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A Review

Irrigation management and crop geometry in hybrid maize under various irrigation methods

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Introduction

Maize is the third most important cereal grain crop after wheat and rice. It is the most efficient coarse cereal crop in utilizing radiant energy and has the highest capacity to generate carbohydrates per day as compared to other cereals. Since there is a limited scope to increase the area under maize cultivation because of competition from other cereals and commercial crops, the only alternative is through increasing the productivity of maize by various management factors. Among the factors limiting the grain yield of maize in many areas is inadequate irrigation and low plant population.

Drip irrigation plays an important role in water scarcity areas by maintaining the optimum soil moisture in crop root zone with increased yield. Drip irrigation provides the efficient use of limited water with higher water use efficiency. Subsurface drip irrigation method facilitate optimum moisture content near to the crop root zone with negligible evaporation losses compared to surface drip irrigation. The utilization of soil moisture by crop varies with method and time of irrigation. IW:CPE is one of the method for scheduling irrigation water.

In addition to irrigation management, optimum plant population also play crucial role in enhancement of crop productivity. It is an established fact that higher yield depends on optimum plant population and adequate nutrient application, particularly nitrogen. In addition to plant population, it is the proper crop geometry which is important from the point of intercepting sunlight for photosynthesis besides efficient use of nutrients and moisture from soil. Correlating these functions to produce the highest possible yields with greatest efficiency has been the aim of research workers since maize production began. There is a need to investigate the optimum crop geometry with suitable irrigation schedule through IW: CPE ratio under subsurface drip irrigation to hybrid maize in sandy loam soils. Therefore literature pertaining to the effect of different irrigation management practices, crop geometry and their interaction on growth, yield attributes and yield of maize

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is reviewed here under :

Effect of irrigation management on maize :

Effect of irrigation levels on growth parameters of maize:

Plant height :

Sahu *et al*. (2005) reported that an increase in plant height of baby corn was obtained by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. Crop receiving 5-6 irrigations showed significantly higher plant height compared to less number of irrigations (Kumar *et al*., 2006). Bharati *et al*. (2007) revealed that maximum plant height of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. According to Douh and Boujelben (2011a), plant height of maize was higher when subsurface drip irrigation was buried at 0.35 m deep compared to 0.05 and 0.20 m depth. At Cairo, Egypt, Hussein and Pibars (2012) conducted a field experiment during summer season and observed an increase in plant height with an irrigation rate of 75 per cent of Et_c under subsurface drip compared to surface drip irrigation. Ertek and Kara (2013) recorded that scheduling drip irrigation at 1.0 and 0.85 ET resulted in increased plant height of sweet corn compared to other treatments.

Leaf area index :

Sahu *et al*. (2005) reported that increase in leaf area of baby corn was obtained by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. Crop receiving 5-6 irrigations showed significantly higher LAI compared to less number of irrigations (Kumar *et al*., 2006). According to Bharati *et al*. (2007), maximum LAI of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. Experiment conducted by Douh and Boujelben (2011) at Tunisia recorded an increase in leaf area of maize when subsurface drip irrigation was buried at 0.35 m deep compared to 0.05 and 0.20 m depth.

Dry matter production :

Viswanatha *et al*. (2000) reported that total dry matter accumulation in different parts of sweet corn at harvest was higher in case of drip irrigation scheduled at 0.8 E_{pan} compared to 0.4 and 0.6 E_{pan}. Experiment conducted on baby corn at Hebbal Research Station revealed that higher total dry weight per hill was obtained by scheduling drip at 0.8 E_{pan} daily compared to furrow irrigation method (Sahu *et al*., 2005). At Pusa, Bihar, Kumar *et al*. (2006) conducted an experiment during *Rabi* season and found that crop receiving 5-6 irrigations showed significantly higher dry matter production per plant compared to less number of irrigations. Stone *et al*. (2008) revealed that early biomass was obtained when laterals were placed at 1m spacing compared to 2 m under subsurface drip irrigation.

Days to 50 per cent flowering (Tasseling and Silking) :

Viswanatha *et al*. (2000) reported that sweet corn came to tasseling earlier in case of drip irrigation scheduled at 0.8 E_{pan} compared to 0.4 and 0.6 E_{pan}. According to Viswanatha *et al*. (2000), number of days taken for 50 per cent silking of sweet corn was less in case of drip irrigation scheduled at 0.8 E_{pan} compared to 0.4 and 0.6 E_{pan}. Stone *et al*. (2008) revealed that early silk emergence biomass was obtained when laterals were placed at 1m spacing compared to 2 m under subsurface drip irrigation.

Effect of irrigation levels on yield attributes of maize:

Cob length :

Sahu *et al*. (2005) opined that higher cob length of baby corn was obtained by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. According to Sanjeev Kumar *et al*. (2006), crop receiving 5-6 irrigations showed significantly higher cob length compared to less number of irrigations. The results of an experiment conducted by Bharati *et al*. (2007) revealed that maximum cob length of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. Stone *et al*. (2008) recorded that there was no significant difference in ear lengths when laterals were placed at 1m and 2 m spacing under subsurface drip irrigation. Ertek and Kara (2013) found that scheduling drip irrigation at IW/CPE ratio of 1.0 resulted in higher ear length of sweet corn compared to other treatments.

Cob girth :

Sahu *et al*. (2005) reported that higher cob girth of baby corn was obtained by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. Experiment conducted by Kumar *et al*. (2006) revealed that crop receiving 5-6 irrigations showed significantly higher cob girth compared to less number of irrigations. Maximum cob girth of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments (Bharati *et al*., 2007). According to Ertek and Kara (2013), scheduling drip irrigation at 1.0 ET resulted in higher ear girth of sweet corn compared to other treatments.

Seed weight per cob :

Experiment conducted by Rajanna *et al*. (2006) at Hebbal, Banglore revealed that maximum weight of baby corn was obtained by scheduling irrigation at IW/CPE ratio of 1.0 throughout the season which was significantly superior over 0.75 IW/CPE ratio. Kumar *et al*. (2006) found that crop receiving 5-6 irrigations showed significantly higher seed weight per cob compared to less number of irrigations. Bharati *et al*. (2007) inferred that maximum number of seeds per cob of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. At Cairo, Egypt, Hussein and Pibars (2012) conducted an experiment and recorded higher seed weight per plant with an irrigation rate of 75 per cent of Et_c under subsurface drip irrigation compared to surface drip irrigation. Ertek and Kara (2013) revealed that scheduling drip irrigation at 1.0 and 0.85 ET resulted in more number of seeds per ear of sweet corn compared to other treatments.

Hundred seed weight :

Kumar *et al*. (2006) found that crop receiving 5-6 irrigations showed significantly higher test weight compared to less number of irrigations. Bharati *et al*. (2007) recorded highest test weight of winter maize when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. Experiment conducted by Douh and Boujelben (2011) during summer season at Tunisia reported higher hundred seed weight of maize when subsurface drip irrigation was buried at 0.35 m deep compared to 0.05 and 0.20 m depth. Hussein and Pibars (2012) recorded higher hundred seed weight with an irrigation rate of 75 per cent of Et_c under subsurface drip irrigation compared to surface drip irrigation.

Effect of irrigation levels on seed and stover yield of maize :

Seed yield :

At Hebbal, Banglore, Viswanatha *et al*. (2000) conducted a field experiment and found higher green cob yield of sweet corn in case of drip irrigation scheduled at 0.8 E_{pan} compared to o.4 and 0.6 E_{pan}. Experiment conducted by Oktem *et al*. (2003) at Turkey revealed that a 2 day irrigation frequency with 100 per cent ET water application by a drip system resulted in higher ear yields in case of sweet corn compared to other treatments. Significant increase in seed yield of corn was obtained when irrigation was given at 75 per cent AET compared to other ratios under subsurface drip irrigation (Lamm and Trooien, 2003). Panda *et al*. (2004) opined that irrigation has to be scheduled at 45 per cent maximum allowable depletion of available soil water at 0-45 cm depth during the non critical stages of maize to obtain maximum seed yield in sandy loam soils in the sub-tropical regions.The experiment conducted by Sahu *et al*. (2005) at GKVK, Banglore reported higher yield of baby corn by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. At GKVK, Banglore, Rajanna *et al*. (2006) conducted a field experiment and revealed that maximum yield of baby corn was obtained by scheduling irrigation at IW/CPE ratio of 1.0 throughout the season which was significantly superior over 0.75 IW/CPE ratio. Higher husked baby corn yield was obtained with drip at 0.8 E_{pan} which was at par with 1.0 E_{pan} (Choudhary *et al*., 2006). According to Gencoglan *et al*. (2006), higher yield of green bean was obtained by scheduling irrigation at 0.8 E_{pan} under subsurface drip irrigation. Experiment conducted by Bharati *et al*. (2007) at Pusa, Bihar on sandy loam soils revealed that maximum seed yield of winter maize was recorded when irrigation was scheduled at IW/CPE ratio of 1.2 compared to other treatments. At Florence, South Carolina, Stone *et al*. (2008) conducted an experiment and summarized that higher corn yields was obtained when laterals were placed at 1m spacing compared to 2 m under subsurface drip irrigation. Payero *et al*. (2008) recorded a linear increase in yield with seasonal ET_c and WUE increased non-linearly with seasonal ET_c and with yield under subsurface drip irrigation. According to Vories *et al*. (2009), replacing 60 per cent of the estimated daily crop ET with subsurface drip irrigation is sufficient for maximum corn yields. Experiment conducted by Hassanli *et al*. (2009) at Southern Iran revealed that highest corn yield was obtained with subsurface drip irrigation when compared with surface drip and furrow irrigation. Zotarelli *et al*. (2009) stated that total yield of tomato was higher in case of surface drip irrigation (placed underneath the plastic mulch) which was at par with subsurface drip irrigation. Corn yields were higher when irrigation was scheduled at 100 per cent ET_c which was followed by 75 per cent ET_c (Jonghan and Piccinni, 2009). According to Douh and Boujelben (2011a), higher seed yield of maize was obtained when subsurface drip irrigation was buried at 0.35 m deep compared to 0.05 and 0.20 m depth. Simon *et al.* (2012) observed that the mean yields of corn were higher in case of irrigation scheduled at 100 per cent ET throughout the crop growing season under subsurface drip irrigation. At Turkey, Ertek and Kara (2013) conducted a field experiment and stated that scheduling drip irrigation at 1.0 and 0.85 ET resulted in higher ear yield of sweet corn compared to other treatments.

Stover yield :

Higher green fodder yield of maize was obtained by scheduling drip at 0.8IW/CPE ratio throughout the crop growing season compared to 0.6 IW/CPE ratio (Mallikarjunaswamy *et al*., 1997). Tyagi *et al.* (1998) revealed that stover yield of spring maize was higher in case of irrigation scheduled at 0.6 IW/CPE ratio compared to 0.2 and 0.4 ratios. According to Viswanatha *et al*. (2000) higher green fodder yield of sweet corn was obtained in case of drip irrigation scheduled at 0.8 E_{pan} compared to o.4 and 0.6 E_{pan}. Field experiment conducted by Sahu *et al*. (2005) at research station, Hebbal revealed that higher green fodder yield of baby corn was obtained by scheduling drip at 0.8 E_{pan} compared to furrow irrigation method. Rajanna *et al*. (2006) found out that maximum fodder yield of baby corn was obtained by scheduling irrigation at IW/CPE of 1.0 ratio throughout the season which was significantly superior over 0.75 IW/CPE ratio. Choudhary *et al*. (2006) summarized that higher green fodder yield of baby corn was obtained with drip at 1.0 E_{pan} which was at par with 0.8 E_{pan}.

Effect of crop geometry on maize :

Effect of crop geometry on growth parameters of maize :

Plant height :

Gollar and Patil (2000) revealed that an increase in plant height of maize at harvest was obtained by maintaining a spacing of 45 × 20 cm compared to other spacings. Gozubenli *et al.* (2003) observed tall plants at 1,00,000 plants ha^{-1} as compared to 50,000 plants ha^{-1}. Altering the plant spacing from 60 cm × 10 cm to 60 cm × 30 cm resulted in increased plant height linearly (151.5 to 176.5 cm) during *Kharif* season (Muniswamy *et al.*, 2007). Kumar (2008) revealed that increase in plant height of pop corn was obtained by maintaining a plant density of 83,333 plants ha^{-1} compared to other treatments. According to Kumar (2008), increase in plant height of sweet corn was obtained by maintaining a plant density of 1,11,111 plants ha^{-1} compared to other treatments. The result of experiment conducted by Amanullah *et al*. (2008) at TNAU, Coimbatore revealed that plant height of maize significantly increased at a spacing of 60 × 20 cm compared to other spacings. Experiment conducted on baby corn during *Kharif* season at TNAU, Coimbatore on sandy clay loam soils revealed that plant height was significantly higher at 60 cm row spacing than 45 cm spacing (Thavaprakaash and Velayudham, 2009). Narayanaswamy and Siddaraju (2011) opined that spacing of 60 cm × 20 cm recorded significantly higher plant height at harvest (206.33 cm) in sweet corn. At Annamalai University, Tamil Nadu, Aravinth *et al.* (2011) conducted a field experiment and revealed that raising of baby corn at 60 × 15 cm spacing resulted in more plant height compared to 45 × 25 cm spacing. According to Singh *et al.* (2012), plant height was increased as the inter plant spacing was increased from 15 to 30 cm. Wasnik *et al.* (2012) noticed that plant height increased with increase in plant density from 67,000 to 1,11,000 plants ha^{-1} in winter maize.

Leaf area index :

Increase in number of green leaves per plant of maize at harvest was obtained by maintaining a spacing of 60 × 30 cm compared to other spacings (Gollar and Patil, 2000). At Banglore, Muniswamy *et al.* (2007) conducted a field experiment on maize and opined that leaf area increased with increasing the spacing from 60 cm × 10 cm to 60 cm × 30 cm. The result of experiment conducted by Amanullah *et al*. (2008) at TNAU, Coimbatore revealed that LAI of maize significantly increased at a spacing of 60 × 20 cm compared to other spacings. Suryavanshi *et al.* (2009) revealed that a wider spacing of 60 cm × 30 cm resulted significantly higher leaf area as compared with 60 cm × 20 cm. Higher LAI of baby corn was obtained at 60 cm × 19 cm row spacing than 45 cm × 25 cm spacing level (Thavaprakaash and Velayudham, 2009). Planting pattern of 60 cm × 20 cm recorded the highest leaf area index of sweet corn and it was at par with 75 cm × 16 cm (Sunitha *et al.,* 2011). Aravinth *et al.* (2011) revealed that raising baby corn at

60 × 15 cm spacing resulted in more increased LAI *i.e.* more leaf area compared to 45 × 25 cm spacing. According to Wasnik *et al.* (2012), leaf area index of winter maize increased significantly with increase in plant density from 67,000 to 1,11,000 plants ha^{-1}.

Dry matter production :

Increase in total dry matter production of maize at harvest was obtained by maintaining a spacing of 60 × 30 cm compared to other spacings (Gollar and Patil, 2000). Viswanatha *et al*. (2000) recorded that total dry matter accumulation in different parts of sweet corn at harvest was higher in case of normal planting method (60 × 30 cm) compared to paired planting method (45-90-45 × 30 cm). According to Singh and Singh (2006), maintenance of hybrid maize at 83,333 plants/ha with a spacing of 60 × 20 cm from sowing resulted in higher dry matter at harvest compared to other treatments. At IARI, New Delhi, Kumar (2008) conducted a field experiment and reported that higher dry weight per plant of pop corn was obtained by maintaining a plant density of 55,555 plants ha^{-1} compared to other treatments. Kumar (2008) opined that higher dry weight per plant of sweet corn was obtained by maintaining a plant density of 66,666 plants ha^{-1} compared to other treatments. The result of experiment conducted by Amanullah *et al.* (2008) at TNAU, Coimbatore revealed that dry matter production of maize significantly increased at a spacing of 60 × 20 cm compared to other spacings. According to Suryavanshi *et al.* (2009), wider spacing of 60 cm × 30 cm had resulted in significantly higher dry matter accumulation per plant as compared with 60 cm × 20 cm spacing. Dry matter production was significantly higher at 60 cm row spacing than 45 cm spacing level (Thavaprakaash and Velayudham, 2009). Sunitha *et al.* (2011) revealed that planting pattern of 60 cm × 20 cm recorded highest dry matter production of sweet corn and it was at par with 75 cm × 16 cm. Aravinth *et al.* (2011) revealed that raising baby corn at 60 × 15 cm spacing resulted in higher dry matter production compared to 45 × 25 cm spacing. Dry matter per plant was declined with increase in plant density from 67,000 to 1,11,000 plants ha^{-1} (Wasnik *et al.*, 2012).

Days to 50 per cent flowering (Tasseling and Silking) :

Viswanatha *et al*. (2000) reported that normal planting methods (60 × 30 cm) took less number of days to 50 per cent tasseling of sweet corn compared to paired row planting method (45-90-45 × 30 cm). According to Viswanatha *et al*. (2000), Days to 50 per cent silking of sweet corn was lesser in case of normal planting method (60 × 30 cm) compared to paired row planting method (45-90-45 × 30 cm). Earlier appearance of silk was observed at wider spacing of 60 cm × 30 cm as compared to 60 cm × 10 cm spacing (Muniswamy *et al.*, 2007). At IARI, New Delhi, Kumar (2008) conducted a field experiment and revealed that days to 50 per cent silking was lesser in case of pop corn by maintaining a plant density of 55,555 plants ha^{-1} compared to other treatments. Wasnik *et al.* (2012) reported that days to silking was found directly proportional to plant population.

Effect of crop geometry on yield attributes of maize:

Cob length :

At Maize Research Station, Hyderabad, Raja (2001) conducted a field experiment and reported that ear length was higher in case of 75 × 25 cm spacing compared to other spacings. Kar *et al.* (2006) found out that cob length of sweet corn was higher in case of 60 × 30 cm spacing compared to other spacings. Increasing of spacing from 60 cm × 10 cm to 60 cm × 30 cm significantly increased the cob length (Muniswamy *et al.,* 2007). A field experiment was conducted at IARI, New Delhi on pop corn revealed that higher cob length was obtained by maintaining a plant density of 55,555 plants ha^{-1} which was at par with 66,666 plants ha^{-1} (Kumar, 2008). The result of experiment conducted by Amanullah *et al*. (2008) at TNAU, Coimbatore revealed that maximum cob length of maize can be obtained at a spacing of 60 × 30 cm compared to other spacings. Kumar (2009) summarized that increasing plant population levels from 55,555 to 83,333 plants ha^{-1} recorded reduced cob length from 13.7 to 12.1 cm. Cob length was significantly higher at 60 cm × 19 cm row spacing than 45 cm × 25 cm spacing level of baby corn (Thavaprakaash and Velayudham, 2009). At Annamalai University, Tamil Nadu, Aravinth *et al*. (2011) conducted a field experiment and revealed that raising of baby corn at 60 × 15 cm spacing resulted in higher cob length compared to 45 × 25 cm spacing. According to Narayanaswamy and Siddaraju (2011), spacing of 60 cm × 20 cm recorded significantly higher cob length (15.72 cm) of sweet corn when compared to other spacings. Sunitha *et al.* (2011) revealed that cob length was significantly higher with the crop geometry of 60 cm × 25 cm. Increase in plant density from 67,000 to 1,11,000 plants ha^{-1} recorded decrease in cob length of winter maize (Wasnik *et al.*, 2012).

Cob girth :

Raja (2001) reported that ear girth was higher in case of 75 × 15 cm spacing compared to other spacings. According to Kar *et al.* (2006), cob girth of sweet corn was higher in case of 60 × 30 cm spacing compared to other spacings. Kumar (2008) recorded higher cob girth of pop corn at a plant density of 55,555 plants ha^{-1} which was at par with 66,666 plants ha^{-1}. The experiment conducted by Amanullah *et al*. (2008) at TNAU, Coimbatore reported that maximum cob girth of maize can be obtained at a spacing of 60 × 30 cm compared to other spacings. Increasing plant population level from 55,555 to 83,333 plants ha^{-1} recorded reduced cob girth (Kumar, 2009). At UAS, Banglore, Narayanaswamy and Siddaraju (2011) conducted a field experiment and opined that increase in cob diameter was observed at a spacing of 60 × 20 cm compared to other spacings. Aravinth *et al.* (2011) noticed that raising baby corn at 60 × 15 cm spacing resulted in higher cob girth compared to 45 × 25 cm spacing. Wasnik *et al.* (2012) found that cob girth declined with increase in plant population from 67,000 to 1,11,000 plants ha^{-1} in Southern Telangana region.

Seed weight per cob :

Raja (2001) noticed that seed weight was higher in case of 75 × 15 cm spacing compared to other spacings. Maintenance of 83,333 plants/ha in hybrid maize with 60 × 20 cm spacing resulted in higher number of seeds per cob compared to other treatments (Singh and Singh, 2006). According to Sahoo and Mahapatra (2007), higher number of seeds per cob of sweet corn was obtained by maintaining a plant density of 55,555 plants ha^{-1} and it was at par with 66,666 plants ha^{-1}. At IARI, New Delhi, Kumar (2008) conducted an experiment and observed that higher fresh seed weight of sweet corn was obtained by maintaining a plant density of 66,666 plants ha^{-1} compared to other treatments. Amanullah *et al*. (2008) reported that maximum seed weight per cob of maize can be obtained at a spacing of 60 × 30 cm compared to other spacings. The result of experiment conducted by Amanullah *et al*. (2008) at TNAU, Coimbatore revealed that raising baby corn at 60 × 15 cm spacing resulted in more cob weight compared to 45 × 25 cm spacing.

Hundred seed weight :

Higher thousand seed weight of maize was obtained by maintaining a spacing of 60 × 30 cm compared to other spacings (Gollar and Patil, 2000). At Udaipur, Rajasthan, Singh and Singh (2006) conducted an experiment and reported that maintenance of hybrid maize at 83,333 plants ha^{-1} with 60 × 20 cm spacing resulted in higher test weight. Thousand seed weight was significantly increased (274.3 to 281.7 g) with increasing spacing from 60 cm × 10 cm to 60 cm × 30 cm (Muniswamy *et al.*, 2007). Amanullah *et al*. (2008) reported that maximum test weight of maize can be obtained at a spacing of 60 × 30 cm compared to other spacings. At UAS, Banglore, Narayanaswamy and Siddaraju (2011) conducted an experiment and revealed that spacing of 60 cm × 20 cm recorded significantly highest test weight (143.17 g) of sweet corn. Test weight of winter maize was reduced with increase of plant population from 67,000 to 1,11,000 plants ha^{-1} (Wasnik *et al.,* 2012).

Effect of crop geometry on seed yield and stover yield:

Seed yield :

Increase in seed yield of maize was obtained by maintaining a spacing of 45 × 20 cm compared to other spacings (Gollar and Patil, 2000). Viswanatha *et al*. (2000) opined that higher green cob yield of sweet corn was obtained in case of normal planting method (60 × 30 cm) compared to paired planting method (45-90-45 × 30 cm). According to Gozubenli *et al.* (2003), seed yield was increased with increasing plant densities upto 90,000 plants ha^{-1} but slightly decreased at 1,00,000 plants ha^{-1}. Kar *et al.* (2006) summarized that cob yield of sweet corn was higher in case of 60 × 20 cm spacing compared to other spacings. Maintenance of hybrid maize at 83,333 plants/ha with 60 × 20 cm spacing from sowing resulted in higher seed yield (0.38 t ha^{-1}) compared to other treatments (Singh and Singh, 2006).The result of experiment conducted by Choudhary *et al.* (2006) at GKVK, Banglore revealed that higher husked baby corn yield was obtained with paired row planting compared to normal row planting method. Sahoo and Mahapatra (2007) found that higher cob yield of sweet corn was obtained by maintaining a plant density of 83,333 plants ha^{-1} compared to other plant densities. According to Kumar (2008), higher seed yield of pop corn was obtained by maintaining a plant density of 83,333 plants ha^{-1} compared to other treatments. Kumar (2008) noticed that higher green cob yield of sweet corn was obtained by maintaining a plant density of 83,333 plants ha^{-1} compared to other treatments. At TNAU, Coimbatore, Amanullah *et al*. (2008) conducted a field experiment and concluded that maximum yield of maize can be obtained at a spacing of 75 × 20 cm with a nitrogen dosage of 200 kg N ha^{-1} compared to other spacings. Gosavi and Bhagat (2009) observed that the spacing of 45 cm × 20 cm recorded significantly higher baby corn yield. Wider spacing of 60 cm × 30 cm resulted in significantly higher seed yield when compared to 60 cm × 20 cm (Suryavanshi *et al.*, 2009). According to Vishalu *et al*. (2009), higher seed yield was recorded in plant density of 74,074 plants ha^{-1}. Higher baby corn yield was obtained with a plant population of 1,33,333 plants ha^{-1} at a spacing of 60 cm × 12.5 cm (Prodhan *et al.*, 2010). Narayanaswamy and Siddaraju (2011) observed that increase in processed seed yield was observed at a spacing of 60 × 20 cm compared to other spacings. The result of experiment conducted by Aravinth *et al.* (2011) at Annamalai University, Tamil Nadu revealed that raising of baby corn at 60 × 15 cm spacing resulted in higher seed yield compared to 45 × 25 cm spacing. A plant population of 1,11,000 plants ha^{-1} recorded significantly highest seed yield (Wasnik *et al.*, 2012).

Stover yield :

According to Gollar and Patil (2000), increase in stover yield of maize was obtained by maintaining a spacing of 45 × 20 cm compared to other spacings. Viswanatha *et al*. (2000) observed that higher green fodder yield of sweet corn was obtained in case of normal planting method (60 × 30 cm) compared to paired method of planting (45-90-45 × 30 cm). Fodder yield of sweet corn was higher in case of 45 × 20 cm spacing compared to other spacings (Kar *et al.*, 2006). Singh and Singh (2006) reported that maintenance of hybrid maize at 83,333 plants/ha with 60 × 20 cm spacing from sowing resulted in higher stover yield compared to other treatments. Choudhary *et al*. (2006) recorded higher green fodder yield of baby corn with paired row planting compared to normal row planting method. According to Sahoo and Mahapatra (2007), higher green fodder yield of sweet corn was obtained by maintaining a plant density of 1,11,111 plants ha^{-1} compared to other plant densities. At IARI, New Delhi, Kumar (2008) conducted a field experiment and observed higher stover yield of pop corn by maintaining a plant density of 83,333 plants ha^{-1} compared to other treatments. Kumar (2008) revealed that higher green fodder yield of sweet corn was obtained by maintaining a plant density of 1,11,111 plants ha^{-1} compared to other treatments. Suryavanshi *et al.* (2009) obtained a significant effect of closer spacing of 60 cm × 20 cm in increase of fodder yield of *Kharif* maize over 60 cm × 30 cm. Fodder yield of baby corn was significantly higher at 60 cm row spacing than 45 cm spacing level (Thavaprakaash and Velayudham, 2009). The stover yield (10,713 kg ha^{-1}) of hybrid maize was significantly higher at plant density of 74,074 plants ha^{-1} (Vishalu *et al.*, 2009). Prodhan *et al.* (2010) revealed that higher fodder yield of baby corn was obtained at plant population of 1,33,333 plants ha^{-1}. According to Sunitha *et al.* (2011), higher green fodder yield of sweet corn was obtained with 83,333 plants ha^{-1} at a spacing of 60 cm × 20 cm. Significantly higher green fodder yield of sweet corn was recorded with plant population of 1,11,111 plants ha^{-1} and remained at par with plant population of 83,333 plants ha^{-1} (Arvadiya *et al.*, 2012). Wasnik *et al.* (2012) recorded significantly highest stover yield with the plant population of 1,11,000 plants ha^{-1}.

Interaction effect of irrigation and crop geometry on yield of maize :

Singh *et al.* (1997) revealed that significant increase in seed yield of maize was observed with 60 × 20 cm spacing at IW/CPE ratio of 1.2. Seed yield of spring maize was higher with the application of nitrogen at 225 kg ha^{-1} with a spacing of 75 × 20 cm and at an irrigation frequency of 0.6 IW/ CPE ratio compared to 0.2 and 0.4 ratios (Tyagi *et al.*, 1998). According to Yohannes and Tadesse (1998), higher crop yield of tomato and WUE were achieved with drip irrigation compared to furrow irrigation. However, crop geometry did not show any significant difference among the treatments. Higher green cob yield of sweet corn was obtained in case of drip irrigation scheduled at 0.8 E_{pan} with normal planting of 60 × 30 cm spacing (Viswanatha *et al*., 2000). Sahu *et al*. (2005) reported that scheduling of drip irrigation at 0.8 E_{pan} daily with two plants $hill^{-1}$ produced higher baby corn and green fodder yield over other irrigation levels. Higher yield of baby corn was obtained with paired row planting with drip irrigation at 0.8 and 1.0 E_{pan} compared to other irrigation levels (Choudhary *et al*., 2006). At Bathinda, Punjab, Thind *et al*. (2008) conducted an experiment on sandy loam soils and revealed that higher seed cotton yield was obtained through drip under dense paired row sown cotton (35/55 × 30 cm) compared to normal paired row sowing (35/100 × 30 cm) and normal sowing method (67.5 × 30 cm). The experiment conducted by Salah *et al.* (2008) at Ismalia, Egypt revealed that seed yield of maize was higher in case of drip irrigation scheduled at 1.00 ET with a plant population of 48,000 plants ha^{-1}.

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