collected for estimation of drymatter production were dried and ground into fine powder in a Willey mill and analyzed for nitrogen, phosphorus and potassium. Based on the contents, the uptake of N, P and K was calculated at first harvest stage.

Nitrogen uptake

The total nitrogen content in the plant sample was estimated by the Micro-Kjeldahl method (Yoshida *et al.*, 1971) [28]. The uptake was calculated by multiplying the nitrogen content of the plant sample with the total drymatter production and expressed in kg/ha

Phosphorus uptake

The total phosphorus content was estimated with triple acid digestion method (Jackson, 1973) [8] and estimation was done calorimetrically using photoelectric calorimeter. The amount of phosphorous content was determined by referring to a standard curve and the uptake was computed and expressed in kg/ha.

Potassium uptake

The total potassium content was estimated with the triple acid

digestion method and estimation was done with flame photometer (Jackson, 1973) [8]. The uptake was calculated by multiplying the potassium content of the plant sample with the total dry matter production and expressed in kg/ha.

Green cob yield

Harvested green cobs from the net plot were weighed and cob yield was recorded from individual plots and expressed as kg/ha.

Green fodder yield

After harvesting of cobs, the babycorn stalks were harvested from the net plot area, weighed and expressed as green fodder yield in t/ha.

Statistical analysis

The data were analyzed statistically following the procedure given by Gomez and Gomez (1984) [7]. Wherever the treatment differences were significant, critical differences were calculated at five per cent probability level for comparison. Non-significant effects are indicated as NS.

Results

Nitrogen uptake

Nitrogen uptake (kg/ha) was significantly influenced by crop geometry and nutrient management practices and are presented in Table 1.

Crop geometry levels showed significant difference in nitrogen uptake. At harvest, significantly higher nitrogen uptake (217.8 and 201.4 kg/ha during *rabi*, 2016-17 and 2017-18; and 199.0 and 204.0 kg/ha during summer 2017 and 2018, respectively) were obtained when babycorn was sown at 45 × 15 cm spacing (S₄) followed by the spacing of 30 × 30 cm (S₅). However, 60 × 20 cm spaced babycorn (S₁) recorded comparatively lower nitrogen uptake of 145.0, 141.8 kg/ha during *rabi* 2016-17 and 2017-18; and 137.2 and 127.0 kg/ha during summer 2017 and 2018, respectively.

Nitrogen uptake was observed to be significant with different nutrient management practices. Babycorn fed with 125% RDN followed by FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₄) recorded higher nitrogen uptake of 186.1, 178.2 kg ha⁻¹ during *rabi*, 2016-17 and 2017-18; and 170.3, 165.2 kg ha⁻¹ during 2017 and 2018, respectively and was comparable with 125% RDN (N₃). Whereas, 100% RDN (N₁) recorded lesser nitrogen uptake of 166.4 and 156.5 kg ha⁻¹ during *rabi*, 2016-17 and 2017-18; and 150.9, 144.0 kg/ha during summer 2017 and 2018, respectively.

Crop geometry and nutrient management practices had significant interaction with each other on nitrogen uptake during the all the four seasons. During the experimentation, babycorn maintained at a spacing of 45 × 15 cm with 125% RDN followed by FeSO₄ foliar spray @ 1% at 30 and 45 DAS (S₄N₄) registered higher nitrogen uptake and it was on par with babycorn sown at 45 × 15 cm with 125% RDN alone (S₄N₃).

Table 1: Effect of crop geometry and nutrient management practices on nitrogen uptake (kg/ha) of babycorn

Treatments	Rabi 2016-17						Rabi 2017-18					
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	132.0	143.2	155.8	221.7	179.4	166.4	127.2	151.4	151.8	195.7	156.4	156.5
N ₂	153.5	164.2	163.5	189.7	170.4	168.3	135.7	158.4	152.4	200.2	152.2	159.8
N ₃	155.0	159.0	182.5	236.9	185.6	183.8	136.9	165.0	169.8	196.9	188.6	171.4
N ₄	139.5	212.1	177.6	222.8	178.6	186.1	167.5	169.2	161.9	212.8	179.5	178.2
Mean	145.0	178.5	169.8	217.8	178.5		141.8	164.2	159.0	201.4	169.2	

	Rabi 2016-17						Rabi 2017-18					
	S	N	S at N	N at S			S	N	S at N	N at S		
SEd	3.9	6.6	14.8	9.4			5.6	4.6	10.3	12.6		
C.D (p=0.05)	8.9	13.5	30.1	19.2			12.9	9.4	21.1	26.1		
Treatments	Summer 2017						Summer 2018					
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	124.3	132.4	141.4	198.3	158.3	150.9	136.0	132.5	127.8	189.3	134.7	144.0
N ₂	135.1	138.0	154.8	203.4	157.0	157.7	120.4	161.1	140.3	188.5	141.2	150.3
N ₃	154.3	162.1	161.5	189.9	166.4	166.9	120.8	152.1	151.6	215.6	179.6	163.9
N ₄	135.0	187.0	162.3	204.3	163.0	170.3	130.7	142.2	165.1	222.5	165.2	165.2
Mean	137.2	162.4	155.0	199.0	161.2		127.0	151.8	146.2	204.0	155.2	
Treatments	Summer 2017						Summer 2018					
	S	N	S at N	N at S			S	N	S at N	N at S		
SEd	5.4	3.7	8.2	12.0			4.1	5.4	12.0	9.5		
C.D (p=0.05)	12.4	7.5	16.8	25.1			9.4	11.0	24.5	19.6		

Main plot (Crop geometry) Sub-plot (N and Fe nutrition)S₁: 60 cm × 20 cm N₁: 100% RDNS₂: 60 cm × 15 cm N₂: 100% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₃: 45 cm × 20 cm N₃: 125% RDNS₄: 45 cm × 15 cm N₄: 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₅: 30 cm × 30 cm**Phosphorus uptake**

Phosphorus uptake (kg/ha) was significantly influenced by crop geometry and nutrient management practices during all four seasons (Table 2).

Crop geometry had influenced positively on the phosphorus uptake during all the growth stages. At harvest, higher phosphorus uptake (31.3 and 26.1 kg/ha during *rabi*, 2016 and 2017; 28.6, 23.3 kg/ha during summer 2017 and 2018, respectively) was observed when babycorn was grown at 45 × 15 cm (S₄) followed by 30 × 30 cm (S₅). The lower phosphorus uptake was recorded with 60 × 20 cm (S₁) during all four seasons.

Phosphorus uptake was greatly influenced by different nutrient management practices. Babycorn applied with 125% RDN and FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₄) recorded

higher phosphorus uptake of 29.9, 22.9 kg/ha during *rabi*, 2016-17 and 2017-18; and 26.3, 22.5 during summer 2017 and 2018, respectively than others. Whereas, 100% RDN (N₁) registered lower phosphorus uptake during *rabi*, 2017-18 and summer 2018; and 100% RDN followed by FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₂) registered lower phosphorous uptake during *rabi*, 2016-17 and summer 2017. However N₁ and N₂ were on par with each other.

Crop geometry and nutrient management practices had significant interaction with each other on phosphorus uptake during the seasons. Babycorn sown at 45 × 15 cm with 125% RDN followed by FeSO₄ foliar spray @ 1% at 30 and 45 DAS (S₄N₄) registered significantly higher phosphorus uptake and it was on par with babycorn spaced at 45 × 15 cm with 125% RDN (S₄N₃).

Table 2: Effect of crop geometry and nutrient management practices on phosphorous uptake (kg/ha) of babycorn

	Rabi 2016-17						Rabi 2017-18					
Treatments	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	25.7	27.4	18.9	29.7	26.9	25.7	17.6	20.5	20.6	25.9	21.1	21.2
N ₂	24.7	28.4	19.8	31.8	22.8	25.5	18.6	21.4	20.7	26.5	20.6	21.6
N ₃	22.3	25.6	30.3	29.0	38.0	29.0	19.1	21.2	21.8	25.1	24.1	22.3
N ₄	22.1	27.2	37.6	34.6	23.5	29.9	21.5	21.7	20.8	27.0	23.5	22.9
Mean	23.7	27.1	26.6	31.3	28.9		19.2	21.4	21.0	26.1	22.3	
Treatments	Summer 2017						Summer 2018					
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	21.5	21.0	22.8	32.0	26.1	24.7	19.8	17.6	19.8	23.3	20.1	20.1
N ₂	24.5	24.0	23.8	24.0	24.8	24.2	19.4	17.9	19.1	23.6	21.2	20.3
N ₃	24.3	22.8	26.1	30.1	26.5	26.0	21.4	19.9	19.8	20.7	20.4	20.4
N ₄	22.1	30.2	25.4	28.2	25.5	26.3	19.4	23.5	20.3	25.7	23.4	22.5
Mean	23.1	25.7	24.5	28.6	25.7		20.0	20.4	19.8	23.3	21.3	
Treatments	Summer 2017						Summer 2018					
	S	N	S at N	N at S			S	N	S at N	N at S		
SEd	0.8	0.7	1.5	1.9			0.8	0.8	1.7	1.8		
C.D (p=0.05)	1.9	1.4	3.0	3.9			1.8	1.6	3.5	3.6		

Main plot (Crop geometry) Sub-plot (N and Fe nutrition)S₁: 60 cm × 20 cm N₁: 100% RDNS₂: 60 cm × 15 cm N₂: 100% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₃: 45 cm × 20 cm N₃: 125% RDNS₄: 45 cm × 15 cm N₄: 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₅: 30 cm × 30 cm

Potassium uptake

Crop geometry and nutrient management practices showed a pronounced effect on the potassium uptake (kg/ha) during all the seasons (Table 3).

Various crop geometry levels increased potassium uptake during the growth stages. At harvest, significantly higher potassium uptake (270.0, 259.7 kg/ha during *rabi*, 2016-17 and 2017-18; and 247.0, 242.4 kg/ha during summer 2017 and 2018, respectively) was registered with 45 × 15 cm spacing (S_4) compared to others. However, it was comparable with babycorn sown at 30 × 30 cm (S_5). Lower potassium uptake (182.6, 172.0 kg/ha during *rabi*, 2016-17 and 2017-18; and 179.8, 168.7 kg/ha during summer 2017 and 2018, respectively) was recorded with 60 × 20 cm spacing level (S_1).

In case of nutrient management practices, application of 125% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) recorded higher potassium uptake of 224.2, 220.5 kg ha⁻¹

during *rabi*, 2016-17 and 2017-18; and 218.9, 205.9 kg/ha during summer 2017 and 2018, respectively than others and was on par with 125% RDN (N_3). Whereas, babycorn fed with 100% RDN (N_1) registered lesser potassium uptake and was on par with 100% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2) during the experimental seasons.

Crop geometry and nutrient management practices had significant interaction with each other on potassium uptake during all four seasons. At harvest stage, babycorn maintained at 45 × 15 cm spacing and fertilized with 125% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (S_4N_4) registered higher potassium uptake and it was on par with 45 × 15 cm spacing level with 125% RDN (S_4N_3). Significantly lower potassium uptake was registered in the combination of 60 × 20 cm spacing with 100% RDN (S_1N_1) during all experimental seasons except during *rabi* 2016-17 where S_1N_3 registered lower K uptake.

Table 3: Effect of crop geometry and nutrient management practices on potassium uptake (kg/ha) of babycorn

Treatments	Rabi 2016-17						Rabi 2017-18									
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean				
N ₁	197.4	193.4	188.2	257.9	195.9	206.6	161.1	174.7	189.8	269.3	218.3	202.6				
N ₂	179.7	225.9	202.3	256.9	203.3	213.6	187.1	200.0	199.1	230.7	207.4	204.8				
N ₃	171.1	206.6	217.3	278.7	237.8	222.3	179.3	184.0	219.0	260.9	216.1	211.9				
N ₄	182.4	195.4	221.4	286.5	235.6	224.2	160.6	248.1	206.5	277.9	209.4	220.5				
Mean	182.6	209.3	207.3	270.0	218.2		172.0	210.7	203.6	259.7	212.8					
	Rabi 2016-17						Rabi 2017-18									
	S		N		S at N		N at S		S		N		S at N		N at S	
SEd	3.6		5.8		13.1		8.7		7.2		5.0		11.1		16.1	
C.D (p=0.05)	8.4		11.9		26.6		17.9		16.6		10.1		22.7		33.6	
Treatments	Summer 2017						Summer 2018									
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean				
N ₁	163.8	191.1	191.6	241.1	203.2	198.1	157.9	167.5	178.2	246.1	198.5	189.6				
N ₂	173.4	199.0	192.2	246.2	195.3	201.2	176.3	185.5	184.8	218.7	190.7	191.2				
N ₃	173.8	205.5	227.6	241.5	232.2	216.1	177.0	180.4	200.5	258.4	203.1	203.9				
N ₄	208.3	210.3	202.0	259.4	214.3	218.9	163.7	225.8	196.3	246.4	197.2	205.9				
Mean	179.8	204.9	203.4	247.0	211.2		168.7	197.2	190.0	242.4	197.3					
	Summer 2017						Summer 2018									
	S		N		S at N		N at S		S		N		S at N		N at S	
SEd	5.1		6.1		13.6		11.8		5.7		4.0		8.9		12.7	
C.D (p=0.05)	11.8		12.5		27.8		24.3		13.1		8.1		18.1		26.5	

Main plot (Crop geometry) Sub-plot (N and Fe nutrition)

S_1 : 60 cm × 20 cm N_1 : 100% RDN

S_2 : 60 cm × 15 cm N_2 : 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS

S_3 : 45 cm × 20 cm N_3 : 125% RDN

S_4 : 45 cm × 15 cm N_4 : 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS

S_5 : 30 cm × 30 cm

Green cob yield

The data on influence of treatments on green cob yield (kg/ha) over seasons are presented in Fig 1 & 2.

Irrespective of the treatments, cob yields were relatively higher during *rabi* 2016-17 and lower during summer 2018.

Effect of crop geometry and interaction between crop geometry and nutrient treatments was significant on the green cob yield of babycorn.

Anticipation of the results showed a positive influence of crop geometry on green cob yield of babycorn. During *rabi* 2016-17, babycorn raised at 45 × 15 cm (S_4) produced higher cob yield (9535 kg/ha) over the other crop geometry levels followed by 30 × 30 cm (S_5), 60 × 15 cm (S_2) and 45 × 20 cm (S_3) which maintained statistical parity with each other while 60 × 20 cm (S_1) recorded a lower green cob yield (5679 kg/ha). A similar trend of results was observed in all seasons wherein the percentage increase in green cob yield of S_4 over S_1 was 67.9, 74.1, 39.8 and 58.6 during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively.

Significant response was absent due to the nutrient treatments on green cob yield during the study period.

Interaction effect of crop geometry and nutrient treatments had a positive effect on green cob yield of babycorn over seasons. Raising of babycorn at 45 × 15 cm spacing together with application of 125% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (S_4N_4) recorded significantly higher green cob yield in all seasons (10100, 9148, 7297 and 6491 kg/ha during *rabi* 2016-17, *rabi* 2017-18, summer 2017 and summer 2018 seasons, respectively) and was on par with S_4N_3 , S_4N_2 and S_4N_1 . Maintaining plant population of 1,11,111 plants/ha [30 × 30 cm (S_5), 60 × 15 cm (S_2) and 45 × 20 cm (S_3)] in combination with any of the nutrient treatments stood in the next order irrespective of the season in terms of green cob yield which however were on par with each other. Lower green cob yield of 5631 kg/ha, 4953 kg/ha, 4856 kg/ha and 3849 kg/ha was noted with babycorn spaced at 60 × 20 cm along with application of 100% RDN (S_1N_1) which was on par with S_1N_2 , S_1N_3 and S_1N_4 .

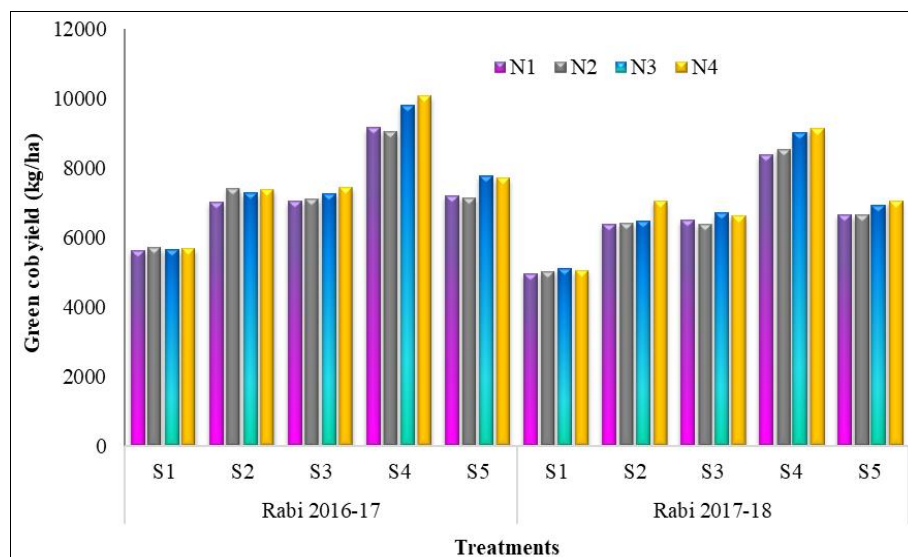


Fig 1: Crop geometry and nutrient management practices on green cob yield (kg/ha) of baby corn during *rabi* seasons

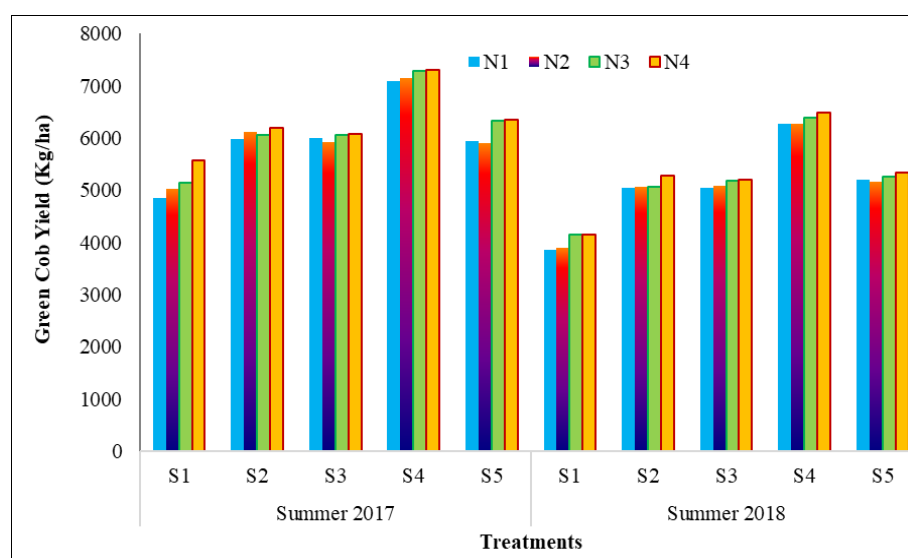


Fig 2: Crop geometry and nutrient management practices on green cob yield (kg/ha) of baby corn during summer seasons

Green fodder yield

The data on green fodder yield (t/ha) of baby corn as influenced by crop geometry and nutrient treatments are furnished under the Table 4.

Perusal of the data indicated that crop geometry and nitrogen levels had a conspicuous effect on the green fodder yield in all seasons wherein a relatively higher green fodder yield was recorded during *rabi* 2016-17.

With respect to crop geometry, baby corn sown at a narrow row spacing of 45×15 cm (S₄) produced significantly higher green fodder yield (50.3, 44.9, 39.0 and 37.5 t/ha during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) followed by 30×30 cm (S₅), 45×20 cm (S₃) and 60×15 cm (S₂), which were found to be on par with each other in all seasons under study, while sowing of baby corn at 60×20 cm (S₁) recorded lower green fodder yield (36.7, 32.0, 28.4 and 25.5 t/ha during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively).

Nitrogen levels did influence the green fodder yield significantly while the effect of iron was not conspicuous. Application of 125% RDN followed by foliar spraying of FeSO₄ @ 1% at 30 and 45 DAS (N₄) recorded higher green fodder yield of 44.6,

39.0, 34.8 and 33.9 t/ha during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively and remained statistically on par with 125% RDN (N₃) in all the seasons of study. The treatment which received 100% RDN (N₁) produced significantly lower green of fodder yield (41.8, 36.1, 31.8 and 30.4 t/ha during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) and was found to be on par with baby corn applied with 100% RDN followed by FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₂).

There existed significant influence due to the interaction between crop geometry and nutrient treatments on green fodder yield irrespective of the seasons. The baby corn raised at 45×15 cm spacing and supplied with 125% RDN along with FeSO₄ foliar spray @ 1% at 30 and 45 DAS (S₄N₄) registered higher green fodder yield in all seasons (52.0, 46.3, 40.7 and 38.6 t/ha during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) and showed a statistical parity with 45×15 cm spaced baby corn and supplied with 125% RDN (S₄N₃) while a lower yield of green fodder yield was noted when baby corn was sown at 60×20 cm spacing and fertilized with 100% RDN (S₁N₁).

Table 4: Effect of crop geometry and nutrient treatments on green fodder yield (t/ha) of babycorn

Treatments	Rabi 2016-17						Rabi 2017-18					
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	35.5	41.3	41.7	48.9	41.8	41.8	30.4	35.5	35.1	43.8	35.8	36.1
N ₂	35.9	41.6	42.0	49.1	42.2	42.2	31.3	36.2	35.8	44.5	36.6	36.9
N ₃	37.4	43.4	43.8	51.0	44.2	44.0	33.0	37.4	37.4	45.0	38.8	38.3
N ₄	38.1	44.0	44.6	52.0	44.5	44.6	33.1	38.1	38.5	46.3	39.2	39.0
Mean	36.7	42.6	43.0	50.3	43.2		32.0	36.8	36.7	44.9	37.6	
Treatments	Rabi 2016-17				Rabi 2017-18				Summer 2017			
	S	N	S at N	N at S	S	N	S at N	N at S	S	N	S at N	N at S
SEd	0.3	0.4	0.8	0.8	0.2	0.4	1.0	0.5	0.3	0.4	0.8	0.8
C.D (p=0.05)	0.8	0.7	1.7	1.6	0.5	0.9	2.0	1.1	0.7	0.7	1.6	1.4
Treatments	Summer 2017						Summer 2018					
	S ₁	S ₂	S ₃	S ₄	S ₅	Mean	S ₁	S ₂	S ₃	S ₄	S ₅	Mean
N ₁	27.5	30.7	31.8	37.1	32.1	31.8	24.3	30.9	30.6	36.5	29.6	30.4
N ₂	27.9	31.6	31.6	37.6	32.8	32.3	25.2	31.4	31.8	36.8	31.9	31.4
N ₃	29.4	34.4	34.2	40.4	33.7	34.4	25.7	33.6	34.4	38.0	35.9	33.5
N ₄	28.9	33.8	35.7	40.7	35.0	34.8	26.7	33.9	35.1	38.6	35.4	33.9
Mean	28.4	32.6	33.3	39.0	33.4		25.5	32.5	33.0	37.5	33.2	
Treatments	Summer 2017				Summer 2018				Summer 2017			
	S	N	S at N	N at S	S	N	S at N	N at S	S	N	S at N	N at S
SEd	0.3	0.4	0.8	0.7	0.6	0.5	1.2	1.3	0.3	0.5	1.2	1.3
C.D (p=0.05)	0.7	0.7	1.6	1.4	1.3	1.1	2.5	2.6	0.7	0.7	1.6	1.4

Main plot (Crop geometry) Sub-plot (N and Fe nutrition)S₁: 60 cm × 20 cm N₁: 100% RDNS₂: 60 cm × 15 cm N₂: 100% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₃: 45 cm × 20 cm N₃: 125% RDNS₄: 45 cm × 15 cm N₄: 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DASS₅: 30 cm × 30 cm**Discussion**

Nutrient uptake is a product of nutrient concentration and drymatter accumulation. Nutrient uptake enhanced under narrow row spacing of 45 × 15 cm as compared to wider row (60 cm) spacing. Higher nutrient uptake in closer row spacing might be due to better nutrient extraction from soil as well as fertilizer source. When the uptake of N is higher, plants generally have the tendency to absorb more P and K, which could be the reason for the higher uptake of the nutrients in case of narrowly spaced babycorn. Aravindh *et al.* (2011b)^[1] opined that higher drymatter accumulation led to higher uptake of nutrients in babycorn. Similar findings were reported by Bisht *et al.* (2013)^[3], Dar *et al.* (2014b)^[6]; and Thakur and Kharwara (1995)^[22].

Application of 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (N₄) recorded higher uptake of NPK and was comparable with the application of 125% RDN (N₃) alone while lower NPK uptake was noticed with 100% RDN (N₁). Application of nitrogen is known to increase root cation exchange capacity, which might have enhanced the absorption of the nutrients. When the uptake of N is higher, plants generally have a tendency to uptake more P and K. These findings are in close agreement with the results reported by Thavaprakash and Velayudham (2007)^[25] Sujatha *et al.* (2008)^[19], Aravindh *et al.* (2011b)^[1]; and Kumar *et al.* (2015)^[12]. Foliar nutrition of iron did not show any significant effect on the uptake of NPK.

Crop geometry and nutrient management practices had significant interaction with each other on nitrogen uptake during the all four seasons. During the experimentation, 45 × 15 cm with 125% RDN *fb* FeSO₄ foliar spray @ 1% at 30 and 45 DAS (S₄N₄) registered higher NPK uptake and it was on par with 45 × 15 cm with 125% RDN (S₄N₃). This increased phosphorous and potassium uptake with increased population and nitrogen level might due to efficient absorption of phosphorous and potassium at high nitrogen levels coupled with higher drymatter production under high nitrogen levels. Similar results were also reported by

Misra *et al.* (1994)^[13] and Dar *et al.* (2014b)^[6].

Babycorn raised at 45 × 15 cm (S₄) spacing produced higher green cob yield (9535, 8770, 7205 and 6358 kg/ha during rabi 2016-17, 2017-18 and summer 2017 and summer 2018, respectively) over the other crop geometry levels. The spacing S₁ (60 × 20 cm) recorded a lower cob yield, regardless of the season. Though the cob yield per plant decreased with increase in plant density, it was compensated by increased plant population. Gosavi and Bhagat (2009)^[9] observed that crop under the closer spacing had utilized all the resources efficiently and hence, the size of source and sink per unit area was larger under it and declined progressively with the increase in the spacing and the lowest values were recorded under the wider spacing. This has further resulted into production of higher cob yield per hectare under the closer spacing than the wider spacing. Bairagi *et al.* (2015)^[2] opined that closer spacing in babycorn intercepted more light owing to higher plant population that might have helped higher photosynthetic activity and concomitant better yield. These results are in conformity with Chamroy *et al.* (2017)^[4].

Higher green fodder yield was observed with narrow planting geometry of 45 x 15 cm This could be attributed to improved growth parameters in case of narrow row planting due to more number of plants/ha (1,48,148). Similar findings were reported by Sukanya *et al.* (1998)^[20], Sahoo and Panda (1999)^[18], Thakur *et al.* (2000)^[24]; Pandey *et al.* (2002)^[15], Rathika (2008)^[16], Thavaprakash *et al.* (2008)^[26]; and Dar *et al.* (2014b)^[6].

Nitrogen levels Foliar application of FeSO₄ did not show any significant influence on the yield during the course of study. Similar results were reported by Zhang *et al.* (2010)^[29] in wheat. Unlike babycorn yield, green fodder yield increased with increasing levels of N. Increase in the uptake of NPK at higher levels of N had contributed to higher green fodder yield. Similar findings were recorded by Thakur *et al.* (1997)^[23], Hammad *et al.* (2011)^[10]; and Sahoo (2011)^[17].

Conclusion

The study demonstrated that a crop geometry of 45 × 15 cm consistently optimized both nutrient uptake (NPK) and yield, significantly outperforming wider spacings such as 60 × 20 cm across all seasons. The highest green cob and fodder yields were achieved through the synergistic interaction of this narrow 45 × 15 cm spacing coupled with a high fertilization level of 125% RDN and 1% FeSO₄ foliar sprays at 30 and 45 DAS, though these results often maintained statistical parity with 125% RDN application alone. While nitrogen levels significantly influenced green fodder yield, the impact of foliar iron was less conspicuous in isolation; however, the interaction between crop geometry and nutrient treatments remained a decisive factor, proving that maintaining a higher plant population in combination with elevated nitrogen levels is essential for maximizing the dual-purpose productivity of baby corn.

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