European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 07, 2020

Effect Of Irrigation Scheduling, Mulching And Hydrogel On Maize Crop

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Abstract: The experimental study "Effect of Irrigation scheduling, Mulching and Hydrogel on Maize (Zea mays)"has been carried out at lovely professional university. The study has been carried out with different treatment combinations of irrigation scheduling, mulching and hydrogel. The effect was observed on plant height, number of leaves, leaf area index, days of silking. The treatment combination of 6kg mulch and 100 grams hydrogel shown the significant effect on maize crop. With these combinations the average height was recorded (78.2 cm, 228.1cm and 230.4 cm) at 30 DAS, 60 DAS and 90 DAS, number of leaves were recorded (5.8, 12.7 and 14.2), LAI (1.5, 3.5 and 4.1).

Keyword : Hydrogel, mulching, irrigation scheduling.

1. INTRODUCTION

Maize also known as corn is a cereal crop and it was first domesticated by the indigenous peoples in southern Mexico about 10,000 years ago. The leafy stalk of the plant produces pollen inflorescences and separate ovuliferous inflorescences called ears that are seeds. Maize has become a staple food in many parts of the world with a total production of maize surpassing that of rice and wheat. But a little of this maize is consumed directly by humans. Mostly used for animal feed, corn ethanol and other maize products like corn starch and syrup. Maize is grown all over the year in India. It is predominantly a kharif crop with 85% of the area under cultivation during the season. Globally maize is known as the queen of cereals because it has highest genetic yield potential among the cereal. The total sowing area, production and yield in 2018 were 150m ha producing 1065 million metric tonnes of corn in 2016-17 grains and at an average yield of global average 5.92 t ha-1(NCoMM Special report: September 2017). A major shift in the global cereal demand is under the way, and by 2020, demand for maize in developing countries is expected to exceed demand for both wheat and rice (ChitraMani & Kumar, P. (2020); Sharma, M., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020); Naik, M., & Kumar, P. (2020); Kumar, P., & Naik, M. (2020); Kumar, P., & Dwivedi, P. (2020). Devi, P., & Kumar, P. (2020); Kumari, P., & Kumar, P. (2020); Kaur, S., & Kumar, P. (2020); Devi, P., & Kumar, P. (2020); Sharma, K., & Kumar, P. (2020); Kumar, S. B. P. (2020); Devi, P., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020).

The issue of water management has assumed paramount importance and occupied the centre stage of all politico-economic debates in the world. India has entered the shadow of the zone of physical and economic water scarcity. The sharp fall in groundwater levels owing to excessive removal for agricultural and other uses coupled with the high costs of fuel and electrical energy used for withdrawing groundwater and poor water use efficiency due to wasteful practices are affecting the economics of water use in all spheres of human activity. Increasing world population, risks of floods and droughts associated with climate change, and demands for fresh water for urban and environmental services are leading to a decline in water resources available for agriculture (Fallon and Betts, 2010). So we need to improve efficiency and productivity of water used in agriculture to ensure sustainable production of food and fibre (Kumar, P. (2019); Kumar, D., Rameshwar, S. D., & Kumar, P. (2019); Dey, S. R., & Kumar, P. (2019); Kumar et al. (2019); Dey, S. R., & Kumar, P. (2019); Kumar, P., & Pathak, S. (2018); Kumar, P., & Dwivedi, P. (2018); Kumar, P., & Pathak, S. (2018); Kumar et al.,2018; Kumar, P., & Hemantaranjan, A. (2017); Dwivedi, P., & Prasann, K. (2016). Kumar, P. (2014); Kumar, P. (2013); Kumar et al. (2013); Prasann, K. (2012); Kumar et al. (2011); Kumar et al. (2014).

When polymer is mixed with the soil, it forms an amorphous gelatinous mass on hydration and is capable of absorption and desorption over a long period of time, hence it acts as a slow release source of water in soil. The hydrogel particles may be taken as “miniature water reservoir” in the soil and water will be absorbed from these reservoirs by the root demand through osmotic pressure difference. Hydrogels can be applied to the soil by mixing with the soil or by spraying. While using the spray technique, hydrogels can also be mixed with the micronutrients and pesticides. The excellent water absorbency and water retaining ability of hydrogel may prove especially practical in agriculture. It performs its wetting/drying cycles over a long period of time, maintaining its very high water swelling and releasing capacity against soil pressure. Consequently evaporation, deep water percolation and nutrient leaching can also be avoided.

The state Punjab is very hot during summer, with less rainfall and cold in winter. Punjab experiences both summer and winter to its extreme. It even receives very less rainfall, but it got 5 rivers which makes the land very fertile. Keeping these points in view, the present investigation, “Effect of Irrigation Scheduling, Mulching and Hydrogel on Maize Crop” was carried out at experimental field of School of Agriculture, LPU.

2. MATERIAL AND METHODS

The soil of the experimental site is loamy soil. It is the most important, fertile and productive soil group of the state Punjab. The field is situated at in lovely professional university central zone of the state. This zone receives rainfall from both south-west and north-west monsoons which is well distributed from June to September. Effect of three different levels such as 25 gm, 50 gm and 100 gm per plot of hydrogels were tested on Maize crop. The effect of hydrogel was observed on different plant growth attributes of Maize. A rectangular plot had been selected for the cultivation. The land was first ploughed by tractor using a mould board plough. Then the big clods were broken by a cultivator and been harrowed once to get a fine tilt. Ridges, bunds, irrigation channel were prepared and the land was good for cultivation. The variety of seed which is used is PMH-1 and is developed by Punjab Agriculture University. The furrows were opened and 2-3 seeds were been sown.

The recommended rate of nutrients (N, P, K120:60:140kg/ha) were applied in the form of urea, diammonium phosphate and Muriate of potash. The available amounts of nitrogen in DAP was deducted from the dose of Urea. Half of the nitrogen was applied at sowing time as basal dose along with the full quantities of phosphorus and potash and remaining half dose of nitrogen was applied as top dress at 30days after sowing to all the treatments. The basal application of fertilizer is being done in band in the small furrows opened manually adjacent to the seed line.

Hydrogel was mixed with soil and applied during the time of irrigation in band of the seed line with the treatments of hydrogel at the rate of 2.5,5 and 7.5 kg/ha. When the hydrogel is applied into the soil it helps to absorb and retain large quantities of water and releases absorbed water slowly to the plant.

Mulching was undertaken in respective treatments with rice straw at the rate of 4 & 6 t/ha on 2-3 DAS with in the inter row space. Mulch was maintained up to the harvest of the crop.

Irrigation was scheduled at critical growth stages. Amount of irrigation water was applied to the plots as per the treatments at the depth of 5cm. The source of irrigation water was ground water with good and poor quality irrigation water.

Treatment Details

T1=25 grams hydrogel and no mulch, T2 =25 grams hydrogel and 4kg mulch, T3=25 grams hydrogel and 6 kg mulch, T4=50 grams hydrogel and no mulch, T5=50 grams hydrogel and 4 kg mulch, T6=50 grams hydrogel and 6 kg mulch, T7=100 gram hydrogel and no mulch, T8=100 gram hydrogel and 4 kg mulch, T9=100 gram hydrogel and 6 kg mulch

3. RESULT AND DISCUSSION

Effect of Irrigation Scheduling, mulching and hydrogel was observed on different plant growth parameters of Maize as follows;

Plant Height

Data of the mean height as affected by various treatments at 30 DAS, 60 DAS, and 90 DAS are presented in table number 1.

Table 1 Effect of irrigation scheduling, mulching and hydrogel on maize plant height at 30 DAS, 60 DAS and 90 DAS

Treatment	30DAS	60 DAS	90 DAS
T1	69.1	201.9	209.9
T2	71.7	215.3	217.6
T3	76.2	225.9	226.8
T4	70.9	208.2	213.4
T5	75.1	219.5	222.0
T6	76.9	225.2	227.6
T7	72.2	210.0	214.6
T8	76.6	225.7	226.2
T9	78.2	228.1	230.4
F test	Sig.	Sig.	Sig.
SE(m)	0.629	0.486	0.443
C.D.	1.903	1.470	1.338

Table 1 reveals that plant height was observed maximum (78.2 cm, 228.1 cm and 230.4cm at 30 DAS, 60 DAS and 90 DAS) in treatment T9 and minimum (69.1cm, 201.9 and209.9cm) in T1. There was a minute difference between T9 (100 g hydrogel and 6 kg mulch) and T6(4kg mulch and 50 g hydrogel) as the amount of mulch is same and amount of hydrogel is different. Same case is observed in T4 and T1 as the amount of hydrogel is different and there is no mulching. The plant height is observed less in T1, it might be due to the low concentration of hydrogel and no mulching on the plot. Which leads to less uptake of nutrition in the plant. Due to the low concentration of hydrogel, the soil didn't absorbed water as much as the other plots and even no mulching affected the soil fertility. Hence T1 values are less due to no application of mulch and low concentration of hydrogel but T9 values are higher as the concentration of hydrogel was 100 grams and applied mulch amount was 6kg. Increase in plant height at higher moisture regime is due to maintenance of adequate and continuous moisture to plant which maintained the good establishment of roots and various metabolic processes. These findings are in accordance with the findings of Ahmad (2002).

Leaves per plant

Data on the mean number of leaves per plant of maize as affected by various treatments at 30 DAS, 60 DAS and 90 DAS are presented at the table 2.

Table 2: Effect of irrigation scheduling, mulching and hydrogel at number of leaves per plant of Maize

Treatment	30 DAS	60 DAS	90 DAS
T1	4.8	10.5	10.8
T2	5.1	11.2	12.6
T3	5.6	12.1	13.5
T4	5.1	11.4	12.6
T5	5.4	11.7	13.2
T6	5.6	12.1	13.7
T7	5.2	11.4	12.7
T8	5.6	12.2	13.6
T9	5.8	12.7	14.2
SE(m)	0.099	0.117	0.091
F test	Sig.	Sig.	Sig.
C.D.	0.299	0.355	0.274

Table 2 reveals that, number of leaves was observed maximum (5.8, 12.7 and 14.2 at 30 DAS, 60 DAS and 90 DAS) in treatment T9 and minimum (4.8, 10.5, 10.8 at 30 DAS 60 DAS and 90 DAS) in T1. There was a minute difference in T8 and T9 as the concentration of hydrogel is same in both of them while amount of mulching application was different. Same case was observed in T4 and T7 and T1 as there were no application of mulch but the concentration of hydrogel was different. Number of leaves was observed less in T1, it might be due to low concentration of hydrogel and no application of mulches. As mulching helps to increase fertility of the soil and hydrogel helps to trap the nutrients from leaching. Hence T1 values are less due to no application of mulches and application of hydrogel in low concentration. And higher in T9 as the amount of hydrogel applied was 100 grams and the amount of mulches applied was 6 kg. Decline in the number of leaves after grand growth period could be due to the result of senescence of older leaves. This is conformity with result of Donald (1961).

Leaf area index

Data on the mean leaf area index as affected by various treatments at 30 DAS, 60 DAS and 90 DAS are presented in table 3.

Table 3: Effect of irrigation scheduling, mulching and hydrogel at leaf area index of Maize

Treatment	30 DAS	60 DAS	90 DAS
T1	1.2	3.0	3.6
T2	1.3	3.2	3.8
T3	1.4	3.3	3.9
T4	1.2	3.1	3.7
T5	1.4	3.3	3.9
T6	1.5	3.4	4.0
T7	1.2	3.1	3.7
T8	1.4	3.3	4.0
T9	1.5	3.5	4.1
SE(m)	0.013	0.021	0.01
F test	Sig.	Sig.	Sig.
C.D.	0.038	0.062	0.058

The table 3 reveals that, plant leaf area index was observed maximum (1.5, 3.5 and 4.1 at 30 DAS, 60 DAS and 90 DAS) in treatment T9 while it was minimum (1.2, 3.0 and 3.6 at 30 DAS, 60DAS and 90 DAS) in treatment T1. There is a minute difference between T3, T6 and T9 as the leaf area index get effected due to water availability, temperature and nutrient availability. The amount of hydrogel was different in all the three plots but the amount of mulches applied were same. Same case is been seen in T1, T4 and T7. The leaf area index is low in these plots as there were no mulch applied and temperature is one of the factors influencing leaf area index. The leaf area index is observed low in T1, it might be due to no mulching and low concentration of hydrogel application. As mulching helps to reduce temperature of soil and hydrogel has ability to trap water and reduce leaching of nutrients. These factors directly influence the leaf area index. Hence the leaf area index of T1 is low due to low concentration of hydrogel (25 grams) and no application of mulches. Less LAI plant-1 due to low availability could be attributed to non-development of embryonic bud of plant to its potential and retardation of cell division in the growing tips. These views are in accordance with the results obtained by Cookson et al., (2001).

Days of silking

Data on the mean of days of silking as affected by various treatments are presented in the table 4.

Table 4: Effect of irrigation scheduling, mulching and hydrogel on silking of Maize

Treatment	Silking (number of days)
T1	68.0
T2	67.3
T3	65.3
T4	67.3
T5	64.6
T6	64.6
T7	66.6
T8	64.3
T9	63.0
SE(m)	0.460
F test	Sig.
C.D.	1.390

The table 4 reveals that the number of days for silking was maximum (68) on T1 and was minimum (63) on T9. There was a minute difference between T9 and T8 as the amount of application of mulches were different but the concentration of hydrogel was same on both the plots. Same case were observed in T1 and T2.the number of silking days were observed more in T1 (no mulch and 25 g hydrogel) as the plot was not mulched an the concentration of hydrogel was also low as compared to the other plots. It might be due to no application of mulch as mulching improves soil fertility and provide desirable temperature for the better growth of pant. Hence the values of number of days of silking is more in T1. Abundant nitrogen is known to stimulate flowering because it is nitro-positive crop. The results are akin to those reported by Barihi et al.,(2013) in maize.

4. CONCLUSION

Hydrogel displays a swelling potential of minimum 400 times, often exceeding 500 times of its weight in pure water. Notably, its swelling ratio increased with the increase in temperature up to 500 C without any adverse effect on the polymer matrix structure. It increases the crop productivity per unit available water and nutrients, particularly in moisture stress condition. It improves physical properties of the soil, seed germination, seedling emergence rate, root growth and density that help plants to prolonged moisture stress. Mulching is proved to be useful in conserving of moisture and increasing productivity of maize. Straw mulch also provide benefit in terms of increasing infiltration rate, lowers the temperature improve availability of fertilizer and increase crop yield

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