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Studies on Yield and Nutrient uptake of Baby Corn as Affected by Nitrogen and Population Levels

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ABSTRACT

A field experiment was conducted during *kharif* 2014 on sandy loam soils of the Agricultural College Farm Bapatla to study the yield and nutrient uptake of baby corn as affected by nitrogen and population levels. The experiment was laid out in randomized block design with factorial concept and the treatments were replicated thrice. The treatments consisted of four levels of nitrogen in Factor – A (60, 120, 180 and 240 kg ha^{-1}) and four plant densities (2,22,222; 1,48,148; P_3: 1,11,111 and P_4: 1,66,666 plants ha^{-1}) in Factor – B. Results of the experiment showed that applying 240 kg N ha^{-1} registered the highest 12024 kg ha^{-1} cob with husk yield which was statistically comparable with 11711 kg ha^{-1} @ 180 kg N ha^{-1}. 1,66,666 plants ha^{-1} with 12,596 kg ha^{-1} and 1,48,148 plants ha^{-1} with 11,647 kg ha^{-1} were statistically comparable and significantly superior to other two densities tried. Regarding nutrient uptake highest N uptake, by fodder was recorded in 2,22,222 plants ha^{-1} along with the application of 240 kg N ha^{-1} (191.08 kg ha^{-1}). While the highest nitrogen uptake by ear was recorded with a planting density of 1,66,666 plants ha^{-1} (93.70 kg ha^{-1}) with the application of 240 kg N ha^{-1}. Significantly the highest phosphorus uptake (19.9 kg ha^{-1}) at a planting density of 2,22,222 plants ha^{-1} and with the application of 240 kg N ha^{-1} (22.1 kg ha^{-1}) was recorded and the lowest phosphorus uptake (15.8 kg ha^{-1}) was registered in 1,11,111 plants ha^{-1}. Significantly the highest potassium uptake (73.4 kg ha^{-1}) at a planting density of 1,66,666 plants ha^{-1} and with the application of 240 kg N ha^{-1} (76.5 kg ha^{-1}) was recorded.

Key words*: Baby corn, Nutrient, Population levels.*

Baby corn is dehusked ear, harvested young especially when the silk have either not emerged or just emerged and no fertilization has taken place. Change in food habit from non vegetarian to vegetarian aggravated the consumption of vegetables especially baby corn (Thavaprakaash *et al.*, 2005). In India, it occupies an area of 8.5 M ha with a production and productivity of 21.3 M t and 2507 kg ha^{-1}, respectively (Government of India, 2011). It is grown for vegetable purpose and it is not a separate type of corn. It is rich in phosphorus content (86 mg/100 g of edible portion) compared to 21 to 57 mg phosphorus content in other commonly used vegetables. Nutrient supply is the key input for ensuring higher productivity in terms of corn and fodder yield of baby corn. Three major nutrients viz., N, P and K must be applied adequately to achieve optimum yield of the crop. The importance of sufficient nutrient supply in corn is further increased because of the high plant density and the extremely short life cycle of baby corn. In addition to NPK, deficiency has been reported over past several years and hence this element in plant nutrition needs to be prioritized. The present study was, therefore, designed to find out the response of baby corn to nitrogen and population levels with regard to yield and nutrient uptake.

MATERIAL AND METHODS

The experiment was conducted at the Agricultural College Farm, Bapatla. Initial soil sample analysis revealed that the experimental soil was sandy loam in texture, neutral in reaction (pH 7.0), medium in organic carbon (0.52%), very low in available nitrogen (189 kg ha^{-1}), medium in available phosphorus (28 kg ha^{-1}) and high in available potassium (324 kg ha^{-1}). The experiment was laid out in a Randomized Block Design with factorial concept replicated thrice. The treatments consisted of four levels of nitrogen in Factor (60, 120, 180 and 240 kg N ha^{-1}) and four planting densities (2,22,222; 1,48,148; 1,11,11and P_4: 1,66,666 plants ha^{-1}) in Factor – B. A sturdy and vigorously growing baby corn hybrid, G-5414 was sown after thorough land preparation.

Nitrogen was applied in the form of urea as per the treatments. It was applied in two equal splits *i.e.* one at the time of sowing and the other at 30 days after sowing. A common dose of 60 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied in the form of single superphosphate and muriate of potash respectively, at the time of sowing.

RESULTS AND DISCUSSION

There was a significant increase in baby corn yield up to 180 kg N ha^{-1} only. Applying 240 kg N ha^{-1} registered the highest 12024 kg ha^{-1} cob with husk yield which was statistically comparable with 11771 kg ha^{-1}obtained with 180 kg N ha^{-1}. Among the plant densities, 1,66,666 plants ha^{-1} yielded 12,596 kg ha^{-1} and 1,48,148 plants ha^{-1} gave 11,647 kg ha^{-1} which were statistically comparable and significantly superior over other two densities tried. Among the combinations, significantly the lowest and the highest cob with husk yield were resulted with 1,11,111 plants ha^{-1} along with 60 kg N ha^{-1} (6223 kg ha^{-1}) and 1,66,666 plants ha^{-1} along with 240 kg N ha^{-1} (15100.0 kg ha^{-1}), respectively. This might be due to more taller plants, higher dry matter, increased ear length, higher ear weight at high levels of nitrogen could be the reason for higher yields. Similar reports of higher yield at higher nitrogen levels was earlier reported by Singh *et al*. (2012). (Table 1)

At all the levels of nitrogen, with decrease in plant population, there was an increase in the cob with husk yield. At all the nitrogen levels 1,11,111 plants ha^{-1} registered the lowest cob along with husk yield and 1,66,666 plants ha^{-1} recorded the highest yield. At all the nitrogen levels, 1,48,148 and 1,66,666 plants ha^{-1} recorded comparable yield. At all the population levels, with increase in the nitrogen level, there was an increase in the cob along with husk yield. This might be due to more taller plants, higher dry matter, increased ear length, higher ear weight at high levels of nitrogen and lower population levels. At higher plant density (2,22,222 plants ha^{-1}) there was increased competition for light, space, nutrients, and moisture between plants and created a stress environment for plant growth which was evident from the poor yield attributes viz., thin, and shorter cobs and lesser weight of cob. Thus plant density above critical population have a negative effect on yield. Similar results were reported by Ashok Kumar (2009) and Lalshankar *et al.* (2013).

Nitrogen content (%)

The highest nitrogen content was found with 240 kg N ha^{-1}, in fodder (1.75) was statistically comparable with 1.66 per cent at 180 kg N ha^{-1} and significantly superior to 120 and 60 kg N ha^{-1}, with 1.32 and 0.83 per cent, respectively. Significantly the lowest of 0.83 per cent was found with 60 kg N ha^{-1}. Adequate availability of nitrogen at higher doses might have resulted in higher nitrogen contents at higher doses of application. The results confirmed the earlier reports of Panwar and Munda (2006).

The nitrogen content in fodder recorded at a plant density of 1,11,111 plants ha^{-1} was the highest (1.74 %) and it was significantly superior to all the other plant densities tried (Table 2). However 1,48,148 and 1,66,666 plant densities were on a par with regard to nitrogen content of fodder. Significantly the lowest nitrogen content (1.30 %) was recorded in the treatment with 2,22,222 plants ha^{-1}. More availability of solar radiation, nutrients and lower interplant competition might have resulted in higher nitrogen content with low plant density. Similar findings were reported by Sahoo and Mahapatra (2007), Thavaprakaash and Velayudham (2008).

Significantly the highest nitrogen content in ear (2.03 %) was recorded in the treatment receiving 240 kg N ha^{-1}, which was statistically comparable with 1.94 per cent registered in the treatment receiving 180 kg N ha^{-1} only. Significantly the lowest nitrogen content (1.62 %) was observed with the application of 60 kg N ha^{-1}. In the treatments applied with higher doses of nitrogen, availability of nitrogen was higher and absorption was also higher. Hence the nitrogen content was also higher. Availability was lower in the treatment with low level of nitrogen application and hence the nitrogen content was also least. Similar findings were also reported by Sahoo and Mahapatra (2007) and Kumar (2008).

The nitrogen content in ear recorded at a plant density of 1,11,111 plants ha^{-1} was the highest (1.98 %) and was significantly superior to 1,66,666 (1.84 %) and 2,22,222 (1.67 %) plant densities. It was also observed that 1,11,111 and 1,48,148 plant densities were on par with each other. The higher nitrogen content at lower plant densities could be due to more availability and absorption of nitrogen. At high plant densities higher interplant competition for nitrogen might have resulted in lower nitrogen content.

Table 1. Interaction effect of baby corn yield with husk (kg ha^{-1}) as influenced by plant densities and levels of nitrogen.

Treatment	N_1-60	N_2-120	N_3-180	N_4-240	Mean
S_1 (2,22,222 Plants ha $^{-1}$)	7163	10384	10415	10698	9665
S_2 (1,48,148 Plants ha $^{-1}$)	7871	11221	13502	13994	11647
S_3 (1,11,111 Plants ha $^{-1}$)	6223	7087	8179	8305	7448
S_4 (1,66,666 Plants ha $^{-1}$)	8711	11585	14987	15100	12596
Mean	7492	10069	11771	12024	10069
	S.Em±	CD (p=0.05)	CV (%)		
N	336.8	988			
S	336.8	988	7.9		
N x S	476.3	1397			

Table 2. Nitrogen content (%) of baby corn as influenced by plant densities and levels of nitrogen.

Treatment	Fodder	Ear
Nitrogen levels (kg ha^{-1})		
N_{60}	0.83	1.62
N_{120}	1.32	1.85
N_{180}	1.66	1.94
N_{240}	1.75	2.03
S.Em±	0.053	0.101
CD (p = 0.05)	0.15	0.29
Plant densities (plants ha^{-1})		
S_1 - 2,22,222	1.30	1.67
S_2 - 1,48,148	1.55	1.88
S_3 - 1,11,111	1.74	1.98
S_4 -1,66,666	1.57	1.84
S.Em±	0.053	0.101
CD (p = 0.05)	0.15	0.29
Interaction (N X S)		
S.Em±	0.075	0.14
CD (p = 0.05)	NS	NS
CV (%)	8.3	13.4

Nitrogen Uptake By Fodder

Increasing in nitrogen dose from 60 to 120 kg N ha^{-1} there was an increase in nitrogen uptake. It was also observed that with increase in plant density also there was an increase in nitrogen uptake (Table 3)

The highest nitrogen uptake at all plant densities was registered with 240 kg N ha^{-1}. In fodder, 191 kg N ha^{-1} uptake was recorded with 2,22,222 plants ha^{-1} receiving 240 kg N ha^{-1} and the lowest of 50 kg N ha^{-1} uptake was registered with 1,11,111 plants ha^{-1} along with 60 kg N ha^{-1} application. This increase in nitrogen uptake at higher nitrogen application and higher plant population could be due to higher nitrogen availability and more drymatter accumulation in these combinations. Similar results were reported by Kar *et al*. (2006) and Ananthi *et al*. (2010).

Nitrogen uptake by ear

In ear, the highest nitrogen uptake was registered by 1,66,666 plants ha^{-1} with 240 kg N ha^{-1} (Table 4). At other combinations of low nitrogen level and lower plant densities, even though individual plant drymatter was higher, total nitrogen uptake was lowest due to low plant population.

Table 3. Nitrogen uptake (kg ha^{-1}) by fodder of baby corn as influenced by plant densities and levels of nitrogen.

Treatment	N_1-60	N_2-120	N_3-180	N_4-240	Mean
S_1 (2,22,222 Plants ha $^{-1}$)	66.2	108.8	176.3	191.0	135.6
S_2 (1,48,148 Plants ha $^{-1}$)	75.0	99.2	132.8	136.1	110.9
S_3 (1,11,111 Plants ha $^{-1}$)	50.1	100.4	116.9	125.8	100.3
S_4 (1,66,666 Plants ha $^{-1}$)	80.0	101.2	138.0	148.4	116.9
Mean	67.8	101	141	150.3	
	S.Em±	CD(p=0.05)	CV (%)		
N	3.52	10.51	7.2		
S	3.52	10.51			
NxS	5.08	14.90			

Table 4. Nitrogen uptake (kg ha^{-1}) by ear of baby corn as influenced by plant densities and levels of nitrogen.

Treatment	N_1-60	N_2-120	N_3-180	N_4-240	Mean
S_1 (2,22,222 Plants ha $^{-1}$)	16.0	31.6	48.8	70.1	41.3
S_2 (1,48,148 Plants ha $^{-1}$)	28.5	41.4	55.9	69.9	48.9
S_3 (1,11,111 Plants ha $^{-1}$)	18.7	25.7	31.6	38.2	28.5
S_4 (1,66,666 Plants ha $^{-1}$)	22.4	30.3	72.8	93.7	54.8
Mean	21.4	31.9	52.3	68.0	
	S.Em±	CD(p=0.05)	CV (%)		
N	2.61	7.67	14.7		
S	2.61	7.67			
NxS	3.70	10.60			

Similar findings were reported by Ananthi *et al*. (2010) and Suthar *et al.* (2014).

Phosphorus Content

Significantly the highest phosphorous content (%) in fodder and ear was registered with the application of 240 kg N ha^{-1} (0.23, 0.26 %) and the phosphorus uptake was higher with the application of 240 kg N ha^{-1} (22.1 kg ha^{-1}) with the plant density of 1,11,111 plants ha^{-1} (0.18, 0.26 %) (Table 5 and 6).

Phosphorus Uptake

The phosphorus uptake by baby corn was maximum with the application of 240 kg N ha^{-1} (22.1 kg ha^{-1}) and it was significantly superior to nitrogen levels 60 and 120 kg N ha^{-1} (12.2, 16.7 kg ha^{-1}) and was on a par with 180 kg N ha^{-1} (21.3 kg ha^{-1}). This increased phosphorous uptake with increased nitrogen level might due to efficient absorption of phosphorous at high nitrogen levels coupled with higher dry matter production under high nitrogen levels. Similar results were also reported by Spandana (2010) and Kalyani (2010).

Significantly, the highest phosphorus uptake (19.94 kg ha^{-1}) of baby corn was recorded at a planting density of 2,22,222 plants ha^{-1} and the lowest phosphorus uptake (15.87 kg ha^{-1}) was registered with 1,11,111 plants ha^{-1}. It was also found that phosphorus uptake with 1,66,666 plants ha^{-1} (18.30 kg ha^{-1}) and 1,48,148 plants ha^{-1} (18.16 kg ha^{-1}) were statistically comparable with each other. This might due to high drymatter at a plant density of 2,22,222 plants ha^{-1}. Similar findings were reported earlier by Kar *et al*. (2006) and Ajaz, *et al.* (2013).

Potassium Content

Significantly the highest potassium content (%) in fodder and ear was found with the application of 240 kg N ha^{-1} (0.75, 0.39 %) with the plant density of 1,11,111 plants ha^{-1} (0.78 and 0.46 %).

Potassium Uptake

Among the nitrogen levels, significantly the highest potassium uptake of baby corn was recorded with the application of 240 kg N ha^{-1} (76.5 kg ha^{-1}) which was significantly higher than that of other lower levels of nitrogen and was on a par

Table 5. Phosphorus and Potassium content (%) of baby corn as influenced by plant densities and levels of nitrogen.

Treatment	Phosphorus (%)		Potassium (%)	
	Fodder	Ear	Fodder	Ear
Nitrogen levels (kg ha^{-1})				
N_{60}	0.12	0.22	0.63	0.33
N_{120}	0.16	0.22	0.68	0.34
N_{180}	0.18	0.25	0.70	0.36
N_{240}	0.23	0.26	0.75	0.39
S.Em±	0.010	0.010	0.016	0.031
CD (p = 0.05)	0.03	0.03	0.05	0.04
Plant densities (plants ha^{-1})				
S_1 - 2,22,222	0.14	0.21	0.62	0.25
S_2 - 1,48,148	0.16	0.23	0.75	0.37
S_3 - 1,11,111	0.18	0.26	0.78	0.46
S_4-1,66,666	0.15	0.25	0.72	0.35
S.Em±	0.010	0.010	0.016	0.031
CD (p = 0.05)	0.03	0.03	0.05	0.04
Interaction (N X S)				
S.Em±	0.014	0.015	0.023	0.044
CD (p = 0.05)	NS	NS	NS	NS
CV (%)	11	11.2	5.9	20

Table 6. Phosphorus and potassium uptake (kg ha^{-1}) of baby corn as influenced by plant densities and levels of nitrogen.

Treatment	Phosphorus	Potassium
Nitrogen levels (kg ha^{-1})		
N_{60}	12.2	45.0
N_{120}	16.7	58.8
N_{180}	21.3	70.3
N_{240}	22.1	76.5
S.Em±	0.90	2.36
CD (p = 0.05)	2.6	6.9
Plant densities (plants ha^{-1})		
S_1 - 2,22,222	19.9	73.4
S_2 - 1,48,148	18.1	66.0
S_3 - 1,11,111	15.8	46.4
S_4-1,66,666	18.3	64.8
S.Em±	0.90	2.36
CD (p = 0.05)	2.6	6.9
Interaction (N X S)		
S.Em±	2.43	19.82
CD (p = 0.05)	NS	NS
CV (%)	18.1	10.09

with 180 kg N ha^{-1} (70.3 kg N ha^{-1}). This might due to efficient absorption of mineral nutrients coupled with higher dry matter production under higher nitrogen levels. Similar results were reported earlier by Spandana (2010) and Kalyani (2010).

Potassium uptake of baby corn recorded significantly the highest at a plant density of 2,22,222 plants ha^{-1} (73.4 kg ha^{-1}) than that of 1,66,666 plants ha^{-1} (64.8 kg ha^{-1}), 1,48,148 plants ha^{-1} (66.0 kg ha^{-1}) and 1,11,111 plants ha^{-1} (46.4 kg ha^{-1}). However , 2,22,222 and 1,48,148 plants ha^{-1}were statistically comparable with each other. Significantly the lowest potassium uptake was recorded with 1,11,111 plants ha^{-1}(46.4 kg ha^{-1}). These results are confirmed with those reports of Spandana (2010) and Kalyani (2010).

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