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Effect of Initial Soil Moisture on Wetting Pattern under Trickle Linear Source in Layered Soil

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ABSTRACT:

Trickle irrigation is considered one of the main methods in field irrigation. Studying and understanding the moisture distribution pattern beneath the drip irrigation is of great importance to reduce deep percolation losses and the number of emitters. The current study aims to understand the effect of initial soil moisture on the wetting pattern and moisture distribution in layered soils under a linear drip source. The study included tests to monitor the advance of the wetting front during both the wetting phase and moisture redistribution phase over time and for a constant volume of added water using two types of soils, sandy loam and clay, for two conditions of layered soil (sandy loam over clay) and (clay over sandy loam). Water was added at two rates and two levels of initial moisture for each soil type were considered. Empirical equations were derived for estimating both the horizontal surface advance with determination coefficient of (R^2=0.979) and vertical advance under the trickle source with determination coefficient of(R^2=0.979). The results showed that the ratio of horizontal advance to vertical advance for the wetting front increases with an increase in cumulative infiltration in the layered soil (sandy loam over clay) whhile this ratio decreases with an increase in cumulative infiltration in layered soil (clay over sandy loam). It was also found that the ratio of horizontal advance to vertical advance decreases with an increase in the initial soil moisture of the upper layer and that vertical advance is greater in the case of high moisture compared to low soil moisture for the lowere layer. In addition, the vertical advance in the subsoil isidentical for all cases of initial moisture and water application rates in layered soil (clay over sandy loam) while there is a clear difference in the effect of moisture and water application rate in layered soil (sandy loam over clay).

Key words:

Initial moisture، layered soil، wetting phase، moisture redistribution phase، trickle irrigation، wetting pattern

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1. INTRODUCTION

Trickle irrigation is the slow and frequent application of water in the form of separate drops or very low flow through small openings called emitters installed along the lateral. Its primary objective is to maintain a portion of the root zone area wet and moist through shallow irrigations provided continuously or intermittently without significant deep percolation losses. The efficient design of a trickle irrigation system depends on understanding the shape and volume of wetted soil, which is influenced by various factors including soil texture arrangement, initial soil moisture, emitter discharge rate, applied water volume, application method (continuous or intermittent), and water and soil temperature [1, 2, 3, 4, 5, 6, 7, 8, 9]. Water movement continues due to hydraulic gradients during the infiltration phase during water application, called the wetting phase, as well as after stopping water application from the emitter during the moisture redistribution phase. Water movement within the soil results from capillary forces in all directions and gravitational forces downward. Consequently, fine-textured soils with relatively small pores are more affected by capillary forces than coarse-textured soils with relatively large pores, which are more influenced by gravitational forces [1, 5, 10, 11, 12, 13, 14, 15, 16]. Water infiltration from a surface emitter generally occurs in three-dimensional flow, where water spreads in the area surrounding the emitter with saturated moisture, surrounded by another area with unsaturated moisture ending with a moving edge called the wetting front, which separates the wetted and dry zones [12]. In fine-textured soils, the horizontal advancement of the wetting front is greater than in coarse-textured soils, while the opposite is true for vertical advancement [5, 17]. In fine-textured soils and at the same applied water volume, the horizontal advancement increases relative to the vertical advancement of the wetting front with increasing emitter discharge rate, and this is more pronounced than in coarse-textured soils [5]. Increased soil permeability makes the soil lighter by increasing the ratio of vertical to horizontal advancement [6]. In coarse-textured soils, both horizontal and vertical advancement of the wetting front increase with increasing applied water volume, with the increase in vertical advancement being greater and more pronounced compared to horizontal advancement [5, 6]. Similarly, in both intermittent and continuous application, the horizontal and vertical advancement of the wetting front will increase when using an equal volume of applied water, because applying the same volume of water will make the total time for this application longer in the intermittent case, depending on the periods of stopping or cutting water addition for a certain application rateas in these periods there is moisture redistribution [5]. Both horizontal and vertical advancement of the wetting front increase with increasing initial soil moisture at a certain water application rate and time, and the magnitude of change in horizontal and vertical advancement during the moisture redistribution phase is more pronounced in soil with higher initial moisture [1]. The shape and pattern of wetting resulting from a trickle source are affected by soil surface slope and the deviation of the wetting pattern center from the emitter location [18, 19, 20,]. When there is localized surface runoff, this will lead to increased water advancement in the direction of soil surface slope below the emitter. Water movement in soil occurs due to hydraulic gradient and not due to moisture content gradient [21]. In layered soils, water movement is similar to that in homogeneous soils until the wetting front (vertical water advancement) reaches the interface between the two soil textures. There are two cases: in the case of fine-textured soils in the upper layer and coarse-textured soils in the lower layer, horizontal movement in the surface layer will increase until the tension decreases enough to allow penetration into the lower layer [22, 23, 24]. In the case of coarse-textured soils in the upper layer and fine-textured soils in the lower layer, horizontal movement will also increase, despite the different cause, due to the lower hydraulic conductivity of finer-textured soils, thus making horizontal movement greater than vertical movement in the soil profile [22]. Tilled soils in the field are layered (tilled surface soil and untilled subsurface soil) [5, 25]. The layered effect also results from water droplets impacting bare tilled soil surface [26]. In the current research, the effect of initial moisture on the wetting pattern (surface horizontal advancement and vertical advancement under the trickle source) was studied in non-homogeneous soil (layered soil).

2. LABORATORY EXPERIMENTS:

The soil was compacted in layers, one above the other, inside a rectangular parallelepiped steel container with dimensions of 5.5 cm × 70 cm × 140 cm. One face was made of transparent rigid plastic through which water advancement could be monitored and marked at selected times until the completion of the added water volume from the supply tank, as shown in Figure (1), which illustrates the laboratory soil container and water supply system. The soil was compacted in layers of 5 cm thickness each, with their mass determined based on the soil layer volume, initial moisture, and required bulk density, at a height of 40 cm for the lower layer texture B and 25 cm for the upper layer texture A for all tests. Water was supplied through a cylindrical tank with constant water level to the trickle source after calibrating two emitters with discharge rates of 1.515 cm³/min/cm and 2.848 cm³/min/cm by maintaining constant pressure head in the tank and using capillary

Figure (1): Laboratory soil container and water preparation system copper tubes coiled in spiral form with different numbers of bends for each discharge rate. For the soil profile preparations, the positions of the wetting front advancement were marked on the transparent face of the container at appropriate time intervals. Water addition continued until the added water volume reached 5 liters, at which point water supply was stopped and the soil surface was covered with a plastic cover to minimize evaporation from the soil surface while observing and marking the wetting front advancement with time until the total time reached 48 hours, after which it became difficult to distinguish the wetting front advancement. Table (1) presents the details of the soil textures, bulk density, and initial volumetric moisture content for the studied soils. Figure (2) summarizes the laboratory test results, while Figure (3) shows wetting patterns for various soil conditions and initial moisture levels.

Table (1) shows the details of soil texture, bulk density, and initial volumetric moisture content for the study soils.

Soil Type	Clay %	Silt %	Sand %	Bulk Density (g/cm³)	Initial Volumetric Moisture	
					Low	High
Sandy Loam	20	23	57	1.48	4.7	7.7
Clay	49	37	14	1.37	10	15.1

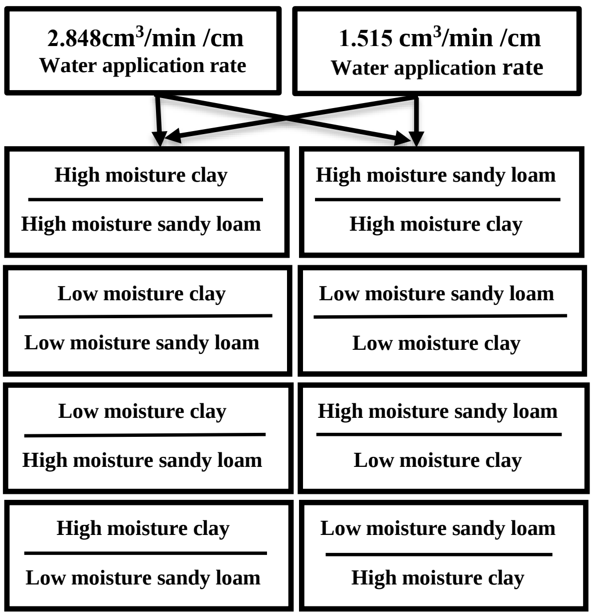

Figure (2) Summary of the laboratory tests.

Figure (3) shows wetting patterns for different soil profiles and initial soil moisture levels.

3. RESULTS:

3.1 Estimation of Wetting Front During the Wetting Phase

Data for surface horizontal advancement and vertical advancement under the emitter for the wetting front were extracted at each measurement time established during laboratory tests, totaling 187 values for each of the surface horizontal advancement X cm and vertical advancement under the trickle source Y cm with time T minutes, water application rate q cm³/min/cm, initial moisture content of surface soil θ_u, initial moisture content of subsurface soil θ_l, basic infiltration rate of surface soil I_u cm/min, and basic infiltration rate of subsurface soil I_l cm/min. The basic infiltration rate of the surface layer I_u cm/min applies when the vertical advancement is less than the depth of the surface layer, and the equivalent basic infiltration rate I_e cm/min applies when the vertical advancement is greater than the depth of surface layer A and is determined as follows:

$$I_e = \frac{A+B}{A/I_u + B/I_l} \quad \text{.............................. (1)}$$

Empirical equations were developed to estimate both horizontal advancement X cm with a coefficient of determination (R^2 = 0.979) and vertical advancement Y cm with a coefficient of determination (R^2 = 0.964) using the Solver tool available in Microsoft Excel in the following forms:

$$X = 0.956\ T^{0.541}\ q^{0.902}\ \theta^{-0.507}\ I_u^{0.202} \quad \text{......... (2)}$$

$$Y = \frac{\left(\dfrac{4.151\ q^{0.753}\ Ie^{0.53}\ T^{0.984} + \theta^{0.77} + 24.901}{q^{-0.086}\ Ie^{0.0416} - 21}\right)}{(1 + q\ \ Ie\ \ T)} \quad \text{.... (3)}$$

3.2 Estimation of Wetting Front During the Moisture Redistribution Phase

From the horizontal and vertical advancement data after stopping water supply, with 32 values for each of time and surface horizontal advancement XX and vertical advancement under the trickle source YY with time T minutes, total experiment time T_i minutes, water application rate q cm³/min/cm, initial moisture content of surface soil θ_u, initial moisture content of subsurface soil θ_l, basic infiltration rate of surface soil I_u cm/min, and basic infiltration rate of subsurface soil I_l cm/min. Using the Solver tool available in Microsoft Excel, despite the limited data, empirical equations were developed to estimate both horizontal advancement XX cm with a coefficient of determination (R^2 = 0.986) and vertical advancement YY cm with a coefficient of determination (R^2 = 0.974) in the following forms:

$$XX = 2.64\ T^{0.032}\ T_i^{0.364}\ q^{0.604}\ I_u^{-0.208}\ \theta^{-0.48} \quad \text{....... (4)}$$

$$YY = 1.785\ T^{0.039}\ T_i^{0.584}\ q^{0.377}\ I_e^{0.246}\ \theta^{0.313} \quad \text{....... (5)}$$

4. DISCUSSION

4.1. Cumulative Infiltration

Table (2) shows both the vertical and horizontal advancement of the wetting front (from equations 2 and 3) and the ratio of horizontal to vertical advancement of the wetting front at cumulative infiltration values of 1L, 2L, 3L, 4L, 5L for water application rates of 1.515 cm³/min/cm and 2.848 cm³/min/cm, for cases of layered soil profiles (sandy loam over clay) and (clay over sandy loam) at low and high initial volumetric moisture levels. This table shows that the horizontal advancement of the wetting front increases with increasing water application rate, while vertical advancement increases with decreasing water application rate. The horizontal advancement increases with decreasing initial volumetric moisture content of soils, and the horizontal advancement in clay over sandy loam soils is greater than in sandy loam over clay soils. The ratio of horizontal to vertical advancement of the wetting front increases with increasing cumulative infiltration in layered soils (sandy loam over clay) and decreases with increasing cumulative infiltration in layered soils (clay over sandy loam). The ratio of horizontal to vertical advancement of the wetting front in layered soil decreases with increasing initial moisture of the surface soil at a specific initial moisture of the subsurface soil and specific cumulative infiltration.

4.2. Horizontal Advance of the Wetting Front During the Wetting Phase

Figure (4) shows the change in the horizontal advance of the wetting front with time in a stratified soil for different levels of low and high initial moisture for a mixed sandy surface soil and a clay surface soil for application rates of 1.515 cm³/min/cm and 2.848 cm³/min/cm. The figure shows that the horizontal advance of the wetting front increases with increasing water application time for all cases of water application rate and initial soil moisture. It is also clear that the horizontal advance increases with increasing water application rate for a certain volume of added water. It is also clear that the horizontal advance increases at a certain application time and at a certain volume of added water with a decrease in the initial moisture for the same soil texture, which is in agreement with [6 ,1].

4.3. Vertical Advance of Wetting Front During the Wetting Phase

Figure (5) shows the change in vertical advancement of the wetting front with time for different levels of low and high initial moisture in layered soil (sandy loam over clay) at different water application rates of 1.515 cm³/min/cm and 2.848 cm³/min/cm. The figure generally shows whether for wetting front advancement in the surface or subsurface layer, that the vertical advancement of the wetting front increases with time, and for a specific volume of added water, the vertical advancement increases with decreasing water application rate in all cases of soil profile and initial moisture, which is in agreement with [6 ,1].

For the advancement of the wetting front in the surface soil, it is also obvious that the vertical advancement until the interface is faster in the case of high initial moisture, which agrees with [1, 6]. There is no difference in vertical advancement due to changing water application rate at the same initial soil moisture level. Figure (5) shows that at the interface between the two layers, the vertical advancement rate increases in all cases of initial moisture and water application rate, with the increase being greater at higher water application rates, and the increase is also greater in the case of high moisture compared to low moisture in the subsurface soil. In the case of wetting front advancement in the subsurface soil, the advancement in soil with high initial moisture is greater than in low moisture for all cases of initial moisture in the surface soil and both water application rates. The vertical advancement is greater with increasing water application rate at a specific time, and the vertical advancement is greater when the initial moisture of the surface soil is high for all cases of initial moisture of the subsurface soil and at the higher water application rate. Figure (6) shows the change in vertical advancement of the wetting front with time for different levels of low and high initial moisture in layered soil (clay over sandy loam) at different

Table (2): Horizontal and vertical advance of the wetting front and the ratio of horizontal to vertical advance (X/Y) at specific values of cumulative infiltration for several water application rates and at different levels of initial soil moisture and in different stratified soil profiles.

Soil profile	Cumulative infiltration litre	Water application rate	High moisture / High moisture			Low moisture / High moisture			High moisture / Low moisture			Low moisture / Low moisture		
			Horizontal advance x	Vertical advance y	x/y	Horizontal advance x	Vertical advance y	x/y	Horizontal advance x	Vertical advance y	x/y	Horizontal advance x	Vertical advance y	x/y
Sandy loam over clay	1	1.515 cm^3/min /cm	17.5	21.3	0.82	22.3	20.7	1.08	17.5	21.3	0.82	22.3	20.7	1.08
	2		25.4	30.3	0.84	32.5	28.0	1.16	25.4	29.1	0.87	32.5	29.1	1.12
	3		31.6	35.7	0.89	40.5	32.7	1.24	31.6	34.6	0.91	40.5	34.6	1.17
	4		37.0	40.2	0.92	47.3	36.4	1.30	37.0	39.1	0.95	47.3	39.1	1.21
	5		41.7	44.0	0.95	53.4	39.5	1.35	41.7	42.9	0.97	53.4	42.9	1.24
	1	2.848cm^3/min /cm	21.9	18.1	1.21	28.0	17.5	1.60	21.9	18.1	1.21	28.0	18.1	1.55
	2		31.9	21.9	1.45	40.8	21.6	1.89	31.9	21.9	1.45	40.8	21.9	1.86
	3		39.7	29.2	1.36	50.8	27.15	1.88	39.7	27.9	1.42	50.8	29.2	1.74
	4		46.4	33.3	1.40	59.4	30.9	1.92	46.4	30.3	1.53	59.4	33.3	1.78
	5		52.4	36.5	1.43	67.0	34.0	1.97	52.4	35.6	1.47	67.0	36.5	1.84
Clay over sandy loam	1	1.515 cm^3/min /cm	19.8	16.9	1.17	24.3	15.0	1.62	19.8	16.9	1.17	24.3	15.0	1.62
	2		28.8	25.0	1.15	35.4	24.2	1.46	28.8	25.9	1.11	35.4	24.2	1.46
	3		35.8	32.8	1.09	44.1	32.2	1.37	35.8	31.8	1.13	44.1	31.8	1.39
	4		41.9	38.6	1.09	51.5	38.4	1.34	41.9	37.8	1.11	51.5	37.8	1.36
	5		47.2	42.3	1.12	58.1	42.4	1.37	47.2	41.7	1.13	58.1	41.7	1.40
	1	2.848cm^3/min /cm	24.8	14.3	1.74	30.6	12.3	2.48	24.8	14.3	1.74	30.6	12.3	2.48
	2		36.1	22.1	1.63	44.5	20.4	2.18	36.1	22.1	1.63	44.5	20.4	2.18
	3		45.0	28.0	1.60	55.4	26.8	2.07	45.0	25.8	1.74	55.4	26.2	2.11
	4		52.5	32.1	1.64	64. 7	31.8	2.04	52.5	31.5	1.67	64.7	28.7	2.26
	5		59.3	36.4	1.63	73.0	36.3	2.01	59.3	35.7	1.66	73.0	35.6	2.05

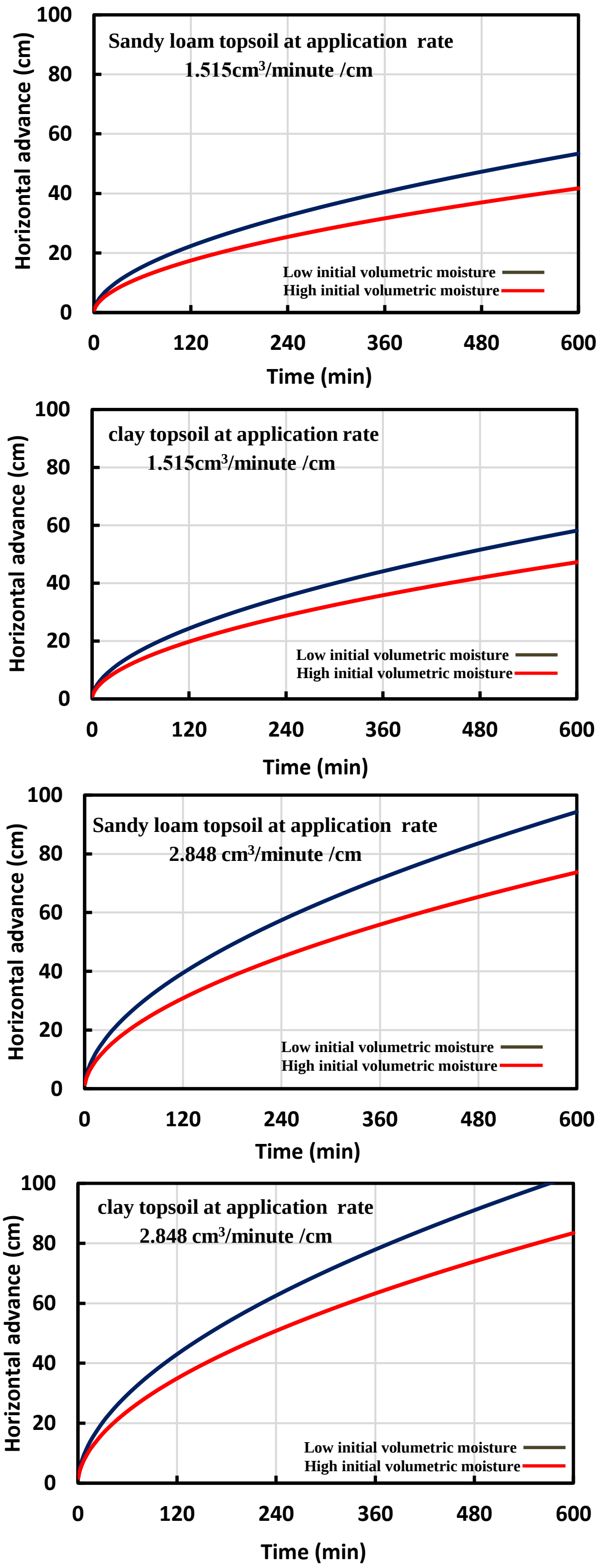

Figure (4): Variation of the horizontal advance of the wetting front with time for different initial soil moisture levels for a sandy loam topsoil and clayey topsoil and at different water application rates.

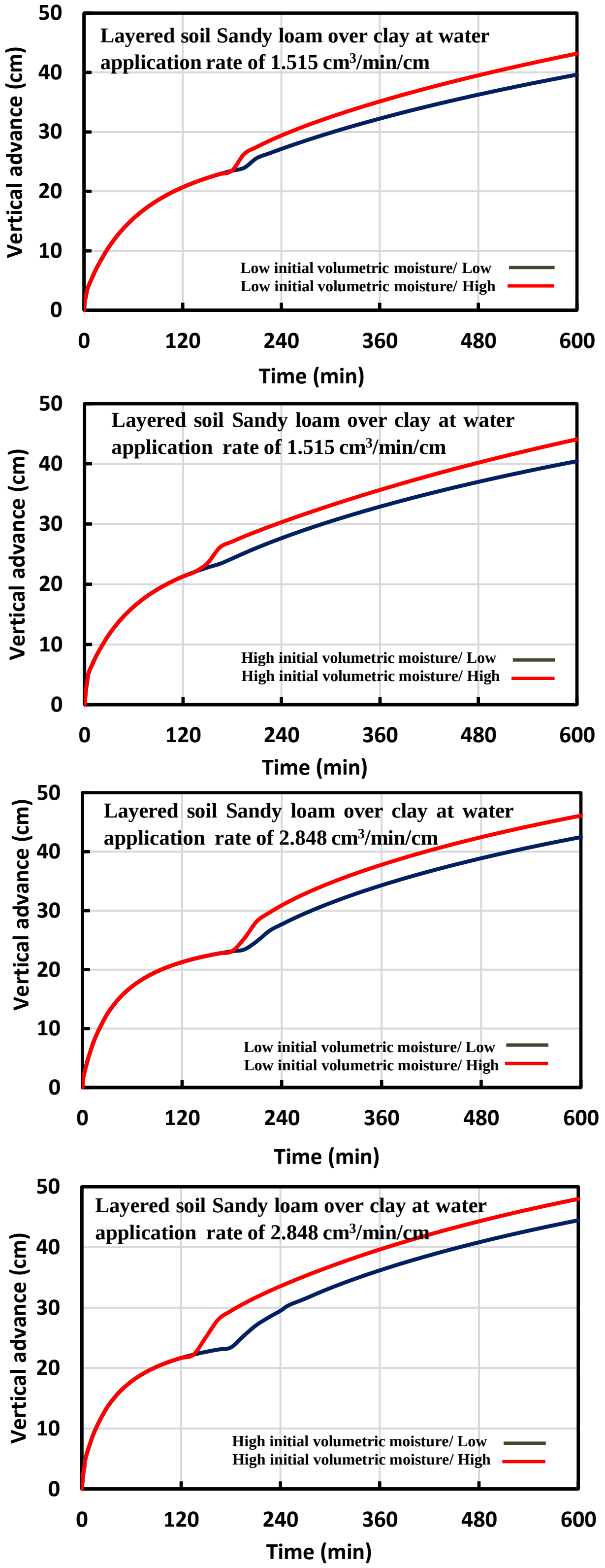

Figure (5): Variation of the vertical advance of the wetting front with time for different levels of initial soil moisture for layered soil (sandy loam over clay) at different water application rates.

water application rates of 1.515 cm³/min/cm and 2.848 cm³/min/cm. Figure (6) generally shows whether for wetting front advancement in the surface or subsurface layer, that the vertical advancement of the wetting front increases with time for a specific volume of added water, and vertical advancement increases with decreasing water application rate for all cases of soil profiles and initial soil moisture levels. For the advancement of the wetting front in the surface soil, it is also clear that the vertical advancement until the interface is greater in the case of high initial moisture, which agrees with [1, 6]. The vertical advancement is greater at the higher water application rate for the same initial soil moisture level. Figure (6) shows that at the interface between the two layers, the vertical advancement rate becomes very slow in all cases of initial moisture and water application rate, and this behavior continues for a longer period when the initial moisture is high for the surface soil and for all cases of initial moisture of the subsurface soil. In the case of wetting front advancement in the subsurface soil, the difference in vertical advancement is almost non-existent for all cases of initial moisture and both water application rates under study. The vertical advancement is greater with increasing water application rate for a specific time. Water movement in soils is governed by capillary tension and gravity forces. As soil texture becomes finer, the effect of tension becomes more significant than gravity, and vice versa. With increasing soil coarseness, gravitational forces become more significant than capillary tension. Therefore, horizontal advancement increases with increasing soil fineness while vertical advancement increases with increasing soil coarseness. When using the same volume of water, this will lead to decreased vertical advancement with increasing soil fineness and decreased horizontal advancement with increasing soil coarseness. Furthermore, as the initial soil moisture increases, the effect of capillary forces decreases, and gravity becomes more influential. Thus, we observe that increasing initial soil moisture leads to a decrease in horizontal advancement and an increase in vertical advancement. According to the information mentioned above, when the effects of soil texture and initial soil moisture interact on horizontal and vertical advancement of the wetting front, the greatest horizontal advancement and least vertical advancement occur at low initial soil moisture in clay soil, while the least horizontal advancement and greatest vertical advancement occur at high initial soil moisture in sandy loam soil. Consequently, the ratio of horizontal to vertical

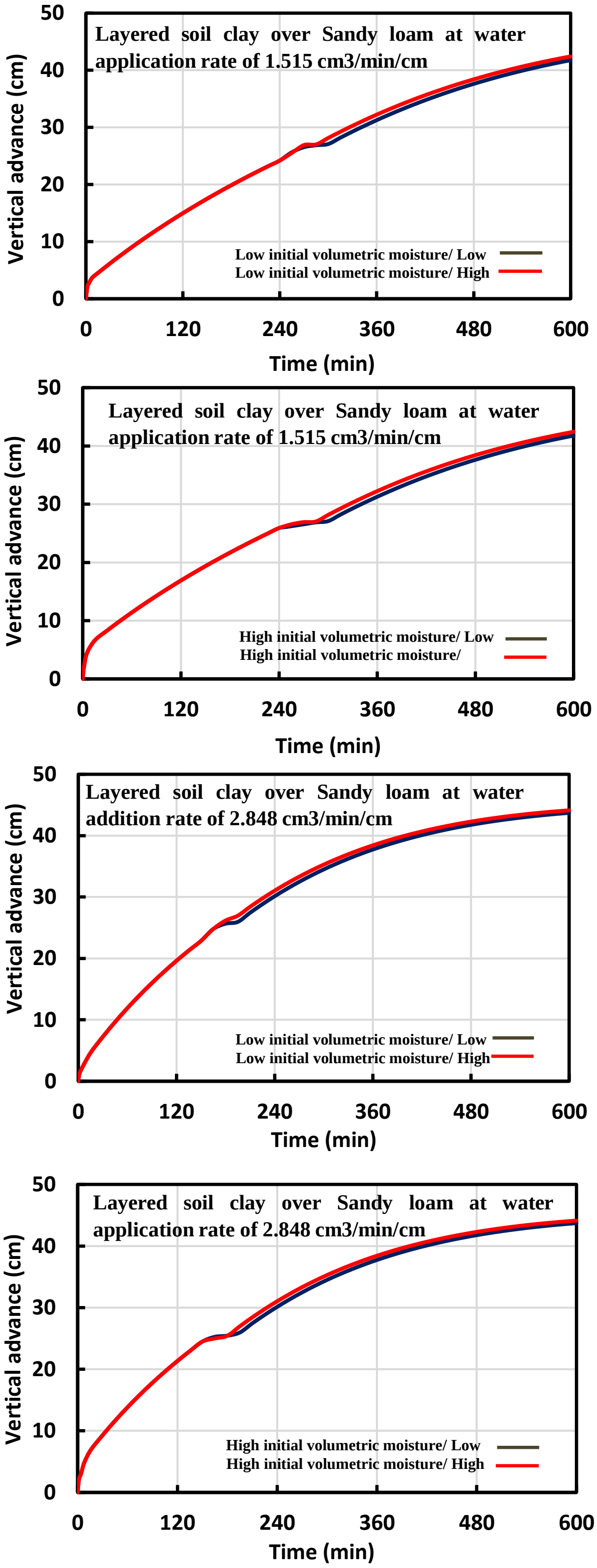

Figure (6): Variation of the vertical advance of wetting front with time for different levels of initial moisture in layered soil (clay over sandy loam) at different water application rates advancement will reflect the effect of variation between tension and gravitational forces as influenced by initial soil moisture and soil texture. In addition to the above, the interactive effect of water application rate on wetting front advancement shows that increasing the water application rate leads to increased surface ponding area and increased horizontal dimension of the saturated zone, which will lead to extended water spread in addition to what occurs due to capillary tension forces.

4.4. Horizontal Advancement of Wetting Front During Moisture Redistribution Phase

Figure (7) shows the change in horizontal advancement of the wetting front with time for different levels of low and high initial moisture during both wetting and moisture redistribution phases for surface sandy loam soil and surface clay soil at different water application rates. The figure shows that horizontal advancement of the wetting front during the moisture redistribution phase increases very slightly with time after stopping supply for all cases of initial moisture and water application rates, which agrees with[1].

4.5. Vertical Advancement of Wetting Front During Moisture Redistribution Phase

Figure (8) shows the change in vertical advancement of the wetting front with time for different levels of initial soil moisture during wetting and moisture redistribution phases for layered soil (sandy loam over clay) at different water application rates. The figure shows that vertical advancement of the wetting front during the moisture redistribution phase increases with time, and generally this increase is similar at different initial moisture levels and also similar at different water application rates. Figure (9) shows the change in vertical advancement of the wetting front with time for different levels of initial soil moisture during wetting and moisture redistribution phases for layered soil (clay over sandy loam) at different water application rates. The figure shows that the increase in vertical advancement of the wetting front during the moisture redistribution phase is greater in the case of high initial moisture in the surface layer compared to low initial moisture in the surface layer, and this increase is more pronounced at the water application rate of 1.515 cm³/min/cm.

4.6. Moisture Distribution in Soil Profile at the End of Wetting Phase

The Surfer program, operating under Microsoft Windows, was used to illustrate moisture distribution in the soil profile. Figure (10) shows moisture distribution for layered soil (sandy loam

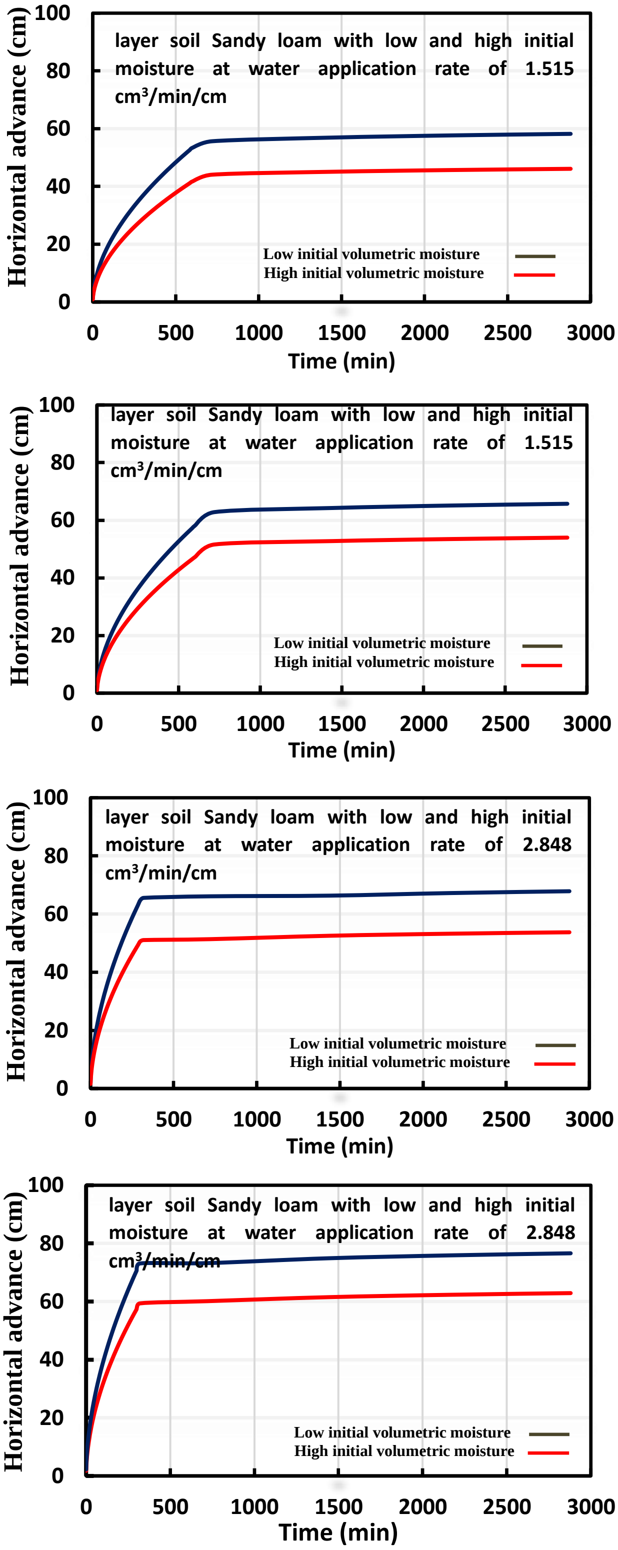

Figure (7): Variation of the horizontal advance of wetting front with time for different levels of initial soil moisture during wetting and moisture redistribution phases for surface sandy loam soil and surface clay soil at different water application rates

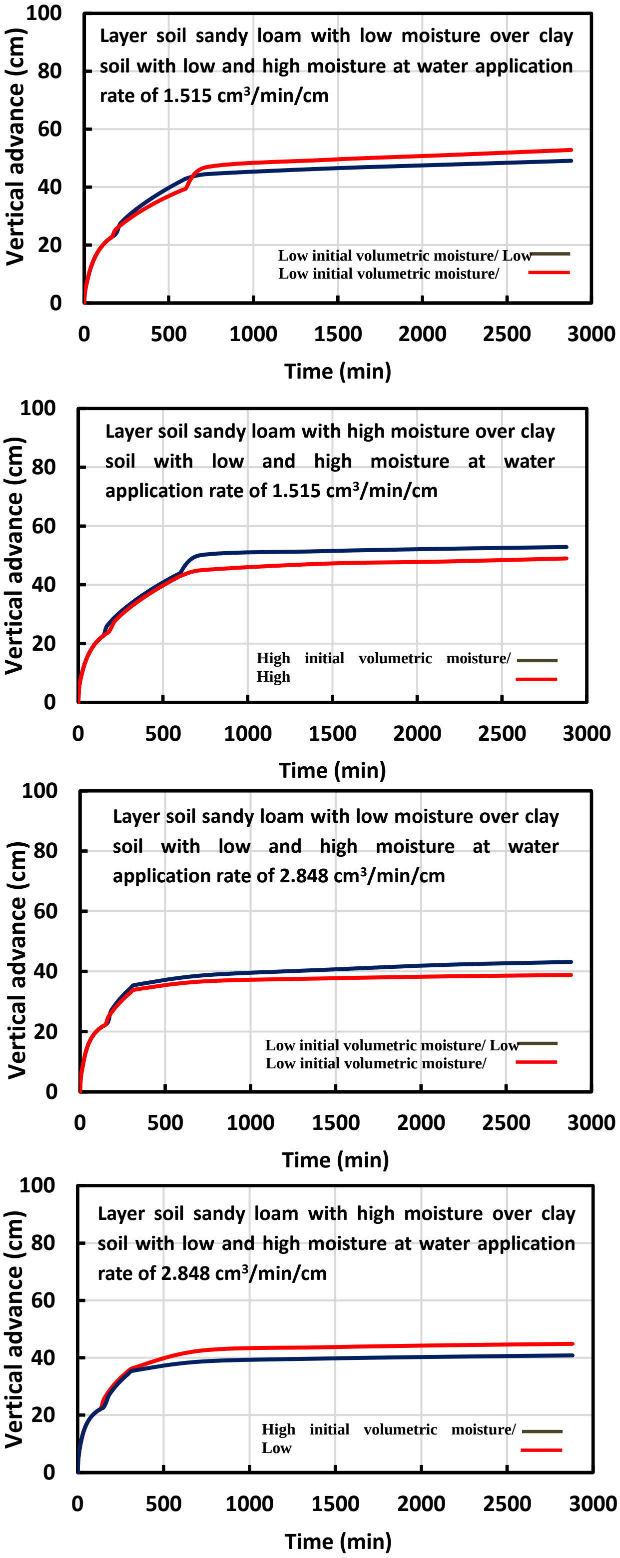

Figure (8): Variation of the vertical advance of wetting front with time for different levels of initial soil moisture during wetting and moisture redistribution phases for layered soil (sandy loam over clay) at different water application rates.

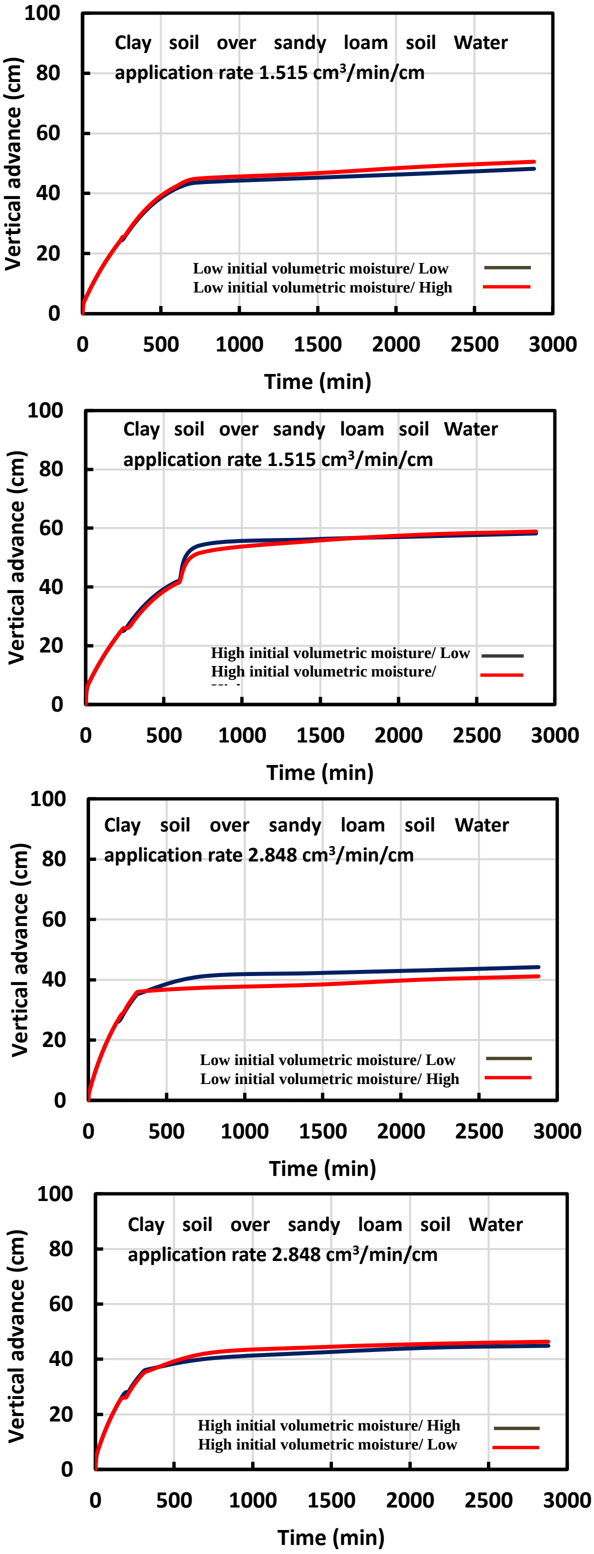

Figure (9): Variation of the vertical advance of wetting front with time for different levels of initial soil moisture during wetting and moisture redistribution phases for layered soil (clay over sandy loam) at different water application rates.

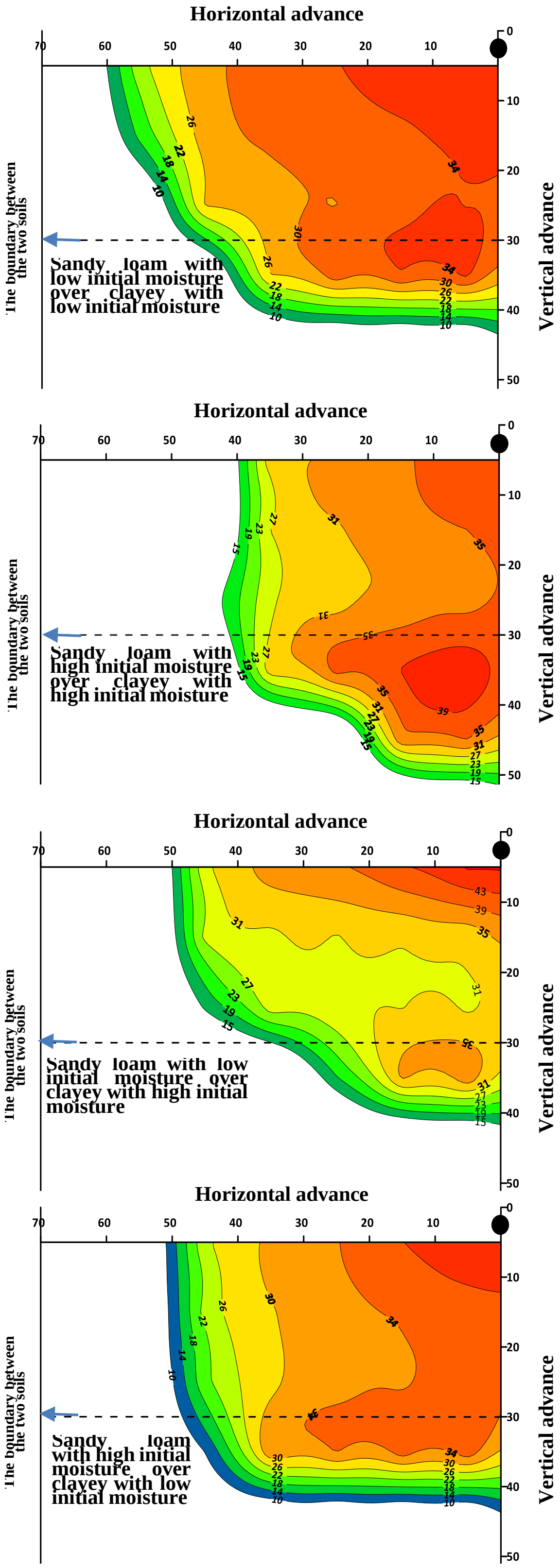

Figure (10): Moisture distribution for layered soil (sandy loam/clay) at the end of wetting phase with application rate of 1.515 cm³/min/cm.

over clay) at the end of the wetting phase with an application rate of 1.515 cm³/min/cm. The figure shows that maximum moisture occurs in the area extending under the trickle source up to the interface between the two textures for all different moisture level cases. The maximum moisture was in the case of layered soil with low-moisture sandy loam over high-moisture clay.

The greatest depth reached by wetting under the trickle source was in the case of layered soil with high-moisture sandy loam over high-moisture clay, and the greatest lateral distance reached by wetting on both sides of the trickle source was in the case of layered soil with low-moisture sandy loam over low-moisture clay. Figure (11) shows moisture distribution for layered soil (clay over sandy loam) at the end of the wetting phase with an application rate of 1.515 cm³/min/cm. The figure shows that maximum moisture occurs in the area surrounding the trickle source for all cases. The maximum moisture was in the cases of layered soil with high-moisture clay over high-moisture sandy loam and low-moisture clay over high-moisture sandy loam. The greatest depth reached by wetting under the trickle source was in the case of layered soil with high-moisture clay over high-moisture sandy loam, and the greatest lateral distance reached by wetting on both sides of the trickle source was in the case of layered soil with low-moisture clay over low-moisture sandy loam.

5. CONCLUSIONS

Under the conditions and limitations of the study, the following can be concluded:

*The ratio of horizontal to vertical advancement of the wetting front in layered soil decreases with increasing initial moisture of the surface soil at specific initial moisture of the subsurface soil and specific cumulative infiltration.

*The horizontal advancement increases at a specific application time and specific volume of added water with decreasing initial moisture for the same soil texture.

*In layered soil (sandy loam over clay) at the interface between the two layers, the vertical advancement rate increases in all cases of initial moisture and water application rate, with the increase being greater in the case of high moisture compared to low moisture in the subsurface soil. The opposite is true as it decreases with increasing initial moisture of the surface soil.

*During the moisture redistribution phase, the horizontal advancement of the wetting front advancement increases with time, with this increases very slightly with time, while vertical

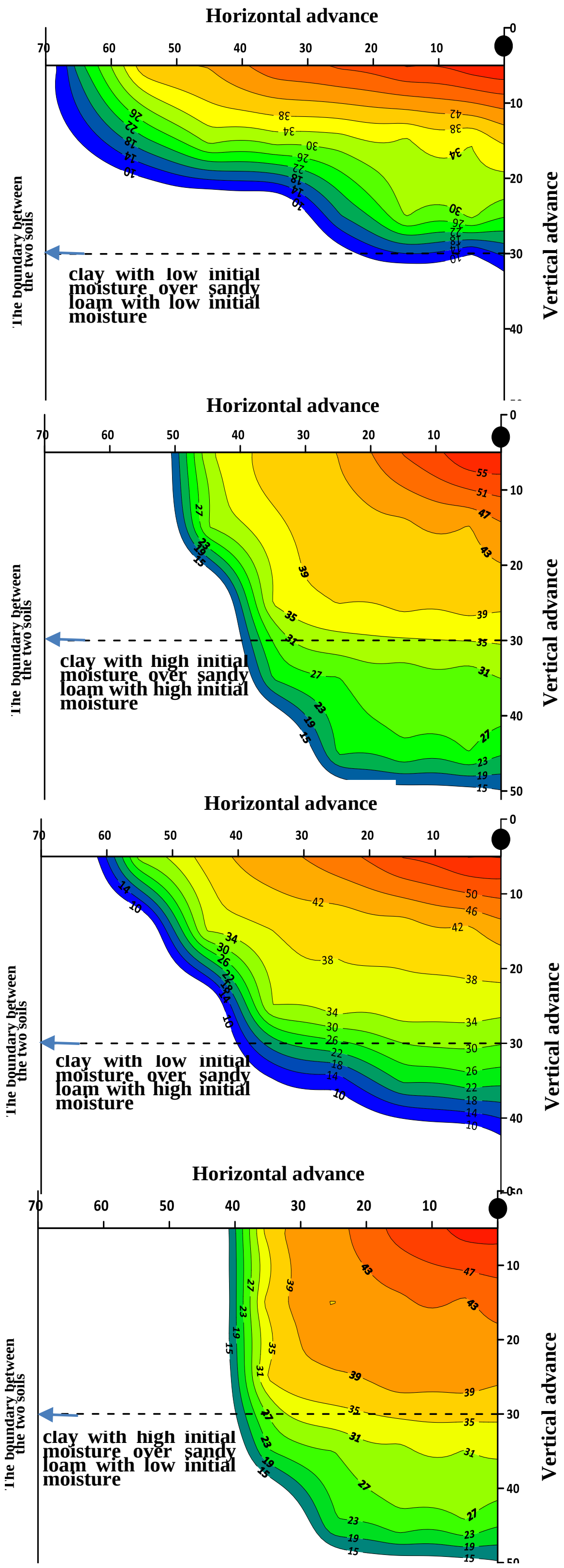

Figure (11): Moisture distribution for layered soil (clay/sandy loam) at the end of wetting phase with application rate of 1.515 cm³/min/cm

increase being similar at different initial moisture levels and different water application rates in layered soils (sandy loam over clay). However, in layered soils (clay over sandy loam), the increase is greater in the case of high initial moisture in the surface layer compared to low initial moisture in the surface layer, and this increase is more pronounced at the water application rate of 1.515 cm³/min/cm.

*Maximum moisture occurs in the area extending under the trickle source up to the interface between the two textures, and the greatest depth reached by wetting (vertical advancement) under the trickle source is in the case of layered soil with high moisture level in both surface and subsurface layers, while the greatest lateral distance reached by wetting on both sides of the trickle source (horizontal advancement) is in the case of layered soil with low moisture level in both surface and subsurface layers

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تأثير الرطوبة الابتدائية للتربة على نمط الابتلال تحت مصدر تنقيط خطي في تربة طباقية

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المستخلص:

يعتبر الري بالتنقيط أحد الطرق الرئيسية في الري الحقلي وان لدراسة وفهم حجم وشكل بصلة الابتلال تحت الري بالتنقيط اهمية كبيرة لغرض التقليل من حجم ضائعات التخلل العميق وتقليل عدد المنقطات. تهدف الدراسة الحالية الى معرفة تأثير الرطوبة الابتدائية للتربة على نمط الابتلال وتوزيع الرطوبة في الترب الطباقية تحت مصدر تنقيط خطي. تضمنت الدراسة فحوصات لمتابعة تقدم جبهة الابتلال خلال طوري الترطيب وإعادة توزيع الرطوبة مع الزمن ولحجم ثابت من الماء المضاف باستخدام نسجتين من الترب مزيجية رملية وطينية ولحالتين من مقد التربة الطباقية (مزيجية رملية فوق طينية) و(طينية فوق مزيجية رملية) وأضافة الماء بمعدلين ومستويين للرطوبة الابتدائية لكل نسجة. تم أستنباط معادلات تخمينية تجريبية لكل من التقدم الافقي السطحي بمعامل تحديد ($R^2 = 0.979$) والتقدم العمودي تحت المنقط بمعامل تحديد ($R^2 = 0.964$). بينت النتائج أن نسبة التقدم الأفقي إلى التقدم العمودي لجبهة الابتلال تزداد بزيادة الارتشاح التراكمي في الترب الطباقية (المزيجية الرملية فوق الطينية) وتقل نسبة التقدم الافقي الى العمودي بزيادة الارتشاح التراكمي في الترب الطباقية (الطينية فوق المزيجية الرملية). كما تبين أن نسبة التقدم الأفقي إلى التقدم العمودي تقل مع زيادة الرطوبة الابتدائية للتربة السطحية وان التقدم العمودي أكبر في حالة الرطوبة العالية مقارنة بالرطوبة الواطئة للتربة التحتية. فضلا عن ان التقدم العمودي بالترب التحتية متشابه لجميع حالات الرطوبة الابتدائية ومعدلي اضافة الماء في الترب الطباقية (طينية فوق مزيجية رملية) بينما هنالك اختلاف واضح لتأثير الرطوبة ومعدل اضافة الماء في الترب الطباقية (مزيجية رملية فوق طينية).

الكلمات الدالة:
رطوبة أبتدائية، تربة طباقية، طور الترطيب، طورأعادة توزيع الرطوبة، الري بالتنقيط، نمط الابتلال.