Print ISSN : 0972-8813
e-ISSN : 2582-2780

[Vol. 19(1), January-April, 2021]

Pantnagar Journal of Research

(Formerly International Journal of Basic and Applied Agricultural Research ISSN : 2349-8765)

G.B. Pant University of Agriculture & Technology, Pantnagar

PANTNAGAR JOURNAL OF RESEARCH

Vol. 19(1) January-April, 2021

CONTENTS

Effect of crop establishment methods and nutrient management options on productivity and economics of baby corn (*Zea mays* L.)

ABHISHEK BAHUGUNA and MAHENDRA SINGH PAL

Department of Agronomy, College of Agriculture, G B Pant University of Agriculture and Technology, Pantnagar-263145 (U.S. Nagar, Uttarakhand)

ABSTRACT: Baby corn is a highly nutritious and fetching high market price but very sensitive to moisture and cold. Normally it is grown in *Kharif* season but it can be grown throughout year with good management practices. Therefore, the present study was carried out in *Kharif* season-2018 to study the effect of crop establishment methods and nutrient management options on productivity and economics of baby corn. The experimental results indicated that ridge planted crop with application of 75%RDF+25%VC gave significantly higher baby corn yield, TSS, gross returns and microbial population. The nitrogen and protein content, net returns, B: C ratio and per day income were recorded under ridge planting. The net profit and net income/day were recorded at 100% RDF that was statistically similar to 75%RDF+25%VC. The microbial population and apparent soil fertility were found higher at 100%VC but it had the lowest net profit and apparent soil fertility. Therefore, the baby corn may be planted on ridges with application of 75%RDF+25%VC for higher baby corn productivity, quality and net profit in whole Indo-Gangetic plains of India.

Key words: Apparent soil fertility, baby corn, economics, microbial population, TSS

Maize (*Zea mays* L.) is widely grown in India and abroad for multiple use covering on 9.22 m ha area, 28.72 mt production with productivity 3.12 metric ton/ha during 2017-18. Presently the specialty maize i.e., baby corn, sweet corn, pop corn and quality protein maize, is gaining popularity due to its special values and high market prices. Therefore, baby corn is one of the better options for both net profit and quality green fodder. It takes only 55-60 days and 3-4 crops can be harvested yearly with good management practices but best agronomy varies with agro-climatic conditions. Presently the modern crop establishment options like furrow irrigated raised bed system (FIRBS) and ridge bed or raised bed planting are being used particularly under low land and high moisture conditions for better crop establishment. Baby corn differs with common maize in morphology, physiology and nutritional requirement mainly because it is grown under higher planting density, hence it requires higher nutrition than common maize (Joshi and Pal, 2019). Therefore, optimum nutrient management under different plant establishment methods is of immense importance for maximizing its production. The current knowledge on different crop establishment methods in conjunction with nutrient management is meager, so it essentially requires standardizing for better crop productivity. Therefore, the present study was carried out to study the effect of crop establishment methods and nutrient management options on productivity and economics of baby corn (*Zea mays* L.).

MATERIALS AND METHODS

Field experiment was carried out at Instructional Dairy Farm, Nagla, G. B. Pant University of Agriculture and Technology, Pantnagar in *Kharif* season of 2018 to study the 'effect of crop establishment methods and nutrient management options on productivity and economics of baby corn (*Zea mays* L.)'. The experimental site was located in the *Tarai* region of Shivalik range of Himalayas in between latitude of 29° N to longitude of 79.3° E and at an altitude of 243.84 meter above the mean sea level. During the experimental period, weekly mean maximum and minimum temperature was ranged between 37.2° C and 24.1°C with relative humidity from 76.4 to 93.6%. An average 93mm rainfall was received during the crop season. The soil was slightly silty clay loam in texture with granular structure having soil pH 7.16, EC 0.190dS/m, organic carbon 0.47% and available nitrogen, phosphorus and potassium, 282.5, 28.2 and 235kg/ha, respectively. The experiment consisted of 3 establishment methods i.e. 'flatbed planting', 'flatbed planting followed by *(fb)* earthing up' and 'ridge bed planting' and 4 nutrient management options i.e. 'control'(no organic and chemical fertilizer application), '100%VC@10t/ha'(VC-vermicompost), '100%RDF'(recommended dose of fertilizers i.e. 180:60:40::$N:P_2O_5:K_20$ kg/ha, '50% RDF+50%VC' and '75%RDF+25%VC' was laid out in split plot design with three replications. The dose of vermicompost (VC) was decided based on nitrogen equivalent basis which also fulfilled the required amount of phosphorus and potassium. The vermicompost (VC) used for the experiment had 1.8, 0.72 and 0.84% nitrogen, phosphorus and potassium, respectively which was applied one week before sowing, while full dose of P and K was applied as a basal but nitrogen was applied in 3 equal splits; one third as basal, one third at knee high stage and one third at pre tasseling stage. 'VL-Baby Corn 1' variety was sown manually in 60 cm x 15cm planting geometry at 4cm sowing depth. Prior to sowing, seed was treated with carbendazim @ 3g per kg seed. Pendimethalin @ 1 kg a.i./ha as pre emergence herbicide was sprayed on second day of sowing with the help of knap sack sprayer followed by one hand weeding at 30 days after sowing. One spray of chlorpyriphos @ 2 ml per liter water was also done at 30 days after sowing to protect the crop from sucking and cutting pests.

The baby com yield, total soluble solids (TSS), nitrogen and protein content, economics, B:C ratio, microbial population i.e. bacterial count, fungi and actinomycetes and apparent soil fertility were recorded. The TSS was measured with the help of hand refractometer. The nitrogen content in baby corn was estimated by Kjeldahl method after each pick and averaged. The crude protein content is the resultant of N content multiplied with coefficient factor 6.25. The microbial population was estimated in soil after harvest of crop by standard procedure (Pramer and Schmidt, 1964). The apparent nutrient balance in soil was calculated by deducting the initial N, P and K content from estimated N, P and K values after crop harvest (Joshi, 2016).

RESULTS AND DISCUSSION

Effect of establishment method

Baby corn yield

The baby corn yield differed significantly due to establishment methods (Table.1). The baby corn yield was recorded significantly highest at ridge bed planting followed by flatbed *fb* earthing up and flatbed method, respectively with 7 and 14% yield superiority over flatbed *fb* earthing up and flat method, respectively. Similarly, flatbed *fb* earthing up produced 8.5% higher baby corn yield than flat method as earthing was found beneficial for plant growth. The higher yield under ridge bed planting might be due to better aeration and drainage resulting in to higher plant growth and development than flatbed *fb* earthing up and flatbed planting. The ridge bed planting improved plant growth mainly due to better conditions for root growth and nutrient uptake with 20-30% water saving and higher water productivity (Bakht *et al*., 2011).

Quality of baby corn

The quality attributes like nitrogen content, TSS and protein content were influenced significantly by establishment methods (Table.1). The highest TSS was recorded under ridge bed planting that had nearly 1.0 and 2.0% higher TSS than flatbed *fb* earthing up and flat bed planting, respectively. The higher TSS under ridge bed planting method was caused due to better soil conditions for growth and development resulting higher formation of better phtotosynthates. Painyuli *et al*. (2013) also reported higher TSS of sweet corn under ridge bed planting.

The ridge bed planting had significantly highest N content compared to flatbed planting method but it showed non-significant effect with flatbed planting *fb* earthing up. Higher nitrogen content might be due to better soil physical conditions favoring higher nutrient uptake. These results are in close agreement with the results reported by Painyuli *et al.* (2013).The protein content was recorded significantly higher under ridge bed planting method than flatbed *fb* earthing up and flatbed method with 0.54 and 2.4% higher values, respectively. Similarly, baby corn planted at flatbed *fb* earthing up produced 2% higher protein content than flatbed method. The higher protein content was caused due to increased nitrogen content in baby corn. Kumar and Narayan (2018) found that bed planting gave 14.17% higher yield and significantly higher protein, oil and starch content in sweet corn than furrow planting crop.

Economics

The ridge bed planting had significantly highest gross return, net return, B:C ratio and net profit per day followed by flatbed *fb* earthing up and significantly lowest with flat bed planting method. The ridge planting gave 8.1% and 16.4% higher gross return and 11.7% and 24.6% higher net return than flatbed planting *fb* earthing up and flatbed planting method, respectively. The flat bed planting *fb* earthing up produced 7.6% and 11.5% higher gross and net return than flatbed planting method, respectively. The higher net income and B:C ratio at ridge bed planting resulted in generation of higher net profit per day i.e., Rs 286/- and Rs 151/- higher than flatbed and flatbed *fb* earthing up method, respectively. Manea (2014) and Nagdeote *et al*. (2016) also reported higher gross and net return as well as B:C ratio of sweet and baby corn, respectively planted in ridge and furrow method than flatbed planting.

Microbial population

Soil microbial population i.e., bacteria, fungi and actinomycetes was recorded after crop harvest and it's a good indicator of soil health. The establishment methods had significant influence on soil microbial population (Table.2). The significantly highest bacterial count in soil was recorded in ridge bed planting method and it remained statistically at par with flatbed planting *fb* earthing up and significantly lowest under flatbed planting method. The higher bacterial population was recorded due to well aerated conditions that promoted growth of aerobic bacteria in soil. Hemmat and Eskandari (2004) also reported higher bacterial count at raised bed planting than flatbed planting due to proper aeration. Similarly, the fungi population was recorded significantly higher in ridge bed planting followed by flatbed fb earthing up and flatbed method. Fungi are the aerobic microbes and ridge bed planting provided more aerated condition in soil that resulted in higher fungi population in soil. The highest actinomycetes population was found in ridge bed planting method that was significantly similar to flatbed fb earthing up and the lowest at flatbed method. Actinomycetes also required aerobic condition for their survival hence the highest actinomycetes count was also recorded at ridge bed planting.

Apparent nutrient balance

The highest nitrogen, phosphorus and potassium balance was recorded in flatbed planting followed by flatbed *fb* earthing up and flatbed planting method, respectively. The positive nutrient balance was found in case of phosphorus and potassium under all establishment methods, however, flatbed *fb* earthing up and ridge bed planting method recorded negative apparent nitrogen balance. The higher apparent nutrient balance under flatbed method was caused due to least nutrient uptake in plants. Raised bed planting led to higher soil respiration rate which had positive effect on soil microbial population (Goverts *et al.,* 2007).

Effect of nutrient management

Baby corn yield

The baby corn yield was recorded significantly highest at 75%RDF+25%VC followed by 100%RDF, 50%RDF+50%VC, 100%VC and control, with 3, 13.0, 25.0 and 60.0% higher value, respectively. Similarly, baby corn yield was nearly by 58.6 and 46.3% higher under 100%RDF and 100%VC, respectively than control. Singh (2011) and Kumar and Chawla (2015) also reported higher corn yield under ridge bed and trench planting than flatbed planted crop.

Quality of baby corn

The TSS recorded significantly higher at 75% RDF+25% VC than 50% RDF+50% VC, 100% VC and control but non-significant with 100% RDF. The application of 50% RDF+50% VC had recorded significantly similar TSS with 100% VC. Dalvi *et al*. (2009) also reported increased TSS of sweet corn at INM. The nitrogen and protein content were found highest at 100% RDF. 100%RDF recorded significantly higher nitrogen content that was statistically at par with 75% RDF+25% VC and significantly lowest N content was found at control followed by 100% VC and 50% RDF+50% VC. Similarly the application of both 100% RDF and 75% RDF+25% VC recorded 1.9, 3.11 and 12.5% higher protein content than 50% RDF+50% VC, 100% VC and control, respectively. 100% VC recorded 9% higher protein content than control. The increased N content under INM was caused due to solublization of nutrients in root zone by the release of organic acids from decaying vermi-compost. Pinjari *et al*. (2009) also reported significantly higher nutrient content in maize grain in 75% RDN+25% poultry manure. Jinjala *et al.* (2016) reported significantly higher vitamin C, total sugar and numerically higher crude protein content at application of 100% nitrogen than vermicompost.

Economics

The gross return, net return, B:C ratio and per day net income were influenced significantly by nutrient management (Table.1). The significantly higher gross return was found at 75% RDF+25% VC followed by 100% RDF, 50% RDF+50% VC, 100% VC and control, respectively. The application of 75% RDF+25% VC and 100% RDF recorded 34.4 and 27.8% higher gross return than 100%VC, respectively. Similarly, gross return was increased nearly by 88 and 141% higher at 100%VC and 100% RDF, respectively than control.

The application of 100% RDF recorded significantly highest net return that was statistically at par with 75% RDF+25% VC. The net profit realization from 100% VC and control was found significantly similar but significantly lower than 50% RDF+50% VC. The 100% RDF generated 3.1, 32 and 64% higher net return than 75% RDF+25% VC, 50% RDF+50% VC and 100% VC, respectively. Application of 100% VC and 100% RDF produced 6.1 and 195% higher net return, respectively than control. The B:C ratio was recorded significantly highest with application of 100% RDF followed by 75% RDF+25% VC, however, 100% VC recorded significantly the lowest B:C ratio. The application of vermicompost resulted in lower B:C ratio as it is costly than chemical fertilizers and its application increased the cost of production which ultimately reduced the net return. Similarly, application of 100% RDF generated significantly highest net profit per day of Rs 1949/- which was 3, 32 and 64% higher than 75% RDF+25% VC, 50% RDF+50% VC and 100% VC, respectively. The higher values of gross return, net return and B:C ratio was caused due higher baby corn and fodder yield along with lower cost of production. Nagvani and Subbian (2014) also reported higher net return per hectare and B:C ratio at 100% RDF than INM treatments.

Microbial population

The microbial population varied significantly by nutrient management (Table.2). Significantly highest bacterial count was recorded at 100% VC followed by 50% RDF+50% VC. The 75% RDF+25% VC and 100% RDF had significantly higher bacterial count than control but remained non-significant with each other. The substitution of chemical fertilizer with vermicompost resulted in more bacterial count in soil possibly due to more bacterial population on vermicompost and vermicast. Khan *et al.* (2017) also reported higher microbial population at INM.

The application of 100%VC recorded significantly highest fungi and actinomycetes population in soil, however 50 and 75% substitution of VC with chemical fertilizers had significantly higher fungi count than 100% RDF but remained statistically similar to each other. The fungi are the saprophytic organism and depend on the dead decaying organic matter for their food demand. The addition of vermicompost added organic matter in soil enriched with microbial activity that resulted in higher fungal count and actinomycetes in soil.

Apparent nutrient balance

The highest apparent nitrogen, phosphorus and potassium balance was recorded at 100% VC followed by 50% RDF+50% VC, 75% RDF+25% VC, 100% RDF and lowest at control. The 100% RDF and control had negative apparent nutrient balance. The higher soil microbial population under 100% VC facilitated faster nutrient mineralization added more nutrients in soil. Similar findings were observed by Joshi (2016). Khan *et al.* (2017) reported the highest population of bacteria (68.6 ×10^5 CFU/g) and fungi (71.3 ×10^5 CFU/g) under the treatment 75% NPK through inorganic fertilizer+25% farm yard manure.

CONCLUSION

Experiment findings indicated that ridge planting method had higher baby corn yield, TSS, protein content, net profit, soil microbial population and also apparent nutrient balance. Among nutrient management options, 75% RDF+25% VC gave higher baby corn productivity, TSS and gross return, however the net return and net income/day were recorded higher with application of 100% RDF and it remained statistically similar to 75% RDF+25% VC. Therefore, it is concluded that baby corn may be grown under ridge bed planting method with application of 75% RDF+25% VC for higher baby corn

Table 1: Effect of crop establishment method and nutrient management options on yield, quality and economics of baby corn

Treatment	Baby corn yield (kg/ha)	TSS (%)	N content (%)	Protein content (%)	Gross returns (Rs/ha)	Net Returns (Rs/ha)	B:C ratio	Net profit (Rs/day)
Crop establishment methods								
Flatbed planting	1235	10.1	1.80	10.87	109416	69839	3.20	1164
Flatbed *fb* earthing up	1341	10.2	1.84	11.08	117774	77918	3.43	1299
Ridge bed planting	1440	10.3	1.84	11.14	127325	87048	3.63	1450
S Em±	11	0.1	0.01	0.004	444	440	0.02	07
LSD (p=0.05)	44	NS	0.02	0.02	1790	1773	0.07	30
Nutrient management options								
Control	674	9.2	1.62	10.13	59219	39596	3.01	660
100% VC @ 10t/ha)	1256	10.1	1.77	11.05	111650	42027	1.78	700
100% RDF	1630	10.6	1.82	11.40	142778	116954	5.54	1949
50% RDF +50% VC	1458	10.3	1.79	11.18	127145	79421	2.67	1324
75% RDF +25% VC	1686	10.7	1.82	11.40	150068	113344	4.09	1889
SEm±	15	0.16	0.003	0.02	2128	2128	0.06	35
LSD (p=0.05)	45	0.5	0.01	0.06	6249	6249	0.16	104

Table 2: Effect of crop establishment method and nutrient management options on soil microbial population and apparent nutrient balance

Treatment	Soil microbial population			Apparent nutrient balance		
	Bacteria (cfu ×10^4)	Fungi (cfu × 10^2)	Actinomycetes (cfu × 10^4)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
Crop establishment methods						
Flatbed Planting	4.33	4.12	0.95	1.78	2.37	5.07
Flatbed *fb* earthing up	5.07	4.50	1.15	-0.523	1.21	2.51
Ridge bed Planting	5.33	5.27	1.23	-2.61	0.47	1.75
S Em±	0.15	0.26	0.40	-	-	-
LSD (p=0.05)	0.62	0.30	0.14	-	-	-
Nutrient management options						
Control	2.67	2.56	0.41	-11.76	-6.06	-16.57
100% VC @ 10t/ha)	7.67	7.06	2.00	10.84	7.18	21.18
100% RDF	3.22	2.87	0.44	-7.43	-1.20	-3.81
50% RDF +50% VC	6.22	5.60	1.50	5.47	4.09	9.58
75% RDF +25% VC	4.78	5.08	1.18	0.63	2.74	5.18
SEm±	0.40	0.26	0.03	-	-	-
LSD (p=0.05)	1.17	0.76	0.08	-	-	-

yield, quality and net profit in *Tarai* region of Uttarakhand and other similar agro-ecological regions of India.

REFERENCES

Bakht, J., Shafi, M., Rehman, H., Uddun, R. and Anwar, S. (2011). Effect of planting methods on growth, phenology and yield of maize varieties. *Pakistan Journal of Botany,* 43: 1629-1633.

Dalvi, S. D., Bhondave, T. S., Jawale, S. M., Shaikh, A. A. and Dalvi, N. D. (2009). Effect of sources of organic manures in integrated nutrient management on yield and quality of sweet corn. *Journal of Maharashtra Agriculture University,* 34: 222-223.

Goverts, B., Sayre, K. D., Lichter, K., Dendooven, L. and Deckers, J. (2007). Influence of permanent raised bed planting and residue management on physical and chemical soil quality in rainfed maize/wheat system. *Plant Soil,* 291: 39-54.

Hemmat, A. and Eskandari, I. (2004). Conservation tillage practices for winter wheat- fallow farming in the temperate continental climate of northwestern Iran. *Field Crops Research,* 89: 123-133.

Jinjala, V.R., Virdia, H. M., Saravaiya, N. N. and Raj, A. D. (2016). Effect of integrated nutrient management on baby corn (*Zea mays L*.). *Agricultural Science Digest,* 36: 291- 294.

Joshi, G. (2016). Integrated nutrient management in baby corn (*Zea mays* L.). M. Sc. (Agronomy) thesis, GBPUAT, Pantnagar, 102p.

Joshi, Garima and Pal, M S. (2019). Effect of bio and chemical fertilizers on productivity, profitability and net profit of baby corn (*Zea mays* L.) production. *Pantnagar Journal of Research*, 17 (1): 32-38.

Khan, A.M., Kirmani, N.A. and Wani, F.S. (2017). Effects of INM on soil carbon pools, soil quality and sustainability in rice-brown sarson cropping system of Kashmir valley. *International Journal on Current Microbiology Applied Sciences,* 6: 85-809.

Kumar, M. and Chawla, J.S. (2015). Influence of methods of sowing on productivity of spring maize (*Zea mays L.)* hybrids. *Journal of plant Science Research,* 31**:**97-99.

Kumar, A. and Narayan, A. (2018). Influence of planting methods, spacing and fertilization on yield and quality of sweet corn (*Zea mays L.*). *International Journal of Current Microbiology Applied Sciences,* 7: 1232-1237.

Manea, M.A.A. (2014). Effect of fertility levels and planting method on yield and national quality of baby corn (*Zea mays L.*) varieties and its residual effect on sorghum (*Sorghum bicolor (L.) Moench*). Ph.D. thesis, Banaras Hindu University, Varanasi, India, 203p.

Nagdeote, V.G., Ghanbahadur, M., Mhaske, A.R., Balpande, S.S. and Ghodpage, R.M. (2016). Effect of land configuration, plant population and nitrogen management on productivity of sweet corn in vertisols. *International Journal of Agricultural Sciences,* 8, 428-3433.

Nagavani, A.V. and Subbian, P. (2014). Productivity and economics of hybrid maize as influenced by integrated nutrient management. *Current Biotica,* 7: 283-293.

Painyuli, A., Pal, M.S., Bhatnagar, A. and Bisht, A.S. (2013). Effect of planting techniques and irrigation scheduling on productivity and water use efficiency of sweet corn (*Zea mays saccharata*). *Indian Journal of Agronomy,* 58:344-348.

Pinjari, S.S., Talathi, M.S., Ranshur, N.J. and Bhondave, T.S. (2009). Integrated nutrient management in maize. *International Journal of Agricultural Sciences, 5:* 623-638.

Pramer, D. and Schmidt, E.L. (1964). Experimental soil microbiology. Burges Publishing Co., U.S.A

Singh, M. (2011). Growth, yield and water productivity of spring planted hybrid maize (*Zea mays L.*) cultivars as influenced by method and time of planting and irrigation regimes. Ph.D. thesis, Punjab Agricultural University, Ludhiana, 120p.

Received: January 4, 2021
Accepted: February 18, 2021