Enhancing crop growth, yield and economics of spring baby corn through different spacing and irrigation regimes

Abstract

A field experiment was conducted during spring season of 2019 at Agronomy Research Farm, CCS Haryana Agricultural Univeristy, Hisar, Haryana to investigate the effect of different spacing and irrigation regimes on growth and yield of spring's baby corn (*Zea mays* L.). The experiment was laid out in split-plot design with four irrigation treatments viz. one irrigation - 6 leaf stage, two irrigation - 6 leaf and knee high stage, two irrigation - knee high and pre-tasselling stage and three irrigation - 6 leaf, knee high and pre-tasselling stage in main plots and four spacing treatments viz. 60 × 20 cm, 60 × 15 cm, 45 × 20 cm and 45 × 15 cm in sub-plots. The results showed significantly higher growth parameters and cob yield in three irrigation – 6 leaf, knee high and pre-tasselling stage. One irrigation – 6 leaf stage recorded early 50% days to tasselling and silking. In case of spacing treatments, 45 × 15 cm recorded higher growth parameters i.e. plant height, dry matter accumulation and LAI. Yield attributes i.e. cob girth, length and weight was observed higher in 60 × 20 cm spacing treatment and yield was recorded maximum in 45 × 15 cm. The highest gross returns, net returns and benefit cost ratio was recorded higher in 45 × 15 cm spacing.

Keywords: Baby corn, spacing, irrigation, yield.

Introduction

Baby corn is a young maize cob harvested within 2-3 days of silk emergence. Baby corn ears are light yellow in colour with regular arrangement of rows, 10 - 12 cm in height and having diameter around 1.0 -1.5 cm are preferred for use in consumer market. A crop of baby corn gets ready within 60-70 days. Being a very short duration crop farmer can grow it 3 to 4 times in a year depending upon the agro-climatic conditions and can also be a good substitute at times when other crop fails. Baby corn is not only a 'cash crop' but also a very good 'catch crop'. Thus, it is one such new crop, which can improve the economic status of poor farmer. For diversification of the crop and value addition to maize as well as for the growth of food processing industries, paper textile and fermentation can be a better option. By offering diverse food items worldwide, baby maize has modernized its food habits. Therefore, the economic prominence of poor farmers can be improved by this different crop. It is not only a vital human food, but a worthy source of nutrients and a simple feedstuff and raw material for the manufacture of many industrial products. Baby corn is rich in nutrient value and

comparable with many vegetables. It is rich source of phosphorus, iron, vitamin A and C, low calories (low density lipoproteins) and more fiber.

Whilst baby corn is gaining popularity in India, systemic development of agro-techniques, namely adequate plant population through optimum spacing and water management methods, are equally vital for achieving better yield in a certain agro-climatic environment. There is plenty of room for agricultural output to increase through better management strategies such as early planting, adequate plant density, balanced fertiliser, optimum irrigation, and need-based plant protection measures. The spatial arrangement of baby maize plants regulates the shape and size of the leaf area per plant. Therefore, establishing the optimum crop geometry for the region is of great importance. For higher yield, spacing management is the most important factor. Crop geometry is recognized one of the most significant aspects for capturing maximum solar radiation and exploits soil resources effectively and in exchange, improved photosynthesis (Neelam and Rinjumoni Dutta, 2018). In spring season (Feb to March), crop water requirement increases with increase in temperature. Precision water management can not only improve growth and development of plants by ensuring optimal soil moisture across the growing season with lower environmental impacts (Javid and Khalid, 2009). The provision of irrigation water as well as optimal nutrients to baby corn may result in a breakthrough in crop output (Dutta *et al.*, 2015).

Considering the above view, research on the effects of different spacing and irrigation regimes on baby corn output is limited. As a result, the current experiment was designed to investigate the influence of various irrigation levels and planting geometry on the growth and cob yield of baby corn.

Materials and Methods

A field experiment was conducted during spring season, 2019 at the Research Farm, Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar which is situated at 29^0 10' North latitude, 75^0 36' East longitude and at the elevation of 215.2 m above mean sea level under subtropical climate in India to investigate the effect of different spacing and irrigation regimes on growth and yield of spring's baby corn.

The soil of the experimental field was sandy loam in texture with pH 8.0, organic carbon (0.33%) and available N, P and K contents were 140, 15.1 and 272.3 kg ha^{-1} respectively.

The experiment was laid out in split-plot design and replicated thrice. Main plots treatments consisted of 4 irrigation treatments, viz. one irrigation - 6 leaf stage, two irrigation - 6 leaf and knee high stage, two irrigation - knee high and pre-tasselling stage and three irrigation - 6

leaf, knee high and pre-tasselling stage and sub-plots consists of four spacing treatments viz. 60 × 20 cm, 60 × 15 cm, 45 × 20 cm and 45 × 15 cm. Recommended doses of N and P @ 120:60 kg ha^{-1} were applied in the form of urea and diammonium phosphate, respectively as basal dose. The half dose of N was applied as basal and remaining half dose was applied at 25-30 days after sowing, depending on the availability of the soil moisture. The potash was not applied since the soil of the experimental field was rich in available potassium. The mean weekly maximum and minimum temperature ranged from 22.6 to 41.4 $^{\circ}C$ and 7.8 to 24.5 $^{\circ}C$, respectively during crop growing period.

Baby corn variety 'Hybrid baby corn (G-5414)' was sown in last week of February, 2019 with 6 × 2.5 m plot size. Plant-protection measures were implemented as needed. Additional cultural operations were carried out in accordance with recommendations. The harvesting of baby corn was started from 1st week of May onwards by four pickings in 5-6 days interval. The growth parameters like plant height, leaf area index and dry matter accumulation etc. were recorded periodically. Observations on yield-attributing and yield parameters were recorded at the time of harvest. According to the treatments, three irrigations were applied in baby corn at 6-leaf stage, knee high stage and pre-tasseling stage that differs according to the given treatments. The total rainfall during the crop growth period was 19.4 mm (feb-may). The profile soil moisture from the soil sample was determined by collecting the soil sample from central row of each plot from successive depths, 0-15, 15-30 and 30-60 cm before sowing, before two days of irrigation and after 2 or 3 days of irrigation.

The mean data was utilized to calculate economics based on the current market price of the product and inputs used in the experiment. Standard techniques were used to statistically analyze the data and interpret the results.

Results and Discussion

Growth and yield attributes

Different irrigation treatments significantly enhanced the growth parameters and yield attributes of baby corn (Table 1). Higher plant height (175.72 cm) was recorded with three irrigation – 6-leaf, knee high and pre-tasseling stage which was statistically at par with two irrigation – 6- leaf and knee high stage (174.99 cm) and two irrigation – knee high and pre-tasseling stage (173.70 cm). Other growth parameters such as LAI and dry matter accumulation (6.80 and 17.28 g $plant^{-1}$ respectively) were significantly higher in irrigation treatment three irrigation – 6-leaf, knee high and pre-tasseling stage. Maintaining the adequate moisture level required by the crop resulted in higher growth parameters in three

irrigation – 6 leaf, knee high and pre-tasseling stage. This might be due to rapid meristematic cell division and elongation because water helps in dissolving nutrients in soil. Higher dry matter accumulation can be due to the effect of optimum soil moisture in maintaining the cell turgidity and cell elongation, thus attaining more leaf area and hence, dry matter accumulation. Shirazi *et al.* (2011) reported higher growth parameters in optimum moisture supply. Similar results were also reported by Roy *et al*. (2015).

Similarly, the significantly higher number of cob plant^{-1} (2.16), cob weight (6.25 g), cob length (6.36 cm) and cob girth (1.25 cm) were recorded with three irrigation – 6 leaf, knee high and pre-tasseling stage. More vigorous vegetative growth, which favoured a better partitioning of assimilates from source to sink. These results corroborate the findings of Bharathi *et al*. (2007) and Ertek and Kara (2013).

The different spacing treatments had significantly influenced both growth and yield attributes of baby corn (Table 1). Baby corn raised at 45 × 15 cm exhibited significantly higher plant height (177.75 cm), higher LAI (6.39) and maximum dry matter accumulation (17.05 g plant^{-1}). This might be due that more severe competition for light and higher intra and inter-row competition for nutrients and water might be responsible for increasing the plant height. Similar result was reported by Kunjir *et al.* (2009) and Gaikwad *et al.* (2015) and Zarapkar (2006) also found that plant height was significantly higher under the closer spacing than wider spacing. Increase in plant height and dry matter production in high plant density resulted in increase in LAI per plant. Similar findings were recorded by Meena *et al.* (2017) and Chamroy *et al*. (2017).

In spacing treatments, 60 x 20 cm produced significantly higher baby cob weight (8.11 g), cob length (12.56 cm) and cob girth (1.33 cm) which was statistically at par with 60 x 15 cm spacing treatment. This might because of better growth of plants in optimum spacing, which results in better utilization of accumulated photosynthates that contributed in the growth and development of yield attributes. These findings were corroborated with Meena *et al*. (2017).

Table 1: Effect of different spacing and irrigation regimes on growth and yield attributes of spring's baby corn.

Treatments				Baby corn cob			
	Plant height at harvest (cm)	LAI	Dry matter accumulation (g plant^{-1})	No. of cobs/ plant/ha	Cob weight (g)	Cob length (cm)	Cob girth (cm)
Irrigation Regimes							
One irrigation (6 leaf stage)	168.90	5.45	15.37	2.07	7.46	10.64	1.26
Two irrigation (6 leaf stage and knee high stage)	173.70	5.73	16.67	2.13	7.53	11.52	1.29
Two irrigation (knee high stage and pre-tasseling stage)	174.99	6.13	17.07	2.15	7.95	12.41	1.31
Three irrigation (6 leaf stage, knee high stage and pre-tasseling stage)	175.72	6.80	17.28	2.20	8.35	13.29	1.32
S.Em. ±	**1.40**	**0.05**	**0.16**	0.02	**0.28**	**0.15**	**0.006**
C.D (p=0.05)	**4.92**	**0.21**	**0.48**	**0.07**	**0.83**	**0.46**	**0.02**
Spacing							
60 × 20 cm	169.68	6.03	16.29	2.02	8.11	12.56	1.33
60 × 15 cm	172.45	6.18	16.31	2.04	7.90	12.10	1.29
45 × 20 cm	172.80	6.20	16.60	2.16	7.70	11.72	1.28
45 × 15 cm	177.75	6.39	17.05	2.31	7.58	11.47	1.26
S.Em. ±	**1.32**	**0.06**	**0.12**	0.03	**0.33**	**0.13**	**0.010**
C.D (p=0.05)	**3.90**	**0.18**	**0.35**	0.09	**0.67**	**0.48**	**0.03**

Yield

Cob yield was significantly influenced by different irrigation treatments (Table 2). Significantly higher baby corn yield i.e. husked and dehusked cob and fodder yield (55.27 q ha^{-1}, 14.96 q ha^{-1} and 254.55 q ha^{-1}) was recorded in three irrigation – 6 leaf, knee high and pre-tasseling. The increase in baby corn yield was mainly because of sufficient moisture availability and augmented nutrients uptake all the way through the crop growth stages, having positive effect on yield. Similar findings was reported by Shivakumar *et al*. (2011). The increase in fodder yield might because of better vegetative growth and higher dry matter production. Similar findings was confirmed with Shweta *et al*., 2022(a).

Spacing of 45 × 15 cm (1,42,857 plants/ha) recorded highest baby corn yield with and without husk (57.13 q/ha, 14.96 q/ha) and highest fodder yield (262.67 q/ha). This might be

due to regular supply of all nutrients at progressive growth stage of crop allowed satisfactory metabolic process in plant. Similar findings were also reported by Shweta *et al.*, 2022(b). Higher fodder yield at 45 × 15 cm treatment might be due to closer spacing due to more number of plants per unit area and also contributing growth parameters i.e. plant height, dry matter accumulation and leaf area index.

Table 2: Effect of different irrigation regimes and spacing on total yield (q/ha) and economics of baby corn.

Treatments	Husked baby corn yield (q/ha)	Dehusked baby corn yield (q/ha)	Fodder yield (q/ha)	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C
Irrigation regimes							
One irrigation (6 leaf stage)	51.66	14.06	241.46	51,819	1,14,544	62,725	2.21
Two irrigation (6 leaf stage and knee high stage)	52.48	14.23	243.64	54,739	1,15,851	61,112	2.11
Two irrigation (knee high stage and pre-tasseling stage)	53.90	14.57	249.98	54,739	1,18,608	63,869	2.16
Three irrigation (6 leaf stage, knee high stage and pre-tasseling stage)	55.27	14.96	254.55	57,659	1,21,529	63,870	2.10
S.Em. ±	**0.42**	**0.12**	**1.92**	-	-	-	-
C.D (p=0.05)	**1.25**	**0.29**	**5.65**	-	-	-	-
Spacing							
60 × 20 cm	50.84	13.77	235.67	53,492	1,12,049	58,557	2.09
60 × 15 cm	51.35	13.91	242.16	54,710	1,13,715	59,005	2.07
45 × 20 cm	53.98	14.64	249.57	54,710	1,18,882	64,172	2.17
45 × 15 cm	57.13	15.50	262.67	56,042	1,25,884	69,842	2.24
S.Em. ±	**0.51**	**0.11**	**2.68**	-	-	-	-
C.D (p=0.05)	**1.81**	**0.41**	**9.24**	-	-	-	-

Economics

The data revealed that three irrigation - 6 leaf, knee high and pre-tasseling stage treatment recorded highest gross returns in (₹ 1,21,529/ha) followed by two irrigation - 6 leaf and knee high stage (₹ 1,18,608 /ha) (Table 2). Whereas, three irrigation - 6 leaf, knee high and pre-tasseling stage treatment recorded highest net returns in (₹ 63,870/ha) and one irrigation - 6 leaf stage treatment recorded highest BC ratio (2.21).

Among spacing treatments, highest gross returns (₹ 1,25,884/ha), net returns (₹ 69,842/ha) and BC ratio (2.24) was observed in 45 × 15 cm, whereas lowest values were obtained from 60 × 20 cm.

It can be concluded from the results that three irrigation – 6 leaf, knee high and pre-tasseling stage along with 45 × 15 cm spacing is found beneficial to improve cob yield and economic returns of spring's baby corn in Hisar district of Haryana.

References:

Bharati, V., Ravi Nandan, Vinod Kumar and Pandey, I.B., 2007. Effect of irrigation levels on yield, water use efficiency and economics of winter maize *(Zea mays* L.*)* based intercropping systems. *Indian Journal of Agronomy*. **52**(1): 27-30.

Chamroy, T., Kale, V.S., Nagre, P.K., Dod, V.N., Wanjari, S.S. and Jahagirdar, S.W., 2017. Growth and yield response of baby corn *(Zea Mays* L.*)* To Sowing Time and Crop Geometry. *Chemical Science Review and Letter*. **6**(22): 978-981.

Choudhary, V.C., Ramachandrappa, B.K. and Nanjappa, H.V., 2006. Effect of planting methods and drip irrigation levels on growth, yield attributing characters and yield of baby corn *(Zea mays* L.*). Mysore Journal of Agricultural Sciences*. **40**(3): 326-330.

Dutta, D., Mudi, D.D. and Thentu, T.L., 2015. Effect of irrigation levels and planting geometry on growth, cob yield and water use efficiency of baby corn (*Zea mays* L.). *Journal Crop and Weed*. **11**(2):105-110.

Ertek, A and Kara, B., 2013. Yield and quality of sweet corn under deficit irrigation. *Agricultural Water Management*. **129**: 138-144.

Gaikwad, J.D., Kohire, V.O., Patil, R.M. Kokate, A.S., Chavan and Kakde, V.S., 2015. Influence of spacing, planting methods and nutrient management on productivity of sweet corn. *Bioinfolet.* **12**(2): 503-505.

Gosavi., 2006. Effect of mulches, fertilizer and levels of organic manure on the performance of rabi sweet corn (*Zea mays*). M.Sc. (Agri.) Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.).

Javaid, A.T. and Khalid, U., 2009. Regulated deficit irrigation scheduling of maize crop. *Sarhad Journal of Agriculture*. **25**(3): 441–450.

Kunjir, S.S., Pinjari, S.S., Suryawanshi, J.S. and Bhondve, T.S., 2009. Effect of planting geometry, nitrogen levels and micronutrients on the growth and yield of sweet corn. *Bioinfolet*. **6**(1): 22-24.

Mahajan, G., Sharda, R., Kumar, A. and Singh, K.G., 2007. Effect of plastic mulch on economizing irrigation water and weed control in baby corn sown by different methods. *African Journal of Agricultural Research*. **2**: 19-26.

Meena, R., Tiwari, R. and Meena, V., Charpota, J. and Meena, A., 2017. Effect of irrigation management and plant population on the performance of summer baby corn *(Zea mays* L.*). International Journal of Current Microbiology and Applied Sciences*. **6**(7): 2319-7706.

Neelam and Rinjumoni Dutta, 2018. Production of baby corn as influenced by spacing and nutrient management. *International Journal of Current Microbiology and Applied Science.* **12**(7): 2319-7706.

Reddy, K.K.K., Singh, A.K. and Singh, R.K., 2018. Consumptive use, water use efficiency and economics of rabi maize as influenced by planting geometry and moisture regimes. *International Journal of Current Microbiology and Applied Sciences.* **7**(9): 3811-3816.

Roy, S., Sengupta, A., Barman, M., Puste, M. and Gunri, M., 2015. Effect of irrigation and nutrient management on growth, yield, quality and water use of summer baby corn *(Zea mays* L.*)* in new alluvial zone of West Bengal. *Journal Crop and Weed*. **11**(2): 111-116.

Shirazi S.M., Sholichin, M., Jameel, M., Akib, S., and Azizi, M., 2011. Effects of different irrigation regimes and nitrogenous fertilizer on yield and growth parameters of maize. *International Journal of Physical Sciences*. **6**(4): 677-683.

Shivakumar, M., Ramachandrappa, B., Nanjappa, H., Mudalagiriyappa, 2011. Effect of phenophase based irrigation schedules on growth, yield and quality of baby corn *(Zea mays* L.*). Agricultural Sciences*. **2**(3): 267-272.

Shweta, Satpal, A. Kumari, Neelam, M. Sewhag, N. Kharor and M. Nagora, 2022. Performance of maize in drip irrigation system under semi-arid region. *Forage Research*. **48**(1) :88-91.

Shweta, Kavita, Neelam, M. Sewhag, Satpal, K. Malik and B. Singh, 2022. Evaluation of various maize based intercropping system. *Forage Research*. **48**(2) :205-208.

Zarapkar, D.S., 2006. Effect of spacing on growth and yield of baby corn. M.Sc. (Agri.) Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (India).