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Drip Irrigation Flow Ratio Influence of the Spatiotemporal Distribution of Moisture, Salts and Temperature Related to Root Zone in Sandy Soil Model.

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Abstract: The trials were conducted to estimate the influence of the drip irrigation flow ratio of the spatiotemporal distributions of moisture, salts and temperature related to the root zone, experiments is being designed as a randomized complete block (R.C.B.D), beside three repeats, conducted by applying equal amounts of irrigation water (4 liters) using three flow ratio of drip irrigation systems (F1 = 0.8, F2 = 4 and F3 = 8 l/h) on the sandy soil section model using plexiglass box. And the obtained results are there are significant differences of the spatiotemporal distribution of soil moisture contents, and the more positive significant is F1 = 0.8l/h more over their influence on the spatiotemporal salts distribution clearing the happened leaching of biggest flow F3 = 8l/h according the more applied water amount per time beside, the vertical velocity of water to bottom taking nutrients to drainage conversely, with reducing of flow ratio, flows ratio don't effect on the spatiotemporal soil temperature distribution. And these are basic considerations must be taken into account when designing and drip irrigation system in the sandy lands of different plants.

Keywords: Drip Flow; Sand; Soil Moisture; salts, temperature; root-zone.

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1. Introduction

The spatiotemporal distribution of soil moisture contents had received increasing importance over recent years because it is widely recognized that improving our knowing and understanding of soil moisture contents and the processes advocated its spatiotemporal distribution is critical write here. **[1].** Supply of water additives and nutrient in sandy soil, can be kept up to 40% of irrigation water and so increase yield by perfect approaches and using ultra-low discharge drip irrigation then having economic feasibility. In sandy soil, approximately 40% of water could be kept. **[2].** Root-zone distribution of corn evaluated at tasseling showed an average of 94% of total root length within 60 centimeters of the ground surface and 85% within 30 cm **[3].** Selecting of the emitters with smaller application rate results a greater wetted depth, which is a common approach in the drip system design for a uniform soil, may not be necessary applied to the layered soils. Measurements of nitrate distribution showed that nitrate accumulated toward the boundary of the wetted volume for both the uniform and the layered soils. This shows the importance of optimal management of drip fertigation because nitrate is susceptible to the movement out of the root zone by mismanagement of fertigation **[4].** The high ground, water content at a depth of 0.6 m can be ascribed to the predominance of the perpendicular motion of water in sandy soils, in which the application of heavy masses of water results in percolation losses **[5].** Soil surface evaporation has a cooling influence on root zone, limit evaporation will result in smaller fluctuations by some irrigation methods in soil temperature and warmer soil temperatures overall. For some crops, this has beneficial impacts by supporting earlier root growth, better plant progress and larger yields **[6].** Irrigation efficiency reduced deep percolation; Water that percolates under the root zone (deep-percolation) is lost to crop production, although deep percolation may be necessary to moderate salinity. Deep percolation can be brought down by improving the evenness

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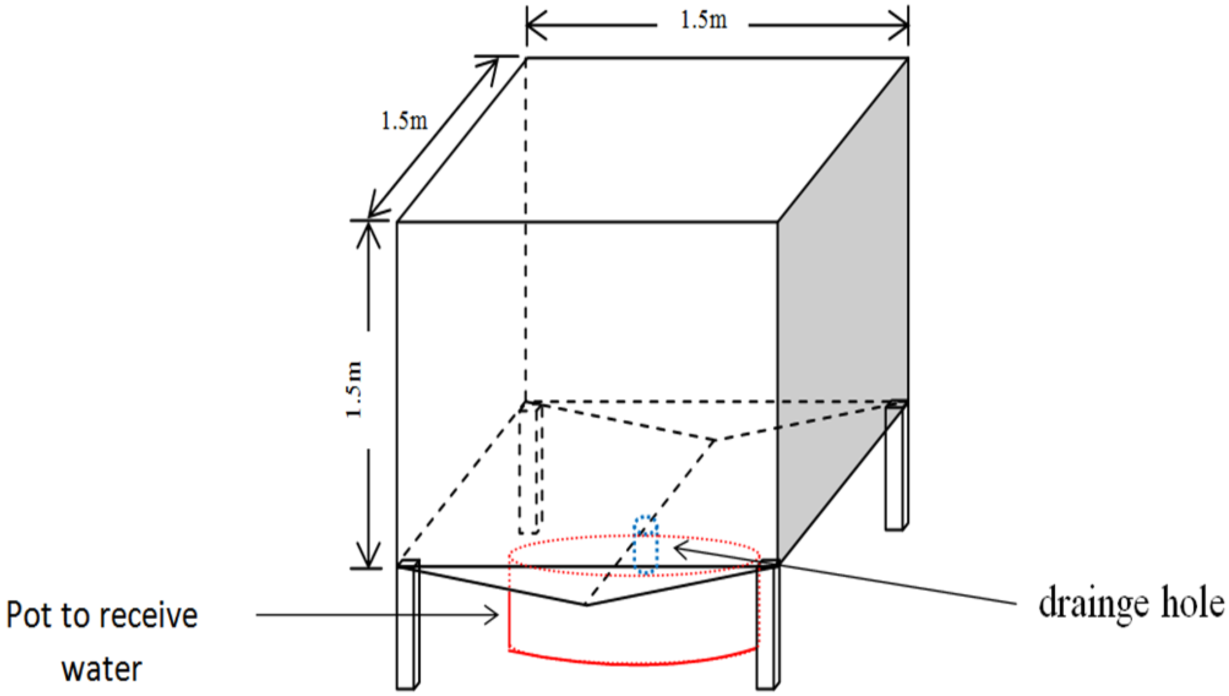
of the applied water and preventing over irrigation. **[7].**

The primary objectives of the research is the study of drip irrigation flow ratio influence of spatial and temporal distribution of moisture, salts and temperature related to the root zone in sandy land to make the basic guide of water, fertilizer and drip irrigation management in sandy soil and covering the water flow applied to hydraulics characters of sandy soil especially in the source zone.

Laboratory experiments are been designed as randomized complete block (R.C.B.D), beside three repeats, conducted by applied equal amounts of irrigation water (4 liters) using three flow ratio of drip irrigation systems (F1 = 0.8, F2 = 4 and F3 = 8 l/h) on sandy soil section model using plexiglass box having dimensions as volume cubic meter (1.5 X 1.5 X 1.5 meter), beside the drainage hole in central bottomed of overturned triangle to drainage exceed water, slopes in the bottom level to direct water to drainage hole, and the walls from plexiglass. And screen galvanized steel to take soil moisture, soil salinity and soil temperature readings, Figure



1.

2. Material and Methods

Figure1: Layout of sandy soil section model (plexiglass box).

2.1. Measurements and calculations:

Soil moisture contents, salinity and temperature.

Soil moisture was measured by (TDR 300 soil moisture meter) and soil salinity and temperature were measured by (Direct soil EC probe), readings were picking in tow direction X, Y, the readings space are 20 cm, readings depth 20 cm, samples number in X direction three beginning from dripper, and four in Z direction beginning from dripper, beside readings were be taken before irrigation process start and after irrigation process finish by 2 hours and then after 12 hours for 3 times for three times.

2.2. Data analysis and calculations:

Graphics of spatial and temporal distribution of salts, moisture and temperature in sandy soil were done by surfer 11 program, and statistical analysis was being done by SPSS 16 program. It is must be notice that the zero point on the patterns refers to dripper position on the soil surface.

Volumetric water content (g/cm3) calculation:

Volumetric water content in sand layers was calculated as follows:

Volumetric water content (mm) = soil water content (%) x bulk density (g/cm3) x soil depth (mm). (1)

3. Results

3.1. The influence of water drippers flow ratio on soil water contents:

Sandy soil hydraulics parameters were a basic cause of water balance and movement behaviors, accordingly, the mineral particles of the sandy soil 1 to 0.5 mm, beside the sandy soil field capacity is from 10 - 13% and available water was 6%according to **[8]** and **[9].** Beside the wilt point is 4.5 % and bulk density is 1.6 g/cm^{3}By contrast, sand has large pores which allows for lots of gravity drainage and hence a low field capacity. The grains have a low surface area, cohesion; adhesion force and water hold capacity/volume giving a low wilting point. Regardless, soil moisture data were be analysis statistically, that's clear there's a flow drippers ratio (0.8, 4 and 8l/h) had a significant impact on sandy soil moisture distribution patterns, F = 88.170, ρ = 0.000, according to the same water amount (4 liters) were be applied by various operating times (5, 1 and 0.5 hours) using deference type of dripper flow ratio (0.8, 4 and 8 l/h) respectively, which in depended on dripper flow, and this clear the time of sandy soil ability to hold water. Each of these experimental positions makes an important contribution to our understanding of water movement behavior in sandy soil layers. So the basic reasons of the significant difference of drippers flow ratio is the behavior of water hydraulic movement in sandy soil in addition to weakness sandy soil's ability to hold water, by other mean decreasing water hold capacity in sandy soil beside these characterizes will be having increasing influence especially under flow ratio of water applied. As a result of increasing of water movement vertically to down layers according to a high infiltration rate of sandy soil (more than 25 to 30 cm per hours) then, be lost by deep-percolation according to the excessive flow ratio of water, which cause a vertical force (water head) caused a stress on water vertical column specially under weekend of all adhesion and cohesion force of sandy soil particles. An equally significant aspect of encouraging deep-percolation, it's gravity force which attracts water down in short time. At the same time, an equally significant aspect of water loss aspects, it's soil surface evaporation which increasing, according to temperature degree increasing and so available water amounts in the surface layer, as we have seen, all of the last conditions were thriving and working whenever the dripper flow ratio is being increased.

Agreement of discussing results in support of this position can be found by **[10]** and **[11].** Figure.2.

According to LSD test, there's a significant difference between soil moisture contents of F_1 and dripper flow F_2 and F_3 in favor of the F_1, beside there's a significant difference between soil moisture contents of dripper flow F_2 and F_1 in favor of the F_1, there's an insignificant difference of F_2 and F_3. Subsequently, there's a significant difference between soil moisture contents of F_3 and F_1 in favor of the F_1, there's an insignificant difference of F_3 and F_2, Table 1.

As we have seen, the influence of the dripper ratio of soil moisture contents in sandy soil is very clear on F3 due to the more water amount which is stored in soil layers using ultra low flow drip irrigation system to apply water and dealing

Table 1: The mean difference of soil moisture contents under three flow ratio.

Difference	*Flow$_1$ (0.8)*	*Flow$_2$ (4.0)*	*Flow$_3$ (8.0)*
Flow$_1$ (0.8)	-	6.2619*	9.5441*
Flow$_2$ (4.0)	-6.2619*	-	3.2822
Flow$_3$ (8.0)	-9.5441*	3.2822	-

*. The mean difference is significant at the. 05 level.

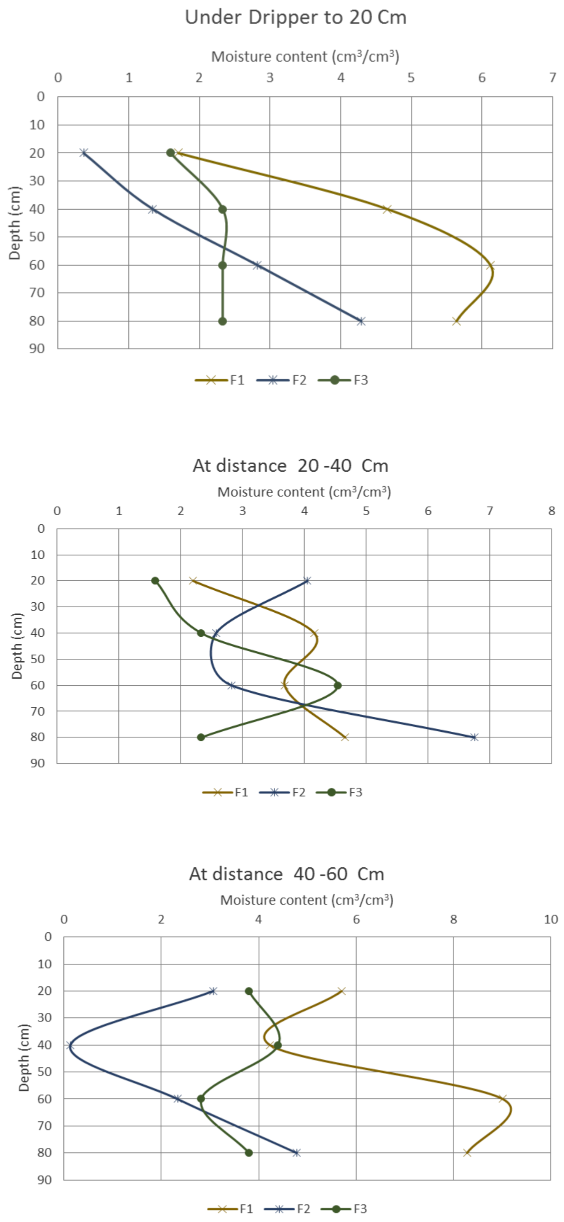


Figure 2: Soil moisture contents profile of dripper flow ratio in sandy soil root zone at three distances from dripper and 24 hours after irrigation process.

with less water hold capacity of sandy soil. As a consequence, the degrading influence By the same token, of both of F2 then F3 according to applied flow increasing, This results approach is similar to the interpretation many researcher, **[12].**

3.2. The Spatiotemporal distribution of moisture contents in the sandy soil root zone:

Unquestionably, the spatial distribution of soil moisture content will be agreed with the statistical analysis. So by studying soil moisture patterns of three drippers flow (F_1, F_2 and F_3). It's clear that the homogenous distribution of water is the highest in F_3 then graduate to F_2 then F_1 according to excessive applied amount of water per time, that's make water movement take a variable behavior especially in sandy soil. It's clear that the advanced water movement in the vertical direction is greater than the horizontal, as a result to excessive applied and sandy texture, Correspondingly. The advanced water movement in the horizontal direction is greater than the vertical, according to ultra-low flow applied of drippers which save water more time inside irrigation systems due to the large of operation times and don't represent the pressure on the movement of water as a result of weight and gravity, beside from F_3 to F_1 this behavior of water movement (from F_3 to F_1) cause the surface layers dried in short time and result a bad effect on root zone specially F_3 and F_2 in The obtained results are in line with **[10] and [5].**

Some 72% of the root system was concentrated in the upper 0.5 m soil layer and within 2 m on either side of the drip line. Deep percolation below the root-soil volume was negligible at 0.3 Et_o, moderate at 0.6 Et_o, and high at the 0.9 Et_o level. **[13].**

All water applications were limited to the surface O-37.5 cm depth interval, which suggests that active root water uptake during the growing season occurred in the surface, soil layer only. However, root excavations showed that roots extended to the 90- 100 cm. **[14].**

By the same token, the temporal distribution of water content, it's clear that the largest contents of water is two hours after the irrigation process finish. This is due to the short time to exposure of different factors of water loss which is more effective with the passage of time. By the same token, the nutrients will be lost in seepage water to underground soil layers far away of the root zone. The most important of this factor is deep-percolation which increasing due to excessive flow, especially in light texture like sandy soil, beside soil surface evaporation, so the range of water loss is higher in F3, F2 and F1 respectively. And water contents were degraded, according to the passage of time, Hence, F_3 flow dripper, it's so clear and significant water loss 12, 24 and 36 hours after the irrigation process finished, but the water losses ratio takes a severe behavior in the time passed, and this is agreed with **[15].** It's been important to notice that every moisture contents values may be considered a part of seepage water losses. And it's depending on the root-zone depths of plants, for example, if the crop which has a surface roots like wheat, corn, and soybean. It's have about 20-30 cm depth, so the soil moisture content in depth 30 cm at the bottom of it is being watered losses by deep percolation. And so like that if the plant has a root depth of 60 cm, so any water moisture contents were being found at the bottom of it were being considered water losses by deep-percolation, moreover the greatest water are up-taken by the surface level of the roots. And reduced when go to the bottom layers and this the basic principal to arrange the ideal management of irrigation scheduling and chosen the positions and number of emitters around plants beside flow ration to maximizing the water use and fertilizer efficiency. Figure 2 and 3.

3.3. The spatiotemporal distribution of salts in sandy soil root zone:

Unquestionably, salts distribution is including nutrients were being affected by both the behavior of water movement in the soil layers and water balance in the soil,

It can be noted that soil salt under F_1, F_2 and F_3 irrigation systems was distributed gradually and homogeneously. But the most homogeneous salts distribution is F_1 then F_2 and $F_{3,}$ soil salt distribution under F_3 irrigation system suffered from high concentration at some points were being far away from dripper location. The effective root zone will be exposed to un-intention nutrients leaching process, moreover soil salt concentrations increased, according to water seepage to the lower soil layers. At the same time, this scenario of soil salt distribution takes a degradation direction whenever water applied ratio decreases, by other mean when the flow ratio of drippers become ultra-low (F_1 = 0.8 l/h), as a result, in reducing deep-percolation and evapotranspiration water losses, and this very significant point to water, fertilizer and irrigation management. By the same token, **[16]** reported the potential for managing root zone salinity and the application of leaching fractions is increasingly important as precision irrigation is implemented. Figure4.

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3.5. The spatiotemporal distribution of temperature in sandy soil root zone:

Soil moisture is a significant variable in hydrologic and biologic processes. It is a controlling variable in the exchange of water and energy between the soil surface and the atmosphere through evapotranspiration. It determines the partitioning of precipitation into runoff, percolation, and

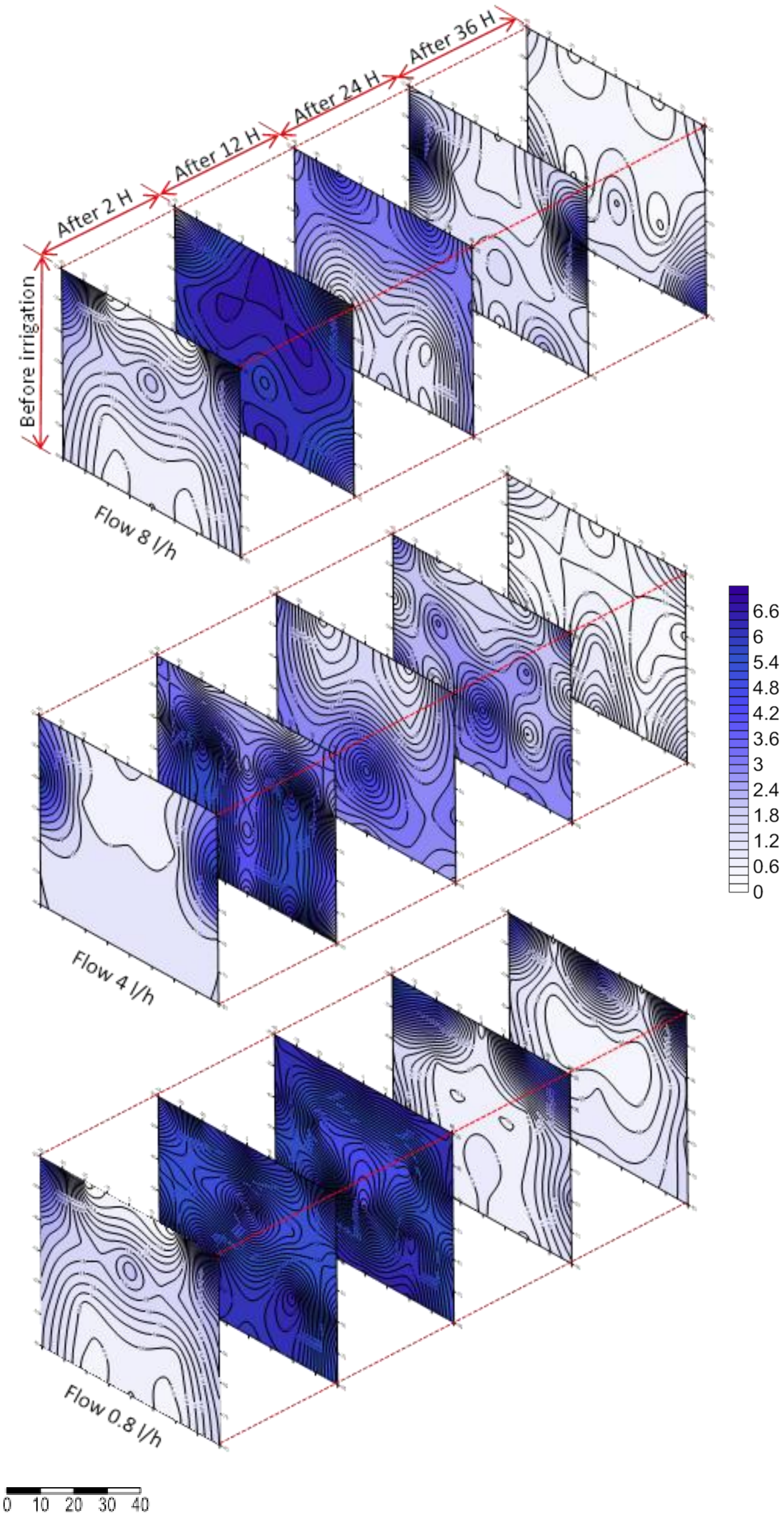

Figure 3: The spatiotemporal distribution of water contents in sandy soil root zone.

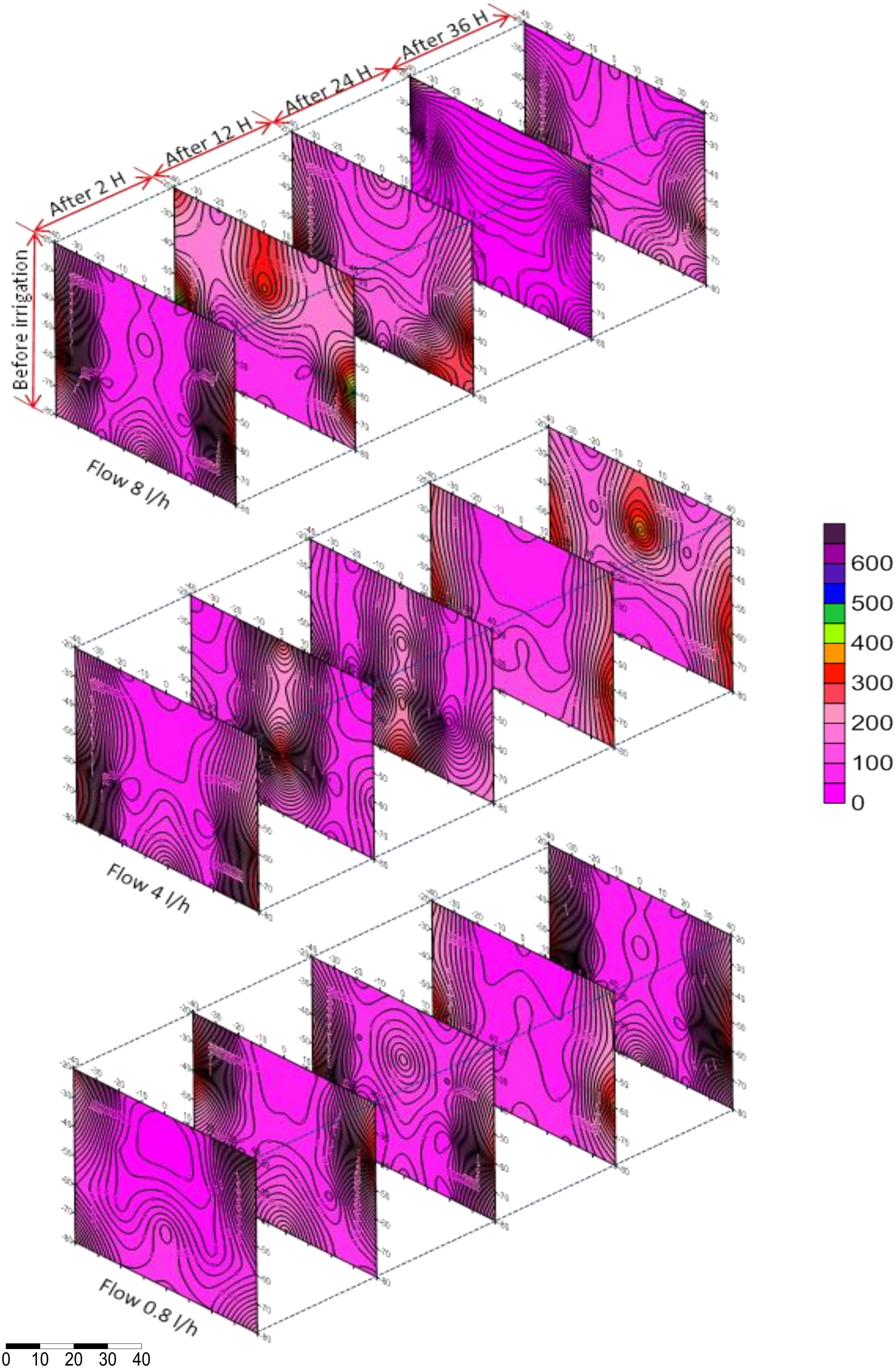

Figure 4: The spatiotemporal distribution of salts in sandy soil root zone.

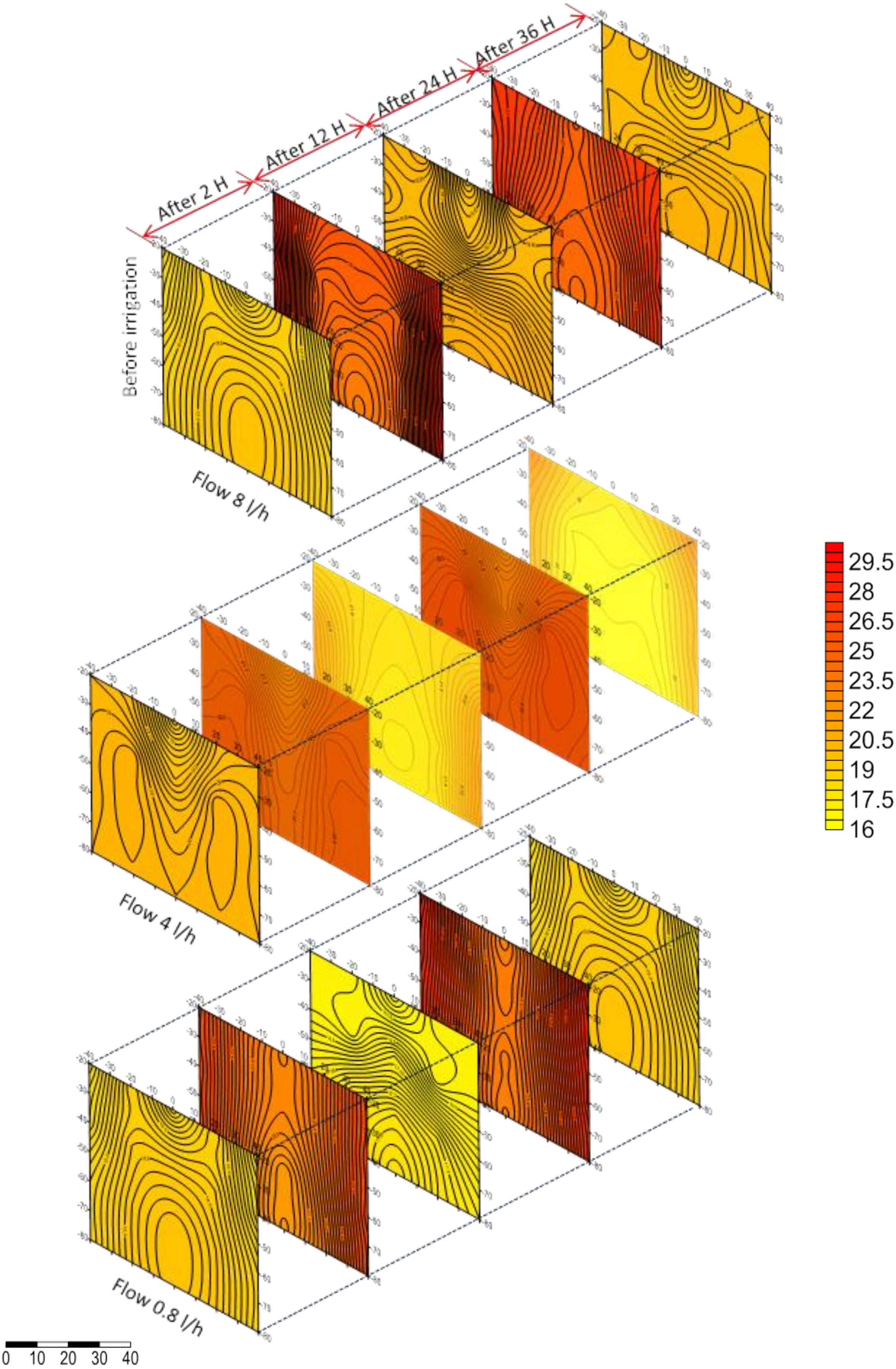

Figure 5: The spatiotemporal distribution of temperature in sandy soil root zone.

surface layers storage, as easily as the partitioning of incoming solar radiation and long wave radiation into outgoing long wave radiation, and latent heat, ground heat, and sensible heat fluxes, **[16].**

An equally significant aspect of the spatiotemporal distribution of temperature behaviors of in sandy soil under three dripper flow, regardless temperatures distribution patterns, the heights mean temperature degree is in F3, F2 and F1 respectively, Despite this, differences of variable temperature of various flow ratios, so are insignificants, it be noticed that the maximum spatial distributions of temperature distribution are 2 hours and 24 after irrigation process due to the time of picking temperature reading are the noon time which the maximum of peak air temperature. Figure 5.

3.6. Discussion

It's very important to understand the nature of sandy soil physical and hydraulics characters and the suitable emitter flow rate of drip irrigation system. And its influence on the spatiotemporal distribution of soil moisture contents, salts and temperature. Which don't cause water or salt stress and don't cause water loss by deep-percolation then nutrients leaching to drainage, taking into account the root zone depths of cultivated crops, and working with available water and nutrients for much time as possible to plant to increase the plant uptake efficiency, the water use efficiency and the fertilize efficiency.

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