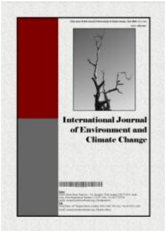

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Influence of Dates of Sowing and Planting Geometry on Yield, Nutrient Uptake and Economics of Baby Corn

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

During the *summer* season of 2018, a field experiment was conducted at Assam Agricultural University, Jorhat. The treatments consisted of four date of sowing *viz.,* 20th February (D_1), 2nd March (D_2), 12th March (D_3) and 22nd March (D_4) in main plot and four planting geometry practices *viz.,* 40 cm x 20 cm (S_1), 40 cm x 25 cm (S_2), 45 cm x 20 cm (S_3) and 45 cm x 25 cm (S_4), in sub-plot with three replications. The results revealed that 2nd March sowing recorded higher plant height, number of cobs per plant, weight of cob, cob yield and fodder yield which was at par with 12th March sowing and significantly higher than other sowing dates. Similar effects of these treatments were also observed in respect to N, P, K uptake and economics. Among the different planting geometry, yield of cob without husk and fodder yield, gross return and net return were found to be higher under spacing 45 cm x 20 cm as compared to others. Total N, P and K uptake were also found to be higher under 45 cm x 20 cm spacing than rest of the planting geometry. Planting geometry had non-significant effect on available N,P_2O_5 and K_2O status of soil after harvest of the crop.

Keywords: Baby corn; planting geometry; dates of sowing; yield; nutrient uptake.

1. INTRODUCTION

Baby corn is a high-value crop used as a vegetable that can help poor farmers diversify their agricultural and enhance their income. It is a common ingredient in salads and soups. The waste portion which is not edible such as stem, leaves, fiber etc., can be fed to cattle as green fodder. Baby corn as a cash crop for intensive agro- ecosystems, in which small farmers

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cultivate three or more crops in a highly varied cropping system. Baby corn is the immature ear of conventionally grown maize harvested within 2-3 days of silking, not genetically dwarf maize as the name implies. Although the agronomic demands of baby corn are comparable to those of regular maize, they must be examined for local agro-climatic conditions, such as the appropriate variety, high plant population per unit area, nitrogen requirements, and planting date. Aside from the various components, the date of planting and plant population per unit area are important factors in determining the yield and quality of baby corn. The date of sowing is a non-monetary input that has a substantial impact on crop output and productivity. According to Monneveux et al., optimal crop geometry is one of the crucial variables for improved productivity since it allows for optimum use of subsurface resources as well as gathering maximum sun radiation, which leads to enhanced photosynthesis [1].

2. MATERIALS AND METHODS

During the summer of 2018, the field experiment was conducted at Assam Agricultural University in Jorhat. With an altitude of 86.6 metres above mean sea level, the site is located at 26°47'N latitude and 94°12'E longitude.

The experiment was laid out in a split-plot design with three replications. The treatments consisted of four dates of sowing *viz.,* 20th February (D_1), 2nd March (D_2), 12th March (D_3), 22nd March (D_4) in main plot and four planting geometry practices *viz.,* 40 cm x 20 cm (S_1), 40 cm x 25 cm (S_2), 45 cm x 20 cm (S_3), 45 cm x 25 cm (S_4), in sub-plot. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.06), medium in organic carbon (0.74%), available N (232.21 kg/ha), available P_2O_5 (25.36 kg/ha) and available K_2O (168.72 kg/ha).

Jorhat district is characterized with sub-tropical and humid climate having warm summers and cold winters. This region receives an average annual rainfall of 2500 mm. The monsoon starts from the month of June and continues up to the month of September with the pre-monsoon shower starting from mid-March, most of which is received during the monsoon period. During the crop growth period, the weekly mean maximum temperature ranged from 23.7ºC to 34.5ºC and the weekly mean minimum temperature ranged from 14.5ºC to 25.1ºC. The weekly average relative humidity during the morning hours ranged from 85 per cent to 97 per cent while mean evening relative humidity ranged from 56 per cent to 82 per cent.

The total precipitation received was 617.5 mm during the crop season from 19thFeb to 15th June, 2018, out of which maximum amount (86.3 mm and 99.4 mm) was received in the last week of May and second week of June. The bright sunshine hours during the crop growing season ranged from 1.0 to 7.1 hours/day.

3. RESULTS AND DISCUSSION

3.1 Growth, Yield Attributes and Baby Corn Yield Without Husk (q/ha)

Data in Table 1 revealed that sowing on 2nd March recorded highest plant height which was at par with 12th March sowing. Sowing dates had a significant effect on number of cobs per plant and cob weight without husk. Maximum number of cobs per plant and weight of cobs without husk were recorded in 2nd March sowing which was at par with 12th March sowing and significantly higher than the other dates of sowing. The maximum baby corn yield without husk was found (18.08 q/ha) on 2nd March sowing which was statistically comparable with the yield obtained in 12th March and both were significantly higher than the sowing dates 20th Feb and 22nd March. This might be due to the fact that late sowing dates were badly affected by higher rainfall before harvesting. Another reason could be that the 2nd March seeding of baby corn produced highest value of growth and yield qualities, resulting in a higher yield. This could be because early sowing of baby corn resulted in more photosynthates being partitioned from source to sink, resulting in better baby corn and fodder yields. Tamadon [2] reported similar results. Among the different planting geometry, highest plant height was recorded in 40 cm x 20 cm spacing which was at par with 45 cm x 20 cm. The higher plant height in closer spacing might be due to increase in competition for sunlight, nutrients, space and water by the plants. The results are in conformity with the findings of Verma et al [3]. Number of cobs per plant and weight of cobs per plant were highest in 45 cm x 25 cm. But baby corn yield without husk was the highest with spacing of 45 cm x 20 cm (16.96 q/ha) which was at par with 45 cm x 25 cm but significantly higher than 40 cm x 20 cm and 40 cm x 25 cm. The lowest yield of cob without husk was noticed with 40 cm x 20 cm (13.41 q/ha). Yield of the crop is function of several yield components which are dependent on complementary interaction between vegetative and reproductive growth of the crop. The highest yield of baby corn without husk was recorded with spacing 45 cm x 20 cm which might be due to optimum plant population (1, 11,000 plants/ha). The yield obtained under spacing 45 cm x 20 cm was statistically at par with 45 cm x 25 cm (89,000 plants/ha) but significantly higher than 40 cm x 25 cm (1, 00,000 plants/ha) and 40 cm x 20 cm (1, 25,000 plants /ha). The yield was lowest when the spacing was 40 cm × 20 cm. All yield-attributing features were at their best with a larger spacing of 45 cm x 25 cm, but the lower plant population per unit area could not compensate for the lower baby corn yield attained under a spacing of 45 cm x 20 cm. These findings are consistent with previous findings by Arvadiya et al. [4], Thavaprakaash and Velayudham [5], Ghosh et al. [6], Neelam and Dutta [7].

3.2 Dry Yield of Baby Corn (q/ha)

Result presented on Table 1 indicated that the date of sowing had a significant effect on the dry yield of baby corn without husk. The highest dry yield of baby corn was recorded on sowing date 2^{nd} March (3.05 q/ha), which was significantly higher than other date of sowing.

Dry yield of baby corn without husk was the highest with spacing of 45 cm x 20 cm (2.92 q/ha) which was at par with 45 cm x 25 cm but significantly higher than 40 cm x 20 cm and 40 cm x 25 cm.

3.3 Fodder Yield (q/ha)

Table 1 indicates that the green fodder yield of baby corn was significantly influenced by date of sowing. The highest green fodder yield (276.55 q/ha) was recorded by sowing baby corn on 2^{nd} March followed by 12^{th} March (266.45 q/ha) which were at par with each other. The lowest green fodder yield was obtained in 22^{nd} March (245.84 q/ha). It might be due to highest plant height and better growth in these two dates of sowing.

The effect of planting geometry on fodder yield was found to be significant. The maximum fodder yield was obtained in 45 cm x 20 cm spacing which was statistically at par with yield obtained in 40 cm x 20 cm but significantly higher than 40 cm x 25 cm and 45 cm x 25 cm spacing. The enhanced yield under spacing 45 cm x 20 cm could be related to a higher green fodder production of baby corn due to the optimal number of plants per unit area, which is similar to spacing 40 cm x 20 cm.

3.4 Dry Fodder Yield (q/ha)

The influence of date of sowing was found to be significant on dry fodder yield. The highest yield was recorded on 2^{nd} March which was at par with 12^{th} March. On the other hand the lowest yield was obtained in the sowing date 22^{nd} March because late sown crop was badly affected by rainfall before harvest.

The effect of planting geometry on dry fodder yield was found to be significant. The maximum dry fodder yield was obtained in 45 cm x 20 cm spacing which was statistically at par with yield obtained in 40 cm x 20 cm but significantly higher than 40 cm x 25 cm and 45 cm x 25 cm. However, the yield obtained in spacing 40 cm x 25 cm was at par with 45 cm x 25 cm.

Closer spacing of 40 cm × 20 cm resulted in a lower green fodder yield than 45 cm x 20 cm, although it was statistically comparable to 45 cm x 20 cm. It could be due to the increasing barrenness under 40 cm x 20 cm spacing, where the availability of growth components such as light, water, and nutrients to plants is influenced by plant interaction and resource efficiency. The greater dry fodder production under spacing 45 cm x 20 cm could be attributable to a higher green fodder yield of baby corn, which is comparable to spacing 40 cm x 20 cm. The lower green fodder production was seen under 45 cm x 25 cm spacing, which was owing to the fact that there were less plants per unit area under this planting geometry than in the other treatments. Sobhana et al [8], Thakur and Sharma [9], and Neelam and Dutta [7] all obtained similar findings for green fodder output of baby corn, stating that green fodder yield increased significantly with decrease in spacing, i.e. with improved plant population.

3.5 Nitrogen Content and Uptake

There was no significant difference was observed on nitrogen content in both baby corn and fodder (Table 2).

The influence of date of sowing was found to be statistically significant in case of nitrogen uptake by baby corn and fodder. The highest uptake was recorded under 2^{nd} March sowing which was at par with 12th March sowing .This might be due to higher dry matter production in these dates. Similar results were observed in total N uptake.

The effect of planting geometry on nitrogen uptake by cob and fodder were found to be significant. The N uptake was the highest in 45 cm x 20 cm spacing which was comparable to 45 cm x 25 cm and 40 cm x 25 cm but all these were significantly higher than 40 cm x 20 cm. Total uptake also follows the similar trend. It might be because of the availability of growth resources (light, nutrient, moisture *etc.*) in optimum quantity.

3.6 Phosphorus Content and Uptake

The influence of dates of sowing could not produce any significant difference in case of P content by cob and fodder. But phosphorus uptake by cob and fodder were significantly affected and highest was recorded on 2nd March sowing which was at par with 12th March sowing. Same trend was observed in total P uptake.

But planting geometry significantly affected the phosphorus uptake. Total P uptake by baby corn was higher in 45 cm x 25 cm which was statistically at par with spacing 45 cm x 20 cm but both were significantly higher than 40 cm x 20 cm and 40 cm x 25 cm. Significantly higher uptake by fodder was noticed in spacing 45 cm x 20 cm as compared to 40 cm x 20 cm but was at par with 45 cm x 25 cm and 40 cm x 25 cm.

There was significant effect of dates of sowing on total uptake of P by baby corn (Table 3). The significantly higher total P uptake was noticed in spacing 45 cm x 20 cm which was at par with 45 cm x 25 cm but both were significantly higher than the spacing 40 cm x 20 cm and 40 cm x 25 cm. This might be due to higher dry matter production in 45 cm x 20 cm which leads to higher uptake.

3.7 Potassium Content and Uptake

The influence of sowing date and planting geometry on K content in cob and fodder was found to be statistically non-significant. Data presented in Table 4 showed that K uptake by the baby corn, fodder and total uptake were significantly influenced by the sowing dates and planting geometry. The highest K uptake was recorded in crop sown on 2nd March which was at par with 12th March and significantly higher than 22nd March sowing. Similar trend was observed in total K uptake also.

Among the different planting geometry, the highest uptake was noticed in spacing 45 cm x 20 cm which was at par with 45 cm x 25 cm but significantly higher than 40 cm x 25 cm and 40 cm x 20 cm. The lowest uptake of K was recorded under 40 cm x 20 cm spacing. Total uptake also followed the similar trend.

At wider spacing (45 cm x 25 cm), the rhizosphere will develop properly, without any mutual competition among the plants and thereby creating favourable environment for higher uptake of nutrients. N, P and K uptake in 40 cm x 20 cm spacing was significantly lesser than 45 cm x 20 cm and 45 cm x 25 cm because less amount of nutrients were available per plant due to different types of competition during different crop growth stages and thereby plants failed to extract desired quantity of nutrients from the soil. Higher N, P and K content by fodder under the wider spacing of 45 cm x 25 cm might due to better vegetative growth of the plants due to more availability of sunlight, water and space, which favoured the growth of plants. These results are in close conformity with Thavaprakaash and Velayudham [5], Sobhana et al [10] ,Neelam and Dutta [1].

3.8 Available Nutrient Content in Soil (kg/ha)

Different treatments failed to produce any significant differences in case of available nutrient status in soil after harvest.

3.9 Economics

The date of sowing 2nd March was found most remunerative and gave maximum gross returns (₹1,72,327.69/ha) and net returns (₹1,38,831.44 /ha) and benefit-cost ratio (4.15), followed by 12th March given gross returns (₹1,57,325.23/ha) and net returns (₹1,23,828.98/ha) and benefit-cost ratio (3.71). The lowest economic return was recorded during the sowing date 22nd March which gave gross returns (₹1, 22,930.60/ha) and net returns of (₹89,434.35/ha) and benefit-cost ratio (2.67).

In the present study, the spacing 45 cm x 20 cm recorded the higher gross return (₹ 1,62,763.61/ha), net return (₹ 1,29,209.61/ha) and benefit-cost ratio (3.85) than the other spacing treatments of 40 cm x 20 cm, 40 cm x 25 cm and 45 cm x 25 cm (Table 4). Spacing 40 cm x 20 cm recorded the lowest gross return (₹ 1,33,569.97/ha), net return (₹99,112.97/ha) and benefit-cost ratio (2.88).

Table 1. Influence of dates of sowing and planting geometry on yield of baby corn

Treatments	Plant height at harvest(cm)	No. of baby corn per plant	Weight of baby corn without husk (g)	Baby corn yield without husk (q/ha)	Dry yield of baby corn without husk (q/ha)	Green fodder yield (q/ha)	Dry fodder Yield (q/ha)
Dates of sowing							
20th February	168.11	1.45	9.80	12.96	2.15	250.52	92.51
2nd March	185.03	2.34	11.40	18.08	3.05	276.55	102.01
12th March	177.56	2.20	11.16	16.34	2.72	266.45	98.36
22nd March	166.28	1.18	8.80	12.29	2.07	245.84	90.77
S.Ed(±)	3.47	0.29	0.53	1.10	0.13	6.50	2.31
CD(0.05)	8.50	0.71	1.30	2.69	0.31	15.91	5.66
Planting geometry							
40 cm x 20 cm	179.51	1.22	8.75	13.41	2.14	262.95	97.30
40 cm x 25 cm	170.87	1.92	10.99	13.70	2.20	256.72	94.96
45 cm x 20 cm	177.06	1.56	9.86	16.96	2.92	270.47	100.09
45 cm x 25 cm	169.54	2.46	11.60	15.60	2.72	249.21	91.30
S.Ed(±)	2.91	0.20	0.41	1.22	0.25	6.64	2.43
CD (0.05)	6.00	0.42	0.85	2.52	0.51	13.70	5.02

Table 2. Influence of date of sowing and planting geometry on nitrogen content and nitrogen uptake by baby corn

Treatments	N content (%)		N uptake (kg/ha)		Total N uptake (kg/ha)
Dates of sowing	**Baby corn**	**Fodder**	**Baby corn**	**Fodder**	
20th February	1.97	0.63	4.13	58.00	62.13
2nd March	1.79	0.69	5.42	69.64	75.07
12th March	1.74	0.67	4.76	65.10	69.86
22nd March	2.05	0.57	4.06	55.86	59.92
S.Ed(±)	0.22	0.07	0.47	3.88	4.10
CD(0.05)	NS	NS	1.27	8.00	8.45
Planting geometry					
40 cm x 20 cm	1.89	0.58	3.70	57.21	60.91
40 cm x 25 cm	2.07	0.61	4.59	59.21	63.81
45 cm x 20 cm	1.77	0.65	5.14	66.68	71.82
45 cm x 25 cm	1.83	0.71	4.94	65.51	70.44
S.Ed(±)	0.15	0.05	0.29	3.61	3.72
CD(0.05)	NS	NS	0.61	7.46	7.68

Table 3. Influence of dates of sowing and planting geometry on phosphorus content and phosphorus uptake by baby corn

Treatments	P content (%)		P uptake (kg/ha)		Total P uptake (kg/ha)
Dates of sowing	**Baby corn**	**Fodder**	**Baby corn**	**Fodder**	
20th February	0.49	0.15	1.04	13.71	14.74
2nd March	0.45	0.16	1.30	15.91	17.20
12th March	0.43	0.15	1.11	15.00	16.11
22nd March	0.52	0.14	1.04	13.48	14.51
S.Ed(±)	0.04	0.01	0.07	0.62	0.83
CD (0.05)	NS	NS	0.14	1.27	1.71
Planting geometry					
40 cm x 20 cm	0.46	0.13	0.92	13.35	14.28
40 cm x 25 cm	0.48	0.14	1.03	13.83	14.86
45 cm x 20 cm	0.46	0.15	1.27	15.48	16.74
45 cm x 25 cm	0.49	0.17	1.28	15.44	16.69
S.Ed(±)	0.03	0.01	0.11	0.87	0.87
CD (0.05)	NS	NS	0.22	1.80	1.79

Table 4. Influence of dates of sowing and planting geometry on potassium content and potassium uptake by baby corn

Treatments	K content (%)		K uptake (kg/ha)		Total K uptake (kg/ha)
Dates of sowing	**Baby corn**	**Fodder**	**Baby corn**	**Fodder**	
20th February	0.56	0.84	1.34	77.57	78.91
2nd March	0.54	0.87	1.48	85.20	86.68
12th March	0.55	0.85	1.40	83.43	84.83
22nd March	0.57	0.82	1.30	76.39	77.69
S.Ed(±)	0.01	0.03	0.07	3.45	3.71
CD (0.05)	NS	NS	0.14	7.10	7.64
Planting geometry					
40 cm x 20 cm	0.56	0.79	1.18	76.35	77.53
40 cm x 25 cm	0.57	0.81	1.25	76.87	78.12
45 cm x 20 cm	0.53	0.86	1.57	86.39	87.95
45 cm x 25 cm	0.56	0.92	1.51	82.98	84.50
S.Ed(±)	0.02	0.05	0.12	3.34	3.37
CD (0.05)	NS	NS	0.25	6.89	6.95

Table 5. Influence of date of sowing and planting geometry on available N, P_2O_5 and K_2O content of soil after harvest

Treatments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Dates of sowing			
20th February	237.22	23.97	133.71
2nd March	230.21	20.62	131.39
12th March	233.23	22.98	132.59
22nd March	241.62	25.81	135.29
S.Ed(±)	33.63	3.91	28.79
CD (0.05)	NS	NS	NS
Planting geometry			
40 cm x 20 cm	240.24	24.21	135.14
40 cm x 25 cm	237.74	23.33	134.41
45 cm x 20 cm	230.72	22.79	130.71
45 cm x 25 cm	233.58	23.06	132.73
S.Ed(±)	13.42	3.03	30.95
CD (0.05)	NS	NS	NS

Table 6. Influence of date of sowing and planting geometry on economics of baby corn

Treatments	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
Dates of sowing				
20th February	33496.25	128726.42	95230.17	2.85
2nd March	33496.25	172327.69	138831.44	4.15
12th March	33496.25	157325.23	123828.98	3.71
22nd March	33496.25	122930.60	89434.35	2.67
Planting geometry				
40 cm x 20 cm	34457.00	133569.97	99112.97	2.88
40 cm x 25 cm	33857.00	135248.83	101391.83	2.99
45 cm x 20 cm	33554.00	162763.61	129209.61	3.85
45 cm x 25 cm	32117.00	149727.51	117610.51	3.66

4. CONCLUSION

The timing of the sowing of baby corn on March 2nd had a major impact on its growth, yield qualities, cob yield, and fodder production. Similarly, a 45 cm x 20 cm planting geometry resulted in highest baby corn and green fodder yields. In Assam, the better performance of baby corn throughout the summer season can be obtained by sowing the seed on March 2nd with a spacing of 45 cm x 20 cm, resulting in increased output and a profitable economic return.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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