International Journal of Agricultural Science, Research and Technology Available online on: www.ijasrt.com

Effect of water stress on potato product in the drip irrigation (T-Tape)

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Using modern irrigation methods such as border irrigation is one way for an optimum usage of water. Potato, for this study, was cultured in a farm located at Kermanshah faculty of agriculture to evaluate the efficiency of border irrigation. The culture potato was the Agria variety and the applied treatment were 50, 75, and 100 percent of potato plant`s water requirement. Tapes were 12 m and the distance of levees was 75cm. Plant`s water requirement was determined by the evaporation pan method and the use of crop coefficient. Comparison of the product performance, efficiency of water consumption, hemispheric wetted volume, and moisture distribution skill were the evaluation indexes. Results showed that maximum product performance related to the 100 percent treatment was 34.455 tons per hectare; it was, for 75 and 50 percent treatments, 25.938 and 19.168 tons per hectare, respectively. Water use efficiency for 100, 75, and 50 percent treatments was 3.59, 3.55, and 3.53 kg of potato tuber for consuming $1m^3$ of water. Comparing the product performance in SAS software, treatments were classified in different groups; significant difference was observed between them. **[F. Ghasemi Sahebi et al. Effect of water stress on potato product in the drip irrigation (T-Tape). International Journal of Agricultural Science, Research and Technology, 2011; 1(2):95-98].**

Keywords: Border irrigation, Potato product performance, hemispheric wetted volume

Received: 10 September2011, Reviewed: 18 September2011, Revised: 23 September 2011, Accepted: 24 September 2011

1. Introduction

Based on the limitation of the water resources, the optimum use of the water resources is necessary. Increasing the water usage efficiency with correct planning and applying suitable irrigation methods are two ways of the optimum use of water. In the other hand, evaluation of an irrigation method needs to be in farm conditions; its results increase the water use efficiency in the method. In the recent years, drip irrigation methods such as the border irrigation method were considered in Iran and studies with specific objectives were carried out in this regard(Singhsaggu and Kaushal, 1991).

Shalhevet et al (1983) studied the overhead and drip irrigation systems for potato product in Palestine and attained the production functions related to each system. Irrigation treatments were based on evaporation from A-class pan. Linear production function showing the whole product function and moisture suction was for the overhead (Y= -23.5 + 1.19 W) and drip (Y= -12.8 + 1.14 W) irrigation, which W was in cm and Y was in ton/ha Gupta and Singh resulted (from a two years study of comparing the corrugation and drip irrigations) that potato product would have a 50 to 65 percent increase under drip irrigation (Gupta and Singh., 1983).

Sing and Sood studied the interaction of water and nitrogen fertilizer on potato under different irrigation methods. Quantity of the irrigation water was used based on 100 and 150 percent evaporations from the pan. Maximum tuber performance and water use efficiency were attained under drip irrigation system and treatment of 150 percent cumulative evaporation from the pan (Singh and Sood, 1994).

Awari and Hiwase used the drip and basin irrigations for irrigating potato in 100 percent of the plant`s needed water in an experimental farm. Results showed that the maximum product and water use efficiency were attained under the drip irrigation system (Awari and Hiwase, 1994).

Singhasaggu and Kaushal studied the effect of irrigation regimes on the potato`s performance and growth under corrugation and drip methods. Providing supplementary water increased the rate of evaporation from the leaf area, fresh weight, tuber growth, and product performance and reduced the

stomatal resistance and the plant`s dry weight (Singhsaggu and Kaushal, 1991).

Baghani and Alizadeh, to compare the effect of corrugation and drip irrigation methods on the performance, product quality and water use efficiency in culturing watermelon (Charleston grey variety),melon (Ghasry variety) ,and tomato (Petvarely variety) ,carried out an experiment - in farm condition – in the Torogh agriculture research station (Mashhad) in 1995-96. These experiments included the corrugation and drip irrigation methods at three levels of the plant`s needed water (50 ,75 ,and 100 percent of the evaporated water from the evaporation pan after applying crop coefficients ,shading ,and the percent of desired water stress). Results showed that ,in average , water use efficiency of the drip irrigation method for watermelon ,melon ,and tomato was 3,3,and 2 times more than the corrugation one (Baghani and Alizadeh,1996).

Akbari ,to determine the most suitable irrigation method ,increase the irrigation efficiency through the correct usage of irrigation method and evaluate the effect of irrigation methods on pests and illness in different varieties of potato such as Kozima ,Moren ,and Marfona ,executed a two years plan as completely random blocks with 4 repetitions using overhead and corrugation irrigation methods in Feridan region. Results showed that the overhead irrigation method, compared with the surface (corrugation) irrigation method, has a higher product performance and, in addition, more than 35 percent of the water consumption is saved. With this quantity of the saved water, a 50 percent increase in the under cultivation area with overhead irrigation would be attained having an important role in increasing the potato, wheat, and barely products(Akbari, 1977).

Madanchi et al evaluated the interaction of the water and fertilizer on potato in the water and soil sector of Hamadan province for 3 years. Results showed that although the effects of water quantities (80,100 ,120 percent of evaporation from the A-class pan) and the quantities of fertilizers (N120 P120, N180 P180 , and N240 P240 Kg of pure fertilizer per hectare) are not statistically significant ,irrigation quantities affect the product increase and the 120 percent evaporation from the A-class pan produces the maximum product; the performances are 80,100 ,and 120 percent of evaporation from the evaporation pan, respectively. The maximum product is related to the treatment of 120 percent evaporation from the A-class pan with N240 P240 and mean performance of 18/5 tons/ha consuming 9820 m^3/ha water. Concerning the water consumption economization ,chemical fertilizer ,and the output of the paid costs , the economically suggested treatment is N120 P120 and 100 percent evaporation from the A-class pan with the mean performance of 17/2 tons /ha. Water consumption of this treatment is 7960 m^3/ha (Madanchi et al, 1993).

Raeesi ,after studying the irrigation (corrugation) regimes ,suggested the 40 and 100 percent evaporation coefficients for the stages of greening to tuber formation and tuber formation to potato harvesting ,respectively (Raeesi ,1991).

Bahrani and Javan evaluated the overhead and corrugation methods on the chickpea and potato. Same water quantities were provided for both methods but, compared with the corrugation irrigation; performance of chickpea seed and the rate of straw were more in the overhead irrigation. Performance and size of the potato tubers in the overhead irrigation were significantly more, too (Bahrani and Javan, 1997).

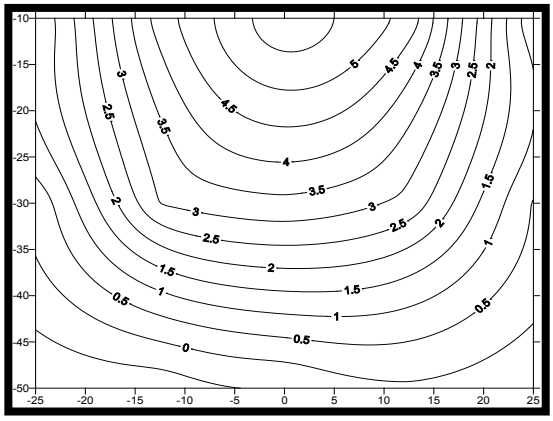
2. Material and Methods

This study was carried out in a 500m^2 land located in Kermanshah Razi university`s agriculture faculty. Soil texture was silty clay with 54 percent of clay and 42percent of silt. Salinity of the soil saturation extract was 1.2 ds/m and the PH of soil was 7.3.Salinity and PH of the irrigation water were 1 ds/m and 7.1, respectively. Potato`s variety of Agria was cultured as mono row with levee distance of 75cm and row length of 40 m ;drip irrigation tapes were located on the levee. Rate of evaporation from the A-class pan, during the potato growth period in April to September of 1389, was measured at the weather station of Kermanshah airport. Pan coefficient, according to the location and conditions of the environment around the evaporation pan, was determined to be 0.8. To measure the crop coefficient, a method introduced in FAO was used. In this method, plant`s growth period is divided into four stages. For the potato plant, in this region, the crop coefficient amounts at the primary, median, and final stage were 0, 5, 0.6, and 1.15, respectively.

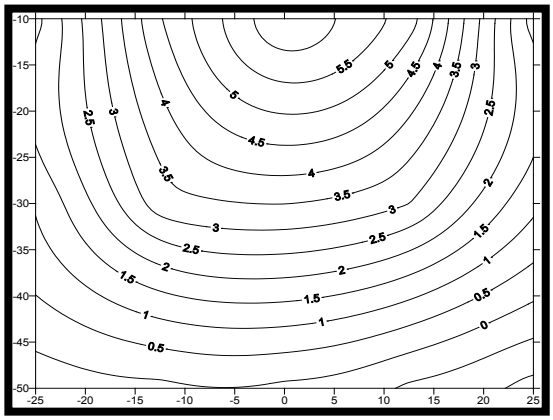
In this study, three water need treatments of 50, 75, and 100 percent, with three repetitions, were considered. To compare the product performance by the drip irrigation in the mentioned treatments, at the harvesting time, in each treatment with nine repetitions in two adjusted 4m rows, sampling and potato harvesting were carried out in each row. Irrigated water quantity was measured by the installed meters. Measuring the total irrigated water through volume meters installed on the path of manifold pipes in each treatment and the product performance, the water use efficiency was measured. To compare the hemispheric wetted volume in the drip irrigation strips system under the mentioned

treatments, weight sampling around the potato levees was carried out during 3 continuous irrigations. Under the mentioned treatments, surfer software was used to compare the hemispheric wetted volume and the manner of moisture distribution in each irrigation; its diagrams are illustrated in figure 1.

(A)



(B)



(C)

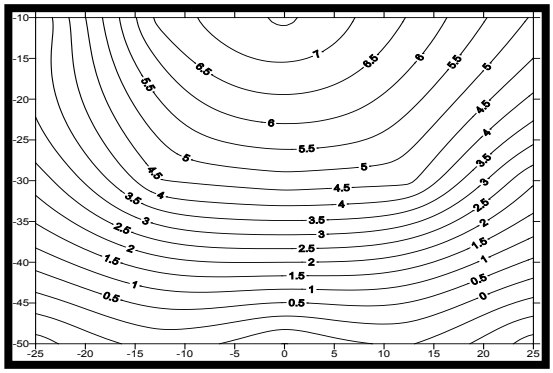


Figure 1. The diagram of hemispheric wetted volume in the first irrigation – A) 50 percent treatment, B) 75 percent treatment, and C) 100 percent treatment Evaluating the rate of product performance based on the potato tuber weight, the rates of potato production in the 100, 75, and 50 percent treatments of water need were 34.455, 25.938 and 19.168 tons/ha ,respectively. According to the irrigated water quantity and the potato product performance, water use efficiency in the used treatments was measured, which is illustrated in table 1.

Table 1. Measurement of water use efficiency at the end of the potato culture period

treatment	Average of performance per hectare (ton/ha)	Irrigated water quantity (m3/ha)	water use efficiency (kg/m3)
100	34.445	9749.62	3.53
75	25.938	7312.22	3.55
50	19.168	4874.81	3.93

3. Conclusions

Drawn moisture curves showed that gradient of humidity deficit variations in all three treatments were, at first, low and would be increased by increasing the depth. Also ,the rate of humidity deficit in all three treatments in the soil higher layers and in the region in which the main root condensation section is located is more than the deeper layers and are become smaller by increasing the depth of the moisture rate. Using SAS software, Duncan classification for the product performance was grouped in different classes.

Table 2. Comparison of the averages[1] of performance of water use efficiency

Water use efficiency (kg/m3)	Performance (tons/ha)	Experimental treatment
A 3.93	C 19.168	50 percent cumulative evaporation from the pan
A 3.55	B 25.938	75 percent cumulative evaporation from the pan
A 3/53	A 34.445	100 percent cumulative evaporation from the pan

4. Recommendation

- Placing tip tapes at different depths and evaluating their effect related to the water use efficiency and product performance.
- Evaluation of tip irrigation in different climates (dry and humid) and soils.
- Evaluation of tip irrigation for different potato varieties
- Economical evaluation of both tip and corrugation methods using more coefficients in the rate of irrigation
- Measuring the qualitative characteristics of potato in different irrigation regimes

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