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Effect of sowing method, mulch and irrigation regimes on yield and yield components of August sown maize (*Zea mays* L.)

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ABSTRACT

An experiment was conducted at Punjab Agricultural University, Ludhiana, Punjab in the year 2010 to study the effect of various sowing methods, mulch levels and irrigation regimes on growth and yield of August sown maize. The field experiment was laid out in split-plot design with 18 treatments combinations, six combinations from method of sowing (flat, ridge and bed) and mulch (no mulch and mulch @ 6t ha^{-1}) as main plot treatments and three irrigation levels as sub plot treatments (irrigation at IW/CPE ratio 0.50, 0.75 and 1.00). The data indicated that grain yield for bed planting (78.2q ha^{-1}) was significantly higher than ridge (74.8q ha^{-1}) and flat (70.6q ha^{-1}). Mulch application had no significant effect on various yield attributing character and yield itself. Significantly higher yield was recorded under irrigation regime $I_{1.00}$ (80.3q ha^{-1}) as compared to $I_{0.75}$ (75.9q ha^{-1}) and $I_{0.50}$ (67.4 q ha^{-1}). The data also revealed that for yield attributes such as total cobs ha^{-1}, green cob yield (q ha^{-1}), stover yield (q ha^{-1}) and harvest index etc., higher numeric values were recorded under bed planting and irrigation regime $I_{1.00}$ as compared to other sowing methods and irrigation regimes.

Keywords: Irrigation regimes, mulch, planting method, yield

Maize (*Zea mays* L.) is the most important cereal crop of the world after wheat and rice. Because of its high productivity, it is also referred to as 'Queen of Cereals' and as 'Emerging Industrial Crop' due to its utility in different forms. As the crop has adapted well to divergent climatic conditions prevailing in the tropical to temperate regions, it is successfully grown under the varying environmental conditions throughout the country. Presently maize is mainly grown in *kharif* season and to some extent, in winter and spring seasons in Punjab. Introduction of rice -wheat system in Punjab has also led to some severe problems among which depleting water table and deteriorating soil health are major ones. So, there is a need to replace the high water requiring rice crop with some low water requiring crop like maize.

Kharif maize is very sensitive to excess moisture but as the maize growing season coincides with monsoon rains which often causes either failure of the crop or very low yields. Therefore, the Punjab Agricultural University has also recommended sowing of maize in the month of August as it faces significantly lower maize borer attack as compared to maize sown in the beginning of *kharif* season (Anon., 2011). Moreover, the delayed sowing (in August) during *kharif* favourably influenced the grain and stover yield and gave higher benefit:cost ratio and gross returns (Panchanathan, 1992). However, in August sowing the frequent spells of rain cause crust formation which adversely affects the crop germination and/or emergence. Water logging at early stages may cause complete failure of the crop or very low yield. Therefore, different planting methods need to be evaluated to tackle these problems. Use of mulch can be an option because it helps in maintaining the soil comparatively loose even after rains and results in better soil moisture storage. Adoption of a better planting method and mulch may protect the crop from water stress or crust formation and protect soil from erosion during rains. As monsoon rains in Punjab invariably recede by 15th September and the temperature starts falling afterwards, almost total water requirement is to be met through irrigation. Planting methods in addition to solving the problem of water logging may also help in reducing the irrigation water requirement through the principle of deficit irrigation water supplies and better moisture availability to root zone of crop plant. Keeping in view above facts, the present study was thus aimed at studying the growth and yield of August sown maize under different sowing methods, mulch levels and irrigation regimes.

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An experiment was carried out at Students' Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana during late *kharif* 2010-11. The soil of the experimental field was loamy sand in texture. The experiment comprising 18 treatment combinations was laid out in a split plot design with four replications. Six combinations from three planting viz. flat, ridge and bed and two levels of mulch were in main plots and three irrigation regimes were in sub plots.

The maize hybrid PMH1 was sown on August 27, 2010. The sowing was done by dibbling two seeds per hill keeping row to row spacing of 60 cm and plant to plant spacing of 20 cm for flat and ridge plots. For bed plots sowing was done on raised beds spaced 67.5 cm apart. One crop row was kept per bed with plant to plant spacing of 17.8cm. The post sowing irrigations were applied as per IW/CPE ratio. The depth of irrigation was 7.5 cm, 6.0 and 5.0 cm for flat, ridge and bed plots, respectively. The irrigation water was measured with Parshall flume (Parshall, 1950). The crop was harvested manually on January 7, 2011 when more than 80 per cent of the cobs turned yellowish brown and grains became hard. Fifteen days after harvesting, the cobs were dehusked manually and were allowed to dry for another fifteen days and thereafter the threshing was done using maize dehusker cum thresher. The maize grain yield was converted to quintal per hectare at 15.0 per cent moisture.

The observations on yield and yield components of the crop were recorded by using standard procedures. Statistical analysis of the data recorded was done as per split plot design (Cochran and Cox, 1967), using CPCS1 software developed by the Department of Mathematics and Statistics, PAU, Ludhiana.

The data regarding the number of cobs per plant are presented in table 1. It is a genetic character of the cultivar but some improvement can be expected due to agronomic manipulations. The number of cobs per plant was significantly higher under the bed sown crop in comparison to ridge sown crop which in turn was statistically better than the flat sown crop (Table 1). This might be due to the fact that crop planted on ridges and beds registered good growth. Moreover, in case of ridge and bed planting frequent irrigations must have resulted in favourable microclimatic conditions when compared to flat planting. These results are supported by the findings of Arif *et al.* (2001) and Singh (2005) who observed more no. of ears per plant in case of ridge planting over flat planting due to better growth and development of crop on ridges. The present trend is also in harmony with those stated by Singh (2011) who reported better number of ears per plant under ridge and bed planting in comparison to flat planting. The number of ears per plant was not affected significantly by the mulch application and various irrigation regimes as well as by the various interactions among different factors taken in the study. Singh (2010) also reported similar findings while testing PMH-1 under various irrigation regimes when the sowing was done on 27th Aug. The no. of cobs per hectare followed almost similar trend.

The data with respect to cob length reveal that the cob length was significantly higher under bed and ridge planting methods as compared to flat planting. The cob length under ridge planting was statistically at par with bed planting. Higher cob girth was also noted in order of bed, ridge and flat planting. The data also revealed a per cent increase in cob girth under bed and ridge planting to the tune of 4.72 and 3.93, respectively as compared to flat planting. Singh (2011) also reported significantly longer ears and more cob girth under ridge and bed planting as compared to flat planting. The mulch application had no significant effect on the cob length and girth. Cob length and girth were reported to be significantly higher under higher irrigation regimes. The per cent increase in cob length was 5.4 and 11.4 under $I_{1.00}$ when compared to $I_{0.75}$ and $I_{0.50}$, respectively. Similarly cob girth was significantly higher under $I_{1.00}$ and $I_{0.75}$ irrigation regimes as compared to $I_{0.50}$. The irrigation regimes $I_{0.75}$ and $I_{1.00}$ were statistically at par with respect to cob girth. Similar results were reported by Singh and Singh (2000) and Singh (2010) who reported that cob length and girth increased with increase in the frequency of irrigation.

Significantly lower barrenness was reported under bed and ridge planting and it was to the tune of 23.14 and 14.4 per cent when compared to flat planting. A decreasing trend in cob barrenness under bed and ridge planting was also reported by Singh (2011) when compared with flat planting. Cob barrenness was not affected significantly by mulch application. The per cent barrenness of cobs was reduced significantly at higher irrigation regimes *i.e.* $I_{1.00}$ (11.0 %) and $I_{0.75}$ (12.5%) due to better moisture availability, although the irrigation regimes $I_{1.00}$ and $I_{0.75}$ were at par with each other. The adverse effect of water stress at the time of pollination or immediately after pollination during early grain filling period is well reported and this causes barrenness in ears owing to the desiccation of pollens or abortion of zygote. Varughese and Iruthayaraj (1996) observed 16.5% reduction in barrenness under IW/CPE ratio of 0.75 over that of 0.5 IW/CPE ratio. None of the interactions between methods of sowing, mulch application and irrigation regimes affected the cob barrenness significantly.

As far as the number of grains per cob is concerned it was maximum under bed planting which was statistically *at par* with ridge planting but significantly better than the flat planting method and higher to the tune of 12.84 and 8.1 per cent in case of bed and ridge planting when compared to flat planting with ridge planting but significantly better than the flat planting method and higher to the tune of 12.84 and 8.1 per cent as compared to latter. The ridge planting was also statistically superior to flat planting with respect to no. of grains per cob. Kaur (2002), Debebe (1999) and Singh (2011) also reported higher no. of grains per cob in case of bed and ridge methods of sowing as compared to flat planting. Number of grains per cob was not affected significantly by mulch application. The irrigation regime $I_{1.00}$ was significantly better than $I_{0.50}$. Irrigation regimes $I_{1.00}$ and $I_{0.75}$ produced 378.4 and 356.4 grains per cob respectively and these were statistically at par with each other with percent increase of 6.17 and 16.0 as compared to $I_{0.50}$. Ayotamuna *et al*. (2007) also reported similar findings.

The data presented in table 1 reveal that the three methods of planting did not differ significantly with respect to test weight. The results are in conformity with those reported by Kumar (2008) and Singh (2011). Mulch application did not affect the grain test weight. Numerically higher values for test weight were recorded under higher irrigation regimes (31.8 g and 31.0 for $I_{1.00}$ and $I_{0.75}$, respectively) for but these differences failed to attain the level of statistical significance (Singh, 2010). The test weight was not affected significantly by any of the interactions between any of the factors under study.

Table 1: Effect of sowing method, mulch application and irrigation regimes on yield attributes of August sown maize

Treatments	No. of cob plant^{-1}	No. of cubs (*ooo ha^{-1})	Cob length (cm)	Cob girth (cm)	Barrenness (%)	No. of grains cob^{-1}	1000 grain weight (g)
Showing method							
Flat	0.9	80.7	18.1	12.7	13.5	333.1	29.4
Ridge	1.0	82.1	18.5	13.2	11.8	360.3	30.5
Bed	1.1	82.2	18.6	13.3	11.0	373.9	31.0
LSD (0.05)	**0.10**	**0.20**	**0.23**	**0.10**	**0.80**	**26.30**	**NS**
Mulching level							
No mulch	1.0	80.8	18.3	13.0	12.3	354.3	30.2
Mulch @ 6 t ha^{-1}	1.0	80.8	18.5	13.1	12.1	357.1	30.5
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Irrigation regimes							
$I_{0.50}$	1.0	80.7	17.5	12.6	13.0	326.2	27.2
$I_{0.75}$	1.0	81.0	18.5	13.2	12.5	356.4	31.0
$I_{1.00}$	1.0	81.1	19.5	13.4	11.0	378.4	31.8
LSD (0.05)	**NS**	**NS**	**0.70**	**0.40**	**0.40**	**33.2**	**NS**
LSD (0.05) for interactions	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Bed planting resulted in the highest green cob yield (143.8 q ha^{-1}) which was significantly higher to that obtained under flat(130.9 q ha^{-1}) planting but it was statistically at par with ridge (140.4 q ha^{-1}) planting. The per cent increase in green cob yield under bed planting was 2.4 and 9.8 as compared to ridge and flat planting, respectively. The results are in conformity with those reported by Singh (2011). Similar trend was observed under stover yield in which stover yield was statistically higher under bed planting (130.9 q ha^{-1}) as compared to flat planting (119.9 q ha^{-1}) but was at par with that recorded under ridge planting (126.9 q ha^{-1}).

Mulch application did not influence the green cob yield and stover yield significantly. Under the influence of different irrigation regimes, the green cob yield (Oktem, 2008; Oktem *et al.*, 2003, Viswanatha *et al.*, 2002; Singh, 2011) and stover yield (Arya and Singh, 2000; Singh, 2010) increased significantly with increase in irrigation frequency or under well watered conditions. Stover yield was significantly higher under irrigation regimes $I_{1.00}$ and $I_{0.75}$ as compared to $I_{0.50}$. The irrigation regimes $I_{0.75}$ was statistically at par with $I_{1.00}$ but significantly better than $I_{0.50}$ with respect to stover yield. None of the interactions between various factors under study affected the stover yield significantly.

Table 2: Effect of sowing method, mulch application and irrigation regimes on green cob yield, stover yield, ear yield, grain yield, shelling percentage and harvest index of August sown maize

Treatment	Green cob yield (q ha^{-1})	Stover yield (q ha^{-1})	Ear yield (q ha^{-1})	Grain yield (q ha^{-1})	Shelling (%)	Harvest index (%)
Sowing method						
Flat	130.9	119.9	86.8	70.6	81.3	34.2
Ridge	140.4	126.9	89.6	74.8	83.5	34.5
Bed	143.8	130.9	91.9	78.2	85.1	35.3
LSD (0.05)	**9.60**	**7.80**	**7.00**	**3.40**	**1.10**	**NS**
Mulching level						
No mulch	137.8	125.5	89.1	74.2	83.0	34.5
Mulch @ 6 t ha^{-1}	139.2	126.0	89.8	74.8	83.3	34.7
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Irrigation regimes						
$I_{0.50}$	126.8	116.0	82.2	67.4	82.0	34.0
$I_{0.75}$	138.9	128.0	90.8	75.9	83.6	34.7
$I_{1.00}$	149.8	134.3	94.9	80.3	84.6	35.1
LSD (0.05)	**6.5**	**10.3**	**6.4**	**4.2**	**1.1**	**NS**
LSD (0.05) for interactions	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Highest grain yield (78.2 q ha^{-1}) was recorded under bed planting and it was statistically higher than that obtained under ridge (74.6 q ha^{-1}) and flat planting (70.6 q ha^{-1}). Ridge planting was also proved statistically jsuperior to than flat planting. The increase in yield under bed planting was to the tune of 10.76 and 4.54 per cent than planting in flat and ridge methods, respectively. Significantly higher yield under sowing of maize in beds and ridges might be due to higher values of yield parameters produced in these sowing methods. Mulch application did not influence the grain yield significantly. The grain yield under irrigation regime $I_{1.00}$ (7 irrigations) was significantly higher than $I_{0.75}$ irrigation regime (5 irrigations) which in turn was significantly superior to $I_{0.50}$ (3 irrigations). The per cent increase in grain yield under $I_{1.00}$ was 5.8 and 19 over $I_{0.75}$ and $I_{0.50}$, respectively. There was a gradual increase in grain yield with increase in irrigation frequency (Panchanathan *et al.*, 1992; Khan *et al.*,1996; Jat *et al.*, 2008; Singh, 2010).

Bed planting was statistically better than ridge and flat planting on the basis of shelling percentage. Shelling percentage was also statistically higher under ridge planting by a margin of 2.7 per cent over flat planting. Higher shelling percentage under ridge and bed sowing methods were due to longer and thicker cobs, lower cob barrenness, higher number of grains per cob and higher 1000-grain weight as compared to flat planting. Shelling percentage was not influenced significantly by mulch application (Table 2). The irrigation regime $I_{1.00}$ recorded the highest shelling percentage (84.6) which was statistically higher over $I_{0.50}$ and statistically at par with $I_{0.75}$. The irrigation regime $I_{0.75}$ was also statistically superior to $I_{0.50}$ with respect to shelling percentage. Hussaini *et al.* (2002) and Singh (2010) also reported higher shelling percentage at IW/CPE ratio 1.00. All the interaction effects due to various treatments were found to be non significant with respect to shelling percentage.

The harvest index (HI) was not affected significantly either due to method of sowing or mulch or irrigation regimes alone or their combinations. Similar findings have been reported by Singh (2011) with respect to the effect of various methods of sowing and irrigation regimes on HI.

REFERENCES

Anonymous 2011. *Package of Practices for Crops in Punjab-Kharif*. Punjab Agricultural University, Ludhiana, pp. 18-23.

Arif, M., Khan, S., Ghani, F. and Yousafzai, H. K. 2001. Response of maize varieties to different planting methods. *Sarhad J. Agric.*, **17**:159-63.

Ayotamuno, J. M., Zuofa, K., Ofori, S. A. and Kogbara, R. B. 2007. Response of maize and cucumber intercrop to soil moisture control through irrigation and mulching during the dry season in Nigeria. *African J. Biotech.,* **6**: 509-15.

Cochran, W. G. and Cox, G. M. 1967. *Experimental Designs*. Asia Publishing House, New Delhi.

Debebe, G. D. 1999. Evaluation and mitigation of yield losses caused by flooding in maize. *M. Sc. Thesis*, Punjab Agricultural University, Ludhiana.

Hussaini, M. A., Ogunlela, V. B., Ramalan, A. A., Falaki, A. M. and Lawal, A. B. 2002. Productivity and water use in maize (*Zea mays* L.) as influenced by nitrogen, phosphorus and irrigation levels. *Crop Res.,* **23**: 228-34.

Jat, M. L., Pal, S. S., Singh, R., Singh, D. and Gill, M. S. 2008. Effect of moisture regimes and nitrogen management options on crop and water productivity and nitrogen-use efficiency in maize (*Zea mays*)-wheat (*Triticum aestivium*) cropping systems. *Indian J. Agric. Sci.,* **78**: 881-83.

Kaur, T. 2002. Studies on the irrigation requirement in relation to method of planting of maize (*Zea mays* L.). *M.Sc. Thesis*, Punjab Agricultural University, Ludhiana.

Khan, G.M., Dand, G.M., Shah, M.H., Bali, A.S. and Singh, K.N. 1996. Response of intercropping system involving maize (*Zea mays*) to irrigation level in Kashmir valley. *Indian J. Agric. Sci.,* **66**: 272-75.

Kumar, A. 2008. Productivity, economics and nitrogen-use efficiency of specialty corn (*Zea mays*) as influenced by planting densities and nitrogen fertilization. *Indian J. Agron.,* **53**: 306-09.

Oktem, A., Simsek, M. and Oktem, A. G. 2003. Deficient irrigation effects on sweet corn (*Zea mays saccharata* Sturt) with drip irrigation system in a semi-arid region. I. water-yield relationship. *Agric. Water Manage.,* **61**: 63-74.

Oktem, A. 2008. Effects of deficit irrigation on some yield characteristics of sweet corn. *Bangladesh J. Bot.,* **37**: 127-31.

Panchanathan, R. M., Reddy, D. S., Subramanian, S. and Palaniappan, S. P. 1992. Evaluation of irrigation schedule and time of sowing for maize, based on economic indices. *Madras Agric. J.,* **79**: 505-10.

Parshall , R. L. 1950. Measuring water in irrigation channels with parshall flumes and small weir. *Soil Conserv. U. S. Dept. Agric. Circ.,* **843**: 62.

Singh, A. 2005. Water productivity of bed planted soybean (*Glycine max* L. Merrill) as influenced by mulching, irrigation regimes and lopping. *M.Sc. Thesis*, Punjab Agricultural University, Ludhiana.

Singh, G. 2010. Irrigation and nitrogen needs of August sown hybrid maize. *M. Sc. Thesis*, Punjab Agricultural University, Ludhiana.

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.

Singh, S. and Singh, T. N. 2000. Response of maize crop to early and late summer sowing conditions. *Indian J. Pl. Physiol.,* **5**:307-13.

Varughese, K. and Iruthayaraj, R. 1996. Response of sole and intercropped maize to irrigation and nitrogen levels. *Madras Agric. J.*, **83**: 189-93.

Viswanatha, G. B., Ramachandrappa, B. K. and Nanjapa, H. V. 2002. Soil-plant water status and yield of sweet corn as influenced by drip irrigation and planting methods. *Agric. Water Manage.,* **55**: 85-91.

Zaidi, P.H. and Singh, N.N. 2005. *Stresses on Maize in Tropics*. Directorate of Maize Research, Pusa Campus, New Delhi, pp. 3-7.