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Evaluation of quality of Babycorn as influenced by crop geometry N and Fe nutrition

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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 babycorn. Experiment was conducted with five crop geometry levels *viz.*, 60 × 20cm (S_1), 60 × 15cm (S_2), 45 × 20cm (S_3), 45 × 15cm (S_4), 30 × 30cm (S_5) in main-plot and four nutrient levels such as 100% recommended dose of nitrogen (RDN) (N_1), 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2), 125% RDN (N_3), 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) in sub-plot in split-plot design. Results revealed that crop geometry did not show any significant influence on the quality parameters of babycorn and its fodder excepting starch content and sugar content of babycorn. With increase in fertilization levels, quality parameters of babycorn except vitamin A and C content also increased up to the level of N_4 and were on par with N_3. The interaction effect was not statistically pronounced on the quality parameters of babycorn.

Keywords: Babycorn, crop geometry, nitrogen, iron, quality

Introduction
Babycorn (*Zea mays* L.), also known as young corn, Cornlets, mini corn, baby sweet corn or candle corn is the ear of maize plant harvested young, when the silks have either not emerged or just emerged and no fertilization has taken place depending on the cultivar grown (Rani *et al.*, 2017) [23]. Babycorn is a unique cereal taken from maize with a difference of value addition in terms of milky tender cob as a fresh natural food cum vegetable. Due to its fast growth, high yielding potential, delicacy and high nutritive value, babycorn is becoming popular in domestic and foreign markets and has enormous processing and export potential. Babycorn has a high nutritive value and can be eaten either raw or cooked. Half a cup (serving size) of boiled babycorn contains 18 calories, 0.1 g fat, 1.7 g protein, 3.6 g carbohydrates and 1.2 g dietary fibre. Besides, it also has vitamin A (276 retinol equivalents), vitamin C (16 mg), potassium (483 mg), sodium (158 mg), magnesium (76 mg), calcium (51 mg) and iron (2 mg) (Bhat, 2013) [2]. It is a low calorie vegetable having higher fibre content without cholesterol. Probably it is the only vegetable without any pesticide residues.
Speciality maize such as babycorn, needs different spatial requirements for realizing its full yield potential as it is harvested at an early stage unlike grain maize. Thus, crop geometry has an important role in increasing the productivity of babycorn. Row spacing of babycorn was tried at different areas and it had significant influence on growth, yield and quality of babycorn (Bairagi *et al.*, 2015; Sukanya *et al.*, 2000) [3, 29].
Nitrogen is a constituent of protoplasm and chlorophyll and is associated with the activity of every living cell (Golada *et al.*, 2013) [8]. It is an essential constituent of protein and is present in many other compounds of physiological importance in plant metabolites such as nucleotides, phosphatides, alkaloids, enzymes, hormones and vitamins, *etc.* (Chaudhary, 2006) [4]. Iron is very essential for chlorophyll formation and photosynthesis and is important in the enzyme systems and respiration of plants (Havlin *et al.*, 2005) [11]. Research evidences have indicated that N fertilization represents an important agronomic practice in increasing grain iron content. Therefore, the plant N status deserves special attention in biofortification of food crops with iron (Aciksoz *et al.*, 2011) [1].

Material and Methods
The field experiment was conducted during 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 babycorn.

The experiment was laid out in split plot design with three replications. Main-plots consisted of five levels of crop geometry *viz.*, 60 × 20cm (S_1), 60 × 15cm (S_2), 45 × 20cm (S_3), 45 × 15cm (S_4), 30 × 30cm (S_5) and four levels of nitrogen and Fe nutrition such as 100% recommended dose of nitrogen (RDN) (N_1), 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2), 125% RDN (N_3), 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) 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. $FeSO_4$ foliar spray @ 1% was given at 30 and 45 DAS. All the other 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.

Quality parameters

Crude protein content

Cobs harvested from the representative plants were analysed for total N by micro-Kjeldahl method. The total N content of the cobs was multiplied by factor 6.25 (Humphries, 1956) [13] for obtaining crude protein content of the babycorn and expressed in per cent.

Calcium content

Calcium content was estimated in fresh babycorn following the EDTA method (Jackson, 1973) [14] and expressed as mg/100g of sample.

Starch content: Starch content was estimated in fresh babycorn following the Anthrone method (Horwitzs, 1975) [12] and expressed as per cent.

Vitamin C content

Fresh babycorns harvested from the representative plants were analyzed for ascorbic acid content by volumetric method (Sadasivam and Manickam, 1996) [26] and expressed as mg/100g of sample.

Vitamin A content

Vitamin A content was estimated in fresh babycorn following the standard method (Horwitzs, 1975) [11] and expressed as mg/100gm.

Total sugar content

Total sugar content was estimated in fresh babycorns by following the standard method (Horwitzs, 1975) [12] and expressed as per cent.

Iron content

Iron content was estimated from the babycorn collected from the sampled plants, following the hydroxylamine hydrochloride method (Jackson, 1973) [14] and expressed as ppm.

Crude fibre (babycorn fodder)

Crude fibre was estimated gravimetrically by successive digestion and washing of weighed plant sample with dilute acid and alkali. The material left un-dissolved was considered as crude fibre and expressed in percentage (Goering and Van Soest, 1970) [7].

Statistical analysis

The data were analyzed statistically following the procedure given by Gomez and Gomez (1984) [9]. Wherever the treatmental differences were significant, critical differences were calculated at five per cent probability level for comparison. Non-significant effects are indicated as NS.

Results

Crude protein content

Crop geometry did not show any significant influence on the crude protein content of babycorn during the course of investigation (Table 1).

Nutrient treatments had a marked influence on the crude protein content of babycorn wherein significantly higher values were obtained during *rabi* over summer during both the years. The treatment 125% RDN and foliar sprayed $FeSO_4$ @ 1% at 30 and 45 DAS (N_4) recorded higher values of crude protein content of babycorn (14.30, 13.81, 12.68 and 12.13 per cent during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) over the rest of the nutrient treatments (Table 1). While significantly lower crude protein content of babycorn was observed with 100% RDN alone applied plots (N_1) in all four seasons and was on par with the treatment 100% RDN along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2) during *rabi* 2016-17. The values of crude protein content of babycorn noted with 100% RDN

Table 1: Effect of crop geometry and nutrient management practices on crude protein content (CPC) (%), calcium content (mg/100g) and starch content (%) of babycorn

Treatments	*Rabi*						Summer					
	2016-17			2017-18			2017			2018		
Crop geometry	CPC (%)	Ca (mg/100g)	Starch content (%)	CPC (%)	Ca (mg/100g)	Starch content (%)	CPC (%)	Ca (mg/100g)	Starch content (%)	CPC (%)	Ca (mg/100g)	Starch content (%)
S_1: 60 cm × 20 cm	13.68	56.11	8.69	13.37	51.60	8.50	11.89	49.29	7.94	11.43	48.34	7.46
S_2: 60 cm × 15 cm	13.14	54.25	8.38	13.09	51.06	8.26	12.19	48.51	7.72	11.13	49.12	7.26
S_3: 45 cm × 20 cm	13.09	52.36	7.62	12.51	49.92	7.53	11.77	47.61	7.16	10.93	48.74	6.48

S_4: 45 cm × 15 cm	12.82	52.00	7.53	12.52	49.48	7.42	11.45	47.18	6.86	10.73	48.22	6.32
S_5: 30 cm × 30 cm	13.32	54.09	8.25	13.15	51.06	8.14	11.68	48.75	7.60	11.44	49.29	7.22
SEd	0.60	2.00	0.20	0.63	1.36	0.21	0.33	1.78	0.17	0.50	1.00	0.21
C.D. (p=0.05)	NS	NS	0.46	NS	NS	0.43	NS	NS	0.40	NS	NS	0.48
N and Fe nutrition												
N_1: 100% RDN*	12.15	51.54	7.67	12.05	47.99	7.52	10.44	46.41	6.96	10.10	45.69	6.54
N_2: 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	12.92	51.81	7.96	12.88	48.71	7.72	11.31	46.13	7.14	10.87	46.87	6.48
N_3: 125% RDN	13.47	54.68	8.23	12.97	51.47	8.19	11.81	49.09	7.61	11.26	49.52	7.41
N_4: 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	14.30	56.39	8.46	13.81	53.55	8.27	12.68	50.87	7.85	12.13	51.98	7.08
SEd	0.41	1.45	0.23	0.33	1.09	0.21	0.36	1.42	0.18	0.37	1.40	0.19
C.D. (p=0.05)	0.83	2.96	0.47	0.68	2.24	0.43	0.73	2.90	0.36	0.76	2.87	0.40

Interaction is absent

*RDN: Recommended Dose of Nitrogen

applied and foliar sprayed with $FeSO_4$ @ 1% at 30 and 45 DAS (N_2) and 125% RDN (N_3) applied plots were comparable with each other which manifested the effect of iron on the crude protein content of babycorn. The interaction effect on crude protein content of babycorn was statistically absent.

Calcium content

Similar to crude protein content of babycorn, calcium content also did not vary due to the different crop geometry levels in all the seasons (Table 1).

Nutrient treatments showed a pronounced effect on the calcium content of babycorn. There was a considerable increase in the calcium content of babycorn (56.39, 53.55, 50.87 and 51.98 mg /100 g during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) with the treatment receiving 125% RDN along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) over 100% RDN applied with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2) and 100% RDN only applied babycorn (N_1), while it was on par with 125% RDN received plots (N_3). Application of 100% RDN (N_1) showed significantly lower calcium content of babycorn and was comparable with N_2 (Table 1). The above results where N_1 and N_2 and also N_3 and N_4 were on par with each other indicate that foliar nutrition of iron did not play any significant role in increasing the calcium content of babycorn.

Starch content

Significant variations in the mean values of starch content of babycorn were observed due to crop geometry and nutrient treatments over the seasons. Babycorn raised at 60 × 20 cm spacing (S_1) registered higher starch content of 8.69, 8.50, 7.94 and 7.46 per cent during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively and was comparable with 60 × 15 cm (S_2) and 30 × 30 cm (S_5) planted babycorn whereas babycorn spaced at 45 × 15 cm (S_4) showed a relatively lower starch content which in turn remained statistically on par with 45 × 20 cm planted babycorn (S_3). Similar trend was observed in all the seasons of study (Table 1).

With regard to nutrient treatments, application of 125% RDN and foliar sprayed with $FeSO_4$ @ 1% at 30 and 45 DAS (N_4) improved the starch content of babycorn significantly (8.46, 8.27, 7.85, 7.08% during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) over the application of 100% RDN alone (N_1) (7.67, 7.52, 6.96 and 6.54% during the respective seasons) (Table 1). However, it was comparable with 125% RDN applied babycorn (N_3) which implies that iron had no effect on the starch content of babycorn. The interaction between the treatments over the seasons was not significant.

Vitamin C and Vitamin A content

During the study, crop geometry, nutrient treatments and their interaction had no significant influence on the vitamin C and vitamin A content of baby corn (Table 2).

Total sugar content

Crop geometry and nutrient treatments had a pronounced effect on the total sugar content (%) of babycorn in all the seasons of study.

Among the various crop geometry levels, babycorn planted at 60 × 20 cm (S_1) recorded significantly higher values of sugar content (1.71, 1.64, 1.60 and 1.55% during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) and remained statistically on par with that of babycorn planted either at 60 × 15 cm spacing (S_2) or at 30 × 30 cm spacing (S_5) with a single exception during summer season of 2018 when it recorded significantly higher values over other levels. Lower values of total sugar content of babycorn were realized with babycorn planted at 45 × 15 cm spacing (S_4) and were on par with 45 × 20 cm (S_3) (Table 2).

The nutrient treatments had a profound effect on the total sugar content of babycorn similar to that of starch content. The treatment receiving 125% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) recorded significantly higher total sugar content of babycorn and was comparable with that of 125% RDN alone applied babycorn (N_3) while lower values were recorded with 100% RDN alone applied plots (N_1) followed by babycorn fertilized with 100% RDN along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2) which were on par with each other. Iron did not show any significant effect on the total sugar content of babycorn. Interaction effect between the treatments was absent.

Iron content

At any of the seasons, crop geometry did not influence the iron content of babycorn. There was a notable difference due to the nutrient treatments on the iron content of babycorn. Application of 125% RDN along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) showed

Table 2: Effect of crop geometry and nutrient management practices on vitamin C content (mg/100 g), vitamin A content (mg/100 g) and total sugar content (TSC) (%) of babycorn

Treatments	*Rabi*						Summer					
	2016-17			2017-18			2017			2018		
Crop geometry	Vit C (mg/100g)	Vit A (mg/100g)	TSC (%)	Vit C (mg/100g)	Vit A (mg/100g)	TSC (%)	Vit C (mg/100g)	Vit A (mg/100g)	TSC (%)	Vit C (mg/100g)	Vit A (mg/100g)	TSC(%)
S_1: 60 cm × 20 cm	17.49	0.379	1.71	16.89	0.370	1.64	17.29	0.362	1.60	16.76	0.349	1.55
S_2: 60 cm × 15 cm	17.38	0.369	1.61	17.16	0.360	1.58	17.21	0.348	1.52	16.86	0.343	1.50
S_3: 45 cm × 20 cm	17.32	0.364	1.50	16.35	0.357	1.45	17.13	0.344	1.46	16.53	0.341	1.39
S_4: 45 cm × 15 cm	17.30	0.359	1.48	16.29	0.353	1.42	17.10	0.343	1.40	16.40	0.337	1.37
S_5: 30 cm × 30 cm	17.32	0.372	1.68	16.43	0.365	1.56	17.12	0.360	1.51	16.83	0.343	1.48
SEd	0.48	0.012	0.04	0.46	0.011	0.04	0.31	0.009	0.04	0.55	0.012	0.04
C.D. (p=0.05)	NS	NS	0.10	NS	NS	0.10	NS	NS	0.10	NS	NS	0.09
N and Fe nutrition												
N_1: 100% RDN*	17.25	0.363	1.51	16.27	0.358	1.49	16.97	0.352	1.43	16.44	0.338	1.38
N_2: 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	17.38	0.367	1.56	16.50	0.359	1.52	17.10	0.347	1.48	16.37	0.342	1.37
N_3: 125% RDN	17.40	0.370	1.63	16.74	0.362	1.60	17.14	0.350	1.55	16.85	0.345	1.46
N_4: 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	17.52	0.372	1.65	16.76	0.367	1.62	17.42	0.360	1.54	16.87	0.348	1.51
SEd	0.52	0.012	0.04	0.39	0.009	0.04	0.44	0.009	0.04	0.44	0.009	0.05
C.D. (p=0.05)	NS	NS	0.07	NS	NS	0.08	NS	NS	0.07	NS	NS	0.10

Interaction is absent
*RDN: Recommended Dose of Nitrogen

Table 3: Effect of crop geometry and nutrient management practices on iron content (Fe) (ppm) in baby corn and crude fibre content (CFC) (%) in babycorn fodder

Treatments	*Rabi*				Summer			
	2016-17		2017-18		2017		2018	
Crop geometry	Fe content (ppm)	CFC (%)	Fe content (ppm)	CFC (%)	Fe content (ppm)	CFC (%)	Fe content (ppm)	CFC (%)
S_1: 60 cm × 20 cm	8.07	39.16	8.10	35.57	7.81	40.69	7.87	41.13
S_2: 60 cm × 15 cm	8.13	38.03	7.98	34.69	7.78	39.55	7.96	38.89
S_3: 45 cm × 20 cm	7.84	37.85	7.80	34.45	7.66	38.95	7.52	37.88
S_4: 45 cm × 15 cm	7.72	37.25	7.78	33.93	7.60	38.69	7.45	37.14
S_5: 30 cm × 30 cm	8.00	38.29	7.95	35.12	7.72	39.40	7.59	40.46
S.Ed	0.26	0.98	0.20	0.74	0.12	1.05	0.23	0.60
C.D. (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
N and Fe nutrition								
N_1: 100% RDN*	7.19	36.83	7.23	35.23	6.09	38.94	6.84	39.38
N_2: 100% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	7.72	37.43	7.67	35.88	7.51	39.03	7.42	40.10
N_3: 125% RDN	8.12	34.08	8.01	32.09	7.92	35.50	7.79	35.85
N_4: 125% RDN *fb* $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS	8.62	34.60	8.59	32.87	8.42	36.33	8.32	36.79
S.Ed	0.24	1.07	0.17	1.05	0.22	1.25	0.22	0.99
C.D. (p=0.05)	0.49	2.16	0.35	2.14	0.45	2.53	0.44	2.02

Interaction is absent
*RDN: Recommended Dose of Nitrogen

a significant increase in the iron content of babycorn over the seasons (8.62, 8.59, 8.42 and 8.32 ppm during *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively) followed by application of 125% RDN alone (N_3) which maintained statistical parity with N_2 (100% RDN + $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS) indicating the significance of iron in enhancing the iron content of babycorn. Lower iron content was recorded with N_1 (100% RDN) (Table 3). Interaction effect between the treatments was not significant.

Crude fibre in babycorn fodder

Crop geometry did not show any significant influence on the crude fibre content of babycorn fodder regardless of the season (Table 3).

Irrespective of seasons, the nutrient treatments showed a considerable effect on the crude fibre content of babycorn fodder wherein 100% RDN applied to babycorn along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_2) recorded significantly higher crude fibre values of 37.43, 35.88, 39.03 and 40.10 per cent in *rabi* 2016-17, 2017-18 and summer 2017 and 2018 seasons, respectively and were on par with 100% RDN (N_1). Lower values of crude fibre content in babycorn fodder were registered with 125% RDN (N_3) which was at par with 125% RDN along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) (Table 3). Interaction effect between the treatments was non-significant.

Discussion

Effect of crop geometry on quality parameters of babycorn

Crop geometry did not show any significant influence on the quality parameters excepting starch content and sugar content of baby corn. Babycorn raised at 60 × 20 cm (S_1) registered higher starch content and sugar content and was on par with S_2 (60 × 15 cm). This was due to higher availability of resources and better photosynthetic rate and other physiological activities of the individual plants under the wider spacing levels. However, it is on contrary to the findings of Cox and Cherney (2001) that crude protein decreased with increasing plant population density. The findings of Ottman and Welch (1989) [20] indicated that planting pattern has an inconsistent effect on plant nutrient concentration. Similar results were also obtained by Ramachandrappa *et al.* (2004) [22], Kar *et al.* (2006) [15], Sahoo and Mahapatra (2007) [27], Thavaprakaash *et al.* (2008) [30]; and Gosavi and Bhagat (2009) [10].

Fodder quality also did not differ due to varied crop geometry. Thavaprakaash *et al.* (2008) [30] opined that quality parameters of babycorn fodder were not affected due to crop geometry since there was no change in the growth nature of the babycorn. Similarly, Rathika *et al.* (2008) [24] did not find any variation on fodder quality characters of babycorn due to varied level of spacing.

Effect of nitrogen and iron foliar nutrition on quality parameters of babycorn

From the data it is evident that quality parameters *i.e.*, crude protein, starch, total sugars, calcium and iron contents of babycorn increased with increase in fertilization levels up to 125% RDN followed by $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) except for vitamin A and C content. The level N_4 was on par with the application of 125% RDN (N_3). Similar results were observed by Singh *et al.* (2010) [28] and Kumar and Bohra (2014) [16].

The increase in crude protein content with the increase in nitrogen rate was due to the enhanced nitrogen metabolism resulting greater production of aminoacids. The results are in conformity with the results of Ramachandrappa *et al.* (2004) [22], Eltelib *et al.* (2006) [6], Kar *et al.* (2006) [15], Kunjir *et al.* (2007) [18]; and Gosavi and Bhagat (2009) [10].

The increase in starch and total sugars with the increase in N rate might be attributed to the role of N in various physico-chemical activities in the plant. These results get support from the findings of Raja (2001) [21], Singh *et al.* (2010) [28], Neupane and Mahajan (2013) [19]; and Kumar and Bohra (2014) [16].

Significant improvement of calcium content in babycorn with increasing levels of fertilizer up to 125% RDN might be due to higher fertilizer level promoting the growth of young root tips by enhancing meristematic activity. Ca^{2+} can be absorbed only by young root tips in which cell walls of endodermis are still unsuberised. Similar reports were observed by Sujatha *et al.* (2008).

Nitrogen along with foliar nutrition of Fe increased the Fe content in baby corn. This might be due to the fact that foliar application of $FeSO_4$ facilitated a rapid and better translocation of the applied nutrient which might have increased the phytase activity and thus, the iron concentration in babycorn. Similar findings were observed by Yuan *et al.* (2013) [31] in rice and; Rezapour-Osalou *et al.* (2015) [25] and Kumar and Salakinkop (2017) [17] in maize.

Interaction effect of crop geometry and nutrient levels on quality parameters of babycorn

The interaction effect between the main plot and sub plot treatments was not statistically pronounced on the quality parameters of babycorn. Babycorn is harvested at a very early stage unlike maize and the transfer of photosynthates from source to sink is incomplete. Therefore, the difference between the treatments in terms of quality aspect of babycorn might not have been so prominent. Similar findings were reported by Ramachandrappa *et al.* (2004) [22] and Thavaprakaash *et al.* (2008) [30].

Conclusion

Crop geometry did not show any significant influence on the quality parameters of babycorn and its fodder during the course of investigation excepting starch content and sugar content of babycorn. Babycorn raised at 60 × 20 cm (S_1) registered higher sugar content and starch content and was on par with S_2 (60 × 15 cm). With increase in fertilization levels, quality parameters *i.e.*, crude protein, starch, total sugars, calcium and iron contents of babycorn except vitamin A and C content also increased up to the level of 125% RDN applied along with $FeSO_4$ foliar spray @ 1% at 30 and 45 DAS (N_4) and was on par with the application of 125% RDN alone. The interaction effect was not statistically pronounced on the quality parameters of babycorn.

References

1. Aciksoz SB, Yazici A, Ozturk L, Cakmak I. Biofortification of wheat with iron through soil and foliar application of nitrogen and iron fertilizers. Plant and Soil 2011;349(1-2):215-225.
2. Bhat J. agropedia.iitk.ac.in./content/ babycorn 2013.
3. Bairagi S, Pandit M, Sidhya P, Adhikary S, Koundinya A. Impacts of date of planting and crop geometry on growth and yield of babycorn (*Zea mays var. rugosa*). Journal Crop and Weed 2015;11(2):127-131.
4. Chaudhary R. Effect of plant population and fertility levels on yield and quality of babycorn (*Zea mays* L.). MPUAT, Udaipur 2006.
5. Crop Production Techniques of Horticultural Crops. Horticultural College and Reasearch Institute, TNAU, Coimbatore 2013.
6. Eltelib HA, Hamad MA, Ali EE. The Effect of Nitrogen and Phosphorus fertilization on growth, yield and quality of forage maize (*Zea mays* L.). J. Agron 2006;5(3):515-518.
7. Goering H, Van Soest P. Forage fiber analysis. United States Department of Agriculture. Agriculture Handbook 1970;379:1-20.
8. Golada SL, Sharma GL, Jain H. Performance of babycorn (*Zea mays* L.) as influenced by spacing, nitrogen fertilization and plant growth regulators under sub humid condition in Rajasthan, India. African Journal of Agricultural Research 2013;8(12):1100-1107.
9. Gomez KA, Gomez AA. Statistical procedures for agricultural research: John Wiley & Sons 1984.
10. Gosavi S, Bhagat S. Effect of nitrogen levels and spacing on yield attributes, yield and quality parameters of babycorn (*Zea mays*). Annals of Agricultural Research 2009,30(3&4).
11. Havlin JL, Beaton JD, Tisdale SL, Nelson WL. Soil fertility and fertilizers: An introduction to nutrient management. Pearson Prentice Hall Upper Saddle River,

NJ 2005,515v.
12. Horwitzs W. Official methods of analysis of the Association of Official Analytical Chemist. Washington DC: AOAC 1975.
13. Humphries E. Mineral components and ash analysis. Moderne Methoden der Pflanzenanalyse/Modern Methods of Plant Analysis Springer 1956,468-502p.
14. Jackson M. Estimation of Phosphorus Content: Soil Chemical Analysis. Printer Hall, New Delhi (India) 1973.
15. Kar P, Barik K, Mahapatra P, Garnayak L, Rath B, Bastia D *et al*. Effect of planting geometry and nitrogen on yield, economics and nitrogen uptake of sweet corn (*Zea mays*). Indian Journal of Agronomy 2006;51(1):43-45.
16. Kumar R, Bohra JS. Effect of NPKS and Zn application on growth, yield, economics and quality of babycorn. Archives of Agronomy and Soil Science 2014;60(9):1193-1206.
17. Kumar N, Salakinkop S. Influence of Agronomic Bio-fortification of Zinc and Iron on Their Density in Maize Grain and Nutrients Uptake. Int. J Environ. Sci. Nat. Res 2017;7(2):1-5.
18. Kunjir S, Chavan S, Bhagat S, Zende N. Effect of planting geometry, nitrogen levels and micronutrients on the growth and yield of sweet corn. Crop Protection and Production 2007;2(3):25-27.
19. Neupane M, Mahajan G. Effect of nitrogen sources and row spacing on yield and quality of babycorn (*Zea mays*). Current Advances in Agricultural Sciences (An International Journal) 2013;5(1):64-67.
20. Ottman M, Welch L. Planting patterns and radiation interception, plant nutrient concentration, and yield in corn. Agronomy Journal 1989;81(2):167-174.
21. Raja V. Effect of nitrogen and plant population on yield and quality of super sweet corn (Zea mays). Indian Journal of Agronomy 2001;46(2):246-249.
22. Ramachandrappa B, Nanjappa H, Shivakumar H. Yield and quality of babycorn (*Zea mays* L.) as influenced by spacing and fertilization levels. Acta Agronomica Hungarica 2004;52(3):237-243.
23. Rani R, Sheoran R, Soni PG, Kaith S, Sharma A. Babycorn: A Wonderful Vegetable. International Journal of Science, Environment and Technology 2017;6(2):1407-1412.
24. Rathika S, Velayudham K, Muthukrishanan P, Thavaprakaash N. Effect of crop geometry and topping practices on the productivity of babycorn (*Zea mays* L.) based intercropping systems. Madras Agricultural Journal 2008;95(7/12):380-385.
25. Rezapour-Osalou P, Tajbakhsh M, Asri-Rezaei S, Hasanzadeh A. Foliar application of nano-Fe_3O_4 induced Iron Content and Phytase Activity in corn seed Single Cross 704. Cumhuriyet Science Journal 2015;36(3):664-671.
26. Sadasivam S, Manickam A. Biochemical Methods New Age International (P) Ltd. Publishers, New Delhi 1996.
27. Sahoo S, Mahapatra P. Yield and economics of sweet corn (*Zea mays*) as affected by plant population and fertility levels. Indian Journal of Agronomy 2007;52(3):239-242.
28. Singh M, Singh R, Singh S, Yadav M, Singh V. Integrated nutrient management for higher yield, quality and profitability of babycorn (*Zea mays*). Indian Journal of Agronomy 2010;55(2):100.
29. Sukanya T, Najnappa H, Ramchandrappa B. Effect of spacings on the growth, development and yield of babycorn varieties. Karnataka J. Agric. Sci 2000;12(1-4):10-14.
30. Thavaprakaash N, Velayudham K, Muthukumar V. Response of crop geometry, intercropping systems and INM practices on yield and fodder quality of babycorn. Asian Journal of Scientific Research 2008;1(2):153-159.
31. Yuan L, Wu L, Yang C, Lv Q. Effects of iron and zinc foliar applications on rice plants and their grain accumulation and grain nutritional quality. Journal of the Science of Food and Agriculture 2013;93(2):254-261.