International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 3416-3418

Received: 16-07-2019
Accepted: 18-08-2019

Deepa Chandravanshi
Department of Soil and Water Engineering {IGKV}, 492012, Raipur, Chhattisgarh, India

MP Tripathi
Department of Soil and Water Engineering {IGKV}, 492012, Raipur, Chhattisgarh, India

Corresponding Author:
Deepa Chandravanshi
Department of Soil and Water Engineering {IGKV}, 492012, Raipur, Chhattisgarh, India

Impact of water management and straw mulch on summer maize (*Zea mays* L.)

Deepa Chandravanshi and MP Tripathi

Abstract
Water management and effect of mulch in Chhattisgarh plains has been conducted to work out in the water requirement and water use efficiency of summer maize. Two Years field experiment on summer maize was carried out at research farm of IGKV, Raipur during the years 2014-2015. The result of analysis of variance for different treatments showed that there was significant difference among all the treatments. The interaction effect of paddy straw mulch with application of water in pair row performed batter as significant higher yield (43.59 q/ha) of maize was recorded, highest water use efficiency was found in case of paddy straw mulch with application of water inpair row (10.68 kg/ ha-mm) followed bypaddy straw mulch with application of water in alternate row (10.24 kg/ ha-mm). On the basis of results of two consecutive year trial it can be conducted that the water requirement of summer maize was about 41.4 cm which can be full fill with eight numbers of irrigations.

Keywords: Furrow irrigation system, maize, mulch, water management, WUE

Introduction
Maize (Zea *mays* L.) is the most important crop in the world after wheat and rice. Maize crop is sensitive to both moisture stress and excessive moisture. Efficient water management is the key to increase the productivity of maize in India. It is an important food crop in India and other Asian countries, which occupies an area of 7 million ha in India (Ministry of Information and Broadcasting, 2000), whereas in Chhattisgarh 107.44 thousands ha area is covered by maize with 1.6 t/ha productivity. According to some experts, India may have to produce 20 million tones of maize to meet its requirement for human consumption, piggery, pharma industry and fodder by 2020 (Singhal, 1999) [9]. Water is a precious and most commonly used resource with limited availability. It acts as one of the limiting factors for agricultural as well as horticultural production. It has been reported that only 29 per cent of total cultivable area is under irrigation in the state of Chhattisgarh. Maize constitutes one of the most widely consumed food sources and a basic raw material for feed mill and beverage industries. Its sustainable production promotes adequate food supply. Water requirement has been defined by Arora (2004) [3] as the quantity of water needed by a crop for normal growth regardless of its supply source for a given period of time under field condition. Climate is one of the main environmental determinants influencing crop yields, and could be used to estimate maize water requirement (Israelson, 1962 and Ezeaku *et al* 2004) [7, 5].

Estimates of Maize water requirement is essential in order to curtail excessive application of water than needed, which could cause crop damage, soil erosion, excessive leaching and the wastage of water, labour and energy (Hudson,1975). Irrigation is one of the major means that can be manipulated to increase food crop production in India. In Chhattisgarh farmers are growing summer paddy (186 thousand ha area) in the canal and tube well commands. Paddy is water loving crop and having high water requirement (90-120 cm). High value crop like maize which may requires less water (500-800 mm) may be replace the summer rice in Chhattisgarh. This can be achieved by increasing the cropping intensity and also by increasing the yield per crop per unit area. Keeping the rainfall pattern and available water in view, different moisture combinationunder paddy straw mulching and without mulching conditionwere studied in the field to assess the feasibility of growing maize crop in midland situation of Chhattisgarh plain. Maize as *rabi* and zaid season crop is grown under irrigated conditions only. However, when grown in *kharif* under rainfed conditions, protective irrigations are necessary during periods of moisture stress. In *kharif*, 2-3 irrigations are required after sowing, whereas, in *rabi*, 5-6 irrigations are required and in summer it requires 8-10 irrigations.

A good crop of maize requires about 480-600 mm of water during its life cycle. A vigorously growing maize plant needs about 2-3 liters of water/day during peak growing period or on an average its consumptive use of water varies from 2.5 to 4.3 mm/day. Growth stages of maize are sowing, four leaf stage, knee high, grand growth, tasseling, silking, early dough and late dough stages. Crop uniformly requires water in all these stages. Out of these stages, the tasseling, silking and early dough stages are critical stages that mean lack of water during these stages adversely affects the yield of maize.

Materials and Methods

This experiment was conducted under the ITRA- water project entitled "Measurement to management (M2M): improved water use efficiency and agricultural productivity through network sensors project" in the Department of Soil and Water Engineering, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur is located at an altitude of 298m above Mean Sea Level (MSL) at an intersection of 19˚05` N latitude and 82˚02` E longitude. The average annual rainfall is ranging between 1200-1400mm. The average daily maximum and minimum temperature is about 31˚C and 19˚C, respectively. The average relative humidity ranges from 72% to 54%. The overall climate of the area is subtropical. The meteorological data of rainfall, temperature (maximum and minimum), relative humidity, wind velocity, evaporation and sunshine hours recorded at Labhandi farm by the Department of Agro meteorology, IGKV, Raipur were used in this study. The seed was sowing with plant to plant spacing 25 cm and row to row spacing 50 cm. Recommended dose of fertilizer NPK 100:60:40 Kg/ha was applied in all the treatments. only one third quantity of nitrogen and full quantity of phosphorous and potash were applied as vassal dose at the sowing time and remaining two third quantity of nitrogen was again divided in to two equal parts and applied at the time of silking and tussling stages.

Two main plots treatments of moisture combination including M_1 (paddy straw mulch), M_2 (without mulch) and five sub plots treatment T1 (application of water in each row), T2 (application of water in alternate row), T3 (application of water in skipped pair row), T4 (application of water in pair row) and T5 (application of water in reverse skipped pair row). These treatments were replicated three times. In this studymoisture content by uses of Time Domain Reflectrometry (TDR).Depth of water application was measured precisely and only the amount of irrigation water required to replenishing the soil to its field capacity was delivered at 50 % moisture depletion time. Soil moisture content were measured at 15 and 30 cm depths, know the available soil moisture status of soil which will lead to maximize the yield. The soil at the site is of sandy loam texture having bulk density is 1.43 gm/cm^3, field capacity is 24.15 % and wilting point is 10.16 %. Depth of irrigation was calculated by the given empirical formula (Acharya *et al*, 1989) [1].

$$D = (FC - PWP).SMDL.BD.RD.10 \quad ... (i)$$

Where,
D = Depth of irrigation (mm) FC= Field Capacity (%)
PWP = Permanent Wilting point SMDL = Soil Moisture Depletion level.
BD = Bulk Density (gm/cm^3) RD = Root zone Depth (meter)

All the recommended packages and practices of maize cultivation were Adopting in this experiment. Yield attribute characteristics were noted time to time for analysis. Crop was matured in about 120 days after sowing. Harvesting was done separately for both net plot as well as border plot. After harvesting of crop threshing operation was done by manual operated maize sheller. The dry weight of crop was also recoded after threshing the both net and border plot.

Results and Discussion

The experiment was conducted for two consecutive year *i.e.* 2014 and 2015 during summer. The grain yield and other yield attributing parameters of maize for different treatments during 2014 and 2015 are given in table 1. Since a specific result could not be drawn out of single year data therefore, analysis of pooled data along with is given table 2. Table 2 shows that there were significant difference between main treatments *i.e.* without mulch and paddy straw mulch in case of plant height. Whereas plant density, grain yield and dry matter yield was found statistically similar. However, water efficiency was recorded to be more (10.68kg /ha-mm) in case paddy straw mulchas compare to without mulch. The table (Table 2) shows that paddy straw much with application of water in pair row (T4) give the significant higher yield (43.59 q/ha) as compared to other treatments. Moreover, (Table 2) shows that the highest water use efficiency (10.68kg/ha-mm) was recorded in case of (T_4) Paddy straw mulch with application of water in pair row. On reviewing of cumulative yield and growth parameters data, it is very clear that there was significant reduction in the yield of maize (T_5) Application of water in reverse skipped pair row. Panchanathan *et al*. (1987) recorded the average grain yield of 3.66 tones ha^{-1} with the application of 553 mm of water over other regimes (449, 429 and 351 mm). The water requirement ranged from 1.94 to 5.96 mm day^{-1} during crop growth period in dark red latosol soil (Andrade *et al*., 1988). Costa *et al*. (1988) observed that increased application of water from 180 to 520.6 mm increased the seed yield of maize from 1.0 to 6.3 t ha^{-1}. Maurya and Lal (1981) [8] reported that the root density and shoot elongation was high under straw mulch. Soil temperature as affected by the straw mulch had a significant effect on root growth, plant vigor and grain yield. Aina (1981) [2] reported that mulching reduced the soil temperature and increased the soil moisture. The mulching also improved plant growth, LAI and root development compared with no mulched plots.

Table 1: Treatment wise grain yield and other yield attributing characteristics (2014-2015)

Treatments	Plant Ht. (m)		No. of Leaf per plant		Grain Yield (q/ha)		Straw Yield (q/ha)		WUE (kg /ha-mm)	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
Paddy straw Mulch	**1.87**	2.04	13.79	13.95	**38.88**	38.42	51.75	68.23	9.35	9.56
Without mulch	1.84	2.01	13.71	13.67	30.15	30.04	49.29	64.82	6.62	6.82
SE (m) ±	0.00	0.00	0.047	0.11	0.439	1.42	0.31	0.52		
CD	0.07	0.02	N/A	N.S.	2.71	N.S.	2.00	3.25		
Application of water in each row	1.87	2.07	13.43	14.22	34.01	38.08	53.38	69.22	7.83	9.07
Application of water in alternate row	1.85	1.99	13.83	13.87	36.88	35.58	51.25	67.40	8.55	8.52

Application of water in skipped pair row	1.85	1.99	13.78	13.90	35.78	34.23	51.04	67.45	8.27	8.25
Application of water in pair row	1.87	2.12	13.6	13.80	38.18	37.77	54.08	72.03	8.84	9.05
Application of water in reverse skipped pair row	1.85	1.93	14.1	13.27	27.71	25.48	42.08	56.53	6.45	6.08
SE (m) ±	0.00	0.01	0.26	0.23	3.08	1.71	2.71	1.88		9.56
CD	0.01	0.05	N/A	N.S.	N/A	5.13	8.19	5.66		6.82

Table 2: Interaction effect of mulch and water application practices on yield of Maize (2014-15)

Treatments	Yield (q/ha)			Water use efficiency (kg / ha-mm)		No. of irrigation		No. of furrows
	Paddy Straw Mulch	Without Mulch	Mean	Paddy Straw Mulch	Without Mulch	Paddy Straw Mulch	Without Mulch	
Application of water in each row	37.66	34.37	36.02	9.23	7.67	8	9	11
Application of water in alternate row	41.82	30.62	36.22	10.24	6.83	8	9	6
Application of water in skipped pair row	38.580	31.51	35.15	9.50	7.02	8	9	6
Application of water in pair row	43.59	32.34	37.97	10.68	7.21	8	9	8
Application of water in reverse skipped pair row	31.30	21.87	26.58	7.65	4.88	8	9	3
Mean	38.63	30.14						

Conclusions

On the basis of this study application of water Application of water in pair row (8 number of irrigation) with paddy straw mulching can be recommended for summer maize. Application of water in alternate row (8 number of irrigation) can also be recommended if water is the limiting factor during summer under mid land situation of Chhattisgarh plain.

References

1. Acharya MS, Gupta AP, Singh J. Irrigation scheduling using Soil moisture depletion in wheat. Proc. of National Seminar on irrigation scheduling. 2-4 march, 1989:1-7.
2. Aina PO. Effects of time and duration of mulching on maize (*Zea mays* L.) in Western Nigeria. Field Crop Research. 1981; 4(1):25-32.
3. Arora KR. Irrigation, Water power and Water Resources Engineering, Standard publishers, Delhi, 2004.
4. Costa JO, Feerreita LGR, Souza FD. Yield of maize under different levels of water stress. Perquisa Agropepnaria Brasileria. 1988; 23(11):1255-1261.
5. Ezeaku RR. Estimation of crop Water Requirement from Climate and Soil Data for Maize Production in Two SE Nigeria locations, a paper presented at the Annual Conference of the Soil Science society of Nigeria 2004.
6. Huson NW. Field Engineering for Agricultural Development, Oxford publishers London, 1975.
7. Israelson 0W, Hansen VE. Irrigation principles and practices. 3rd ed. John Wiley and Sons, Inc., New York. Panchanathan, R.M., Mohan Das, S. and Kondaswammy, D. 1987. Effect of moisture regimes and nitrogen application on maize. Indian Journal of Agronomy. 1962; 32(4):471-472.
8. Maurya PR, Lal R. Effect of different mulch materials on soil properties and on the root growth and yield of maize (*Zea mays*) and cowpea (*Vigna unguiculata).* Field Crop Research 1981; 4(1):31-45.
9. Singhal V. Indian Agriculture 1999. Indian Economic Data Research Centre. New Delhi, 1999, 99-105.