Original Research Article

Impact of mulches on water dynamics for chrysanthemum (*dendranthema grandiflora l.)* crop under drip irrigation system

ABSTRACT

A field experiment was conducted at Precision Farming Development Center, college farm, college of agriculture, Rajendranagar, Hyderabad during *kharif*, The experiment was laid out in split plot design with three drip irrigation levels as main plot treatments (viz., I_1- Drip irrigation at 1.0 E pan, I_2- Drip irrigation 0.8 E pan, I_3- Drip irrigation 0.6E pan) and four mulches (viz., M_1-No mulch, M_2- Paddy straw, M_3- Black plastic mulch, M_4- Dried leaves) as sub treatments and were replicated thrice. The experimental soil was sandy clay loam in texture with low in available nitrogen and high in available phosphorus and potassium. Moisture content was estimated under all three main plot treatments and four subplot treatments. Higher moisture was observed below black plastic mulch and lowest moisture observed below the no mulch condition. Drip irrigation scheduled at 0.6 E pan recorded higher water use efficiency (111.09 kg ha^{-1} mm^{-1}). The least WUE was observed in drip irrigation at 1.0 E pan. On the other hand maximum WUE was recorded with application of polythene mulch (113.5 kg ha^{-1} mm^{-1}), While the least was recorded with no mulch (90.43 kg ha^{-1} mm^{-1}). The results of soil moisture content in the present study indicated that, application of black plastic mulch would reduce the soil moisture evaporation which will enhance the uniform distribution availability of soil moisture for longer days, compare to other mulches namely no mulch, paddy straw and dried leaves.

Keywords- *Chrysanthemum crop, Drip irrigation, Mulches and Water use efficiency.*

INTRODUCTION

Floriculture has been identified as a potential sector of business in India as well as the world due to divergence of farmers towards high value floriculture and utilization of flowers in social events as well as for industrial utility. Chrysanthemum being a shallow rooted flower crop, nutrition enrichment for the crop and the prevalence of congenial soil moisture and temperature are considered important for improved crop yield. Besides weed competition, evapotranspiration loss of moisture without proper supplement of irrigation impedes the economical productivity of the crop. Hence irrigation plays an important role on the crop production of chrysanthemum. The first extensive comparison of drip irrigation with conventional form of irrigation were made by Glodberg and his co-workers under severely limiting environmental conditions in the Arava and Negev districts of Israel and where an yield of more than 75 percent was observed. To study the moisture distribution pattern under different type of mulches with drip irrigation. in case of pepper, tomato crops (Goldberg and Shumeli, 1971a; Goldberg and Shumeli, 1971b). In view of deficit of water condition prevailing in the study area, there is a need to adopt micro irrigation to conserve the water in the soil profile and its best possible utilization for plant growth. Covering the gaps between the rows with mulch material prevent rapid evaporation from the soil surface and reduce rapid drying of the land. Mulching also suppress weed infestation effectively. Furthermore, it stimulates microbial activity in soil by increasing soil temperature, which improves agro physical properties of soil (Solaiman *et al.*, 2008). Several research evidences on mulches in flower crops such as China aster, Crossandra, Gladiolus and Marigold proved to be effective in preventing the loss of moisture (Solaiman *et al.*, 2008, Murugan and Gopinath 2001, Barman *et al.*, 2005, Gavhane *et al.*, 2004). However, information on the effectiveness of using different mulches on growth and development of chrysanthemum to this region is not adequately available. Therefore to generate research evidences on these aspects, the present investigation as impact of mulches on water dynamics for chrysanthemum crop under drip irrigation system

Materials and Methods

In the drip irrigation generally frequent application of small quantity of water is supplied directly to the plant roots in drops by emitters placed along the lateral. In the present field experiment the drip irrigation was used for chrysanthemum. The water source for irrigation was from an open well. The water from the open was lifted with a pressurized submersible water pump to a sand filter system and then to screen filtration system to remove both organic and inorganic impurities from irrigation water. Filtered water then flowed to an irrigation manifold which in turn supplied water to the specific plots. Flow meters were used to measure flow rates to each individual treatment according to the designed pan evaporation replenishment factor. Irrigation water from manifolds flowed into 12 mm dripper lines laid out on the ground surface along the crop rows with emitters spaced 45 cm apart with delivering rate of 4lph. Drip irrigation system consist of main, sub-main and laterals that were laid out in the experimental plot. The laterals of 12 mm diameter were laid 1.2m apart with spacing of 45 cm distance between two inline emitters. The each emitter discharge capacity was 4 lph and control valve were fixed on all laterals to facilitate in controlling the water flow in the system.

Design and layout of the experiment

The experiment was laid out using split plot design with three replications. Three irrigation levels were taken as the main treatments and four different types of mulches are taken as sub treatments.

Soil moisture content

Soil moisture content (%) was measured through augers at different depth of soil layers at various crop growth stages (flowering, flower maturity and harvest)

Observation of soil moisture

Soil moisture content (%) at 30 cm depth.

Soil samples were taken at 30 cm depth from all plots of the experimental area. The soil moisture was determined gravimetrically, after oven drying the samples at 105^{o}C for 24 hours to a constant weight, soil moisture was calculated and expressed in percentage.

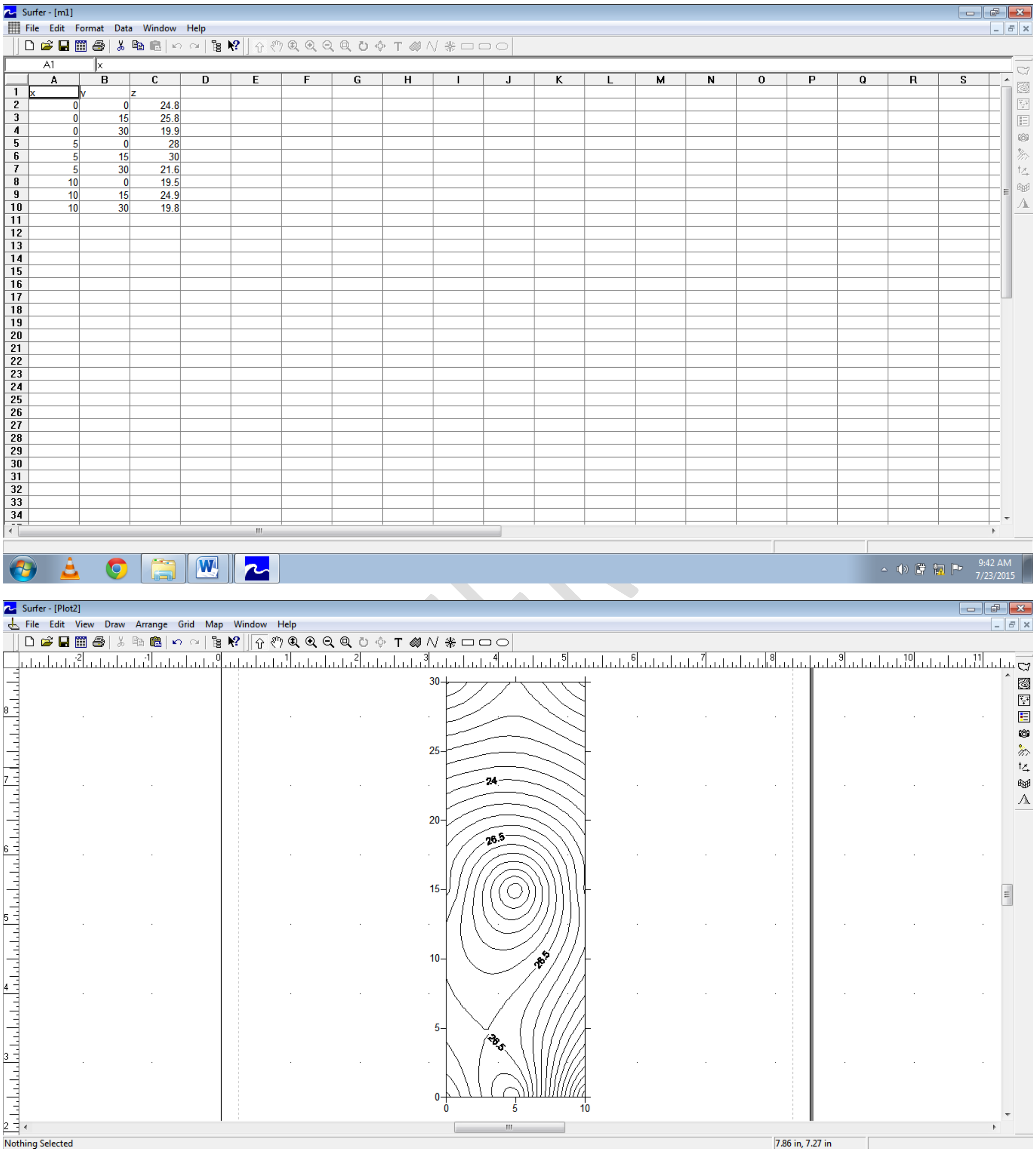
$$\text{Percentage of soil moisture} = \frac{w1-w2}{w2}$$

Where, W_1 = Initial weight of soil, grams

W_2 = Oven dry weight of soil percentage, grams

Moisture distribution pattern below emitter can be analyzed from the known moisture percentage readings with a SURFER package by supplying the moisture data as the input. On starting the software, there are two commands displayed, one is work sheet and another is plot document, on opening the worksheet, supply the data taken from gravimetric method and save the file after that choose plot document and choose the file (work sheet) and save these files in grids. In the next stage select map and go to contour map next, new contour map and select the file in the grid format moisture distribution pattern can be displayed on plot document after that click on view then fit to window.

Image 1:



Soil moisture contents that showed that the semi variance depended on distance were interpolated, without bias and with minimum variance using the kriging system (Vieira, 2000). The kriging estimator $z^*(x_0)$ at location x⁰ is expressed by:

$$Z^*(x_0) = \sum_{i=1}^{n} \lambda_i \, (x_i)$$

Where li is the kriging weight associated with observation i at location x_i. When submitted to un biasedness and minimum variance conditions, the kriging system, in terms of semivariogram, becomes:

$$\sum_{j}^{n} \lambda_i \gamma(x_i, x_j) + \mu = \gamma(x_i, x_0) \quad i = 1, 2, \ldots, n$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

Where μ is the Lagrange multiplier.

Kriging was used in this study to provide values at every 5 cm spacing both in the X and Y directions in order to properly build contour maps of soil moisture contents for different sampling dates with Surfer program (Golden Software, 1999).

Results and Discussions

Moisture content in the soil was estimated by collecting the soil samples of the field during the day of any irrigation level covering all the 24 hours period starting from the first hour of irrigation i.e., T1 and further the moisture is also observed during the next 24 hours on the second day i.e., one day after irrigation, all these soil samples are collected at representative depths of 10 cm, 20 cm and 30 cm from the ground level.

Compared to the black plastic mulch the other mulch conditions namely no mulch condition, paddy straw and dried leaves mulch had low moisture content values. However in case of black plastic mulch the contours of soil moisture are seemed to be parallel.

The moisture content of the field is also analyzed to observe water/moisture dynamics in the irrigated field for black plastic mulch condition, the moisture content at surface layer of (0-10 cm) was found to be 38.2 cm^3 / cm^3 immediately after irrigation, similarly a moisture content of 30.2 cm^3 / cm^3 was observed at a depth of 20 cm and 28.4 cm^3 / cm^3 was noted down at 30 cm depth. A moisture content also assessed on the next day after irrigation moisture content of 34.4 cm^3 / cm^3 was observed in the upper layer of 10 cm, 25.0 cm^3 / cm^3 was observed at 20 cm depth and also observed moisture content of 22.5 cm^3 / cm^3 observed at 30 cm depth. Hence there is a difference of 3.8 cm^3 / cm^3 at top layer of 10 cm from first day to second day after irrigation, similarly there is a difference of 5. cm^3 / cm^3 in the layer of 20 cm and difference of 8.4 cm^3 / cm^3 at 30 cm depth.

The moisture content of the field is also analyzed to observe water/moisture dynamics in the irrigated field for no mulch condition, the moisture content at surface layer of 10 cm was found to be 20.8 cm^3 / cm^3 immediately after irrigation, similarly a moisture content of 24.7 cm^3 / cm^3 was observed at 20 cm depth and 23.6 cm^3 / cm^3 was observed at 30 cm depth. a moisture content on the next day after irrigation moisture content of 19.9 cm^3 / cm^3 was observed in the upper layer of 10 cm, 20.82 cm^3 / cm^3 was observed at 20 cm depth and 22.8 cm^3 / cm^3 was observed at the 30 cm depth, hence these variation is because of the application of mulches and dynamics of water/moisture during the day of any irrigation level 1.0 E pan as shown in (Fig 1, 2, 3 and 4), as well as the water/moisture dynamics of the field day after irrigation as shown in (Fig 3, 4, 5 and 6).

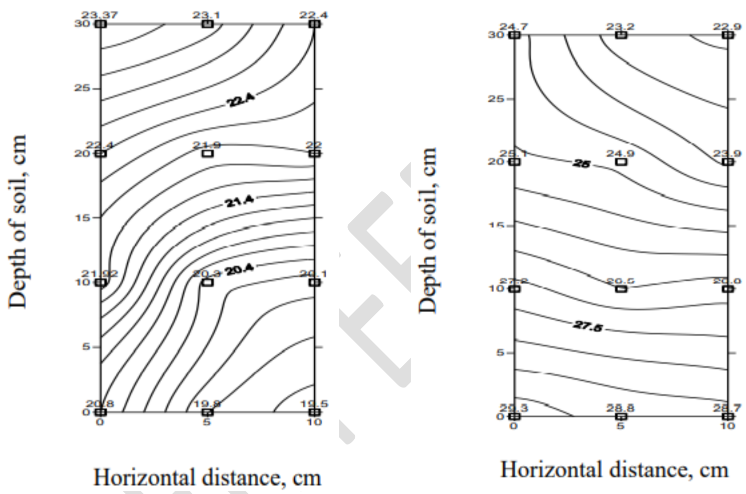


Fig. 1: Moisture distribution under no mulch & paddy straw mulch on the day of irrigation at 1.0 Epan

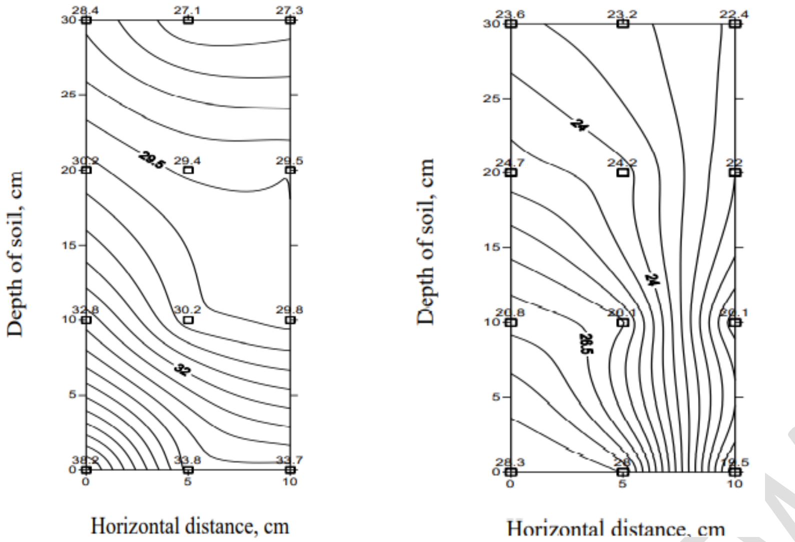


Fig. 2: Moisture distribution under plastic mulch & dried leaves mulch on the day of irrigation at 1.0 Epan

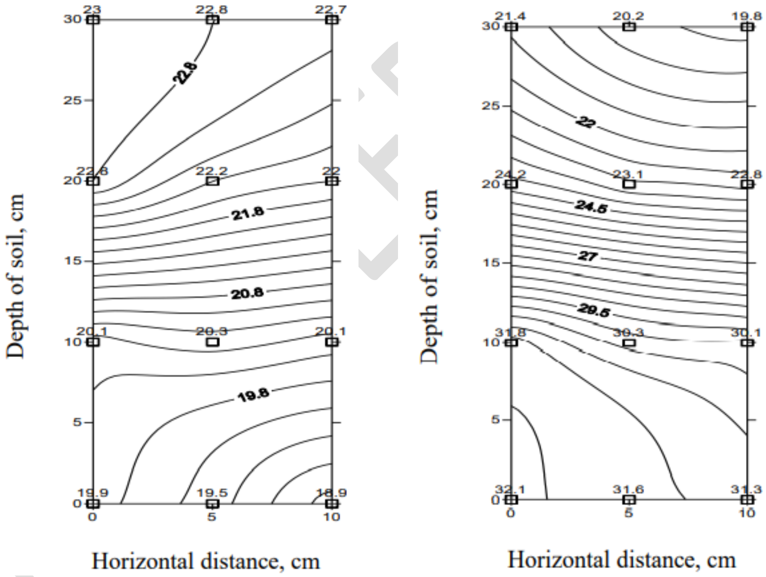


Fig. 3: Moisture distribution under no mulch & paddy straw mulch next day after irrigation at 1.0 Epan

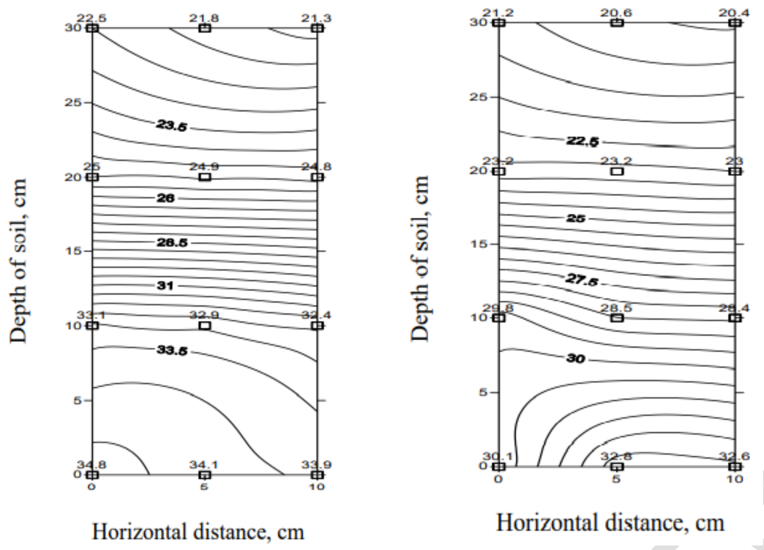


Fig. 4: Moisture distribution under plastic mulch & dried leaves next day after irrigation at 1.0 Epan

Similarly for irrigation level of 0.8 E pan the water/moisture dynamics are also discussed has The moisture content of the field is also analyzed to observe water/moisture dynamics in the 87 irrigated field for black plastic mulch condition, the moisture content at surface layer of (0-10 cm) was found to be 34.8 cm^3 / cm^3 Immediately after irrigation, similarly a moisture content of 27.4 cm^3 / cm^3 was observed at a depth of 20 cm and 25.0 cm^3 / cm^3 was noted down at 30 cm depth. A moisture content also assets on the next day after irrigation moisture content of 29.8 cm^3 / cm^3 was observed in the upper layer of 10 cm, 26.5 cm^3 / cm^3 was observed at 20 cm depth and also observed moisture content of 24.2 cm^3 / cm^3 observed at 30 cm depth. Hence there is a difference of 5 cm^3 / cm^3 at top layer of 10 cm from first day to second day after irrigation; similarly there is a difference of 0.9 cm^3 / cm^3 at the layer of 20 cm and difference of 0.8 cm^3 / cm^3 at 30 cm depth.

The moisture content of the field is also analyzed to observe water/moisture dynamics in the irrigated field for no mulch condition, the moisture content at surface layer of 10 cm was found to be 17.8 cm^3 / cm^3 immediately after irrigation, similarly a moisture content of 18.5 cm^3 / cm^3 was observed at 20 cm depth and 20.27 cm^3 / cm^3 was observed at 30 cm depth. a moisture content on the next day after irrigation moisture content of 16.8 cm^3 / cm^3 was observed in the upper layer of 10 cm, 18.1 cm^3 / cm^3 was observed at 20 cm depth and 19.5 cm^3 / cm^3 was observed at the 30 cm depth, hence these variation is because of the application of mulches and dynamics of water/moisture during the day of any irrigation level 0.8 E pan as shown in (Fig 5, 6, 7 and 8), as well as the water/moisture dynamics of the field day after irrigation as shown in (Fig 5, 6, 7 and 8)

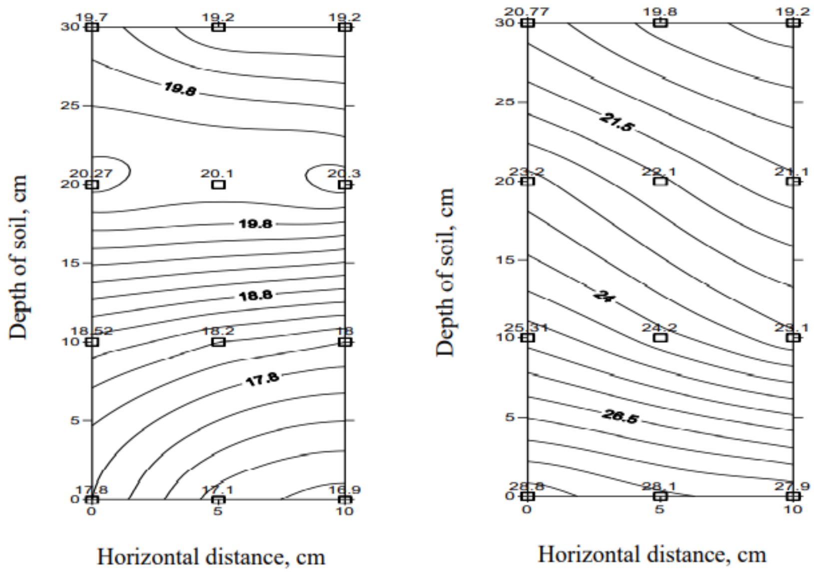


Fig. 5: Moisture distribution under no mulch day & paddy straw day of irrigation at 0.8 Epan

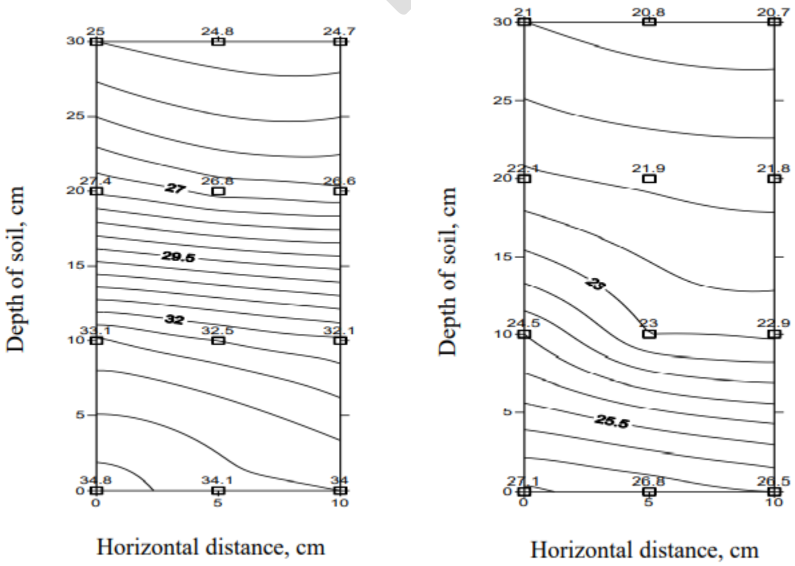


Fig. 6: Moisture distribution under plastic mulch day & dried leaves mulch day of irrigation at 0.8 Epan

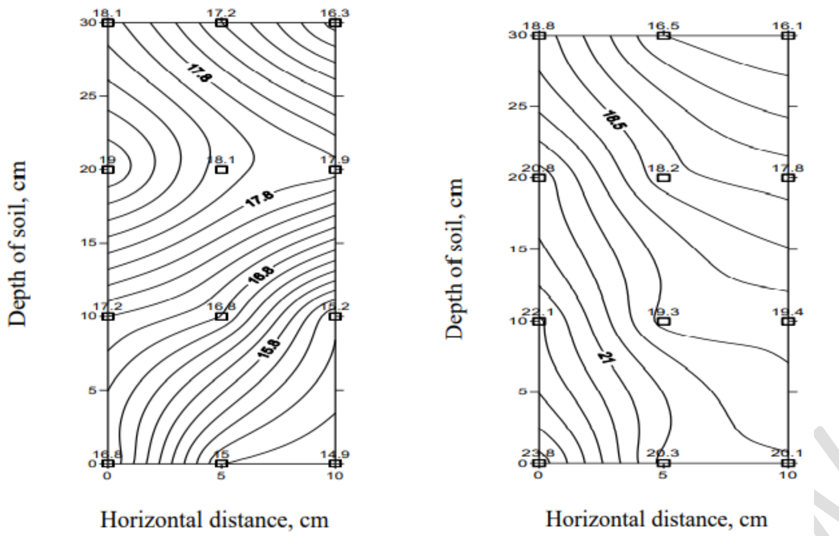


Fig. 7: Moisture distribution under no mulch & paddy straw mulch next day after irrigation at 0.8 Epan

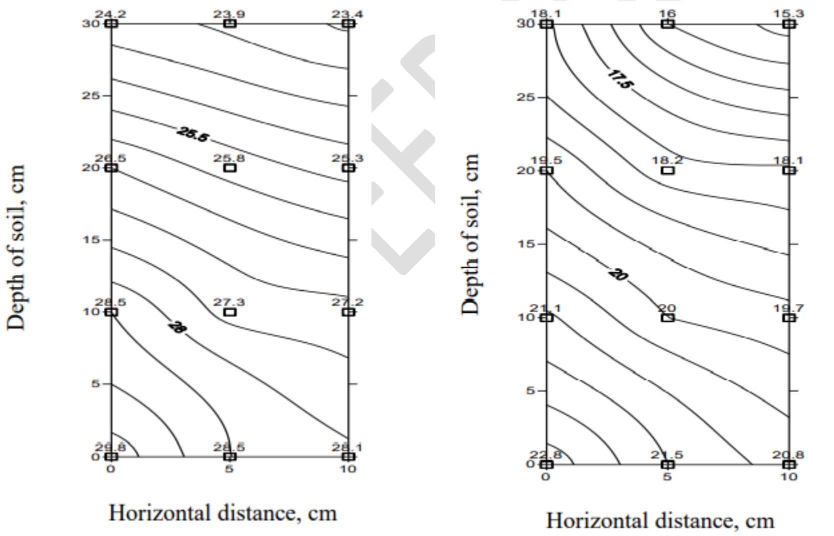


Fig. 8: Moisture distribution under plastic mulch & dried leaves mulch next day after irrigation at 0.8 Epan

Similarly for irrigation level of 0.6 E pan the water/moisture dynamics are discussed as the moisture content of the field is also analyzed to observe water/moisture dynamics in the irrigated field for black plastic mulch condition, the moisture content at surface layer of (0-10 cm) was found to be 24.8 cm^3 / cm^3 Immediately after irrigation, similarly a moisture content of 21.1 cm^3 / cm^3 was observed at a depth of 20 cm and 19.9 cm^3 / cm^3 was noted down at 30 cm depth. A moisture content also assets on the next day after irrigation moisture content of 20.1 cm^3 / cm^3 was observed in the upper layer of 10 cm, 18.5 cm^3 / cm^3 was observed at 20 cm depth and also observed moisture content of 17.1 cm^3 / cm^3 observed at 30 cm depth. Hence there is a difference of 4.7 cm^3 / cm^3 at top layer of 10 cm from first day to second day after irrigation; similarly there is a difference of 2.6 cm^3 / cm^3 at the layer of 20 cm and difference of 2.8 cm^3 / cm^3 at 30 cm depth. the results of soil moisture content in the present study indicated that, application of black 88 plastic mulch would reduce the soil moisture evaporation which will enhance the uniform distribution availability of soil moisture for longer days.

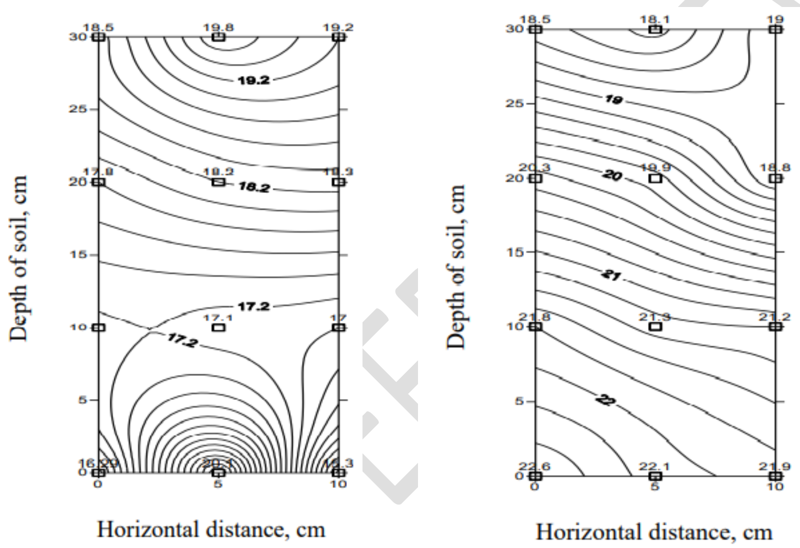


Fig. 9: Moisture distribution under no mulch day & paddy straw mulch day of irrigation at 0.6 Epan

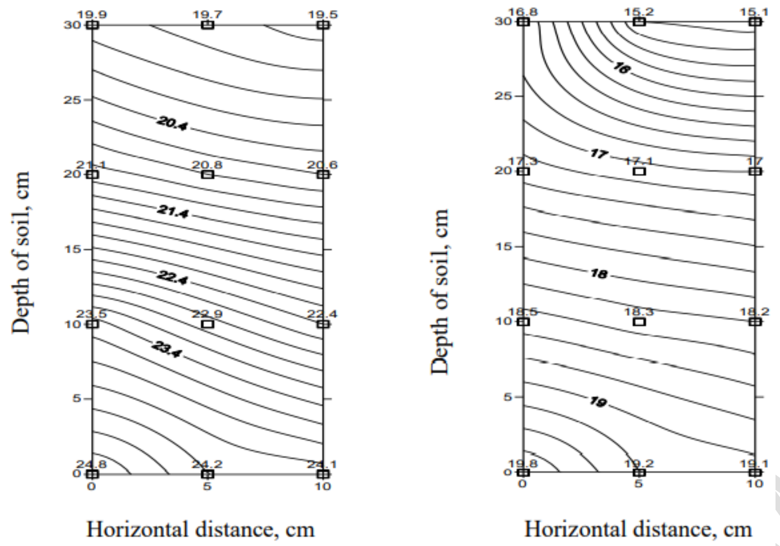


Fig. 10: Moisture distribution under plastic mulch day & dried leaves mulch day of irrigation at 0.6 Epan

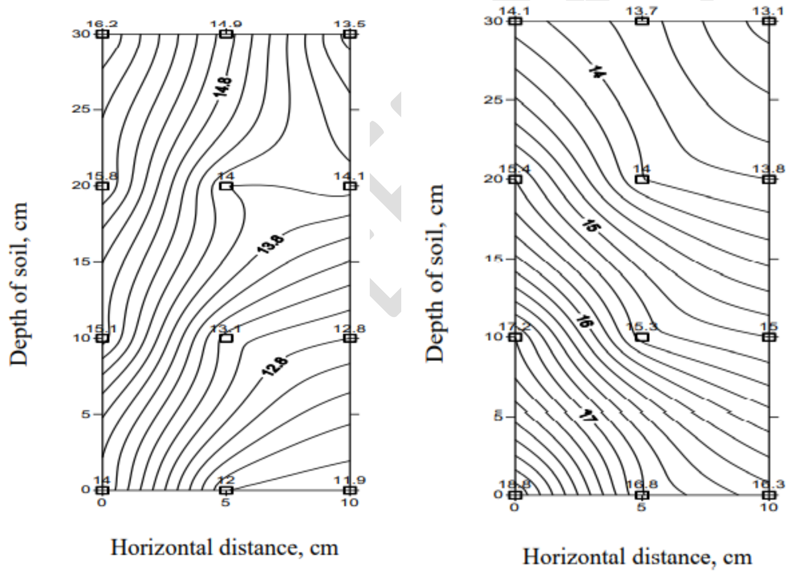


Fig. 11: Moisture distribution under no mulch & paddy straw mulch next day after irrigation at 0.6 Epan

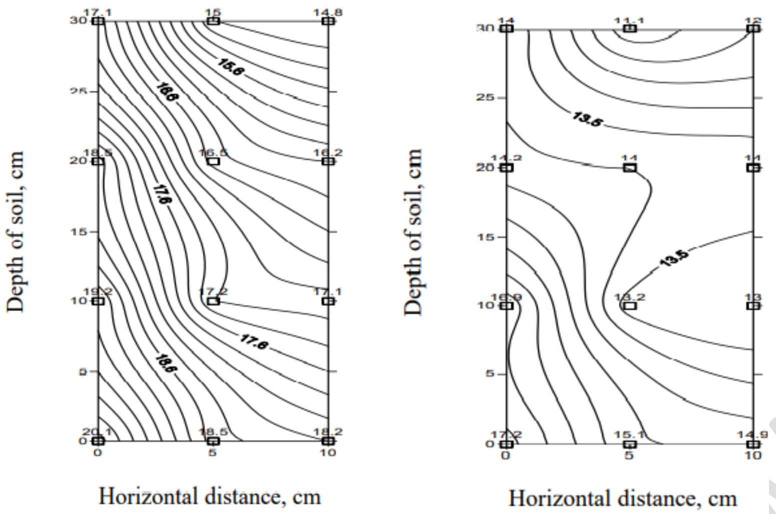


Fig. 12: Moisture distribution under plastic mulch & dried leaves mulch next day after irrigation at 0.6 Epan

Conclusions

Drip irrigation scheduled at 0.6 E pan had shown the highest water use efficiency (111.09 Kg ha^{-1} mm^{-1}) and the lowest was observed in drip irrigation scheduled at 1.0 E pan (90.5 Kg ha^{-1} mm^{-1}). Application of black plastic mulch had given maximum WUE (113.5 Kg ha^{-1} mm^{-1}) while the lowest was noticed with no mulch treatment (90.43 kg ha^{-1} mm^{-1}).

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