Indian Journal of Ecology (2023) 50(2): 363-366
DOI: https://doi.org/10.55362/IJE/2023/3903

Manuscript Number: 3903
NAAS Rating: 5.79

Influence of Organic Mulches on Soil Moisture Conservation in Maize (*Zea mays* L.) in Alfisols of Eastern Dry Zone of Karnataka

Shashikanth Murukannappa and Altaf Kuntoji[1]

Department of Soil and Water Engineering, [1]Department of Soil Science and Agricultural Chemistry
University of Agricultural Sciences, GKVK, Bengaluru-560 065, India
E-mail: shashishanu786@gmail.com

Abstract: A field experiment was conducted at Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore during *kharif* 2019 to study the influence of different organic mulches on soil moisture conservation in *Alfisols* of eastern dry zone of Karnataka. The experiment consists of seven treatments *viz*, mulching with paddy straw, mulching with saw dust, mulching with grass, mulching with newspaper, mulching with dry leaves, dust mulching and no mulch (control) which were replicated thrice in randomized complete block design. Maize crop was sown as a test crop. The results of study revealed that mulching with dry leaves treatment recorded significantly higher soil moisture content 24.07, 18.90, 21.70 and 20.73 per cent at 30, 51, 72 and 93 DAS respectively compare to other treatments at 15 cm depth. The similar treatment recorded significantly higher soil moisture 24.83, 20.87, 22.90 and 21.80 per cent at 30, 51, 72 and 93 DAS respectively at 15-30 cm depth. Overall, the mulching with dry leaves treatment showed higher soil moisture content, higher infiltration rate and lower bulk density compare to other treatments.

Keywords: Organic mulches, Dust mulch, Soil moisture content, Dry leaves mulching, Paper mulch

The biggest challenge in present day agriculture is to produce more food grains per every drop of rain water to feed the global population utilizing very limited natural resources. Due to change in climatic condition coupled with uneven and erratic rainfall distribution leading more deterioration of land, water and environment which drastically reduce the production level. India is the seventh-largest country by area in the world (2.4 per cent of the world area and second-most populated 1.32 billion people constituting 17.74 per cent of the world population) is expected to produce 350 MT of food grain by the year 2050. Presently, India's total food grain production is 276.5 MT out of which 9 per cent (22.23 mt) is contributed by maize crop alone. In Karnataka, maize (*Zea Mays* L) is grown over an area of 1.18 million hectares with production of 3.27 million tonnes and average productivity of maize is 27.73 q ha^{-1} (Anonymous 2016). In our state presently most of the crops like cotton, groundnut, ragi, sorghum have been replaced by maize which is having multipurpose as feed, food and fodder. Soil moisture is one of the major factors limiting crop production under rainfed situation, suitable conservation measures lead to higher yields but the Maize is most exhaustive crop and depletes the soil moisture and nutrients resulting in reduction in productivity. Mulching is one of the effective soil moisture conserving practice, reducing evaporation and regulating the soil temperature (Ratan 2004 and Pervaiz et al 2009). The use of different organic mulching materials is the low cost technologies (Mupangwa et al 2013) which helps in improving soil conservation and soil fertility as well apart from several advantages such as regulating soil surface temperatures due to their higher surface ground cover, increasing soil organic matter content to the soil thus improving the soil physical properties, controlling soil erosion and conserving it more effectively with this an experiment was conducted at UAS,GKVK Bengaluru to know the effects of different organic mulches on soil moisture conservation in Maize (*Zea Mays* L.) in Alfisols of Eastern Dry Zone of Karnataka.

MATERIAL AND METHODS

A field experiment was conducted at Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore during *kharif* 2019 and experiment was conducted to study the influence of different organic mulches on soil moisture in maize (*Zea mays* L.) in Alfisols of eastern dry zone of Karnataka.. Composite soil sample from 0-30 cm depth was collected randomly from the experimental area before sowing of the crop and determine the initial soil moisture condition and also various soil physio-chemical properties (Table1). The soil was red sandy loam in texture and slightly acidic in reaction (pH 5.80) with electrical conductivity was 0.15 dsm^{-1}, medium in soil organic carbon (0.42 per cent), available phosphorus (17.60 kg ha^{-1}) and

potash (109 kg ha^{-1}), low in available nitrogen (159 kg ha^{-1}). Initial soil moisture content at experimental plot was 16.80%. The measured infiltration rate and bulk density in the experimental plot were 4.55 cm hr^{-1} and 1.53 g cc^{-1} before starting of the experiment.

The experiment consists of seven treatments in randomized complete block design and replicated thrice (Table 2). The mulching practices were carried out at 30 days after sowing. The soil samples were collected with the help of screw auger from 0 to 15 cm and 15 to 30 cm depths from each plot at 30, 72 and 93 days after sowing. The moisture content was determined by gravimetric method (Piper 1966).

RESULTS AND DISCUSSION

Effect on soil moisture condition before sowing: The soil moisture content in the experimental plot was 16.80 per cent (Table 1). The probable reason for this soil moisture content in the experimental field could be due to even distribution of rain fall over a period and there is no significant difference in the field elevation too.

Table 1. Soil physic-chemical properties of experimental site before sowing of crop

Initial soil properties	Values
Soil texture	Sandy loam
Soil pH	5.80
EC (dsm^{-1})	0.15
OC (%)	0.42
Available Nitrogen (kg ha^{-1})	159
Available phosphorus (kg ha^{-1})	17.60
Available potassium (kg ha^{-1})	109
Soil moisture content (%)	16.80
Infiltration rate (cm h^{-1})	4.55
Bulk density (g cc^{-1})	1.53

Effect of different organic mulches on soil moisture content at different depths: soil moisture content at 0-15 cm depth differs significantly at all stages of crop growth throughout the experiment (Table 2). However, mulching with dry leaves in maize plot (T_5) recorded significantly higher soil moisture content of 24.07 per cent after three weeks of treatment and closely followed by mulching with paddy straw and mulching with grass, mulching with newspaper. The same treatment recorded significantly higher soil moisture content at six weeks (21.70%) and nine weeks (20.73%) of treatment imposed. The control treatment was recorded significantly lower soil moisture content of 14.67 to 16.10 per cent respectively at all growth stages of the experiment period. The soil moisture content measured at 15-30 cm depth at different crop growth stages differed significantly at all stages of the crop growth throughout the experimental period. Mulching with dry leaves recorded significantly higher moisture content of 20.87per cent after three weeks of treatment imposed which was significantly superior over control treatment. The same treatment recorded significantly higher soil moisture content at six weeks (22.90%) and nine weeks (21.80 %) of treatment imposed. In general, all the stages of the crop growth mulching with paddy straw and mulching with grass are in the next order of merit and are on par with mulching with dry leaves.

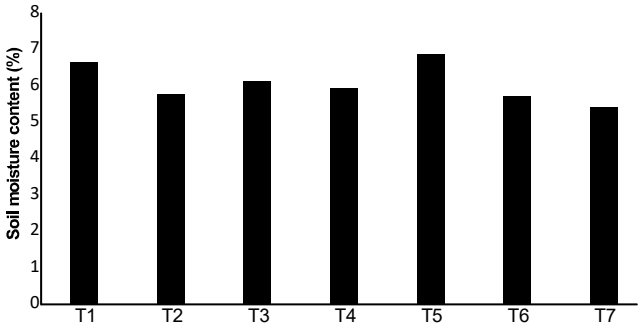
Effect of rainfall characteristics on per cent soil moisture condition after crop harvest: The data pertaining to soil moisture level after crop harvest is presented in Figure 1 and soil moisture content differs significantly after crop harvest

Table 2. Soil moisture content (%) as influenced by different organic mulches in maize at different depths (0 -15 cm and 15-30 cm)

Treatments	Soil moisture content (%)							
	0 - 15 cm depth				15-30 cm depth			
	30 DAS	51 DAS	72 DAS	93 DAS	30 DAS	51 DAS	72 DAS	93 DAS
T_1: Mulching with paddy straw	20.70	17.97	20.80	19.70	23.44	20.30	22.30	21.40
T_2: Mulching with saw dust	16.45	15.70	17.70	16.60	19.47	19.47	18.87	18.00
T_3: Mulching with grass	19.99	16.70	19.20	18.77	21.30	19.80	20.80	19.53
T_4: Mulching with newspaper	16.92	16.27	18.13	17.30	20.36	19.53	19.50	18.50
T_5: Mulching with dry leaves	24.07	18.90	21.70	20.73	24.83	20.87	22.90	21.80
T_6: Dust mulching	16.09	15.37	17.10	16.23	18.30	18.47	18.50	17.30
T_7:Control	14.67	15.00	16.10	15.57	17.53	17.17	17.17	16.37
CD (P =0.05)	0.60	0.43	0.18	0.45	0.55	0.44	0.20	0.39

even under longer dry spell the study indicated that the mulching treatment with dry leaves recorded the higher soil moisture content of 6.86 per cent closely followed by mulching with paddy straw (6.64%), mulching with grass (6.12%), mulching with newspaper (5.92%). The control plot recorded the lowest soil moisture content (5.40%) after harvest of maize crop. The probable reason for significant variation in soil moisture content among different mulching treatment could be due to organic mulches covered the soil between the crop rows helps in more infiltration of rainwater, reducing runoff and soil loss. In addition, mulching materials helps to prevent evaporation of soil moisture, improves soil structure and water holding capacity of the soil too. The supporting reason may also could be reduction in growth of weeds due to different organic mulches might facilitated better moisture conservation and these results were in accordance with the findings of Mal et al 2006, Zhibing et al 2015.

Infiltration rate and bulk density of soil after harvest: Infiltration rate of soil showed significant variation among the treatments and results of the study indicated that the higher infiltration rate of 5.79 cm hr^{-1} was registered in mulching with dry leaves which was numerically superior over the other treatments. Mulching with paddy straw, grass, newspaper are in the next order of merit in improving the infiltration rate (Table 3). This was mainly attributed to rain drop interception by the crop canopy and mulching material under the treatment as a result of reduction in runoff and increased time of concentration coupled with prolific type of maize roots. Better growth of maize in these treatments besides porosity and mulching with dry leaves facilitated higher infiltration rate. These results are in complimentary with the findings of Adekalu et al 2007, Chaudhry et al 2004. Bulk density of the soil estimated after the harvest of the crop revealed that the significant differences among different treatments. However, numerically lower bulk density (1.43 g cc^{-1}) recorded by



*Date of harvest 27-12-2019 (Dry spell of > 25 days from the date of harvest)

Fig. 1. Effect of rainfall on soil moisture content (%) after harvest

Table 3. Effect of mulching method on physical properties of soil after harvest

Treatments	Infiltration rate (cm h^{-1})	Bulk density (g cc^{-1})
T_1	5.32	1.45
T_2	4.68	1.48
T_3	4.97	1.46
T_4	4.72	1.47
T_5	5.79	1.43
T_6	4.61	1.49
T_7	4.55	1.51
CD (p=0.05)	0.03	0.003

mulching with dry leaves followed by mulching with paddy straw(1.45 g cc^{-1}) and mulching with grass(1.46 g cc^{-1}). The higher bulk density of 1.51 g cc^{-1} was noticed in the control plot (Table 3). The reason for lower bulk density compared to initial bulk density might be due to addition of organic matter through incorporation of mulched material such as with dry leaves and paddy straw which add more organic carbon to soil may enhanced slightly higher and may also due to the additional organic matter incorporation may increases the soil porosity because of more micro pores in soil loose and consequently leads to lower bulk density. Similar results were also noticed by (Sharma et al 2009, Singh et al 2010).

CONCLUSION

The climatic parameters *viz*., rainfall, temperature, soil moisture and sunshine hours are most important for crop growth, development and to maintain sustainable crop yield. Rainfall is the most important climatic parameter among other factors and moisture deficit at critical stages of the crop growth in rainfed crop may result in drastic reduction in growth and yield of crop. Hence, the moisture conservation practices in dry farming may help in enhancing maize yield and low-cost mulching technique for moisture conservation. From the investigation it can be inferred that, introduction of mulching with dry leaves in maize was imposed at 30 days after sowing found not only superior with respect to soil moisture conservation, yield and economic returns but also it influences overall improvement soil physical properties and to sustain the crop yield under dryland condition.

REFERENCES

Anonymous 2016. Area, production and productivity of major cereals in India.www.Indiastat.com.

Adekalu KO, Olorunfemi IA and Osunbiton JA 2007. Grass mulching effect on infiltration, surface runoff and soil loss of three agricultural soils in Nigeria. *Bio Resource Technology* **98**(4): 912-917.

Chaudhry MR, Malik AA and Sidhu M 2004. Mulching impact on moisture conservation- soil properties and plant growth. *Pakistan Journal of Water Resource* **8**(2): 1-8.

Mal B, Banik BC, Ghosh SN and Maity PK 2006. Studied on the effect of mulching in pomegranate cv. Ganesh. Proceeding of National Symposium Prod. Util. and Export of Under-Utilized Fruit with Commercial Potentials, *World Journal of Agricultural Sciences* **6**(2): 160-165.

Muntasir IM, Tauhiduzza S and Ishaque M 2001. Study on the effect of N fertilizer and green manure on the growth and yield of B R 22 rice. *Indian Journal of Agricultural Chemistry* **XXXIV**(1.2): 15-21.

Mupangwa W, Twomlow S and Walke 2013. Cumulative effect of reduced tillage and mulching on soil properties under semi-arid conditions. *Journal of Arid Environments* **91**: 45-52.

Pervaiz MA, Iqbal M, Shahzad K and Anwar H 2009. Effect of mulch on soil physical properties and N, P and K concentration in maize (*Zea mays*) shoots two tillage systems. *International journal of Agriculture and Biology* **11**: 119-124.

Piper CS 1966. *Soil and Plant Analysis*. Hans Publications, Bombay.

Ratan L 2004. Effect of mulching on maize (*Zea mays* L.) higher growth rate and vigour. *International Journal of Plant and Soil Science* **40**(1): 49-67.

Sharma P, Vikas A, Maruthi Sand Singh B 2009. Influence of tillage practices and mulching options on productivity, economics and soil physical properties of maize (*Zea mays*) - Wheat (*Triticum aestivum*) system. *Indian Journal of Agricultural Sciences* **79**(11): 865-870.

Shulan, Pingruli, Xueyun, Zhaohui and Xinping Chenaa 2011. Effect of tillage and plastic mulch on soil water, growth and yield of spring sown maize. *Soil and Tillage Research* **112**: 92-97.

Singh AK, Singh S, Rao VVA, Bagle BG and More TA 2010. Efficiency of organic mulches on soil properties, earthworm population, growth and yield of aonla cv. NA7 in semi-arid ecosystem. *Indian Journal of Horticulture* **63**(1): 124-128.

Zhibing, Hui Liu, Shuixiawan KH, Chaoqiang J, Daozhongwan, Chuanlong H and Xisheng G 2015. Enhanced yields and soil quality in a wheat-maize rotation using buried straw mulch. *Journal of the Science of Food and Agriculture* **97**: 3333-3341.

Received 12 December, 2022; Accepted 07 March, 2023