Original Research Article

Response of maize yield to varying plant densities in paired row configuration under drip irrigation

ABSTRACT

A field experiment was conducted at the Agricultural Research Station during the *Kharif* and *Rabi* seasons of 2014–15 to evaluate the effect of increasing plant population on the productivity of maize under a paired row system, using both drip and conventional methods of irrigation. The experiment was laid out in a split-split plot design with three replications. The treatments consisted of two main plots: (i) Drip irrigation and (ii) Conventional irrigation. The sub-plots included two maize hybrids: P3501 and DHM117. The sub-sub plots comprised six planting densities 100:50×10cm (1,33,333 plants/ha), 100:50×15cm (88,890 plants/ha),100:50×20cm (66,668 plants/ha), 90:60×10cm (1,33,333 plants/ha), 90:60×15cm (88,890 plants/ha), and 90:60×20cm (66,668 plants/ha). Overall, the results indicated that among the plant density treatments, the maize yield was significantly higher in both paired row configurations of 100:50×15cm and 90:60×15cm, with a plant population of 88,890 plants per hectare.

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1. INTRODUCTION

Maize (*Zea mays* L.) is the main food grain crop in India and ranks as the third most important cereal crop globally after wheat and rice. It is increasingly gaining popularity in India due to rising market prices and the high production potential of hybrids under both irrigated and rainfed conditions. In India, approximately 50–55% of total maize production is consumed as food, 30–35% is used in the poultry, piggery, and fish meal industries, and 10–12% is directed to the wet milling industry (Arun Kumar et al., 2007). Maize is considered the most efficient coarse cereal in terms of utilizing radiant energy and has the highest potential for carbohydrate generation per day compared to other cereals. Given the limited scope for expanding the area under maize cultivation due to competition from other cereals and commercial crops, improving productivity through better management practices is the most viable alternative. One of the key constraints to higher maize yields in many regions is inadequate irrigation and low plant population.

Drip irrigation has emerged as a crucial technique in water-scarce areas, maintaining optimal soil moisture levels. Alongside irrigation, plant population density plays a critical role in enhancing crop productivity. It is well established that higher yields depend on achieving optimal plant population and providing adequate nutrient application, especially nitrogen. Moreover, appropriate crop geometry is essential for efficient interception of sunlight for photosynthesis and for maximizing nutrient and moisture utilization within the crop's root zone (Niveditha and Nagavani, 2015). In crops like cotton, for instance, yields have improved with wider row spacing and increased plant population.

Planting geometry is a key agronomic practice that significantly influences maize productivity (Jiang et al., 2013). Maize, due to its C4 photosynthetic pathway, exhibits a high level of flexibility to changes in row spacing and nutrient management. It is exceptionally efficient in converting solar energy into dry matter (Anjanagouda et al., 2018).Therefore, to evaluate the impact of increasing plant population on the productivity of maize, the present experiment has been planned.

2. METHOD AND MATERIALS

A field experiment was conducted during two seasons *kharif & Rabi* of 2014-15 at Agricultural Research station, Karimnagar, The soils are red sandy loam, medium in organic carbon (0.65 %), available N (613.8 kg ha^{-1}), available P (62.84 kg ha^{-1}) and available K (436 kg ha^{-1}) during two years. This experiment is laidout in split spit plot design. The treatments comprised of two main plot one is method of irrigation (Drip irrigation), second one is Conventional irrigation and sub plot consists of maize hybrids P3501 & DHM117and sub- sub plots consists six planting densities (100:50X10cm   (1,33,333plants/ha),   100:50X15cm   (88,890plants/ha), 100:50X20cm(66,668plants/ha), 90:60X10cm (1,33,333plants/ha),   90:60X15cm (88,890 plants/ha),   90:60X20cm (66,668 plants/ha). The irrigations and weed control measures were adopted in crop according to need of crop from time to time. Intercultural operations were also done twice in between 25 to 30 DAS and followed by earthing up. Biometric observations such as plant height, cobs per plot, length of cobs, grains rows per cob, number of grains per row of cob, test weight, grain and Stover yield were recorded after harvesting of crop.

List 1- **The details of planting densities:**

100: 50 X 10cm	100cm in between two pairs, 50cm between rows in the pair & 10cm between the plants within the row
100: 50 X 15cm	100cm in between two pairs, 50cm between rows in the pair & 15cm between the plants within the row
100: 50 X 20cm	100cm in between two pairs, 50cm between rows in the pair & 20cm between the plants within the row
90 : 60 X10cm	90cm in between two pairs, 60cm between rows in the pair & 10cm between the plants within the row
90 : 60 X 15cm	90cm in between two pairs, 60cm between rows in the pair & 15cm between the plants within the row
90 : 60 X 20cm	90cm in between two pairs, 60cm between rows in the pair & 20cm between the plants within the row

3. **RESULTS AND DISCUSSION**

The results indicated that among the two hybrids tested for plant density under paired row method, the grain yield of DHM 117 hybrid recorded significantly higher (8881 & 7540 kg/ha respectively in drip & conventional method) than compared P3501 (7615 & 6826 kg/ha respectively in drip & conventional method). Among the plant density treatments, the maize yield was significantly higher in both paired rows of 100:50X15 (8597kg/ha) & 90:60X15 (8781 kg/ha) with plant population of (88,890 plants/ha). The yield attributes of cob length and 1000 grain weight contributed to the higher yield in those treatments in maize growing either drip or conventional method. During *rabi* season also observed that the significantly highest yield with population of 88,890 plants/ha in irrespective of paired row method (100:50X15 & 90:60X15) 9634 kg/ha, 9443kg/ha respectively. The same trend was observed interms of yield attributes. Therefore, it can be stated that assimilated material share, distributed into each ear maize, become less in high density because of increasing competition between crucibles and resource constraints (Duncan, 1984). The main reasons related to kernel weight in lower density levels result from an increased photosynthetic capability of plants, due to less shading characteristic and increased

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light absorption (Shakarami, 2009). The results agree with the findings of some researchers (Damavandi and Latifi, 1999).

Table 1: Effect of increasing plant density in paired row method under drip on maize yield during *Kharif* 2014-15

Treatment	Grain yield (kg/ha)	Cob yield (kg/ha)	Cob length (cm)	Cob girth (cm)	No. of Kernel rows	No. of kernels/ row	1000 grain weight (g)
Method of irrigation							
Drip	8748	11222	15.3	14.2	14	35.7	269
Conventional	7283	10320	13.2	13.8	14	32.1	243
CD (0.05)	1210	1434	1.4	NS	NS	NS	22.6
Hybrids							
DHM117	8881	12162	16.1	14.2	14	36.9	280
P3501	7615	10283	16.3	13.9	14	33.1	262
CD (0.05)	810	875	NS	NS	NS	3.2	15.1
Planting density							
100X50X10 (1,33,333 pl/ha)	7057	8639	12.5	13.6	14	35.3	257
100X50X15 (88,890 pl/ha)	8597	11119	15.8	14.1	14	36.4	269
100X50X20 (66,668 pl/ha)	6975	8433	16.1	14.4	14	36.3	278
90X60X10 (1,33,333 pl/ha)	6998	9174	12.9	14.2	14	34.9	247
90X60X15 (88,890 pl/ha)	8781	12459	16.6	14.5	14	35.8	287
90X60X20 (66,668 pl/ha)	7109	9513	16.7	14.6	14	36.5	277
CD (0.05)	1403	1515	1.5	NS	NS	NS	25.7
Interaction							
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of increasing plant density in paired row method under drip on maize yield during *Rabi* 2014-15

Treatment	Grain yield (kg/ha)	Cob yield (kg/ha)	Cob length (cm)	Cob girth (cm)	No. of Kernel rows	No. of kernels/ row	1000 grain weight (g)
Method of irrigation							
Drip	8554	10650	16.9	15.4	16	39.8	298
Conventional	7153	9236	14.9	14.3	16	38.4	272
CD (0.05)	1180	1210	1.6	NS	NS	NS	23.6
Hybrids							
DHM117	9635	11958	17.4	16.2	16	39.1	292
P3501	8742	10943	16.4	15	16	38.1	275
CD (0.05)	NS	NS	NS	0.17	NS	NS	NS
Planting density							
100X50X10 (1,33,333 pl/ha)	6882	8940	15.3	15.3	14	34.1	273
100X50X15 (88,890 pl/ha)	9634	12907	17.9	15.6	16	41.2	281
100X50X20 (66,667 pl/ha)	8024	10119	17.5	15.7	16	39.2	283
90X60X10 (1,33,333 pl/ha)	6532	838	15.8	14.9	14	36.1	277
90X60X15 (88,890 pl/ha)	9443	12098	17.6	16.0	16	40.7	286
90X60X20 (66,667 pl/ha)	7943	9855	17.4	15.9	16	40.1	289
CD (0.05)	1565	1751	1.4	NS	NS	4.2	NS
Interaction							
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

4. CONCLUSIONS

Results showed that the among the plant density treatments, the maize yield was significantly higher in both paired rows of 100:50X15 & 90:60X15 with plant population of (88,890 plants/ha). The yield attributes of cob length and 1000 grain weight contributed to the higher yield in those treatments in maize growing either drip or conventional method. In *Rabi* also observed that the significantly highest yield with population of 88,890 plants/ha in irrespective of paired row method.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that no generative AI technologies such as large language models (chatgpt, copilot, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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