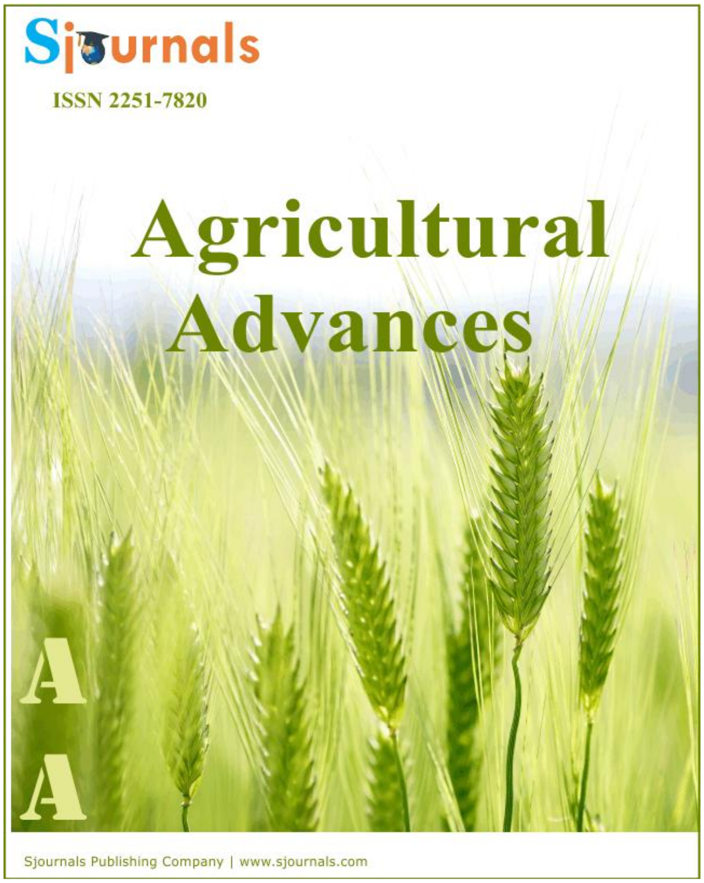
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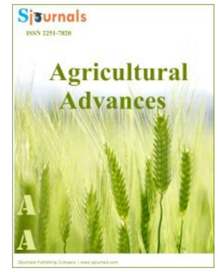

Original article

Effects of trickle irrigation system from southern Iran district Chabahar free zone

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This research was carried out on steep slope area planted with trees in different elevation terraces. The experiments were conducted at the experimental site at the Chabahar Free Zone. One major disadvantage of trickle systems is the tendency for emitters to clog. A trickle irrigation system was installed in a 50 m long and 20 m wide plot. The hydraulic performance of emitters was based on water flow, uniformity coefficient, application efficiency, and water losses through deep percolation. The flow volumes along the lateral length were fairly consistent and the variation was diminutive under both types suggesting uniform distribution of water. The difference in elevation between upper and lower terraces at the area of study was about 50 m irrigated by drip irrigation system. The system of irrigation has a problem in distribution uniformity of water resulted from initial filling of the pipes and drainage of water after stopping irrigation. Therefore, the lowest terrace receives the highest, while the upper terrace receives the lowest amount of water. The problem of a lateral pipe with equally emitters and uniform supply of water is investigated. The flow volumes along the lateral length were fairly consistent and the variation was diminutive under both types suggesting uniform distribution of water. The system achieved rationally high DU, CU, Ea. The CU values for randomly selected laterals with smooth emitters averaged to 81.7% and spiral emitters averaged to 87.4%. The DU values averaged to 75.4% for smooth and averaged to 81% for spiral emitters. The overall Ea achieved were 82.7% and 89.4% for smooth and spiral emitters, respectively. The higher values of CU, DU, and Ea with spiral emitters as compared to smooth emitters suggest that they performed better and could be preferred to achieve uniform water distribution. Water movement below the emission point was more pronounced in the vertical.

1. Introduction

This paper describes drip or trickle irrigation system applied in Chabahar Free Zone in the Makoran area. The area of the study is near the border of Iran and Pakistan, extending south to the Gulf of Oman. The climate of the region varies from subtropical arid and semi-arid to temperate sub-humid in the plains of Sistan & Balochistan. In any system development an objective must first be looked and explained at complete different angles. As the system develops, thus the research must be known that quality or cost-effectiveness of the trickle irrigation system for that site is a direct function of how well it meets the requirements, and fulfills its basics objective. The development of a typical irrigation in such arid area in Bahokalat (Sistan & Balochistan) drip irrigation system can be a fairly straight forward process (Mosh, 2006). Trickle irrigation is a localized irrigation method that slowly and frequently provides water directly to the plant root zone. Emitter clogging has often been recognized as inconvenient and one of the most important concerns for trickle irrigation systems, resulting in lowered system performance and water stress to the non-irrigated plants. Partial and total clogging of emitters is closely related to the quality of the irrigation water, and occurs as a result of multiple factors, including physical, biological and chemical agents (Ribeiro et al., 2008). Trickle irrigation is the precise, slow application of water as discrete drops, continuous drops, small streams, or miniature sprays through mechanical devices called emitters located close to the plants. Water analysis prior to system design, a preventive maintenance program and field evaluation of clogging and uniformity are strongly recommended. Proposed a classification scheme for water quality to indicate clogging potential. The evaluation has been carried out according to (Mosh, 2006) recommendations, which have been followed in later works of authors. Irrigation is the controlled application of water artificially to the soil for the purpose of supplying the moisture needs and requirements of the crops for production and optimum performance in the field or farm. Drip irrigation is the frequent, slow application of water either directly into the land surface or into the root zone of the crops, (Bralts et al., 1981), according to (Mosh, 2006), drip irrigation is a method of watering plants with a volume of water approaching the consumptive use (CU) of the plants or trees. Adequate water is vital not only for the survival of trees in Chabahar Free Zone (Sistan & Balochistan), but also the frequent intervals and application of water can boost both the quality and quantity of these trees. Drip irrigation has a higher capability for minimizing the loss of water by evaporation, runoff, and deep percolation in comparison to other irrigation systems that supply water to the soil (Alizadeh, 2006). This may include such parameters as soil conditions, topography, water quality, water quantity available in Sarbaz River where water is irrigated for that plants or trees for Bahowkalat farm in which drip irrigation is applied, although type of crop or landscaping to be planted, plant spacing and similar type parameters could be researched. In this regards for Chabahar free zone arid or semi-arid area system type requirements then take this site and project conditions and transpose them into irrigation system standard (Anyoji and Wu, 1998).

2. Materials and methods

Iran with an area of 165 million hectare of arable land of which only 8 million hectare are irrigated, 6 million hectare are rain-fed, and 4.5 million hectare remain in the form of fallow land. The climate of Iran is one the greatest extremes due to its geographic location and variation in topography. The summer is extremely hot in its central deserts and fall far below zero in the West Mountains. Annual rainfall ranges from less than 50 mm in the deserts to more than 1600 mm on the Caspian Plain. The average annual rainfall is 252 mm and approximately 90%

of the country is arid or semiarid. Taken as a whole, about two-thirds of the country annually receives less than 250 mm of rainfall.

This experiment was carried out at Chabahar Free Zone research center, in Makoran Chabahar, Iran. Tests were carried out in the experimental area of the Chabahar Free Zone. The irrigation system was evaluated in a subunit with trickle irrigation system, comprising 10 lateral lines, 50 m long, 3 m apart from each other, set in a hilly area. The lateral irrigation lines were of polyethylene pipes of high density, (16 mm diameter), with a screen filter at the beginning (Ella et al., 2012). Trickle irrigation is the precise, slow application of water as discrete drops, continuous drops, small streams, or miniature sprays through mechanical devices called emitters located close to the plants. The water supply was taken from a tube well and firstly supplied into the big pound, then pumped by the tube well into the lateral line. Also the emitter's flow of a trickle irrigation system is mainly affected by hydraulic dimensions, manufacturing variations, temperature and clogging of emitter. Furthermore, in this procedure if emitter's flow is turbulent, it is less affected by temperature and, if the water taken into the system can be controlled by filters, which are essential for trickle irrigation systems, the emitter's variation will be only affected by pressure and manufacturing variations.

Individual emitters are considered in discharge and pressure estimations along the lateral and also the friction head loss between successive emitters. An important aim and objective of any trickle or drip irrigation system is a uniform distribution of water delivered through the emitters however, there would be an accurate filtering in this pipe network system. Computational of flow distribution requires knowledge of the variables such as pressure, flow rate, length of lateral, characteristics of the orifice, and frictional loss or emitters clogging. Trickle irrigation has become a well–established method for irrigation high value crops and trees in Chabahar Free Zone (Sistan and Balochistan) province where water resources are scarce and expensive.

3. System consideration

During the first phase of the methodology was applied in the site the research could be analysis, the sensitive design for that area with tropical climate would be considered not only the performance and ability of the components selected, but many other parameters that influence the operation of a system. For example, the operation system will be forced by the availability of the product stated, at the time of settled in the Chabahar free zone Drip irrigation site, though experience and capability of the personnel available for its settlement and operation (Mosh, 2006). Increasingly, many other effects considered that come into play in determining the ultimate effectiveness of an irrigation system such as emitter clogging and physical suspended solids and chemical problem like Power hydrogen (pH) factors of water, hydrogen sulfide, dissolved solids, organic matter, temperature, bacterial growth and slime development can be influenced (Ella et al., 2012). Emitter clogging greatly reduces the water distribution uniformity in irrigated fields (Ribeiro et al., 2008), which negatively influences crop growth and yield. Evaluated local trickle irrigation units and calculated average emission uniformity, average absolute emission uniformity, and system emission uniformity. According to the criteria proposed by (Michael, 2011) there should be an accurate filter in this system to reduce sedimentation from network (Michael, 2011).

Maintenance and operation of this farm continued many years, but due to miss management in this system was not play positive role in this farm thus, drip irrigation was failed in the Chabahar Free Zone farm. Because it is not only properly handle but also not suitably designed. Therefore, an increase in the initial acquisition cost is easily justified if it can be demonstrated at the Chabahar Free Zone farm that this will represent an annual savings throughout in this agricultural farm the life of a system. Of course, research create project for under initial cost. In this case it is hard to convince the client that “life-cycle” cost is a significant parameter (Elmaloglou and Diamantopoulos, 2011). Furthermore, in sandy soils like Chabahar Free zone drip irrigation system, reduce the spacing between drip lines from 18'' inches to 12'' inches or less. Irrigation water will tend to go down through sandy soil rather than spreading out by capillary action. Therefore, in this case should keep drip irrigation session about 45 minutes long but water more frequently. Thus, commercial growers often bury drip line to avoid damage from machinery but I could recommend keeping drip line on the surface to avoid any possibility of muddy water flowing back into the drip line during shut down the drip irrigation in Chabahar Free Zone site (Bralts et al., 1981).

4. Effectiveness of drip irrigation

A drip irrigation system can be composed of filters and strainers, valves, pressure regulators, chemical injectors, emitters, hose or tubing, pipe and proper fittings to do then it could be properly managed and organized. Furthermore, the importance of this Agricultural site with this system is obviously no better than the function of its individual parts can be available in that farm. This, in turn, is a function of both the products selected and the hydraulic design of the system. Generally the measure of importance of a system is a function of how well it performs with in this farms its handle and operational scenario. From the investigation of water pumped into this system, therefore, the pumping unit was not appropriate, because the pump was applied in to this site was carried many sand and silt. That means the size and type of pump applied were not appropriate for these agricultural sites. Because it brought sand and silt into the system and clogging occur to emitters and due to this reason less water supply for trees then growth of trees were low (Bralts et al., 1981). Increasingly, in the Chabahar free zone Horticultural park PH of water is 7.4 to 7.8 which are originated from city water supply. Perhaps, the diameter of lateral pipes was not appropriate for that trees like mangoes and Chekov because these trees needs more water naturally and also due to tropical climate. However, due to less water applied to these trees the growth was failed for these trees sharply (Kim et al., 2009).

5. Data analysis of flow meter performance

The performance of a flow meter is defined by its characteristic (calibration) analysis curve. This curve relates flow meter response to volume of flow and volumetric flow rate. Figure 1 shows the site of drip irrigation in Chabahar free zone. Test to find flow meter response over a range of expected flows are normally used to define the characteristic curve of a flow meter. Typical non-linear characteristic curve is shown in figure 2, figure, 2 to 5. For most nonlinear flow-meter, flow is proportional to the square root of flow meter response and the shape of the characteristic curve is similar to curve of figure 3. Indicated flow is that given by the flow meter or calculated from its readings while true flow is found by a high accuracy measured device used in the calibration test. Plots of such parameter as the coefficient of discharge, meter correction term, meter factor, and K-factor against flow or quantities such as the Reynolds number, however, describe deviations from true flow indicates such a plot in figure 4. Therefore, Individual emitter flow for each tree of fertility soil with manifold characteristic to refer with figure 7, 8 and 9 with average irrigated water into root zone of different trees with equal space of that emitter. Considering emitters flow for each terrace amount of water flow is different for each trees according to figure 8 and 9. It could be grateful if we have emitter with adjustable and appropriate quality of emitter, thus towards amount of flow is less than need of tree because need of each tree at least 45 liter per day per week with refer according to figure 9.

Individual emitters are considered in discharge and pressure estimations along the lateral and also the friction head loss between successive emitters. An important aim and objective of any trickle or drip irrigation system is a uniform distribution of water delivered through the emitters however, there would be an accurate filtering in this pipe network system. Computational of flow distribution requires knowledge of the variables such as pressure, flow rate, length of lateral, characteristics of the orifice, and frictional loss or emitters clogging. Trickle irrigation has become a well–established method for irrigation high value crops and trees in Chabahar Free Zone (Sistan & Balochistan) province where water resources are scarce and expensive.

Fig. 1. Study area of Chabahar free zone trickle irrigation site.

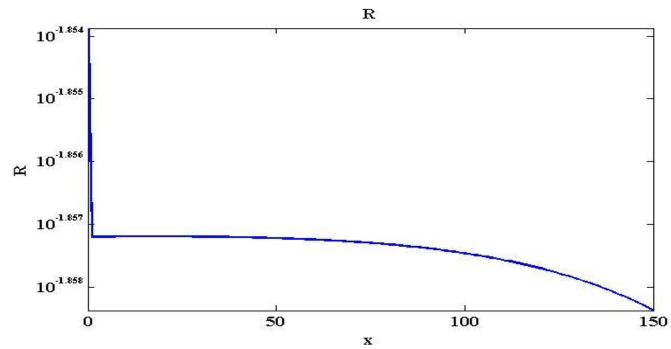

Fig. 2. Relationship between length of pipe and Reynolds number in pipe (diameter of lateral 16mm).

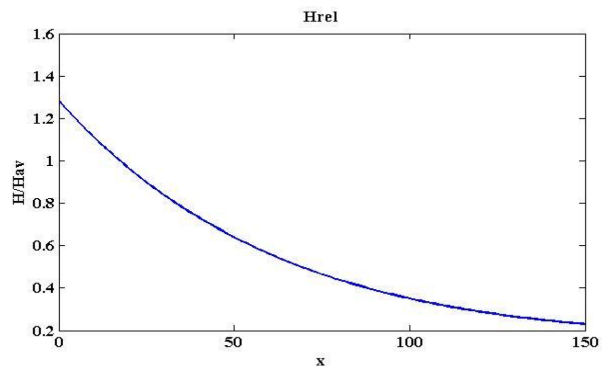

Fig. 3. Relationship between emitter number and pressure head at emitter (diameter of lateral 16mm).

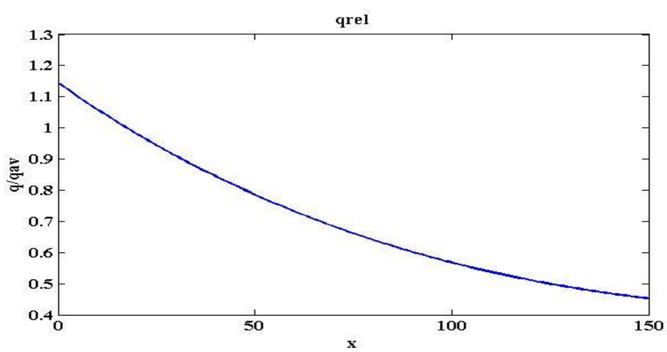

Fig. 4. Relationship between emitter number and flow out of emitter.

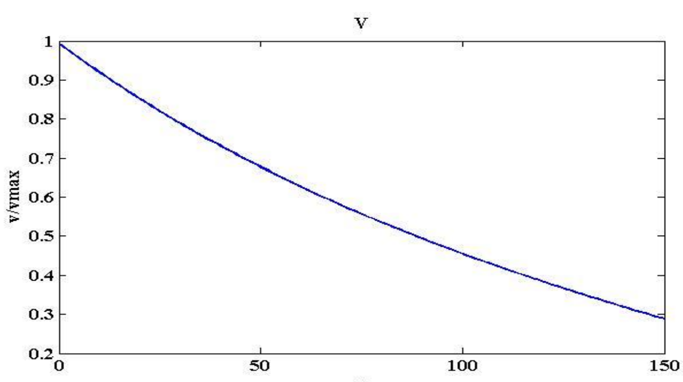

Fig. 5. Relationship between length of pipe and velocity in pipe (diameter of lateral 16 mm).

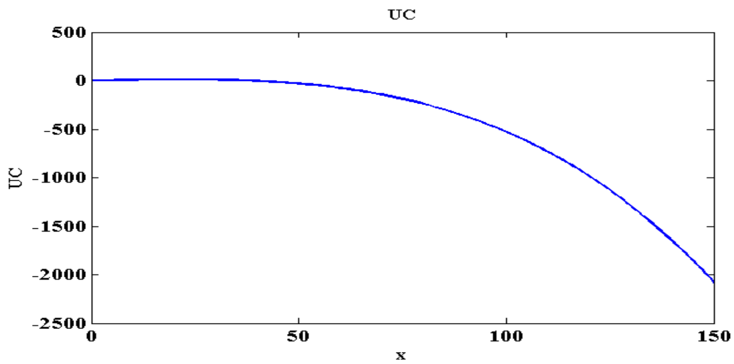

Fig. 6. Relationship between length of pipe and uniformity coefficient.

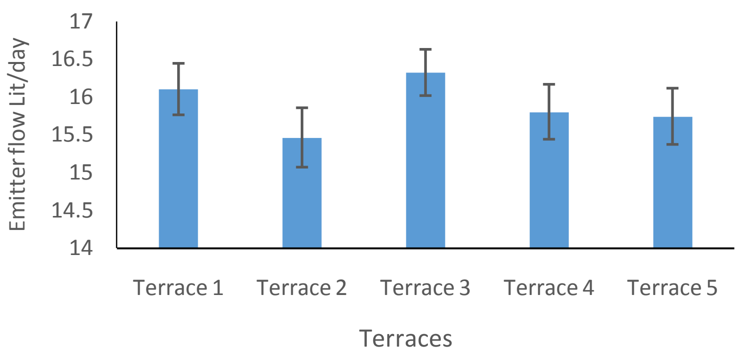

Fig. 7. The amount of water for each emitter in existing design of lower slope trees.

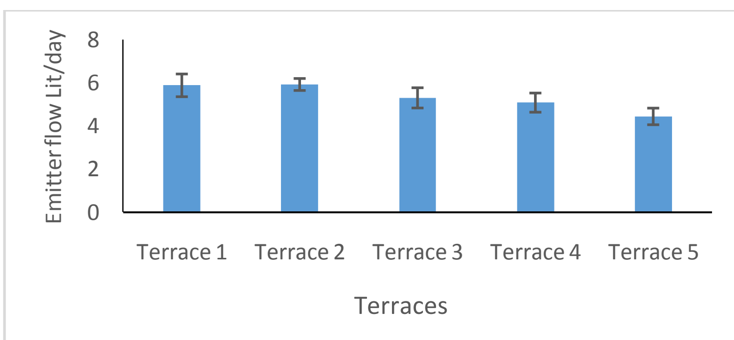

Fig. 8. The amount of water for each emitter in existing design of Upper slope trees.

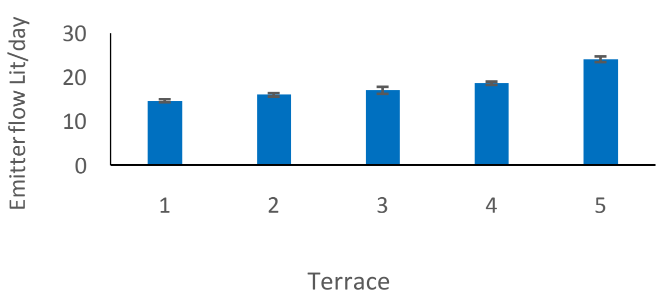

Fig. 9. The amount of water for each emitter in all Terraces of suggested design in the Lipar Park of Chabahar free zone.

6. Emitter clogging

Emitter clogging in the Chabahar Free Zone area is a major problem involved with the trickle irrigation operation system. However, information is available on the causal factors; control measures are not always successful. Once, a trickle irrigation system is expensive, it must be maximized to assure a favorable cost-benefit ratio. In this way so if emitters plugged in Kahirbord agricultural farm site then a short time after their installation, reclamation procedures to correct plugging increase maintenance costs and unfortunately may not be permanent. Therefore, clogging cause to a less efficient drip or trickle irrigation method for Chabahar Free Zone regions (Mosh, 2006).

Increasingly, emitter clogging is directly related to the quality of the irrigation water, i.e., suspended load, chemical composition, and microbial activity. Thus, these factors consequently follow the type of water treatment necessary for controlling clogging. Sometimes solution for clogging is not always available (Yavuz et al., 2010). Regarding of water sources for Chabahar free zone site, trickle systems require some type of filtration to remove the bulk of suspended materials. Furthermore, it is not practical to remove all the suspended particles. Importantly, calcium or magnesium carbonate can precipitate in filters, pipe lines, or emitters when source water has PH values above 7.5 and a high degree of hardness. Though water is applied in this area of Chabahar free zone site. Sometimes it has a PH above 7.5 and then it could be one factor for clogging of their sites for drip irrigation (Bralts et al., 1981).

7. Physical aspects (suspended solids)

In the site of Chabahar Free Zone it shall be physical clogging happen by factors such as suspended inorganic particles (sand, silt, clay or plastic), organic materials (plant fragments, animal residues, fish, snails, etc.), and microbiological debris (algae, diatoms, larva). It could be possibility organic materials and though by research confirmed there was sand and silt may carry into the irrigation water supply from Sarbaz River water by open water canals or pumped from wells. Sand and silt introduced in the lateral lines during installation can cause problems unless they are flushed out before the emitters are placed on the line, that is confirmed from management and organizers this action did not to take for this Chabahar free zone site. Therefore, it is cause problematic to drip irrigation system which is applied and although that was failed due to these reasons (Ella et al., 2012).

8. Results and discussion

Three factors can affect the flow variation of emitters in the drip irrigation system of steep slope land, such as: initial filling of pipe, drainage water from the pipe after stopping irrigation and pressure variation. Initial filling and drainage of water from the pipe after stopping irrigation can affect the flow variation significantly because the last lateral has the first water filling and the last one of drainage while the first line has the last filling and the first one of water drainage (Bralts et al., 1981). Drip irrigation systems, as cutting edge technology in irrigation methods have many advantages but it is associated with some problems and obstacles *i.e*. low water pressure at the end of lateral lines and salt accumulation. The trickle irrigation seems to have a better future in the area with water scarcity. Since water is applied directly to individual plants instead of irrigating the entire area, thus saves water which is otherwise lost by the use of traditional surface irrigation methods. The method is more suitable for production of orchards and high value vegetables. Results of this and previous studies suggest that over 50-75% water could be saved. Water can be provided to a plant with low pressure and at a high frequency. Closed-circuits were proposed as incorporating modification to the traditional drip irrigation system. The aims of the work were to study the effect of drip irrigation circuits (DIC) used: 1) Closed irrigation circuit with one manifold for lateral lines (CM1DIS); 2) Closed irrigation circuit with two manifolds for lateral lines (CM2DIS), 3) and Closed irrigation circuit with one manifold for lateral lines (CM1DIS), 4) and closed irrigation circuit with two manifold for lateral lines (CM2DIS), 5) as well. Traditional drip irrigation system (TDIS) as a control and lateral lines lengths (LLL): (LLL1 = 50 m, LLL2 = 50 m, LLL3 = 60 m, LLL 4 = 70 m, LLL5 = 80 m) on: flow velocity and velocity head (Mosh, 2006).

Table 1 and Figure 6 indicated the effect of DIC and LLL on FV. The reader can deduce that the change in FV took the same trend of PH, whereas, it was opposite to that of friction loss. The explanation for this could be due to the effect of both DIC on both PH and friction loss. Also, increasing LLL increased its discharge and de- creased the amount of water flowing along the lateral lines while, their cross section areas are constant are other reasons (Ribeiro et al., 2008; Yavuz et al., 2010). Another addition of the proposed automation system is to install the digital cameras to monitor the plant growth and overall condition of the field. In addition, the developed irrigation method partly removes the excess workload of the farmers. To identify the suitable pump with facility for maintaining certain recommended pressure in the water pipe. To identify proper sensors and monitoring device required for the farming data like soil moisture, soil temperature, soil fertilizer & chemical constituents (Kim et al., 2009; Mosh, 2006).

Search of appropriate sensors with specifications and coordinating wireless system for acquisition of various data. To process the data based on the limits set and there by controlling the whole irrigation management. To find the economic method of drip irrigation and its technique for automation regarding short term and long term crop (Kim et al., 2009; Mosh, 2006). The physical, chemical and biological properties of water in the experimental areas were compared with the water quality criteria for emitter clogging proposed by (Ribeiro et al., 2008). According to (Ribeiro et al., 2008; Yavuz et al., 2010) the tested irrigation waters, based on properties (PH, TDS, TSS, Fe, Mn) can be classified, in general, as minor hazardous to severe hazardous in some cases. According to (Ribeiro et al., 2008), the hazard rating is, in general, from minor to moderate for EC except Ghom that was severe, minor for TSS, from minor to moderate for Ca except Ghom that was severe, from minor to severe for Mg, minor for Fe and Mn. The bicarbonate values for Izeh, Damghan, Sari, Ghom, Nahavand, and Talesh was high. Bicarbonate concentrations of more than 5 meq/l, or 305 mg/l, caused serious problems due to precipitates in the irrigation system. In Talesh, large formations of biological biofilm were observed as well as the occurrence of the same formation in the micro jet orifice (Ribeiro et al., 2008; Yavuz et al., 2010). The amounts of water (liters per irrigation) for all emitters in all terraces in the existing design are indicated in Table 1.

Table 1
The amount of water for each emitter in all terraces of the existing design (liters per irrigation).

Terrace	Emitter 1	Emitter 2	Emitter 3	Emitter 4	Emitter 5	Total	Mean
1	14.2	14.5	15.0	14.8	15.0	73.5	14.7
2	15.5	15.8	16.2	16.2	16.5	80.2	16.04
3	17.2	16.5	16.0	17.5	18.0	85.2	17.04
4	18.5	18.5	19.2	18.8	18.2	93.2	18.64
5	23.5	23.5	24.0	24.5	25.0	120.5	24.1

9. Conclusion

Results of the study revealed that the trickle irrigation achieved high uniformity coefficient and distribution uniformity. The *CU* of randomly selected laterals with smooth emitters ranged between 79.1 and 84.4% with an average value of 81.7%. However, it ranged between 85.9 and 89% with average value of 87.4% with spiral emitters. Similarly, the distribution uniformity ranged between 71.2 and 81.2% and averaged to 75.4% for the smooth emitters, while it ranged between 76.9 and 85% and averaged to 81% for the spiral emitters. The system achieved an overall field application efficiency of 82.7% with smooth emitters compared to 89.4% with spiral emitters. Further, the spiral emitters showed higher uniformity coefficient, and application efficiency as compared to smooth ones hence could be preferred with a great degree of confidence to achieve uniform water distribution.

Flow variation of drip irrigation system of steep slope land required a rational distribution of lateral on the manifold and careful selection of suitable length of both laterals and manifold to eliminate the problems of the initial filling, drainage of water from the pipe and reduce the pressure variation that resulted from the difference in elevation to ensure the uniformity of emitters distribution. Though the main problems associated with drip or trickle irrigation system in the Chabahar Free Zone sites was poor distribution drip system. Because that begun slowly water supply reduction to that trees. Therefore, there was no enough or lengthy loop for lateral pipe when water should be applied for that trees when they are bigger and bigger it means for many years where trees grown up and it needs more water. Results of the study revealed that the trickle irrigation achieved high uniformity coefficient and distribution uniformity, although there could be an accurate filtering to eliminate and solve sedimentation problems from this entire drip irrigation system.

Increasingly, during water supply there was sand and silt mixture with water and biological problems to this system where also cause emitters clogging occurred or less water supplied to the system. From the studies it was seen that the different chemicals are useful only to improve the relative discharge rates. Prevention is the best solution to reduce clogging of emitters. Filtration of water is absolutely essential in this pipe network. Periodical flushing of laterals line helps to minimize sediment build up in the lines. Actually water-use efficiency, which is defined as crop yield per unit volume of water applied in the trickle system excellent result in distribution and a very good system, but when it applied with best management. Therefore, trickle irrigation is a convenient and efficient means of supplying water. Of course, several problems arise in this system when it is applied due to miss management and lack of poor organizing.

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References

Aali, K.A., Liaghat, A., Dehghanisanij, H., 2009. The effect of acidification and magnetic field on emitter clogging under saline water application. J. Agr. Sci., 1(1), 132−141.

Alizadeh, A., 2006. Principles and practices of trickle irrigation. Ferdowsi University, Mashhad, Iran. Ph.D dissertation of drip irrigation. 120.

Anyoji, H., Wu, I.P., 1998. Normal distribution water application for drip irrigation schedules. Transaction of the ASAE. 37, 159-164.

ASAE Standards. EP405.1 FEB03., 2005. Design and installation of micro-irrigation systems. ASAE, St. Joseph, Mich.

Bralts, V.F., Wu, I.P., Gitlin, H.M., 1981. Manufacturing variation and drip irrigation uniformity. Transaction of the ASAE. 24, 113-119.

Ella, V.B., Reyesand, M.R., Yoder, R., 2012. Effect of hydraulic head and slope on water distribution uniformity of a low-cost drip irrigation system. App. Eng. Agr., 25(3), 349-356.

Elmaloglou, S., Diamantopoulos, E., 2011. Soil water dynamics under surface trickle irrigation as affected by soil hydraulic properties, discharge rate, dripper spacing and irrigation duration. Irrigation and Drainage. Articles online in advance of printing. DOI: 10.1002/ird.

James, L.G., 2006. Principles of farm irrigation system design, 1st Edition, John Wiley and Sons Inc. New York. Malheur experiment station, introduction to drip irrigation systems, Oregun State University. 1997-2006; www.cropinfo.net/drip.ntm.

Kim, Y., Evans, R.G., Iversen, W.M., 2008. Remote sensing and control of an irrigation system using a distributed wireless sensor network. IEEE Trans. Instrum. Meas., 57(7), 1379-1387.

Kim, Y., Evans, R.G., Iversen, W.M., 2009. Evaluation of closed-loop site-specific irrigation with wireless sensor network. J. Irrig. Drain. Eng., 135(1), 25-31.

Michael, A.M., 2011. Irrigation theory and practice, 3rd Edition, Vikas Publishing House, PVT Limited New Delhi Nnaji, O.A., Njoku, J.D., C Iwujl, M., Spatial analysis of soil fertility using geographical information system technology. Afr. Res. Rev., 1998-2011.

Mosh, S., 2006. Guidelines for planning and design of micro irrigation in arid and semi arid regions. Int. Comm. Irrig. Drain.

Ribeiro, T.A.P., Paterniani, J.E.S., Coletti, C., 2008. Chemical treatment to unclogging dripper irrigation system due to biological problems. Sci. Agr., 65(1), 1−9.

Yavuz, M.Y., Demirel, K., Erken, O., Bahar, E., Deveciler, M., 2010. Emitter clogging and effects on drip irrigation system performances. Afr. J. Agr. Res., 5(7), 532−538.

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