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Amendment speed of water infiltration in surge irrigation for cinnamon forest soil

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Abstract. *There are many explorations on the surge irrigation by furrows showing that it has considerable advantages to the continuous one. The advantages are as follows: shorter time for reaching the furrow end by the water, significantly improved uniformity of irrigation water application, reduction of irrigation water losses caused by the deep filtration and the flow, and so on. The experiments have been carried out in experimental field "Chelopechene" for 3 years. The furrow slope is 1 percent and the distance - 150 m. The number of furrows observed is 8. It has been established that the time for reaching a certain part of the furrow during the second phase of the water flow has been reduced, and the time for draining away the back head of the water has been increased, and constant values are demonstrated. The speed of infiltration approaches the constant value of water filtration in the soil.*

Keywords: surge irrigation, soil, infiltration, parameters

Introduction

From numerous studies over the past 20 years on surge irrigation furrows it has been found in most cases that it has advantages compared to the continuous one. These advantages are reflected in the shorter time for water to reach the end of the furrows, high uniformity of irrigation rate along the furrows, reducing the surface runoff loss of irrigation water from deep filtration and flow if properly designed and managed (Bichop et al., 1982; Ismail, 2004; Podmore et al., 1983). Surveys performed already in our country on leached smolnitsa (Gospodinov, 2009; Gospodinov et al., 2009) showed that surge irrigation has the above advantages over continuous one.

Bautista and Wallender (1985) did not find any effect of surge irrigation in sandy medium clay (clay loam) soils. Izuno and Podmore (1985) have examined the law of water filtration in the soil at surge mode of water submission. The result showed that a complete cycle of the pulse (reach and drainage) is sufficient to dramatically shift from changing by the time of speed to infiltration rate to constant filtration rate of the soil. Three phases of infiltration have been established: with initially dry soil, in transit caused by the initial wetting of the furrow and in wet soil. In the first part of the wetting furrow infiltration rate is identical to that of constant watering. In the secondary surgee, already moistened at the first surgee part of the furrow, is considered. This subject is subordinated to the "transit" infiltrative function. In the third successive surge "wet", "transit" and "dry" mode of infiltration are altered.

The purpose of the study was to determine the speed of change and softly bring it closer to the steady speed of filtration of water in soil irrigated with surge on Cinnamon forest soils.

Material and methods

The experiments were carried out on the cinnamonic forest soils in field station "Chelopechene" . The maximal field capacity of the soil layer 0-100 cm was 21.8%. The slope of furrows was 1% and the length was 150 m. The number of furrows observed was 8. Two variants for the cycle time were investigated - 10 and 20 min. The change of the speed of infiltration of water in the soil can be determined indirectly through the time of achievement and drain to a certain length of the furrow, during the different stages of water infiltration into soil. When at each subsequent surge these times became equal, this means that the infiltration rate has gained its upper limit, which is the speed of water infiltration in the given soil.

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Results and discussion

The results of time for the water front to reach certain distances (25, 50, 75, 100, 125 and 150 m) along the furrow for water movement in wet and dry bed, are given in Table 1 and 2. In Table 1 he data pulses for 10 minutes and in the second pulses in 20 minutes are given. With pulses of 10 minutes it is shown that 50 m along the furrow still wetting the bed of furrows the time of wetting reach its constant value. At larger distances from the first wetting pulse the time has been dramatically reduced, after 2-3 pulses it reaches the fixed values.

For pulses of 20 minutes the same rule applies - after the first wetting pulse the time is dramatically reduced. In the second and third pulse a constant value is reached. Constant values of time show that the rate of infiltration is close to the constant speed of filtration of water in the soil.

On Figure 1 and 2 time drainage and water contact along the furrows with pulse irrigation (by 10- and 20-minute pulses) in cinnamon forest soil and water movement only in a wet bed (the so called 2nd phase of water movement) are presented. The time for drainage was gradually increased after 3-4 pulses taking constant values for the respective distances along the furrows. With increasing distances along the furrow drainage times increases and the curve connecting the values has a convex form.

The curve showing time for the water front to reach the distances along the furrow in reaching constant values is concave

Table 1. Times to reach certain lengths of furrow in Cinnamon forest soils. Surge irrigation t_{imp}= 10 min, T_{pol} = 140 min.

Surge №	Times to reach (min)					
	L = 25 m	L = 50 m	L = 75 m	L = 100m	L = 125m	L = 150m
1	6					
2	2	16				
3	2	3				
4	2	3	45			
5	2	3	10			
6	2	3	8	58		
7	2	3	5	11		
8	2	3	6	10		
9	2	3	7	10	88	
10	2	3	6	6	12	
11	2	3	6	10	10	
12	2	3	6	8	10	
13	2	3	6	9	10	137
14	2	3	6	8	10	14

Table 2. Times to reach certain lengths of furrow in Cinnamon forest soils. t_{imp}= 20 min, T_{pol} = 160 min

Surge №	Times to reach certain lengths of furrow in Cinnamon forest soils (min)			
	L = 25 *m*	L = 50 *m*	L = 75 *m*	L =100 *m*
1	7	17		
2	4	6	40	
3	3	6	9	62
4	2	3	10	12
5	2	3	7	12
6	2	3	8	10
7	2	3	7	10

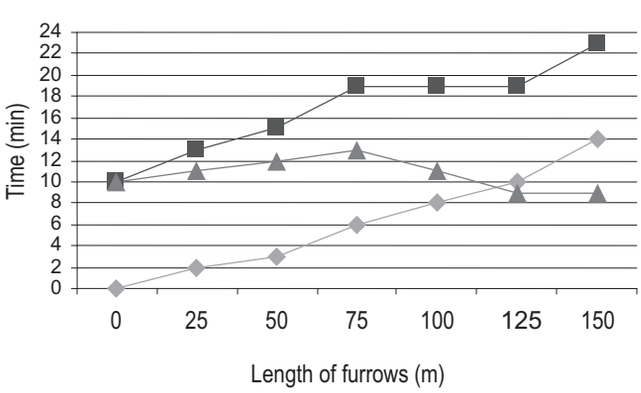


Figure 1. Time to achieve, and drainage of water contact along the furrows -surge irrigation (after 13 surge - 10 min).Water movement in furrow wetted

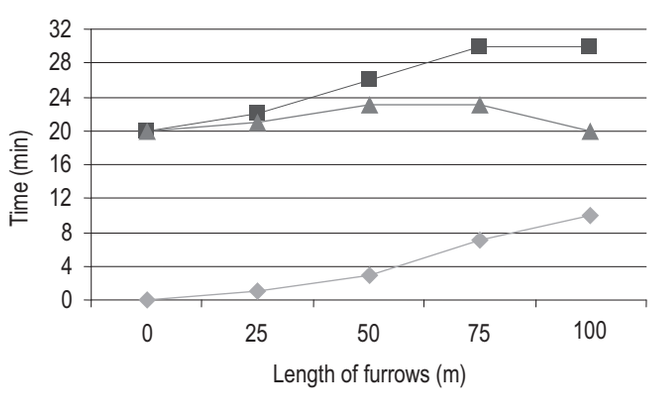
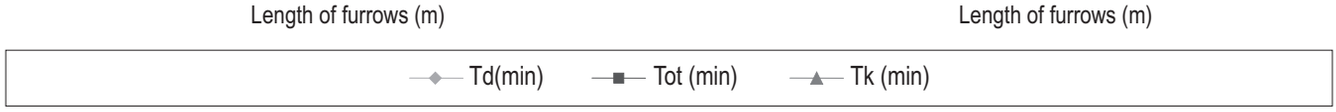


Figure 2. Time to achieve, and drainage of water contact along the furrows - surge irrigation (after 6 surge - 20 min). Water movement in furrow wetted



type. Reducing the time in the second phase of the movement of water in the furrows to reach constant values corresponding to constant speed of filtration of water in the soil, combined with the increasing value of time to reach the rear drainage leads to increased contact time of water in the soil along the furrows and is the basis of the advantages of pulse irrigation to continuous one. (Figures 1 and 2). These advantages consist of reducing the time to reach the end of furrows, increasing the time of contact with ground

water along the furrows, more equal distribution of irrigation rate, realization of irrigation rate near to the optimal standards reducing losses of irrigation water from deep filtration and runoff, reducing irrigation erosion.

Conclusion

Application of surge irrigation on Cinnamon forest soils during the second phase of water movement in furrows (wet bed movement) even after the first pulse leads to change of the most important characteristics of the irrigation process. The time to reach was sharply reduced and is close to its permanent value for the length of the furrow. The time to drain is rising and is close to constant values. The speed of infiltration is close to the constant speed of filtration of water in the soil.

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