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EFFECT OF IRRIGATION SCHEDULING, MULCHING AND HYDROGEL ON SOIL PARAMETERS

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Abstract

Theexperimentalstudy"EffectofIrrigationscheduling,MulchingandHydrogelonMaize (Zeamays)" hasbeencarriedoutatlovelyprofessionaluniversityduringJune2018toAugust2018. Thestudyhasbeencarriedoutwithdifferenttreatmentcombinationsofirrigationscheduling, mulchingandhydrogel.TheeffectwasobservedonAvailable nitrogen, available phosphorus and availablepotassium. The treatment combination of 6kg mulch and 100 grams hydrogel showed the significant effectonmaizecrop.Withthiscombinationthe available nitrogen (164.1 kg/ha, 353.3 kg/ha, 312 kg/ha and 281.1 kg/ha at before sowing, 30 DAS, 60 DAS and 90 DAS), available potassium (231.5kg/ha, 339.5kg/ha, 305.1kg/ha and 286.9kg/ha at before sowing, 30 DAS, 60 DAS and 90DAS).

Keywords : *Mulching, hydrogel, irrigation*

Introduction

The issue of water management has assumed paramount importance and occupied the center 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.

Water resources available for agriculture are decreasing due to increasing world population, risks of floods and droughts due to climate change and demands for fresh water for urban and environmental services. So we need to improve water use efficiency and productivity in agriculture to ensure sustainable production of food.

Mulching is very useful in conservation of moisture and increasing productivity. Straw mulch also provide benefit in terms of increasing infiltration rate, lowers the temperature improve availability of fertilizer and increase crop yield. Organic mulches are ultimately influencing soil water status and improved plant canopy in terms of biomass, leaf areaindex, root growth and grain yield, which subsequently improve nitrogen and water uptake and reducing runoff and evaporation losses. Plastic mulch are the inorganic mulches and

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primitively used for the greatest volume of mulch commercial crop production. The beneficial effects of organic and synthetic mulches for crop production have been widely discussed by many researchers. Researches has shown that mulchesare so beneficial to cropproduction through soil and water conservation which enhances the soil biological activity and improve chemical and physical properties of the soil. So, mulching can be effective in changing and increasing cereal crop production in water scarcity regions. Application of straw mulch was evaluated for their effect on growth, yield and moisture use by crop to control moisture loss through evaporation. Higher yield and water use efficiency under surface mulch can be achieved compared to no mulch. Mulches significantly increase water holding capacity, facilitated nutrients absorption, reduce weeds competition and increase plant growth. Mulching conserve water and improve irrigation efficiency in agriculture, especially in the areas where water resources are limited. Till now, most of the works on scheduling irrigation of crops were based either on soil or plant parameters. These two scheduling approaches do not incorporate the climatic components. Thus, a practical approach has been used for scheduling of irrigation on the basis of irrigation depth: cumulative pan evaporation known as IW/CPE ratio.

Hydrogel is 3d, hydrophilic polymer, loosely cross-linked networks capable of conserving large amount of water or biological fluids. 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 soilor 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.

Materials and Methods

The field study was “Effect of different types mulching on Maize (Zea mays)” carried out in the experimental field of Lovely Professional University, Phagwara, Punjab during 2017-2018. The soil of the experimental site is loamy soil. It is the most fertile and productive soil group of the state Punjab.

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Application of hydrogel

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.

Application of mulching

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.

Treatmentcombinations

T1 - H1M1=25 grams hydrogel and nomulch

T2- H1M2=25 grams hydrogel and 4kgmulch

T3- H1M3=25 grams hydrogel and 6 kgmulch

T4- H2M1=50 grams hydrogel and nomulch

T5- H2M2=50 grams hydrogel and 4 kgmulch

T6- H2M3=50 grams hydrogel and 6 kgmulch

T7- H3M1=100 gram hydrogel and nomulch

T8- H3M2=100 gram hydrogel and 4 kgmulch

T9- H3M3=100 gram hydrogel and 6 kgmulch

Results and Discussion

Soil moisture determination was done by using gravimetric method from all the plots. Soil samples were drawn with the help of a screw auger from 0-15, 15-30, 30-45 cm soil depth. From all the treatments soil samples were collected before sowing and before and after of each irrigation. The moisture content from different depths of soil was used to calculate consumptive use of water and soil moisture extraction pattern of the crop for irrigation treatments. The nitrogen, phosphorus and potassium contents in grain of maize were estimated at maturity. The grain sample of crop was collected separately as per treatment at harvest. These samples were ground in the grinder after drying in oven at 70^0C

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temperatures for 48 hours. Thus, the ground plant materials passed through 30-mesh sieve, and these materials used for determination of nitrogen, phosphorus and potassium content. The nutrient contents of these materials were analyzed chemically in laboratory following the standard procedures.

Nutrient content

1. **Available Nitrogen**

Data of the mean of available nitrogen as effected by various treatments at before sowing, 30 DAS, 60 DAS, and 90 DAS are presented in table 1 and graphical representation on Fig 1.

Data reveals that available nitrogen was significantly affected due to effected due to various nutritional levels at before sowing, 30, 60, 90 DAS.

Table 1 Effect of irrigation scheduling, mulching and hydrogel on available nitrogen at before sowing, 30, 60, 90 DAS.

Treatment	Before sowing	30 DAS	60 DAS	90 DAS
T1	143.3	325.4	283.5	252.4
T2	148.6	331.9	290.2	256.0
T3	160.9	345.4	303.1	274.6
T4	146.6	339.5	285.1	252.2
T5	156.6	346.7	310.4	280.4
T6	162	350.7	311.6	281
T7	152.3	341.8	293.9	267.1
T8	162.1	352.4	311.9	280.1
T9	164.1	353.3	312	281.1
SE(m)	2.065	1.675	1.730	1.552
F test	Sig.	Sig.	Sig.	Sig.
C.D.	6.244	5.065	5.233	4.693

Table 1 reveals that available nitrogen was observed maximum (164.1, 353.3, 312 and 281.1at before sowing, 30, 60, 90 DAS.) in treatment T9 and minimum (143.3, 325.4, 283.5 and 252.4 at before sowing, 30, 60, 90 DAS.) in T1. There was a minute difference between T9 and T8 as the amount of mulch is different and amount of hydrogel is same. Same case is observed in T1 and T4 as the amount of hydrogel is different and no mulch was applied. The available nitrogen is observed less in T1 (no mulch and 25 g hydrogel), it might be due to low

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availability of readily available nitrogen in the soilbefore application of fertilizers. The nitrogen might have leached or been eroded due to water or they might be in the fixed form. The availability of nitrogen increases as we applied nitrogenfertilizer but not at its highest limits. Its availability were in optimum limits. And the availability of of nitrogen were highest on T9 (6kg mulch and 100 g hydrogel) as there were mulches and hydrogel which helps to reduce leaching and reduces erosion. Hence the available nitrogen is low in T1 and high in T9. The nutrients in the inorganic fertilizer are already in the mineral form and it provides a ready source of nutrients to the crop and is available within a short period of time.

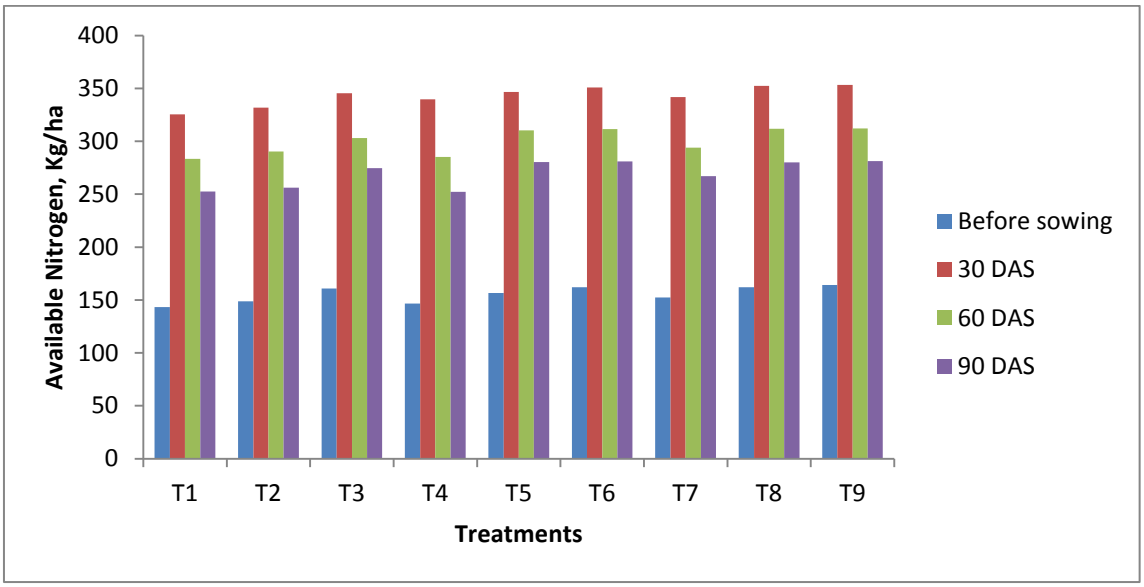

Fig. 1 Effect of irrigation scheduling, mulching and hydrogel on available nitrogen at before sowing, 30, 60, 90 DAS on maize.

2. Availablephosphorus

Data of the mean of available phosphorus as affected by various treatments at before sowing, 30, 60, 90 DAS.are presented in table 2 and graphical representation on Fig 2.

Data reveals that available phosphorus was significantly affected due to effected due to various nutritional levels at before sowing, 30, 60, 90 DAS.

Table 2 Effect of irrigation scheduling, mulching and hydrogel on available phosphorus at before sowing, 30, 60, 90 DAS.

Treatment	Before sowing	30 DAS	60 DAS	90 DAS
T1	12.9	16.1	15.4	11.4
T2	13	16.2	15.6	12.4
T3	14.1	17.3	16.2	12.6
T4	13.4	16.6	15.7	12.2

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T5	14.5	17.6	16.4	13
T6	14.8	18.2	16.5	13.3
T7	14.0	17.1	15.9	12.9
T8	14.7	17.7	16.2	14
T9	15.1	19.4	17.6	14.4
SE(m)	0.326	0.549	0.384	0.252
F test	Sig.	Sig.	Sig.	Sig.
C.D.	0.986	1.659	1.161	0.762

Table 2 reveals that available phosphorus was observed maximum (15.1, 19.4, 17.6 and 14.4 at before sowing, 30, 60, 90 DAS) in treatment T9 and minimum (12.9, 16.1, 15.4 and 11.4 at before sowing, 30, 60, 90 DAS) in T1. There was a minute difference between T9, T8 and T7as the amount of mulch is different and amount of hydrogel is same. Same case is observed in T2 and T4 as the amount of hydrogel was different and no mulch was applied on both the treatments. The available phosphorus is observed less in T1 (no mulch and 25 g hydrogel), it might be due to low availability of readily available phosphorus in the soil before application of fertilizers. The phosphorus might have leached, eroded due to water or they might be in the fixed form. The availability of phosphorus increases after application of phosphate fertilizer but not at its highest limits. Its availability was in optimum limits. And the availability of phosphorus was highest on T9 (6kg mulch and 100 g hydrogel) as there were mulches and hydrogel in higher concentration which helps to reduce leaching and reduces erosion. Hence the available phosphorus is low in T1 and high in T9. Phosphorus was 64% higher in vermicomposting than in the original organic material which was suggested to be due to increased phosphatase activity from the direct action of gut enzymes and indirectly by the stimulation of microorganisms.

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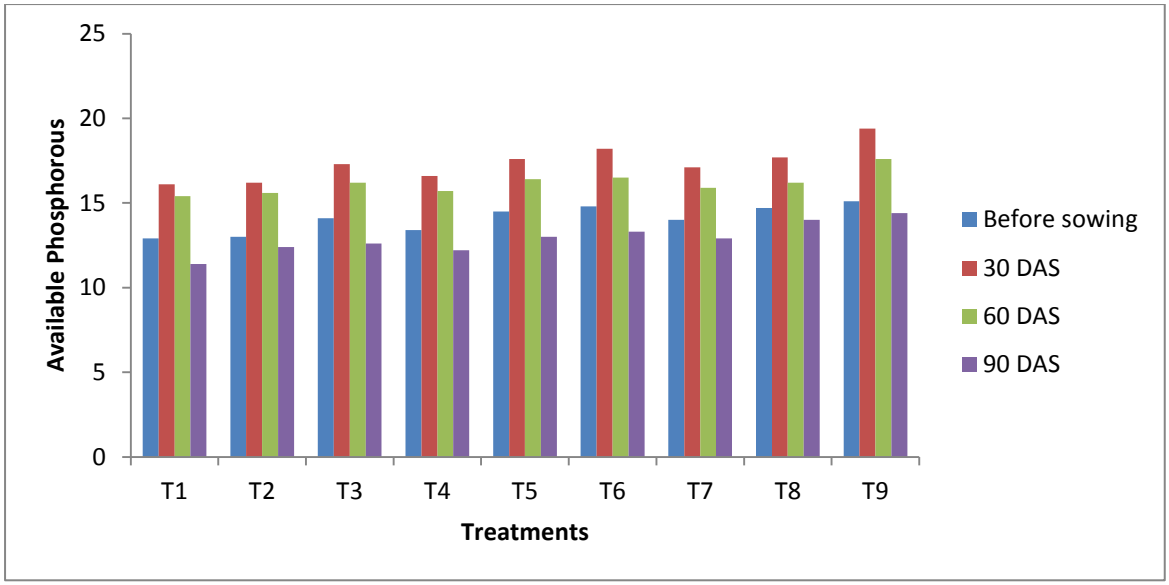

Fig. 2 Effect of irrigation scheduling, mulching and hydrogel on available phosphorus at before sowing, 30, 60, 90 DAS on maize

3. Available potassium

Data of the mean of available potassium as effected by various treatments at before sowing, 30, 60, 90 DAS are presented in table 3 and graphical representation on Fig 3.

Data reveals that available potassium was significantly affected due to effected due to various nutritional levels at before sowing, 30, 60, 90 DAS.

Table 3 Effect of irrigation scheduling, mulching and hydrogel on available potassium at before sowing, 30, 60, 90 DAS on maize

Treatment	Before sowing	30 DAS	60 DAS	90 DAS
T1	216.7	327.1	295.4	276.2
T2	218.1	328.3	296.3	276.8
T3	217.2	327.0	294.1	275.9
T4	217.6	326.9	295.6	278.4
T5	225.9	335.6	301.4	283.1
T6	223.2	333.	301.3	282.6
T7	226	336.1	303.1	281.2
T8	228.5	337.5	303.6	285.6
T9	231.5	339.5	305.1	286.9
SE(m)	2.312	1.569	1.919	2.551

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F test	Sig.	Sig.	Sig.	Sig.
C.D.	6.992	4.744	5.802	7.714

Table 3 reveals that available potassium was observed maximum (231.5, 339.5, 305.1 and 286.9 at before sowing, 30, 60, 90 DAS) in treatment T9 and minimum (216.7, 327.1, 295.4 and 276.2 at before sowing, 30, 60, 90 DAS) in T1. There was a minute difference between T9, T8 and T7as the amount of mulch is different and amount of hydrogel is same. Same case is observed in T2 and T4 as the amount of hydrogel was different and no mulch was applied on both the treatments. The available potassium is observed less inT1, it might be due to low availability of readily available potassium in the soil before application of fertilizers. The potassium might have leached, eroded due to water or they might be in the fixed form. The availability of phosphorus increases after application of potassium fertilizer but not at its highest limits. Its availability was in optimum limits. And the availability of potassium was highest on T9 as there were mulches and hydrogel in higher concentration which helps to reduce leaching and reduces erosion. Hence the available potassium is low in T1 (no mulch and 25 g hydrogel) and high in T9 (6kg mulch and 100 g hydrogel). Critical observations revealed that potassium uptake by the crop was increased with increase in level of nitrogen, which mightbedue to the enhanced number of small root hairs which in turn facilitated the absorbing ability per unit dry weight.

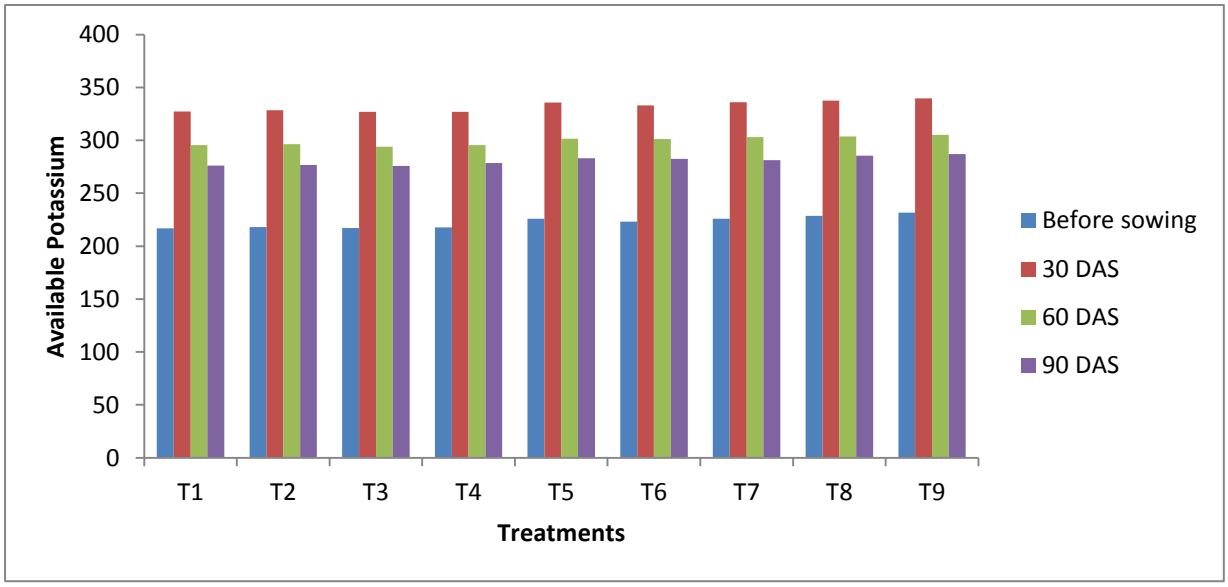

Fig. 3 Effect of irrigation scheduling, mulching and hydrogel on available potassium at before sowing, 30, 60, 90 DAS on maize

Conclusion

Based on the pooled results from the present investigation the following conclusion

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has been drawn that by the application of 100 grams of hydrogel and 6 kg of mulch available nitrogen by 89.7%, available phosphorus by 79.1% and available potassium by 92.6% as compared to other the treatment with 25 grams of hydrogel and no mulching.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 50^0 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.
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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