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POSSIBILITY OF PLANTING COTTON USING SUBSURFACE IRRIGATION AND DRIP IRRIGATION SYSTEMS AND IRRIGATION PERIODS

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Abstract

The experiment was conducted to evaluate the possibility of planting cotton using subsurface irrigation and drip irrigation systems and different irrigation durations at the experimental fields of the College of Agricultural Engineering Sciences, University of Baghdad during the agricultural seasons of 2019. Two Irrigation systems included, subsurface irrigation and drip irrigation system and two irrigation durations included first duration (two days) and second duration (four days) were used in this study. Branches number per plant, plant height, total bolls number per plant, weight of bolls, and lint cotton yield were studied in this research. Split plot design under randomized complete block design with three replications was used in this experiment. Least significant differences at probability of 0.05 ($LSD_{=0.05}$) was used to compare the mean of treatments. The experiment results were showed the following: (1) Subsurface irrigation system was superior in getting plant branch stood 6.50 branch.plant^{-1}, plant height stood 104.00 cm, bolls number stood 70.67 boll.plant^{-1}, bolls weight stood 29.83 gm.boll^{-1}, and lint cotton yield stood 2150 kg.ha^{-1} on drip irrigation. (2) First irrigation period (2 days) was superior in getting plant height stood 102.00 cm, bolls number stood 60.33 boll.plant^{-1}, and cotton yield stood 2145 kg.ha^{-1} on the second period (4 days). (3) The interaction between subsurface irrigation system and first irrigation period increased significantly all the properties which were studied in this research compared with other interaction treatments.

Keywords: Subsurface Irrigation, Drip Irrigation, irrigation periods, Cotton boll weight, plant height.

Introduction

Surface and subsurface drip irrigation systems is considered among the most efficient systems of up to 96%, the most economical in terms of the water supply that may reach 35% to 55% of the added water furthermore the least irrigation water losing, hence the most prevalent recently in comparison to traditional irrigation systems such as surface irrigation system, and traditional spray irrigation system. They are wetting the root growth zone only, (Jasim and Alroahdi, 2015).

Many researchers have demonstrated the superiority of the subsurface dripping irrigation system in comparison with the dripping irrigation system in terms of the most soil physical traits, moreover the growth and production of many crops (Bader *et al*., 2010; Patel and Rajput, 2009; Elhindi, 2012; Asenso, 2011; Obaidi, 2001). The limitation of wetted surface area around the crop reduces weeds growth that are competitive for plants. The cause of the spreading of drip irrigation system in arid and semi-arid regions is the high cost of access to water, and the scarcity of available water, nevertheless it is my not be befitted for all types of crops, (Jasim and Abdullah, 2017 and Akram, 2008; FAO, 2007; Chippy *et al*., 2002).

One of the most important issues facing water scarcity is good management in controlling the amount of water given in each irrigation, reducing the number of irrigation (scheduling of irrigation) and reducing the duration of irrigation as well as the use of modern irrigation systems and less water losses. (Jasim and Ibraheem, 2018; Al-Shahrabali, 2009; Jasim and Sahar, 2018).

Cotton is one of the most important crops of fiber and seeds, its fibers constitute one third of the crop, it's used in the manufacture of cotton textiles. While the seeds constitute two-thirds of the cotton crop, the importance of the seeds lies in its many uses as it is involved in the manufacture of vegetable oils with percentage of 18-26% and soap industry. The residue resulting from the extraction of oil from seeds is used in the diets of animals because it contains a high percentage of protein, (Shaker, 1999; Jasim *et al*., a2008; Ali and others, 2009; Jasim and Ali, 2011).

The study aims to find out the possibility of planting cotton (Lashata class), using subsurface irrigation and drip irrigation systems along with different irrigation durations.

Materials and Method

The experiment was carried out on the fields of the College of Agricultural Engineering Sciences - University of Baghdad, for the agricultural season of 2019, in a silt clay loam soil to study the possibility of planting cotton crop class Lashata using irrigation systems along with different irrigation durations. Two irrigation systems included surface and subsurface drip irrigation and tow irrigation durations included first irrigation duration (2 days) and the second irrigation duration (4 days) were used in this experiment. Branches number per plant, plant height, total bolls number per plant, weight of bolls, and yield of cotton lint were measured in this research.

Split-plot design under complete randomized block design was used. The results were analyzed statistically and the treatment means differences were tested by using the least significant differences (LSD) at a probability of 0.05.

The land was plowed using a moldboard plow to a depth of 20-25 cm afterwards soil was leveled and divided into main blocks of dimensions of (6*3)m, leaving 1.5 m separation between the blocks and 2 m between the blocks for the purpose of preventing the impact among treatments , hence surface and subsurface drip irrigation systems were installed.

Treatments were fertilized with chemical fertilizers (urea at a rate of 0.4 tones. ha^{-1} by three times) after the process of dilution, the beginning of the formation of the flower bud and when flowering) supper triple phosphate 0.06 tons. ha^{-1} was added before planting. Soil samples were taken prior to planting to determine some chemical and soil physical properties (Table, 1). Seeds were planted on April, 2/2019. 3-4 seeds were put in each pit, and decreased into one plant after two weeks of germination. Each experimental unit included 3 lines, the distance between line and another was 75 cm and the distance between pit and another was 25 cm. The number of Plants per hectare was 55555 plants. Confidor was used to control cotton boll's worm. The first harvesting was in September and the second harvesting was a month after the first one**.**

Studied properties

1. **Number of branches:** branch.$plant^{-1}$ was calculated by taking the average number of branches of ten plants from the mid lines.
2. **Plant height, cm :** was calculated by taking the average height of ten plants from the mid lines.
3. **Total bolls per plant:** was calculated by taking the average of 10 plants from the mid lines**.**
4. **Cotton boll weight:** the weight of the boll in grams was calculated from summing the intact and blooming bolls, of ten plants, taken randomly from the middle lines and divided by the number of bolls.
5. **Yield of cotton lint :** Total sum of cotton lint yields by taking the sum of mid lines with the exclusions of peripheral plants from each experimental unit calculated in grams per block, then transforming it into $kg.ha^{-1}$.

Data were analyzed statistically by means of variance and averages were compared using the least significant difference test (LSD) at probability of 0.05 (Steel and Torrie, 1980).

Table 1 : Some Physical and Chemical traits of the Studied Soil

Indicators		Scale
Soil Texture		Silt clay loam
sand	g.kg^{-1}	90
silt		580
Clay		330
Electrical conductivity (dS.m^{-1})		3,50
PH		7.73
Carbonate minerals	g.kg^{-1}	240.000
gypsum		Nill
Organic material		11.21
Total nitrogen		**0.65**

Results and Discussion

Number of Branches per plant, (Branch.$Plant^{-1}$)

The results in Table (2**)** showed that the subsurface irrigation system was significantly exceeded the drip irrigation system in the average number of branches which got 6.50 branch. $Plant^{-1}$, while drip irrigation system got 4.67 branch.$Plant^{-1}$. That's may be due to the increasing of soil water storage in the root zone, because of decreasing soil evaporation, (Jasim *et al*., 2008 and Ali *et al*., 2009).

The duration of the first irrigation (2 days) physically was better in comparison with the duration of the second irrigation (4 days) in the average number of branches **,** whereas the first irrigation duration recorded 5.83 a branch.$Plat^{-1}$ while the second irrigation duration got 5.33 branches.$plant^{-1}$**.**

The interaction between subsurface irrigation and the first duration is superior in getting higher branch per plant stood 7.33 branch.$plan^{-1}$ comparing with the rest of the interactions.

Table 2 : Effect of irrigation systems and irrigation durations on the average number of branches per plant (branch .$plant^{-1}$)

Irrigation Systems	Irrigation Duration		Irrigation Systems Average
	Two Days	Four Days	
Subsurface Irrigation	7.33	5.67	6.50
Drip Irrigation	4.33	5.00	4.67
LSD= 0.05	0.814		0.717
Irrigation Duration Average	5.33	5.83	
LSD= 0.05	NS		

Plant height, (cm)

The results in Table (3) showed that subsurface irrigation system was significantly better than drip irrigation system in the average height of plants, whereby the subsurface irrigation recorded 104.00 cm while the drip irrigation recorded 98.73 cm. That's may be due to the retention of soil moisture content at the root zone that provided a permanent condition of water availability, (Jasim *et al*., 2008_b and Ali *et al*., 2009).

The duration of the first irrigation (2 days) significantly was better than the duration of the second irrigation (4 days) in the average height of the plant **,** whereas the first irrigation duration recorded 102.00 cm while the second irrigation duration recorded 100.72 cm. That's may also be due to the fact of the retention of soil moisture content at the root zone that in turn provided a permanent condition of water availability, and no wastes have been happened as a result of evaporation and deep percolation . These findings are in consistent with the results which got by Jasim *et al*. (2008_a) and Ali *et al*. (2009).

The interaction between the subsurface irrigation system and the first irrigation duration is superior in getting higher pant height recorded 104.33 cm, compared with the rest of the interactions.

Table 3 : Effect of irrigation systems and irrigation durations on the average plant height, cm. $plant^{-1}$

Irrigation Systems	Irrigation Duration		Irrigation Systems Average
	Two Days	Four Days	
Subsurface Irrigation	104.33	103.66	104.00
Drip Irrigation	99.67	97.78	98.73
LSD= 0.05	1.330		1.434
Irrigation Duration Average	102.00	100.72	
LSD= 0.05	0.98		

Number of cotton bolls, boll.plant^{-1}

The results in Table (4) showed that the subsurface irrigation system was significantly better than the drip irrigation system in the average number of cotton boll per plant, whereby the subsurface irrigation system recorded 70.67 boll · Plant $^{-1}$ while drip irrigation system recorded 45.50 boll.plant^{-1}. This may be due to the increase in the number of branches per the plant as well as the height of the plant. These results are in consistent with the results which got by Jasim *et al*. (2008$_a$) and Jasim and Ali, (2011).

Also the first irrigation duration (2 days) significantly outperformed in comparison with the duration of the second irrigation (4 days) in the average number of boll per plant. The first irrigation duration got higher boll per plant stood 60.33 boll .plant $^{-1}$, while the second irrigation duration recorded 55.83 boll.plant^{-1}. This was also due to the retention of the root area of the soil moisture content, and permanent availability as a result of continuous irrigation in a short period of time hence led to increase in the number of branches of the plant as furthermore plant height. These results are consistent with the results which obtained by Jasim *et al*. (2008b) and Jasim and Ali (2011).

The interaction between the subsurface irrigation system and the first irrigation duration superior in getting higher boll per plant stood 79.67 boll.plant^{-1} than the rest of the interactions.

Table 4 : Effect of irrigation systems and irrigation durations on the average number of boll. Plant^{-1}

Irrigation Systems	Irrigation Duration		Irrigation Systems Average
	Two Days	Four Days	
Subsurface Irrigation	79.67	61.67	70.67
Drip Irrigation	41.00	50.00	45.50
LSD= 0.05	1.302		1.795
Irrigation Duration Average	60.33	55.83	
LSD= 0.05	2.776		

Cotton Boll Weight, (gm. plant $^{-1}$)

The results illustrated in Table (5) showed the superiority of subsurface irrigation treatment in getting cotton boll weight stood 29.83 gm. Plant^{-1} while drip irrigation system recorded 28.00 gm. Plant^{-1}, it may be due to increasing soil moisture content at the root zone because reducing evaporation in addition to plant height. These results are in consistent with the results which got by Ali *et al*. (2009) and Jasim and Ali, (2011). The results also showed that there is no significant differences between the first irrigation duration (2 days) and the second irrigation duration (4 days) on the average of cotton boll weight per plant.

The interaction between subsurface irrigation system and the first irrigation duration recorded the highest cotton boll weight stood 30.00 gm .Plant $^{-1}$ comparing with the other interactions.

Table 5 : Effect of irrigation systems and irrigation durations on cotton boll weight, gm. plant $^{-1}$

Irrigation Systems	Irrigation Duration		Irrigation Systems Average
	Two Days	Four Days	
Subsurface Irrigation	30.00	29.67	29.83
Drip Irrigation	26.00	28.10	27.05
LSD= 0.05	1.126		0.901
Irrigation Duration Average	29.83	28.89	
LSD= 0.05	NS		

Lint Cotton Yield, (kg.ha^{-1}).

Table (6) showed that subsurface irrigation system performed significantly better than the drip irrigation system on lint cotton yield . Subsurface irrigation system recorded 2150 kg. ha $^{-1}$ while drip irrigation system recorded 2098 kg. ha $^{-1}$ .The reason for that is due to retention soil moisture content at the root zone, plant height, number of branches per plant and the number of cotton bolls per plant. These results are in consistent with the results that obtained by Jasim *et al*. (2008a) and Jasim and Ali (2011).

The table also showed the superiority of first irrigation duration (2 days) in getting higher lint cotton yield stood 2145kg. ha^{-1} on the second irrigation duration (4 days) which got 2103 kg ha^{-1} This is may also be due to the retention of soil moisture content at the root zone, plant height, number of branches per plant in addition to the number of cotton bolls per plant. These results are consistent with the results which obtained by Jasim *et al*., (2008$_b$).

The superiority of overlap between subsurface irrigation system and first irrigation duration which got 2161 kg. ha $^{-1}$. on the rest of the interactions.

Table 6 : Effect of irrigation systems and irrigation durations on the average lint cotton yield (kg. h $^{-1}$)

Irrigation Systems	Irrigation Duration		Irrigation Systems Average
	Two Days	Four Days	
Subsurface Irrigation	2139	2161	2150
Drip Irrigation	2067	2128	2098
	55.32		34.01
Irrigation Duration Average	2103	2145	
	29.90		

Through the above results we conclude:

1. The possibility of cultivation of cotton crop using surface irrigation and drip irrigation systems and different irrigation durations.
2. Subsurface irrigation system is superiority in getting higher number of branches per plant, higher height of the plant**,** higher total number of bolls in each plant**,** higher weight of one boll and higher yield cotton lint on drip irrigation system.
3. The first irrigation duration (2 days) is superiority in getting higher plant height and higher total number of bolls in each plant and higher cotton lint yield on second irrigation duration.
4. The interaction between subsurface irrigation system and first irrigation duration (2 days) resulted in a significant increase in most studied properties.

Subsurface irrigation systems and first irrigation duration interaction is recommended.

References

Akram, M. **(**2008) Drip irrigation systems. Published research, Riyadh 12: 469-478.

Al-Obaidi, Ibrahim Ahmed Hadi (2001). Study of some technical indicators of drip irrigation system in productivity crop option, Master Thesis, College of Agriculture, Anbar University.

AL-shahrabali, Q. (2009). Surface watwr resources in Iraq current and future senarios .Iraq soil salinity and water management conference Baghdad Iraq. 15-17.

Asenso, E. (2011). Design and Evaluation of A Simple PVC Irrigation System Using, Akposoe Maize Variety as a Test Crop, M.Sc. thesis, Dep. of Agricultural Engineering, Kwame Nkrumah University of Science and Technology.

Bader, M.A.; Abo Hussein, S.D.; El-Tohamy, W.A. and Gruda, N. (2010). Efficiency of Subsurface Drip Irrigation for Potayjuto Production Under Different Dry Stress Conditions, GesundePflanzen, 62(2): 63-70.

Elhindi, K.M. (2012). Evaluation of Composted Green Waste Ferti-gation Through Subsurface Drip Irrigation System on Pot Marigold Plant (*Calendula officinalis* L.) Groen on Sandy Soil, Australian J. of Crop S., 6(8): 1249-1259.

FAO (2007). Agriculture and Irrigation. Rome, P. 22-28.

Jasim, A.A. and Ibraheem, I.S. (2018). The Effect of Irrigation systems and Planting Methods on Soil Porosity and Soil Electrical Conductivity and Potato Yield sunder Two Irrigation Duration. International Journal of Environment, Agriculture and Biotechnology (IJEAB) 3(2).

Jasim, A.A.; Ali, M.M. and Hamid, R.M. (2008_a). Effect of tillage and organic and chemical fertilization systems on yield and yield components of cotton **.**The First International Agricultural Conference proceeding of Aleppo University**-./**15-13 -10-2008 **.**Aleppo, Syria.

Jasim, A.A.; Ali, M.M. and Ati, A.S. (2008_b). Effect of some tillage and fertilization systems on some physical properties of soil and cotton yield. Egyptian Journal of Agricultural Engineering. Year, 2008: 25(2): 286- 308.

Ali, M.M.; Jasim, A.A. and Hamid, R.M. (2009). Response of some cotton recipes *Gossypium hirsutum L.* For tillage and fertilizer systems. Diyala Journal of Agricultural Sciences. 1(1): 150-160.

Jasim, A.A. and Ali, M.M. (2011). Effect of some tillage and fertilization systems on some physical properties of soil, growth and production of cotton and sunflower crops. Proceedings of the Twelfth Conference of the Technical Education Commission, Agricultural and Veterinary Research, Part 1. 2011/3 61-72.

Jasim, A.A. and Abdullah, M.N. (2017). The Effect of Energy Sources, Discharge and Drip irrigation Tube Types on some Soil Physically Properties and Sunflower yield. Proceeding of the Agricultural conference. Ministry of Agriculture. 10/12/2017. Iraqi Journal of Agriculture Research. 22(7): 2017.

Jasim, A.A. and Al-Ruwaishdi, Z.A. (2015). Manufacturing a Combine Implement Used for Tillage and Subsurface Irrigation Tubes Installation and Evaluate Its Effect on some Implement Indicators and Plant Yields. Scientific Conference for Mussaiab Technical College. 26-28/5/2015.Technical Education, Foundation, Mussaiab, Babylon, Iraq.

Talaat, Sh.I. (1999) Forage crop. Ministry of Higher Education and Scientific Researches. Mosul University, p. 64.

Shibia, M.; Mikhailf, A. and Riyadi, A.B. (2002). Some aspects related to the adoption of the farmers of the province of Al-Kharj for some modern irrigation systems **,**Journal of King Saud University, (14) Riyadh, 149-171.

Patel, N. and Rajput, T.B.S. (2009). Effect of Subsurface Drip Irrigation on Onion Yield, Irrigation Science, 27(2): 97-108.