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Performance of Baby Corn under Different Plant Densities and Fertility Levels in Lateritic Soils of Eastern India

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ABSTRACT

Maize cultivation for vegetable purpose, such as baby corn is a diversified and value addition in food industries. Baby corn is the female inflorescence in the maize plant, harvested at silk emergence and is sweet in taste and crisp. A field experiment was conducted on lateritic medium fertile soil during the summer season of 2008 at the agricultural farm of Palli Siksha Bhavana (Institute of Agriculture), Visva Bharati, Sriniketan, West Bengal to study the performance of baby corn under varying plant densities and fertility levels. The experiment consisting of three fertility levels and four levels of plant densities was laid out in factorial randomized block design with three replications. The results showed that growth, cob yield in cob number/ha, young corn yield, fodder yield (q/ha) and benefit/cost ratio were found maximum at high fertility level (100-50-50 kg N-P_2O_5-K_2O/ha). Cob yield (q/ha) increased significantly up to high fertility, but young baby corn yield increased significantly up to medium fertility (75-37.5-37.5 kg N-P_2O_5-K_2O/ha). Plant density of 1,00,000 plants/ha was found to be superior than others. Cob number/ha increased significantly up to 100,000 plants/ha. Highest cob yield, young corn yield and benefit/cost ratio were also found at the density of 1,00,000 plants/ha; but in case of fodder yield, it was maximum with 1,20,000 plants/ha. Baby corn grown at a density of 1,00,000 plants/ha under high fertility (100-50-50 kg N-P_2O_5-K_2O/ha) level performed better than under other treatment combinations under the lateritic soil of eastern India.

Key words: *Summer Maize, Plant Population, Fertilizer Dose*

INTRODUCTION

Maize is the third most important cereal crop next to rice and wheat and has the highest production potential among the cereals. Growing of maize for vegetable purpose, as baby corn is a diversified and value addition in cropping system and food processing industries. Baby corn is de-husked young ear of female inflorescence in the maize plant, harvested at silk emergence before fertilization, is sweet in taste and crisp[7]. Baby corn ears are in light yellow colour with regular row arrangement, 10-12 cm long and a diameter of 1.0-1.2 cm are preferred in the market[5].

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The cultivation of maize as baby corn is in vogue in the countries like Thailand, Taiwan, China and Japan since long and in India, it is relatively new introduction. Baby corn has revolutionized the food habits by providing diversified food items in the world over. The nutritional value of baby corn is at par or even superior to some vegetables. It is a rich source of fibres, protein, vitamins and iron and easy to digest. Baby corn is highly remunerative and farmers can get a high return in a short period of 45-60 days. Baby corn cultivation provides avenues for crop diversification, value addition and revenue generation as baby corn cultivation not only produces nutritious vegetables but also provides green fodder for the livestock. Increasing natural calamities due to changing climate, the sustainable crop production and maintaining nutritional security is a big challenge. It is very much essential to provide resources judiciously and in such a manner, that it can be need based. Fertilizer management is an important window for sustainable crop production as it plays the most crucial role on growth and productivity of corn. Works on fertility management of baby corn are meagre in eastern part of India. Most of the works on fertility management are on corn production where the crop requires high dose of fertilizers application[1]. Kotch *et al*.[4] suggested that high dose of fertilizer application may not be essential as baby corn is harvested before ear maturation. Plant density plays an important role in influencing the productivity of any crop. Optimum plant density is required for obtaining high crop productivity. Baby corn needs to be planted at a spacing of 90cm between rows and 10cm between the plants within the row having a plant population of approximately 1,10,000 plant per hectare[4]. Researchers indicated a requirement of 70% extra population (1,10,000/ha) than for normal maize is (65,000/ha) for baby corn, required population can be obtained by adopting a spacing of either 45 x 20 or 60 x 15cm. Sahoo and Mahapatra[9] noted that 83,300 plants/ha produced 16.48 t/ha green cobs, which was 7.6% more than that of 66,700 plants/ha and it gave the maximum net profit. All these works indicated different plant densities of baby corn for different places. Soil fertility and plant density seem to be critical in baby corn cultivation. In one hand it may look that the same maize crop should require less nutrient since it is harvested much before grain maturity. On the other hand, when young cobs are harvested, the maize plant has the tendency to develop newer cob from the lower nodes. Hence, high nutrient supply may enhance this process. Market preference of baby corn is very much related to its size and average weight. These quality standards can be maintained by managing soil fertility and plant density. Keeping the above idea in view and realizing the importance of the problem, the study emphasizes the development of plant density and nutrient level in baby corn production in lateritic belt of Indian sub-tropic.

MATERIAL AND METHODS

Experimental site

Field experiment was conducted in the research farm of Palli Siksha Bhavana, Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal, India (23°39′ N latitude, 87°42′ E longitude and an elevation of 58.9 m above sea level). The soil of the location is sandy loam in texture and low in fertility status. The experiment was conducted in the summer (dry) season (February 26 to May 5, 2008). The minimum temperature varied from 12.4°C in February to 26.7°C in April and the maximum temperature ranged from 27.7°C in February to 41.8°C in April. The mean monthly temperature went above 35°C in May and continued till middle of June.

Experimental details and treatments

The experiment was conducted to study the effect of fertility level and plant density on growth, productivity and economics of baby corn in factorial randomized block design with three replications. The experiment included three fertility levels (F1: 100 kg N-50 kg P_2O_5-50 kg K_2O/ha; F2: 75 kg N-37.5 kg P_2O_5-37.5 kg K_2O/ha and F3: 50kg N-25kg P_2O_5-25kg K_2O/ha) and four levels plant populations (P1:

60,000 plants/ha; P2: 80,000 plants/ha; P3: 100,000 plants/ha and P4: 120,000 plants/ha). The spacing between the plants was 33.3 cm, 25 cm, 20 cm and 16.6 cm for P1, P2, P3 and P4 respectively with the fixed row spacing of 50 cm. The sources of fertilizers were urea for N, single super phosphate for P and muriate of potash for K. Half dose of nitrogen and full dose of phosphorus and potassium were applied as basal before sowing of corn. The remaining half of nitrogen was top dressed at knee high stage.

Crop management

The crop variety tested under this investigation was K 25 a hybrid of 'Kanchan Ganga Seeds Company Private Limited', and procured from local market. Seeds are light yellow in colour. All the standard crop management practices except the treatment concerned were followed for raising the summer maize crop under irrigated condition.

Observations recorded

An area 3 m^2 from each plot was ear–marked for destructive sampling and the rest of the plot was used for yield estimation. Various biometric data were recorded at different growth stages of the crop from the ear–marked area of each plot and economic yield was estimated after the final harvest. The cob number per plant, cob and corn fresh weight, corn length and corn diameter were recorded from each plot at maturity. The crop was harvested from 10 m^2 area for yield estimation in each plot.

Statistical analysis

The data were analyzed statistically by applying "Analysis of Variance" (ANOVA) technique of RCBD (Cochran and Cox, 1985). The significance of different sources of variations was tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05. Standard error of mean (SEm±) and critical difference (CD) at 5% level of significance were worked out for each character and provided in the summary tables of the results to compare the difference between the treatment means.

RESULTS AND DISCUSSION

Yield of young cob and baby corn

The young cobs were harvested as and when they matured and there were four times harvesting were made at three days interval up to maturity. High fertility level (F1) recorded significantly higher number of young cobs/ha and with increasing plant density up to 1,00,000 plants/ha, but declined marginally thereafter. The highest number of cob (1,40,000/ha) was harvested from the plot with 1,00,000 plants/ha which was statistically on a par with that of 80,000 and 1,20,000 plants/ha (Table 1). The slight decline in cob count at the highest plant density might be due to increased plant barrenness at that plant density as reported by Pandey *et al* (2002). Young cob yield differed significantly among the fertility levels. The high fertility level (F1) recorded significantly higher quantity of cob yield (71.33 q/ha) than that of the medium (F2) and low fertility (F3) level. The high and medium fertility increased the young cob yield by 46.1% and 20.2% respectively over the low fertility level. The findings of fertility effect on young cob yield also confirm the report of different authors[1,8]. The quantity of young cob yield (q/ha) differed significantly among the different plant densities. The highest total cob yield (63.67 q/ha) was recorded with 1,00,000 plants/ha which was statistically at par with that of the plant densities of 60,000 and 80,000 plants/ha (Table 1). However, the quantity of young cob yield recorded at a plant density of 1,20,000 plants/ha was also statistically at par with the yields obtained at plant densities of 60,000 and 80,000 plants/ha which was in accordance with the findings of Pandey *et al.*[6]. The baby corn yield did not follow the trend of young cob yield (Table 1) exactly. Though the highest baby corn yield was obtained with the high fertility level and was statistically at par with medium fertility. The high and medium fertility levels recorded respectively 40.5% and 27.7% higher baby corn yield from the total harvests over low fertility level. The effect of plant density on young corn yield remained non significant. The highest corn yield (10.5 q/ha) was obtained from the plot having 1,00,000 plants/ha, but it was at par with those of all other plant densities. Though plant density expressed significant effect on yield of young cob, but failed to record the same on the yield of baby corn. This was because of the fact that higher plant density improved corn/cob ratio significantly (Table 2). Higher plant densities (1,00,000 and 1,20,000 plants/ha) was capable to produce significantly higher number of baby cobs but not the quantity of young cob or corn yield in terms of q/ha. The findings may hold significance in baby corn cultivation considering that baby cob or corn can also be marketed on count basis. Higher plant density (1,00,000 plants/ha or more) was suggested by several workers to maximize the production of baby corn (Koauychai *et al.,* 2001; Pandey *et al.*[6]. The fodder yield was significantly affected by fertility levels at the time of final harvest. The fodder yield at low fertility level was significantly lower than that of both medium and high fertility levels; however, the latter two treatments were statistically at par with each other (Table 1). Increased green fodder yield of baby corn due to high fertility was also reported by several workers[1,8]. The fodder yield increased steadily due to increase in plant density and the highest fodder yield was recorded at the highest plant density (1,20,000 plants/ha) but was at par with that of the crop at 100,000 plants/ha. Both the plant densities recorded significantly higher fodder yield over that of the lower plant densities.

Cob and corn parameters

Cob fresh weight, corn fresh weight, corn length, corn diameter and corn/cob ratio were significantly influenced by the fertility levels. Medium fertility level resulted in the highest cob weight, corn weight, corn length, corn diameter and corn/cob ratio being statistically on at par with those of high fertility level. Cob fresh weights at high and medium fertility level were almost similar and significantly higher than low fertility level. Bindhani *et al.*[1] reported significant increase in length and girth of baby corn even up to with the application of 120 kg N/ha. Plant density also exerted significant effect on fresh cob weight and corn/cob ratio; but fresh corn weight, corn length and corn diameter were not affected significantly due to the variation in plant density (Table 2). The fresh cob weight at the highest plant density (P4) (36.01 g/cob) was significantly less than that of lowest plant density (P1) only. The fresh cob weight of the later plant densities (P2 and P3) were statistically at par with each other. The corn recovery was maximum when the crop was grown at 1,20,000 plants/ha as it was evident from the highest corn/cob ratio (0.18) which was significantly higher than the corn/cob ratios recorded at both 60,000 and 80,000 plants/ha. The observation that significantly lowest cob fresh weight and the highest corn/cob ratio recorded as the plant density 1,20,000 plants/ha was something noteworthy in this study which had led to nullify the effect of plant density on corn fresh weight.

Economics

Economics of baby corn was calculated on the basis of the number of cobs (Rs 0.50/cob) as market price. Though gross return, net return and benefit:cost ratio were maximum at high fertility level but those values were significantly higher over low fertility level only in case of first two parameters and the difference in benefit:cost ratio among the different fertility levels remained insignificant. High net return is the most attractive aspect of baby corn cultivation provided market channel is available. The findings of the economics of baby corn cultivation in the present study reveals a link between marketing strategies and agronomic management. If young cob can be marketed as count basis, then earning can be optimized with low to medium level of fertilizer application. The plant densities showed that the crop grown at 1,00,000 plants/ha paid the highest gross return (Rs. 76,704/ha), net return (Rs 62,368/ha) as well as benefit : cost ratio (4.34); however, 1,20,000 plants/ha density recorded the above economic parameters statistically on a par with those of 1,00,000 plants/ha density (Table 3). However, researcher suggested that the increased net return and benefit:cost ratio can be increased up to 1,33,000 plants/ha [7].

Table 1: Effect of fertility level and plant density on cob number, cob yield, corn yield and fodder yield of summer maize grown as baby corn

Treatment	Cob number (ha^{-1})	Young cob yield (q ha^{-1})	Baby corn yield (q ha^{-1})	Fodder yield (q ha^{-1})
Fertility level				
F_1 (100-50-50 kg N-P_2O_5-K_2O/ha)	1,42,216	71.33	11.00	187.06
F_2 (75-37.5-37.5 kg N-P_2O_5-K_2O/ha)	1,25,416	58.67	10.00	174.55
F_3 (50-25-25 kg N-P_2O_5-K_2O/ha)	1,10,000	48.83	7.83	167.89
SEm (±)	6,383	2.50	0.50	4.71
C D at 5%	18,750	7.33	1.50	13.81
Plant density (plants/ha)				
P_1 (60,000)	108,333	62.00	9.00	154.92
P_2 (80,000)	120,000	58.67	9.00	167.64
P_3 (100,000)	140,000	63.67	10.50	187.21
P_4 (120,000)	136,850	54.33	9.67	196.24
SEm (±)	7366	2.83	0.67	5.44
C D at 5%	21,666	8.33	NS	15.95

SEm(±) = Standard error of mean; CD = Critical difference

Table 2: Effect of fertility level and plant density on cob parameters of summer maize grown as baby corn

Treatment	Cob fresh weight (g/cob)	Corn fresh weight (g/corn)	Corn length (cm)	Corn diameter (cm)	Corn/Cob ratio*
Fertility level					
F_1 (100-50-50 kg N-P_2O_5-K_2O/ha)	44.14	6.66	7.68	1.19	0.15 (0.39)
F_2 (75-37.5-37.5 kg N-P_2O_5-K_2O/ha)	44.18	7.42	7.97	1.24	0.17 (0.41)
F_3 (50-25-25 kg N-P_2O_5-K_2O/ha)	36.18	5.54	6.98	1.12	0.15 (0.39)
SEm (±)	2.05	0.28	0.16	0.02	0.01
C D at 5%	6.01	0.83	0.46	0.06	NS
Plant density (plants/ha)					
P_1 (60,000)	47.01	6.74	7.60	1.18	0.14 (0.37)
P_2 (80,000)	41.50	6.21	7.58	1.18	0.14 (0.38)
P_3 (100,000)	41.49	6.74	7.56	1.19	0.16 (0.40)
P_4 (120,000)	36.01	6.48	7.43	1.17	0.18 (0.42)
SEm (±)	2.37	0.33	0.18	0.02	0.01
C D at 5%	6.95	NS	NS	NS	0.03

* Transformed (square root) data are mentioned in the parentheses. SEm(±) = Standard error of mean; CD = Critical difference

Table 3: Effect of fertility level and plant density on economics of summer maize grown as baby corn

	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Fertility level			
F_1 (100-50-50 kg N-P_2O_5-K_2O/ha)	77443	62531	4.19
F_2 (75-37.5-37.5 kg N-P_2O_5-K_2O/ha)	69001	54894	3.89
F_3 (50-25-25 kg N-P_2O_5-K_2O/ha)	61341	48040	3.59
S Em (±)	3170	3170	0.22
C D at 5%	9296	9296	NS
Plant density (plants/ha)			
P_1 (60,000)	59267	45850	3.40
P_2 (80,000)	65899	52022	3.73
P_3 (100,000)	76704	62368	4.34
P_4 (120,000)	75175	60379	4.08
SEm (±)	3660	3660	0.25
C D at 5%	10734	10734	0.74

SEm(±) = Standard error of mean; CD = Critical difference

CONCLUSIONS

The bridge between the demand and supply of fertilizer and a synchrony between suitable plant populations with adequate nutrient can augment the profit of the farmers. The study suggested that cultivation of maize as baby corn during summer season at lateritic tract of eastern India was quite remunerative with an average net return Rs. 62,531 /- per ha and benefit:cost ratio 4.19 within a short period of about 70 days even with a moderate market price for young cobs @ Rs. 0.50/cob. The findings strongly suggested that the dose of N, P_2O_5 and K_2O @ 100-50-50 kg/ha with basal application of whole amount of P_2O_5 and K_2O and applying N as ½ basal + ½ top dressing at first earthing up (30 days after planting) and growing the crop at a density of 1,00,000 plants/ha with 50cm × 20cm spacing was found to be the most productive and remunerative in summer maize when grown for baby corn purpose in the subtropics of eastern India.

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