Indian Journal of Agricultural Sciences **85** (11): 1424–7, November 2015/Article
https://doi.org/10.56093/ijas.v85i11.53669

Production potential of baby corn (*Zea mays*) on raised bed in waterlogged lowland rice fallow in North East India

A S PANWAR[1] and Y S SHIVAY[2]

ICAR Research Complex for NEH Region, Umiam , Meghalaya 793 103

Received: 4 February 2015; Accepted: 18 May 2015

ABSTRACT

A field experiment was conducted during rainy (*Kharif*) season of 2008-09 and 2009-10 at research farm of ICAR-Research Complex of NEH Region of Umiam, Meghalaya, to study the production potential of baby corn (*Zea mays* L.) as influenced by raised bed height in waterlogged low land area and nitrogen levels. Taller plants with more number of leaves were recorded with 50 cm height of raised bed. The days to harvest initiation and harvest duration were more at 50 cm height of raised bed. The barrenness in baby corn was also comparatively lesser with 50 cm height of raised bed. The maximum baby corn and fodder yield was recorded with 50 cm height of raised bed, which were 11.3 and 10.7% higher than 40 cm height of raised bed. Further, decrease in height of raised bed up to 30 and 20 cm markedly reduced babycorn yield as compared to 50 cm height of raised bed. The nitrogen content and uptake, protein yield, nitrogen use efficiency and economical parameters were also higher at 50 cm height of raised bed. Increasing nitrogen level produced taller plants with more number of leaves. The harvest initiation decreased by 4 days while harvest duration was increased by 4 days with 120 kg N/ha. The barrenness declined with increasing nitrogen levels. The highest baby corn yield, nitrogen uptake and protein yield were recorded with 80 kg N/ha. Increasing nitrogen levels progressively reduced agronomic N use efficiency and physiological efficiency of nitrogen, but apparent recovery increased up to 80 kg N/ha. The gross, net return and benefit: cost ratio were higher with 80 kg N/ha. Therefore, for getting higher yield and net return, the baby corn should be grown at 50 cm height above the moisture level on raised bed and fertilized at the rate of 80 kg N/ha.

Key words: Baby corn, Economics, Nitrogen, Nitrogen use efficiency, Raised and sunken bed

Baby corn (*Zea mays* L.) is a dehusked maize ear, harvested within 2-3 days of silk emergence. It is a new economic product of maize and is little known to the maize growers in north eastern region. It has high nutritive value as compared to many other vegetables. The farmers of this region are not very well aware of its economic importance and production technology due to which it could not gain popularity but now a days it is fetching more price. Maize is the second most profitable crop of this region. The production potential and economic returns from grains of maize, its cultivation as babycorn can be exploited to improve the economic status of maize growers of this region.

The valley low lands of North East (NE) India has either high moisture content or waterlogged conditions which do not allow any crop except rice to grow due to which vast area in the region remains fallow after harvest of rice. If raised bed of suitable height is made in valley low land, it can bring down the moisture content at optimum level which may allow a number of crops including vegetables to grow (Panwar 2006). These raised beds will open the new vistas for maize cultivation for grain, green cobs and baby corn in valley land areas also. Babycorn cultivation provides avenues for crop diversification, value addition and green fodder production. Babycorn being a new introduction require development of production technology especially the standardization of height of raised bed in low land area to counter adverse effect of high moisture in root zone area and optimum nitrogen dose for realizing higher babycorn yield. Keeping these facts in view, the present investigation was undertaken in low land area under mid hill conditions of Northeast India.

MATERIALS AND METHODS

A field experiment was conducted during rainy season of 2008-09 and 2009-10 at the research farm of ICAR-Research Complex for NEH Region, Umiam, Meghalaya. Raised beds 5 m long with 4 m width were prepared in low land area by cut and carry method one year before initiation of the experiment i.e. during 2007. Sunken bed area of 2 m × 5 m was kept at both the sides of raised beds which were having 5-10 cm standing water, while other two sides were provided with drainage cum irrigation channel. The height

[1]Principal Scientist (e mail: draspanwar@gmail.com), [2]Division of Agronomy, Indian Agricultural Research Institute, New Delhi 110 012

of the raised bed were kept as 20, 30, 40 and 50 cm above the moisture level and treated as main plots while 4 nitrogen levels (0, 40, 80, and 120 kg N/ha) were arranged in sub plots. The treatments were tested in split plot design with 3 replications. The soil of experimental field was sandy loam acidic in reaction (*p*H 5.2). The soil of experimental field had 250.0 kg/ha alkaline permanganate oxidizable N (Subbiah and Asija 1956), and available phosphorus 8.6 kg/ha and available K 255 kg/ha. The rainfall received during cropping seasons was 1,102 and 856 mm during 2008 and 2009, respectively. The Vijay composite cv of maize was sown on 11 and 14 July during 2008 and 2009, respectively with a spacing of 50 cm × 15 cm. Half dose of nitrogen as per treatment and full dose of phosphorus and potash was applied at sowing. The remaining half nitrogen was top dressed 25 days after sowing and earthing up was done to support plants and to remove weeds from raised beds. All the agronomic practices were followed throughout the cropping period. For recording days to babycorn production, the crop was regularly watched 45 days after sowing. The immature cobs (babycorn) were harvested at 1-2 and 1-3 days of silk emergence during 2008 and 2009, respectively. These babycorn were counted and weighted and thereafter husk and silk was removed and babycorn yield was recorded and expressed in g/cob. The data on plant height and number of functional leaves/plant was recorded from 10 randomly selected plants. After harvest of babycorn, the crop was harvested and weighted for green fodder yield and expressed in tones/ha as given in this manuscript. The nitrogen content was determined by modified Kjeldahl method (Prasad *et al.* 2006) and uptake was calculated by multiplying the content with dry matter yield of babycorn and fodder. Protein content in babycorn was estimated by multiplying the N content with 6.25 coefficient factor. The efficiency parameters related to applied nitrogen usage were calculated using following equations as suggested by Shivay and Prasad (2012):

$$AE_N = \Delta Y_N \div F_N$$

where, AE_N is the agronomic efficiency, often termed as incremental efficiency of applied N fertilizers, ΔY_N is the incremental yield due to fertilizers N input and F_N amount of fertilizers N applied.

$$AR_N = (\Delta U \div F_N) \times 100$$

where, AR_N is the apparent recovery of fertilizers N, ΔU is the incremental uptake of N due to fertilizers application.

$$PE_N = (\Delta Y \div \Delta U) \times 100$$

where, PE_N is the physiological efficiency of N, and ΔU is the incremental uptake of N due to fertilizers application.

The economics of babycorn was worked out by calculating operational cost, gross return, net return and benefit: cost ratio based on the prevailing price of baby corn (₹ 50/kg) and green fodder (₹ 1/kg). The data of both years was pooled and were statistically analysed as per the procedure of analysis of variance and significance was tested by "F" test (Gomez and Gomez 1984).

RESULTS AND DISDUSSION

Effect of raised bed height

The growth and yield attributes except green cob: babycorn ratio of babycorn significantly influenced due to height of raised beds (Table 1). Tallest plants with more number of leaves were recorded with 50 cm height of raised bed, while lowest plant heights with lesser number of leaves were recorded with 20 cm height of raised bed. This might be due to adverse effect of high moisture content at 20 cm height above the moisture level (Fig 1). The days to harvest initiation were less with 50 cm height, while 20 cm height took 3 more days to harvest initiation. But the harvest period was increased by 1 day with 50 cm height of raised bed. Maximum numbers of cobs per plant as well as per

Table 2 Yield and economics of babycorn as influenced by land configuration and nitrogen levels (pooled data of two years)

Treatment	Baby corn yield (kg/ha)	Fodder yield (tonnes/ha)	Nitrogen content (%)		Total nitrogen uptake (kg/ha)	Protein content (%)	Protein yield (kg/ha)	N use efficiency		
			Baby corn	Green fodder				AE (kg baby corn increased/ kg N applied	PE (kg baby corn increased/ kg N uptake)	AR (%)
Height of raised bed (cm)										
20	325.0	18.38	1.19	0.63	16.1	7.4	24.6	2.4	13.9	17.1
30	598.8	21.43	1.38	0.75	24.9	8.6	53.3	4.4	23.4	19.2
40	1152.9	31.85	1.49	0.86	45.9	9.3	109.6	10.8	25.1	42.5
50	1283.1	35.25	1.80	1.10	64.1	11.3	149.8	11.3	18.8	60.0
CD (P=0.05)	268.06	11.14	0.11	0.14	9.65	0.47	11.24			
Nitrogen levels (kg/ha)										
0	446.4	19.33	1.24	0.59	17.9	7.7	36.3			
40	803.5	22.85	1.41	0.85	32.5	8.8	76.3	8.9	24.2	36.4
80	1063.9	32.63	1.58	0.95	50.7	9.9	112.8	7.7	18.4	41.0
120	1046.1	32.10	1.62	0.95	49.9	10.1	111.9	5.0	18.3	26.7
CD (P=0.05)	216.87	8.52	0.13	0.15	8.72	0.21	10.76			

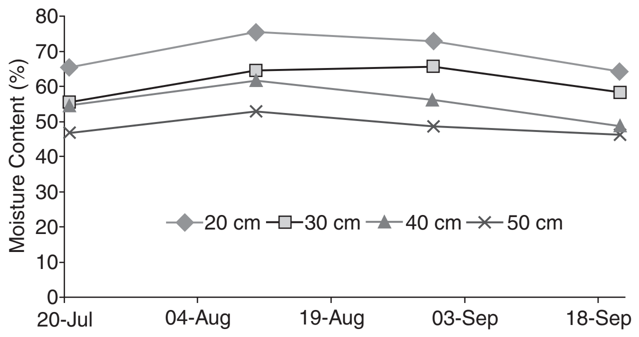

Fig 1 Moisture dynamics at different height of raised bed

hectare were recorded with raised bed of 50 cm height. However, the maximum barren plants (%) were observed with 20 cm height of raised bed and minimum with 50 cm indicating adverse effect of high moisture content at lower level in raised bed. Green cob and baby corn weight were also significantly influenced due to raised bed height but green cob: babycorn ratio remained unaffected.

Babycorn yield significantly and linearly increased with increase in raised bed height recording maximum yield of 1283.1 kg/ha with 50 cm height of raised bed. This may be ascribed to the maintenance of optimum moisture levels in the rhizosphere of the plant at 50 cm height of raised bed as compared to lower height (Fig 1). The lowest yield was recorded with 20 cm which was 294.8% lower than that of 50 cm height of raised bed. Green fodder yield followed similar trend as that of babycorn. The content and uptake of nitrogen was significantly increased with increase in height of raised beds and the highest nitrogen uptake of 64.1 kg/ha was recorded with 50 cm height, which was 39.6% higher over 40 cm height of raised bed. The protein content (%) also linearly increased up to 50 cm height of raised bed which resulted into significant improvement in protein yield due to favourable soil moisture and aeration in the root zone as compared to lower level of raised bed height. Increasing raised bed height from 20 cm to 50 cm linearly increased agronomic efficiency, physiological efficiency and apparent nitrogen recovery (%). The values for different economic parameters were also varied due to different raised bed heights. Higher gross returns (₹ 67 678), net return (₹ 47 554) were recorded with 50 cm height of raised bed among different heights of raised bed. The benefit: cost ratio was also recorded higher with 50 cm height but it was on par with 40 cm height of raised beds. This might be due to the fact that higher yield was recorded with 50 cm raised bed height which also compensated the cost of raised beds preparation (Panwar 2006).

Effect of nitrogen

Application of nitrogen significantly increased plant height up to 80 kg N/ha, however, the functional leaves were more with 120 kg N/ha (Table 1). The days to harvest initiation were maximum with no nitrogen, which significantly reduced with each increase in nitrogen levels; this might be due the fact that nitrogen might have hastened the harvest initiation. However, harvesting duration was more with high nitrogen levels and minimum was recorded with control. The increase in harvest period due to successive increase in nitrogen dose was attributed to continuous initiation of babycorn owing to availability of nitrogen (Pandey *et al.* 2000). The number of cob/plant as well as per hectare were improved significantly with each successive increase in nitrogen levels up to 80 kg/ha. Maximum barren plants were recorded with control, which drastically decreased with the increase in nitrogen levels. The green cob weight (g) was increased with each successive increase in nitrogen dose but babycorn weight was not significant beyond 80 kg N/ha. More availability of nitrogen at higher levels might have resulted in better growth attributes which consequently reflected on yield attributes and yields of baby corn. Sahoo and Mahapatra (2004) also found higher values of yield attributes and yield of sweet corn with increasing levels of nitrogen. The favorable effect of nitrogen indicated that nitrogen played a key role in improving the growth and yield attributes of babycorn. These results are in agreement with those of Pandey *et al.* (2000).

Table 1 Yield and economics of babycorn as influenced by land configuration and nitrogen levels (pooled data of two years)

Treatment	Plant height (cm)	Functional leaves	Harvest initiation (Days)	Harvest duration (Days)	Barrenness (%)	Green cob weight (g)	Babycorn weight (g)	Green cob: babycorn ratio	Cobs/ plant (Nos.)	Cobs in lakh/ha (Nos.)
Height of raised bed (cm)										
20	127.5	7.8	56.9	15.8	18.7	13.0	2.8	4.71	1.10	1.48
30	155.1	8.8	56.7	15.3	9.3	20.5	4.1	4.95	1.40	1.89
40	194. 8	9.3	55.3	15.5	7.7	23.6	4.8	4.97	1.89	2.54
50	217.4	10.9	53.9	16.7	6.2	24.8	5.5	4.49	1.99	2.68
CD (P=0.05)	6.62	0.30	1.12	0.49	1.15	1.48	1.32	NS	0.11	0.22
Nitrogen levels (kg/ha)										
0	140.0	6.9	57.8	14.0	13.3	14.5	2.7	5.30	1.32	1.77
40	168.3	8.7	56.6	15.4	11.4	19.9	4.4	4.49	1.54	2.08
80	193.2	10.1	55.2	16.6	9.1	23.6	5.0	4.74	1.69	2.28
120	193.3	11.3	53.1	17.5	8.1	23.8	5.0	4.78	1.83	2.46
CD (P=0.05)	5.42	0.42	0.87	0.54	1.23	1.16	0.95	NS	0.09	0.13

Table 3 Economics of babycorn as influenced by height of raised beds and nitrogen levels (pooled data of two years)

Treatment	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit : cost ratio
Height of raised bed (cm)				
20 cm	15,620	18,089	2,469	1.16
30 cm	16,822	32,083	15,261	1.91
40 cm	18,324	60,831	42,507	3.32
50 cm	20,124	67,678	47,554	3.36
CD (P=0.05)	642	2,754	2,754	0.21
Nitrogen levels (kg/ha)				
0	16,100	24,250	8,150	1.51
40	17,635	42,461	24,826	2.41
80	18,170	56,455	38,285	3.11
120	18,684	55,513	36,829	2.97
CD (P=0.05)	712	1,834	1,834	0.17

Application of 80 kg N/ha resulted in maximum baby corn yield, which was significantly higher compared with 0 and 40 kg N/ha (Table 2). The baby corn green fodder yield was also significantly increased with each successive increase in nitrogen levels up to 80 kg/ha. The increase in babycorn and green fodder yield with the increase in nitrogen application may be ascribed to the favorable effect of nitrogen on growth and yield attributes (Table 1). Nitrogen application increased N content in babycorn and green fodder up to 80 and 40 kg N/ha, respectively. The total N uptake was recorded highest with 80 kg/ha, which was 56.3 and 183.4% higher compared with 40 and 0 kg N/ha, respectively. These results are in agreement with those reported by Bhindhani *et al.* (2007). Protein content in baby corn was increased significantly up to 120 kg N/ha but protein yield improved only up to 80 kg N/ha. These results are in conformity with the findings of Kar *et al.* (2006), who stated that nitrogen in corn plant is associated with the metabolism of protein. The agronomic and physiological efficiencies of applied nitrogen were highest with 40 kg N/ha, which progressively decreased with each successive increase in nitrogen level. These results are in agreement with those of Bhindhani *et al.* (2007). The apparent recovery of applied nitrogen was increased up to 80 kg N/ha and thereafter, it declined. Gross return, net return and benefit cost ratio showed considerable differences in their values due to various doses of nitrogen (Table 3). The highest net return of ₹ 38 285 was accrued with 80 kg N/ha, which was 1.7, 33.0 and 132.8% higher over 120, 40 and 0 kg N/ha, respectively. Similar results were also reported by Shivay *et al*. (1999). The benefit: cost ratio linearly increased with each successive increase in nitrogen dose up to 80 kg N/ha, thereafter non-significant effect was noticed, indicated that nitrogen application beyond 80 kg/ha was not economical.

Based on the pooled data of two year study, it was concluded that for obtaining higher economic yield of baby corn and monetary returns, the crop should be sown on 50 cm height of raised beds and fertilized with nitrogen @ 80 kg/ha under mid hills attitude conditions of North East India.

REFERENCES

Bhindhani A, Barik K K, Garnayak L M and Mahapatra P K. 2007. Nitrogen management in babycorn *(Zea mays)*. *Indian Journal of Agronomy* **52**(1): 135–8.

Gomez K A and Gomez A A. 1984. *Statistical Procedures for Agricultural Research*, Second edition. An International Rice Research Institute Book, A Wiley-Inter-science Publication, John Wiley & Sons, New York.

Kar P P, Barik K C, Mahapatra P K, Garnaya L M, Rath B S, Bastia,, D K and Khanda C M. 2006. Effect of planting geometry and nitrogen levels on yield, economics and nitrogen uptake in sweetcorn (*Zea mays* L.). *Indian Journal of Agronomy* **51**(1): 43–5.

Pandey A K, Prakesh V, Mani VP and Singh R D. 2000. Effect of rate of nitrogen and time of application on yield and economics of baby corn (*Zea mays.*) *Indian Journal of Agronomy* **45**(2): 338–43.

Panwar A S. 2006. Development of marshy land for crop production. (*In*) Proceedings of National Seminal on Land Resources Management for Sustainable Development, 16-17 Feb, 2006 at Itanagar, Arunachal Pradesh, pp 75–82.

Prasad R, Shivay Y S, Kumar D and Sharma S N. 2006. *Learning by Doing Exercises in Soil Fertility (A practical manual for soil fertility)*. Division of Agronomy, Indian Agricultural Research Institute, New Delhi, p 68.

Sahoo S C and Mahapatra P K. 2004. Response of sweet corn (*Zea mays*) to nitrogen levels and plant population. *Indian Journal of Agricultural Sciences* **74**(6): 337–8.

Shivay Y S and Prasad R. 2012. Zinc-coated urea improves productivity and quality of *Basmati* rice (*Oryza sativa* L.) under zinc stress condition. *Journal of Plant Nutrition* **35**: 928–51. http://dx.doi.org/10.1080/01904167.2012.663444

Shivay Y S, Singh R P and Pandey C S. 1999. Response of nitrogen in maize (*Zea mays*)-based intercropping system. *Indian Journal of Agronomy* **44**(2): 261–6.

Singh R and Agarwal S K. 2004. Effect of organic manuring and nitrogen fertilization on productivity, nitrogen use efficiency and economics of wheat (*Triticum aestivam*). *Indian Journal of Agronomy* **49**(1): 49–2.

Subbiah B V and Asija G L. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Current Science* **25**(8): 259–60.