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Production of Baby corn hybrid as influenced by nitrogen and phosphorus in *rabi* season

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Abstract
A field experiment was conducted at Main Maize Research Station, AAU, Godhra during the *Rabi* 2019-20 to *Rabi* 2020-21 to study the yield of baby corn and quality parameters of baby corn by keeping spacing 45 cm x 20 cm under three levels of nitrogen (40kgN/ha, 60 kg N/ha and 80 kgN/ha), two levels of phosphorus (20 kg P2O5/ha, 40 kg P2O5/ha) with 4 replications. Experimental findings showing that 80kgN/ha gave baby corn yield with husk (6205 kg/ha) and 1102 kg/ha baby corn yield without husk but it is at par with 60 kg N/ha while 20 kg P2O5 gave higher baby corn yield with husk (5766 kg/ha) and without husk (1029 kg/ha). The nitrogen dose of 80 kg N/ha gave 5.19% TSS and 10.11% Total carbohydrates% where as 40 kg P2O5/ha gave higher TSS% (5.10%) and higher carbohydrates% (10.02%). Among the six treatments, the treatment N3P1 (80 kg N/ha + 20 kg P2O5/ha) gave higher net profit (Rs.1,50,462) with high BCR (6.24) than other treatments. So, the farmers of middle Gujarat agro-climatic zone growing *rabi* baby corn hybrid maize (GAYMH 1) are recommended to apply the crop with 60 kg N/ha (50% as basal and 50% at 30 DAS) and 20 kg P2O5/ha to achieve higher baby corn yield with high net return.

Keywords: Baby corn, total carbohydrates, TSS%, BCR, GAYMH-1

Introduction
Babycorn is one of the dual-purpose crop. After harvesting of baby corn, it can be utilized for green fodder. Being a dual-purpose crop, the ears (baby corns) are used (15 – 20%) as human food and the remaining is used as green fodder for animals because of its succulent palatable nature and excellent fodder quality (Kumar *et al*. (2015) [6]. Asia ranks 1st in the consumption of Babycorn while worldwide, USA ranks 1st in production (2018-2019) (12.42 billion bushels), followed by China (10.91 billion bushels). In India, maize is cultivated in an area of 9.38 million hectares with a production and productivity of 28.75 million tons and 3065 kg ha-1 respectively. (Indiastat, 2017) [4]. Babycorn being a C_4 plant has tremendous yield potential and responds well to applied inputs. However, its potential could not be exploited fully due to lack of proper management practices like nutrient management, season and variety (Singh *et al*., 2010) [9]. Babycorn is a nutrient exhaustive crop and due to high planting density, integrated nutrient management practices are important to get maximum benefit. To cope up with the situation, inorganic sources of nutrients was taken up to evaluate the varying levels of nutrients on the physio- chemical properties of soil and crop yield. Profitability of Baby corn cultivation has drastically declined owing to increased cost of cultivation and declining factor productivity of monetary inputs such as fertilizer and plant protection chemicals. Nitrogen plays a significant role in plants. It is well known that baby corn is widely adaptable to the application of N. It imposes some effects on cob size, cob weight, and finally in cob yield in all the plants. The adoption of INM practices on the field will reduce the production cost, thereby increasing the economic yield of the farmers and also increases the supply and availability of soil nutrients to the crop as well as increasing the activity of beneficial soil microorganism.

Among the different agronomic practices, the spacing requirement has been standardized for grain and fodder maize, the information on the influence of nitrogen and phosphorus on yield of baby corn hybrids still unclear. Proper nutrient management system is the important aspect for getting better yield of baby corn. As a heavy feeder of nutrients, its productivity is largely dependent on nutrient management. Chemical fertilizers are the primary source of plant nutrients.

Their application may assist in obtaining maximum production of baby corn, but the excessive use of chemical fertilizers has been associated with decline in soil physical and chemical properties and crop yield (Kumar *et al*., 2015) [6]. Management of in organic fertilizers that decrease the requirement for agricultural chemicals are needed in order to avoid adverse effect on environment and soil. The study was designed by concentrating on the above points to standardize the spacing and nutrient requirement for maximizing the production of baby corn.

Materials and Methods

Site and Source of biological materials

The experiment was conducted at our Main Maize Research Station, Anand Agricultural University, Godhra, Gujarat during *Rabi* 2019-20 to *Rabi* 2020-21. The soil of experimental site was sandy loam in texture. A newly released baby corn hybrid, GAYMH-1 was obtained to conduct the trial. The powdered farmyard manure was collected and deposited earlier in the whole field.

Land preparation

The experimental field was ploughed by passing tractor mounted cultivator twice and the field was well prepared and made free from volunteer plants and provided drainage facility. Soil was prepared by 3 to 4 rounds of harrowing to get fine tilth. After final harrowing and preparation of field, the experimental plot were laid down according to the experimental treatments. The individual plots were prepared as per the respective plot size. Finally ridges and furrows were made at 45 cm interval uniformly in all the plots.

Experimental design, data collection and statistical analysis: The experiment was laid out in randomized block design (RBD Factorial) with six treatments replicated four times using different fertilizer combination as per the treatment schedule *viz*., The treatments consisted of three doses of Nitogen *viz*., N_1: 40 kg N/ha, N_2: 60 kg N/ha, N_3: 80 kg N/ha in main plot and two doses of Phosphorus *viz*., P_1: 20 kg P2O5/ha, P_2: 20 kg P_2O_5/ha in sub-plot with four replications in RBD (Factorial) design. The net plot size was 1.80 m × 4.6 m with four rows in each plot having 45 cm and 20 cm distance between and within rows, respectively. The field was kept free from weeds. Two hand weeding at 25 DAS and 45 DAS were performed. Harvesting of baby corn was done at 2-3 days of silk emergence stage by leaving border rows. Prior to experimentation the land was utilized for growing maize during *kharif* season. From each plot five plants were selected randomly leaving the border rows of the for recording different observations. The data pertaining to various observations were statistically analyzed by the procedure of analysis of variance for RBD (Factorial) given by Panse and Sukhatma (1985). For significant ‘F’ test, critical difference (CD) was reported at 5 per cent probability level. The data were collected at the time of harvesting and the data collected to study the yield components *i.e*., number of baby corn plant-1, cob length, cob girth, baby corn yield and green fodder yield of babycorn were recorded.

Results and Discussion

Yield attributes

The Treatments N_3 (80 kg N/ha) gave higher baby corn yield with husk (6205 kg/ha) and 1102 kg/ha baby corn yield without husk but it is *at par* with N_2 (60 kg N/ha) while P_1 (20 kg P_2O_5) gave higher baby corn yield with husk (5766 kg/ha) and without husk (1029 kg/ha)

(Table-1). Yield attributing characters, *viz*. cob length, cob girth, baby corn yield and green fodder yield were significantly influenced by different fertilizer combination (Table 1& 2). Yield parameters of baby corn *viz*., baby corn yield with husk and without husk, cob length and cob girth were deviated significantly due to different fertilizer treatments. The similar result was observed by (Khaliq *et al*., 2004) [5]. The increased supply of nitrogen might have stimulated the rate of various physiological processes in plant and led to increased yield attributes and yield. The similar findings were also reported by Pal *et al*. (2017) [8].

Green fodder yield

Fertilizer treatments exerted non-significant influence on green fodder yield of babycorn. (Table 1). Among the treatments, application of N_3 (80 kg N/ha) registered higher green fodder yield of 36111 kg/ha. The next best treatment was the application of N_2*i.e* 60 kg N/ha as it gave 33360 kg/ha of green fodder yield. The treatment of P_2 gave 34105 kg/ha green fodder yield. These findings are similar to the finding of Yadav and Lourduraj (2006) [11].

Cob length and Girth of cob

The cob length of babycorn did not significantly influenced by the different fertilizer treatment. Among the treatments, The treatment N_3 (80 kg N/ha) gave higher Length (7.40 cm) while P_1 (20 kg P_2O_5 /ha) gave 7.24 cm length. (Table-2). The next best treatment was the application of 60 kg N/ha for the length of baby corn (7.31 cm). The girth of cob did not significantly influenced by the treatments of fertilizer. Among the treatments, application of 80 kg N/ha recorded the higher girth of 3.92 cm while the application of 60 kg N/ha gave 3.82 cm girth where as P_2 gave higher girth of baby corn *i.e* 3.86 cm (40 kg P_2O_5) while P_1 (20 kg/P_2O_5) gave 3.82 cm girth of baby corn. The results are familiar with the results of Anees*et al*., 2016.

Quality parameters of baby corn hybrid

Fertilizer treatments exerted significant difference on the quality parameters like TSS% and Total carbohydrate. The treatment N_3 (80 kg N/ha) gave 5.19% TSS and 10.11% Total carbohydrates%. Effect of phosphorus is also found significant effect on TSS% and Total carbohydrates%. Treatment P_2 (40 kg N/ha) gave higher TSS% (5.10%) and higher carbohydrates% (10.02%) (Table-3). This is accordance with the findings of Okoroafor *et al*., (2013) [7].

Economics of baby corn

Treatments N_2P_1 (60 kg N/ha + 20 kg P_2O_5/ha) gave higher net profit (Rs.1,47,390) with high BCR (6.24) than other treatments. (Table-4) with low cost of cultivation.

Table 1: Effect of nitrogen and phosphorus on yield of baby corn in *rabi* season

Treatments	Baby corn yield with husk (kg/ha)			Baby corn yield without husk (kg/ha)			Baby corn Green fodder yield (kg/ha)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
N_1 (40)	5527	4569	5048	1017	829	923	31463	32296	31879
N_2 (60)	6002	5308	5655	1074	964	1019	33759	32962	33360

N_3 (80)	6395	6016	6205	1134	1069	1102	35231	36991	36111
S.Em ±	212	320	192	37	51	32	906	1279	1049
CD (P=0.05)	639	965	579	NS	155	97	2731	3854	NS
P_1 (20)	5979	5555	5766	1056	1001	1029	33556	33370	33463
P_2 (40)	5970	5040	5505	1094	908	1001	33414	34796	34105
S.Em ±	173	261	156	30	42	26	740	1044	857
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
N x P									
S.Em ±	300	453	271	52	73	46	1281	1808	1484
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	10.1	17.1	13.6	9.6	15.3	12.7	7.7	10.6	12.4
Year									
S.Em ±	-	-	237			41			493
CD (P=0.05)	-	-	NS			NS			NS
N x Y									
S.Em ±			410			72			854
CD (P=0.05)			NS			NS			NS
P x Y									
S.Em ±			335			58			697
CD (P=0.05)			NS			NS			NS
N x P x Y									
S.Em ±			580			101			1207
CD (P=0.05)			NS			NS			NS
CV%			20.5			19.9			7.1

Table 2: Effect of nitrogen and phosphorus on plant height, Babycorn length and Babycorn girth in *rabi* season

Treatments	Length of Baby corn without husk (cm)			Girth of Baby corn without husk (cm)		
	2019	2020	Pooled	2019	2020	Pooled
N_1 (40)	6.60	7.44	7.02	3.63	3.90	3.77
N_2 (60	6.72	7.80	7.31	3.64	4.01	3.82
N_3 (80)	7.00	7.89	7.40	3.75	4.08	3.92
S.Em ±	0.15	0.16	0.12	0.09	0.08	0.05
CD (P=0.05)	NS	NS	NS	NS	NS	NS
P_1 (20)	6.70	7.65	7.24	3.60	3.96	3.82
P_2 (40)	6.84	7.77	7.25	3.75	4.04	3.86
S.Em ±	0.12	0.13	0.09	0.07	0.06	0.04
CD (P=0.05)	NS	NS	NS	NS	NS	NS
N x P						
S.Em ±	0.21	0.23	0.16	0.12	0.11	0.07
CD (P=0.05)	NS	NS	NS	NS	NS	NS
C.V.%	6.3	5.9	6.4	6.9	5.4	5.2
Year						
S.Em ±			0.11			0.05
CD (P=0.05)			0.34*			0.15*
N x Y						
S.Em ±			0.20			0.09
CD (P=0.05)			NS			NS
P x Y						
S.Em ±			0.16			0.07
CD (P=0.05)			NS			NS
N x P x Y						
S.Em ±			0.28			0.13
CD (P=0.05)			NS			NS
CV%			7.6			6.6

Table 3: Effect of nitrogen and phosphorus on moisture, Total soluble sugar and Total carbohydrates

Treatments	Moisture (%)	TSS (%)	Total carbohydrates (%)
N_1 (40)	78.90	4.94	9.73
N_2 (60)	79.30	5.09	10.10
N_3 (80)	79.40	5.19*	10.11*
S.Em ±	0.51	0.02	0.03
CD (P=0.05)	NS	0.06	0.08
P_1 (20)	79.30	5.04	9.94
P_2 (40)	79.10	5.10	10.02
S.Em ±	0.41	0.02	0.02
CD (P=0.05)	NS	0.05	0.06
N x P			

S.Em ±	0.72	0.03	0.04
CD (P=0.05)	NS	0.09	NS
C.V.%	1.8	1.2	1.0

Table 4: Economics Table-1

Treatments	Babcorn yield without husk kg/ha	Baby corn green fodder yield kg/ha	Baby corn Income Rs/ha	Green fodder Income (Rs/ha)	Total Income (Rs/ha)	Total cost (Rs/ha)	Net profit (Rs/ha)	BCR
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
$T_1 N_1P_1$	902	31462	90200	62924	153124	28242	124882	5.42
$T_2 N_1P_2$	944	33759	94400	67518	161918	29295	132623	5.52
$T_3 N_2P_1$	1052	35231	105200	70642	175842	28452	147390	6.18
$T_4 N_2P_2$	986	32296	98600	64592	163192	29505	133687	5.53
$T_5 N_3P_1$	1132	32962	113200	65924	179124	28662	150462	6.24
$T_6 N_3P_2$	1072	36990	107200	73980	181180	29715	151465	6.10

Table 4: Economics Table-2

Treatments	Babcorn yield without husk kg/ha	Baby corn green fodder yield kg/ha	Baby corn Income Rs/ha	Green fodder Income (Rs/ha)	Total Income (Rs/ha)	Total cost (Rs/ha)	Net profit (Rs/ha)	BCR
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Nitrogen								
N_1 (40)	923	31879	92300	63758	156058	27188	128870	5.73
N_2 (60)	1019	33360	101900	66720	168620	27398	141222	6.15
N_3 (80)	1102	36111	110200	72222	182422	27608	154814	6.60
Phosporus								
P_1 (20)	1029	33463	102900	66926	169826	27822	142004	6.10
P_2 (40)	1001	34105	100100	68210	168310	28875	139435	5.82

Baby corn price Rs.100/kg
Green fodder price Rs.2.00/kg
Fix cost of cultivation 26768 Rs/ha

Conclusion
From this experiment, it can be concluded that the application of 60 kg N/ha (50% as basal and 50% at 30 DAS) and 20 kg P2O5/ha was found to be superior with respect to yield attributes, cob and fodder yield. Hence, the farmers of middle Gujarat Agro-climatic zone growing *rabi* baby corn hybrid maize GAYMH-1 are recommended to apply the crop with 60 kg N/ha and 20 kg P_2O_5 to achieve higher baby corn yield with high net return.

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